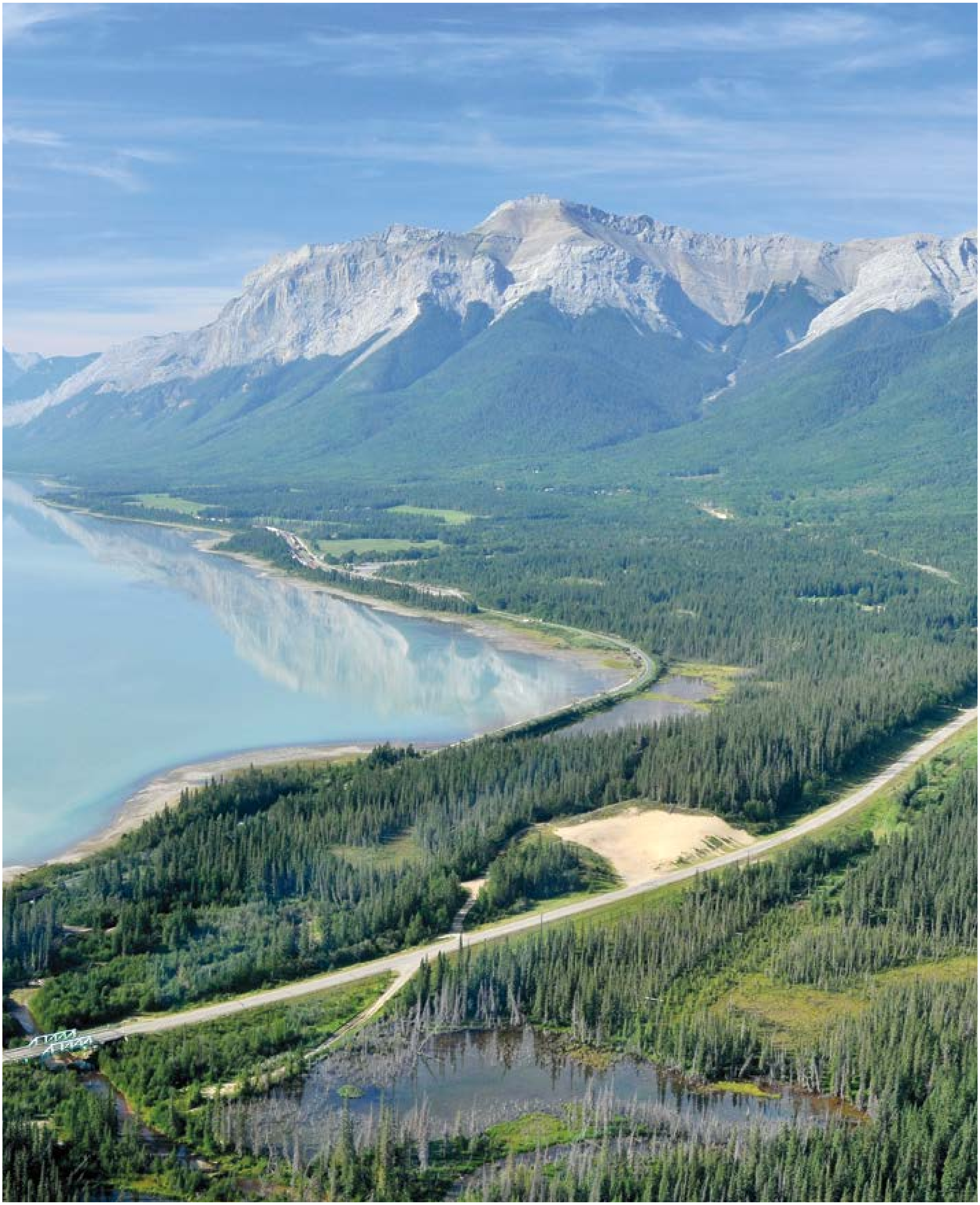
THE fRI RESEARCH STORY

Learning from the Landscape

ROBERT D. BOTT
ROBERT W. UDELL

BUILDING KNOWLEDGE AND TOOLS FOR FOREST STEWARDSHIP AND SUSTAINABILITY 1992–2017



Brule Lake and the Boule Range west of Hinton. *Brian Carnell Photography*

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BY

ROBERT D. BOTT

AND

ROBERT W. UDELL

fRI Research
Informing Land & Resource Management

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fRI Research
Informing Land & Resource Management

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Acronyms and Abbreviations

Organizations, Programs, and Policies

AAFMI	Alberta Advanced Forest Management Institute
ABMI	Alberta Biodiversity Monitoring Institute
ACA	Alberta Conservation Association
ACCG	Aboriginal Consultation Coordination Group
AFGO	Alberta Forest Growth Organization
AFPA	Alberta Forest Products Association
AFRAC	Alberta Forest Research Advisory Council
AFRI	Alberta Forestry Research Institute
AFS	Alberta Forest Service
AIP	Aboriginal Involvement Program
Al-Pac	Alberta-Pacific Forest Industries
APPI	Alberta Professional Planners Institute
ARC	Alberta Research Council
ASRD	Alberta Sustainable Resource Development
AWA	Alberta Wilderness Association
AWN	Aseniwuche Winewak Nation
CAPP	Canadian Association of Petroleum Producers
CBFA	Canadian Boreal Forest Agreement
CCFM	Canadian Council of Forest Ministers
CFA	Canadian Forestry Association
CFCP	Clayoquot Forest Communities Program
CFS	Canadian Forest Service
CIF	Canadian Institute of Forestry
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
CLMA	Caribou Landscape Management Association
CNR	Canadian National Railway
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPAWS	Canadian Parks and Wilderness Society
CRD	Collaborative Research and Development
CSA	Canadian Standards Association
CWS	Canadian Wildlife Service
DAOs	Delegated Administrative Organizations
DFMP	Detailed Forest Management Plan
DFO	Department of Fisheries and Oceans
ECA	Environmental Conservation Authority
EOMF	Eastern Ontario Model Forest
ESRI	Environmental Systems Research Institute
FCP	Forest Communities Program
FEESA	Friends of Environmental Education Society of Alberta

FERIC	Forest Engineering Research Institute of Canada
FGrOW	Forest Growth Organization of Western Canada
FGYA	Foothills Growth and Yield Association
FLMF	Foothills Landscape Management Forum
FMF	Foothills Model Forest
FMF	Fundy Model Forest
FMRA	Forest Recreation Management Association
FPAC	Forest Products Association of Canada
FRAG	Forest Resource Advisory Group
fRI	fRI Research
FRIAA	Forest Resource Improvement Association of Alberta
FRIP	Forest Resource Improvement Program
FSC	Forest Stewardship Council
FSCP	Foothills Stream Crossing Partnership
FtMF	Foothills Model Forest
IDRC	International Development Research Council
IMFN	International Model Forest Network
IMFP	International Model Forest Program
IPCC	Intergovernmental Panel on Climate Change
IRMSC	Integrated Resource Management Steering Committee
JNP	Jasper National Park
LAMF	Lake Abitibi Model Forest
LBMF	Long Beach Model Forest
LuKN	Land-use Knowledge Network
McMF	McGregor Model Forest
MMEE	Moose Mountain Environmental Enhancement Fund
MMF	Manitoba Model Forest
MPBEP	Mountain Pine Beetle Ecology Program
MWMA	Mixedwood Management Association of Alberta
NAFRI	National Advanced Fire and Resource Institute
NAIT	Northern Alberta Institute of Technology
NARTC	National Advanced Resource Technology Center
NCE	Networks of Centres of Excellence
ND	Natural Disturbance Program
NFS	*National Forest Strategy*
NRBS	Northern River Basins Study
NSERC	Natural Sciences and Engineering Research Council
NWC	North West Company
OMNR	Ontario Ministry of Natural Resources
PAMF	Prince Albert Model Forest
Paprican	Pulp and Paper Research Institute of Canada
PGYI	Provincial Growth and Yield Initiative

RCMG	Regional Carnivore Management Group
RLP	Regenerated Lodgepole Pine Trial
RNV	Range of Natural Variation
RSA	Reforestation Standard of Alberta
SARA	Species at Risk Act
SEMARNAP	Mexican Secretariat of the Environment, Natural Resources, and Fisheries
SIAST	Saskatchewan Institute of Applied Science and Technology
SLMF	Bas-Saint-Laurent Model Forest
SPaDES	Spatial Discrete Event Modelling System
STOP	Save Tomorrow – Oppose Pollution
TIA	Tree Improvement Alberta
UBC	University of British Columbia
UNB	University of New Brunswick
UNBC	University of Northern British Columbia
UNCED	United Nations Commission on Environment and Development
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UofA	University of Alberta
WCACSC	West Central Alberta Caribou Standing Committee
WCWC	Western Canada Wilderness Committee
WESBOGY	Western Boreal Growth and Yield Association
WNMF	Western Newfoundland Model Forest
WOLF	Woodland Operations Learning Foundation
YEWG	Yellowhead Ecosystem Working Group
YEG	Yellowhead Ecosystem Group

Models, Computer Programs, and Other Abbreviations

AAC	annual allowable cut
AVI	Alberta Vegetation Inventory
BMA	bear management area
C&I	criteria and indicators
CBM	Carbon Budgeting and Climate Change Model
CBM-CFS	Carbon Budget Model of the Canadian Forest Sector
CGE	computable general equilibrium model
DIKW	data, information, knowledge, and wisdom
DSS	decision support system
EBM	ecosystem-based management
EFM	enhanced forest management
ELDAR	Ecological Land Data Acquisition Resource
EMEND	Ecosystem Management Emulating Natural Disturbance
END	Emulating Natural Disturbance
FMA	forest management agreement

FRIPSY	Foothills Reforestation Interactive Planning System
FWMIS	Fish and Wildlife Management Information System
G&Y	growth and yield
GHG	greenhouse gas
GIS	geographic information system
GPS	global positioning systems
GRS	geotextile-reinforced soil
GYPSY	Growth and Yield Projection System
HAGGIS	Hydrology Attributes Generated from GIS
HARP	Harvest with Regeneration Protection
HSI	habitat suitability index
HSM	habitat suitability model
LANDMINE	landscape disturbance simulation model
LandWeb	Landscape Dynamics in the Western Boreal
LiDAR	Light Detection and Ranging
MGM	Mixedwood Growth Model
MOOC	massive open online course
MPB	mountain pine beetle
Mt CO_2e	millions of tonnes of carbon dioxide equivalent
NEPTUNE	New Emulation Planning Tool for Understanding Natural Events
NFPE	natural forest pattern emulation
NRV	Natural Range of Variation
RSF	resource selection function
SFM	sustainable forest management
SPF	spruce-pine-fir
SRD	sustainable resource development
TEK	traditional ecological knowledge
TFL	tree farm licence
UTM	Universal Transverse Mercator
VOITS	values, objectives, indicators, and targets
WAM	Watershed Assessment Model
WRENSS	Water Resource Evaluation of Non-Point Silvicultural Sources
WRNSFMF	Water Resource Evaluation of Non-Point Silvicultural Sources for the Foothills Model Forest
WUI	wildland-urban interface

Foreword

By Fred Pollett

It was a dark and stormy night …

Well, not exactly. However, it was definitely nighttime and I was sitting on the side of my bed scribbling thoughts on one Post-it Note after another—thoughts that led to the conceptualization and creation of the Model Forest Program and the genesis of fRI Research. That was 27 years ago. This publication pages through the impressive history of fRI Research and provides an excellent account of the institute's evolution and notable accomplishments.

fRI Research exists because of vision, chance taken, and opportunity seized.

The vision was first expressed on February 27, 1992, in a proposal submitted to establish a foothills model forest. It was one of 50 proposals invited to enter the *Green Plan* national competition to select a series of model forests across Canada. The letter of submission was signed by Robert Udell and Dennis Quintilio, two notable foresters. A few months later, in June 1992, my friend and colleague, Dr. Arthur May, then president of Memorial University and chairman of the National Advisory Committee on Model Forests, submitted his committee's report with recommendations.

Site #49, the Foothills Forest, Alberta, was most highly recommended.

It has often been said that timing is everything. And so it was with the creation of the concept of the Model Forest Program. To place events in perspective, it is important to reflect on the growing environmental movement of the 1980s. Not only the rise of key ENGOs [environmental non-government organizations], but also of environmental politics and the emergence of Environment Canada as a key government ministry. Forestry practices in Canada at the time, justly or not, were particularly targeted and criticized by ENGOs.

Then, in 1987, the World Commission on Environment and Development, under the chairmanship of Gro Brundtland, published its report, *Our Common Future*, promoting the concept of sustainable development. Canadian politicians were ready to accept the challenge and announced the national *Green Plan* in December 1990. The *Green Plan* itself was short-lived, but it was wisely used to launch and sustain a "decade of dialogue" in forestry. Canadian forestry needed a platform and substantive dialogue among forestry stakeholders, many of whom had become environmental adversaries. The dialogue began with the model forest competition. It continued into the Earth Summit at Rio, and led to the launch of the National Forest Sector Strategy and the development of the *Canada Accord*. A parallel international dialogue led to the creation of the Montréal Process. All these major achievements were realized within a six-year period.

Why and how did this happen at that time?

The forest sector in the 1980s was more prepared for the shift to sustainable development than any other natural resource sector in Canada. The achievements of the early 1990s propelled Canadian forestry onto the world stage, front and centre. It did not mean we had all the answers, but we had prepared the foundation for a shift towards sustainable development. In large measure, our readiness stemmed from a long history of Canadian conservation research and its application in the Canada Land Inventory (CLI), followed by the emergence of regional and national approaches to ecological land classification.

I will trace my own experience as an example of the time.

In the mid-sixties, I was a master's student in marine biology at Memorial University in Newfoundland, undertaking some of the first detailed dissections on giant squid—it's a fact.

However, my summer employment included a survey of Newfoundland's peatlands, my interests changed, and, in 1967, I completed my MSc thesis on "Aspects of Peatland Ecology" and was immediately recruited by the Canadian Forest Service (CFS) as a peatland

Opposite page: A Headwaters Stream

specialist. My transformation from marine to terrestrial ecology was spurred by time well spent in the field with Dr. A.W.H. (Ton) Damman. Ton generously taught me the art and science of ecological land classification and the role of key indicator species as he classified Newfoundland and Labrador forests and defined the ecoregions of Newfoundland. This extraordinary man soon introduced me to another, eco-philosopher Dr. John Stanley Rowe, a native son of Hardisty, Alberta. I met Stan mere weeks after I joined the Canadian Forest Service, and I was immensely impressed with his ecological approach to forestry. He had just left the CFS to take up a professorship in plant ecology at the University of Saskatchewan. I frequently sought his advice on policy issues during my tenure with the federal government. Rowe's 1972 publication, *Forest Regions of Canada*, laid the basis for future ecoregional maps. I mention these two scholars as well as one other, Dr. Michel Jurdant, a leader and pioneer in ecological land classification in Quebec. All three influenced my thinking in the early stages of my career. It was a time when ecological land classification began to gain traction.

In 1976, the Canada Committee on Ecological Land Classification (CCELC) was created within Environment Canada and led by remarkable individuals like Ed Wiken. This amazing initiative laid the pathways for understanding the functioning of ecosystems and the mapping of the ecozones and ecoregions of Canada.

Under the CCELC, I gained experience as chairman of the National Wetlands Working Group. I had the benefit of having skilled members such as Steve Zoltai and Charles Tarnocai, among others. We travelled as a group. We stood on, studied, and discussed peatlands in every region of Canada. By generating substantive knowledge of wetlands in all parts of Canada, we developed an ecologically based national wetland classification, prepared national wetland maps, and generated a science base on which wetland policy has been and continues to be based nationally and regionally. I raise this point because the CCELC approach and philosophy of investigation greatly influenced our thinking on the formation of the Model Forest Program.

The United Nations Conference on Environment and Development (UNCED), the Rio Earth Summit, in 1992 redefined humanity's interaction with the planet. Although no convention on forests emerged from Rio, the importance of forests across the environmental, social, and environmental landscape was clearly acknowledged. At Rio, Canada announced the launch of the Model Forest Program, inviting other counties to join the venture. In the same year, Canada endorsed a national forest strategy, entitled *Sustainable Forests: A Canadian Commitment*, and its companion, the *Canada Forest Accord*, a set of 96 action items to promote sustainable forest management at home.

Also in that eventful year of 1992, few people are aware of another opportunity that arose from an unlikely international source, the Conference on Security and Cooperation in Europe (CSCE), now the Organization on Security and Cooperation in Europe (OSCE), of which Canada is a member. Member countries of the CSCE were given an opportunity to present a proposal to the organization that would highlight emerging international environmental priorities. Seizing on the chance, a few of us in the CFS quickly developed a proposal and were fortunate enough to be selected by the federal government to pitch our concept to the CSCE. Our proposal involved the development of international criteria and indicators to define and measure sustainable development in forestry. I was the "lucky" individual who presented the idea to the international body in Helsinki, and, despite being up against proposals from other countries, we prevailed. This included several side meetings to convince Russian delegates and others who requested more details.
At the 1992 summit of CSCE, it was stated:

> "Encouraging early implementation of the forest principles adopted at UNCED and recognizing the importance of sustaining the forest ecosystems of the CSCE region … a seminar of CSCE experts on the subject of 'Sustainable Development

> of Boreal and Temperate Forests,' will be convened in Montreal from 27 September to 6 October 1993. A proposal outlining the budget, agenda, and modalities of this seminar will be presented by Canada for approval before the end of 1992."

We soon provided an agenda, and a principal outcome of the seminar was the formation of the Montréal Process Working Group and the eventual implementation of the Montréal Process, with the goal of achieving internationally agreed-upon criteria and indicators for the conservation and sustainable management of temperate and boreal forests. The rest of this story, as we say, is history.

The six-language CSCE seminar put Canada at the centre of the global forestry shift towards sustainable development. It was also a highly significant achievement in that several of the major ENGOs participated as equals alongside country delegations.

I mention these key events because it is important to understand the whirlwind dynamics of the years after the *Brundtland Report* and during UNCED to emphasize the fact that we could take full advantage of the opportunities offered. And that was in no small measure because of the ecologically based science foundation created by individuals such as Stan Rowe. Many of the contributors were operational foresters. I can safely state that without their foresight, we would never have had the successes through the *Green Plan* and the model forests, including the Foothills Model Forest, and many of the achievements that underpin forestry today would likely not have existed.

In those few years, Canada placed itself at the centre of global forest policy and began to level the playing field on which it had to participate.

The history of the model forests in Canada is well covered in this book. Nevertheless, it should be repeated that the model forest concept was global in perspective from its initiation. It became clear to me at the 2005 Model Forest Global Forum in Costa Rica that the program had become international in its direction, leadership, and scope. Some 110 participants representing 35 model forests in 17 countries attended the 2005 forum. Today, in 2017, there are 60 model forests distributed across continents—a community of practice, sharing knowledge and fostering sustainable trade, conservation, and prosperity.

By the nature of the concept, every model forest fits the framework, yet every model forest as defined by local context is understandably different. Over the past 25 years, the model forest alumni have come to number in the thousands, and they carry their exposure to and experience with the concept with them into every endeavour. These individuals are distributed across the spectrum of the private sector, governments at all levels, and cultural, academic, and non-governmental agencies. The overall success of the concept is the result of actions taken by those who have been or are involved in the model forest work, and together represent a considerable global pool of influential talent.

Led by an engaged board of directors, fRI Research continues to build on the legacy of the Foothills Model Forest and the Foothills Research Institute. It remains a consensus-driven partnership, using a shared decision-making process. My experiences with fRI Research have generated great memories, and I have benefited immensely from my shared experiences with Peter Murphy, Tom Peterson, and Bob Udell.

My challenge to fRI Research is to continue to be inclusive in its partnership and approach and unconstrained by convention and artificial boundaries. Your foundation is strong and true, based in part on the philosophies of many who were involved in your genesis and contributors to the "decade of dialogue." I also hope fRI Research creates strong links with the International Model Forest Network (IMFN). There is much the network can gain from your experience and much more that you can receive from the network.

Acknowledgements

Writing a book of this nature would be difficult if not impossible to accomplish by simply poring through the thousands of documents and files accumulated over the 25-year journey of the remarkable institution now called fRI Research. Indeed, in the course of this project, which began in 2015, we have accumulated some 5,300 reports and other files.

In writing this book over the last three years, we have attempted to provide a balanced perspective on a multi-faceted, long-term, complex endeavour spanning 25 years. There is little doubt that we have overlooked some aspects and perhaps over- or under-emphasized other elements of that complex history in the writing of this text. However, we have sought out people involved with the program over the years to review chapters as they developed, and we have worked hard to review and rationalize as much relevant material as possible from the files collected in the course of this project.

This book has also drawn upon the testimony and assistance of those who have played a role in the history of fRI Research since its inception in 1992. These have included researchers, program leaders, board members, staff, government agencies and bureaucrats, clients, and not the least the many volunteer hours that have been spent by the members of our Forest History Team at fRI Research – Peter Murphy, Bob Stevenson, Tom Peterson, and Bruce Mayer.

We apologize to those whose names we have inadvertently omitted from this list of contributors to this project.

As background to the project, we conducted 46 interviews with key players in the program, and received 30 written responses to detailed questionnaires. To that one can add hundreds of email enquiries and phone calls to these respondents as well as others in pursuit of more information.

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Unless otherwise identified, sources are the authors' interviews, personal communications, first-hand knowledge, or internal fRI Research documents, and all photos not otherwise credited are from the image collection of West Fraser, Bob Udell, or fRI Research.

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We accept full responsibility for the final contents herein, and apologize for any errors or oversights.

Bob Udell and Bob Bott
April 2018

Bob Bott and Bob Udell

Introduction
Applying Science for Sustainable Forest Management

Since the early 1960s, the world has become increasingly aware of the limits to growth and the need for what the 1980 World Conservation Strategy and the 1987 Brundtland Commission termed "sustainable development." In 1990, Canada unveiled its five-year, $3-billion environmental action plan entitled *Canada's Green Plan for a Healthy Environment.* One of eight strategic areas to be addressed was the goal of promoting the "sustainable use of Canada's renewable resources," which included forestry, fisheries, and agriculture.

Plans were advancing for the 1992 United Nations Commission on Environment and Development (UNCED) conference in Rio de Janeiro, where the concept of sustainable development really began its journey into mainstream policy. Here the Canadian government would unveil its *Green Plan* on the world stage.

In September 1991, Natural Resources Canada announced a Canada-wide competition with a view to establishing "working models of sustainable forest management" in the major forest regions of Canada. The day after the announcement, Dennis Quintilio and Ross Risvold from the Alberta Forest Technology School in Hinton met with Don Laishley and Bob Udell of Weldwood's Hinton Division to propose that the two institutions partner on a proposal for a model forest in Hinton.

The Forest Technology School was already a recognized leader in fire training and proposed expanding that service delivery to forest management and integrated resource management. Weldwood had an internationally recognized program of forest management and had embarked on the creation of an innovative forestry-wildlife program, which was being developed by management forester Doug Walker and Rick Bonar, the first forest industry biologist in Alberta, along with their government colleagues. The letter of intent was sent in on October 17, 1991, and a committee began work on a detailed proposal. Forestry, Lands and Wildlife added its resources and land base to the proposal. Jasper National Park joined the working group, and committed resources to conduct model forest research within the park.

The rest is history, and it has been our challenge to condense the first 25 years of the fRI Research journey into this book.

The name of the institution has changed several times—from Foothills Forest (1992–1995) to Foothills Model Forest (1995–2007), then Foothills Research Institute (2007–2015), and finally fRI Research—and the scope has broadened, often far beyond the forests in the foothills around Hinton, Alberta. Yet the essential mission has remained the same: to provide sound science in the furtherance of *sustainable forest management* (SFM). This was clearly identified in the first mission statement of the fledgling organization.

Mission: To develop and recommend an approach to sustainability and integrated resource management through research and technology developed by means of collaborative partnerships. This approach will achieve local, national, and international recognition.

SFM is a concept that evolved in the 1980s and 1990s to supplant *sustained-yield forest management*. The SFM concept embraces all the values of forested landscapes and watersheds, including fibre supply and renewal, but also integrates other social, economic, and environmental values such as biological diversity, water quality and quantity, Indigenous peoples' land use, fishing, hunting, recreational activities, infrastructure, and non-renewable resource development. As a result, the research results often have much wider applicability beyond forestry in the Alberta foothills.

A small service group at fRI Research has supported all of the programs since the beginning of operations at Hinton. Geographic information system (GIS) managers and specialists have used existing technology for this purpose and, when that technology was lacking or unavailable, have developed new technological approaches and tools for the research program.

Figure 0-1 the DIKW pyramid.

Building Pyramids

One way to envision the work of fRI Research (fRI) and its predecessors is in terms of building hierarchies or pyramids known as DIKW—Data, Information, Knowledge, and Wisdom.[1] Some of the structures came together relatively quickly, some were left unfinished, some are still under construction, and others are continually being elaborated upon.

Data are the foundation. Trillions of facts have been acquired from observations, remote monitoring, imagery, testing, sampling, and other current and historical sources. Examples include tree rings, fire scars, sample plot measurements, lake sediments, fish counts, flowmeters, aerial photographs, LiDAR images, insect traps, wildlife telemetry collars, hair and scat DNA, bird nests, harvest records, logbooks, economic statistics, censuses, and many more. Government and industry employees, contractors, students, and members of the public continually add to fRI Research's collection of data. Rigorous protocols ensure accuracy.

Information systems store and organize data in usable forms. fRI Research's GIS categorizes data spatially and temporally so that the landscape or any portion thereof can be viewed as a many-layered map with each layer showing what is known about a feature such as topography, hydrology, soils, vegetation, wildlife species, infrastructure, or human use. Change can also be seen over time for whatever periods are covered by the data; for example, forest inventories derived from aerial photography and sample plots dating back to the 1950s, or many centuries of fire history from analysis of lake sediments, as well as photo interpretation and field studies. Patterns emerge from analysis of the information.

Knowledge is both procedural and substantive: how we learn things as well as what we learn. It is "know-how" often expressed in "if-then" statements. The knowledge produced by fRI Research can take various forms—peer-reviewed publications, academic theses, monographs, conference presentations, government and industry reports, videos, seminars, and webinars—and almost all of it is publicly available on the fRI Research website and the Land-use Knowledge Network administered by the institute. Government, industry, and non-government partners also share the knowledge through their organizations.

Wisdom provides defensible answers to the questions "What to do?" and "Why?" Wisdom based on fRI Research products is evident in many government and industry operations and policies. Examples include forest management plans, operating ground rules, recovery strategies for endangered species, approaches to dealing with fire and insects, integrated resource management plans, fish and wildlife regulations, and public education programs. The research results and the technology transfer efforts of the model forest and fRI Research are of high interest and value to both government and industry. They contributed directly to the creation of groups such as the Foothills Landscape Management Forum, the Forest Growth Organization of Western Canada, and the Foothills Stream Crossing Partnership, all of which now conduct their business from within the fRI Research organization.

Fulfilling the pyramid-building mission has required an infrastructure of governance, management, and support services. Directors drawn from government, industry, academia, and community have provided governance. General managers, seconded from the provincial government, have led the small staff housed in offices at the Hinton Training Centre (formerly the Forest Technology School and known as the Environmental Training Centre from 1993 to 2003). Program leaders and their teams have played key roles in defining research programs, raising funds, and conducting the research. Communicating the results of research to users, fellow scientists, and the public has been an essential component of the work from the beginning.

The best illustration of the institute's success is the continuing support of the funding partners in industry and government. Applied research helps them develop sustainable operations and effective policies and regulations. Sound science helps to address the economic, social, and environmental concerns of stakeholders. John Kerkhoven, a director since 1999, representing Petro-Canada and, after 2009, Suncor, said that research in areas such as wildlife and watersheds could be directly applicable to his company's operations and often could also benefit the oil and gas industry as a whole. In addition, he valued the networking opportunities provided by the Board and institute activities. "There were lots of people that I wouldn't have met otherwise that were able to bridge into other sectors and just make the overall landscape management step that much more … I wouldn't say easier, but that it worked better."

Location has been an important asset. Hinton is at the centre of a large area of provincial Crown land managed for multiple uses, including forestry, coal mining, oil and gas exploration and production, transportation, recreation, hunting, fishing, and trapping. It is the cradle of large-scale industrial forest management in Alberta, the first large-scale forest operation to accept full responsibility for the cost and delivery of sustained-yield forest management. At Weldwood, Alberta's first industrial biologist, Rick Bonar, was hired in 1988, and research was underway with the province on an integrated wildlife-forestry program on the million-hectare industrial forest. This research was a major pillar of the proposal submitted to the Canadian model forest competition and the subsequent awarding of the model forest at Hinton.

Jasper National Park was tied into the Model Forest Program from the outset because it faced many of the same challenges that were being addressed in the research. The addition of its adjacent landscape to the core research land base in 1995 expanded opportunities for the integration of research across a broader landscape with sometimes conflicting, sometimes complementary, management philosophies and objectives. Building and incorporating information on a large landscape of industrial forest management and protected areas included expansion and integration of research on topics such as forest composition, wildlife, watersheds, fire, and human activities. A number of synergies were identified that will be seen in this story, and the relationships and collaborative programs continue.

The work of the institute has evolved through five-year planning phases. In the first three, from 1992 to 2007, the federal Model Forest Program provided significant funding and influenced the direction of research activities. By 2002, Hinton had the most partners and the biggest budget among the 10 Canadian model forests.

The Canadian Model Forest Program ended in 2007, but by then, the institute was well supported by the provincial government and industry. The shareholders committed additional resources to replace the annual $500,000 federal commitment, and the program continued, strong as ever.

Phase I, 1992–1997, was one of building partnerships, internal communications, and a strong sense of direction. Research got underway in forestry, wildlife, watersheds, carbon budgeting, socio-economics, natural disturbance, and forest history. Staff began building GIS technology and tools that would be at the core of all future projects, as well as applications for SFM practice in the broader forestry management community. In 1995, Jasper National Park became a sponsor of the model forest, adding its land base to the core research area.

Phase II, 1997–2002, saw an emphasis on targeted research to meet the practical needs of forest practitioners and resource managers, providing tools that could be used on the ground. Willmore Wilderness and Switzer Provincial Parks added their land bases to the core research area in 1997. Research activities began to spread well beyond the core research land base. There was more emphasis on communicating results to practitioners and the public, and a forest history program was started. Research areas included cumulative effects, biological diversity, local-level sustainability indicators, traditional ecological knowledge, fish and aquatics, and grizzly bear habitat and populations. A large grant from the province derived from the softwood lumber levy allowed the model forest to expand its current programs, as well as embark on new ones.

Phase III, 2002–2007, stressed the application of knowledge, technology, and tools to implement SFM on forested landscapes. Industrial partnerships widened. Communications and outreach included publication of *Learning from the Forest*, about the evolution of forest management in the Hinton area. The Grizzly Bear Program drew recognition. Other programs included Aboriginal* involvement, caribou studies, fire research and FireSmart communities, and the early beginnings of mountain pine beetle research. The model forest promoted a cooperative research program in pine growth and yield, hiring its first director.

Phase IV, 2007–2012, brought more than 100 partners into the renamed Foothills Research Institute. The geographic scope widened, and efforts focused on meeting partners' needs and communicating knowledge to decision makers. The Healthy Landscapes Program (formerly the Natural Disturbance Program) had significant impacts on forest management practices in Alberta and beyond. The Fish and Watershed Program created a stream classification manual, and a full-scale mountain pine beetle research program, the Mountain Pine Beetle Ecology Program (MPBEP), began. Tools such as grizzly bear and fish habitat mapping aided practitioners.

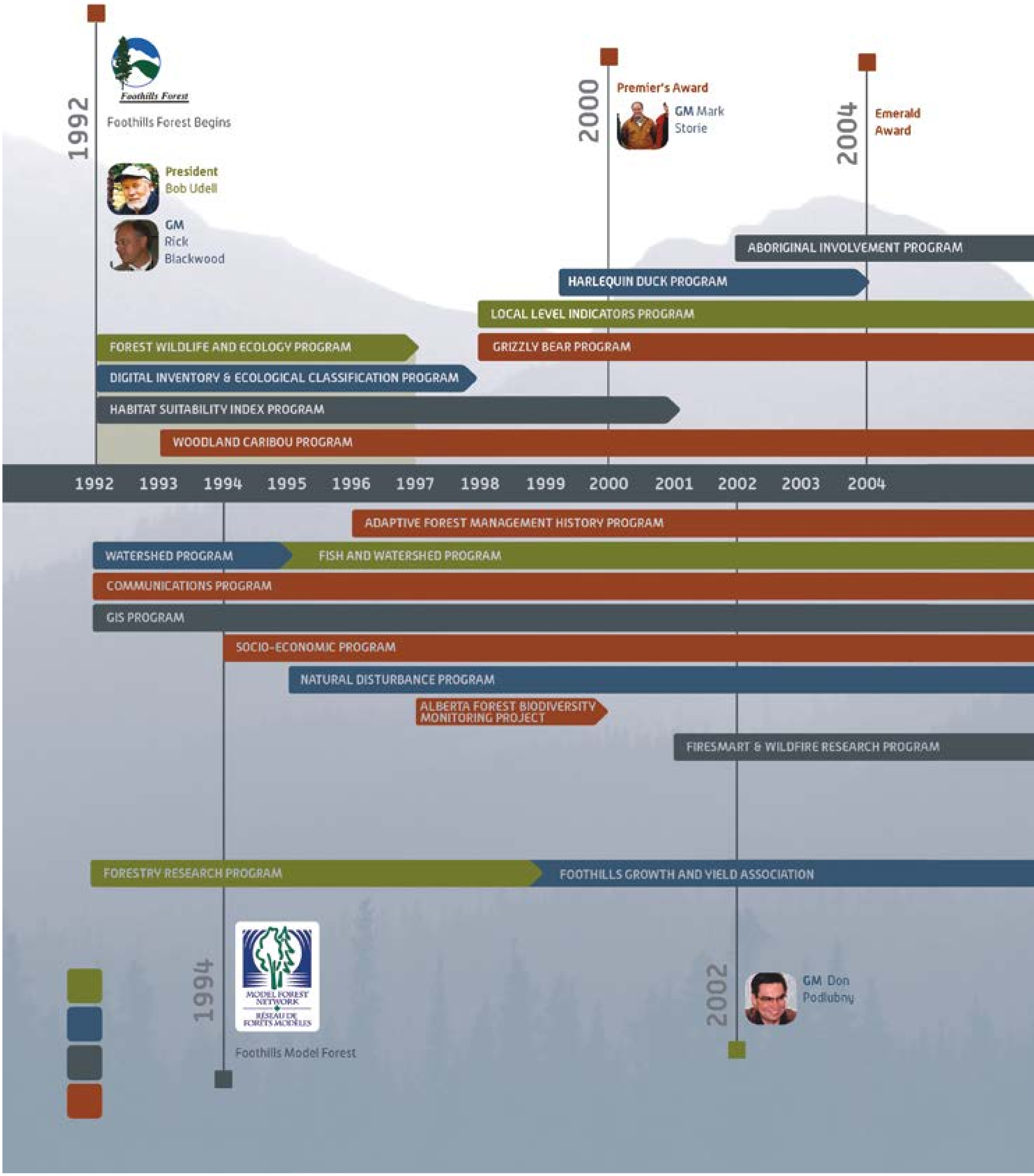
Phase V, 2012–2017, continued to widen the scope and influence of the institute (renamed fRI Research in 2015). The success of programs such as Healthy Landscapes and grizzly bear research is widely recognized. Research has had direct impacts in areas such as fire and mountain pine beetle management, stream crossing, and caribou range-management strategies. The Land-use Knowledge Network provided vital knowledge for land-use planning across Alberta. More research cooperatives brought their operations under the fRI Research umbrella.

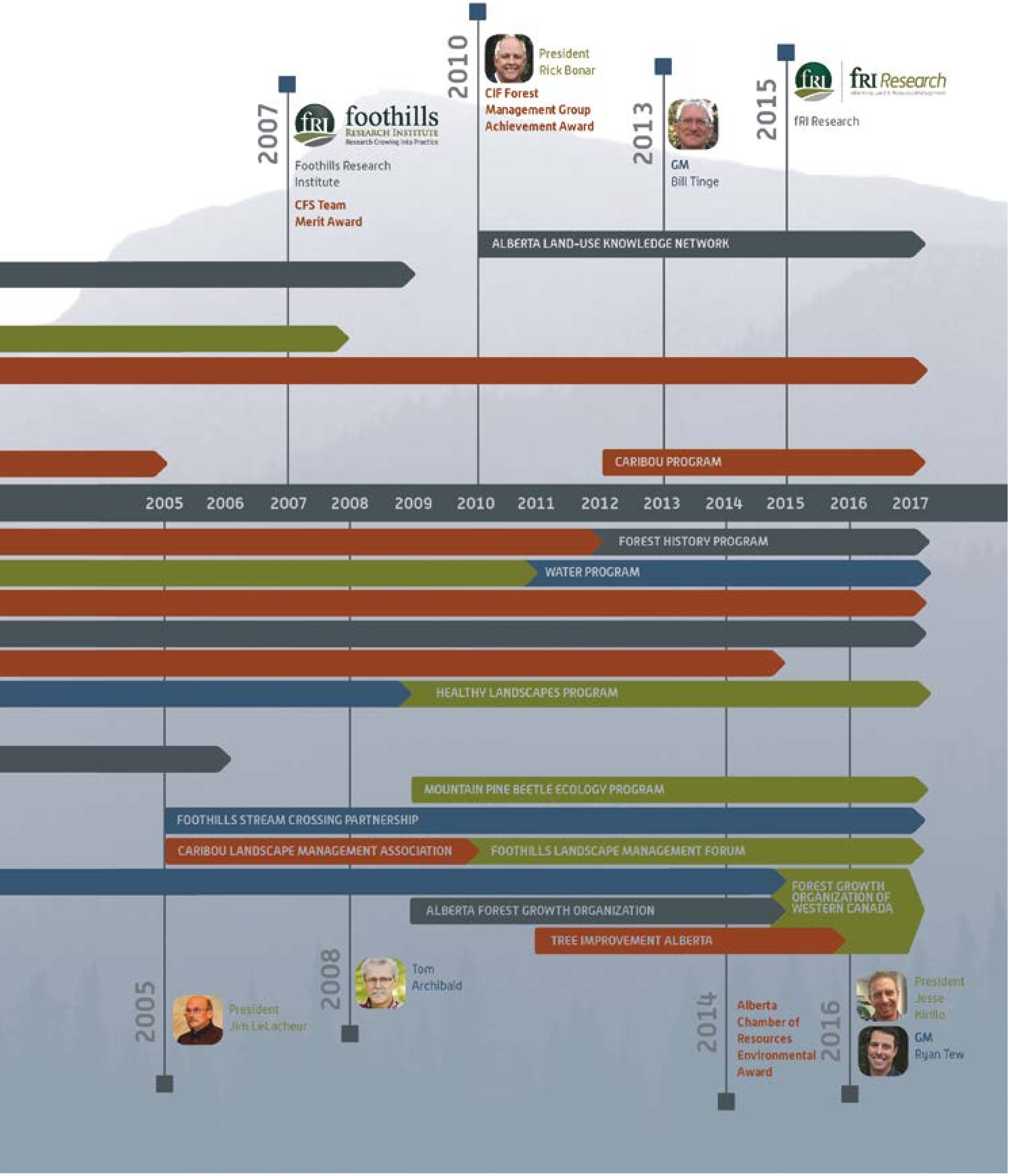
While Phase I was underway, the Canadian Council of Forest Ministers (CCFM) was developing criteria and indicators for SFM, which were published initially in 1995 and have been revised several times since then. The same criteria were incorporated in the Canadian Standards Association *SFM Standard*, first released in 1996, and they have also formed the basis for the *Alberta Forest Planning Standard* released in 2006. During Phase II of the program, there was a Strategic Initiative of the Canadian Model Forest Network to develop criteria and indicators (C&I) for SFM, and each model forest was required to develop C&I for

continued on page xx

* The term "Indigenous" has replaced "Aboriginal" in much Canadian usage since adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Although the UN issued the declaration in 2007, Canada was one of four countries that initially objected to it—along with the United States, Australia, and New Zealand—and there was little change in usage here. The usage began to change after July 2015 when the Government of Alberta announced plans to incorporate UNDRIP provisions into law and policy. The federal government followed suit and withdrew Canada's objector status in May 2016. Since then, governments across Canada have been implementing UNDRIP in accordance with the Canadian Constitution. This book retains the term "Aboriginal" in most instances because it was the common usage during most of the period under discussion, including references such as program names, policy titles, and quoted documents.

fRI Research – A Selective Chronology




2007
Foothills Research Institute
CFS Team Merit Award
2010
President Rick Bonar
CIF Forest Management Group Achievement Award
2013
GM Bill Tinge
2015
fRI Research
ALBERTA LAND-USE KNOWLEDGE NETWORK
CARIBOU PROGRAM
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
FOREST HISTORY PROGRAM
WATER PROGRAM
HEALTHY LANDSCAPES PROGRAM
MOUNTAIN PINE BEETLE ECOLOGY PROGRAM
FOOTHILLS STREAM CROSSING PARTNERSHIP
CARIBOU LANDSCAPE MANAGEMENT ASSOCIATION
FOOTHILLS LANDSCAPE MANAGEMENT FORUM
FOREST GROWTH ORGANIZATION OF WESTERN CANADA
ALBERTA FOREST GROWTH ORGANIZATION
TREE IMPROVEMENT ALBERTA
2005
President Jim LeLacheur
2008
Tom Archibald
2014
Alberta Chamber of Resources Environmental Award
2016
President Jesse Kirillo
GM Ryan Tew

Opposite page:
Sylvie's Photography

their areas. The six criteria encompass the main areas of research undertaken by fRI and its predecessors. Using the original 1995 language, they are:

1. **Conservation of biological diversity:** This includes both the "coarse-filter" approach based on habitats and ecosystems and the "fine-filter" approach based on specific species. Examples range from grizzly bear and caribou studies to the Healthy Landscapes Program. The model forest was also the birthplace of the program that became the Alberta Biodiversity Monitoring Institute.
2. **Maintenance and enhancement of forest ecosystem condition and productivity:** Programs such as growth and yield, alternative harvest treatments, mountain pine beetle ecology, and fire management help to meet this criterion.
3. **Conservation of soil and water resources:** Fisheries, watershed assessment and mapping, and stream crossing programs are among the fRI Research contributions.
4. **Forest ecosystem contribution to global ecological cycles:** Carbon budget research helped to provide clarity in this area, although today it continues and has now gone well beyond the scope of the institute's work. Research has also continued on the implications of climate change for forest management.
5. **Multiple benefits of forests to society:** Model forest and fRI contributions include the socio-economic program and development of local-level indicators of sustainability.
6. **Accepting society's responsibility for sustainable development:** This has included communications, outreach, and technology transfer through programs and organizations such as the Yellowhead Ecosystem Working Group, the Yellowhead Carnivore Working Group, the Land Managers Forum, the Northeast Slopes Integrated Resource Management Pilot Program, the provincial Land-use Framework, the Aboriginal Involvement Program, and the Land-use Knowledge Network.

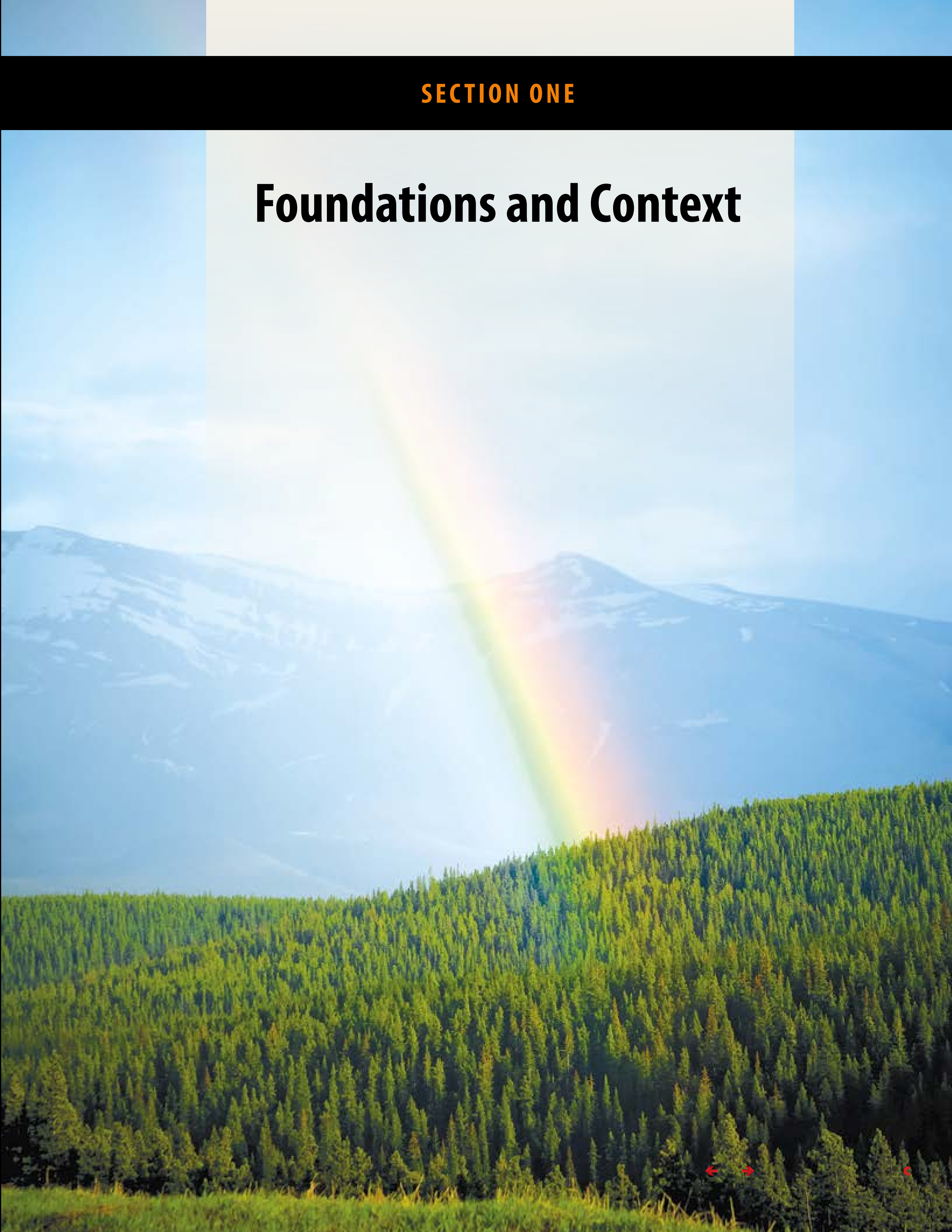
In this book, we describe the genesis and evolution of the institute (Chapters 1 and 2), the research and activities under each of the CCFM criteria (Chapters 3 to 8), the fate of the other model forests (Chapter 9), and some thoughts on future opportunities and challenges (Chapter 10).

Endnotes

1 Jennifer Rowley, The wisdom hierarchy: representations of the DIKW hierarchy, Journal of Information Science 2, no. 33 (April 2007): 163–180. Accessed January 2018. **http://journals.sagepub.com/doi/abs/10.1177/0165551506070706**

SECTION ONE

Foundations and Context



CHAPTER ONE

Genesis

The Foothills Forest, later renamed Foothills Model Forest, the Foothills Research Institute and then fRI Research, has played a vital role in advancing the sustainable management of forested lands and watersheds in the Alberta foothills and beyond. Sound science from independent researchers has helped to resolve controversies, integrate values, forge partnerships, and make management more accountable to society and stakeholders. This evolution began at the confluence of economic, social, and environmental currents swirling at the local, provincial, national, and international levels.

In this chapter, we examine the context in which the Hinton-based research institution was founded.

The Historical Context for Alberta's Model Forest

Forest Ownership and Regulation

The forests in the Alberta foothills, mountains, and boreal regions—like most across Canada—are owned by the Crown ("Her Majesty in right of Alberta" or "in right of Canada") under policies dating back to colonial times that were initially intended to secure timber for the Royal Navy. The Crown reservation was modified in 1826 to allow the tender or auction of renewable rights to harvest timber not needed for naval use. In 1849, the government of Upper and Lower Canada proclaimed *An Act for the Sale and Betterment of Timber upon Public Lands*, which incorporated the 1826 principles and remains the basis for the lease of harvest rights on public forest lands.

> "Early settlement and development in Canada resulted in great impacts on the forests through land clearing for both farming and timber. By 1906, forest depletion prompted the Canadian Forestry Association to hold the first National Forest Congress. This was a first for public involvement in national forestry discussions, and influential voices represented newly established conservation movements. The outcome was positive, resulting in provincial legislation to protect and manage forests. Seventy tumultuous years went by from 1906 before another national forestry convention was to have significant impact. Concerns about forest renewal were the focus of the 1977 Forest Regeneration Conference. Its collaborative approach led to improvements in forest renewal." –Peter Murphy, *People and Forests in Harmony – Evolution of Canada's National Forest Strategy,* XII World Forestry Congress, Quebec City, Quebec, September 21–28, 2003

The federal government administered Alberta's forests until 1930. The Department of the Interior prevented settlement and squatting in large areas of the foothills, attempted to prevent fires, and leased a modest number of "berths" to loggers and sawmill operators. Protecting water supplies for the arid prairies was an early concern. John Stoughton Dennis, chief inspector of surveys and an advocate for irrigation farming, wrote to the department secretary in 1896 that "the permanency of our water supply is largely dependent upon the preservation of the forests at present covering the watershed, and this protection can only be secured by prohibiting the cutting of the timber." In addition to the initial concern about watersheds, recreational use and grazing were also encouraged, although in large measure with fire protection in mind. Timber harvests also became established on the landscape. Abraham Knechtel, Alberta director for the Dominion Forestry Branch, Department of the Interior, said:

> "... our legislators ... are well aware that forests feed springs, prevent floods, hinder erosion, shelter from storms, give health and recreation, protect game and fish, and give the country aesthetic features. However, the Dominion Forest Reserve policy has for its motto, 'Seek ye first the production of wood and its right use—and all these other things will be added unto it.'" –Abraham Knechtel, 1910[1]

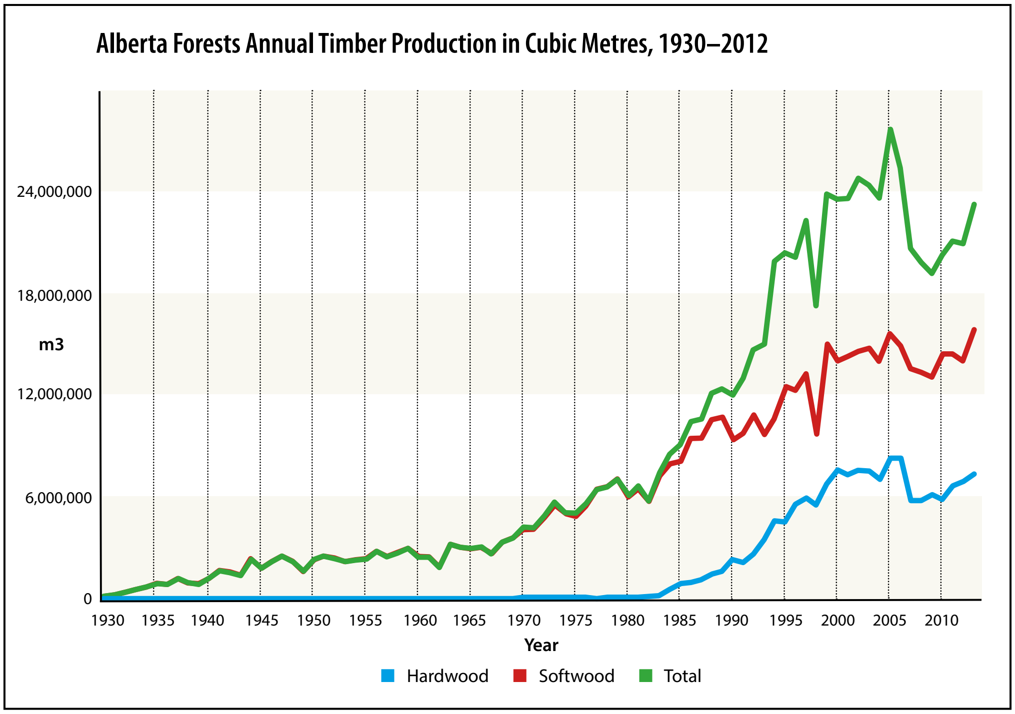
The government created the Rocky Mountains Forest Reserve in 1910 on the Eastern Slopes in part to protect the headwaters, but it adopted a more multi-use approach, continuing to allow logging and coal mining. Frank Oliver, Minister of the Interior, explained:

> "The primary object is to conserve the sources of water supply by the protection and production, or reproduction, of timber or wood around the sources of the water supply—to reproduce the timber growth for the benefit of the dwellers on the prairies surrounding these areas." –Frank Oliver, 1911[2]

Forester W.N. Millar on inspection, Rocky Mountain Forest Reserve, 1913. Millar went on to teach Forestry at UofT before enlisting to serve in WWI.

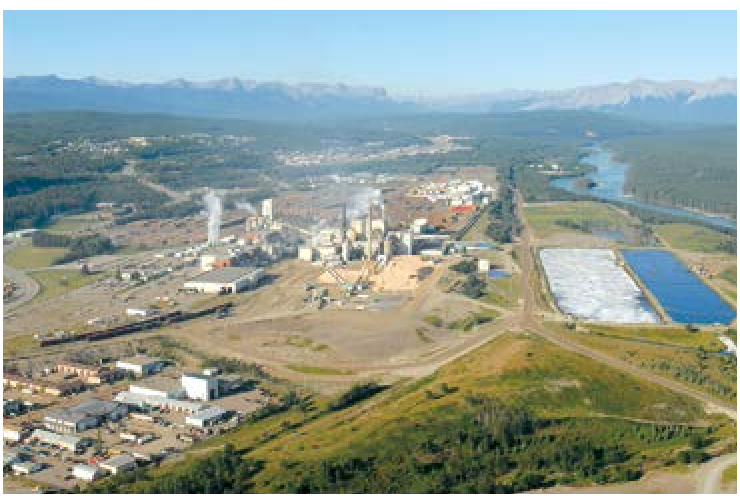
Alberta gained ownership of the forests, with the exception of those in national parks and on First Nations reserves, under the 1930 Transfer of Resources Act, but the Great Depression and the Second World War limited management efforts until the late 1940s, when more funds became available and professional foresters were recruited to set up a modern program. The technology of the time—hand sawing, horse-drawn skidding, and transportation by river drives or rail—limited the impacts. The introduction of crawler tractors, chainsaws, and heavy trucks in the 1950s enabled much larger harvests in more remote areas; then came articulated skidders in the 1960s and feller-buncher harvesters in

Figure 1-1 *Courtesy Brad Stelfox*



the 1970s. New products and processes led to the harvesting of hardwoods (mainly aspen) in the 1980s in addition to the traditional spruce, pine, and fir softwoods.

Technology also improved management in the post–World War II era. Aerial photography supported the first comprehensive inventories of forest resources. Water bombers, helicopters, bulldozers, and more advanced communications improved fire control. Foresters had access to better roads and vehicles, or helicopters, to carry out surveys and transport tree-planting crews. Nurseries produced containerized seedlings with higher survival and growth rates. New machines were developed for site preparation after harvest to improve the success of planting, seeding, and natural regeneration.



West Fraser's Hinton operation is the mainstay of the Hinton economy. *Brian Carnell Photography*

Multiple Uses and Users of the Forest

The first large-scale industrial forest licence based on sustained-yield forest management was established at Hinton. The 1954 Hinton Forest Management Agreement (FMA) included only a passing reference to other users. The key provision was the requirement that all company roads be open to the public free of charge. The agreement also allowed the government to set aside lands for "townsite, mining, petroleum, natural gas or summer resort purposes … [or otherwise] deemed by the Minister [of Lands and Forests] to be essential to the industrial development of the province." The latter phrase seemed vague at the time, but in the 1960s, it turned out to include greatly increased oil and gas industry activity, new coal mines, and a railway line through the northwestern part of the lease.

In 1968, the revised FMA added a specific reference to "the right of others to travel, hunt, fish, or otherwise use the said lands for recreational purposes." However, the 1968 agreement also recognized that "on the Forest Management Agreement area, timber growing is the prime use, in keeping with the policy of providing for multiple uses of the same public land."

In the 1970s, as industrial and recreational activities proliferated in the Hinton area and elsewhere in the foothills, the provincial government was developing a formal process for integrated resource planning. This began in 1970 with two planning studies on the Eastern Slopes—the Foothills Resource Allocation Study and the Hinton Yellowhead Regional Land Use Study—followed by Environmental Conservation Authority (ECA) hearings in 1973, which in turn led to the 1977 *Policy for Resource Management of the Eastern Slopes*. The studies and consultations brought together stakeholders—government ministries and agencies, municipalities, commercial and industrial interests, environmental and recreational organizations, and the general public—to develop plans for multiple uses of each area.

One of the results was the revision of the government's *Eastern Slopes Policy* in 1984 to establish regional land-use zoning for various categories of protection, management, and development. More detailed sub-regional plans followed.

In 1988, Weldwood signed a new FMA based on major expansion of pulp and sawmill operations at Hinton. This agreement specified the requirement to address other resource values such as fish and wildlife. Rick Bonar, a British Columbia–based biologist, was hired to lead the project to design and implement a forestry-wildlife program on the FMA area.

In addition to these formal consultation processes, the company and the government always encouraged informal contacts with the general public and other stakeholders, and their advice was often helpful in planning and operations. Direct public input into forest management planning began in 1989, when Weldwood of Canada Ltd. formed the first public advisory committee for an Alberta forest operation. The committee included government, professional, industrial, recreational, youth, and other interest groups. This Forest Management Liaison Committee was consulted during preparation of the Foothills Forest proposal in 1991–1992 and expressed support for it.

Timing is Everything

In the aftermath of a recession in the early 1980s, the Progressive Conservative government of Premier Peter Lougheed sought alternatives to the boom-and-bust cycles of the province's traditional resource markets. The government produced a white paper, *Proposals for an Industrial and Science Strategy for Albertans, 1985–1990*, which promoted economic diversification and direct government action to stimulate the economy. The forest industry was identified as one of the pillars that would support economic diversification. Don Getty replaced Lougheed as premier in 1986 and strongly supported the policy.

The provincial diversification thrust was assisted by a 1984 agreement, known as the *Canada-Alberta Forest Resource Development Agreement*, which provided $23 million for equally cost-shared forestry programming over a five-year period. The main program areas of this agreement were: 1) reforestation; 2) applied research, technology transfer, and opportunity identification, including a significant component of hardwood product research and development; and 3) public information, evaluation, and administration.

The Forest Industry Development Division of Alberta Forestry, Lands and Wildlife was established in 1985 under Executive Director Al Brennan. He set out to aggressively promote the development of forest products based on the assignment of Alberta's unallocated forest lands to new FMAs. The remarkable success of this initiative led to public controversy over the rapid expansion of the forest industry. Existing mills, including Weldwood's at Hinton, modernized and expanded their operations. New technologies enabled the production of panelboard and pulp from previously unutilized hardwoods (mainly aspen poplar), and this led to large new mill projects, new or enlarged FMAs, and the allocation of nearly all the province's annual allowable cut.

In 1988, the Millar Western pulp mill at Whitecourt became the third pulp mill in Alberta, the first to open since the Procter & Gamble mill at Grande Prairie in 1973 and the Hinton mill in 1957. By 1988, four other new pulp mill projects had been proposed or were underway, and existing mills were expanding and modernizing, along with numerous other solid-wood plants that utilized both coniferous and hardwood stock. This burst of activity culminated in the announcement of the Alberta-Pacific Forest Industries' hardwood pulp mill at Boyle, which at the time was the largest single-line pulp mill in the world.

This rapid expansion of the forest products sector was a catalyst for environmental movements, inciting vigorous demonstrations and sustained criticism from groups such as the Alberta Wilderness Association (AWA), the Sierra Club, the Western Canada Wilderness Committee (WCWC), and the Canadian Parks and Wilderness Society (CPAWS). A frequent target was former Calgary mayor Ralph Klein, who served as environment minister in the Getty government from 1989 until he took over as premier at the end of 1992.

The Alberta government responded by forming two commissions, one to review water and air concerns, and the other to review impacts on forests and forestry. The Expert Panel on Forestry was formed in 1989 and reported in 1990. The four-member panel comprised University of Alberta forestry professor Bruce Dancik as chair, retired Canadian Forest Service silviculture research scientist Lorne Brace, wildlife biologist John Stelfox, and Weldwood forester Bob Udell.

The *Expert Panel Report* precipitated a number of policy direction changes in Alberta,[4] announced by the Department of Forestry, Lands and Wildlife, among which were:

1. Requirement for a public involvement process in forest management planning, including advisory committees
2. Improved public involvement in significant policy and planning decisions
3. Greater consideration of non-timber resources in forest management decision making

The department embarked on a province-wide strategic planning initiative to strengthen natural resource management into the 1990s and beyond, a period of major change and transition for the forest service. From this would eventually come a *Natural Resource Policy Framework* (1994), a *Forest Conservation Strategy* (1997), the *Alberta Forest Legacy: Implementation Framework for Sustainable Forest Management* (1998), and *Alberta's Commitment to Sustainable Resource and Environmental Management* (1999).

Partly following recommendations of the Canadian Council of Forest Ministers, the Alberta Forest Research Advisory Council (AFRAC) was established in 1988, with membership from provincial and federal governments, the forest industry, the Alberta Research Council, and the University of Alberta. It was tasked with advising the province on research priorities, as well as encouraging collaboration among research agencies.

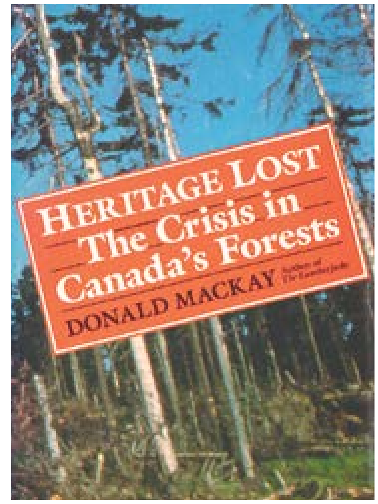
In a 1991 reorganization, the Alberta Forest Service Research Branch was disbanded and staff reassigned to other branches. This came at a time of crippling cutbacks in provincial spending, which continued through the 1990s (see Chapter 2).

> "As I recall, the Research Branch was closed in the early 1990s when Ken Higginbotham was appointed ADM and there was little capability left in the Research unit. Additionally, the Treasury Board demanded severe downsizing to meet fiscal targets to commence paying off the Provincial debt. The Forest Service downsized from about 2,200 to 1,100 FTEs [full-time employee equivalents] and budgets were downsized accordingly. The demise of the Research Branch led to the enhancement of research by FERIC [Forest Engineering Research Institute of Canada] and eventually the Foothills Model Forest." –Assistant Deputy Minister Cliff Henderson (retired), personal communication, 2015

During his tenure as environment minister, Klein began a major restructuring of government responsibilities leading to the Environmental Protection and Enhancement Act, introduced in 1992 and passed in 1993. The Department of Forestry, Lands and Wildlife was eliminated, and at the end of 1992, most of its responsibilities became part of the new

Department of Environmental Protection under Brian Evans as minister. The Alberta Forest Service was renamed Alberta Land and Forest Services.

An expanding forestry sector combined with diminished government capacity meant that more management responsibility devolved to the companies holding FMAs, which by the mid-1990s included most of the province's harvestable forest areas. Independent research, widely shared, would play a key role in the rejuvenated sector's adaptation to the requirements of sustainable development.



Heritage Lost, by Donald MacKay, provided a dim view of Canadian forestry practices in the 1980s.

National and International Policy Context

The modern environmental movement is often dated from the 1962 publication of Rachel Carson's *Silent Spring*, about the effect of pesticides. Growing concerns about such issues led to the creation of government environment departments in the United States and Canada, and in Alberta in 1971, as well as to the first Earth Summit in 1972. The movement lost some momentum amid energy crises and recessions, but came to the fore again in the 1980s and helped set the stage for the *Green Plan* and the Model Forest Program.

Donald MacKay's *Heritage Lost*, published in 1985, cast a critical eye on the state of forest management in Canada. A notable exception to this criticism was the forestry program at Hinton, which received high praise in the chapter "Des Crossley's Obsession." MacKay's book gave popular expression to the concerns voiced in the 1983 *Green Ghetto* report prepared by Progressive Conservative forestry critic Frank Oberle Sr.*

In Canada, the challenge of sustainable forest management had particular urgency in the late 1980s. With 10 percent of the world's forests and as the world's largest exporter of wood and paper products, Canada clearly had a special responsibility, both to its own citizens and to the world at large, to manage its forests sustainably. From 1984 to 1993, the Progressive Conservative government of Prime Minister Brian Mulroney and the newly formed Canadian Council of Forest Ministers (CCFM) endeavoured to deal with the challenges through initiatives such as the 1987 *Forest Sector Strategy for Canada*, developed through consultation with selected stakeholders.

The United Nations Commission on Environment and Development (UNCED), established in 1983 and chaired by Gro Harlem Brundtland of Norway, published its findings in 1987 as *Our Common Future* (also known as the *Brundtland Report*). This report stressed the urgency of creating economic development that could be sustained by available ecological resources. It was followed by *Environmentally Sustainable Economic Development: Building on Brundtland,* a report co-published in 1991 by the United Nations and the World Bank, which noted that the critical next step was to put the recommendations of the *Brundtland Report* into practice.

Following the release of the *Brundtland Report*, it became apparent that neither the scope of consultation nor the range of values addressed in the first CCFM strategy would be adequate. The forestry community was facing unprecedented challenges in the form of public demands for the implementation of ecological principles in forest management and for higher value to be placed on non-timber components of the ecosystem. To address these challenges, the forestry community needed a better understanding of the systems that sustain forest productivity and biological diversity and of the impacts of human interventions on these systems. A change in attitude was needed, from managing trees to managing forest ecosystems for a multitude of values.

In 1990, the CCFM launched a series of national consultations and questionnaires involving people who represented a wide range of interests. At Halifax in 1990, Gordon Baskerville, dean of forestry at the University of New Brunswick, chaired a national forum on the sustainable development of forests under the auspices of the CCFM. The delegates recommended that a variety of different approaches to sustainable forest management be tried in the context of Canada's diverse regions, including:

* Oberle later became Canada's fifth minister of forestry, heading the full-fledged, Cabinet-level department from 1990 to 1993. Before then, Forestry had been a junior portfolio, held most recently by Oberle as a minister of state. There was also a Department of Forestry from 1960 to 1966, led by four different ministers, but otherwise since 1899, Forestry had always operated as a division within departments such as Environment, Resources, or the Interior. There would be only two more federal forestry ministers: Calgary MP Bobbie Sparrow in 1993 and Edmonton MP Anne McLellan from 1993 to 1995, after which Forestry again became part of a larger ministry, Natural Resources. (Oberle's son Frank Jr. would later also head the Alberta provincial ministry responsible for forestry, Sustainable Resource Development, in 2011 and 2012; he was a forester with Daishowa-Marubeni International Ltd. in Peace River, Alberta, from 1988 until his election to the Legislative Assembly in 2004.)

- Managing the forest for all values, and creating the knowledge base and technology to do so
- Creating a partnership approach, rather than institutionalizing conflicting interests
- Encouraging a societal change in attitudes to recognize the legitimacy of the full range of forest values

In September 1990, Canada's ministers responsible for wildlife signed *A Wildlife Policy for Canada.* Many of the same ministers would be involved in developing a new approach to forestry. The aim of the wildlife policy was "to maintain and enhance the health and diversity of Canada's wildlife, for its own sake and for the benefit of present and future generations." Significantly, the policy widened the definition of wildlife to include "all wild organisms and their habitats—including wild plants, invertebrates, and microorganisms, as well as fishes, amphibians, reptiles, and the birds and mammals traditionally regarded as wildlife."

In 1991, the CCFM invited the public to express concerns, hopes, and ideas for Canada's forests in a series of public forums. The vision that emerged from these public meetings included an emerging spirit of co-operation and a willingness to become partners in the next generation of forest management. These culminated in 1992 with the first *National Forest Strategy* (NFS)[5] and the signing of the *National Forest Accord*, which incorporated the principles of sustainable development into an overall action plan. As well, new legislation was formulated in some provinces to ensure that forest managers sought input from others in the preparation of forest management plans.

> "Our forests come to us as a legacy, to be sustained and passed on in that spirit. Ensuring that we have forests will in itself help ensure that there are future generations. Canadians have deeply held values that shape their vision of the future for Canada's forests: our values and our vision represent our national and global commitment toward sustainable forests." –CCFM report, 1992[6]

The United Nations Conference on Environment and Development (UNCED), also known as the "Rio Earth Summit," was held in Rio de Janeiro, Brazil, from June 3 to 14, 1992. Prime Minister Mulroney announced Canada's intention to support an international network of model forests at the summit. From this conference also came an initiative on forest sustainability that was launched in Europe under the aegis of the Conference for Security and Cooperation. Canada successfully lobbied for the establishment of a set of criteria to assess the quality and effectiveness of sustainable forest management measures, along with a related set of rigorous indicators to measure success. This led to a meeting in Montreal in September 1993 where this initiative, now called the "Montréal Process," for the development of these criteria and indicators (C&I) was launched. More work and meetings followed until, in February 1995, in Santiago, Chile, the final version of seven criteria with associated quantitative and qualitative indicators was produced.

Echoing principles of Canada's wildlife policy, the *United Nations Convention on Biological Diversity* was opened for signature at the Earth Summit in Rio, and Canada was the first industrialized country to sign. In 1995, Canada followed up with the *Canadian Biodiversity Strategy*, which placed the Convention into a Canadian context. It provided guidance on how to better reflect biodiversity conservation in policies, plans, strategies, and programs.

The *United Nations Framework Convention on Climate Change*, also signed at the Earth Summit, committed signatory countries to promote the conservation and enhancement of sinks (carbon sequesters) and reservoirs (carbon pools), and to develop and publish national inventories of greenhouse gas emissions, including anthropogenic activities related to sinks.

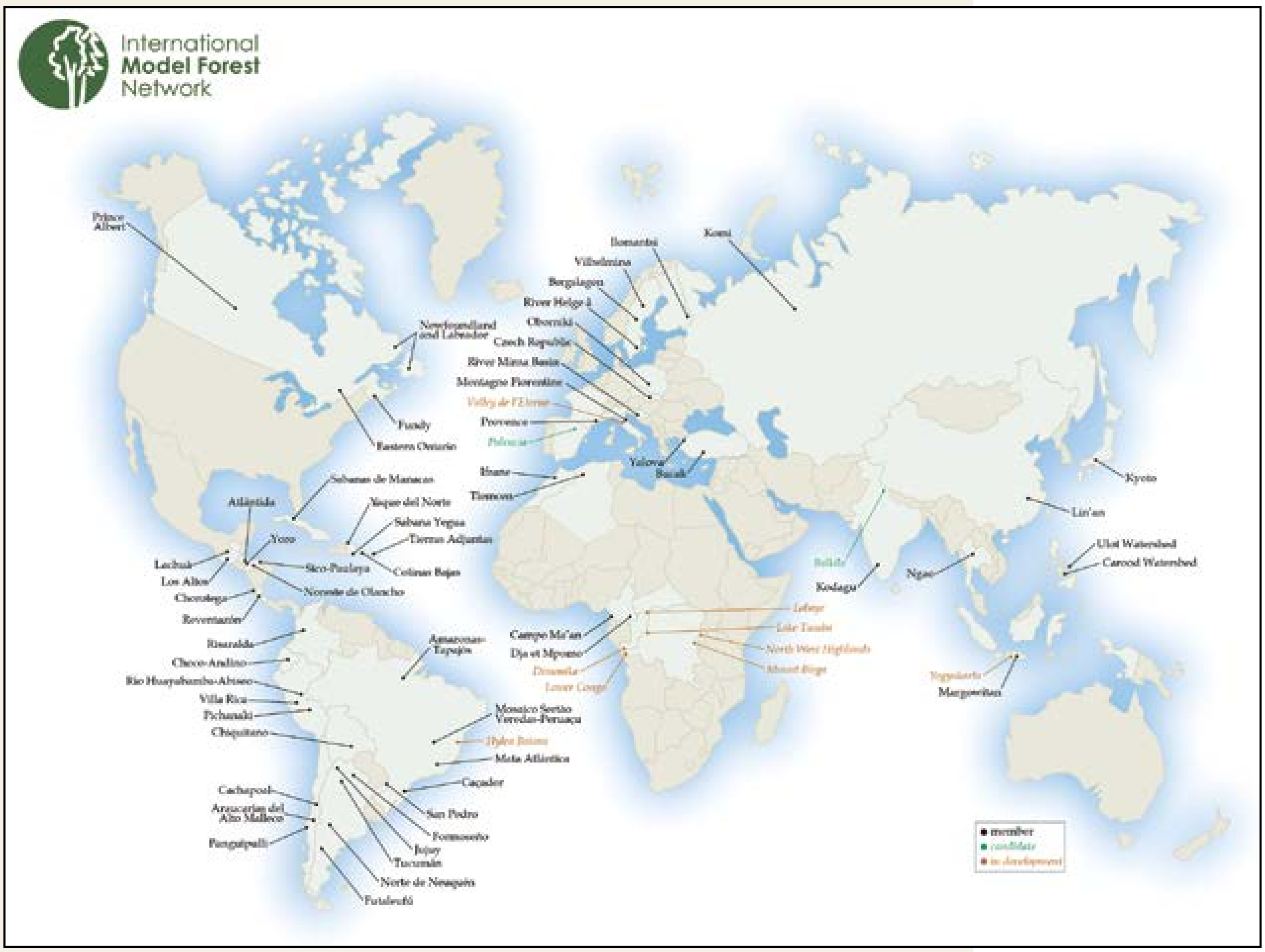
The International Model Forest Program – A Continuing *Green Plan* Legacy

The intent from the beginning was that model forests in Canada would, in due course, stimulate a worldwide network of similar endeavours, and Canada would be part of that network. Prime Minister Mulroney and Forestry Minister Frank Oberle pushed the process, insisting that an announcement of the international program had to be ready for the Rio Earth Summit in 1992. The International Model Forest Program thus began in 1993 with two model forests, one in Mexico and the other in Russia. They were twinned with Canadian model forests that administered their funding and provided mentoring as these countries developed their programs. (As described in Chapter 2, the Foothills Forest partnered with the Chihuahua Model Forest in Mexico from 1994 to 1998.)

Fred Pollett, in his 2016 interview, reported that the original intent was to have all the model forests—Canadian, as well as international—under one secretariat. The CFS at the time had neither the mandate nor the legislation to run an international program, so in 1995, discussions got underway with the International Development Research Council (IDRC) to place the program in that organization. The CFS wanted to retain control over the Canadian model forests, so the programs were separated, with the Canadian Model Forest Network Secretariat in the CFS and the International Model Forest Network Secretariat in the IDRC. By 2007, the international program was operating in areas outside the IDRC mandate, and a decision was made to move the secretariat back to the CFS.

International Model Forest Network

Map 1-1 International Model Forest Network, 2017. *Courtesy Canadian Forest Service*



"It wasn't until about 2005 before the international program really started to take off, and then it went like gangbusters. Then, in that brief 10-year span, it grew quite a lot, as you know. That, to me, is the real success because what it shows, it shows the power of the concept. Not each individual model forest, but the power of the concept being used as it should be used in different areas. That's it in a nutshell." – Fred Pollett, interview, 2016

"I think it [the International Model Forest Program] is one of the most successful federal government programs ever. Ironically, some believe it was never intended to be successful at all …!" –David Andison, personal correspondence, 2016

In 2018, the international program continues to thrive, with a worldwide network of over 60 large landscapes in six regional networks covering 84 million hectares in 31 countries. A small secretariat located at the Canadian Forest Service in Ottawa provides coordination, development, and support services to the program. Members of the Canadian Model Forest Network are also de facto members of the International Model Forest Network. Since 2011, the Foothills Research Institute and fRI Research have not been members of the Canadian or international networks, although the institute still collaborates with the Vilhelmina Model Forest in Sweden on a grizzly bear–brown bear project, which began in 2009.

The *United Nations Commission on Sustainable Development* was created in December 1992 to ensure effective follow-up of UNCED and to monitor and report on the implementation of Earth Summit agreements at the local, national, regional, and international levels.

The *Green Plan* and the Model Forest Program

"Canada's goal is to shift the management of our forests from sustained yield to sustainable development." – Environment Canada, *Canada's Green Plan for a Healthy Environment*, 1990

The 1987 *Brundtland Report* inspired the Mulroney government to set up the National Task Force on the Environment and the Economy (later renamed the National Round Table on the Environment and Economy). Based on the task force's recommendations, Environment Canada began work on the $3-billion environmental action plan entitled *Canada's Green Plan for a Healthy Environment* during the summer of 1989, under the rising star of Environment Minister Lucien Bouchard. Bouchard quit the Tories in May 1990 to lead the Bloc Québécois, after which René de Cotret took over the Environment portfolio. Canada was under fire from environmental groups for its forest practices at the time, and the government wanted to include some projects that would demonstrate its commitment to sustainable forest management. Forestry Canada, by then its own department under Frank Oberle, was asked to develop some proposals for possible inclusion in the *Green Plan*.

Oberle, a former logger and businessman from Chetwynd, British Columbia, was a Progressive Conservative Member of Parliament from 1972 to 1993. Prior to the 1984 election, he served as his party's forestry critic, and he co-authored with Warren Everson a lengthy report in 1983 entitled *The Green Ghetto: Can We Save Canadian Forestry?* (an excerpt also appeared in the *Forestry Chronicle* in 1984). Oberle said the title "was intended to symbolize the grim future we are facing through apathy" and that he wanted "to make obvious the optionality of forest policy; we can choose our forestry future. It can be an exciting and prosperous growth industry, but not without effort."

"Shall the forests be available, as they can be, for foresters and campers and wildlife, into perpetuity, or will they be consumed and thereby be denied to everyone? We must choose or resign ourselves to life in a GREEN GHETTO." –Frank Oberle, MP, 1983

In December 1990, the federal government announced the five-year *Green Plan.* One of eight strategic areas to be addressed was the goal of promoting the "sustainable use of Canada's renewable resources," which included forestry, fisheries, and agriculture. Forestry Canada would oversee the forestry program.

This government commitment came at the peak of what became known as the Canadian "war in the woods," which lasted from the early 1980s to the mid-1990s. The "war" began with disputes over the logging of British Columbia's coastal forests—also the site of an eventual truce in 1995—and the conflict spread across Canada as activists protested harvest and silviculture practices, pesticide use, wildlife impacts, effects on water and fisheries, loss of old-growth forests, aesthetics of clear-cuts, and the related government policies and regulations. In Alberta, controversies also centred on pulp mill effluents and the awarding of large forest management agreement (FMA) areas. Foresters and other scientists in industry, government, and academia shared many of the protesters' concerns and for years had been warning of an impending "crisis" if these issues were not addressed. Change was needed, and the Model Forest Program would be part of it.

Fred Pollett was a principal author of the Forest History Program's *Northern Rockies Ecotour* and attended the Edmonton launch of the book in May 2012.

Green Plan Forestry Programs: Birth of the Model Forest Program

Fred Pollett, director-general of Science and Sustainable Development in the Canadian Forest Service (CFS), was assigned to develop forestry proposals for the *Green Plan*. He credits one of his staff, fire researcher Dennis Dubé, who later worked at the CFS Northern Forestry Centre in Edmonton, with inspiring the Model Forest Program. Following discussions with several individuals about the assignment, the two met in a café in Ottawa to brainstorm. Dubé broached the idea of developing some demonstration projects at a landscape level and transcending administrative boundaries.

Pollett described the next stage of the development during a July 2016 interview for this book. "After I had the discussions with Dennis and others, I was trying to figure out how to put this all together and who should be involved." Pollett described how the model forest program concept came to him in the middle of the night, and how he scribbled the bare bones of the concept onto a bunch of yellow sticky notes. The next morning, he and his secretary transcribed this late-night inspiration into a brief overview of what would become Canada's Model Forest Program.

> "I called it the 'model forest concept,' just as a working title for the minister, intending to change it to something more appropriate later. The last thing I wanted was for people to think we were trying to develop models of good forests, where every tree was literally in its place. If you look at the original tenets of the programs, it was not meant to be necessarily forestry, but rather landscape-level concepts. I looked at the ecoregional map of the world and thought, if we could develop sustainable forest practices in each of these regions around the world and learn from one another, then we could create a set of values and practices that people would understand globally. It was meant to be an international initiative from day one. Even though we set up the process in Canada, it was always meant to be the start of an international program. But the title 'model forest' stuck." – Fred Pollett, interview, 2016

Pollett then took this rough concept of landscape-level sustainable forest management projects to Oberle's staff, who were under time pressure (as Pollett described it "sweating bullets") to come up with sound ideas for a forestry-related program to include in the Green Plan. With some concerns, they passed it up to Oberle. The minister liked it and directed the CFS to flesh out the terms of reference for the program, as well as a nationwide competition to choose the sites. That task was accepted by Pollett and other CFS staff—Yvon Hardy, Dave Brand, Paul Addison, and Doug Pollard—along with Mike Innes from Abitibi-Price.

Conceptually, Pollett said, model forests would provide a neutral forum that brought individuals from different backgrounds and interests together to participate in decisions about how forests could be sustainably managed to achieve common goals related to SFM. Their design would be supported by the most up-to-date science and technology in this quest.

The proposed program was submitted to the Treasury Board in February 1991. After some refinements, the federal Cabinet approved the Model Forest Program in late March 1991. It would be a sub-program of a six-year, $100-million Partners in Sustainable Development of Forests Program, which included three main components designed to demonstrate leadership in the forest sector and to indicate a shift in Canada's forest management from sustained timber yield to forest ecosystem management—in other words, sustainable development:

1. Model Forests: Establishment of a network of large-scale, working models of sustainable forestry in each of the major forest regions of Canada ($54 million)
2. Research: Implementation of an accelerated and expanded forestry research program leading to the development of a new array of environmentally sound management techniques and strategies ($33 million)
3. Information: Expansion of the data and information available on Canada's forests, including forest health monitoring networks and environmental databases to improve decision making and better reflect the multiple values of Canada's forests ($13 million)

Funding for the Research and Information components was directly administered by Forestry Canada and included initiatives in decision support systems, integrated pest management, forestry practices, forest fire, bioenergy, environmentally acceptable forest products and processes, bio-monitoring, a national forest database, ecological forest land classification, a seed and gene bank, and ecological reserves.

Model forests—as independent research, development, and demonstration partnerships among governments, industry, academia, and other stakeholders—were appealing, not only ideologically, but also because deficit-constrained federal and provincial governments were cutting back their own in-house forestry, wildlife, and watershed research programs.

Minister Oberle then established a National Advisory Committee on Model Forests, chaired by Art May, president of Memorial University, to develop program infrastructure and oversee a national competition for the awarding of model forest sites. A broad invitation went out, stimulating over 100 initial responses and ending up with 49 detailed proposals for the $54-million, five-year program. The committee operated at arm's length from government.

A series of program criteria were approved by Cabinet and given to the committee, including that:

1. A network of six to nine model forests that reflect the ecological diversity of the country should be established.
2. The model forests should be working scale models of sustainable development.
3. The model forests should include management for more than one resource or value in the forest, but timber must be one of the resources managed for.
4. The model forests should be managed by a partnership of key stakeholders in the forest area concerned.
5. The model forests should demonstrate the application of the most advanced forestry practices and should support research and development activities.
6. The network of model forest sites should be chosen by a national competition.

The Model Forest Program was officially announced at the annual general meeting of the Canadian Institute of Forestry on September 25, 1991. Canadian federal government objectives for the program were as follows:

- To improve Canada's image by providing evidence at a working forest level that the country was moving towards environmentally sustainable forestry practices.
- To create a platform on which the Canadian service sector could develop state-of-the-art technologies, skills, and products.
- To provide a new direction for the federal forestry role in Canada that supported local initiatives within the context and priorities of provincial governments, yet fostered sharing of approaches and technology among provinces. The federal role would become one of facilitation and research support, reflecting provincial leadership in forest management.

The overall network of model forests would comprise highly productive sites, representing the eight major forest regions of Canada. It would reflect the various types of land tenure and major uses of the forest. The network would also represent a variety of values, such as wildlife, biodiversity, watersheds, fisheries, and carbon pools, in addition to the essential component of fibre or timber, and would serve to demonstrate how to manage forest systems in a sustainable development context. Regional issues of concern to the public and forest managers, such as old growth, clear-cutting, and pest management, among others, would be given serious consideration during the selection of appropriate model forests.

Although a minimum size for a model forest was not prescribed, the intent of the program was to implement sustainable development over a large scale, applicable and representative of the major Canadian forest regions, and the guidelines suggested that would be at least 100,000 hectares. To achieve this, several owners or managers could form a partnership involving a larger area of forest. The exact number of model forests was not determined but was expected to be as many as nine or as few as six.

The experts on the federal review panel had received about 50 detailed submissions by the time they submitted their selections to the government on June 3, 1992, the opening day of the Earth Summit in Rio de Janeiro. The Foothills Forest proposal was ranked highest of the 49 reviewed. The selection committee initially recommended nine candidates in 1992. Input from Minister Oberle suggested including another model forest that represented the large boreal region of Ontario and Quebec, and the Lake Abitibi Model Forest joined the final group of 10.

On June 25, 1992, Oberle announced the selection of the Foothills Forest as one of 10 across Canada that would demonstrate and develop sustainable forest management, as promised in the government's 1990 *Green Plan*. The announcement came less than two weeks after the close of the United Nations Conference on the Environment and Development (Earth Summit), during which Canada committed to supporting forestry science and sustainable forest practices in Canada and abroad.

Funding proposals had to represent a broad area, at least at a landscape level, but beyond that, proponents were given a relatively free hand to develop new approaches and new ways to deal with the move towards sustainable development. The program was not designed to have successes or failures but rather to try new ideas. Pollett said the process itself brought benefits.

> "I can remember receiving an email from somebody in the industry out west, but I don't recall who sent it. They said, 'If this program were closed down right now before it even gets off the ground, we'll have achieved something that was never achieved before; i.e., a number of us have sat down with people who wouldn't talk with us before, and now we're sitting there and we're talking as if we're both talking the same language. You've bridged something.'" –Fred Pollett, interview, 2016

Green Plan Epilogue

Kim Campbell succeeded Brian Mulroney as prime minister in June 1993, and her government was defeated by the Liberals under Jean Chrétien that November. The *Green Plan* was cancelled in 1995, and Model Forest Program funds that remained unspent were turned over to the Canadian Forest Service (CFS), which became part of Natural Resources Canada.

There was a huge federal government downsizing in 1995–1996, and all programs came under heavy scrutiny. Natural Resources Canada had to cut one-third of its budget and one-quarter of its staff.[7] A review of all its programs was conducted, and the Model Forest Program came out as a high priority for retention.

> "We already had a 57 percent cut in budget. I was on the departmental team managing the cuts. If we didn't have that *Green Plan* money coming in, I think we would've literally closed up shop." –Fred Pollett, interview, 2016

The CFS continued to fund the Canadian Model Forest Program through the remainder of Phase I, as well as through Phase II (1997–2002) and Phase III (2002–2007) before bringing the funding to a close and announcing a competition for the short-lived (2007–2012) Forest Communities Program. And it is also clear, as noted by Fred Pollett, that the Model Forest Program in its own way supported the CFS for this same period. (Chapter 9 describes the fate of the other model forests up to, and since, 2007.)

One measure of the eventual success of the Mulroney government's initiatives was that media references to Canada as "the Brazil of the North," comparing timber harvesting and reforestation here to deforestation there, peaked in 1992–1993 and almost disappeared after 1995.[8] With the benefit of hindsight, a panel of leading environmentalists in 2006 chose Mulroney as Canada's "greenest" prime minister.[9] By 2010, the science-based integrated management approach launched two decades earlier had progressed sufficiently that major environmental organizations and forest products companies were able to join in a pact called the Canadian Boreal Forest Agreement.

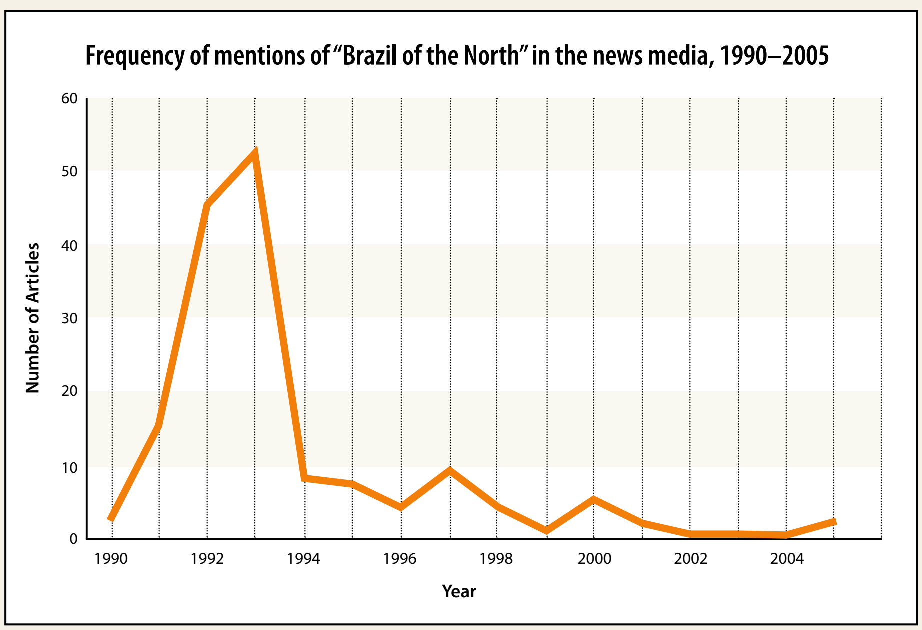
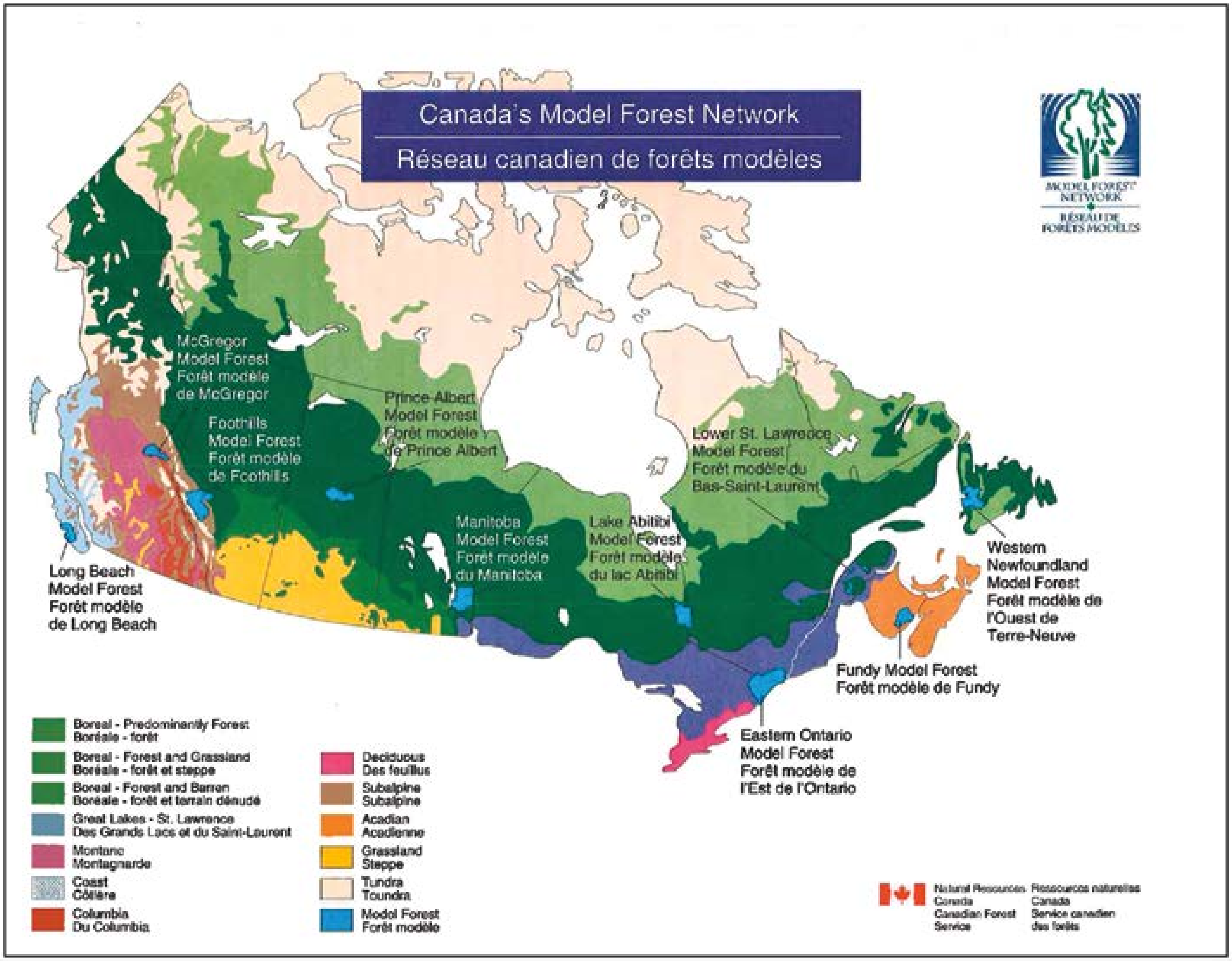


Figure 1-2 (compiled by Sara Beth Pralle from the LexisNexis Academic Universe using the search terms "Brazil of the North" in combination with "Canada"10).



Map 1-2 The Canadian Model Forest Network, 1992. *Courtesy Canadian Forest Service*

The Foothills Forest Proposal – Built on a Long-Established Foundation of Knowledge and Research

In 1955, Des Crossley was the newly appointed first chief forester for the original FMA holder, North Western Pulp & Power Ltd., at Hinton. He had previously been a research scientist with the CFS and developed new methods to ensure the reforestation of harvested sites. In his new position, he was able to draw upon decades of research by himself and other CFS researchers in the forests of Alberta. Also, because this was the Alberta's first foray into large-scale sustainable forestry, it provided a golden opportunity for scientists to establish new research trials in a so-called "working forest." Crossley actively encouraged his old colleagues from the CFS, as well as Canadian Wildlife Service (CWS) researchers, to come to Hinton and study reforestation challenges, inventory systems, watershed management, wildlife, and a wide range of other forestry-related issues. They responded enthusiastically. In 1988, John Powell of the CFS prepared a summary of CFS research from 1955 to 1988 on the company's FMA, describing 64 research projects in silviculture systems, watershed, and forest growth and yield.[11]

In addition, seconded St. Regis forester John Miller, along with Jack Wright and others on Crossley's staff, developed an intensive forest inventory system based on permanent sample plots that would soon become the largest repository of information on the growth and

NWP&P Chief Forester Des Crossley, 1967.

yield of lodgepole pine in western North America. In the 1980s, Weldwood and provincial foresters and biologists were well advanced with the development of an integrated wildlife-forestry program on the million-hectare industrial forest centred at Hinton.

With all this as background, the Foothills Forest was able to tap into a great deal of operational and scientific data, information, research, and knowledge already available about the landscapes and watersheds of the proposed Foothills Forest.

The problem, Dennis Quintilio noted, was that the knowledge tended to accumulate in vertical "stovepipes," or silos, with little communication among the disciplines and practitioners. The model forest partnerships offered the opportunity to integrate knowledge and practice into a more sustainable framework.

The core research area would be the Weldwood FMA area, the site of pioneering sustained-yield forest management since its establishment in 1954.

Wildlife surveys since the 1950s by federal biologist John Stelfox and others laid the groundwork for later studies of biological diversity. The presence of the Forest Technology School and the cooperation of the company and government agencies, aided by easy access by highway from Edmonton, made the Hinton area a frequent subject for academic studies ranging from fisheries to lodgepole pine regeneration.

It was well known that fire was the principal cause of natural disturbance and forest renewal in the foothills and throughout the boreal region. Weldwood's forest management system was built upon detailed studies and mapping of the fire-origin forests on its FMA, and this work laid the foundation for what would later become the Healthy Landscapes Program of fRI Research. Dave Kiil of the CFS conducted a number of prescribed burn research trials in the Hinton area. Alberta had a wildfire database dating back to 1961, and fire management was a major focus of study and training at the Forest Technology School. Other research preceded and arose from the recent introduction of prescribed burning in national parks, including Jasper. Foresters and environmentalists had long debated and researched the extent to which harvests could emulate the effects of fire on forest ecosystems.

Weldwood was also involved in managing non-timber values such as recreation. The company operated campgrounds in the FMA area, mainly to reduce wildfire risk from random camping, and it also established cross-country ski trails as an amenity for employees, their families, and the community. Hunters, fishers, trappers, and outfitters were among those consulted during the development of management and operating plans. Activities of the coal and petroleum industries, although regulated differently, were well documented. There was ample fodder for research on integrated management and socio-economics.

Following a presentation on wildlife and forestry in 1983 by Jack Ward Thomas of the U.S. Forest Service, Woodlands Manager Jim Clark offered the company's Hinton forest as a case study for integrated wildlife-forestry management. Soon thereafter, a joint committee of the company, the Alberta Forest Service and the Alberta Fish and Wildlife Service began work on an approach. Proposals in 1986 to ban logging in large areas of the U.S. Pacific Northwest to protect endangered spotted owl habitat showed the potential risk and reinforced the need for proactive steps. Don Laishley, the first chair of the Foothills Forest, joined the company in 1986 and committed to accelerating the wildlife-forestry integration program. Biologist Rick Bonar was hired in 1988 to lead this initiative, and he soon began working with the University of Alberta to develop habitat suitability indices for key species in the FMA area (see Chapter 3). This work was well underway prior to the model forest proposal.

Dennis Quintilio and Ross Risvold* were the first to recognize the potential of a Hinton-based model forest after the competition was announced in September 1991. Quintilio, a fire behaviour specialist, was director of the provincial Forest Technology School in Hinton from 1990 to 1995. Risvold was the mayor of Hinton and an instructor in recreation management at the school (and a former student there). The school, established in 1951 and

* Risvold succeeded Quintilio as director of the renamed Environmental Training Centre in 1995. He also served as a director and Board chair of the Foothills Model Forest and several terms as mayor of Hinton. His daughter, Lisa, worked in communications for the model forest between 1998 and 2008, and then for one of the area coal mining companies (see Chapter 8).

moved to Hinton in 1960, taught forest technology as well as fire management and firefighting courses, and its facilities included the 1,600-hectare Cache Percotte Forest, a training and study area south of the town.

> "I started to think, we've got a real opportunity here with Cache Percotte because I've seen some of the educational facilities in these field camps go to the moon in the U.S.* I'm thinking, this would fit right in. This is something that would add value, especially because we were starting to think of going national with national courses." –Dennis Quintilio, interview, 2016

* Quintilio cited the training and education programs that the U.S. Forest Service had offered at the National Advanced Resource Technology Center (NARTC) near Tucson, Arizona, since 1980; it had been established in 1967 for fire management training. In 2004, NARTC relocated into Tucson and was renamed the National Advanced Fire and Resource Institute (NAFRI).

Soon after the terms of the competition were announced, Quintilio and Risvold took the idea of participating to Weldwood as the operator of the sawmill and pulp mill in town and a frequent collaborator with the technology school. Woodlands Manager Laishley and Forest Planning Manager Bob Udell quickly saw the potential, and Laishley got approval to proceed from company chief executive George Richards from the head office in Vancouver. The company's million-hectare FMA area had been a proving ground for progressive practices since the 1950s and seemed ideally suited for the Model Forest Program. Weldwood had completed a modernization in 1990 that doubled the Hinton pulp mill's capacity and was constructing a new sawmill, scheduled to open in 1993, so the company welcomed the opportunity to bolster public and political support and validate or improve its forest practices.

Quintilio and Udell then donned their best business suits and drove into Edmonton to meet with Cliff Smith, deputy minister of Forestry, Lands and Wildlife, and members of his staff. Smith gave his support for provincial participation, including the addition of adjacent and embedded Crown Management Units into the proposal. (On the way back after the meeting, the pair stopped to celebrate their victory at a rather rough bar in Nojack and received some razzing when, in their pinstripes, they were mistaken for lawyers.)

The letter of intent, signed by Dennis Quintilio and Don Laishley, went to Forestry Canada on October 17, 1991. The applicants were the Forest Resource Department, Weldwood of Canada Ltd., and the Alberta Forest Technology School. By this time, a number of other partners were already confirmed, including the Alberta Forest Service, the Department of Forest Science, the University of Alberta, the Alberta Research Council, Forestry Canada (Petawawa National Forest Institute), Forestry Canada (Northern Forestry Centre), the Town of Hinton, the Forest Engineering Research Institute of Canada, and the Environmental Systems Research Institute (ESRI) Canada.

Dennis Quintilio and Rob Thorburn, Forest Technology School (now the Hinton Training Centre) fire-training lab, early 1990s. Quintilio and Thorburn developed many innovations to fire-simulator training at the FTS. Both went on to become directors of the school.

Developing the Proposal

With their bosses onside, Udell and Quintilio co-chaired the committee that drafted the proposal. Most of the work took place at a table in the technology school dining hall. The final submission was due February 28, 1992. The first meeting is recorded as being held on October 31, 1991. On November 6, Udell and Quintilio met with Deputy Minister Cliff Smith and Assistant Deputy Ministers Jim Nichols (Fish and Wildlife), Ken Higginbotham (Forestry), and Al Brennan (Forest Industry Development Division).

A month later, in December 1991, the Department of Forestry, Lands and Wildlife decided to join the committee as a sponsoring and land management partner. At the meeting on December 11, 1991, Jasper National Park also joined the committee, and John Taylor prepared a paper outlining how Jasper could participate as a land-based management partner. Several planning meetings continued through January and February 1992, leading to the final proposal, which was submitted before the deadline of February 28, 1992. Rick

Rick Bonar, 2015. Bonar continued his involvement with the program at Hinton, serving variously as program lead, researcher, chair, and president before retiring from the Board in January 2017.

Bonar prepared the text of the final proposal, with significant participation by Doug Walker.

There was some fluidity in committee membership, but the core members were:

- Forest Technology School: Dennis Quintilio (co-chair), Ross Risvold, Andy Neigel
- Weldwood of Canada Ltd.: Bob Udell (co-chair), Doug Walker, Bryon Muhly, Sean Curry, Rick Bonar, Brian Maier
- Forestry, Lands and Wildlife – Alberta Forest Service: Bill Fairless (Edson Forest Superintendent), Rod Simpson
- Forestry, Lands and Wildlife – Fish and Wildlife: Richard Quinlan, Hugh Wollis
- Parks Canada: John Taylor (senior warden), Terry Winkler, John McIntosh (Calgary office)

Bonar, the first full-time biologist on the staff of an Alberta forest company, was already working with foresters to develop the first integrated wildlife-forestry management program in Alberta on the Weldwood FMA, so the model forest concept was a good fit. With the addition of Jasper National Park to the committee, a number of projects were proposed within the park itself. Dave Kiil, director-general of the CFS Northern Forestry Centre in Edmonton, met with the committee in Hinton and also attended briefing sessions at Forestry Canada in Ottawa.

The key requirement for inclusion in the program was a "working forest" that included not only industrial harvests, but also other interests and values. Portions might consist of protected, unharvested areas. Participants had to commit to multi-stakeholder management and partnerships, and to linkages with other national and international model forests. The goal was to accelerate the implementation of sustainable development through integrated management for diverse values, supported by:

- New approaches and concepts
- Research and technological innovation
- Developing forest information systems and databases
- Testing and demonstrating best forestry practices
- Training, education, communications, and technology transfer[12]

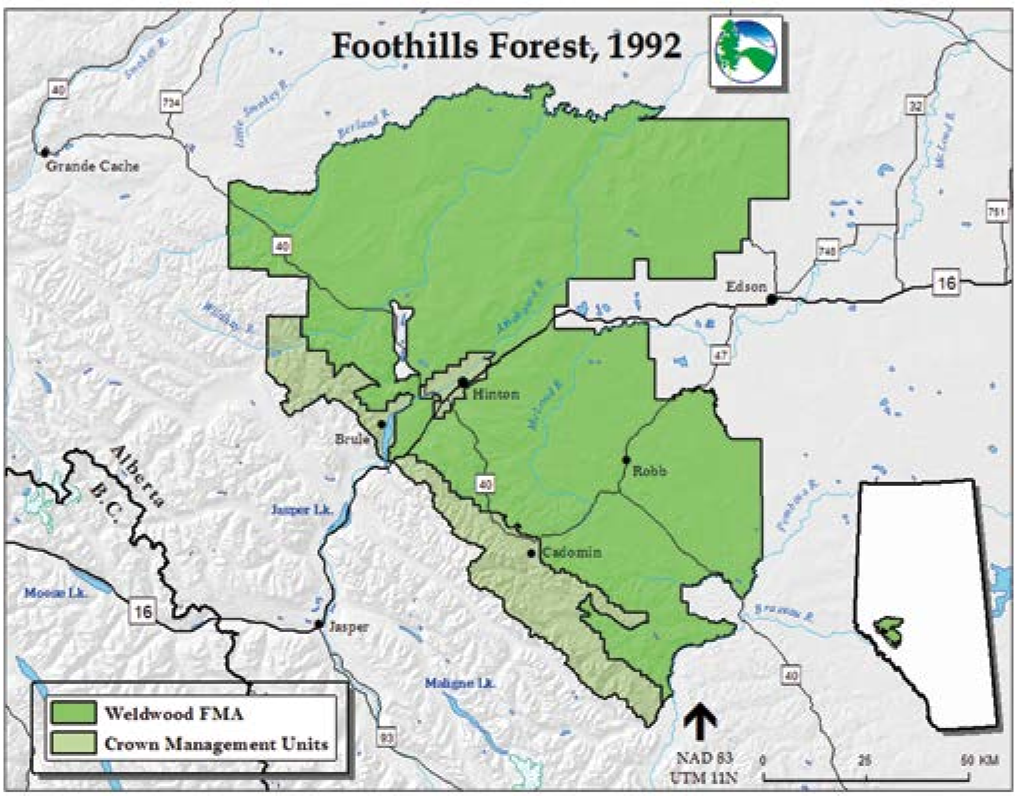
Each model forest had to create its own vision, goals, and work plan within this broad framework. The establishment of working partnerships among diverse stakeholders was a social experiment as well as a research and management initiative for forest, land, and water resources.

Quintilio said the strongest feature of the Hinton proposal was the emphasis on partnerships—not only between Weldwood and provincial agencies, but also with academics, the local community, recreational users, and the coal and petroleum industries. Another strong point was wildlife research and the integration of wildlife management into forest planning. "That was quite a heady time," said Kirby Smith, praising Bonar for his work developing the wildlife program.

> "We had a little group at Weldwood that said, 'Well, we were already doing some of these things. Here's a chance to get a pot of federal money to do more, faster. It's a competition. We've got to write a proposal.' We sat down and built on what was already in place and came up with a proposal and submitted it. It was successful. One thing, though, the proposal was much more grandiose than the funding we received." –Rick Bonar, interview, 2015

The Hinton group started with an almost ideal land base on which to fulfill the intentions of the program. The Foothills Forest comprised 1.22 million hectares of forest in west-central Alberta, in the foothills east of the Rocky Mountains, adjoining Jasper National Park. It lay within three of the Canadian forest regions described by J.S. Rowe:[13] boreal, subalpine, and montane. Jasper National Park was keen to be part of the program, but the timing for such approvals in the federal hierarchy precluded inclusion of the Jasper National Park land base at the outset. Parks personnel were, however, at the table throughout the process. In fact, Assistant Park Superintendent Michel Audy facilitated the committee that developed the first work plan of the new Foothills Forest. The addition of Jasper National Park in 1995 and Willmore Wilderness Park in 1997 would bring the Foothills Model Forest study area to 2.75 million hectares and provide learning opportunities from a wide range of management approaches.

Foothills Forest was a joint venture of Weldwood's Hinton Division, the Alberta Forest Technology School, and the Alberta Department of Forestry, Lands and Wildlife. These sponsoring partners shared a common vision of "sustainable development and integrated management of forest resources through conservation and cooperation."



Map 1-3. Foothills Forest core research land base, 1992.

Vision and Principles

The Foothills Forest partners stated their commitment to sustainable development and integrated management of forest resources through conservation and cooperation now and into the future. The balance among environmental, economic, social, cultural, and spiritual values was to be accomplished through integrated resource management based on the principles of:

- Stewardship, ecological integrity, and wise use
- Improved resource information and understanding
- Coordinated objectives
- Partnerships and consensus

- Best available, economically feasible technology
- Adaptive management for evaluation and improvement

The partners committed to develop, implement, and enhance ecologically based and environmentally responsible integrated resource management systems and strategies. The five-year proposal had a mission statement to "develop an integrated resource management strategy for the Foothills Forest, representing a balance of integrated resource management objectives, using consensus development techniques with the participation of representative stakeholders."

The proposal identified five strategic initiatives: integrated resource management, innovative forest operations, communications and public information, technology transfer, and research.

The first Board signing the new agreement.

Canadian Forest Service representatives and the first Board members and officers of the Foothills Forest at the signing ceremony. Back row, L–R: Bill Fairless (Alberta Forest Service), Frank Cardinal (Alberta Fish and Wildlife), Dennis Quintilio and Ross Risvold (Forest Technology School), Bob Udell (Weldwood, president of Foothills Forest), Gaby Fortin (Jasper National Park), Colin Edey (Canadian Association of Petroleum Producers), Marsha Spearin (Weldwood, secretary of Foothills Forest), Jim Beck (University of Alberta), Bob Newstead (Canadian Forest Service). Front row, L–R: Dennis Dubé (Canadian Forest Service), Dave Kiil (Canadian Forest Service), Don Laishley (Weldwood, chair of Foothills Forest), Ron Staple (Weldwood).

These initiatives led to a series of projects and activities, including such things as resource inventories, ecosystem classification, decision support system development, integration of commercial and non-commercial forest use, community forestry, harvesting and silviculture, computerized planning and mapping and training tools, public information, and demonstration projects in integrated resource management.

The contribution agreement was signed on December 8, 1992, by Foothills Forest Chair Don Laishley and the Northern Forestry Centre's Director General Dave Kiil, and witnessed by Dennis Dubé of the CFS and Ron Staple, vice-president of Weldwood and model forest Board member.

Conclusion

The Model Forest Program could not have been better timed. It came in an era of rapid transition in the Alberta forest products industry, provincial and federal policies, and the expectations of non-government organizations and the public. In 1990, for example, the Alberta Forest Products Association had begun developing its FOREST*CARE* Codes of Practice and certification program—a precursor of national and international standards for third-party verification of sustainability. There was a pressing need for trustworthy research to address stakeholder concerns, meet regulatory requirements, and validate or alter the management of land, water, and other resources.

The Foothills Forest was thus born amid a maelstrom of competing demands—economic development, social responsibility, and environmental protection—and its success depended on bringing together partners with parallel, diverging, or opposing interests and perspectives. The Hinton area's wealth of operational experience and "stovepipes" of data, information, and knowledge provided a solid foundation on which to build. The policy environment was ripe for innovative approaches and sound science to further sustainable management.

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Evolution

The federal Model Forest Program initially sponsored the Hinton-based institution now known as fRI Research and provided important funding during its first 15 years as the Foothills Model Forest. Yet it was increasing support from the Alberta government, the forest industry, the energy sector, and other partners that enabled the model forest to evolve into an independent centre for applied research. The diverse Board, committed funders, dedicated staff, and skilled researchers produced results of proven value. The areas studied broadened over time, as did the complexity of the issues addressed. Some early initiatives were discontinued before their potential was reached, some proved premature and only blossomed later, some flourished from the outset and continue today, while others never got off the ground.

This chapter provides an overview of turning points in the institution's 25-year evolution. Part A addresses issues that were common across the entire period, while Part B provides chronological highlights of programs and events in each of the five, five-year phases of development.

Bob Newstead at the World Forestry Congress 2003 with Marie Anick Liboiron from the CFS Model Forest Ottawa office.

Part A: Key Contributors to Survival and Success

In the 1990s, both the federal and Alberta governments committed to supporting sustainable forest management (SFM) and related policies addressing biological diversity, climate change, water conservation, and public engagement. However, those commitments coincided with severe budget cuts by both levels of government due to high levels of debt and deficits. The cuts were particularly deep for staffing and research activities of the Canadian Forest Service (CFS) and the Alberta Land and Forest Service. As a result, responsibility for the scientific research and demonstration projects to implement the commitments devolved from the federal to the provincial level and from the provincial government to industry and academia. The Foothills Model Forest and fRI Research played an important role in these transitions and benefited from them.

Robert (Bob) Newstead was the regional coordinator for the federal Model Forest Program in the Northwest Region and also represented the Canadian Forest Service on the Foothills Model Forest Board of Directors from 1993 to 2003. He said the institution succeeded because it focused on partners' needs.

> "The greatest success of the Foothills Model Forest was its ability to become self-sustaining at the conclusion of the Model Forest Program. Its strengths, from both financial and program relevancy perspectives, enabled this outcome. I cannot think of any 'failures' that might be attributed to FMF/fRI other than, possibly, early lack of inclusiveness of Aboriginal and environmental non-government organization interests. Au contraire, this factor also allowed FMF/fRI to make progress in many program areas, while other model forests faltered when

attempting to satisfy many widely divergent interests. The foregoing was accomplished by way of the partners' willingness to work together toward (for the most part) common goals and objectives. Open dialogue and on-the-ground demonstration of accrued knowledge led to more collaboration than confrontation as the FMF/fRI matured." –Bob Newstead, questionnaire response, 2015

As an independent institution, FMF/fRI had the flexibility to take on research in response to priorities identified by industry and government and to deliver results efficiently. Major advances emerged in many areas, including:

- Improved understanding of the dynamics of wildlife, fish, and other species, and their responses to human activities and natural processes on the landscape
- Adapting and expanding the CFS ecological site classification system to the model forest land base and using it to develop a landscape classification for an expanded core research area that included protected areas and industrial forests
- Widely recognized, and useful, research on individual species such as grizzly bear and caribou that is improving knowledge about, and management of, the two species
- Development of habitat models for wildlife that are still cited today
- Modelling the behaviour of wildfires, planning and training for fire management, reducing fire risks, and incorporating public involvement in risk-reduction strategies
- Understanding the historical and ecological effects of fire and other natural disturbances, studying their patterns, and incorporating them into forestry and land management
- Refining forest inventories, harvest practices, and silviculture methods
- Hosting agencies that deployed research into operations in areas such as stream crossings, forest growth and yield, and integrated land management
- Watershed mapping and modelling, fisheries studies, and research into issues such as riparian buffers
- Advancing historical knowledge of human activities on the forest landscape
- Helping to quantify the role of forests in climate change
- Socio-economic studies on sustainability in forest-based communities
- Development of local-level indicators for sustainable forest management
- Communicating the scientific basis, principles, and practices of sustainable forest management to users, decision makers, educators, and the public

The establishment of the model forest came just after the birth of the World Wide Web (often cited as August 6, 1991, the day the first website launched). The 25-year evolution of FMF/fRI coincided with continual advances in the speed, capacity, and affordability of computers, telecommunications, and equipment such as plotters and scanners. The ever-expanding FMF/fRI geographic information system (GIS) became a vital tool for researchers and land managers, and the GIS staff developed new tools with wider application. The use of global positioning systems (GPS) and ever-improving telemetry opened up new dimensions in wildlife studies. Imaging systems such as LiDAR* enabled new levels of inventory and mapping of forests, landscapes, and watersheds. The Internet also became a central part of the institution's communications and technology-transfer initiatives, getting information to people who could use it.

There are two main categories of data at fRI Research, non-spatial and geospatial. Non-spatial data includes documents, spreadsheets, and databases, whereas geospatial data comprises aerial photography, digital satellite imagery, and LiDAR, and is used in GIS

* LiDAR (Light Detection and Ranging) is a remote-sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. LiDAR aerial surveys enable high-resolution mapping of surface features such as vegetation, watersheds, and the effects of natural disturbance and human activities.

processes and analyses. As of 2014, non-spatial data accounted for 11 percent of fRI's overall digital resources, while geospatial data accounted for the remaining 89 percent.

Over the last 25 years, there has been a dramatic shift in storage requirements for digital resources at fRI Research. In 2004, fRI began acquiring satellite imagery products from partners. The imagery was updated annually and became available in much finer resolutions. Combined with the expansion of study area boundaries and the increasing complexity of analysis outputs, the amount of digital resources managed at fRI Research exploded (see Figure 2-1).

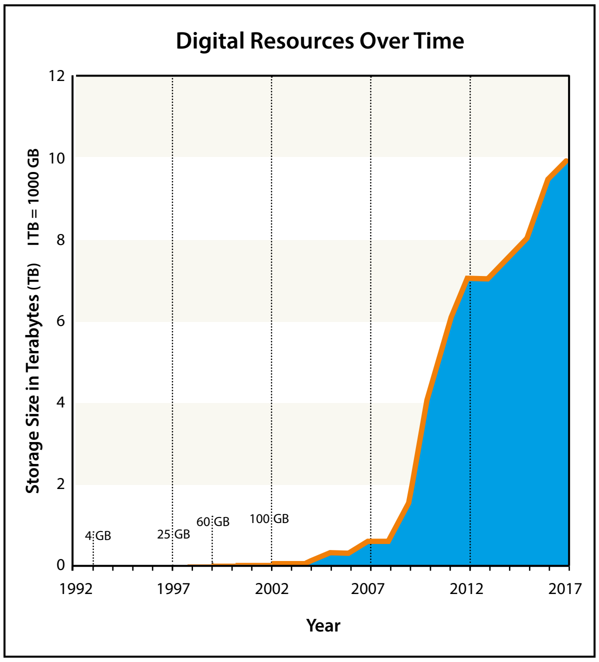


Figure 2-1. Digital resource storage and management requirements at fRI Research, 1992–2017.

Jim LeLacheur, a general manager with Weldwood's Hinton operation who later became chief forester of West Fraser's Alberta forest operations, served as the elected president of FMF and fRI from 2005 to 2009. He said that "ever-expanding and continually strengthening partnerships" were the greatest success of the institution. "Another huge success was watching fRI's credibility expand and get stronger," he said. "Perhaps the greatest example of this was how the Grizzly Bear Program constantly rose above this controversial topic as a result of becoming the credible broker of knowledge on the subject locally, nationally, and, increasingly, internationally." LeLacheur, like a number of other former directors, said the greatest disappointment was the inability to engage more fully with Aboriginal people.

> "The stable and growing partnerships were the result of trust and communications, senior representation, and a widespread commitment to applied research on an ever-expanding landscape. The failure with First Nations, in my opinion, was largely due to conflicting goals. The First Nations were focused on early economic benefits from fRI activities, and the partnership base was searching for answers to common resource-management problems. When we were supplying some economic benefits through our Aboriginal Program activities, there was a fledgling relationship. We also lacked alignment between fRI's partnership methods and the Alberta government's Aboriginal relations mandate and regulations." –Jim LeLacheur, questionnaire response, 2015

Some other initiatives did not live up to expectations. For example, the *Northern East Slopes Strategy* for the province, launched in June 1999, was in large part informed by research conducted by FMF, and many FMF participants worked long hours on the report that was produced in May 2003,[1] but in 2004, the province began consultations on a new planning approach, the Land-use Framework, with no reference to the *Northern East Slopes Strategy.* The original FMF proposal (February 1992) also envisioned a major technology-transfer program and a close working relationship with the Environmental Training Centre in Hinton and its Cache Percotte Forest, but this never got very far, although the Centre continues to provide facilities for FMF/fRI offices and events. Other disappointments came when research projects such as Local Level Indicators and the Decision Support System Framework did not lead to wider adoption by government or industry, although the work was cited by some officials and companies as influential and valuable in other ways. LeLacheur said that the institution might have benefited from a "more robust communications strategy and program" to build public and political support for its programs and findings. Kevin van Tighem, former Board chair (2002–2005) and later superintendent of Banff National Park, also noted this deficiency.

> "While being a great place to demonstrate the results of various applied forest management practices, the area around Hinton isn't where you're going to reach

> the urban audiences, post-secondary students, or other key target audiences for which this kind of outreach would be most important. I think the FMF might have had greater success if it had, in fact, had two centres of operation: one in Hinton at the ETC for the core research, analysis, and technical programs, and one in Edmonton focused on technology transfer and public outreach." –Kevin van Tighem, questionnaire response, 2015

The breadth of partnerships brought diverse perspectives and mutual benefits. For example, Michel Audy, assistant superintendent and later superintendent of Jasper National Park (JNP), helped the committee developing the initial proposal for the model forest, and he facilitated a workshop in which the first work plan for the new model forest was developed. He was a keen supporter of the model forest and JNP involvement. Audy was instrumental, along with Jeff Anderson (JNP Board member 1996–1998), in bringing the Jasper land base into the model forest research area on September 15, 1995. Audy served on the FMF Board from 1994 to 1997 before moving to senior positions with Parks Canada in Edmonton and, eventually, Ottawa until his retirement in 2009. He said that FMF "proved to be an invaluable asset in gaining a better understanding of the broader ecoregion and the interrelationships between JNP land-use policies and those of operators outside the park boundaries. Public consultations on JNP's revised park management plan in 1996 were better informed because of research data generated by the institute, most importantly GIS mapping. On this latter point, I recall that we displayed a GIS-generated map of the FMF during public consultations. This document had a huge visual impact for the public and helped shift public discussions from specific one-off issues led by special-interest groups to discussions on a landscape level." Audy said that FMF/fRI had significant impacts on JNP's approaches to fire management, public engagement, and ecological planning, programs, monitoring, and reporting.

> "The FMF provided the ways and means for JNP to leverage its research budget to achieve a broader range of results. In addition, the FMF's research program established and maintained a clear set of ecosystem-based goals compatible with JNP's. The FMF facilitated the integration of JNP's interests with resource-based operations (i.e., forestry, coal, oil and gas, recreation) on the Eastern Slopes and in the Yellowhead Corridor. Accountabilities and responsibilities were clearly established with a Board accountable for reviewing research goals and budgets, and ensuring that measurable results were produced." –Michel Audy, questionnaire response, 2015

JNP Superintendent Michel Audy at a new model forest kiosk in Jasper, celebrating the addition of JNP to the model forest research land base, September 1995.

Audy's summation of the factors in FMF/fRI success echoed those offered by many others:

1. Transparency in deliberations, decisions, and results achieved
2. A pragmatic approach to defining and achieving ecosystem-based goals, in harmonizing data collection methodology, and in sharing research results, supported by a strong commitment in human and financial resources from participating organizations
3. Access to information, publication of research results, integration of research into management and land-use plans, and maintaining a strong public education program were important from the outset
4. Broad and inclusive partnerships built on trust and respect for their individual mandates
5. Dedicated administrative support and research staff to ensure deliverables

6. Financial self-sustainability ensured by participating organizations with oversight mechanism
7. The scale of the model forest (e.g., JNP, Hinton Wood Products' working forest, Willmore Wilderness Park, William A. Switzer Provincial Park, and provincial Crown Management Units) and the variety of land use (e.g., conservation, forestry, oil and gas extraction, coal mining, and recreational)

Funding

The prerequisite for survival and success was adequate funding, totaling $91,955,976 over the first 25 years. Table 2-1 and Figure 2-2 show the evolution of sources. The Canadian Forest Service got things going with roughly $1 million per year during Phase I and about $500,000 per year in Phases II and III, for a cumulative total of $10.4 million, and other federal funding has included almost $2 million from Jasper National Park to date. The value of in-kind involvement by CFS and other researchers, partners, and Board members was reported in annual reports during the early years of the program, and it was substantial. For instance, in the first five years of the program, 1992 to 1997, direct expenditures totaled $5,937,964 and in-kind contributions (including the seconded position) totaled $3,412,371. Forest companies, energy companies, other non-government partners, and other federal funding such as NSERC grants directly contributed $24.9 million over the 25 years. Forest companies contributed a further $21.7 million through the sponsorship of projects and initiatives under the Forest Resource Improvement Program (FRIP) discussed below. Beginning in 1997, the provincial government accounted directly for more than one-third of the funding.

Weldwood Canada's Hinton operation (which in 2004 became the Hinton Wood Products division of West Fraser Timber Co. Ltd.) was a founding shareholder and the largest of the industry partners that contributed significant funding. In fact, during Phase I of the

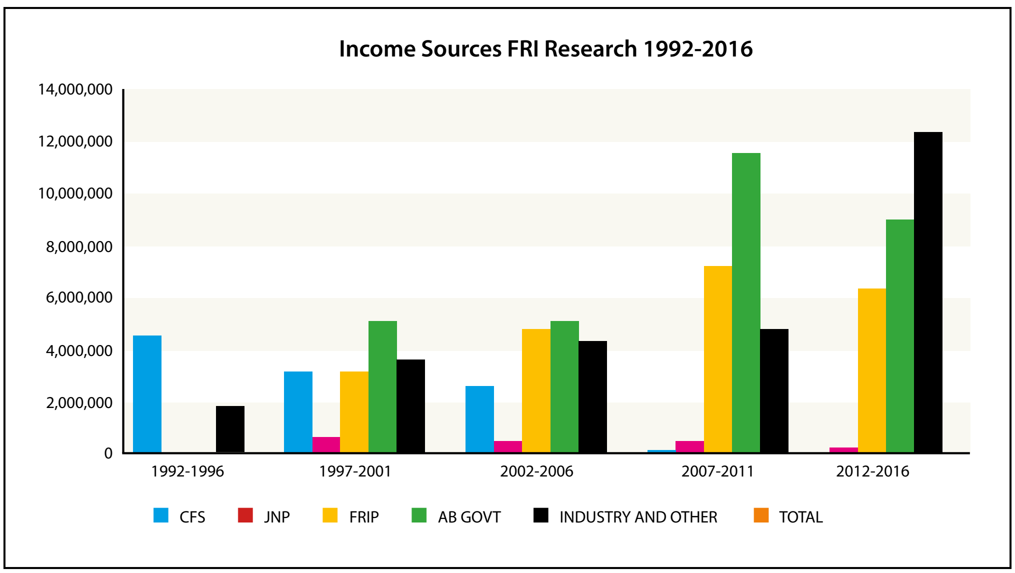


Figure 2-2. Major funding sources and five-year Phases I to V.

model forest, Weldwood sponsored most of the "other" funding directly and also through FRIP to carry on projects already begun in forestry and wildlife research. Other forestry companies and the oil and gas and mining sectors became increasingly important funding sources as the scope of research expanded and the relevance to their operations became evident. Industry support played a key role in the 2007 decision to continue as an independent institute after the end of the federal Model Forest Program.

A 1996 evaluation of Phase I of the Model Forest Program rated Foothills as the best-performing in the Canadian Model Forest Program.[2] However, the 50 percent reduction in federal funding after 1997 for Phase II threatened severe curtailment of research

SOURCES OF FUNDS - FROM STATEMENTS OF CASH FLOW

YEAR	TOTAL SPENT	CFS	JNP	FRIP*	ALB. GOV.	OTHER	TOTAL INCOME
1992-93	487,910	807,800	0			10,877	818,677
1993-94	1,007,040	670,000	15,000			227,095	897,095
1994-95	1,196,802	1,012,000	0			366,313	1,378,313
1995-96	1,507,598	918,200	0			569,847	1,488,047
1996-97	1,738,614	1,101,000	2,000			667,634	1,770,634
1997-98	1,807,847	792,141	168,991		937,772	869,580	2,768,484
1998-99	1,906,309	585,921	151,496	819,880	3,589,482	817,709	5,964,488
1999-00	3,970,613	772,103	260,000	1,210,236	61,823	394,779	2,698,941
2000-01	3,051,555	531,741	56,000	462,961	152,750	1,344,148	2,547,600
2001-02	2,659,944	500,000	11,600	664,967	400,430	272,220	1,849,217
2002-03	2,761,271	505,220	108,600	1,261,652	463,046	-3,144	2,335,374
2003-04	2,787,335	555,501	100,140	715,080	722,054	550,108	2,642,883
2004-05	2,878,312	500,000	102,593	548,175	662,833	616,186	2,429,787
2005-06	4,208,626	527,000	100,100	1,178,226	1,037,102	1,575,369	4,417,797
2006-07	4,766,086	525,000	112,311	1,207,797	2,207,840	1,616,719	5,669,667
2007-08	4,486,914	120,000	0	2,221,429	2,116,960	288,673	4,747,062
2008-09	5,245,354		270,996	1,770,625	3,029,543	1,629,077	6,700,241
2009-10	3,946,653		110,000	1,688,145	1,761,418	232,728	3,792,291
2010-11	3,599,640		110,000	1,071,405	3,427,866	1,071,016	5,680,287
2011-12	4,289,861		51,000	501,531	1,308,780	1,556,621	3,417,932
2012-13	5,075,254		50,000	1,134,141	1,307,431	1,761,394	4,252,966
2013-14	5,249,346		50,000	1,013,653	1,967,263	2,517,165	5,548,081
2014-15	6,807,238		100,000	999,054	2,612,650	2,999,946	6,711,650
2015-16	6,545,344		41,813	1,797,896	1,771,027	2,990,687	6,601,423
2016-17	5,426,745		25,000	1,417,786	1,327,269	2,056,984	4,827,039
TOTALS	87,408,211	10,423,627	1,997,640	21,684,639	30,865,339	26,999,731	91,955,976

* FRIP expenditures are only shown starting in 1997. "Industry" funding is primarily forest industry, but includes other industries, particularly oil and gas in recent years. Considerable funds came from FRIP through Weldwood during the period 1994–1996, but these are not shown separately and are incorporated as "other."

Table 2-1. Income and Expenditures, 1992–2017.

activities despite increased industry contributions and Parks Canada payments. In 1997, the three shareholders (Alberta, Jasper National Park, and Weldwood) committed to replacing the funding lost by the reduction so that the planned research could continue unaffected.

Ty Lund, Alberta Minister of Environmental Protection from 1994 to 1998, and his assistant deputy minister for forestry, Cliff Henderson, were enthusiastic champions of the Model Forest Program in Alberta. Lund paid attention to the research at Hinton, visiting often. He saw its value for Alberta and took pains to ensure that this was also well understood by his colleagues in the legislature. Representatives of the model forest were frequently invited to discuss the program at meetings of his Department's Standing Policy Committee. This kind of provincial support was unique within the Canadian Model Forest Program and was unquestionably a major contribution to the early and ongoing success of the initiative.

Minister Ty Lund with Chihuahua Model Forest President Oscar Estrada Murrieta, Chihuahua Model Forest Tour, February 1996.

Bob Udell and others have said that Cliff Henderson's advocacy deserved a lot of the credit for the provincial commitment. Among other things, Henderson actively promoted the program right down into the halls of the Legislative Assembly.

> "I was actively involved with the Model Forest and Research Institute from its founding until my retirement in 2008. I felt privileged to be part of the team and provide insight and direction for the government's legislative, policy, and budgetary processes that contributed to the long-term success. The senior government officials, ministers (noteworthy was Minister Ty Lund, with whom I had developed a very good working relationship), Treasury Board, and Cabinet deserve to be congratulated for their wisdom for legislating the agreements and policies that provided the funding and direction for the program. There were no 'ivory tower' research findings at Hinton. The Foothills Model Forest was more than successful, it was outstanding."
> –Cliff Henderson, questionnaire response, 2015

Cliff Henderson and Ty Lund championed some major Government of Alberta initiatives in the mid- to late 1990s that set the program on a very solid footing, which continues today.

The Forest Resource Improvement Program (FRIP), 1994

In 1994, Cliff Henderson conceived the idea of a progressive stumpage levy tied to the selling price of lumber, producing revenues that would be managed as an independent fund for forest improvement projects. With support from Minister Ty Lund and Chris Anderson (Woodlands Manager, Canfor Grande Prairie), Henderson was successful in bringing both the forest industry and the provincial government onside, and the Forest Resource Improvement Program (FRIP) began.

FRIP was established to provide the Alberta forest industry with funds for any activity or research that improves the sustainability and stewardship of the forest and the land that supports it. The program only supports projects deemed to go above and beyond applicants' existing regulatory responsibilities, and monies may not be used for capital assets. Many Foothills Model Forest and fRI initiatives qualified for FRIP, and the program became a major source of funds.

The FRIP mandate was designed, among other things, to avoid creating a "subsidy" under the terms of the Softwood Lumber Agreement between Canada and the United States.

As lumber prices rose after 1994, suddenly there was funding available for such projects as wildlife studies and other research, communications programs, and recreation developments. Companies that put money into this fund could propose projects that, once approved, were paid for in whole or part with FRIP dollars. As such, FRIP funds were and are considered to be forest industry contributions to the FMF and fRI Research. Much of Weldwood's early contribution to the Model Forest Program between 1994 and 1996 came through FRIP project sponsorships.

The Forest Resource Improvement Association of Alberta (FRIAA)

In the 1990s, the provincial government of Premier Ralph Klein was repositioning itself to focus more on core functions such as policy, strategy, and enforcement, and it was looking for alternative ways to deliver services that were not regarded as core. To this end, the Government Organization Act of 1994 allowed for the creation of Delegated Administrative Organizations (DAOs) empowered to collect levies on industries or activities in order to carry out specific purposes. Examples of DAOs include the Orphan Well Association, which collects levies from oil and gas companies for site abandonment and reclamation, and the Alberta Conservation Association, which uses licence fees for fish and wildlife habitat enhancements.

In 1997, Henderson and Lund were instrumental in creating a new DAO—the Forest Resource Improvement Association of Alberta (FRIAA)—and moving the FRIP program over to it. Today, FRIAA continues to administer FRIP and other programs on behalf of the provincial government. These programs include the Community Reforestation Program, Wildfire Reclamation Program, Mountain Pine Beetle Program, Mountain Pine Beetle Rehabilitation Program, FRIAA FireSmart Program, and Incidental Conifer Program.

Under FRIAA, FRIP became a major funding source for the Foothills Model Forest and fRI, contributing a total of $21.7 million over the following 20 years (not including Weldwood's 1994–1996 FRIP project sponsorships). The majority of this was sponsored by Weldwood, and later West Fraser, representing the lion's share of the company's committed funding to FMF/fRI research. But the total also includes substantial funds granted under the organization's Open Fund call for proposals. This 25-year history story is one such beneficiary of the Open Funds process.

The Environmental Enhancement Trust Fund

A result of the Softwood Lumber Agreement in 1996 was the rebate of U.S. levies collected on Canadian lumber imports during the lengthy litigation that preceded it. Alberta's share of the rebate was deposited in the Environmental Enhancement Fund (a multi-purpose fund created under 1993 legislation). Most of this fund went into the provincial government's wildfire management program, but $3.2 million was directed to the Foothills Model Forest in 1998 for a series of priority projects identified by the government and the forest industry through the Alberta Forest Products Association. Funding also allowed for the addition of other projects, provided the total spending did not exceed the $3.2 million. This marked a major turning point. The funds supported FMF/fRI projects such as the Prometheus fire growth simulation model and the Forest History Program. Some new projects were begun from which benefits continue to flow today (e.g., the Forest Growth Organization of Western Canada and the Mountain Pine Beetle Ecology Program).

Priority funding went to Group "A" projects; i.e., those identified as priorities of the Alberta Forest Products Association (AFPA) and the assistant deputy minister of the Alberta Land and Forest Service. Group "B" projects were identified by the Board of the Foothills Model Forest and endorsed by the AFPA Board. Group "C" projects were those chosen by the FMF Board when the study on the Utilization of Burnt Fibre in Pulping[3] (Group "A" project) was terminated before it was finished, based on the AFPA's recommendation.

Organization

Both the Foothills Model Forest and fRI were set up as non-profit Alberta corporations. The first two shareholders were Weldwood and the Government of Alberta. The list of shareholders expanded over the years and, by 2015, included Hinton Wood Products (3 shares),

Table 2-2. Environmental Enhancement Fund Projects, 1998–2002.

* Forintek Canada Corp. was a government-industry partnership established in 1979 to conduct research for the forest products industry. In 2007, Forintek amalgamated with FERIC, Paprican, and the Canadian Wood Fibre Centre of Natural Resources Canada to form a single non-profit research organization, FPInnovations.

Provincial Environmental Enhancement Fund Grant, 1998–2002

Project	Funding ($)	Comments
Group "A" Projects – AFPA/Provincial Priority		
Transportation Efficiencies	205,100	Stump-to-mill wood haul model developed by the Forest Engineering Research Institute of Canada (FERIC). In use by 80 companies from Alberta to Quebec.
Wood Processing Technologies	349,700	Joint project of the Northern Alberta Institute of Technology (NAIT) and Forintek Canada Corp.* for training in sawmill technology. Dry kiln installed at NAIT and training programs developed.
Western Canada Forest Industry Partnership	327,300	A promotional program aimed at developing new markets in the Pacific Rim for Alberta forest products.
Economic Modelling	150,000	Support for economic modelling in the Foothills Model Forest Socio-Economics Program.
Community Sustainability	400,000	Support for community participation in senior processes and forums affecting forest-based communities in Alberta.
Alberta Advanced Forest Management Institute (AAFMI)	65,100	Development and delivery of training modules in AAFMI for upgrading the technical skills of forest practitioners in Alberta.
Utilization of Burnt Fibre in Pulping	600,000	Following the 1998 Alberta wildfires, this was a joint project of the Pulp and Paper Research Institute of Canada (Paprican), FERIC, and the Alberta Research Council to investigate methods for handling and using burnt fibre in pulp production. The project was terminated before completion, with only $133,000 spent.
Total Group "A" Funding	**$2,097,200**	Original Group "A" funding estimate
Group "A" Funding Revenue 2001	**$1,630,200**	Net amount spent on Group "A" projects
Group "B" Projects – FMF Board Priority, AFPA-Endorsed		
Growth and Yield Research	200,000	Support for the establishment and initial operation of the Foothills Growth and Yield Association. Nine Alberta FMAs involved.
Grizzly Bear Research	295,000	Ongoing support for a $500,000-per-year program with heavy dependence on fundraising. The program arose in part from concerns expressed during 1997 Canada-Alberta Cheviot coal mine hearings.
Canadian Environmental Assessment Act Training Development	10,000	Training programs for environmental auditing. This was considered important as more Alberta companies were seeking certification.

Project	Funding ($)	Comments
Canadian Wildfire Growth Model	25,000	Support for the development of Prometheus, a wildfire spread model for use in wildfire suppression and planning.
Ecosite Chronosequence	200,000	Ecosite guides to this point were based on mature stands. This model would be applied to immature stands as a basis for ecosite classification and forecasting.
Japan Mission – FMF Delegate	12,800	FMF was asked to join an intergovernmental panel on a mission to Japan to explore future forest sector opportunities.
Natural Disturbance Research	40,000	Support for a program that, in 2000, was becoming the standard for forest management planning in Alberta.
Administration	320,000	Foothills charged a 10 percent administration fee to manage the funding.
Total Group "B" Funding	**$1,102,800**	
Group "C" Projects – Reallocation of Funds 2001 – FMF Board Priority, AFPA-Endorsed		
Western Canada Forest Industry Partnership Program	116,000	The SPF Japan/Pacific Rim Market Development Program was designed to improve market access opportunities for Western Canada spruce-pine-fir (SPF) lumber in Japan and the Pacific Rim.
Grizzly Bear Program	100,000	Ongoing support for a critical program.
Mountain Pine Beetle (MPB) Spatial Model	21,000	Development of a spatial model for predicting the spread of MPB.
Chisholm Fire Research	70,000	Support for the contract of Dennis Quintilio as project manager for the research.
Foothills Growth and Yield Association	70,000	Support for the contract of W.R. (Dick) Dempster, director, for 2002–2003
Adaptive Forest Management Program	90,000	Publication of two major reports.
Total Group "C" Funding	**$467,000**	
Grand Total	**$3,200,000**	

the Government of Alberta (3 shares), Jasper National Park (2 shares), Foothills Energy Partners* (2 shares), Weyerhaeuser Company (1 share), and Canadian Forest Products Ltd. (1 share). The shareholders are major funders that provide nominal equity, accept legal responsibilities, and, if necessary, can serve as final decision makers.

Strategic direction has always come from the Board of Directors, who are elected by shareholders and funding partners. The Board identifies priority needs and allocates funding and human resources to meet those needs. Although composition has varied, directors have included representatives of the Government of Alberta, the Canadian Forest Service (during the model forest era), Jasper National Park, the forest industry, the University of Alberta, the oil and gas sector, coal mining, the Town of Hinton, and Aboriginal communities. The Board elects a chair and a president—both of whom come from the shareholders in the enterprise. An Executive Committee provides continuing direction.

From the beginning, the Government of Alberta offered to second a forester to the institute, and this person has served as the General Manager since the position was created. This secondment demonstrates the government's continuing commitment to support the model forest and fRI Research. Alberta's total secondments over the first 25 years have amounted to almost 50 person-years, a key contributor to the ongoing success of the institute. Similarly, the presidents and chairs have contributed an estimated 12.5 person-years (at three months per year). Program leads and researchers from other organizations have added countless additional in-kind person-years (see Table 2-3).

John Kerkhoven represented the oil and gas industry† on the Board from 1999 to 2016. He said the diverse membership brought different perspectives to bear on common land

* Foothills Energy Partners represents oil and gas companies active in the region: ConocoPhillips Canada Ltd., Encana Corp., Suncor Energy Inc., and Repsol Canada Inc.

† The first representative of the oil and gas sector was Colin Edey from NOVA Corp., who was on the Board from 1992 to 1998.

Table 2-3. Senior Management and Seconded Positions of FMF and fRI Research, 1992–2017.

Year	President		Chair		General Manager (Seconded)		Other Seconded	
1992–1993	Bob Udell		Don Laishley				Rick Blackwood (forester)	
1994–1995	Bob Udell		Dennis Quintilio				Rick Blackwood	
1995–1996	Bob Udell		Ross Risvold				Rick Blackwood	
1996–1997	Bob Udell		Ross Risvold		Rick Blackwood			
1998–1999	Bob Udell		Ross Risvold		Rick Blackwood		Gord Stenhouse	(Grizzly Bear Program)
1999–2000	Bob Udell		Ross Risvold		Rick Blackwood	Mark Storie (Jan)	Gord Stenhouse	
2000–2001	Bob Udell		Ross Risvold		Mark Storie		Gord Stenhouse	
2001–2002	Bob Udell		Don Podlubny		Mark Storie		Gord Stenhouse	
2002–2003	Bob Udell		Kevin van Tighem		Mark Storie	Don Podlubny (August)	Gord Stenhouse	
2003–2004	Bob Udell		Kevin van Tighem		Don Podlubny		Gord Stenhouse	
2005–2006	Bob Udell Jim LeLacheur		Rick Bonar		Don Podlubny		Gord Stenhouse	
2007–2008	Jim LeLacheur		Rick Bonar		Don Podlubny	Tom Archibald (March)	Gord Stenhouse	
2008–2009	Jim LeLacheur		Rick Bonar		Tom Archibald		Gord Stenhouse	
2009–2010	Rick Bonar		Rick Bonar		Tom Archibald		Gord Stenhouse	
2011–2012	Rick Bonar		Rick Bonar		Tom Archibald		Gord Stenhouse	Axel Anderson (Water Program)
2012–2013	Rick Bonar		Rick Bonar	Bruce Mayer	Tom Archibald	Bill Tinge (Dec)	Gord Stenhouse	Axel Anderson
2013–2014	Rick Bonar		Bruce Mayer		Bill Tinge		Gord Stenhouse	Axel Anderson
2015–2016	Rick Bonar		Bruce Mayer		Bill Tinge		Gord Stenhouse	Axel Anderson
2016–2017	Rick Bonar	Jesse Kirillo	Bruce Mayer		Bill Tinge	Ryan Tew (july)	Gord Stenhouse	Axel Anderson

management issues such as wildlife and water. He also said that significant areas of the research were directly relevant to his company's operations—initially Petro-Canada and, since 2009, Suncor Energy—but that was not the only benefit.

> "Because I was also involved with the resource access committee at CAPP [the Canadian Association of Petroleum Producers], I was able to bridge that back—expand upon it and bring it to the attention of other folks. Certain of the projects had a larger notoriety, for example, grizzly bear, just because the nature of the species and those kinds of things. We'd get [bear scientist] Gord Stenhouse to come down and make presentations at CAPP and so on. I was able to facilitate introducing him to lots of other folks who we subsequently were able to make contact with to look for sponsorship dollars, etc. As far as the benefit to the industry, those kinds of projects were pertinent to your ability to gain access to the lands and to know more about what was on the landscape and what type of activities were going on. Another component of that was the networking opportunities, which I was able to enhance by virtue of my involvement with the Board. There were lots of people that I wouldn't have met otherwise that were able to bridge in to other sectors and just make that—the overall landscape management step—that much more … I wouldn't say easier, but that it worked better." –John Kerkhoven, telephone interview, 2016

Partners are the other organizations and individuals that have provided funding, in-kind support, personnel, program participation, or endorsement. The Foothills Model Forest began with more than 70 partners, and the research organization has generally had more than 100 partners at any given time. As of 2016, there were 63 funding partners, 34 providing in-kind support, and 53 "alignment partners" endorsing or supporting fRI Research's work in other ways. Some of the in-kind support, such as that from the Canadian Forest Service, was substantial.

Relatively small staffs, based in Hinton, have provided the support services for day-to-day operations such as administration, accounting, information technology, and communications, as well as research and program leadership. Since 1996, the staffs have been led by a general manager seconded from the Government of Alberta.* One of the main staff priorities since the beginning has been the development and maintenance of the geographic information system (GIS), the essential data and mapping resource for almost all the programs. Communicating research results to practitioners, partners, and the public has always been another priority.

Although some staff members have led research programs, the majority of the program leaders have been on contract or seconded from industry, academia, or government. Most of the programs' work has also involved government agencies, companies, academics, non-government organizations, contractors, or consultants.

Rick Blackwood, a forester with the Alberta Forest Service, became one of the first Foothills Model Forest staff members when he was seconded to the fledgling organization late in 1992. He served as operations forester and project coordinator before becoming the first General Manager when that position was created in 1996. He remained as General Manager until August 1999, and then rose through a variety of government postings to become assistant deputy minister for strategy in Alberta Environment and Parks. Blackwood said that it was exciting to be part of a start-up and to help address pressing issues such as debate in the late 1990s over the Cheviot coal mine proposal west of Hinton near the Jasper National Park boundary.

> "Being able to develop research projects or collaborations with key stakeholders to try to address some of the key resource questions coming from the local

* Cliff Mathies, an administrator recruited from Saskatchewan municipal government, served as administrative coordinator of the Foothills Model Forest from its inception until the creation of the General Manager position. Mathies then became coordinator of the Chihuahua Model Forest in Mexico from 1995 to 1998, reporting to General Manager Rick Blackwood (see Part B of this chapter).

A reclaimed minesite south of Hinton along Hwy 40 provides habitat as well as escape terrain for bighorn sheep and other wildlife.

> debate was both interesting and rewarding. The evolving role of General Manager allowed me to grow during my tenure there and also provided me with some of the best 'hands-on' learning and mentoring you could ever ask for. I was routinely dealing with not only very strong technical staff and/or partners who had tremendous levels of experience and academic/technical training but ongoing involvement with the Board also provided me with excellent opportunities to work with very senior management staff of partner and stakeholder organizations and to learn from them.
>
> "As we developed programs and research plans, we continually sought consensus on issues and approaches in hopes of finding solutions that met the needs of a broad audience. Presenting that information to a very broad range of audiences in Alberta, Canada, Mexico, and Japan also was invaluable. The experience that I gained has continued to serve me in the different roles I have fulfilled since leaving the model forest, both technically and from a management perspective.
>
> "The collaborative multi-sectoral approach used in the model forest is now the way we do business on all fronts, both internally within the Government of Alberta and externally with stakeholders and has been the way I have done things since returning to government. The multi-faceted look at resource management questions (e.g., not from just a singular lens but from an environmental, economic, and social perspective) is also fundamental to making well-informed decisions and has been with me since my time there (both with staff and stakeholders)." –Rick Blackwood, questionnaire response, 2015

Rick Blackwood, 1995.

Mark Storie, who succeeded Blackwood as General Manager until July 2002, was another of the many former staff members who cited the value of FMF/fRI work in their subsequent careers. Storie said that FMF/fRI projects such as Local Level Indicators proved valuable in his later work as regional director of Alberta Parks in the Kananaskis Region. Lisa Risvold, a former FMF communications manager, made similar observations about the indicators' relevance to her next job with Teck Corp. coal mining operations in the Hinton area.

The Policy Environment

Commitments to sustainability were all very well in principle, but they posed numerous practical challenges for foresters in government and industry, industrial land users, and managers of federal and provincial parks and protected areas. What exactly is meant by sustaining "all values" of the landscape? How do you balance and integrate social, economic, and environmental values?

The evolving answers to those questions added (and continue to add) new dimensions to planning and operations on lands that previously had been managed for a single primary objective such as timber, recreation, or mineral extraction, or later "multiple-use" with one use defined as primary (this was timber on FMA lands). One conclusion was the primacy of ecological values; i.e., that without functioning ecosystems, it would not be possible to sustain social and economic values over the long term. Under Alberta law, even mineral extraction is supposed to be a temporary land use followed by reclamation to restore "equivalent land capability."

In Alberta, the task of implementing sustainable forest management (SFM) fell mainly on government officials and the holders of 20-year renewable forest management agreements (FMAs). The FMA holders are responsible for inventories and management planning in the areas covered by their agreements. Prior to 1983, only four FMAs had been awarded,* covering 10.6 percent of the forested Green Area and 23.6 percent of the annual allowable cut (AAC). By the early 2000s, FMAs accounted for 62.4 percent of the Green Area and 90.1 percent of the AAC. The largest number and area of FMAs were awarded between 1986 and

* The Hinton FMA was the first in 1954, followed by Canfor Grande Prairie in 1964, Procter & Gamble Grande Prairie in 1968 and Blue Ridge Lumber in 1975.

1996.[4] As they developed the 10-year forest management plans and operating ground rules for their areas, the FMA holders needed working definitions of sustainable management, as did the officials reviewing and approving the plans. Federal and provincial officials needed similar guidance as they regulated other industrial activities and put together their own management plans for government activities, infrastructure, parks, and protected areas.

Policy insights flowed in both directions—from industry, academia, and model forests to the provincial and federal governments and international bodies, and from the top down. The Alberta industry had already enunciated some principles while developing the Alberta Forest Products Association FOREST*CARE* Code of Practice and certification program between 1990 and 1992.

While Phase I of the Model Forest Program was underway, the Canadian Council of Forest Ministers (CCFM) was developing the *Criteria and Indicators of Sustainable Management of Canada's Forests*, published initially in 1995[5] and revised several times since then. The six criteria and 83 indicators collectively provided a framework for describing the state of forests and forest management in Canada and for periodically demonstrating achievements in implementing sustainable forest management. This publication was followed up with progress reports in 1997 and 2000. These steps were important in implementing Canada's national and international commitments related to sustainable forest management.

The same criteria were incorporated in the Canadian Standards Association (CSA) Sustainable Forest Management (SFM) standard and certification system, first released in 1996. Two people closely associated with FMF/fRI, Weldwood biologist Rick Bonar and University of Alberta forestry professor Peter Murphy, participated in the CSA deliberations, which occurred in parallel and in frequent contact with the CCFM process. The six criteria (using the original 1995 language) were:

1. Conservation of biological diversity
2. Maintenance and enhancement of forest ecosystem condition and productivity
3. Conservation of soil and water resources
4. Forest ecosystem contribution to global ecological cycles
5. Multiple benefits of forests to society
6. Accepting society's responsibility for sustainable development

Elaborating these criteria became a strategic initiative during Phase II of the federal Model Forest Program, and each model forest was required to develop criteria and indicators for SFM for their areas. The framework came to be widely used as companies developed forest management plans and sought certification using the CSA SFM standard. The CCFM continues to maintain and develop its Criteria and Indicators Program, and in 2012, the Foothills Research Institute built its five-year business plan in the context of the current C&I list from the CCFM.

The CCFM criteria and the CSA SFM standard formed the basis for the Values, Objectives, Indicators, and Targets (VOITs) mandated in the *Alberta Forest Planning Standard*[6] released in 2006. The VOITs encompass the main areas of research undertaken by FMF and fRI.

New approaches also emerged in Alberta during the 1990s. In 1993, the provincial government invited industry, environmental groups, and academics to help formulate a strategy to reflect "the diversity of forest values and uses." This collaboration led to a report submitted in May 1997, *The Alberta Forest Conservation Strategy: A New Perspective on Sustaining Alberta's Forests.*[7] The recommendations included ending industrial activity in significant protected areas, as well as other major changes to legislation, policies, and practices. Rather than adopt the recommendations, Assistant Deputy Minister Cliff Henderson asked FMF General Manager Rick Blackwood to take the lead in drafting the government's response. Input from the FMF thus helped to shape the resulting 1998 Alberta Environmen-

Framework of Criteria and Indicators of Sustainable Forest Management*

1 – Biological Diversity	2 – Ecosystem Condition and Productivity	3 – Soil and Water	4 – Role in Global Ecological Cycles	5 – Economic and Social Benefits	6 – Society's Responsibility
1.1 – Ecosystem Diversity	2.1 – Total Growing Stock of Tree Species – Merchantable and Non-merchantable on Forest Land	3.1 – Rate of Compliance with Locally Applicable Soil Disturbance Standards	4.1 – Carbon Cycle	5.1 – Economic Benefits	6.1 – Aboriginal and Treaty Rights
1.2 – Species Diversity	2.2 – Additions and Deletions of Forest Area by Cause	3.2 – Rate of Compliance with Locally Applicable Road Construction Standards, Stream Crossing, and Riparian Management Systems		5.2 – Distribution of Benefits	6.2 – Aboriginal Traditional Land Use and Forest-Based Ecological Knowledge
1.3 – Genetic Diversity	2.3 – Area of Forest Disturbed by Fire, Insect, Disease and Timber Harvest	3.3 – Proportion of Watersheds with Substantial Stand-Replacing Disturbance in the last 20 years		5.3 – Sustainability of Benefits	6.3 – Forest Community Well-being and Resilience
	2.4 – Area of Forest with Impaired Function due to Ozone or Acid Rain				6.4 – Fair and Effective Decision-Making
	2.5 – Proportion of Timber Harvest Area Successfully Regenerated				6.5 – Informed Decision-Making

* Adapted from "Framework of Criteria and Indicators of Sustainable Forest Management" – Canadian Council of Forest Ministers, 2005.

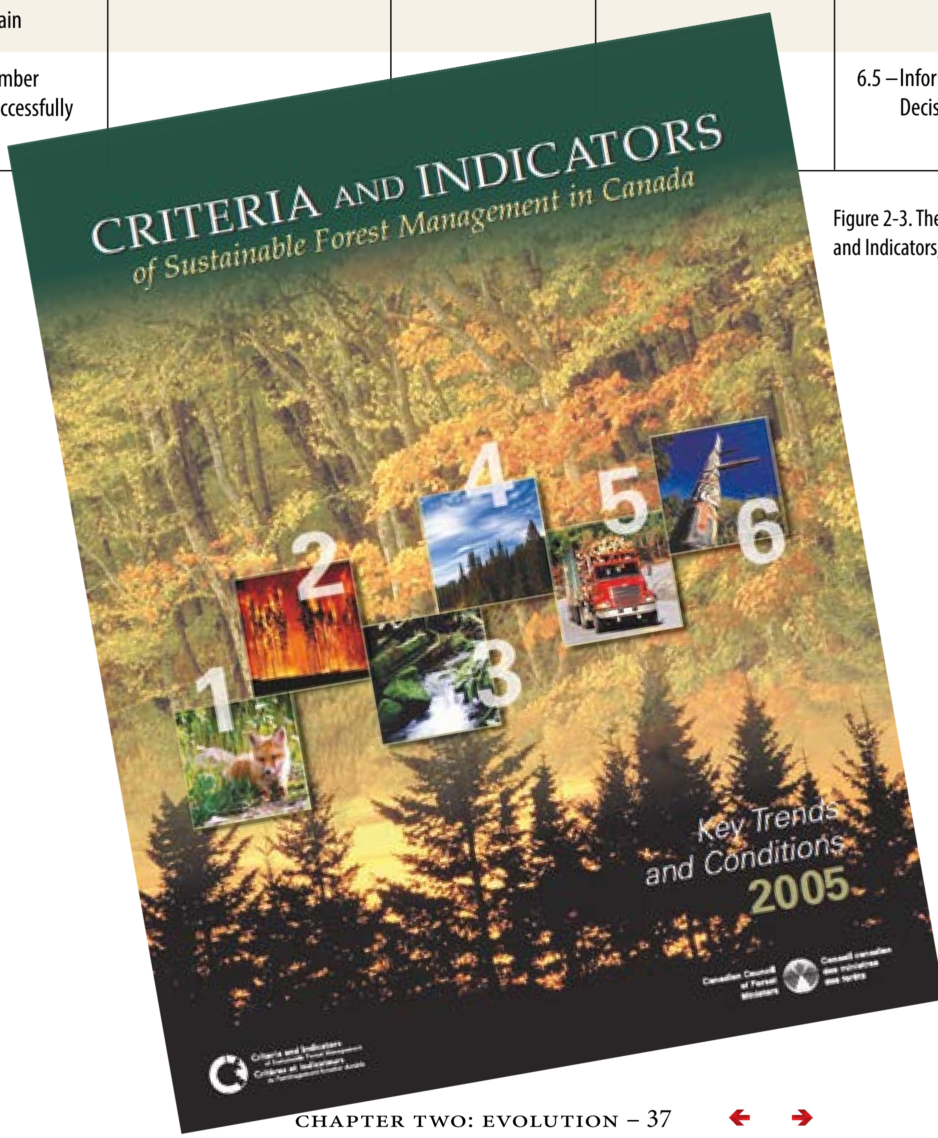


Figure 2-3. The CCFM Criteria and Indicators, 2005.

tal Protection document, *The Alberta Forest Legacy: Implementation Framework for Sustainable Forest Management.*[8]

Concepts developed at the FMF, such as habitat suitability indices (HSIs), became part of the interim provincial planning standard in 1998 and were used in the 1999 Weldwood forest management plan for the Hinton FMA area. Melissa Todd, the model forest's first biologist, continues to use the HSIs today in her work as a forest ecosystem specialist with the British Columbia Ministry of Forests and, in a 2016 interview for this project, noted that they are continually being cited by environmental assessment consultants such as those involved in the Site C Dam project in northern British Columbia.

> "I still use the HSI models, and all those ones that are publicly posted on the Foothills Model Forest or Foothills Research site get used all the time by tons of people. Barb Beck and I modified some of those that Richard Quinlan and Rick Bonar developed, revising and restructuring them. Then we would have individual graduate students like Lisa Tackets take on new models, in her case the barred owl model. Even after I moved to British Columbia, I continued working on the Foothills Model Forest models, because you take all that knowledge with you, and I hadn't fallen off the planet. There are a lot of 1999 versions of those models where I am a co-author." –Melissa Todd, interview, 2016

Other FMF/fRI research on species such as on grizzly bears, caribou, and pileated woodpeckers had significant impacts on management strategies. Gord Stenhouse, leader of the Grizzly Bear Program since its inception in 1997, began a two-year transition in 2017 to become the provincial government's Wildlife Science Advisor.

The Alberta Land Stewardship Act in 2009 began a massive land-use planning effort that in 2017 was still in the early stages of development and implementation. Many aspects of fRI research, from hydrology to integrated resource management, play important roles in the watershed-based regional plans developed as part of the land-use framework. The institution also hosts the Land-use Knowledge Network, an information clearing house for the planning process.

One of the most far-reaching FMF/fRI influences on government policies and industry practices has been the Natural Disturbance/Healthy Landscapes Program led by David Andison (see Chapter 3). The underlying principle is that human-caused land disturbances will be least disruptive and most beneficial to the extent that they approximate natural disturbance patterns. In the boreal forests of western and northern Canada, fire is by far the most common natural disturbance (the others being insects, disease, wind, precipitation, and floods). The Healthy Landscapes Program grew out of Andison's Natural Disturbance Research Program with FMF and fRI since 1994, identified as a "coarse-filter"* biodiversity strategy, which led to an approach often termed ecosystem-based management (EBM). The program was renamed Healthy Landscapes in 2011. The practical results included significant changes in harvest patterns, including stand structure retention and dispersed or "single-entry" harvests replacing the previous "two-pass" design.

Keith McClain was a Board member from 2003 to 2012, while he was director of science policy for Alberta Sustainable Resource Development, and he subsequently led the fRI Mountain Pine Beetle Program as a consultant. He said FMF/fRI succeeded because it met partners' needs for unbiased information.

> "The Grizzly Bear Program greatly facilitated the rise in confidence in the FMF through its early work as it worked to address questions related to mining development and later with the DNA census. The current ABMI [Alberta Biodiversity Monitoring Institute] had its early beginnings with the FMF with the development of biodiversity indicators. There are many other examples, but what was

* "Fine-filter" conservation strategies focus on individual species and populations as indicators of ecosystem health, whereas "coarse-filter" strategies are based on habitats and landscapes. The two types of strategies are complementary and are often used in tandem, with each providing verification and validation for the other (see Chapter 3).

> built was a sense of FMF being the *honest broker* in the provision of science-based knowledge. Also, driven by the need to move research into practice, partners further developed their confidence in the FMF, especially in the areas of natural disturbance protocols for management and the application of indicators of SFM. As a Board member and Director of Science Policy in SRD, I was frequently questioned by other model forests as to 'how did we do it?'–meaning how were we able to sustain funding while everyone else was facing diminishing budgets …. There was a growing reliance on science in Alberta, especially after the Alberta government shut their research branch in the '90s."* –Keith McClain, questionnaire response, 2015

* In a 1991 reorganization, the Alberta Forest Service Research Branch was disbanded and staff reassigned to other branches.

Research by FMF and fRI complemented other SFM research also underway by forest companies, universities, technical institutes, consultants, and government agencies. In northwestern Alberta, for example, the Ecosystem Management Emulating Natural Disturbance (EMEND) Project began in 1988 as a large-scale, multi-partner harvest experiment designed to test the effects of variable forest structure retention on ecosystem integrity and forest regeneration over the long term (80 to 100 years). In northeastern Alberta, Alberta-Pacific Forest Industries (Al-Pac) partnered with the University of Alberta on numerous projects to study areas such as cumulative effects, natural disturbance, and biological diversity. Al-Pac, which had unsuccessfully proposed a model forest during the initial program, also subsequently participated in FMF/fRI programs such as Healthy Landscapes. The provincial government meanwhile worked with the University of New Brunswick and Alberta universities on various hydrology and wetlands mapping initiatives.

Keith McClain has been involved with the Model Forest Program since its outset, beginning with the MacGregor Model Forest.

Political developments in the past decade illustrate the continuing importance of sound science to underpin policies for managing forested lands and watersheds:

- In 2008, the Canadian Council of Forest Ministers released *A Vision for Canada's Forests: 2008 and Beyond*, reaffirming Canada's commitment to sustainable forest management. The vision document outlined five strategies:
  - Encourage domestic and international engagement on forest management issues
  - Facilitate the creation of partnerships among traditional and non-traditional forest uses
  - Increase awareness of forest issues in Canada and abroad
  - Propose new ways to address challenges facing Canada's forest sector
  - Reaffirm Canada's continuing commitment to sustainable forest management.
- After four years of consultations, the Government of Alberta published the Land-use Framework in 2008, describing a watershed-based approach to future land-use planning in the province. This was followed by the Land Stewardship Act in 2009 and a regional planning process that was still in the early stages of development and implementation in 2018.
- A government-industry committee submitted its report, *Forest Industry Competitiveness: Recommendations for Enhancing Alberta's Business Model*, on August 29, 2008.[9] In response to the Land-use Framework, the report recommended that the Government of Alberta should be responsible for all stewardship functions and costs such as wildlife, water, fire, and pest management that were not considered core to the development and delivery of industry resource management and operating plans. Alberta Sustainable Resource Development accepted the recommendation and detailed the new responsibilities in a February 2010 document, *Forest Tenure Roles and Responsibilities in Alberta*.

- On May 18, 2010, members of the Forest Products Association of Canada (FPAC) signed the Canadian Boreal Forest Agreement with nine major environmental organizations.[10] The 21 forest companies agreed to set aside more than 72 million hectares of forest land and work together with environmentalists on caribou conservation and other issues such as forest practices, species at risk, and climate change. In Alberta, industry signatories included West Fraser, Canfor, Weyerhaeuser, Al-Pac, Tolko, and Millar Western. The agreement affected a relatively small portion of the Hinton FMA area, primarily in the northwestern corner, which had already been set aside from logging. Environmental groups, for their part, agreed to suspend their "do not buy" campaigns targeting companies' products.
- In 2014, the *Fish Conservation and Management Strategy for Alberta* classified Athabasca rainbow trout and bull trout as "threatened" under the Alberta Wildlife Act.
- On March 4, 2015, Alberta Sustainable Resource Development issued the *Watercourse Crossings Remediation Directive*, which endorsed and mandated the approach taken by the Foothills Stream Crossing Partnership (FSCP) and recommended that organizations wishing to meet the requirements of this directive take steps to use the same protocols through discussion and perhaps contracts with FSCP.
- The 2015 United Nations Climate Change Conference in Paris, France, negotiated a global agreement on the reduction of climate change. On April 22 (Earth Day), 2016, 174 countries, including Canada, signed the agreement in New York, and they began adopting it within their own legal systems.
- In May 2015, Alberta announced a draft *Grizzly Bear Recovery Plan*[11] that included funding of $475,000 for fRI to improve the understanding of grizzly bear populations.
- On June 8, 2016, Alberta Environment and Parks released *Alberta's Caribou Action Plan: Leadership for the Recovery of Alberta's Caribou Populations*. In anticipation of the restoration of historical lineal disturbances (primarily seismic lines) playing a significant role in caribou action planning, the fRI Research–based Foothills Landscape Management Forum (FLMF) and the Government of Alberta partnered to prepare a "netted-down" restoration plan in February 2016. This was completed in June 2016 and was used as the basis for the government to prepare "requests for proposals" for restoration planning and implementation in late 2016.

Darren Tapp, executive director of the Forest Management Branch in Alberta Agriculture and Forestry, served on the fRI Board from 2011 to 2017. He said all the work of FMF and fRI has had some influence on the development of policies and practices for land and watershed management in Alberta and beyond.

> "Particularly, the work around the Healthy Landscapes Program and the Grizzly Bear Program has really influenced how we manage the resources in Alberta. The *Grizzly Bear Recovery Plan* [with requirements developed from fRI research] really helps us develop the models and management of forests in those areas where grizzly bears are. Similarly, with the Healthy Landscapes Program, the understanding of fire regimes across Alberta and their impact on a natural forest, then how we integrate that with a strong human-caused influence on the forest as well has been a challenge. Having the research that Andison has done has really helped us move forward with accepting and moving away from things like two-pass forest harvesting, more into the Regeneration Standards of Alberta, where

we do a single-pass harvesting into larger areas, a variety of cutblock sizes, not necessarily a low end or a high end, but a variety of sizes.

"The Water Program that we have now and the precursor with the Fisheries Program have helped us understand the impact of industrial uses on those watercourses. Some of the things we are doing are adjusting the strict buffers that we have on watercourses. So we are moving from 30 metres everywhere all the time to what is the actual riparian area, what are the values that we want to try to protect and manage for, and then how do we make sure that those values are there over time. Not just once and walk away and just assume that it's always going to be there. There's a whole bunch of different things. It's not necessarily one thing that I can point to, but it's just the body of knowledge that's really helped us to move forward with a variety of different things." –Darren Tapp, interview, 2016

Part B: Evolving Priorities and Programs

The research and demonstration work unfolded in five phases of five years each—a pattern established by the length of the initial Model Forest Program.* There were three phases as a model forest and two as an independent research institute. Emphasis shifted from phase to phase, and to some extent each year, based on Board direction, partners' needs, available funds, and the progress being achieved in the various program areas.

* The relationship with the federal and provincial governments also led to a fiscal year running from April 1 to March 31 of the following year.

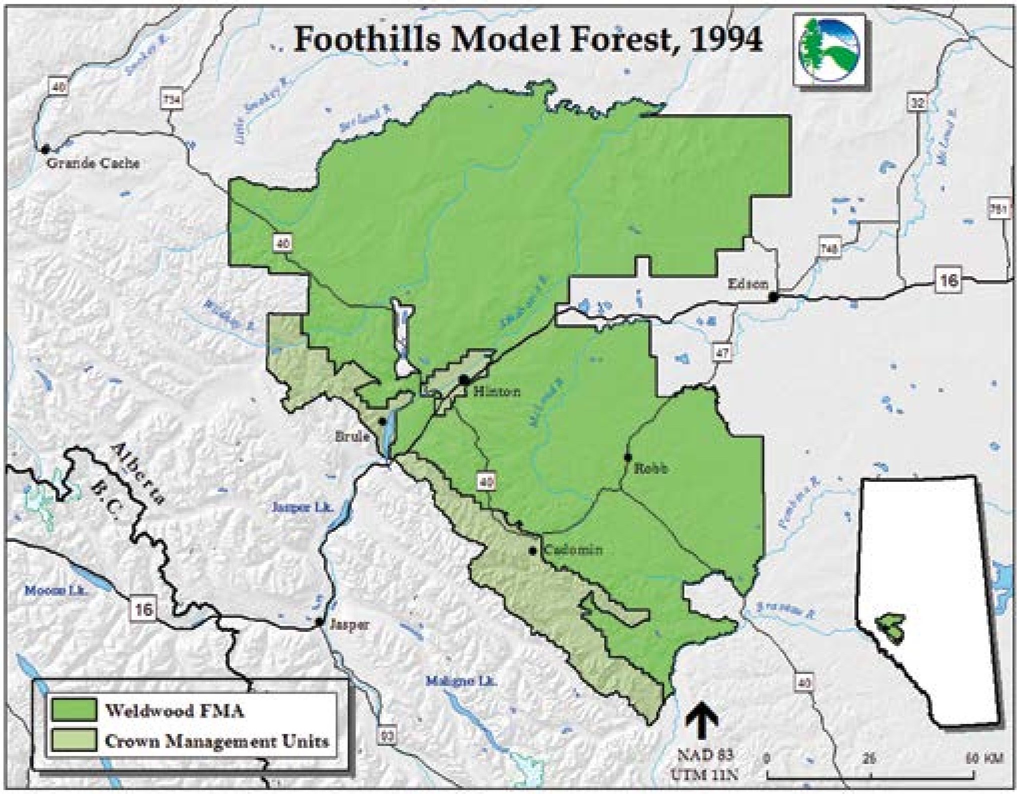
Phase I, 1992–1997

The agreement that created Foothills Forest was formally signed on December 8, 1992, by Dave Kiil of the Canadian Forest Service, representing the federal government, and Don Laishley of Weldwood on behalf of the Board of Directors. By that time, administrator Cliff Mathies and forester Rick Blackwood were already preparing for the ambitious list of programs described in the Model Forest Program proposal, based on priorities identified by the Board. The Foothills Model Forest gained a new champion when Ty Lund replaced Brian Evans as Minister of Environmental Protection in October 1994. Although Jasper National Park (JNP) would not formally join the model forest research landbase until 1995, JNP superintendent Gaby Fortin sat on the Board and assigned Mike Westbrook of his staff to work with the model forest.

Courtesy of the Province of Alberta, offices were set up in the Environmental Training Centre, where they remain today. The facility was renamed Hinton Training Centre in 2003. In 1994, Foothills Forest changed its name to Foothills Model Forest, with no change in the research land base.

Biologist Melissa Todd was among the first scientists hired, and she continued the work begun several years earlier by Weldwood biologist Rick Bonar, planning forester Doug Walker, Alberta Forest Service forester Tony Sikora, Richard Quinlan of Alberta Fish and Wildlife, and University of Alberta professor Jim Beck, to integrate wildlife values into forest management planning (see Chapter 3). She said working with 35 species and their habitats proved to be extremely complicated, but a research plan eventually emerged. "It was early days," she said, and there was a "disjoint" between the programs' intentions and what could actually be achieved on the ground. For her and GIS analyst Carol Doering, "It was like, wow, we don't even know where to start …. I mean, one of the model forest's supposed strong points was to be able to do manipulative experimentation on the ground," Todd said.[12]

"The scientific community became aware of what we were doing … in the early days of FMF, and we set a standard that was then reflected in further wildlife/forestry research on the lands of Al-Pac and other major forestry allocations that



Map 2-1. Foothills Model Forest research land base, 1994.

were happening at the time. We contributed to a new understanding that forest management caused wide-ranging landscape and resource impacts but also provided wildlife habitat management opportunities. We contributed to an expectation that forestry companies needed to look beyond wood fibre production and include planning for conservation and management of wildlife, fisheries, and other natural values." –Richard Quinlan, questionnaire response, 2015

Todd departed after two years and was replaced by Dan Farr, who was just completing his PhD under Jim Butler at the University of Alberta. As part of the wildlife program, Bonar began work on a PhD (completed in 2000) based on his pileated woodpecker research. By 1993, Bonar said, it was clear that the original model forest proposal was too ambitious. "We had to realign our program to match available resources and staffing."

In 1994, biologist Karen Graham began work on a master's program studying the long-toed salamander, a species red-listed by Alberta Forestry, Lands and Wildlife (1991), meaning that populations may be "in serious trouble." It was thought that the populations in Alberta were particularly vulnerable to habitat destruction or alterations associated with industrial, recreational, or transportation development. Over 400 salamanders were collected and analyzed. This project found the species to be more abundant and in more locations than previously thought, leading to an easing of its classification in the species-at-risk hierarchy. Graham remains with FMF and fRI Research, working in the Grizzly Bear Program, and continues to update her salamander research.

Carol Doering set up the initial GIS system that would become the data source and repository for much of FMF/fRI's subsequent work. Doering also established a 10-station GIS ArcInfo training lab. One of Doering's big challenges was recovering GIS functionality for the model forest and Weldwood after a devastating fire destroyed the company's operations office in May 1993; she and Weldwood staff were able to shift operations to the GIS training lab while the organization recovered from the fire. The lab had been part of the initial model forest technology-transfer mandate, in cooperation with the Environmental

Training Centre. The intent was that the Centre would use the lab for GIS training as well as technology transfer. This did not happen, and a subsequent attempt to use it in collaboration with the University of Alberta Faculty of Extension also did not work out. Sporadic use of the lab as intended during 1994 and 1995 did not justify the continuing investment of time by the GIS analyst, and the Environmental Training Centre did not have the resources to manage and promote it. The Board decided to end the project and dispose of the equipment.

Doering said her biggest disappointment from her three years at FMF was that they did not make more progress on an integrated decision support system for SFM planning, another feature of the initial proposal. The structure of the model, however, became the foundation of Weldwood's 1999 forest management plan, setting the stage for subsequent plans. However, the development of a more prescriptive government planning manual in 2006, and the subsequent decision by the Government of Alberta (at the request of industry) to take a more active role in most of the non-timber aspects of forest management planning (see Chapter 4), precluded that outcome.

The netted-down 1994 business plan identified the integration of forest management with watershed and aquatic ecosystem management as one of the priorities for Phase I research. In January 1995, the model forest held a workshop, organized by Melissa Todd, to scope out the essential elements of a watershed modelling project. Following this, forest hydrologist Jan Traynor was hired to develop a model that would be of value to land and resource managers in assessing the impacts of proposed activities such as harvest plans on quantities and qualities of water yields and associated fish habitats. This model was produced at the end of Phase I and was widely used in government and industry (see Chapter 5). Other water research included studies of fisheries, habitat, and sediment impacts.

A GIS Reunion at the fRI Research 25-year Celebration, October 5 2017. All the GIS managers, along with three of the specialists involved with this increasingly important service group at fRI Research were gathered at one table for this historic occasion. From near left, going clockwise: Dan Wismer (current analyst), Christian Weik (manager 1999-2006), Debbie Mucha (manager 2007-14), Carol Doering (manager 1992-96), Kevin Myles (analyst), Julie Duval (manager 2014-present), Tammy Kobliuk (manager 1996-98), and Heather Daw (analyst, 2007). *Brian Carnell Photography*

Weldwood foresters Sean Curry and Dave Presslee, working with Ian Corns of the Canadian Forest Service and John Beckingham of Geographic Dynamics Corp., adapted an earlier ecological classification system, producing a 1996 field guide (see Chapter 4). This guide was one of the enduring legacies of the FMF and became the basis for a common ecological classification for the entire land base, including Jasper National Park and, later, Willmore Wilderness Park. Kirby Smith, a biologist with Alberta Fish and Wildlife in Edson, led the initial caribou program that would eventually include his own master's degree on the species and research that is still used as governments and industries continue to develop recovery strategies for this at-risk species.

These programs led eventually to the wildlife, fisheries, and habitat inventories incorporated into the 1999 Weldwood Forest Management Plan.

An ambitious forestry research program was underway, initially centred on the Weldwood FMA with plans to also use the Cache Percotte Forest as a demonstration and research site. Because the model forest was federally funded, any projects with potential environmental impacts were subject to the rigours of a federal environmental impact assessment. This process was expensive and time consuming. As a result, the Board directed that projects requiring an environmental impact assessment be conducted outside the Model Forest Program, so a number of operational projects were dropped. Hopes for a closer relationship with the Environmental Training Centre dimmed when the centre decided to rescind its offer to use its Cache Percotte Forest for the second installation of a shelterwood trial begun on the Weldwood FMA. Plans for Cache Percotte to be the showcase of model forest research were, unfortunately, not to bear fruit.

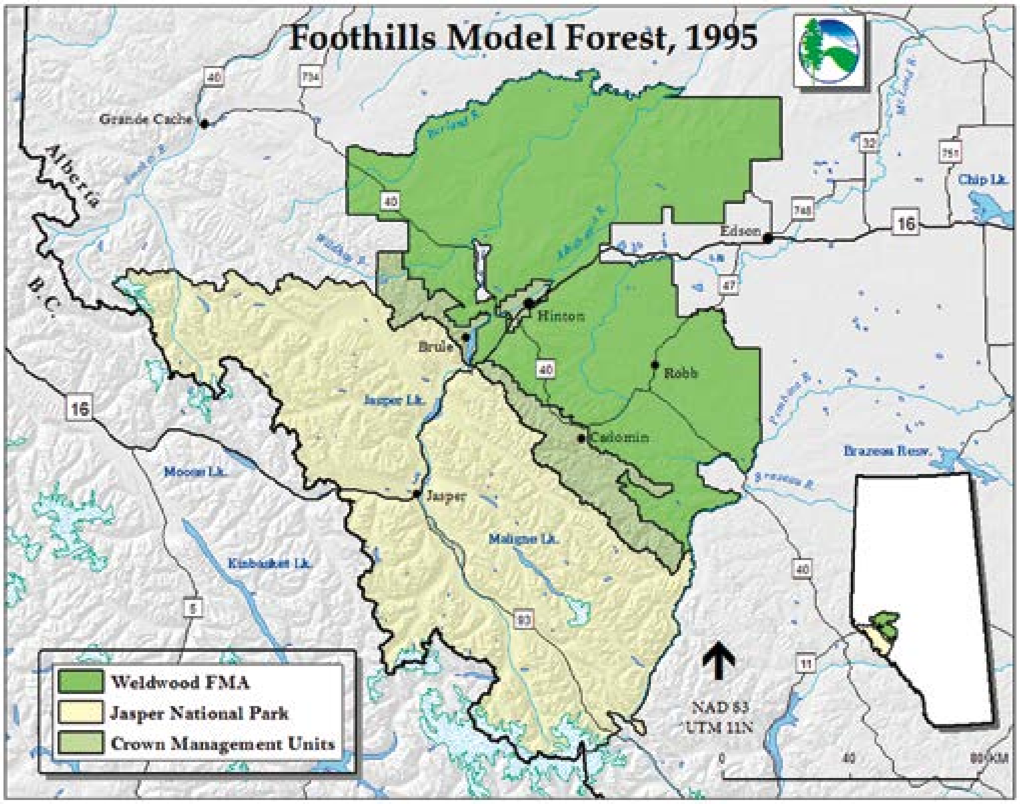
Working with the Canadian Forest Service, socio-economic research got underway in 1994, led by Tom Beckley of the Canadian Forest Service. This was in part stimulated by controversy surrounding the impact of the proposed Cheviot coal mine near the eastern boundary of Jasper National Park.

A national carbon budget model developed for the Canadian Forest Sector was modified to be applied on the model forest land base, comparing the industrial land base with a "natural forest" where no interventions or harvesting occurred. One conclusion was that carbon storage in the boreal forest would be offset by losses due to wildfires.

In 1994, the Natural Disturbance Program was launched to study ecosystem processes—especially fire as the principal natural disturbance—and their relationship to stand structure and features such as coarse woody debris and standing dead trees. Initially led by Dan Farr, and since 1998 by David Andison, this program, later renamed Healthy Landscapes, would eventually have profound impacts on forest management and harvest practices across western Canada.

Michel Audy was Foothills Forest Board alternate for Gaby Fortin, then replaced him as the superintendent of Jasper National Park in 1994, continuing with the Board. JNP formally joined the model forest as a shareholder in September 1995. With this addition, the FMF land base increased to 2.3 million hectares. As part of its commitment under the new 1995 agreement, JNP pledged \$100,000 annually to the Model Forest Program and coordinated with the model forest in areas such as carnivore strategy, impact of insects, fire management and fire regimes, land classification, and usage of the buffer zone east of the park. In December 1995, George Mercer was brought in from Wood Buffalo National Park to replace Mike Westbrook as model forest liaison to the Foothills Model Forest. Jasper National Park now saw itself as part of the larger land base.

Jasper National Park valued its involvement in an innovative partnership with shared research and information. Although this did not change its mandate, benefits included landscape-level issue management, shared information, and commitment to a regional advisory group for the first time. JNP was particularly interested in landscape-level research initiatives such as fire, mountain pine beetle, grizzly bear, and caribou management. Mercer's first priority was to work on a common land classification and mapping project to establish



Map 2-2. Foothills Model Forest research land base, 1995.

the foundation for working on these shared priorities. Soon after, Mercer decided to adopt the ecological land classification system adapted by Corns and Presslee for west-central Alberta, and work began on the Jasper classification. By 1996, this work was expanding into adjacent landscapes in British Columbia.

Rick Blackwood recommended the hiring of a fisheries biologist, and in 1995, ads went out that led to the recruitment of Craig Johnson, who would lead the program in Phase II.

In 1996, a major review of FMF public awareness programs arranged by Mike Voisin and conducted by CUE Research showed a low level of awareness of model forest activities and research. This triggered a major review and restructuring of the communications program into Phase II.

Board members and Natural Resource Canada Minister Anne McLellan at the new FMF kiosk, September 15, 1995. L–R: Chair Ross Risvold, President Bob Udell, Minister McLellan, Board members Jerry Sunderland and Jim Beck.

The Yellowhead Ecosystem Working Group (YEWG) was formed in 1995 to bring together government and industry stakeholders, including British Columbia Parks, to address common issues. This was not an FMF initiative, but there were many common participants and issues addressed. For example, the FMF Grizzly Bear Program was one outcome of the work of its Yellowhead Ecosystem Carnivore Working Group, as well as of the Cheviot coal mine hearings. In March 1997, the Board directed Bob Udell and Jeff Anderson to pick up on this work and develop a proposal for a land managers' forum to add decision-making power to the work of YEWG.

In 1996, Bob Udell began working with University of Alberta professor emeritus Peter Murphy and retired forester Bob Stevenson on a history project that focused initially on the Weldwood FMA forestry story and eventually encompassed nearly every aspect of the human history in the FMF/fRI area, including sponsorship of a repeat photography and vegetation change study centred in Jasper National Park.

The FMF also completed a study of environmentally significant areas, including two that were designated for protection under Alberta's Special Places 2000 Program.

Interest in the Model Forest Program was high, nationally and internationally, and hosting visiting delegations was an unexpected but welcome opportunity to showcase the work of the model forest and its partnership.

By the end of Phase I, the FMF staff had grown to nine, and there were at least nine others involved in leading about a dozen programs. The 12-person Board was led by Ross Risvold, director of the Environmental Training Centre, as chairman, and Bob Udell as president. The Board accepted a provincial proposal to add Willmore Wilderness Park to the FMF area in 1997.

Consultant Hugh Walker evaluated FMF as the best-performing in Phase I the national Model Forest Program.[13] Another study recommended more public engagement, and this led to development of a new communications strategy for Phase II.

On October 4, 1996, Natural Resources Canada Minister Anne McLellan announced the extension of the Canadian Model Forest Program for an additional five years. Federal funding would be reduced to $500,000 per year for each of the 10 model forests in the Canadian network, and an 11th, an Aboriginal Model Forest, would be added in the new program.

German tour group, along with representatives of the provincial government, the model forest board, staff, and researchers. Gregg Cabin, October 1, 1996.

Chihuahua Model Forest, 1994–1998

The Canadian Model Forest Program was barely underway when Prime Minister Brian Mulroney, at the urging of the Forestry Minister Frank Oberle, decided to sponsor a $10-million International Model Forest Program, announced at the June 1992 United Nations Conference on the Environment and Development (Earth Summit) in Rio de Janeiro. Russia, Malaysia, and Mexico were the first countries invited to participate, and Mexico was chosen as the country to host the first two model forests. Canada and Mexico agreed to sponsor these on a shared-cost basis. The Mexican government held a limited competition in the spring of 1993 to select the two locations. Eight regions were invited to submit letters of intent, and the two best proposals—one each from the tropical (Calakmul) and temperate (Chihuahua) regions of the country—were then invited to develop full project proposals. Foothills Forest was asked, and agreed, to help with the Chihuahua project, and the Eastern Ontario Model Forest assisted the Calakmul project. Two Foothills Forest staff, geographic information system (GIS) analyst Carol Doering and communications coordinator Pat Golec, joined a Canadian delegation to Mexico to work on developing the two model forest proposals.

On February 15, 1994, the governments of Canada and Mexico signed a contribution agreement for the Chihuahua Model Forest, to be administered by Foothills Forest. Each

Map 2-3. Chihuahua Model Forest, 1994.

government pledged $500,000 per year for three years. Cliff Mathies of Foothills Forest was named the Canadian agent to administer the funds. The mission was "Integrating people with sustainable environmental practices." Foothills Forest Chair Dennis Quintilio, President Bob Udell, and Administrator Cliff Mathies travelled to Chihuahua in February 1994 with Bob Newstead of the Canadian Forest Service to negotiate the details of the agreement and discuss the program to be developed.

The 110,000-hectare Chihuahua Model Forest was centred on the small town of Creel, in the Western Sierra Madre range, also known as the Sierra Tarahumara. The area has a wet-temperate climate with a mean annual temperature of 9.8°C and an average of 148 frost-free days per year. Most of the area's forests are pine-oak associations. Illegal logging, grazing, and subsistence deforestation by a growing population were major threats to these forests, and little remained of the original old growth. Copper Canyon, located within the area, was a major tourist attraction and home of the Tarahumara tribe of native people, internationally renowned as long-distance runners. The Tarahumara once lived over the whole area, but Spanish invaders in the 17th century drove them off the more productive lands into the canyons, where they remain today.

The Foothills Model Forest and Chihuahua had much in common. Both are mountainous areas with pine forests, and the model forest programs were both interested in wildlife conservation, watershed management, ecotourism, and the application of new information technologies to forest management. To attempt to reduce human impact on the forests, the model forest aimed to improve forest management techniques, conserve the biodiversity of the region, develop alternative opportunities, reduce pressure on the forests, and encourage cultural awareness of the environment through educational activities. To these ends, the model forest partnership included members of the environment, government, industry, and academic communities, as well as participants from the community at large.

The president of the Chihuahua Model Forest was Oscar Estrada Murrieta, a senior forester of the Mexican Secretariat of the Environment, Natural Resources, and Fisheries (SEMARNAP), who had a keen interest in bringing Canadian technology and expertise to bear on some of the issues affecting the sustainability of forests in Chihuahua. The model forest set up offices in the state capital, Chihuahua, and in Creel. A year later, a training program in silviculture and fire management began for Mexicans at the Environmental Training Centre in Hinton.

In the first year of operation, early signs of problems with the partnership were seen as the model forest struggled to cope with the challenges associated with the change of the Mexican federal government, Mexico's economic crisis, and one of the most severe droughts in the region's recorded history. Also, Mexico did not come through with its promised $500,000 funding.

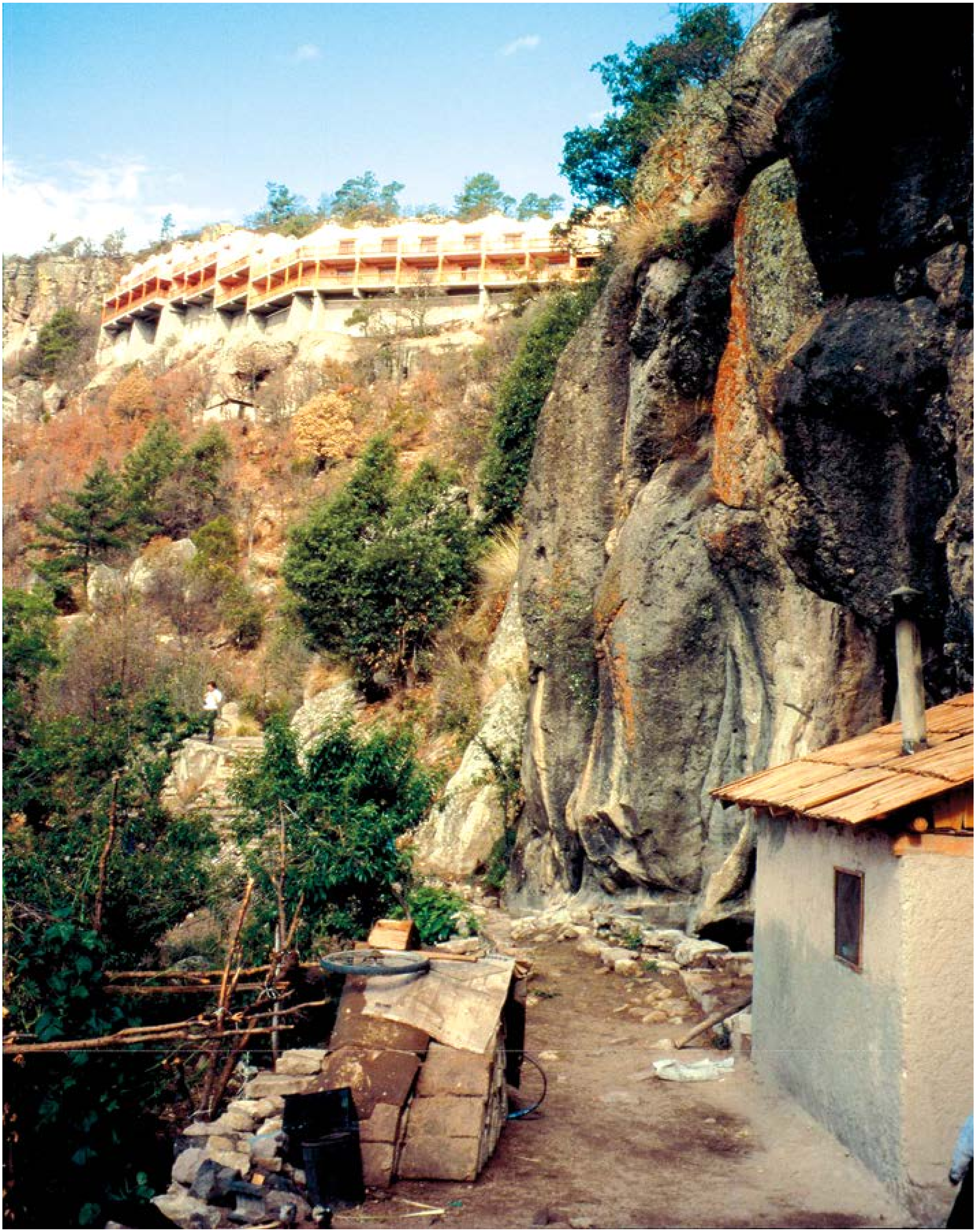
In the ensuing four years, projects were developed to begin the integration of non-timber values into forest management, to improve and diversify the local economy, and to develop alternative food sources through agriculture and fish culture. Among the projects were:

1. Installation of a GIS system to improve mapping and database management for the model forest area for improved planning and resource management.
2. Establishment of a tree nursery for genetic research and the production of planting stock for reforestation and reclamation.
3. Development of fish-rearing ponds where rainbow trout were propagated and grown. This was an attempt to introduce a new approach to provide alternative food sources for local people, as well as potential economic diversification.
4. An agriculture project to return to the use of bean and corn varieties better suited to local growing conditions, as well as developing improved varieties through genetic research. Over time, intensive agricultural use had resulted in erosion and degraded productive capacity of the land.
5. Initiation of a project to preserve the endangered Chihuahua spruce (*Picea chihuahuana*), as well as the Mexican spotted owl (*Strix occidentalis lucida*) and other endangered wildlife species.
6. Development of public education programs, but the complicated process of public engagement and decision-making in natural resource management under the *ejido** system of communal land management and ownership for much of the area was only just begun.

In 1995, the Canadian government moved the International Model Forest Program from the Canadian Forest Service to the International Development Research Centre. Cliff

* Originally abolished by the Spaniards, the *ejido* system of communal land management and decision making was reinstated after the Mexican Revolution (1910–1920), an uprising of peasants seeking the return of their lands under the slogan *"Tierra y Libertad"* ("Land and Liberty"). Redistribution of large amounts of land began after 1934. The system was reformed in the 1990s to allow the privatization and sale of the land as a result of negotiations for the North American Free Trade Agreement.

Tarahumara children at their cliffside home in Copper Canyon.



Mathies transferred to Mexico full-time to administer the Chihuahua Model Forest. In February 1996, Alberta Environment Minister Ty Lund and Assistant Deputy Minister Cliff Henderson toured the Chihuahua Model Forest, and in October 1996, the first meeting of the International Model Forest Network was held in Chihuahua.

Opposite page. A study in contrasts. Tarahumara cliffside dwelling below a tourist lodge at the edge of Copper Canyon.

FMF General Manager Rick Blackwood said the international program was "an interesting concept, and there were great relationships built, but I don't believe there was great value. The primary reason was that many of the jurisdictions involved had very different political and regulatory systems than Canada and were also at very different places economically and technically to implement any ideas or concepts perhaps provided by Canada." As to the Mexican partnership, he said, "I think Foothills' participation with Chihuahua was much appreciated, but the ability of Chihuahua to sustain anything without direct support from Canada was very limited and also tied to the local and regional political circumstance."[14] Several board members shared this view and saw little value from Foothills' investment in this project.

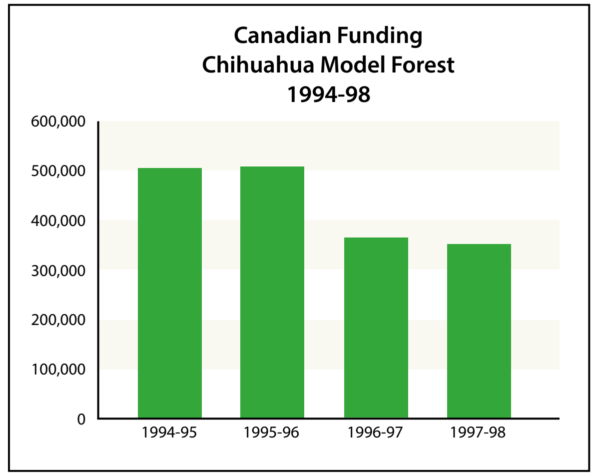


Figure 2-4. Canadian federal government funding for the Chihuahua Model Forest, 1994–1998.

Despite repeated urgings, the Mexican government failed to deliver its promised matching funds, and on March 31, 1998, the Canadian government terminated the agreement and ended the funding after providing $1.73 million to the program.

Cliff Mathies, the Foothills agent, remained in Mexico and continued to work with non-profits on sustainability initiatives. He later told an interviewer that the Model Forest Program ran into resistance from local authorities.

> "The Canadian Model Forest Program put a real effort into encouraging the involvement of all stakeholders in the management of the forests. They did not come in with any prescribed formula for success and found out quickly that what works in Canada cannot be duplicated in Mexico.... Where it failed is when the local authorities and governmental officials recognized that empowerment of the local people potentially threatened their positions ..." –Cliff Mathies, former Chihuahua program manager for the Canadian Model Forest Program, interview with Randall Gingrich, 2004[15]

Phase II, 1997–2002

In Phase II, the federal contribution was reduced by 50 percent to $500,000 per year, while at the same time, the Canadian Forest Service proposed a number of "national initiatives" involving the network. The FMF shareholders committed to making up the difference in funding, and the focus on targeted research meeting the practical and priority needs of forest practitioners and resource managers continued. Some programs were discontinued, and new ones emerged, reflecting the evolving priorities as identified by the Board and sponsors. This shift was accompanied by an emphasis on communicating results to users and the public. "The agencies involved wanted to spend their money on projects that would give them information in the short term that they could use to improve their practices and stewardship," said FMF President Udell.

The addition of Willmore Wilderness Park and Switzer Provincial Park brought the FMF land base to 2.75 million hectares in 1997. Mark Storie, a forest officer with the Alberta Land and Forest Service, replaced Rick Blackwood as General Manager from 2000 to 2002.

Funding in Phase I had been widely dispersed among a range of projects, but in Phase II, the allocation was narrowed down into key areas identified in the Phase II proposal and supplemented with funds from other sources, notably Alberta's Forest Resource Improvement Program (FRIP). Core funding was assigned yearly based on changing priorities.

Four new initiatives emerged in Phase II: the Cumulative Effects Project, the Local Level Indicators of Sustainable Forest Management Project (also a Network initiative), the Grizzly Bear Project, and the Alberta Forest Biodiversity Monitoring Project.

Following the decision to cancel work on the Watershed Assessment Model (WAM), leading to the resignation of Jan Traynor at the end of Phase I, Craig Johnson took over a water program aimed more at fish inventories and the effects of stream crossings. Then, in 1998, Rick Blackwood led a reassessment and upgrading of the Watershed Assessment Model at Foothills, while Traynor continued to refine the model at The Forestry Corp. The improved model, also modified for the boreal landscape, would see wide use in Alberta for many years to come, including the development of the management plan for the C5 forest management unit in the Crowsnest Pass area and many other applications.

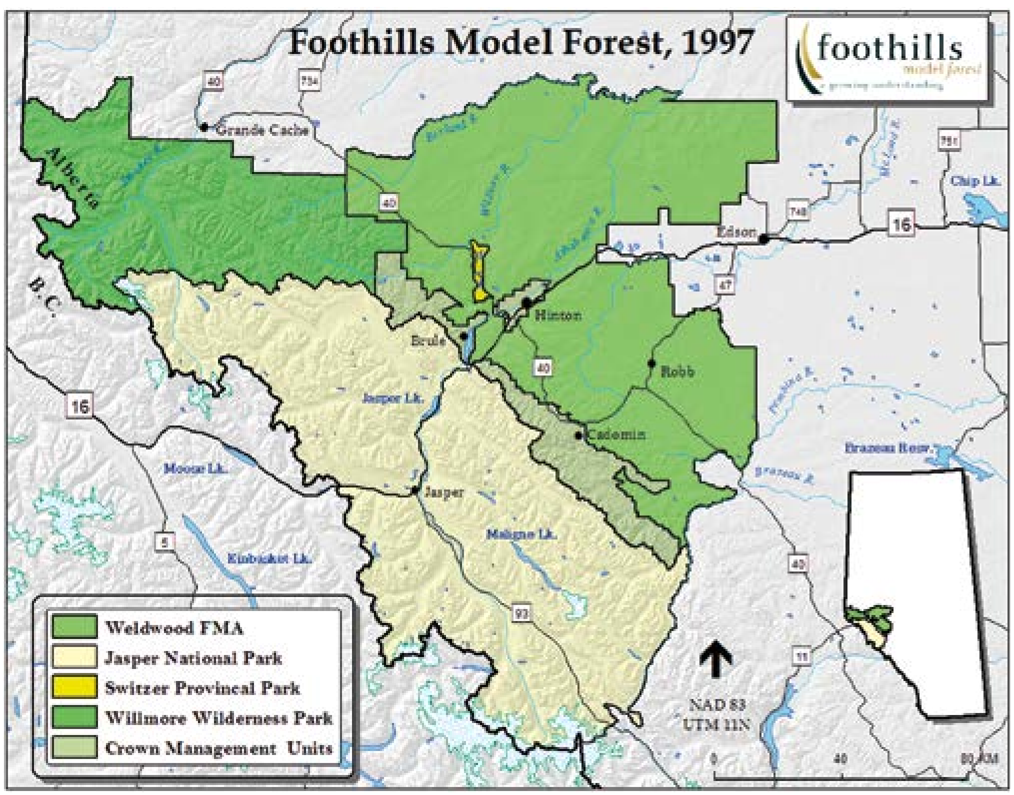
Mark Storie with Phoenix film crew, 2002.

Previous forestry programs were also dropped—reverting to companies in most instances—but a program was proposed for enhanced forest management, championed by Sean Curry who left Weldwood soon after. No one was found to take his place, so the program was set aside until 1999, then revived in a modified form through the Foothills Growth and Yield Association.

Funding for the Socio-Economics Program, led by Tom Beckley of the CFS, peaked during Phase II, although not at the level championed by Board member Don Laishley. He resigned as Board liaison to the program in protest. During Phase II, this program continued its work, with many projects focusing on the economic and social aspects of sustainable resource management in the area.

The "fine-filter" biodiversity program, exemplified by HSI and habitat modelling work in Phase I, was reduced and restricted to projects in caribou and grizzly bear, although Melissa Todd and others continued to refine the HSI models developed in Phase I. Use of these models continues, particularly in management planning and environmental impact

Map 2-4. The Foothills Model Forest research land base, 1997.



assessments. Rick Bonar and Kirby Smith worked with the West Central Alberta Caribou Standing Committee (WCACSC) to develop some proposals for a caribou program, but they experienced challenges due to internal WCACSC issues.

At the beginning of Phase II, no work plan had come forward for the Carbon Budget Program, but the Board was still interested in it and directed follow-up with Mike Apps of the CFS to see if it could be revitalized. This culminated in a Board meeting with Apps in June 1998 at which a number of options were discussed regarding the Carbon Budgeting and Climate Change Model (CBM) of the CFS. In September, the Board funded a proposal by Apps and David Price on the economics of climate change. Work continued on and off on this into Phase III, with limited success.

Led by George Mercer from Jasper National Park from 1997 to 2000, the Cumulative Effects Project was an ambitious effort to identify umbrella indicators linking together impacts of human activities on the ecological health and biological diversity of shared landscapes. The project would have brought together the work of other programs such as Natural Disturbance, Caribou, Grizzly Bear, Criteria and Indicators, Socio-economics, and Communications. This approach to cumulative effects turned out to be premature, since data were still being collected and models were not fully developed. The project was subsumed into the work of the Regional Steering Group for a *Northern East Slopes Sustainable Resource and Environmental Management Strategy*, appointed by the provincial government in 2000.

The Grizzly Bear Project was a response to issues raised since 1996 by the government-industry Yellowhead Ecosystem Working Group and given prominence during 1997 environmental hearings on the Cheviot coal mine near the boundary of Jasper National Park. The working group developed a regional strategy following the first round of Cheviot hearings. Called *Grizzly Bear Conservation in the Alberta Yellowhead Ecosystem*, this strategy was the impetus for the FMF Grizzly Bear Program. Shortly after, the Yellowhead Ecosystem Carnivore Working Group was established and issued a call for proposals for a grizzly bear research program (see Chapter 3). This was the beginning of one of the institute's landmark programs.

Gordon Stenhouse, a wildlife biologist with previous experience studying polar bears, resigned from his position with Weldwood and was hired by Alberta Environment as a provincial carnivore biologist, seconded full-time to the model forest to head up the project. Most of the initial research funding came from the model forest. A 535,200-hectare area was chosen in which grizzly bear movements, population status and trends, and mortality would be tracked over the next five years. The project used leading-edge technologies such as GPS and telemetry collars to map the habitat and monitor the bears' movements.

Another result of the Cheviot hearings was a study of harlequin duck populations and habitat. Data from collared caribou provided insight into management activities that might help conserve this at-risk species and its habitat. Socio-economic research included a study of camping and hunting in the model forest.

In 1997, the FMF also embarked on a comprehensive project to develop a protocol for monitoring forest biodiversity in Alberta. Wildlife biologist Dan Farr, the project lead, sought out others in the province with similar monitoring requirements as a strategy to develop efficient and cost-effective research activity. Farr developed the protocol and left the model forest in 2000 to lead a province-wide monitoring initiative, established in 2007 as the Alberta Biodiversity Monitoring Institute (see Chapter 3).

In 1998, David Andison replaced Farr as leader of the Natural Disturbance Program (later renamed Healthy Landscapes). Vivid evidence of natural disturbance patterns came from a University of Alberta project, supported by the FMF, to replicate the topographic photographs taken in 1915 in Jasper National Park by M.P. Bridgland of the Geological Survey of Canada. In 2000, Andison began issuing "QuickNotes" summarizing natural disturbance research findings. Usually just one or two pages, the notes became a vital communication tool to keep practitioners and fellow scientists up to date on developments in a fast-evolving discipline. The Natural Disturbance Program held its first symposium in 2001, and feedback from the attendees indicated a thirst for understanding natural disturbance concepts and applications.

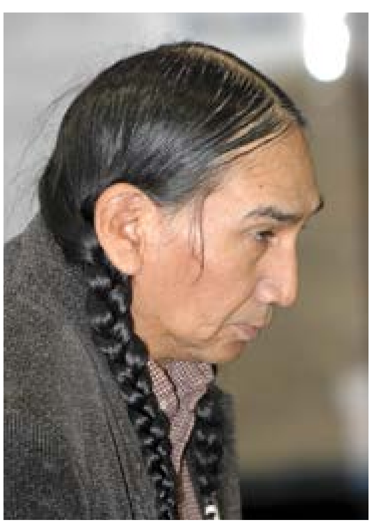
Programs such as the Grizzly Bear Project created huge new demands for data handling. Julie Duval was hired initially in 1998 on a six-month contract to work on the Cumulative Effects Project, and she ended up becoming one of the longest-serving FMF/fRI employees. In 2014, she was named GIS program leader. Christian Weik, GIS coordinator from 1999 to 2006, said the quantity and quality of resource-based information grew tremendously in Phase II, as did the demand for GIS products and services.

> "GIS was more focused as a service to researchers. Our service was to perform complex spatial analysis—how do ecological variables relate to one another geographically—and modelling, which is critical to forestry, ecology, and wildlife research. We also played a key role in managing the enormous amounts of data that were a significant part of the research projects." –Christian Weik, quoted in the 2011–2012 fRI annual report

In 2000, the Northern East Slopes Region was chosen for an integrated resource management pilot project based on the large body of science, research, and technological resources available at the Foothills Model Forest. Not the least of this was the work of the FMF socio-economic research group, conducted largely by experts from the Canadian Forest Service and the University of Alberta. FMF General Manager Mark Storie contributed as an advisor to the steering group. The *Northern East Slopes Strategy* report in 2003 recommended the creation of a cumulative effects management system that incorporated many of the principles proposed for the FMF Cumulative Effects Project. The recommendations appeared to go nowhere, but a somewhat similar approach was brought forward a decade later for land-use plans developed under the 2009 *Land Stewardship Act*. Jerry Sunderland, former regional director of the Northern East Slopes, noted in correspondence that the Land-use Framework learned from the Northern East Slopes IRM strategy, which was "driven in part by FMF research." He went on to say that in his view "FMF has contributed to provincial land-use policy in the form of the Land-use Framework, and forest management policy related to natural disturbance, local-level indicators, [and] socio-economic outcomes."

Two major wildfires in 2001, Chisholm and Dogrib, led to FMF research programs using funds from the Provincial Environmental Enhancement Fund. Recently retired from the provincial government, Dennis Quintilio would lead the initiative.

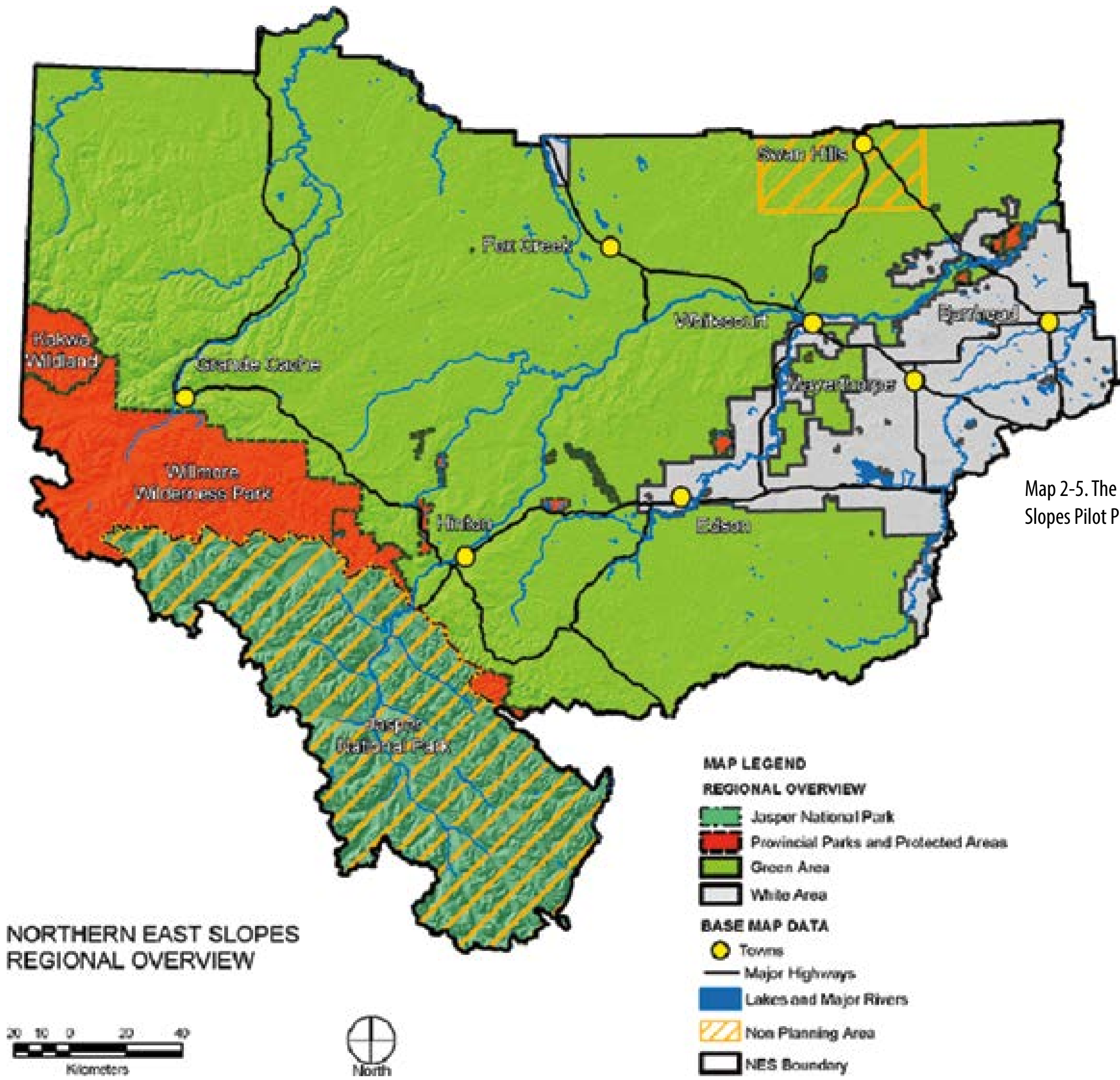
Jasper National Park took its first steps towards a FireSmart Program in 2000, intended to reduce risk to the townsite and infrastructure. After two years and six demonstration sites, the Firesmart-Forestwise Project would begin in earnest at Foothills in 2002.



Foothills Ojibway Chief Jimmy O'Chiese, 2008.

In January 2001, Chief Jimmy O'Chiese of the Foothills Ojibway was hired as coordinator to identify and work with Indigenous communities to prepare a traditional ecological knowledge (TEK) protocol for traditional studies in the FMF area. O'Chiese and Weldwood logging manager Ritchard Laboucane embarked on consultation with elders on the elements of the protocol and support for such a study. In October 2001, about 150 people convened for two days in Hinton to consider the FMF Traditional Studies Protocol, which was unanimously endorsed. Elders individually pledged their willingness to support the gathering of the information, and the FMF Board subsequently decided to proceed with a Traditional Land Use Study in 2002.

The Adaptive Forest Management (Forest History) Program grew out of a Weldwood project to record the natural and management history of its Hinton forest. University of Alberta professor emeritus Peter Murphy and retired forester Bob Stevenson were already working with Bob Udell on the Weldwood project in 1997 when the FMF Board agreed to accept the project and expand it to encompass the entire model forest land base. The first publication was *The Development of Adaptive Management in the Protected Areas of the Foothills Model Forest*, by Michael den Otter (2000), examining Switzer Provincial Park, Willmore Wilderness Park, and Jasper National Park. A landmark study by Peter Murphy and Marty Luckert on the evolution of adaptive management in Alberta as reflected in successive forest management agreements on Weldwood's FMA followed soon after (see Chapter 8). The series continued with other publications up to and including this book.



Map 2-5. The Northern East Slopes Pilot Project, 2000.

In Phase II, the FMF began a partnership with the Friends of Environmental Education Society of Alberta (FEESA, later renamed Inside Education) to conduct teacher field trips and training seminars.

Foothills Model Forest was granted a Premiers Award (Bronze) in 2000 for exemplary work in public, regulatory, and industrial cooperation in scientific advancement and cost savings. Team members cited included Rick Blackwood (team leader), Doug Hodgins (Jasper National Park), Bob Newstead (Canadian Forest Service), Dennis Quintilio (Alberta Land and Forest Service), and Bob Udell (Weldwood). Udell and Quintilio accepted the award from Premier Ralph Klein at a ceremony in the Jubilee Auditorium in Edmonton.

Phase III, 2002–2007

The business plan for Phase III of the model forest emphasized demonstration and communication of sustainable forest management as more of the research projects produced results that could be applied in operations and policies. Communications programs, previously focused mainly on local and provincial audiences, aimed for broader reach in Phase III. The FMF adopted a new motto, "Research Growing into Practice." The Board committed to going ahead with an Enhanced Aboriginal Initiative (later entitled the Aboriginal Involvement Program), and in December 2002, the first full-time coordinator, Bob Phillips, was hired to develop and implement the program. A new climate change initiative from the CFS was approved. During this period, two new organizations arose primarily through the work done under the model forest, and they were housed within the model forest organization—the Foothills Stream Crossing Association (2004) and the Caribou Landscape Management Association (2006). At the end of this phase, FMF prepared an application for the new Forest Communities Program, but this was unsuccessful.

General Manager Mark Storie returned to Provincial service in 2002, and he was replaced by Don Podlubny.

One of the biggest planned demonstration projects was never fully implemented, but it still provided many useful insights. The Highway 40 North Demonstration Project would have applied natural disturbance principles, including prescribed burning and dispersed harvest, in a large area north of Hinton. The area included parts of three forest company tenures, active oil and gas exploration and well sites, pipelines and power lines, and a portion of Willmore Wilderness Park. It also had important caribou, grizzly bear, and bull trout habitat, was at high risk of wildfire and mountain pine beetle infestation, and included a well-travelled public corridor used for recreation. Planning and consultation continued through Phase II and into Phase III, but divergent priorities kept getting in the way. The planning process was still worthwhile, said program leader Dave Andison.

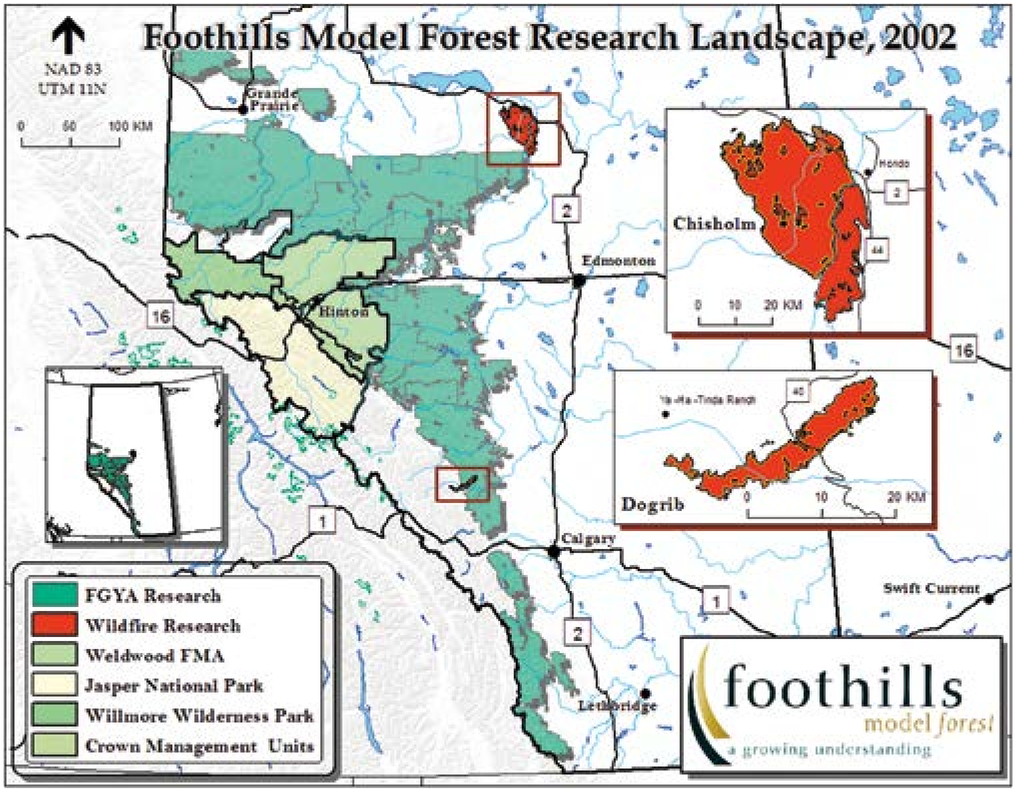
> "I would think Highway 40 was a huge success because we got a chance to see what it might look like even if it didn't happen on the ground. We went through the paces. No one's ever done that before. That was really cool. That brought people out of the woodwork saying, 'Strongly one way for or against it,' but again, I didn't consider that failure. The fact that it didn't go in, it's too bad. I don't think of it as a failure because of that." –Dave Andison, interview, 2015

Don Podlubny on a field tour with map of mountain pine beetle incursions, Berland River, 2008.

Research following the Chisholm and Dogrib fires in 2001 produced new insights into ecological responses to severe fires, quantification of fire intensity, fire spread spatial modelling, and social response to evacuations. This and other FMF research on public involvement contributed to development of the successful FireSmart-ForestWise Program in Jasper, which began in 2002, initially under the Natural Disturbance Program. The program was led by Al Westhaver, who developed it in conjunction with a master's degree study. FMF played a coordinating role in the program and provided linkages and support through the Natural Disturbance Program. An extensive public consultation and information program helped to make the Jasper program a success and a model for similar programs across Canada.

The fire findings also fed into research on riparian area management. FMF's fire research was presented in 2005 at a conference in Edmonton.

The Hardisty Creek Restoration Project was launched in 2002 to restore the creek, which runs through Hinton, by addressing fish migration barriers at stream crossings and impacts from previous streamside developments. FMF was one of six partners in the project, initi-



Map 2-6. Model forest research land base, 2002.

ated by the Athabasca Bioregional Society to commemorate UNESCO's International Year for Fresh Water. Model forest fish biologists, particularly Rich McLeary, provided technical support in the effort to restore fish habitat and connectivity in the 3,000-hectare Hardisty watershed. The project built partnerships to repair all the crossings by 2007, and it also included pathway development, public participation, and education components. Equally important was that it provided a model for cooperation and collaboration across much larger landscapes. In 2006, the Hardisty Creek Restoration Project was the recipient of the Forest Stewardship Recognition Award from Wildlife Habitat Canada. This award is presented annually to individuals, organizations, and companies for outstanding stewardship in Canada's forests.

After an auspicious start, the Aboriginal Involvement Program was relatively successful in creating a confidential database recording sites of social, cultural, and spiritual importance, and the development of a prototype referral system for resource developers and others. But ultimately it failed for a number of reasons, including changes in provincial policy. "We needed to spend more time up front building trust with the different Aboriginal groups," said Don Podlubny, who had been director of the Environmental Training Centre since 1998 and replaced Mark Storie as FMF General Manager from 2002 to 2007. "We all wanted to get this out of the blocks and working as quickly as possible, and that was where we made the error."[16] The Aboriginal Involvement Program continued until 2009. The data collected from Aboriginal people for the program was returned to them in 2013 (see Chapter 8).

In 2003, the FMF Board decided to add two Aboriginal seats, one representing First Nations and one Métis. The Government of Alberta's *First Nations Consultation Strategy on Land Management and Resource Development*, announced in May 2005, made a formal commitment to consult with First Nations where land management or resource development had the potential to adversely impact Indigenous rights and traditional uses of Crown land. The strategy did not then include any responsibility to consult with Métis or Non-Status groups; a strategy for Métis consultation was added in 2017.

Hardisty Creek bank restoration through grass seeding was a community event.

Also in 2003, Foothills Model Forest and Fifth House published the first book in the Adaptive Forest Management History series, *Learning from the Forest: A Fifty-Year Journey Towards Sustainable Forest Management,* by Robert Bott, Peter Murphy, and Robert Udell. This was followed in 2007 by *A Hard Road to Travel: Land, Forests and People in the Upper Athabasca Region,* by Peter Murphy with Robert Udell, Robert Stevenson, and Thomas Peterson.

In September 2003, Bob Udell and David Andison (with Keith Jones) were invited to present papers at the World Forestry Congress in Montreal, where they talked about the contributions of the model forest to improved forest management systems.

In November 2003, the Province of Alberta released its water conservation strategy, *Water for Life: Alberta's Strategy for Sustainability*, including a significant research component. In April 2004, the FMF held a second Forest Land-Fish Conference, following up the success of a similar conference in 1996. The FMF work on watershed mapping and stream classification enabled biologists to develop models predicting the presence or absence of fish in water bodies. These results were used by industry and government for designing and building roads with appropriate stream crossings, for determining the time of year that industrial activities occur, and for stream crossing remediation. The FMF developed strategies to apply natural disturbance principles to riparian area management.

In 2004, the FMF received the Emerald Award (Research and Innovation category) from the Alberta-based Foundation for Environmental Excellence for its five-year grizzly bear research, which had yielded grizzly bear habitat maps and movement models for a 10-million-hectare area—an unprecedented scale in wildlife management. Gord Stenhouse's team by that time had mapped 46,000 grizzly bear location points. Hinton Wood Products used the maps to develop access plans for its Athabasca West area. In 2006, the Government of

Alberta endorsed the Provincial Grizzly Bear Recovery Plan, providing additional direction and impetus to the FMF Grizzly Bear Program.

Water research, including findings from the Hardisty Creek project, led to creation of the Foothills Stream Crossing Partnership (FSCP) in 2004 with initial members including Hinton Wood Products, several energy companies, and the Foothills Model Forest. Led by Jerry Bauer, this initiative developed a common approach to assess and repair stream crossings to ensure fish passage across the model forest's land base—a challenging task involving 2.75 million hectares, 208 watersheds, more than 2,500 stream crossings, and over 30 stream crossing owners. In the next 10 years, the partnership inventoried over 1300 crossings belonging to over 40 companies and government agencies, and they were prioritized into high-, medium-, and low-risk watersheds. All FSCP companies in high-risk watersheds have participated in the design of remediation plans that outline the strategies, timing, and the justification for the order in which the crossings are mitigated. It was renamed the Foothills Stream Crossing Program in 2005, and the Foothills Stream Crossing Partnership in 2012.

Another partnership emerged in 2005 with the creation of the Caribou Landscape Management Association (later renamed the Foothills Landscape Management Forum), initially coordinated by Rick Bonar and later by Wayne Thorp. The association was a non-profit partnership established under the FMF umbrella to facilitate integrated landscape management and conservation for the Little Smoky and A la Peche caribou herds in west-central Alberta. Conceptually, it proposed to develop and promote industrial activities that mitigate the impact on caribou habitat through partnership with the Alberta government and working within existing resource planning and approval processes. The GIS Program worked with the association to develop a website displaying maps relating to access and other features. Implementation proved challenging, however, and recovery strategies were still being developed and implemented in 2017 (see Chapter 3).

On January 31 and February 1, 2005, the Foothills Model Forest, along with the Alberta Forest Genetics Resource Council, the Foothills Growth and Yield Association, and the Forest Resource Improvement Association of Alberta, hosted the Post-Harvest Stand Development Conference, integrating knowledge from the disciplines of genetics, silviculture, and forest health into the prediction of stand development, growth, and yield following harvesting. Also in 2005, a one-day workshop in 2005 presented results of the FMF's fire research, and the GIS team organized a workshop on modelling and geographic databases.

In April 2005, Bob Udell retired from Hinton Wood Products and was replaced by Jim LeLacheur as president of the Foothills Model Forest. Kevin van Tighem stepped down as chair and was replaced by Rick Bonar.

In November 2005, the FMF hosted an extensive "Research Into Practice" workshop for government professionals in Edmonton. The workshop described how FMF projects, programs, and technologies would be of value to government aims. Presenters included Rich McCleary (disturbance in riparian zones), David Andison (natural disturbance patterns and scales), Wayne Thorp (caribou), Bob Udell (adaptive forest management history), Dennis Quintilio (Wildland Fire Model, impact of salvage logging on elk habitat), Erica Lee (mountain pine beetle), Christian Weik (local-level indicators), Jerry Bauer (Foothills Stream Crossing Partnership), Bonnie McFarlane (recreation management), Gord Stenhouse (grizzly bear health and census), and Dick Dempster (pre- and post-harvest stand productivity). The three plenary sessions dealt with grizzly bear habitat modelling, social science, and natural disturbance.

Between 2004 and 2006, David Andison and Lisa Risvold developed a short course, "Introduction to Natural Disturbance," based on growing interest in the application of natural disturbance principles to sustainable forest management. This was based on a "primer" course presented in collaboration with the Saskatchewan Institute of Applied Science and Technology. The first introductory course was held in 2006, three more in 2007, and beginning in 2008, the course was offered as needed on a cost-recovery basis.

In 2006, as the Model Forest Program drew to a close, Natural Resources Canada announced a five-year, $350-million Community Forest Program to assist community-based partnerships to develop and share knowledge, strategies, and tools to adjust to forest sector transition and take advantage of emerging forest-based opportunities. A nationwide competition for sites was held, and 11 sites were chosen, each receiving $325,000 per year. The Foothills Model Forest was unsuccessful in its application to the program, reportedly because reviewers felt it did not need federal help anymore. The community program began in April 2007, was renewed for another five years in 2012, and ended in March 2017. The Alberta partner in the program was Weberville Community Model Forest in Peace River.

The Foothills Model Forest was one of the recipients of the 2006–2007 Canadian Forest Service Team Merit Award, presented under the category of Collaboration and Partnership and recognizing FMF's work in transferring the Canadian Forest Service Carbon Budget Model to various end-users. Also in 2006, the Hardisty Creek Restoration Project was the recipient of the Forest Stewardship Recognition Award from Wildlife Habitat Canada. This award is presented annually to individuals, organizations, and companies for outstanding stewardship in Canada's forests.

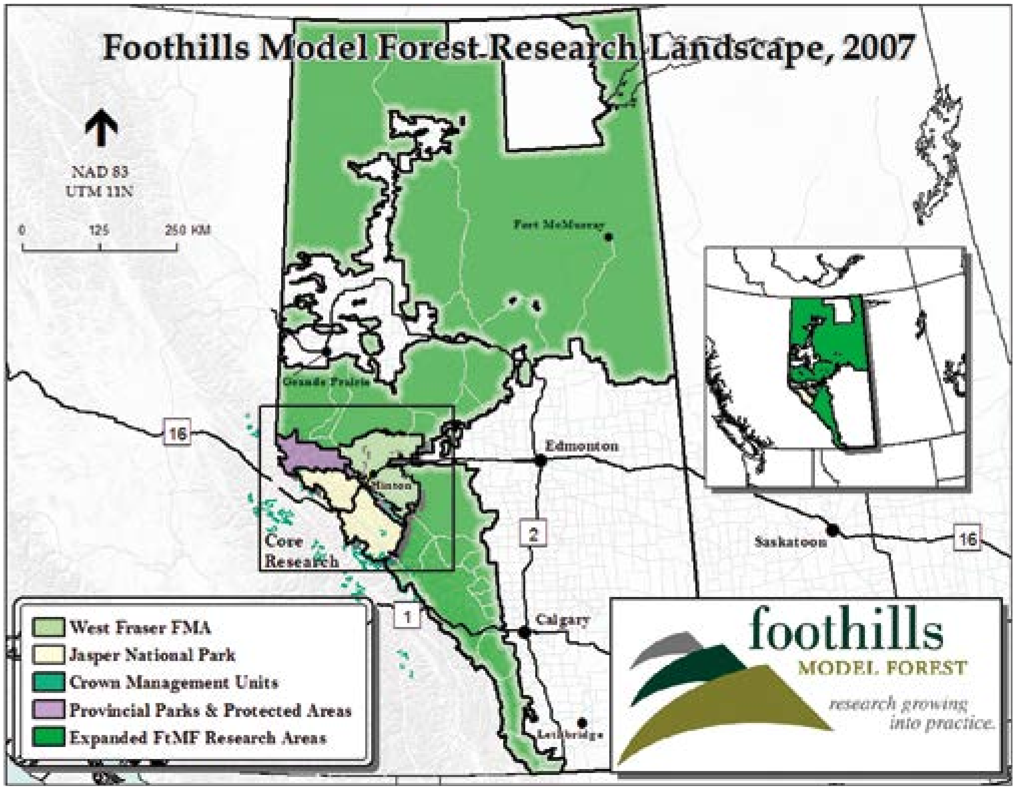
Phase IV, 2007–2012

In Phase IV, the Foothills Model Forest became the Foothills Research Institute (fRI) in 2008 and took on a new identity as an independent research centre. The energy sector signed on as a shareholder and sponsor of the program. This new funding, along with major commitments from the provincial government, enabled fRI to continue most of the model forest programs and take on new projects. The business plan emphasized two themes: Going Beyond Boundaries and Broadening Partnerships. A $1.5-million Alberta Forestry Research Institute (AFRI) grant was used for international and national linkages as well as other strategic initiatives including mountain pine beetle, climate change, and water programs. The Social Sciences Program went into decline as much of its funding was directed towards other priorities. Climate change work continued in fits and starts. The Aboriginal Involvement Program ended for lack of buy-in, primarily by the Government of Alberta, to the process that had been developed.

New projects emerging in the fourth phase of the institute's evolution included:

- A major mountain pine beetle research program (2008) headed by former General Manager Don Podlubny
- A new Alberta Forest Growth Organization (2009) under Barry Waito, former woods manager for Louisiana-Pacific in Manitoba
- A Circumboreal Research Initiative (2009) in partnership with the Canadian Model Forest Network and the International Model Forest Program, with Keith McClain leading the institute projects contributing to the program
- Development of the Alberta Land-use Knowledge Network (2010), funded by the Government of Alberta in support of its Land-use Framework
- Wrap-up of the the Fish and Watershed Program (2010) by Rick McCleary, and the decision to establish a new Water Program; Axel Anderson was seconded by the provincial government to lead the program in 2011
- Establishment of the Yellowhead Ecosystem Group (2009) under Bob Udell and then Wayne Thorp— an attempt to re-establish the Yellowhead Ecosystem Working Group, the activities of which had been suspended in 2000 and folded into the Northern East Slopes Integrated Resource Management Project

In 2007, five oil and gas companies—PetroCanada, ConocoPhillips, Encana, Canadian Natural Resources, and Talisman—formed the Foothills Energy Partnership. The partnership became a shareholder in fRI and committed to $250,000 annual funding.



Map 2-7. Model forest research land base, 2007.

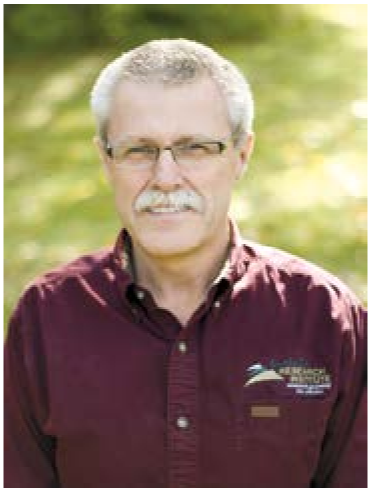
The FMF Social Sciences Program reported in 2007 on research into the socio-economic dimensions of community vulnerability to mountain pine beetle. Studies examined exposure and adaptive capacity from biophysical, social, economic, and political perspectives and compared results to communities in British Columbia. "The report's value was in creating awareness of a potential natural crisis that would impact Alberta," said Don Podlubny. "It provided information that allowed us to focus on the factors of the mountain pine beetle that would have an impact on Alberta's pine forests, Alberta's economy, and, most importantly, Alberta's forest ecosystems and their sustainability after infestation."

Also in 2007, the Alberta Forestry Research Institute* granted $1.5 million to fRI to build its national and international linkages and to support new climate change and water research programs. The grant included funding for two initiatives of the International Model Forest Network (IMFN), the Global Forum meeting ($180,000) and the Circumboreal Initiative ($320,000). Climate change programs got $615,000, including $300,000 specifically for a Canadian Forest Service tree ring project. Mountain pine beetle research received $300,000 and water research $85,000. The fRI Board was given discretion in the final allocation of funds.

Don Podlubny retired in April 2007, and Tom Archibald, Forestry Manager of the Peace River District, was brought in to replace him. Podlubny continued to share duties with Archibald as he transitioned into the job, and in December, Podlubny was announced as the new program lead for mountain pine beetle research at FMF. Tom retired in 2012 and continues to live in Hinton.

fRI hosted more than 150 delegates from 31 countries at the triennial International Model Forest Network (IMFN) Global Forum, June 16–18, 2008, at the Hinton Training Centre. The forum discussed issues such as community development, fire management, adaptation to climate change, environmental services, education, and knowledge sharing. The delegates agreed to move ahead on the Circumboreal Initiative linking researchers in Canada, Sweden, Russia, China, the United States, and Finland. As a result, fRI partnered with the Vilhelmina Model Forest in Sweden for research on climate change and commu-

* The Alberta Forestry Research Institute (AFRI) was established in 2000 under the Alberta Science and Research Authority Act to "encourage and support private and public investment in the economic, environmental, ecological, and community sustainability of Alberta's forestry sector." The AFRI Board was drawn from industry, academia, and government and was mandated to "prioritize, coordinate, and promote innovation and research, and encourage their application in our forest sector." After a 2010 government reorganization, AFRI became part of Alberta Innovates Bio Solutions.



General Manager Tom Archibald, 2009.

nity vulnerability and signed a memorandum of understanding with the University of Norway to provide the basis for working on brown (grizzly) bear conservation.

The fRI Grizzly Bear Program was awarded the first-ever Syncrude Award for Excellence in Sustainability at the Canadian Institute of Mining, Metallurgy and Petroleum's (CIM) annual conference in Montreal, on April 30, 2007. The award recognized that the research "provides resource managers with the necessary knowledge and planning tools to ensure the long-term conservation of grizzly bears in Alberta." And the 2007 Canadian Remote Sensing Society Gold Medal was presented to Steve Franklin for his work on the Grizzly Bear Program.

In November 2007, the Government of Alberta designated fRI to develop and provide the scientific knowledge required for grizzly bear recovery plans across the province.

The Mountain Pine Beetle Ecology Program (MPBEP), led initially by Don Podlubny and after 2011 by Keith McClain, was a major focus in Phase IV. The program built on previous FMF research into aspects such as susceptibility, spread, and socio-economic implications. One concern was increased wildfire risk due to infestations. The fRI program's *Mountain Pine Beetle Research Compendium* in 2010 allowed researchers and resource managers to review past research work and identify current knowledge gaps by searching information on 357 projects across North America. The program also developed a decision-support tool to help resource managers mitigate or manage various infestation scenarios and outcomes.

On April 30, 2007, Sustainable Resource Development Minister Ted Morton announced that the highest priority for his department would be the development of a Land-use Framework (LUF) for Alberta, based on consultations underway since 2004. This direction was

International Model Forest Network Forum delegates, Hinton, 2008.

given him by newly elected Premier Ed Stelmach. The LUF plan made no reference to the Northern East Slopes Project and its extensive work on planning, management, coordination, monitoring, and indicators.

The Fish and Watershed Program, led by Richard McCleary, created a field classification manual in 2008 and a predictive modelling system for watercourses in 2009. The resulting *Field Manual for Erosion-based Channel Classification*[17] is now used by Hinton Wood Products as well as the Government of Alberta, replacing the old stream classification systems based on channel width with a new one based on erosion processes. The Fish and Watershed Program ended in 2010, and its fish inventories were turned over to the Government of Alberta. The program was replaced by the new Water Program led by Axel Anderson, seconded by the provincial government for three years. He continues to lead it in 2018. The Water Program would focus on water quantity and quality research, expanded to at least an Alberta-wide scale. The program's first major project was a cumulative effects assessment of the Eastern Slopes.

The fRI Adaptive Forest Management History Program began a project in 2008 to produce a highway guide and smartphone application called the *Northern Rockies Ecotour*, published in 2012. The *Ecotour* focuses on the landscapes, ecology, culture, people, and history of the Northern Rockies region of Alberta.

fRI's involvement in the Mountain Legacy Project began in 2009 and built on the repeat photography work during Phase II of the Model Forest Program. Since 1997, the project had rephotographed more than 5,000 landscapes shown in archival glass plate negatives taken by government surveyors from the 1880s to the 1960s. Digitizing and comparing the new and old images revealed many aspects of landscape change over time—vegetation, glacial retreat, treeline advancement, fire ecology, and human use—and assisted in setting goals for landscape management based on historical patterns of change.

The LUF regional planning process became mandatory following passage of the Land Stewardship Act in 2009, and the process was still unfolding in 2018. The government recognized that participants would need a reliable source of information on the issues related to land use and planning. As a result, fRI received a $1.2-million grant in 2010 to establish the Land-use Knowledge Network as an online library, workshop provider, and network facilitator. "The environmental, economic, and social dimensions of land-use issues are complex problems for which there is no perfect solution," said program lead Kirby Wright.[18] "We are and will continue to be grappling with an emerging, evolving knowledge base, and we're going to have to talk about the balance."

In September 2009, the Board suspended activity in the Aboriginal Involvement Program and the coordinator, Brad Young, resigned in December. There were a number of issues that were increasingly problematical (see Chapter 8).

In 2010, the Yellowhead Ecosystem Group partnered with fRI to provide administrative and GIS services, as well as communication and extension support. The group of area resource managers had been in existence, off and on, since the early 1990s and shared many common interests and members with fRI. A strategic planning session identified access management as a key topic as they addressed issues such as grizzly bear and caribou conservation. The collaboration produced two studies, one on grizzly bear movements around a coal mining area and the other on interprovincial policy alignment. The group ceased to exist after 2012 when the Foothills Landscape Management Forum (FLMF) was created.

The Foothills Research Institute received the 2010 Canadian Institute of Forestry Forest Management Group Achievement Award, recognizing unique and outstanding achievement in forest management by a group or organization.

In September 2010, the fRI shareholders determined that climate change projects should be done within existing programs rather than have a stand-alone climate change program.

Effective March 31, 2011, fRI withdrew from the Canadian Model Forest Network and the International Model Forest Network. Tom Archibald, who replaced Don Podlubny as

The formative meeting of the Yellowhead Ecosystem Group, at the Palisades in Jasper April 2010. L-R Back Row: Dan Rollert (Hinton Wood Products), Mary Luckert (UofA), Ron Hooper (facilitator), David Andison (Foothills Research Institute), Steve Otway (Parks Canada), Kirby Balfour (Foothills FP), Bob Udell (facilitator). L-R Front Row: Tom Archibald (Foothills Research Institute), Andy VanimShoot (AB Parks), John Wilmshurst (Parks Canada), Brent Schleppy (ASRD), Garth Davis (Conoco Phillips), Mark Symbaluk (Teck), Rick Bonar (Hinton Wood Products), Scott Back (BC Parks), Keith McClain (ASRD), Matt Wheatley (AB Parks).

General Manager in 2008, said the network's focus on communities no longer aligned with fRI's focus on forest management. In 2012, the Board also agreed to move all future work plans to a document management system called Sharepoint.

Phase V, 2012–2017

The fifth five-year business strategy set out nine goals:

1. Partnerships: Nurture and expand fRI partnerships.
2. Geographic scope: Expand the fRI geographic scope to encompass partner interests as appropriate for each program.
3. Business portfolio: Review and expand the fRI business portfolio scope and integration based on partner priorities.
4. Science excellence: Ensure research is non-partisan and meets high standards for quality, relevance, and recognition.
5. Knowledge transfer: Facilitate the adoption of fRI knowledge, tools, and technology into land and resource management practice.
6. Partner outreach and support: Contribute to the success of fRI partners.
7. Land and resource management: Contribute to improved land and resource management in Alberta and beyond.
8. Reporting: Report to fRI partners and audiences on achievements and progress.
9. Resources: Expand fRI resources and investment.

At the beginning of this business plan, the Yellowhead Ecosystem Group was discontinued. This final attempt to implement the Land Managers Forum initiated in Phase III was ultimately abandoned in recognition that shared landscape decision-making across major jurisdictional boundaries was a laudable concept but one that is very difficult to achieve in practice. The Land-use Knowledge Network began operations with a three-year commitment of $1.2 million. Funding was acquired from Alberta Fish and Wildlife to begin a caribou research program hosted at fRI, and Laura Finnegan was hired to head it.

In 2015, the Alberta Forest Growth Organization amalgamated with three other associations, including the Foothills Growth and Yield Association, to form the Forest Growth Organization of Western Canada (FGrOW). This was coordinated by Sharon Meredith, who at the time was also the director of the FGYA. Tree Improvement Alberta joined FGrOW in 2016. The new organization remained under the fRI umbrella.

During Phase V, Bill Tinge replaced Tom Archibald as General Manager from 2012 until 2016, when Ryan Tew was named to the post. Weyerhaeuser (in 2012) and Canadian Forest Products (in 2015) became shareholders. In 2015, fRI Research became the legal name of the institution and its official logo.

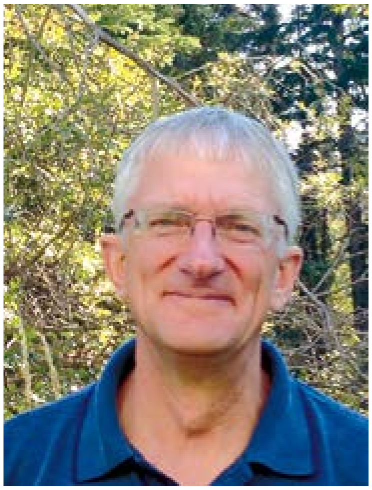
Map 2-8. The scope of fRI research in 2012.

In 2014, fRI won the Alberta Chamber of Resources Environmental Award, given to organizations or individuals that have demonstrated "sustained and stellar environmental stewardship." Chamber president Brad Anderson said that fRI research and innovation "promotes and enables the orderly and responsible development of the resource, and all of the social and economic benefits and environmental performance improvements that entails."

Gordon Stenhouse and the Grizzly Bear Program continued to gain prominence, issue publications, and win honours. In 2012, Stenhouse was awarded the prestigious J. Dewey Soper Award from the Alberta Society of Professional Biologists. *Alberta Venture* magazine selected him in 2014 as one of "Alberta's 50 Most Influential People," and in 2016, he received the Tree of Life Award from the Canadian Institute of Forestry. Stenhouse was also asked in 2012 to participate in a grizzly bear project with the 10-community St'at'imc Government near Lillooet, British Columbia.

At the 2012 Emerald Awards, the Foothills Landscape Management Forum (FLMF) received the Shared Footprints Award for the Berland Smoky Regional Access Develop-

Foothills Research Institute Board members attending the fall meeting, 2012. L-R: Vic Lieffers, Jim LeLacheur, John Kerkhoven, Steve Otway, Rick Bonar, Darren Tapp, Jennifer Hancock (staff), Stan Holmes, Dean McCluskey, Garth Davis, Graham Statt, Tom Archibald (General Manager), Roger Loberg.



General Manager Bill Tinge, 2013.
Bill is now retired and living in Hinton.

ment Plan. The award citation said the project exemplified how projects could reduce their ecological footprint." We are demonstrating that resource extraction can be done in a sustainable way and can be done in a way that looks after other values on the landscape," said Wayne Thorp, FLMF program lead. The Berland Smoky plan drew on work completed since 2005 by FMF and fRI programs, and it incorporated input from government, First Nations, specialists, and industry. In 2015, FLMF received $500,000 in funding from the provincial government for caribou range planning activities.

In 2013, Laura Finnegan was hired to lead the new Caribou Research Program. The previous FMF program had been dropped 10 years earlier, and FMF/fRI involvement had been through projects of the West Central Alberta Caribou Standing Committee, the Caribou Landscape Management Association, and the Foothills Landscape Management Forum. At a January 2012 workshop, researchers shared what had been learned in the past and what they were working on, while government and industry partners discussed what they needed to know to support caribou recovery. Finnegan would take the results from the workshop and, working with partners, develop projects that would assist in testing caribou recovery initiatives as they are implemented. The Government of Alberta announced its Caribou Recovery Plan in 2016.

Teck Coal committed in 2013 to provide $60,000 per year to be used for fRI research on species such as grizzly bear, harlequin duck, Athabasca rainbow trout, and bull trout. Representatives of Alberta Parks, Jasper National Park, Alberta Environment, and Sustainable Resource Development joined Axel Anderson, Beth MacCallum, and coal industry partners at a meeting on December 20, 2013, to discuss their interests and identify knowledge gaps regarding species of special concern.

Emerald Awards Trophies 2012 – President Rick Bonar and Wayne Thorp, accepting the award.

In 2015, the fRI Board decided to no longer pursue the Social Science Program. A small amount of money had been earmarked to seed the development of a new program, but little interest was shown, and no research proposals emerged.

In 2016, the Grizzly Bear Program received a $1.4-million grant from the Natural Sciences and Engineering Research Council (NSERC) to support a combination of remote sensing, tracking technologies, and biological markers to investigate the environment, population performance, and the health of the grizzly bear in west-central Alberta.

In 2016, the Healthy Landscapes Program launched an interactive website called lessonsfromnature.ca to help decision makers and the public discover new forest management research and applications.

In June 2016, the Board of Directors overseeing the final year of the first 25 met in the Cache Percotte Forest, saying farewell to long time board member John Kerkhoven and retiring General Manager Bill Tinge, and welcoming new General Manager Ryan Tew.

On January 1, 2017, Rick Bonar retired as president of fRI Research, ending his continuous involvement with the institution since its earliest conceptual stages. On the same date, Jerry Bauer retired as lead for the Forest Stream Crossing Program, a position he had held since the program's initiation in 2004. Bonar noted that science can provide the tools for good management, but ultimately it is up to government, industry, and the public to decide how the knowledge will be applied.

> "Science isn't going to tell you, you should go this way or that way or how much. It'll just say, if you do this, this is the potential consequence. If you do that, here's what's likely to happen. You've still got to make a decision. Science isn't going to make the decision." –Rick Bonar, interview, 2015

2016-17 fRI Board of Directors attending spring meeting, June 2016. L-R. Bill Tinge, Gordon Sanders, Stan Holmes, Erica Sivell, Rick Bonar, Salman Rasheed, Jesse Kirillo, John Doornbos, Darren Tapp, Ken Greenway, Dwight Weeks, Ryan Tew, John Kerkhoven.

Opposite page: *Courtesy John Luckhurst*

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14 Rick Blackwood, questionnaire response, 2015.

15 Gingrich, Randall. "Building effective international, multicultural alliances for restoration of ejido forests in the Sierra Madre Occidental." In *Connecting mountain islands and desert seas: biodiversity and management of the Madrean Archipelago II*, Proc. RMRS-P-36, Gerald J. Gottfried, Brooke S. Gebow, Lane G. Eskew, and Carleton B. Edminster, 364–370. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 2005. Accessed January 2018. **https://www.fs.fed.us/rm/pubs/rmrs_p036/rmrs_p036_364_370.pdf**

16 Don Podlubny, questionnaire response, August 2015.

17 McCleary, Richard, Stephen Haslett, and Kevin Christie. 2012. *Field Manual for Erosion-Based Channel Classification, Version 7.0*. Hinton, AB: Foothills Research Institute.

18 Kirby Wright, quoted in 2010 fRI annual report.

SECTION TWO

Evolution of Results – Focused Research Programs

Section One examined the institutional evolution of the Foothills Model Forest (FMF) and fRI Research. In Section Two, we address the various areas of research undertaken by the institution. These are organized under the headings of the six criteria for sustainable forest management established by the Canadian Council of Forest Ministers (CCFM). All of the FMF and fRI research pertains to at least one criterion, and some programs apply to several criteria. Fish and watershed research, for example, involves both biodiversity (Criterion 1, Chapter 3) and water issues (Criterion 3, Chapter 5); these topics are addressed more fully in the latter chapter. Most of the FMF and fRI research on genetic diversity concerned tree species, and this topic is discussed along with forest productivity (Criterion 2, Chapter 4). We go into greater detail on some programs due to their scope, relevance, or longevity compared to others.

CHAPTER THREE

CCFM Criterion One

Conservation of Biological Diversity

"Diversity is a building block for sustainability. Just as having a diversified economic base makes it easier for communities and countries to adapt to global market changes, biological diversity, or biodiversity, makes it possible for organisms and ecosystems to respond and adapt to environmental change. The conservation of biodiversity is, therefore, an absolute necessity to ensure that forests are managed sustainably. Biodiversity comprises the variability found among living organisms and the ecosystems that harbour them. This variability can be assessed at different levels, ranging from the diversity of ecosystems across the planet, to the abundance of species within each ecosystem and, finally, to the wealth of genetic material found within each species." –Canadian Council of Forest Ministers, 2005[1]

Conservation of biological diversity, also known as biodiversity, became a global, national, and provincial policy imperative as Foothills Forest was getting established. Researchers and practitioners have generally followed two complementary paths to monitoring and managing biodiversity, often characterized as "fine-filter" and "coarse-filter" approaches. Both approaches are reviewed in this chapter.

Historical Context – Biodiversity

Paraphrasing William Shakespeare (*As You Like It*, act 2, scene 7):

> All the world's a stage,
> And all the living things merely players;
> They have their exits and their entrances,
> And one life in its time plays many parts.

Aboriginal people have affected biodiversity in Western Canada since the last ice age through their use of fire and their hunting, gathering, fishing, and trapping practices. The introduction of horses altered some of these effects by the late 18th century, as did the opening of the fur trade in that century, contacts with Americans and Europeans in the early 19th century, and the subsequent use of firearms. Several of the largest changes in Alberta's biodiversity occurred in the late 19th century with the near extirpation of bison on the prairies, establishment of Aboriginal reserves, introduction of cattle ranching, clearing land for agriculture, and construction of railways, roads, and settlements. (For example, the southward spread of aspen parklands onto former prairie has been linked to the disappearance of the bison in those areas.[2]) Hunting, trapping, and poison altered predator-prey dynamics.

These changes coincided with similar dramatic changes occurring in eastern North America due to land-use conversion, overcutting the most desirable timber, and overhunting various species. Extinction of the passenger pigeon, whose flocks once darkened the skies, showed how easily that could happen; the species was "victimized by the fallacy that no amount of exploitation could endanger a creature so abundant."[3] By the turn of the 20th century, these events had helped to spur a vigorous conservation movement led by Theodore Roosevelt and Gifford Pinchot in the United States and Sir Clifford Sifton in Canada. The Government of Canada established the Advisory Board on Wildlife Protection in 1909. Parks and forestry officials undertook efforts to preserve species such as the pronghorn antelope and wood bison. One of the biggest achievements was the *International Migratory Bird Convention* in 1916. This was the beginning of a focus on endangered species that continues today and has seen successes such as the gradual recovery of whooping cranes since the species' near-extinction in the 1940s.[4]

A more holistic view of the environment and human impacts began to emerge in the 1960s. Rachel Carson's 1962 book, *Silent Spring*, linking the use of the pesticide DDT to declining bird populations, is often cited as the catalyst. The National and Provincial Parks Association of Canada (renamed the Canadian Parks and Wilderness Society in 1986) was established in 1963, World Wildlife Fund Canada in 1967, the Canadian arm of the Sierra Club in 1970, and Greenpeace and the Canadian Nature Federation (now Nature Canada) in 1971. These organizations, scientific associations, and groups that were traditionally less active in conservation issues, such as game and fish associations, also increased their emphasis on environmental issues; the latter were represented nationally by the Canadian Wildlife Federation. In the 1970s, federal and provincial governments established departments of the environment, environmental protection laws, and environmental assessment legislation. During this period, much of the concern for nature conservation centred on preserving wilderness and protecting unique areas or ecosystems as ecological reserves. Some legislation, such as that passed in Ontario in 1971, sought to protect rare or endangered species of all plants and animals, including insects. The first Earth Summit in 1972 endorsed measures to safeguard wildlife and natural resources. In 1978, the intergovernmental Committee on the Status of Endangered Wildlife in Canada (COSEWIC) began to define a national list of species at risk.[5]

Environmentalists also began to focus on biodiversity aspects of forestry in the 1970s and 1980s. One concern was that conventional sustained-yield harvesting could eliminate "old growth" if all trees were cut at maturity, removing habitat for species dependent on older forest stands. (In reality, some old growth would typically remain in this scenario due to inoperable terrain and regulations protecting wetlands and riparian areas.) There were concerns that planting after harvests would result in "monocultures" replacing mixedwood stands. Forestry and other industrial activities and infrastructure also increased public access to formerly remote areas, which led to impacts on fish and game. Early vegetation growth on cutblocks attracted some game species, as well as hunters and predators. Linear disturbances such as roads, pipelines, power lines, and seismic cutlines provided travel corridors for both humans and wildlife and altered the use of the landscape and predator-prey relationships. How to measure and mitigate these impacts became a growing concern for resource managers in government and industry, scientists, non-government organizations, Aboriginal people, recreational users, and the general public. In 1986, the U.S. Forest Service began to limit timber sales in the Pacific Northwest to preserve old-growth habitat for endangered spotted owls.[6] Federal and provincial parks officials faced some of the same issues managing impacts due to recreational use, infrastructure development, and fire suppression. Parks Canada recognized one key aspect in a 1989 report, *Keepers of the Flame: Implementing Fire Management in the Canadian Parks Service*.

Many of the elements were therefore in place already when conservation of biological diversity went from concept to policy and practice in the course of a decade:

- In 1986, the National Forum on BioDiversity in Washington, D.C., brought together experts in biology, agronomy, economics, and philosophy, among others, as well as representatives of agencies and non-government organizations.

The conference proceedings, *Biodiversity*, edited by Edward O. Wilson and published in 1988,[7] became an influential text for the rapidly emerging science of conservation biology.[8] "The book before you offers an overall view of this biological diversity and carries the urgent warning that we are rapidly altering and destroying the environments that have fostered the diversity of life forms for more than a billion years," said Wilson in his foreword.

- In 1987, *Our Common Future*,[9] the report of the World Commission on Environment and Development (Brundtland Commission), drew attention to species extinctions: "Some genetic variability inevitably will be lost, but all species should be safeguarded to the extent that it is technically, economically, and politically feasible."
- In 1988, the UN Environment Program began technical and legal consultations that led to the adoption of the *Convention on Biological Diversity*, which was endorsed by 168 nations at the Earth Summit in 1992.[10]
- In 1990, Canada's ministers responsible for wildlife signed A Wildlife Policy for Canada, pledging to maintain and enhance "all wild organisms and their habitats."
- The federal *Green Plan* in 1990 committed Canada to protect endangered species, habitats, and ecosystems, and it identified "conserving forest biodiversity" among a number of goals for the Model Forest Program.

Figure 3-1. The components of biodiversity, from the *Northern East Slopes Strategy*, final report, 2003.[11]

Conservation of Biological Diversity	Ecosystem Diversity	Representative Distribution of Ecosystems	Maintain a diversity of ecosystem types and local elements within the natural range of variability
			Maintain landscape connectivity Protect unique and rare landscape elements
	Species Diversity	Wildlife Habitat	Maintain wildlife habitat Maintain fish and aquatic species habitat
		Species at Risk	Protect or enhance habitats for species at risk
		Rare and Unique Vegetation	Protect rare vegetation
		Species Richness and Diversity	Maintain species richness and diversity on the landscape
	Genetic Diversity	Reservoir of Genetic Diversity Within Species	Ensure genetic diversity is maintained

As the Foothills Forest proposal was drafted and approved in 1991 and 1992, the full meaning of biodiversity conservation was still being elaborated. It would be another three years before the Canadian Council of Forest Ministers and the Canadian Standards Association clearly enunciated the implications for sustainable forest management (see Chapter 2). Federal, provincial, and territorial ministers adopted the *Accord for the Protection of Species at Risk* in 1996, and in 1997, the provincial government produced *A Strategy for the Management of Species at Risk in Alberta*. The national accord led to the federal Habitat Stewardship Program in 2000 and the Species at Risk Act in 2002. The federal legislation governs national parks, other federal lands, and species under federal jurisdiction such as fish and migratory birds. Alberta's 1985 Wildlife Act continues to be the main provincial legislation protecting endangered species and habitats under its jurisdiction.

The Terrestrial Wildlife Research Program

A well-balanced and defensible management system includes both "fine-filter" and "coarse-filter" management strategies. These will be discussed at some length in this chapter. The fine-filter approach, initiated at the Foothills Model Forest from the very beginning and continuing today, focuses on individual species and populations as indicators of ecosystem health. The coarse-filter approach emphasizes perpetuation of the habitats, landscapes, and ecological processes that currently sustain the full spectrum of diversity from microbes to mammals and from tiny water plants to towering forests. Integrating the approaches and applying the knowledge on large landscapes is a continuing challenge. FMF and fRI Research have already built a large body of knowledge, which has led to significant changes in management policies and practices and continues to do so.

Early Groundwork at Hinton

In the Hinton Forest Management Agreement (FMA) area, biodiversity conservation programs could draw on a body of knowledge about the landscape and its management dating back to the first harvests in 1956. The information included detailed forest inventories—species, age, height, and growth rates—drawn from aerial and on-ground surveys, operating experience, and a grid pattern of sample plots. Additional information came from wildlife, fisheries, and hydrology studies in the area. An effort to integrate wildlife into forest management began in 1982.

Biologist John Stelfox, a research scientist with Alberta Fish and Wildlife (1955–1966) and the Canadian Wildlife Service (1966–1986), established a series of research plots on scarified and unscarified harvest areas in spruce (montane ecoregion), pine (upper foothills), and mixedwood (lower foothills) sites in the Hinton FMA area as operations commenced in 1956. His initial purpose was to determine the effect of logging on ungulates, but his records also included careful documentation of the vegetation and non-ungulate wildlife on the sites. He returned to measure these plots at 10-year intervals, even after his retirement, and later with the assistance of his son, Brad Stelfox, also a biologist. The study provided fundamental insights into the long-term response of the forest ecosystem to management activities.[12]

This "exclusion plot," photographed in 1961, was in one of the early cuts at Northwestern Pulp & Power's "Camp 1" logging operation, west of Hinton. By excluding wildlife from the enclosure, Stelfox could study the effects of harvesting and reforestation on habitat and grazing in the surrounding area.

Stelfox's work showed, in detail, how plants respond after logging. He and other biologists compared these ecosystem responses to the natural process of succession after forest fire. The results suggested that the responses were similar but not identical. Stelfox was one of the first to point out that retaining "structure" from the original stand benefits biodiversity conservation. Structure may include live and dead trees, individually or in clumps, as well as shrubs and immature understorey trees.

Bob Swanson of the Canadian Forest Service also established early experiments to examine the impact of forest harvesting on watersheds. This research later inspired the Tri-Creeks Experimental Watershed study on the forest management area, a major initiative begun in the late 1960s, looking at the effects of forest management and public use on water yield and quality, as well as fish stocks (see Chapter 5). Ongoing studies by various government agencies—including Alberta Fish and Wildlife, the Alberta Forest Service, the Alberta Research Council, the Canadian Wildlife Service, and the Canadian Forest Service—provided additional information about fish and wildlife and their habitats, soils, erosion, and water flows on the forest management area. University scientists also contributed to this body of knowledge. During periodic reviews of the operating ground rules, company and government officials incorporated the applicable results of this research into operations.

In April 1982, the Alberta Forest Products Association (AFPA) and the Alberta Department of Energy and Natural Resources hosted a workshop in Jasper to address the theme "Timber Harvesting in the Boreal Forest: Capitalizing for Wildlife." The keynote speaker was Jack Ward Thomas,* then chief biologist of the Range and Wildlife Habitat Laboratory of the U.S. Forest Service in Portland, Oregon. Thomas explained the integration process he had developed for managing timber and wildlife in Washington and Oregon.

Jim Clark, the woodlands manager for the Hinton FMA holder,† serving a term as president of the AFPA, had been instrumental in arranging Thomas's presentation at the Jasper workshop. With company support, Clark offered the Hinton forest management area as a pilot project for implementing a similar program in Alberta. A nine-member task force of industry and government representatives, including Clark, submitted their report in 1987, setting the stage for the wildlife program that began in 1988. This report, *Integrated Forestry-Wildlife-Fish Resource Management Approach for the Champion Forest Products (Alberta) Ltd. Forest Management Area, Hinton, Alberta,* drew on an earlier report for the area by consultants Rainer Ebel and Beth MacCallum in 1984.

Clark retired in 1985, and Don Laishley became the company's manager of forest resources in January 1986. Laishley said his own epiphany to the wildlife cause occurred in 1987, during a visit to the woodlands with Ray Ranger and Bob Udell. They saw a big clearing, full of willow, "the nicest looking piece of moose pasture I have ever seen in my life," Laishley recalled. None of them could explain why there were no moose to be seen, and he realized they would need an explanation if hunters arrived one fall and found no moose. That same year, the government-industry task force indicated that, with dedication and willingness to adapt harvest practices, the company should be able to sustain habitat for all wildlife species in the forest management area. "I think we'd better get into the wildlife biology business," Laishley decided. Company executives agreed that having a biologist on staff would provide "an insurance policy" to ensure that the company's forest management program also supported healthy populations of wildlife and fish.

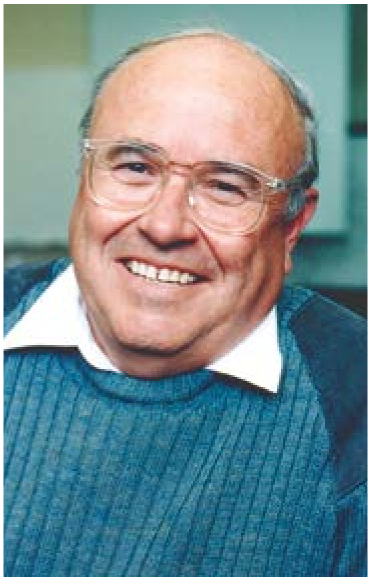
In May 1988, Weldwood's Hinton Division hired Rick Bonar, a wildlife biologist with 14 years' experience in British Columbia. He was made responsible for the company's wildlife management, including fish, and ultimately for the broad issue of biological diversity. Bonar immediately began collecting a huge amount of information on selected species that were representative of almost all the above-ground species in the forest management area. Bonar's work, along with the company's other research activities, contributed significantly to the establishment of the model forest in 1992.

Along with that tangible company commitment to wildlife, other changes were occur-

* Jack Ward Thomas retired in 1996 after a three-year term as the 13th chief of the U.S. Forest Service, the first non-forester in that role. He described his philosophy in "Forest Management Approaches on the Public's Lands: Turmoil and Transition," the Horace M. Albright Conservation Lectureship to the University of California Department of Forestry and Resource Management at Berkeley, April 14, 1992. http://forestry.berkeley.edu/lectures/albright/1992thomas.html

† The Hinton FMA holder and mill operator was North Western Pulp & Power Co. from founding in 1954 to 1978; St. Regis (Alberta) Ltd., 1978 to 1985; Champion Forest Products (Alberta) Ltd., 1985 to 1988; Weldwood of Canada Ltd., Hinton Division, 1988 to 2004; and since 2004, Hinton Wood Products, a division of West Fraser Mills Ltd.

Opposite page: Backed by the front ranges of the Rockies, the Gregg River meanders through a managed forest landscape.



Don Laishley, first chair of the Foothills Model Forest (1992–1994) and General Manager of Hinton Forest Resources. Don was an avid supporter of the model forest and championed it within a number of provincial and national task forces on which he served, as well as at Weldwood's head office in Vancouver.

ring. The ground rules negotiated after the 1988 Forest Management Agreement renewal incorporated recommendations made by the 1987 task force. The next step was to decide what was needed for the integrated wildlife-forestry program. A new government-industry committee was formed, called the Integrated Resource Management Steering Committee (IRMSC), comprising Rick Bonar and Doug Walker from Weldwood, Richard Quinlan from Alberta Fish and Wildlife, and Tony Sikora from the Alberta Forest Service. The IRMSC decided that the government and the company would work on wildlife plans jointly, but Weldwood would have primary responsibility for managing habitat and the government for managing wildlife populations.

Habitat Suitability Indices

The approach used by Jack Ward Thomas in the Pacific Northwest was based on maintaining populations of species, but the IRMSC decided this would not fit with the dynamic nature of the forest around Hinton. It was more important, they decided, to focus on habitats rather than individual species. "That was when we came up with the concept of taking all of the vertebrates and seeing if we could associate each species with a certain kind of habitat," Bonar said. For this purpose, the committee adapted a method for indexing habitat suitability that had been developed by the U.S. Fish and Wildlife Service.[13]

Although nearly 300 vertebrate species are found in the foothills region, they can be divided into about 16 terrestrial groupings and one aquatic grouping, each dependent on a particular habitat. The IRMSC identified 30 species to study based on their ranking as: 1) indicator species representing habitat associations; 2) special status species such as rare, threatened, or endangered species; and 3) emphasis species representing species of socio-economic importance in the region. The group then looked at the species' association with the 16 habitat types. If each species could be associated with a habitat—young or old stands, of various species and age—then conserving the habitats was expected also to conserve the species. "At the time, we were not calling it biodiversity, but our strategy was basically a biodiversity conservation strategy," Bonar said.[14]

Jim Beck, a forester and professor in the Renewable Resources Department at the University of Alberta, learned of the habitat strategy as a member of the Forest Management Liaison Committee formed by Weldwood in 1989. He said it was a chance to delve into a subject that had interested him since his undergraduate days at Berkeley decades earlier. His wife, Barbara Hardin Beck, was an information systems specialist and adjunct professor in the same department.* Together, they worked with IRMSC members to develop habitat suitability indices (HSIs) correlating species and habitat types. The initial profiles were based on searches in the scientific literature and the committee members' knowledge and experience; the indices would later be greatly refined through peer review and research on the ground.[15] Evaluation of the HSI models started in 1989 with two graduate research projects on forest songbirds (Dan Farr) and American marten (Rob Stewart). Jim Beck said that one of the early attempts yielded a humorous result.

> "We spent the better part of a half a day doing just one model, trying to come up with a model that fit the red squirrel. We went round and round and round. Every time we would do something, one of us would say, that won't work because of this, etc. We finally had this model, we'd decided. I bring it home to Barb, she looks at it for about five minutes and starts uproariously laughing. She says, 'A blacktop parking lot is red squirrel habitat according to you guys.' In essence, it was. I don't remember why we hadn't eliminated a completely bare area, but we had somehow—and, of course, she never let us forget it ….
>
> "Once we had more or less selected some species and we were pretty sure they wanted those, then Barb and I ran an individual study course here at the university with some undergraduate students who were interested in wildlife.

* Jim Beck was one of the first two forestry professors hired by the University of Alberta in 1971. The Becks were also keen naturalists known for their work recording and collecting bird sounds. In addition, they led data collection on butterflies in Alberta and edited the Alberta Butterfly Counts.

> We explained to them what an HSI model was. Talked about from a zero to a one—if it's one, it's absolutely habitat, if it's zero, it's nothing. For a lot of these things, we had very limited research other than talking to people that went into it. Each one of these students was assigned three species, and they were then to go into the literature and find everything they could, reference it, and then either help prove or disprove our model. This was really good because I think there were six students and three things each. We picked the 18 ones we wanted most. I didn't have enough students to go to 30." –Jim Beck, interview, 2016

The prototypes were not completed in time to include in the company's 1991 Forest Management Plan. However, a year later, the establishment of the model forest provided an opportunity to push ahead with the research.

With the model forest, researchers began to expand wildlife and fisheries inventories and research for the expanded land base. In fact, the inclusion of this already-established wildlife-forestry initiative was a major factor in the selection of the Foothills Forest as one of the 10 original model forests in Canada. The previous HSI work provided a starting point for studies of sensitive and at-risk species such as grizzly bear, caribou, various birds, and bull trout, as well as socially and economically important species such as moose and elk. Some populations, such as long-toed salamander, and some habitats, such as those for cavity-nesting birds, turned out to be more prevalent—and sometimes in different ecosystems—than previously believed. Improved understanding of grizzly bear movements and mortality enabled better management. Woodland caribou research helped to clarify the continuing management challenges for this species.

"Test, evaluate, and revise the set of 30 spatial wildlife Habitat Suitability Index models" became one of the objectives of the successful proposal for the Foothills Forest. The species-specific proposals included research on caribou, grizzly bears, elk, and pileated woodpeckers. Habitat-related proposals dealt with topics such as coarse woody debris, snags, and old growth. Broader research topics included "wildlife habitat supply and population vulnerability" and a proposal to inventory undisturbed ecosystems and identify ecosystems "that may be suitable and desirable for protection as undisturbed ecosystems."

During Phase I of the Model Forest Program, HSI models were developed for 35 species in the research area, representing a wide range of species and forest habitat requirements. Models were initially based on workshops and literature review as well as expert advice. The drafts were documented and refined by some of the Becks' students in the University of Alberta Department of Renewable Resources, then edited and standardized by Melissa Todd, the model forest's biologist. Testing and verification followed for many of the species (see Table 3-1).[16]

The HSI models continued to be refined by model forest researchers over the following decade, with some models going through as many as six revisions. The methodology was also adopted by other model forests, forest companies, government agencies, and land managers. With the advent of digitized geographic information systems (acquired by Weldwood in 1990), use of the Alberta Vegetation Inventory (initiated in 1987), adaptation of an ecosite field guide (1996) for west-central Alberta, and subsequent mapping of ecological classifications across the entire research land base, including Jasper National Park, it became possible to do increasingly sophisticated correlations of wildlife habitat and management planning as the speed and capacity of computer systems continued to grow.

Evaluation of the pileated woodpecker, elk, and caribou HSI models started in 1993, and evaluation of red squirrel, northern goshawk, barred owl, hairy woodpecker, American three-toed woodpecker, long-toed salamander, and moose models started in 1994. Most of the work was done by graduate students. Partners in the modelling project included the Canadian Forest Service, Weldwood, Alberta Fish and Wildlife, six Canadian universities, and several other organizations and individuals. The original set of HSI models was revised

Table 3-1. Wildlife Models Developed by Researchers and Associates of the Foothills Model Forest, 1996.

Common Name	Scientific Name	Draft Model	Spatial Model	Fine Filter	Testing Program
Barred Owl	*Strix varia*	X	X	X	X
Black Bear	*Ursus americanus*	X	X		
Boreal Owl	*Aegolius funereus*	X			
Brown Creeper	*Certhia americana*	X		X	
Chipping Sparrow	*Spizella passerina*	X	X		X
Clay-colored Sparrow	*Spizella pallida*	X			X
Common Yellowthroat	*Geothlypis trichas*	X	X		X
Elk	*Cervus elaphus*	X	X	X	X
Fisher	*Martes pennanti*	X	X		
Northern Flying Squirrel	*Glaucomys sabrinus*	X		X	
Golden-crowned Kinglet	*Regulus satrapa*	X			X
Great Gray Owl	*Strix nebulosa*	X	X	X	
Great Horned Owl	*Bubo virginianus*	X	X		
Grizzly Bear	*Ursus arctos*	X	X	X	
Hairy Woodpecker	*Picoides villosus*	X			X
Hermit Thrush	*Catharus guttatus*	X			X
Hoary Bat	*Lasiurus cinereus*	X			
Long-toed Salamander	*Ambystoma macrodactylum*	X	X		X
American Marten	*Martes americana*	X		X	X
Mink	*Neovison vison*	X	X		
Moose	*Alces alces*	X	X	X	X
Mule Deer	*Odocoileus hemionus*	X	X		
Northern Goshawk	*Accipiter gentilis*	X	X	X	X
Ovenbird	*Seiurus aurocapilla*	X			X
Pileated Woodpecker	*Dryocopus pileatus*	X	X	X	X
Red Squirrel	*Tamiasciurus hudsonicus*	X		X	X
Red-backed Vole	*Myodes gapperi*	X			
Ruffed Grouse	*Bonasa umbellus*	X		X	
Savannah Sparrow	*Passerculus sandwichensis*	X			X
Snowshoe Hare	*Lepus americanus*	X		X	
American Three-toed Woodpecker	*Picoides dorsalis*	X			X
Varied Thrush	*Ixoreus naevius*	X			X
Warbling Vireo	*Vireo gilvus*	X	X		X
White-tailed Deer	*Odocoileus virginianus*	X	X		
Winter Wren	*Troglodytes hiemalis*	X			X

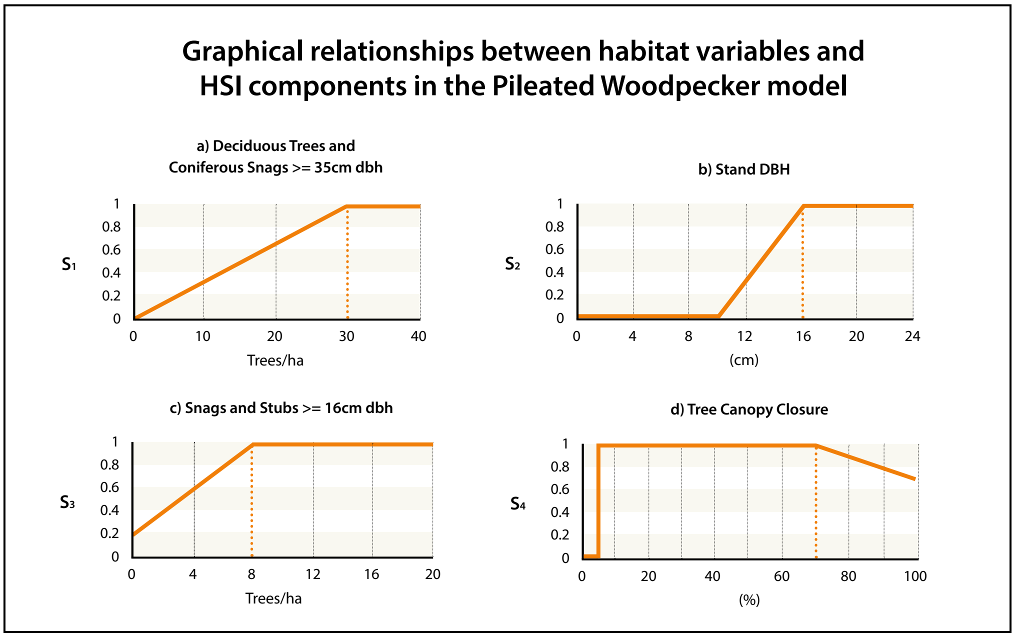


Figure 3-2. Pileated woodpecker winter habitat HSI table, Rick Bonar, 1999.[17]

in 1995–1996 using additional literature review, expert opinion, and local evaluation data. At the same time, HSI models were developed for new species. Review copies of revised HSI models were mailed to 110 species experts in 1996.

Results from the HSI model evaluations suggested that some of the draft models were quite good predictors of species occurrence and relative abundance, while others were not. The chipping sparrow and Tennessee warbler models were removed from the modelling program because field data suggested that neither species had any particular association with the habitat variables in the draft models. For trumpeter swans, it was decided that the best way to address habitat conservation concerns was to identify known and potential nesting ponds and then apply site-specific strategies.

Melissa Todd led the evaluation effort in the early years. Researchers for the models included Rick Bonar (pileated woodpecker), Jody Watson (other woodpecker species), Rob Stewart (American marten), Paul Jones (elk), Lisa Takats (barred owl), Warren Schaeffer (northern goshawk), Karen Graham (long-toed salamander), and Matt Wheatley (red squirrel). John Church began a project on white-tailed deer, but he was unable to capture enough deer to continue.

Graduate student Lisa Takats (centre) and University of Alberta professor and FMF board member Jim Beck (right) with Natural Resources Minister Anne McLellan (left), September 1995, during a field tour associated with Jasper National Park adding its land base to the model forest research area.

For example, the multi-year elk study began in 1993, with assistance from the Rocky Mountain Elk Foundation and the Hinton Fish and Game Association. This research aimed to improve the management of elk and elk habitat by developing a better understanding of elk ecology in forested habitat and how it was affected by various disturbances and impacts related to forestry practices. It would also suggest potential approaches to range enhancement. The study had challenges, with elusive elk evading the traps, while white-tailed deer (and one moose) had no such reservations. Still, five animals were radio-collared and were tracked on a daily basis by Paul Jones, the contract biologist running the program, and John Church, a PhD student working on the telemetry component of the program.

Another study inventoried small mammals and furbearers and measured their response to timber harvesting. Small mammals were captured using snap traps and pitfalls. Inventories of furbearers before, during, and after timber harvesting used predetermined winter snow track transects. Local trapper participation was encouraged. The winter of 1994 rep-

Opposite page: Pileated woodpecker.

resented a preliminary sampling effort to examine the effectiveness of snow tracking as a technique for determining the distribution and habitat use of mammal species. Sampling sites were randomly located along roads with all-weather access; the survey effort was proportionately distributed among the four forest regions present in the Foothills Model Forest research area—upper foothills, lower foothills, montane, and subalpine. At each sampling location, transects totalling 6 kilometres in length were surveyed for tracks according to a predetermined survey protocol. A field team of two people snowshoed each location (3 kilometres per person) within 24 to 72 hours of a fresh snowfall. Transects produced tracks of lynx, marten, fisher, moose, and coyote, just to name a few. Transect locations were revisited in spring to describe, in detail, the habitat types within which tracks occurred.

The habitat models and subsequent refinements are still in use today.

> "I still use the HSI models. The versions that were publicly posted on the Foothills Model Forest, now [the] Foothills Research Institute, website get used all the time as starting points and reference materials for new and emerging predictive habitat models by other biologists and agencies. Barb Beck and I modified and expanded on draft models developed by Richard Quinlan and Rick Bonar and others, revising and restructuring them. Then we would have individual graduate students like Lisa Takats take on the testing and verification of model variables and relationships, in her case, the barred owl, resulting in data-based model revisions (Takats 1998). After I moved to British Columbia, I continued working on the Foothills Model Forest models because the models and knowledge were useful in my closely related work integrating wildlife habitat into strategic and operational forest management, and I could continue to contribute to the developing FMF models." –Melissa Todd, personal correspondence, 2017

Making a Difference – Research-Confounding Assumptions

Two examples of model forest research showed that previous assumptions about habitats and populations were not necessarily valid in the Alberta foothills ecosystem.

Photo of artist Norma Bonar with her pileated woodpecker painting (2017). Norma also designed the Foothills Model Forest logo. *Courtesy Rick Bonar*

Pileated Woodpecker

The pileated woodpecker is an old-growth "indicator species" used for management in some U.S. forests, and it was chosen as a management species for both the Weldwood FMA area and the Foothills Forest. At least 45 other species were associated with pileated woodpecker habitat, so validation of the preliminary habitat model was a high priority, and the results confounded existing assumptions. Rick Bonar headed the evaluation effort, which involved five years of research and eventually led to Bonar's 2001 doctoral thesis, which was supervised by Jim Beck and Susan Hannon at the University of Alberta.[18]

Beginning in 1993, Bonar organized crews to search for nests, which would be followed by trapping for the placement of radio tags for tracking. Posters and promotional materials advertised the activity, with rewards for nest locations. His wife, wildlife artist Norma Bonar, donated a painting and a limited-edition pileated woodpecker print to publicize and raise money for the research. However, the first year's results were disappointing, and Bonar began to challenge the prevailing belief about the bird's habitat in boreal forests. He also widened the appeal for public assistance.

Item in the February 1994 Foothills Forest *Inform* newsletter:

> **Request for Pileated Woodpecker Information**
> *by Rick Bonar*
>
> Volunteers are needed to help with a three-year study of pileated woodpecker habitat ecology under the Foothills Forest progrm based in Hinton. One of our main interests is information on pileated woodpecker nests from any place in the boreal forests of Albeerta, northern B.C., and Sasakatchewan.
>
> In an effort to recruit and encourage volunteer help, we are sponsoring a March 1 to May 31 treasure hunt to locate nests within 50 km of Hinton, except in Jasper National Park. We will provide a search package with maps and instructions to any volunteers that want to search for nests and we can even supply copies of air potos who are serious about looking. We are offering a reward of $200 for any new active nest located within the treasure hunt area, as confirmed by us. If you are looking for something different to do on a spring weekend, and the chance to earn a reward, come to Hinton and look for PIWO nests! Access is generally good and much of the snow in the Athabasca River valley is usually melted by March. If the 1994 treasure hunt is successful, it will be repeated in 1995.

Based on U.S. research—none had been done in Canada—old conifers were expected to provide the primary habitat, Bonar said.

> "The first year of looking for nests up here, we spent an awful lot of time walking through the forest where there were big conifer snags, looking for woodpecker nests. We found precious few. In fact, we only found two the first year, and they weren't in conifer snags. They were both in big, living aspen that were infected with heart rot fungus. It turned out that's ideal for woodpeckers because the aspen have this nice, hard, outer sapwood that they can drill through, and then it's soft inside. Once inside, they can easily excavate down through the rotted wood. It's really hard excavating the end grain on solid wood.
>
> "After we changed the search image, we found almost 700 pileated woodpecker cavities. Something like 80 percent of them were in aspen trees. We did find a few in conifer snags, but nowhere near the proportion from the U.S. That's just an illustration that you can't extrapolate necessarily from a species that lives in a very different ecological area into somewhere else, even though the species is the same. They're using habitat differently and have a different niche. The other huge surprise was that their territory sizes up here were an order of magnitude bigger than they were in the U.S. There were reasons for that, too. The primary one is probably that they need to corral enough resources in the summer to make it through a long winter, whereas in the U.S. Northwest, they had more food resources. They didn't need such big territories to get enough food … almost exclusively carpenter ants in winter." –Rick Bonar, interview, 2015

With the support of his company and the model forest, Bonar pursued his doctoral research project while continuing to work full-time. He said he reserved one day each weekend for writing. His work led to a much-revised HSI model and new management strategies for the pileated woodpecker in boreal Canada.

Jim Beck recalled that Evelyn Bull,* a leading U.S. authority on the pileated woodpecker, visited Hinton later in the research and went on a tour with Bonar. He took her to a pure aspen stand and pointed out the cavities. "She was just astounded," Beck said. "I guess they don't have any aspen stands down in the coastal parts of Oregon. The only deciduous stands they are going to have there are alder, and they probably don't get that big or rot that easy."

* Evelyn Bull was a wildlife biologist with the Pacific Northwest Research Station of the U.S. Forest Service. She published numerous research notes on the pileated woodpecker and other species. One intriguing title was *Creating Snags with Explosives*, which she co-authored in 1980 with Arthur Partridge and Wayne Williams.

Long-toed Salamander

The long-toed salamander was chosen as an indicator species because it depends on a particular combination of aquatic and terrestrial habitats. Alberta Forestry, Lands and Wildlife "red-listed" the species in 1991—meaning populations could be "in serious trouble"—based on perceived effects of industrial, recreational, and transportation developments on those habitats. Evaluation of the HSI model led to revised, less-endangered status for the species and became a long-term project for the researcher.

Biologist Karen Graham first came to the Hinton area in 1992 to work on a songbird project (Dan Farr's University of Alberta doctoral thesis research). After learning about the then-nascent model forest and the intent to pursue a salamander study, Graham wrote a proposal that was accepted, and she used it for her master's thesis at the University of Guelph. When she began fieldwork in 1994, the first task was to find the breeding areas, which were water bodies without egg-eating fish populations.

Long-toed salamanders.

> "First of all, I had to find them. There were some anecdotal observations of them. That's where I went to first. I just started looking into ponds and looking for eggs because I was there in the spring. That's the easiest time to look for evidence that they're around. That was my first thing. I looked at all these ortho-images across the FMA and I looked for ponds that were not huge, but not too small. I just went out and circled them looking for eggs for the first few weeks in the spring. I would find eggs and then go back to the ones that had the most egg evidence. Then I would set up my little pitfall array around them." –Karen Graham, interview, 2015

To build the traps, Graham collected scraps of lath and building wrap and went around to Hinton restaurants collecting big cans. As the salamanders emerged from the water and headed for their adult terrestrial habitat, they would walk along the lath fences and fall into the cans. The first season, she focused on ponds in the Hinton area, and in the second, extended the collection to more sites in western Alberta and eastern British Columbia. She had collected 999 specimens by the end of the second season—"I couldn't get that one more" (to make an even thousand), she said.

Graham found salamander populations to be "way more than people thought," and she showed that the nocturnal creatures were using terrestrial habitat up to 500 metres or more from the water bodies.[19] Her work, along with that of other researchers, led to revised status from "red" to "yellow" (i.e., from "are at risk" to "may be at risk"). Her revised HSI model was used in Weldwood's 1999 forest management plan and is still in use today. "There wasn't a whole lot of literature back then on these animals," she said. "I was definitely learning new things that never had been documented before." Her research also revealed an interesting bit of genetic diversity—that salamanders in the Hinton region are more closely related to those in central British Columbia than to salamanders in the southern foothills of Alberta.

In 2017, Karen Graham works as a grizzly bear researcher at fRI Research but has continued her salamander studies on a volunteer basis.

After getting her master's degree in 1997, Graham spent a year working in British Columbia, and then returned to Hinton to work on various Weldwood and model forest projects before being hired in 2003 to work full-time with the Grizzly Bear Program. She continues to voluntarily do salamander egg counts at area ponds each spring, has assisted Alberta Fish and Wildlife amphibian surveys, and has collected salamander genetic data for a possible future publication. Sometimes in the spring, she takes people out to the Hinton golf course at night to show them all the salamanders swimming around laying eggs during breeding season. "Lots of people, even in Hinton, they don't know that they're around," she said. "There are lots of them, but you just don't see them."

Models for Integration of Wildlife and Forest Management

"Really, what we're looking at when we talk about habitat is various forest types and various seral stages of those forest types," Bonar said.[20] The fine-filter work on species and habitats thus complemented subsequent coarse-filter research on historic patterns of natural disturbance, ecosystem responses, and natural variability in the foothills forests. The model forest would also develop protocols for monitoring biodiversity that were later improved, expanded, and implemented on a province-wide scale.

A forested landscape with a diversity of forest stands and ages, including various ages of fire-origin stands and recent harvest areas designed to emulate fire patterns, north of Brule.

In Alberta and other parts of Canada today, a combined coarse-filter/fine-filter management system is a well-established standard and is largely based on work at the model forest and its successors. Fine-filter species are those selected for habitat maintenance in forest management planning. Priority is given to select species for which the HSI also represents the habitat needs of a number of other species. It is, however, virtually impossible to research and document the full range of habitat requirements of every one of the hundreds of species that depend on the forest, and therefore some proxy in the absence of such research is needed. This proxy is coarse-filter planning, a biodiversity management strategy focused on managing the forest to sustain a range of ecosystems and seral stages on the landscape that are representative of historic distributions arising from natural disturbances. Logically, the resulting landscape should thus sustain populations of wildlife that have historically used these ecosystems, and the purpose of fine-filter species checks is to test whether this assumption is being met. The fine-filter approach can focus on species that might be missed by the coarse filter or need special attention for one reason or another. In 1994, the Foothills Model Forest initiated the coarse-filter Natural Disturbance Research Program, renamed the Healthy Landscapes Program in 2011.

HSI model development was only the first step in the Terrestrial Wildlife Research Program, which continues uninterrupted to this day under various other names; e.g., the Grizzly Bear Program. The 1996 HSI overview by Barbara and Jim Beck, Wayne Bessie, Rick Bonar, and Melissa Todd provided the context for and background to today's forest management planning standard in Alberta. It also adequately describes the intent of today's research programs.

> "In the Foothills Model Forest, HSI models will be used to predict changes in suitable habitat areas in relation to forest management objectives and practices. These objectives include forest harvesting and regeneration, other activities which alter forest land areas (e.g., mining, oil and gas exploration, road construction), as well as the effects of forest maturation in areas protected from natural disturbances. The modelling is referred to as habitat supply analysis (HSA). The suitable wildlife habitat area predictions are called habitat units (HU), and these will be aggregated across many habitat types within a geographic information system (GIS) analysis. Then, by linking the models to forest growth and yield models, habitat structure development models, and a forest harvest and regrowth simu-

> lator, the models will be used to make temporal predictions of HU in relation to various management scenarios." –Beck et al., 1996[21]

The incorporation of this into forest management planning, the authors explained, would allow planning foresters to incorporate HSA and forecasting through simulations of timing, locations, patterns, and systems of harvest and reforestation. Alternative strategies could be tested to assess their effects on wildlife habitat and carrying capacities, thereby allowing planners to determine whether the habitat area for the wildlife species under investigation would decrease, increase, or stay constant in relation to these plans. This was the process used in Weldwood's 1999 forest management plan for the Hinton Forest.[22]

> "The HSA will thus allow harvesting proposals to be tested ahead of time to simulate the potential effects on the wildlife resource. The testing of various management scenarios will allow land managers to optimize both the habitat area of each wildlife species and the level of harvest. This integration of wildlife needs with forest planning is one of the key components of Foothills Model Forest's Ecologically Based Decision Support System." –Curry et al., 1993[23]

In order to make forest-level habitat projections, some sort of spatial projection capability was needed to simulate the layout of future harvest patterns. Habitat supply modelling, which also began in 1993, aimed to link timber supply modelling to the assessment of wildlife attributes. Weldwood forester Sean Curry coordinated a team that included Rick Bonar, Jim Beck, and Richard Quinlan and Kirby Smith from Alberta Fish and Wildlife. The supply modelling would be used to evaluate various management alternatives and assist with developing wildlife habitat and population objectives for the Foothills Forest.

Barb Beck developed (and named) a series of programs to integrate forest management and wildlife habitat. FOREST MUNCHER established cutting priorities based on yield. CRITTER CRUNCHER produced strata-based yield tables for all non-spatial aspects of HSI models. WILD WEASEL interpreted CRITTER CRUNCHER yield tables and produced a database that could express HSI value or population density using a set of related HSI/density relationship rules. TRIBBLE was a spatial program (named after a *Star Trek* alien life form because it was "spacey"); it used the database produced by WILD WEASEL and grid information from a GIS to determine the HSI value for models with spatial relationships. Jim Beck said that these programs would make it possible to design harvest plans within acceptable upper and lower limits for habitat.

Four of Weldwood's HSI models were converted to use the spatial capabilities of a GIS system. In 1993, a pilot study was run on a small area (30,000 hectares) of the Foothills Forest to determine the interactions between forest-level habitat goals, stand-level assessment of habitat, long-term wood supply, and operational implementation. The four habitat models were used in conjunction with a spatial inventory projection model. The pilot study identified modelling constraints as well as defined the scope of the task on a larger landscape, following which all models were converted for this type of forecasting and analysis. This would be followed up with a project to integrate non-FMA areas into the habitat supply analysis for the Foothills Forest area.

Ecologist Wayne Bessie meanwhile developed yield curves to determine characteristics of the habitat over time as forests regenerate after fire or harvesting and grow to maturity. Habitat variables included tree diameter, height, density, total volume, and crown closure, as well as shrub, herb, grass, sedge, moss, lichen, downed wood, and snag characteristics. Habitat yield curves provide the same type of information as the merchantable volume yield curves that drive wood supply models, except that the habitat yield curves provide information on habitat variables needed to derive the habitat suitability indices within the habitat supply analysis.

The yield curve initiative led to other habitat-related projects. One project developed and assessed methods of integrating wildlife habitat evaluation procedures within the framework of an ecosystem-based, predictive mapping system.

Species at Risk

Although habitat evaluation addressed many fine-filter biodiversity conservation issues, there are continuing scientific and management concerns regarding at-risk populations of woodland caribou, grizzly bears, bull trout, and Athabasca rainbow trout. The fish species are discussed in Chapter 5. Caribou and grizzly bears both use multiple habitats, have experienced population declines, are affected by human activities, are considered management priorities for government and industry, and have been highlighted by non-government organizations in public campaigns and regulatory proceedings. Model forest and fRI research played important roles in advancing scientific knowledge and management approaches for both these terrestrial species. The Grizzly Bear Program is widely recognized as a world leader in the field.

Harlequin Duck

In 1997, a joint Canada-Alberta environmental panel entertained input to a proposed coal mine expansion in the Mountain Park area south of Cadomin. In its final report, the panel noted some potential adverse effects on grizzly bears, as well as some concerns regarding bird impacts—particularly on harlequin ducks—as well as fisheries. The harlequin is a small sea duck that moves inland in spring to breed, migrating back to coastal waters in the fall. For breeding, they favour the upper reaches of fast-flowing, turbulent streams such as Whitehorse Creek and the headwaters of the McLeod River, where the new Cheviot coal mine was proposed. In Alberta, their numbers are estimated at 1,600 to 4,000 birds, restricted to 5.3 million hectares of the East Slopes and mountains from Waterton Lakes to north of Kakwa Wildland Provincial Park. The harlequin duck is currently considered "sensitive" in Alberta, and several other agencies in western North America have identified the harlequin duck to be of special management concern. The eastern population of harlequin duck is assessed as "endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).[24]

In 1999, with support and sponsorship from Cardinal River Coals, biologist Beth MacCallum began working on a Foothills Model Forest project to study harlequin ducks. Cardinal River withdrew its financial support in 2000, putting some of the proposed reports at risk, including consolidation of earlier work by the company, but six reports were completed, including a final report in 2001–2002 that discussed the status and distribution of harlequin ducks in the northern Rockies and foothills of Alberta. MacCallum has continued her studies with funding from Teck and others, including the Forest Resource Improvement Association of Alberta (FRIAA). Now she is using geotags to find out where the ducks go in the winter and whether they return to the same breeding streams (they do).[25]

Male harlequin duck.

Woodland Caribou

Alberta's woodland caribou populations and ranges have been declining since 1900, including a sharp drop in the 1940s and continuing decreases since the 1970s.[26] The provincial government first listed woodland caribou as a species at risk in 1987, and it has had "threatened" status since 1997 when that category was added to the at-risk classification system; the federal government listed the populations as "threatened" in 2002 under the Species at Risk Act.

Alberta Fish and Wildlife began monitoring caribou with radio collars in 1980. The West Central Alberta Caribou Standing Committee (WCACSC) was formed in 1993 with the purpose of developing a regional management strategy for caribou based on the involvement and cooperation of industries, the public, and government agencies. Foothills Forest

Northern Rockies Ecotour

fRI's Northern Rockies Ecotour project (2012) provided a succinct summary of the caribou issue north of Hinton, which we have updated to 2017 and include below:[27]

Research by scientists at the University of Alberta and elsewhere indicates that many caribou and reindeer populations are in decline, from Alaska and Canada to Greenland, Scandinavia, and Russia. Natural systems are dynamic, and caribou populations have historically experienced increases and decreases. What is different today is the current rate and extent of the decline across Canada and globally.

Four herds are located north and west of Hinton. After declining, the A la Peche herd has maintained a population of about 150 for the past two decades. The Little Smoky herd, which has also been in decline, was 114 animals in 2015, according to a Government of Alberta study of fecal DNA. The Narraway herd, north of Grande Cache, numbers about 100 animals and is considered to be in decline. A recovery plan, including the culling of wolves, was begun in the early 2000s and has, for now, halted the Little Smoky herd decline. Another herd, the South Jasper herd, declined precipitously from about 450 animals in the 1960s to fewer than 100 in 2009.*

The A la Peche caribou used to migrate annually between the foothills in winter and the mountains in summer. The Little Smoky herd, which lives mainly east of Highway 40, stays in the same general area all year. Because caribou sometimes frequent the Highway 40 corridor, a 365-metre wildlife sanctuary has been declared on both sides of the road.

The southern limit of Canada's caribou herds has been moving north since the early 20th century. This may be a response to the natural climatic warming that has occurred. As caribou habitat disappears in the southern portion of their range, only herds in the north persist. But there's a difference today, including the accelerated pace of climate change; increased numbers of white-tailed deer, elk, and moose sharing the caribou ecosystem; increased wolf populations; and fragmentation of habitat by development. To complicate the issue, research shows that the A la Peche migratory herd used to winter in the foothills, but most of them now spend the entire year in the mountains. The caribou's natural ecosystem is changing, and much research is still needed to understand and hopefully reverse the decline of this northern icon. The caribou is one of many species—including humans—that are challenged by altered and shifting ecosystems as the pace of climate change and land use accelerates.

* Few, if any, members of this herd remain in 2017.

set aside $20,000 towards a cooperative assessment of the impacts of harvesting and silviculture practices on the caribou's winter range. This project used radio-collared caribou and on-ground tracking to gather information on winter habitat distribution, use of fragmented versus unfragmented habitat, and alternate prey distributions. Other model forest and fRI research on habitat, food sources, human activities, and disturbance patterns has also contributed to knowledge about the species.

After a 1998 review of information on caribou in the region found major gaps in the knowledge needed for management decisions, WCACSC initiated a coordinated research effort to address these gaps. In 2000, the model forest was asked to contribute to the initiative, and it agreed to support the research with a modest contribution in lieu of creating its own program. The model forest continued to report the results of the WCACSC research in its annual reports.

After 1995, multi-stakeholder management organizations coordinated with the model forest on wildlife issues, including caribou. A forestry-energy industry group formed under the umbrella of the model forest in 2005; this partnership, known as the Foothills Landscape Management Forum since 2012, has continued under fRI. A new fRI caribou research program began in 2013.

Much of the model forest and fRI research and management activity has concerned the Little Smoky herd of boreal woodland caribou and the A la Peche herd of southern mountain* woodland caribou. Those herds' ranges are within or adjacent to the northwest corner of the FMF land base (fRI no longer has a specific land base). Some of the research is also relevant to the four herds of southern mountain woodland caribou in Jasper National Park. (The last five surviving members of the southern mountain caribou population in Banff National Park were wiped out by an avalanche in 2009.[28]) FMF and fRI research has also dealt with other ranges, including those of the Narraway, Redrock/Prairie Creek, and Chinchaga herds farther to the north in Alberta and along the B.C.-Alberta border.

* The main distinctions between *southern mountain* and *boreal woodland* caribou are habitat (upland versus lowland) and the fact that the mountain populations are more dependent on arboreal lichen as a food source, whereas the boreal populations make greater use of terrestrial lichen and vegetation.

Kirby Smith, an Edson-based biologist with Alberta Fish and Wildlife, led the model forest and fRI caribou research from 1993 until his retirement in 2010; the model forest contributed funding until 2000. His findings became the basis for his University of Alberta master's thesis in 2004.

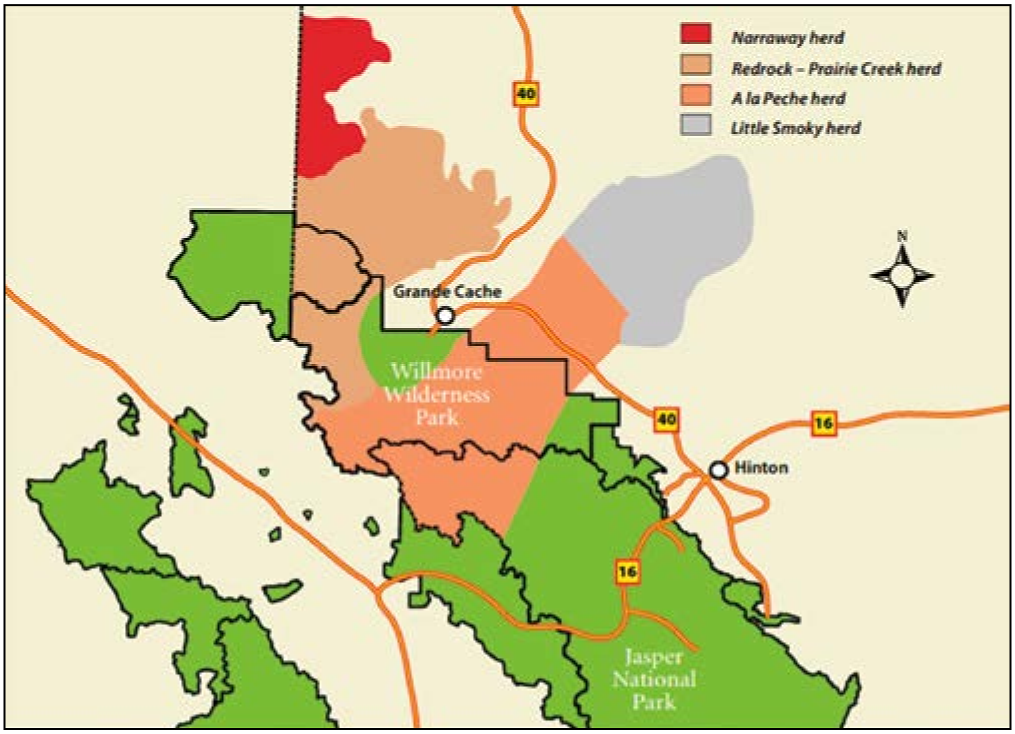
Research by Smith and others showed a confluence of factors affecting the sensitive species. The direct cause of adult mortality was often predation by wolves; other causes included bear predation and vehicle collisions. Wolf populations were increasing due to increased populations of moose, white-tailed deer, and elk, and wolves had greater mobility due to linear disturbances such as roads, pipeline and power line rights-of-way, and seismic cutlines. Use of these features by snowmobiles created "wolf highways," Smith said. In addition, forestry and energy sector activity reduced caribou habitat and food supply. However, caribou populations also declined in national parks in the absence of industrial activity. Jasper National Park officials noted that elk populations increased near townsites and that backcountry skiers and snowshoers created packed travel corridors for wolves.[29] Vehicle collisions have been a factor in both parks and provincial lands. Research at the University of Alberta suggested that climate change could be causing the increased white-tailed deer populations in boreal Alberta.[30] Smith cited milder winters and less snow as yet another factor. "Caribou use snow as a way to keep away from predators," he said.

> "The other aspect of that is what we call apparent competition. We were hanging our hats on food and then realized that caribou were at such low density over such large areas, they were never going to starve to death. I never did catch a caribou that was thin. Even in March, they were all fat as pigs. They weren't going to starve to death, they were just going to get eaten. The apparent competition issue is when you create habitat that favours elk, moose, and deer, there is an increase in predators. Caribou are the easiest mark in the forest. I've been just about run over by a yearling white-tail buck, but I can still grab a full-grown bull caribou and handle it without fear of being charged or anything like that. They're quite docile." –Kirby Smith, interview, 2015

The model forest also joined a cooperative caribou project already underway that involved Alberta Fish and Wildlife, Weldwood, and Weyerhaeuser. This project was located on the Weyerhaeuser FMA area in the Redrock Creek area, and the purpose was to determine caribou distribution and habitat selection on two winter ranges—one that had been altered through timber harvest and one that was undisturbed.

These studies contributed to the development of an HSI model for woodland caribou and were used in subsequent forest management planning by Weldwood, Weyerhaeuser, the Alberta Newsprint Company, and Canadian Forest Products. During the 1997 Cheviot coal mine hearings, the collared caribou research provided insight into management activities that might help conserve the species and its habitat.

In 1994, Ken Kranrod began a lichen study to examine the survival and regeneration of



Map 3-1. Woodland caribou herd ranges in west-central Alberta, 2010, *Northern Rockies Ecotour.*

Woodland caribou. *Courtesy Doug MacNearny*

Rick Bonar displays ground lichen at the Berland River commercial thinning trial, International Model Forest Network tour, 2008.

terrestrial lichen species—important food sources for caribou—in response to various harvesting and silviculture practices. Pre-treatment and post-treatment lichen densities and species composition were included in the study. His work was used for his master's thesis and by Weldwood in planning harvest and silvicultural treatments. The study found that all lichen species initially decreased in abundance following each treatment combination. The greatest reductions in lichen and plant communities were observed following summer logging and stump-side delimbing with scarification, with the smallest reductions in lichen and plant communities observed following winter logging and stump-side delimbing without scarification.[31] Kranrod remeasured his plots about 10 years later and plans to do them again. "Bottom line, the lichens came back over time," Rick Bonar said.[32]

In 1997, the model forest initiated a study on the effects of clear-cutting on the distribution of the A la Peche herd. This herd typically spent summers in Jasper National Park and Willmore Wilderness Park and wintered in forest management areas of Weldwood, Weyerhaeuser, Alberta Newsprint, and Canfor. About 10 percent of the winter range was within the model forest land base. In the following year, the radio-collar program extended to the Little Smoky and Redrock/Prairie Creek herds. Blood sampling and testing for herpes allowed biologists to determine the genetic relationship between herds and the origin of individual herds. The caribou program also worked on the development of a forest inventory that would predict the presence of caribou based on a variety of landscape and habitat criteria.

In 1998, a number of FMA holders along Highway 40 North installed a commercial thinning and research project to examine survival, growth, and regeneration of lichen in pine stands following commercial thinning. This followed a much earlier study coordinated by Paul Woodard at the University of Alberta, which observed that ground lichen regeneration in reforested cutovers was occurring much earlier and in greater amounts than in

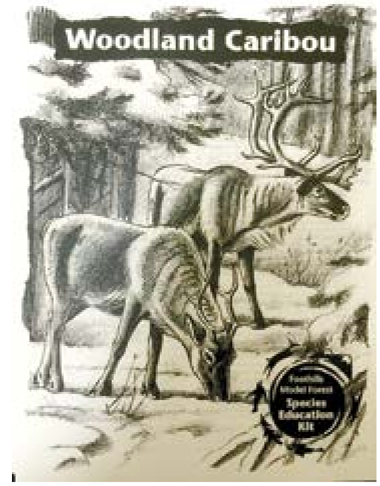
Weldwood's commercial thinning trial just south of the Berland River on Highway 40.

fire-origin stands of the same age. Ground lichens require light, and the more open spacing of regenerated stands appeared to facilitate this regeneration at an earlier stage. University of Alberta biologist Dale Vitt and colleagues remeasured the plots in 2016, and the lichens had definitely increased.[33]

In 2000, the model forest contracted with the Friends of Environmental Education Society of Alberta (FEESA, now known as Inside Education) to produce a teaching aid, the Woodland Caribou EduKit.

In 2000, the FMF was asked to contribute to the research initiative of the West Central Alberta Caribou Standing Committee (WCACSC), and the model forest agreed to support the research with a modest contribution in lieu of creating its own program.

Among the findings in 2000–2001 was that 31 wolves were collared in the Redrock/Prairie Creek and Little Smoky ranges. Packs varied in size, with moose their preferred prey. The A la Peche herd stayed in the mountains for the fourth year in a row. The caribou tended to avoid active roads and, to a lesser degree, inactive roads and streams. They preferred older stands and avoided stands less than 80 years old. During 2002–2003, biologists studied the effects of land use on woodland caribou mortality due to predation, primarily from wolves. A woodland caribou habitat supply map, based on information collected to date, could be used to direct the type and location of industrial activities to complement conservation of this species.



Woodland Caribou EduKit, 2000.

Access management, habitat protection, and linear disturbance were widely recognized by then as caribou conservation issues that involved multiple jurisdictions and industrial land dispositions. However, it was a continuing challenge to integrate plans and resolve the differing priorities of participants. As early as 1992, decision makers in the Yellowhead region, including Jasper National Park and B.C. Parks, began discussing common approaches to ecological issues. The Yellowhead Ecosystem Working Group (YEWG) was established in early 1995 as an adjunct program of the Foothills Model Forest. This group had some success—notably establishment of the Grizzly Bear Program—but lost momentum after 1997, deciding to suspend work until research from the Grizzly Bear Program was sufficiently advanced to suggest some conservation strategies. Many of the same partners were involved after 2000 in developing the *Northern East Slopes Strategy*, published in 2003. The never-implemented strategy proposed sub-regional sustainable landscape plans that would assist in addressing caribou issues.

Parallel and Complementary Initiatives

Highway 40 North Demonstration Project – Caribou Monitoring

Caribou conservation was one of the goals of the Highway 40 Demonstration Project (discussed later in this chapter under Natural Disturbance), planned since 2002 and partially implemented over the following decade. The proposed 70,000-hectare demonstration area north of Hinton included much of the range of the A la Peche herd outside protected areas. Caribou monitoring was a sub-project of the main project. During 2005 and 2006, funds were used to purchase and deploy 12 radio collars. In 2006–2007, seven animals were collared in FMA areas and five were collared in Jasper and Willmore parks. The data were used for collaborative research projects with Jasper National Park and the Alberta Research Council.

Caribou Landscape Management Association (CLMA) – Foothills Landscape Management Forum (FLMF)

Several energy and forest sector companies operating in the Hinton area discussed the concept of developing a caribou management association in November 2004. In May 2005, the concept came to fruition as the Caribou Landscape Management Association (CLMA). Its mandate covered the ranges of the A la Peche and Little Smoky caribou herds. The Foothills Model Forest provided administrative support for the association as a pilot project for integrated land management. The member organizations, 12 industrial and one Aboriginal, would pool resources to:

- Reduce their future ecological footprint on the home ranges of the two herds
- Restore the existing footprint to improve caribou habitat
- Improve funding for caribou monitoring and research
- Work with the Alberta government to recover caribou populations

Initially coordinated by Rick Bonar and subsequently by Wayne Thorp, the CLMA (renamed the Foothills Landscape Management Forum in 2012) is a non-profit partnership under the FMF umbrella, supported by annual dues from the industrial members. Initially, it proposed to develop and promote industrial activities that mitigate the impact on caribou habitat through partnership with the Alberta government, with everyone working within existing resource planning and approval processes.

The model forest GIS Program worked with the association to develop a website displaying maps relating to access and other features. The Little Smoky Caribou Calf Survival Enhancement Project in 2006 was a trial using penning during the calving season to prevent predator access to the vulnerable animals during this critical season. In the summer of 2007, the association undertook a regeneration survey of historic lineal disturbances within the Little Smoky and A la Peche caribou ranges. This project was in support of the recommendations from the provincial government's West Central Caribou Team interim guidelines on anthropogenic footprint recovery. In addition, the association began work on regional access development plans. The CLMA worked with the government's West-Central Alberta Landscape Planning Team process to develop a recovery strategy for six caribou herds, including the A la Peche and Little Smoky herds. As part of this process, the CLMA developed an adaptive management plan.

The CLMA also joined with the Forest Products Association of Canada to commission Golder Associates to perform an audit of industry practices and caribou conservation measures. The audit aimed to evaluate the effectiveness of mitigation measures being employed by the oil and gas and forest industries when operating within woodland caribou ranges in Alberta and across Canada. The final report was delivered in May 2007. Four key messages came out of the audit:

1. Despite having applied a large number of operating practices and mitigation measures (over 70) within woodland caribou ranges over the previous 10 to 15 years, woodland caribou population numbers continued to decline. Blanket prescriptive operating practices were applied on an individual basis, rather than being integrated into an overall landscape or adaptive management plan.
2. Even though operating practices and mitigation measures had been used for a long time and appeared to have provided some benefits, there had been no monitoring to evaluate the effectiveness of these measures in terms of their value for achieving caribou recovery goals.
3. Given the lack of monitoring and the importance of monitoring, the audit was inconclusive when ranking the effectiveness of mitigation and operating practices. As a result, implementation of an adaptive management plan with experimental trials to test mitigation was identified as a next step to be implemented by caribou managers and resource industry managers. The need to monitor the responses of caribou, primary prey, and predators to land management experiments was stressed.
4. Although the ranking of the effectiveness of mitigation and operating practices was inconclusive, it was suggested that with limited time and resources,

> managers should focus the adaptive management plan and experimental trials around those measures rated as being highly effective.

An attempt in 2010 to resurrect the Yellowhead Ecosystem Group was suspended when the Foothills Landscape Management Forum (FLMF) was created in 2012.

> "There are four pieces to integrated land management that need to be managed simultaneously. Industry is responsible for managing the first two—the potential footprint and vegetation—while government is responsible for managing human use and wildlife population." –Wayne Thorp, quoted in the 2009 Foothills Research Institute annual report

Government of Alberta representatives participated in the FLMF in an advisory role on the steering and technical committees. In addition, the executive met regularly with the assistant deputy ministers to update, seek clarification, and provide advice to government on issues such as communications and integrated land management.

At the 2012 Emerald Awards, the FLMF received the Shared Footprints Award for its *Berland Smoky Regional Access Development Plan*. The award citation said the plan exemplified how projects could reduce their ecological footprint. "We are demonstrating that resource extraction can be done in a sustainable way and can be done in a way that looks after other values on the landscape," said Thorp. The *Berland Smoky Plan* drew on work completed since 2005 by FMF and fRI programs, and it incorporated input from government, First Nations, specialists, and industry. In 2015, the FLMF received $500,000 in funding from the provincial government for caribou range planning activities.

Wayne Thorp said the experience leading the FLMF had been instructive:

> "Government tends to make resource allocations in silos and leave it to industry and bureaucrats to figure out land-use conflicts and how to protect significant environmental values. When confronted with overlapping rights and dispositions for a variety of interests, it has become impossible for one sector to meet objectives and adequately accommodate other values. Only the government has the responsibility and authority to look after multiple and overlapping land uses and resolve conflicts.
>
> "The business model of constraining access after the resource is allocated is a serious problem and can no longer be overlooked.
>
> "There is opportunity to meet industry and government objectives, but it will require a change in approach by both …. Strategic alliances and partnerships between government and industry to make the shifts and address the issues will be necessary. Government must re-affirm its role as land manager and provide certainty of access and accountability for overlapping resource allocation decisions, timely dispute resolution including front-end Aboriginal consultation, and a robust monitoring system, including maintenance of a provincial as-built inventory. Government should also provide for incentives to improving industries' footprint management through integration between and within sectors and, for example, how vegetation will be managed over the long term to provide other values (e.g., wildlife habitat, clean water) for the long term." –Wayne Thorp, questionnaire response, 2015

Wayne Thorpe and Rick Bonar with the Shared Footprint Emerald Award, 2012.

Caribou Patrol

The Aseniwuche Winewak Nation (AWN), an Aboriginal community in Grande Cache, voluntarily ceased hunting caribou over 40 years ago. The AWN, with assistance from the Foothills Landscape Management Forum, began road patrols in 2012, primarily to reduce mortality within the A la Peche caribou herd as it crosses Highway 40 between Hinton and Grande Cache each spring and fall. This work continues. The AWN also gathers traditional knowledge about caribou, and the patrollers distribute educational literature about caribou to motorists and community members.

> "Caribou Patrol is a building block for the engagement of Aboriginal people in the region on caribou recovery. AWN has a vision that they would like to turn that program into something much larger, getting involved in other areas such as monitoring, caribou recovery, population management, educating industry and locals, and restoration." –Wayne Thorp, quoted in the 2015–2016 fRI Research annual report

Three versions of a Caribou Patrol EduKit were professionally designed and printed in 2014—one each for students, industry, and the general public. Tourists were also educated through displays at tourist information centres in the area, where more than 2,000 EduKits were distributed. More than 400 EduKits were also taken from billboard-style information signs at the Berland River and Muskeg locations. The great interest from teachers in Hinton, Grande Cache, and Fox Creek resulted in the need for a second printing of 5,000 booklets. A total of 34 presentations were given at seven schools, reaching over 830 students.

The forum continues to provide administrative and geographic information system support for the patrol. The AWN signed a Statement of Intent with the Alberta Minister of the Environment, intended to enhance the Caribou Patrol Program and engage the AWN and Indigenous people in the local community to work with the government in a full spectrum of recovery strategies such as habitat restoration, predator controls, and management initiatives. A multi-year grant reduced fiscal restraints on the Caribou Patrol Program.

Caribou mortality from vehicles along Highway 40 is an ongoing concern, particularly when the caribou are on the move or, as seen here, eating road salt from highway maintenance operations.

Activities of the Caribou Patrol Program include:

- Warning motorists when caribou are likely to be on specific roads
- Collecting data from caribou collars and sightings by the public
- Engaging the public through email, text, phone, website, Twitter, Instagram, and Facebook
- Providing "passports" that can be used to record information about caribou sightings, which can then be passed to the Caribou Patrol
- Providing EduKits to schools, industry, and the public
- Giving presentations at local schools

Caribou Patrol website, fRI Research.

A Dedicated Caribou Research Program, 2012

West Fraser and Weyerhaeuser provided initial funding of about $100,000 in 2012 for a new caribou research program hosted at fRI, which gained subsequent backing from Alberta Fish and Wildlife. To help inform decisions as the program was set up, fRI hosted a workshop January 12–13, 2012. More than 90 participants from the governments of Alberta, British Columbia, and Canada as well as from academia, industry, consultants, and non-government organizations gathered to provide insight on what had happened, what was happening, and what needs to happen in the future. Researchers shared what had been learned in the past and what they were working on, while government and industry partners discussed what they needed to know to support caribou recovery. A list of priorities was developed. The new program would take the results from the workshop and, working with partners, develop projects to assist in testing caribou recovery initiatives as they were implemented.

Laura Finnegan, a biologist who had been doing post-doctoral research in Ontario, was hired in 2013 to lead the new fRI program. The program uses long-term GPS data from collared caribou collected by the provincial government's monitoring and by Weyerhaeuser, as well as its own field data. New research includes assessing vegetation and regeneration on linear features across west-central and northwestern Alberta and assessing the effects of mountain pine beetle and pine beetle management on the food supply for caribou and grizzly bears.

Laura Finnegan, on a moose research project in Ontario, 2009.

> "There's been a huge volume of research on caribou to date. We know a lot about caribou in Alberta, but there is still more to learn. And some of our new research is only possible because of our strong ties with partners and with the Government of Alberta. For example, working with the Government of Alberta and Weyer-

> haeuser, we are using LiDAR to assess animal response to regeneration on seismic lines, for the first time measuring this response across broad geographic areas. We are also working with the University of Calgary and the B.C. Boreal Caribou Health Monitoring Program to carry out the first detailed health and disease assessment for caribou and other ungulates within caribou ranges … collecting baseline data of diseases that might change into the future with climate change or lots more deer or moose.
>
> "As part of this same collaboration, we're also doing a mortality survey for caribou. We're trying to get to the mortality within 24 hours of the caribou dying to figure out what predator actually killed the animal. Also, caribou foods haven't been mapped at a broad scale, either. With our new field data, our pine beetle project will allow us to map lichens across our study area for the first time. Those are the projects that we're focusing on right now—building on all the other research knowledge that's been carried out to date both in west-central and northwest Alberta." –Laura Finnegan, interview, 2015

Finnegan said the linear disturbance work could lead to more successful restoration "from more of a caribou perspective." The research is also trying to identify how caribou respond to different disturbances such as wells being drilled, pumping, inactive, or reclaimed. "Then we have broader-scale projects looking at range shifts in some of these herds in response to anthropogenic disturbance and climate." She noted that LiDAR has greatly reduced the labour requirement for vegetation surveys.

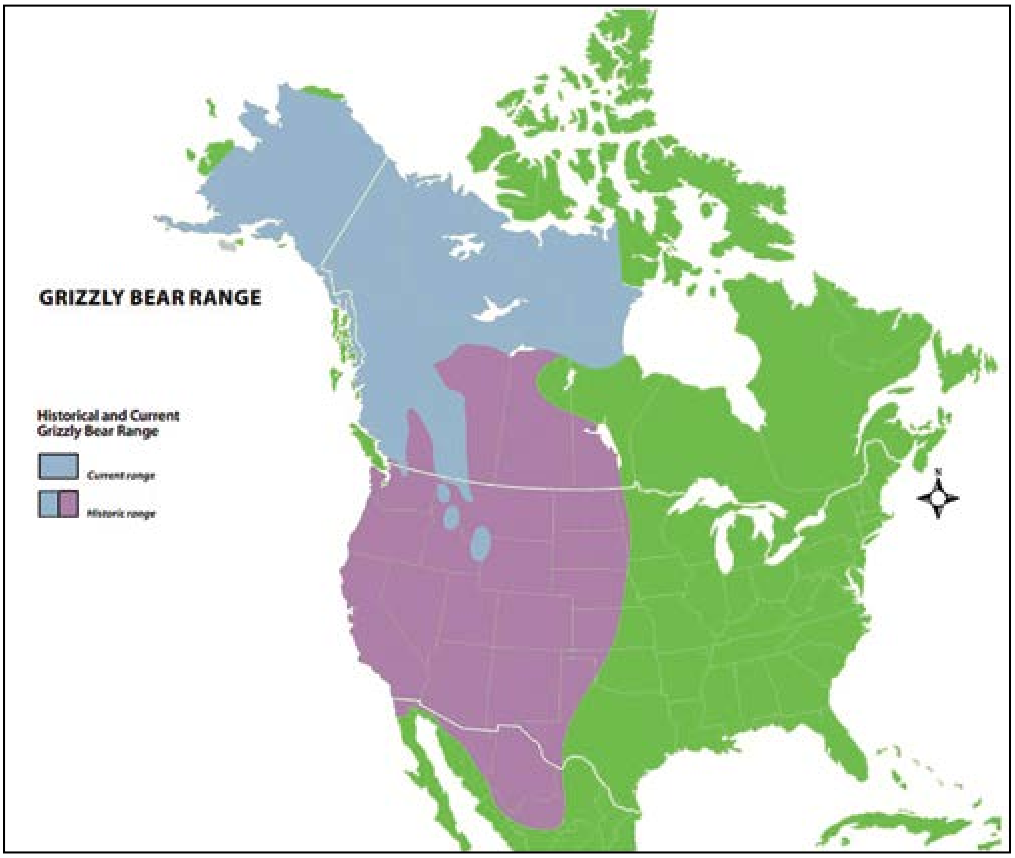
On June 8, 2016, Alberta Environment and Parks released *Alberta's Caribou Action Plan: Leadership for the Recovery of Alberta's Caribou Populations*. In anticipation of the restoration of historical linear disturbances (primarily seismic lines) playing a significant role in caribou action planning, the FLMF and the Government of Alberta partnered to prepare a "netted-down" restoration plan in February 2016. This was completed in June 2016 and used as the basis on which the government prepared its draft range plan for the Little Smoky and A la Peche herds.

Grizzly Bear

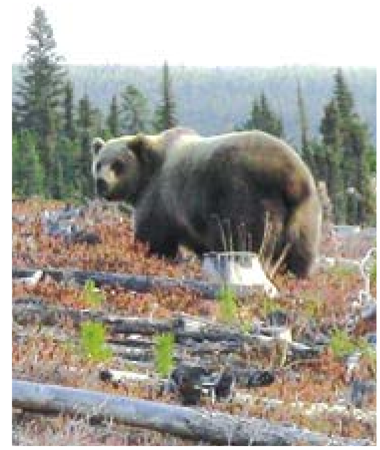
In 1996–1997, during the federal-provincial environmental hearings on the proposed Cheviot coal mine southwest of Hinton, most of the scientific evidence regarding grizzly bears came from research elsewhere—mainly the Bow Valley near Banff and Yellowstone National Park in Montana. The Foothills Model Forest Grizzly Bear Research Project was established shortly thereafter, in part to address the knowledge gaps revealed at the hearings. Since then, the Grizzly Bear Program has produced more than 175 publications—including more than 150 authored or co-authored by program leader Gordon Stenhouse—and at least 34 graduate theses. It has become a world leader in research on the species. This body of knowledge, on topics from genetics and health to behaviour and monitoring, now forms the basis for conservation strategies in Alberta and other jurisdictions.

Grizzly bears are considered to be an "umbrella species"—i.e., a species with large area requirements and general habitat use. By maintaining the habitat and area requirements of an umbrella species, the ecological requirements of many other species, but not all, may also be conserved. The grizzly bear may also act as an indicator of the integrity and health of other ecosystem processes and wildlife populations.

fRI Research conducts one of the largest grizzly bear research programs in the world from Hinton, at the eastern edge of the grizzly's current range, where the bears co-exist on a multi-use landscape. Grizzly bear range is shrinking in many areas in North America, although they have lived here for millennia. An estimated 50,000 grizzlies roamed the United States, not including Alaska, in the early 1800s, but today, only 1,100 to 1,400 remain south of Canada.



Map 3-2. Grizzly bear range in North America—then and now (from *Northern Rockies Ecotour,* 2013).



Sow grizzly in reforested harvest area. Research has shown that grizzly bears, in the absence of poaching, can thrive in a variety of early succession forests such as reforested areas.

The grizzly bear is not listed as an endangered species in Canada, but it is classified as a species of "special concern" under the Species at Risk Act. In 2002, there were an estimated 26,000 in Canada, with the largest population, about 14,000, in British Columbia. In Alaska, there are upwards of 40,000 grizzlies. Human-caused mortality currently accounts for the majority of bear deaths in Alberta, and the fRI program has seen several of its research bears killed by poachers. Responding to the data gathered through model forest research and elsewhere, in 2006, the provincial government halted grizzly bear hunting,* and in 2010, designated grizzlies as "threatened" in Alberta. It is also classified as a species at risk in British Columbia.

By the mid-1990s, the increase in recreational use and natural resource extraction activities within the Yellowhead† region had raised concerns about potential negative effects on grizzly bear populations, including:

- The impacts of harvest and reforestation and access on grizzly bear habitat and its use
- Encroachment of recreation on grizzly habitat; e.g., Jasper's montane valley
- Impacts of the proposed Cheviot mine on bear populations in the area

Yellowhead Ecosystem Working Group

In late 1995, 13 Alberta and British Columbia government and industry representatives, including one from the Foothills Model Forest, formed the Yellowhead Ecosystem Working Group (YEWG). In 1996, this body established the Yellowhead Ecosystem Carnivore Working Group, chaired by Gord Stenhouse, then a wildlife biologist with Weldwood's Hinton operation who had prior experience working with polar bears in the Northwest Territories. Their review, "Status of Carnivores in the Yellowhead Region," noted that that grizzly bear was the carnivore species of greatest management concern within the 6.8 million hectares of the Yellowhead Region.

* The grizzly bear hunt was initially suspended for three years, but the ban has remained in effect.

† The "Yellowhead region" refers to the area around the Yellowhead Highway in west-central Alberta, and as in this instance, the term sometimes includes adjacent areas of British Columbia. The name originated as *Tête Jaune* (French for "yellow head"), apparently referring to the blond hair of Métis Pierre Bostonais, who guided a Hudson's Bay Company expedition through the eponymous B.C.-Alberta pass in 1820.

Following the Cheviot coal mine hearings in early 1997, the Alberta government prepared to implement a draft Framework for the Integrated Conservation of Grizzly Bears in the foothills. This was largely based on U.S. research in Yellowstone National Park, and the province was persuaded by industry to defer it until foothills-specific research could gather regional data to help inform the decision.

YEWG's carnivore group became the Yellowhead Regional Carnivore Management Group, a government-industry body chaired by a representative of Alberta Environment. It prepared a request for proposals from identified grizzly bear specialists for a multi-year, multi-agency, cooperative research program in the model forest area. The overall direction of the program was described as follows:

> "To investigate the cumulative effects of human pressures and the specific impacts of human activities on grizzly bear populations in this region. Primary focus will be to investigate grizzly bear mortality, movements, and resilience to human-caused disturbance, in a cumulative impact framework as these are seen as key elements for future management and conservation efforts for this species. A multi-scale approach is desired which considers a broad regional perspective, but also incorporates a number of smaller study areas within the Yellowhead region. These study areas will be located in such a manner as to ensure that regional variation in both grizzly bear ecology and human use patterns will be considered."

The working group found that within an adaptive management framework, a combination of indirect and direct modelling and monitoring techniques would be necessary. They set forth a number of guiding principles for a project that would ensue for a minimum of five years, starting in 1998. The detailed proposals were required by December 1997.

Establishing the Grizzly Bear Research Program

In response to the request for proposals, four recognized grizzly bear experts formed a consortium and submitted a bear research plan for managers in the Yellowhead ecosystem. Jasper National Park and the Government of Alberta also drafted a working framework document to address grizzly bear conservation in the Yellowhead region. The research plan and the working framework provided the Yellowhead Ecosystem Carnivore Working Group with guidance for project implementation.

The program would be based in the Foothills Model Forest. Grizzly bears require large tracts of land with linkages between seasonally important food sources, and the model forest research area was an appropriate size for this type of research. The program would be expensive, expected to average $500,000 annually, and although fundraising was a challenge, both government and industry were prepared to contribute. With the implementation of this program in the model forest, YEWG suspended its activities.

In 1998, Gord Stenhouse resigned from Weldwood to lead the project. A year later, he was hired by Alberta Environment in a salaried position with the title of Provincial Grizzly Bear Biologist, seconded full-time to the model forest to head up the project.

> "I came home one day and I told my wife, 'Well, I've resigned my position at Weldwood, and I'm taking this one year position with no benefits, no pension.' It was called a wage position, which means you get paid by the hour, and it was for one year. She looked at me in horror and disgust and, yeah, other words came out …. When I looked back and I looked at the many years that I'd worked on bears in the Canadian Arctic, they were some of the most rewarding and fulfilling times that I'd ever had. I said this could work out or not, but I'd like to pursue it.
>
> "I felt it was sort of a blank slate to a large degree in Alberta about bears. A lot of work had gone on in the national parks on bears, mostly done in Banff with

[University of Calgary professor] Steve Herrero. It was an interesting time to try to get not only baseline data, but learn a lot more about how bears are responding to human activities." –Gord Stenhouse, interview, 2015

Barbed-wire hair snares continue to be essential tools in DNA collection. Sarah Milligan, wildlife research biologist and project lead, collecting grizzly bear hair samples, 2014. Malodorous bait nearby attracts the bears, who walk under the wire to get it, leaving samples of their hair on the wire.

Early Years

A 535,200-hectare area south of Hinton was chosen over which grizzly bear movements, population status and trends, and mortality would be tracked over the next five years. Work began in 1999, using leading-edge technologies such as GPS telemetry collars, which had just become available, to monitor the bears' movements. Each year, biologists aimed to capture and collar about 20 bears during the period of May to October, then upload data and map points indicating where each bear had travelled. DNA analysis was also used and was collected by a number of means, including barbed wire, tree rubs, and specially trained dogs sniffing out grizzly bear scat (feces).

The initial partnership included Alberta Environment, Jasper National Park, Weldwood's Hinton Division, the Alberta Conservation Association, Cardinal River Coals, and the U.S. Center for Wildlife Conservation. Stenhouse praised the support the project got from the model forest Board, especially Ross Risvold, mayor of Hinton and Board chair from 1996 to 2001.

Key team members were gathered, including Bernie Goski, who had been capturing grizzly bears for researchers in Alberta since 1972; Marc Cattet, professor at the Western College of Veterinary Medicine in Saskatoon, who provided critical guidance on grizzly bear health, safety, and handling; model forest GIS staff, who helped with data collection and management; Steven Franklin, an expert in remote sensing at the University of Calgary; and Curtis Strobeck of the University of Alberta, who provided expertise on genetics. Biologist Karen Graham joined the program full-time in 2003.

In 1999, 23 bears were successfully captured, tagged, and collared for GPS monitoring. Preliminary findings were presented at the second round of the Cheviot mine hearings in February 2000. The project and its initial results received favourable support from industry, government, and other interest groups. The funding partnership grew, and the project was able to raise approximately $750,000 for the first year of research and $500,000 for year two of the project. It was featured both on television (Discovery Channel) and in print media.

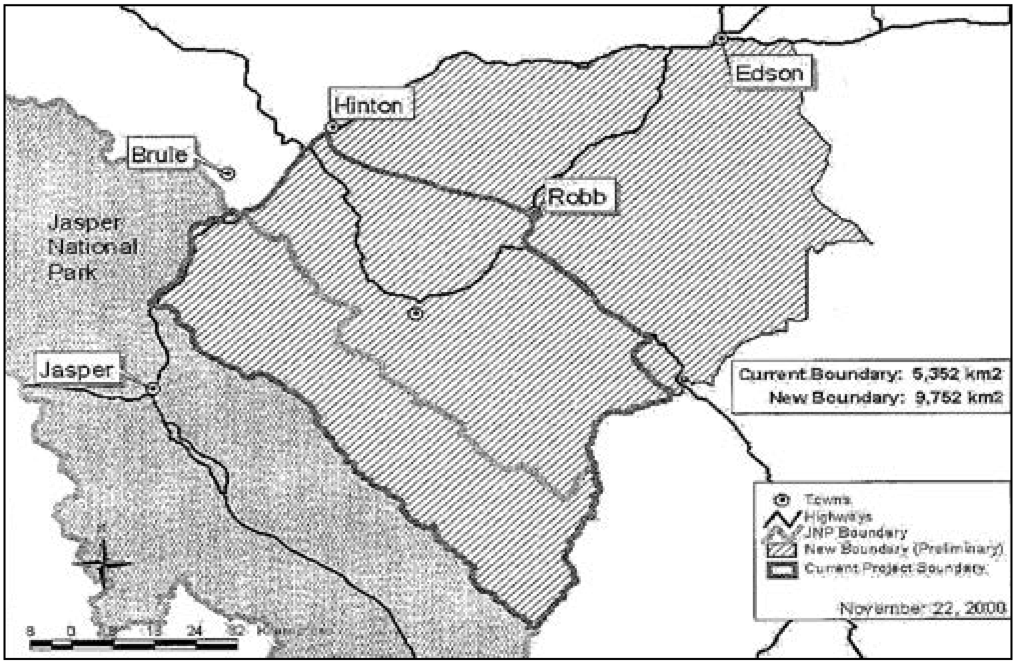
A regional strategy, "Grizzly Bear Conservation in the Yellowhead Ecosystem: A Strategic Framework," was unveiled in 2000 by the Government of Alberta and Parks Canada, reacting to concerns expressed during the Cheviot mine hearings.[34] The cumulative effects of human pressures and the specific impacts of human activities on grizzly bear mortality and movement were selected as focal points for future management and conservation efforts within the region. This gave special impetus to the model forest's research program, as the forestry and energy industries again lobbied the province to defer implementing what was seen as a punitive strategy arising from U.S. research.

In 2000, the research study area was expanded to 970,000 hectares, including a portion of Jasper National Park. The research partnership and scope expanded as more questions required answers.

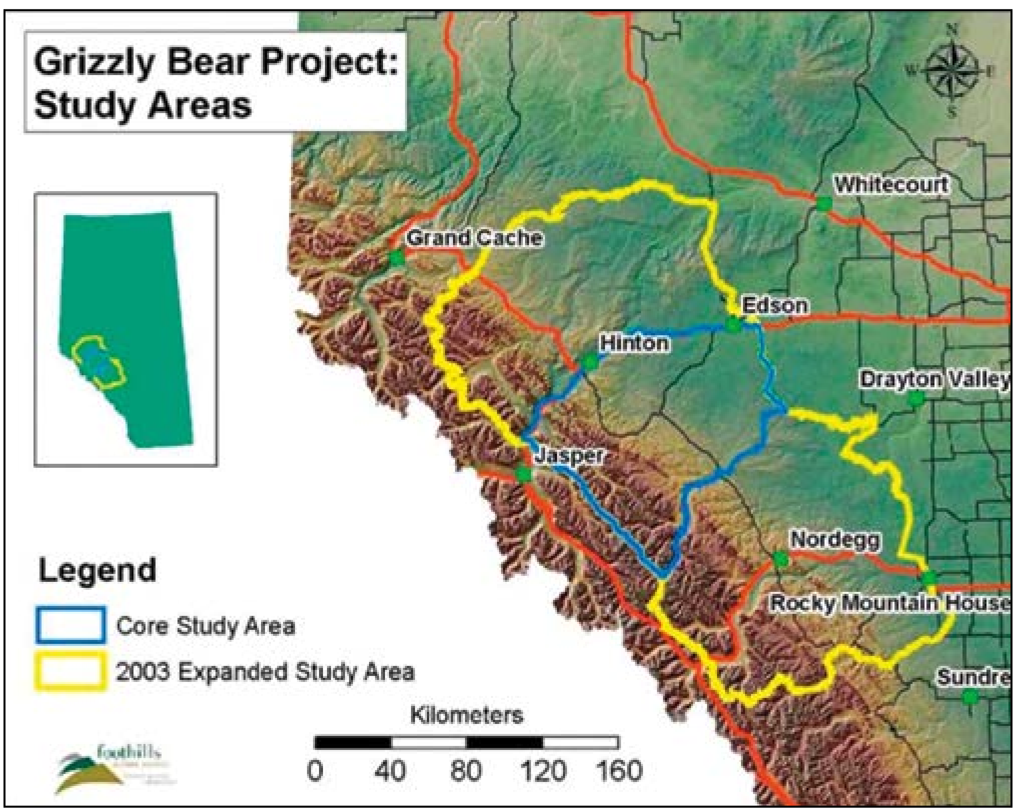
- Data were now available over a three-year period, and bears were exhibiting a great deal of home range fidelity. Bears continued to find mates and successfully mate within the study area. Many radio-collared female bears emerged from their dens with cubs in 2001.
- Collaborators from the University of Washington returned with a field crew and trained scat detection dogs, retrieving approximately 500 samples of bear scat for DNA analysis.
- University of Calgary partners continued developing a grizzly bear habitat map for the expanded study area, and new satellite-imaging techniques were used to

measure and quantify landscape change and links between landscape metrics and bear densities and movements.

- Collaborators at the University of Alberta, led by Professor Scott Nielsen, completed the first set of resource selection function (RSF) models to identify the location of bears within the study area and to determine the variables related to bear habitat use.
- Researchers continued to investigate the possible relationship between road densities and habitat use and response by grizzly bears.



Map 3-3. Grizzly bear research study area, 2000.



Map 3-4. Grizzly bear study area, 2003.

Grizzly exhibit on display at the Jasper-Yellowhead Museum & Archives, 2001.

From July 18 to November 13, 2001, the Foothills Model Forest partnered with Jasper National Park and the Jasper-Yellowhead Museum & Archives to present "A Terrible Beauty," a grizzly bear exhibit at the museum in Jasper seen by about 5,500 people. This exhibit was part of the "Year of the Bear" initiative and won the Jasper National Park Heritage Communications Award. Renamed "Within Growling Distance," the exhibit went on tour in Alberta and other parts of Canada in 2003. Interpretive programs on grizzly bear research were also featured at Whistlers Campground in Jasper during the summer.

The accumulated data, tools, skills, knowledge, and infrastructure of the program continued to grow. In 2001, the Director of Wildlife in Alberta Sustainable Resource Development announced that the Foothills Model Forest Grizzly Bear Research Program would coordinate and lead all grizzly bear research in the province, bringing four more projects under the program.

"The data indicate that grizzly bears continue to use areas that are becoming increasingly industrialized," observed Stenhouse in 2002, after the third year of study. Population densities appeared to be similar to those found in a study 22 years earlier. "The presence of grizzly bears is considered to be a sign of a healthy ecosystem. The assumption is that grizzly bears require a large, undisturbed area to survive. They are believed to be vulnerable to stress and presumably to changes in the ecosystem."

By 2003, the original study area had been expanded from near Grande Cache to south of Rocky Mountain House, approximately 10 million hectares.

Bears at Risk – Poachers Raise the Profile of the Program

On September 20, 2002, the carcasses of Grizzly Bear G20 (locally known as "Mary") and her cubs, popular icons of the model forest Grizzly Bear Research Program, were found near Highway 40, where local residents often travelled to view her and her cubs feeding. They had been killed by poachers. This news made headlines around Alberta, including the February 2003 CBC television documentary, *Who Killed Mary?* In the show, Stenhouse described research findings on roads and bears: "Roads provide access for people who are poachers. They have more opportunity to move into areas previously not gone into before, to look for elk or sheep or grizzly bears." However, Alberta Sustainable Resource Development Minister Mike Cardinal said that limiting road access would be costly, and, "We're used to a certain lifestyle in Alberta."[35]

Grizzly Bear G20, popularly known as Mary, and her cubs were killed by poachers in 2002.
Bob McGouey Photography

Model Forest Social Science Group

In 2002–2003, the model forest Social Science Group began to delve into some issues regarding grizzly bear management. The question to be explored was whether society would be willing to curtail industrial and recreational uses of the forest if it meant maintaining the ecological conditions required for healthy fish and grizzly bear populations.

In 2004, Bonnie McFarlane, senior human dimensions specialist at the Canadian Forest Service, undertook a study to understand public attitudes and opinions on grizzly bear management. Her research found the following:

- Residents of the Foothills Model Forest (residents of Hinton and surrounding communities) and Edmonton had positive views towards grizzly bears but were not well informed about them.
- There was support for making some sacrifices of industrial development and economic opportunities to enhance grizzly bear conservation.
- Jasper residents were better informed, had more positive views of grizzly bears, and were more supportive of reduced industrial activity.
- Opposition to some of the management options appeared to be driven primarily by specific interest groups including hunters, recreational off-road vehicle users, and Foothills Model Forest residents employed in the mining sector.

Broadening the Scope and Applications of Research, 2003–2007

The Government of Alberta declared its intention to apply the results and knowledge from the program to develop a grizzly bear conservation strategy for all of the current range of the species in the province.

It was originally envisaged that 2003 would mark the final year of fieldwork on the project and that 2004 would be a year of report and publication completion to mark the end of the program. The model forest was the acknowledged leader in grizzly bear research and knowledge in Alberta, delivering a number of new models and approaches to resource managers to allow them to integrate grizzly bear habitat needs into land management decisions well beyond the model forest research land base. Using new technologies from a variety of disciplines, and in some cases pioneering that use, the program had accumulated an extremely large and complex grizzly bear dataset, the most extensive in North America.

More than 48 partners were helping fund the program. ConocoPhillips and Petro-Canada used the grizzly habitat maps in road and pipeline planning within the research area, and Weldwood also used the maps for road planning. As the program ended its first five-year phase, the maps developed for the original study area were being considered for expansion to cover the remainder of Alberta. Weldwood requested that the mapping project be expanded to cover the full land bases of the Hinton and Sunpine FMA areas. Other industry partners in the forestry and energy sectors had supported the early development of mapping products, and they also wanted these products prepared for other areas in Alberta where grizzly bears were found.

As demand continued to grow for information on grizzly bear needs and management, the end of the program was postponed.

A new five-year plan for the 2003–2007 period set out to:

1. Complete the current research program (including reporting)
2. Develop technology transfer initiatives and planning assistance for end users of research products
3. Evaluate research products against an independent dataset from the Eastern Slopes Grizzly Bear Research Program*
4. Provide advice to land and resource managers on grizzly bear habitat needs in land management decisions

The research results and models had direct relevance to forest management planning and were already being used to guide management. Grizzly bears were "charismatic" and a high-profile species potentially at risk, so the work was seen as a flagship in forest biodiversity conservation programs. There was a great deal of public interest in reports, models, publications, and mass media products.

The Regional Carnivore Management Group (RCMG) used the program's initial findings to make management recommendations that were then integrated into the provincial *Grizzly Bear Conservation Strategy*, the *Northern East Slopes Integrated Resource Management Strategy*, and forest industry management plans.

Advances in technology played an important role in the program's success. The first-generation GPS collars were "store-on-board" models, and data could only be retrieved when the bear was recaptured or the collar fell off. The next generation of collars could provide radio telemetry at programmed intervals but required an aircraft nearby at the right time to receive the data. These were replaced by collars with two-way communication that could upload data whenever the unit received a signal from an aircraft. The testing of satellite collars began in 2009, and by 2011, they were fully operational, eliminating the need for overflights. The frequency of the collars' location recordings also improved to hourly from once every four hours. The newest version of these collars allows remote two-way communication so that scientists can change the GPS acquisition schedule through satel-

* The Eastern Slopes Grizzly Bear Research Program was led by Professor Stephen Herrero of the University of Calgary. It dealt with the biology, demography, ecology, and management of grizzly bears in and around Banff National Park and Kananaskis Country. The project began in 1994 and issued its final report in 2005.

lite links. Stenhouse recalled that when he started polar bear research in the 1980s, he was happy to get 12 location points during an entire year. The improvements were welcomed by researcher Karen Graham.

> "Back in the day, it was horrible having to circle for 40 minutes above a bear in a little fixed-wing plane doing these data uploads, six or seven in a day. Now, with these satellite collars, I can just log in and say, 'Oh, there's the data. The bear is moving.'" –Karen Graham, interview, 2015

GPS collar uploads combined with other remote-sensing technology demonstrate how grizzly bears use and move around on the landscape over time. In 2003 the GB research team developed camera mounts for GPS collars, as shown here.

The program also pioneered advances in digital camera technology beginning in 2003, adding modified cameras to existing GPS collars and collecting one image per hour to learn more about the foraging habits and movement corridors of the bears. Later improvements included the development of a new multi-sensor camera unit for the collection of detailed data on grizzly bear habitat use and movements and a motion collar that fully integrated a GPS receiver chip, gyros/accelerometers, environmental sensors, pedometer, digital imagery, and communication technologies.

Workshops, Training, and Communications

The Grizzly Bear Research Project began delivery of research products to program partners in 2005, including remote-sensing-based land cover maps and resource selection function (RSF) maps for the areas studied. The intent was to ensure that the knowledge and tools amassed were put to use in making land management decisions related to grizzly bear conservation.

Formal workshops providing new habitat maps and models began in 2005, starting with industrial and governmental organizations that had supported the research during the initial six years. These included Alberta Forest Products Association members, Canadian Association of Petroleum Producers members, and Alberta Sustainable Resource Development staff. These workshops started the process of training for resource and land managers in the interpretation and use of these maps and models in resource development and land management planning.

More models, tools, and GIS applications were added in 2006, but few users had the background knowledge and expertise to understand and apply the research findings and management tools. Practical training for a broader audience was needed, but no precedent could be found in North America, so the program struck a partnership with Calgary-based Enform,* an industrial training organization, to work with the research scientists in the preparation and delivery of a structured two-day training program.

The first training programs took place in spring 2008, with three more held during the year. Subsequent extension and outreach included information forums in Peace River, Edmonton, and Hinton. Enform continues to include bear awareness as part of its online Wildlife Awareness course and certification for field workers.[36]

In addition to training, communication and outreach work continued, with a focus on program presentations aimed at broadening the partner base and explaining research results to a wider cross-section of Canadians. This was achieved by working with various media outlets and fostering key contacts within these organizations.

The program's communications group, formally established in 2009, included representation from the University of Saskatchewan, the University of Calgary, the University of Waterloo, and the Foothills Research Institute. The primary aim of this group was to communicate and disseminate research results and conclusions from the different research teams, including papers and presentations at national and international forums.

* Enform is the oil and gas industry safety and training organization, formerly known as the Petroleum Industry Training Society, or PITS.

Between 15 and 25 bears had been captured and collared each year since 1999, and it was proposed that this continue annually across the entire grizzly bear range in Alberta. The program extended its reach south in 2004, capturing and collaring 23 bears from the Clearwater River to the Montana border. A DNA hair census provided population estimates for a newly defined grizzly bear management area between Highway 16 and Highway 11. Data from this project was used to streamline DNA sampling strategies for future grizzly bear population inventories.

On June 9, 2004, the Foothills Model Forest received the Emerald Award (Research and Innovation category) from the Alberta-based Foundation for Environmental Excellence for its five-year grizzly bear research, which produced grizzly bear habitat maps and movement models for a 10-million-hectare area—an unprecedented scale in wildlife management research.

In November 2004, sponsors of the Grizzly Bear Research Program were invited to one-day workshops that would introduce resource selection function (RSF) models and movement models. An RSF model provides values proportional to the probability of use of a resource unit. By showing the probability of a bear using a particular habitat, the information could be used to forecast the risk of grizzly bear mortality. For instance, the risk of a grizzly bear being killed by humans increased if access was built in good grizzly bear habitat (high RSF value) and decreased in poor grizzly bear habitat. Land and resource managers were beginning to use these tools when developing long-term access plans. This was the program's first step in knowledge and technology transfer, and plans were underway for developing and delivering more formal training (see sidebar).

In 2005–2006, the program's annual spending reached $1.1 million.

The intensive grizzly bear DNA census effort between 2004 and 2007 found fewer grizzly bears in Alberta than previously suggested. The new estimated population of 239 bears south of Highway 16 was a serious cause for concern for both wildlife and forest management.

In 2006, based to a large degree on the program's findings, Alberta halted the spring

Partners in the Grizzly Bear Research Program have access to a large database of tools and information for use in further research and conservation activities. This database was designed by the fRI Research group.

grizzly bear hunt. Stenhouse's position changed from Grizzly Bear Specialist for Alberta to Research Scientist and Grizzly Bear Program Lead for the Foothills Research Institute. The program was one of 17 projects across Alberta selected for an Innovation and Science Grant Award. This grant supported further research into linkages between grizzly bear health and the structure and changes to landscape within grizzly bear home ranges (see health discussion, pages 111-114). The grant also aided the development of advanced remote-sensing maps and models to identify key grizzly bear habitat and to track landscape change.

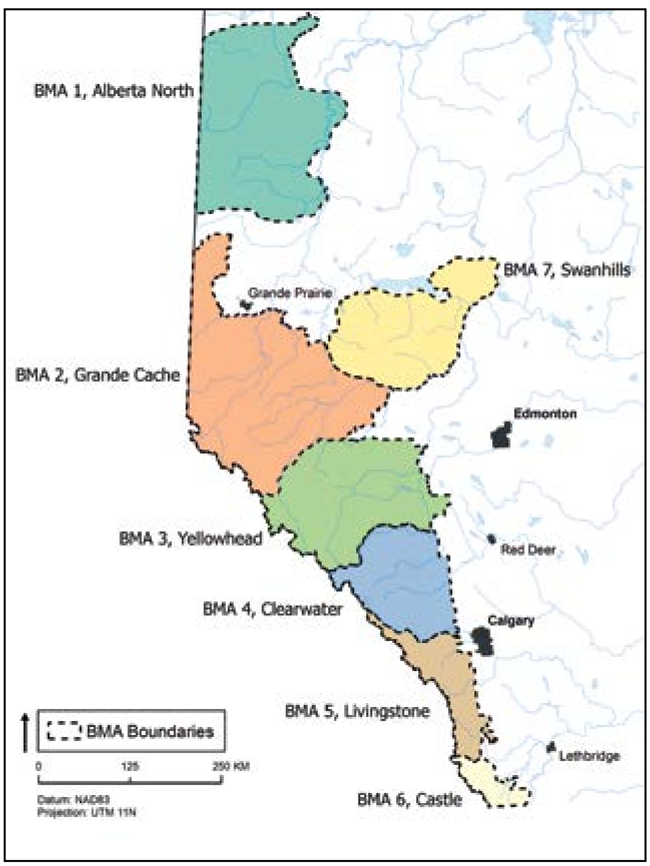
In 2006, Shell Canada and Husky Energy established the Moose Mountain Environmental Enhancement Fund (MMEE) for restoring, enhancing, and protecting the ecology of the Moose Mountain area in Kananaskis. The MMEE funded a model forest pilot grizzly bear habitat enhancement trial in the area. The results showed that abandoned oil and gas facilities within high-value grizzly bear habitat could be reclaimed as resource-rich "safe havens" for grizzly bears by limiting motorized access and cultivating bear foods. The results are applicable to the many thousands of well sites and kilometres of pipeline in Alberta that are no longer in production and require reclamation certificates. This concept was later incorporated into guidelines under the 2008 Alberta Grizzly Bear Recovery Plan.

A Major Milestone, Expanded Scope, and New Products, 2007–2012

By 2007, there were 14 senior scientists from across Canada working with the program, and it had more than 50 funding partners. New planning tools were available for use by forest and land managers.

The program continued its core mandate to complete the mapping and modelling of grizzly bear habitat in Alberta, moving into northwestern Alberta. It was soon clear that bear densities were lower in the north. Fewer bears were captured, limiting the information available to generate the tools and models developed in other parts of the province. The research team, having pursued other areas of study over the previous four years, rose to the challenge with modifications using new technologies, and met their planned objectives on the original schedule.

New habitat maps were prepared, along with other information such as mortality risk, safe harbour areas, and grizzly bear movement corridors for the 22.8 million hectares of grizzly range in Alberta. These final products and updates, along with GIS applications, would give program partners an understanding of current conditions for grizzly bears and also allow the evaluation of land-use activities on current and future landscape conditions on grizzly bears. This had never been attempted or accomplished for any jurisdiction in North America where grizzly bears exist.



Map 3-5 Grizzly bear range in Alberta, bear management area (BMA) map, 2014.

"It took us 10 years, and we built the first seamless grizzly bear habitat map for the province of Alberta. To me, that is still a huge accomplishment. The map, although we use it for bears, has been used for many other things. It's been a base map for many other projects at universities and within parks. They've used it with caribou work. It's a map for more than just bears. It's an important base map." –Gord Stenhouse, interview, 2015

On April 30, 2007, the Foothills Model Forest was awarded the first-ever Syncrude Award for Excellence in Sustainable Development at the Canadian Institute of Mining, Metallurgy and Petroleum's (CIM) annual conference in Montreal. The award recognized the model forest and its Grizzly Bear Research Program for providing resource managers with the necessary knowledge and planning tools to ensure the long-term conservation of grizzly bears in Alberta. Also in 2007, the Canadian Remote Sensing Society Gold Medal was presented to Dr. Steve Franklin for his work on the Grizzly Bear Program.

Alberta Sustainable Resource Development asked the research team in 2007 to assist them in learning more about grizzly bear response to mountain pine beetle outbreaks and management actions (see discussion following).

Another new 2007 project was set up to examine the possible relationships between grizzly bear denning behaviour and environmental (weather) parameters using new data and the datasets from 1999 to 2007. This work continued until 2011, contributing new and important information about possible impacts of climate change and grizzly bear ecology. This work also had linkages to the fRI Mountain Pine Beetle Ecology Program.

International Collaboration

In 2007, the research team was contacted by the Scandinavian Brown Bear Research Program in Norway and Sweden regarding possible research collaboration. Like North American grizzly bears, European brown bears are a subspecies of *Ursus arctos*. Following the 2008 Global International Model Forest Network (IMFN) Forum in Hinton, fRI signed a memorandum of understanding with the University of Norway for collaborative studies on brown bear conservation in Scandinavia, including factors such as health, genetics, habitat, and behaviour. Funding for the project came from a 2007 Alberta Forestry Research Institute (AFRI) grant of $1.5 million to fRI in support of national and international linkages. The grant provided $320,000 to the Circumboreal Initiative, which included the Brown Bear Project as well as a major report, *The Future of Alberta's Forests: Impacts of Climate and Landscape Change on Forest Resources.*[37]

Scientific collaboration began in March 2009 with a two-day workshop in Edmonton. "We have techniques, procedures, and expertise that they don't have in Scandinavia, for instance, in monitoring bear health, while they have strong data on how their bear population has recovered over time," Stenhouse said. The interests chosen included comparison of the health results of their long-term study with fRI's data over a shorter time period, along with the climate change impacts on this boreal forest species, and comparisons of how forestry practices in the countries were impacting bear habitat use and selection. One difference was that Swedish bear females were smaller and often had triplets. On a research trip there, Stenhouse learned why that could be occurring.

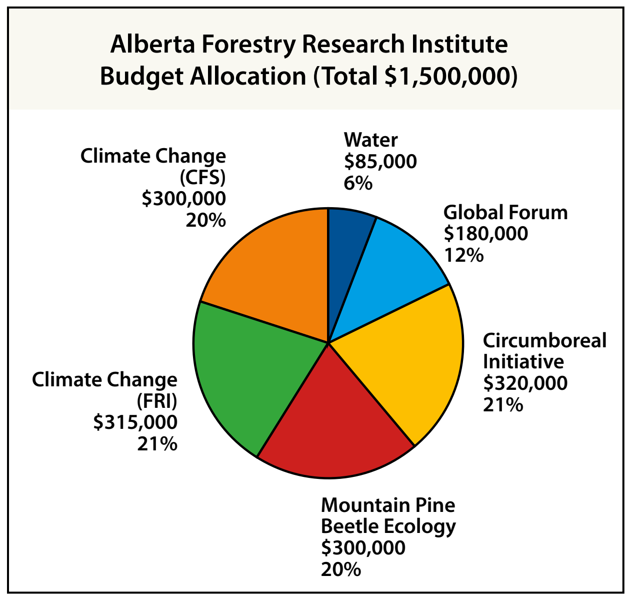


Figure 3-3. AFRI grant to the Foothills Model Forest.

> "My epiphany came when I was working on this bear. There are cubs everywhere. I looked down on my pants, and the knees on my pants were just red. I thought, 'Uh-oh,' because we were taking blood samples. It was berries. I look around and, of course, their landscape is like a park. They've done selective logging, using specialised equipment. They go in and take single trees out, there's lots of light coming in, and there are berries everywhere. The bears have benefited hugely from that food resource from forestry. That's related to the productivity. That's why they have 3,500 bears. Forestry has generated a landscape that would help support that resource. Now, I come back to Alberta, and I think forestry is the way forward to help recover bears in this province, as I see it. If we can deal with human-caused mortality, which is poaching, forestry has the ability to recover bears in this province." –Gord Stenhouse, interview, 2015

Another reason for the robust population was strict enforcement. "You shoot a bear in Sweden, you go to jail for two years, automatic," Stenhouse said.

Gord Stenhouse and NHL Hockey Hall of Fame member Mats Sundin with sedated brown bear cubs, Brown Bear Project, 2009. Swedish star Mats Sundin retired from NHL hockey in 2009, returning to his native Sweden.

Population Inventories and a New Grizzly Bear Recovery Plan

In 2007, the Grizzly Bear Program worked with the Government of Alberta on an assessment of the grizzly bear population occurring south of Highway 3 to the Montana border, including portions of British Columbia where data indicated a shared population. These results were also used within the ongoing program to evaluate new maps and model output. The following year, the researchers worked on another grizzly bear population survey in the landscape between Highway 16 and Grande Prairie. This census used DNA analysis of hair caught in snags. It was a new research project as the approach was based on new research analysis and prediction techniques.

Alberta unveiled a new grizzly bear recovery plan in March 2008,[38] prepared by the Alberta Grizzly Bear Recovery Team, co-chaired by Gord Stenhouse and Lisa Wilkinson of the Alberta Fish and Wildlife Division. The plan noted the need for a census of bears by bear management areas and an expanded research program, particularly in the areas used by both humans and grizzlies, as human-caused mortality was a key factor in grizzly bear numbers. Illegal hunting was estimated to account for between 16 and 25 percent of all grizzly bear deaths. Elements of the plan included suspension of sport hunting grizzly bears and developing motorized access management strategies in important grizzly bear habitats. Alberta Sustainable Resource Development asked the fRI Grizzly Bear Program to serve as the key science group in assisting the government with the implementation of grizzly bear recovery actions in Alberta.

At the International Model Forest Forum in 2008, Minister Ted Morton, with MLA Robin Campbell, presented General Manager Tom Archibald and President Jim LeLacheur of Foothills Model Forest with a $733,000 cheque for the grizzly bear population study.

Stenhouse said a "significant turning point" came shortly thereafter when Doug Sklar, assistant deputy minister of Sustainable Resource Development, told an industry meeting that incorporating the grizzly bear research findings would henceforth be a requirement for approval of their management plans.

Accomplishments to 2008

By 2008, the fRI program could report on a wide range of research, tools, and models used to assist with the goal of sustainable management and long-term conservation of grizzly bears. These included:

- A satellite image classification and landscape classification protocol for large areas and the ability to standardize products with multiple temporal scales
- Remote-sensing tools to map and identify grizzly bear habitats and human-use features at the landscape level
- The use of resource selection function (RSF) models to predict the probability of grizzly bear occurrence at the landscape level, including new models to indicate areas of mortality risk and "safe harbours" for grizzly bears
- New GIS applications to assess grizzly bear response to forest harvesting, regeneration, and access development
- New provincial scale maps identifying landscapes with high, medium, and low

probability of occurrence for grizzly bears; new research results (DNA provincial grizzly bear population census work in 2004, 2005, and 2006) showed that these new maps correlated well with actual bear occurrence on the landscape
- The use of graph theory models to identify grizzly bear movement corridors at both the home range (watershed) and landscape level; these models also identify where current landscape conditions may make it more difficult for the bears to move between important habitat patches
- A detailed understanding of grizzly bear habitat use in relation to current forest management practices and landscape conditions along the Eastern Slopes in Alberta

A multi-disciplinary team of researchers from the Foothills Research Institute, the University of Alberta, University of Calgary, University of Saskatchewan, and Wilfrid Laurier University had developed these tools and models, which had been tested and validated over a 19-million-hectare study area along the Eastern Slopes of Alberta from the area south of Grande Prairie to the Montana border. The results of this program were being used to assist the government with the identification and delineation of Grizzly Bear Priority Areas along the Eastern Slopes. The research project had met all of its annual program deliverables since 1999.

New Projects, 2009–2011

In 2009, the team began to study the "energy budget" of grizzly bears—i.e., the energetics involved with food, habitat use, and movement. Energy budget models would make it possible to forecast the landscape's carrying capacity for grizzly bears, considered critical information for setting recovery population targets. Grizzly bear foods were collected and analyzed seasonally in selected management units to determine the amount of energy they contained and therefore the total amount of energy available on the landscape by bear management area and season. The average amount of energy required by a grizzly bear on a seasonal and yearly basis was established using the project's GPS dataset on grizzly bear movements in each bear management area, along with information from the literature on the expenditure of energy by grizzly bears during various activities. Using food models and the energy budget, it was then possible to determine the impact various landscape changes could have on grizzly bear carrying capacity.

A related PhD project examined bear food phenology* in relation to elevation and temperature and how spatially explicit bear food phenophase maps could be developed with satellite imagery. A draft of the nutritional landscapes and carrying capacity was produced in 2012.

* Phenology is the study of biological world timing as plants and animals take their cues from local climate factors such as temperature, precipitation, and available sunlight. Predictable yearly changes in climate determine when species start natural events such as breeding or flowering.

Work also began in 2009 on an innovative project using new remote-sensing technology and procedures to document human use of the landscape over large areas. The project produced a series of monthly maps identifying current land-use activities and highlighting changes linked with GPS bear data. The team also completed retroactive annual landscape condition maps for the time period 2004–2009 to link with grizzly bear movement and health data for the Kakwa River area northwest of Grande Cache.

In 2010, the Grizzly Bears and Park Users Project looked at the effects of humans on grizzly bear activity, movement, and behaviour in an area located at the interface between the foothills and the Eastern Slopes of the Rocky Mountains in Alberta. The 1-million-hectare area was centred on the Cheviot, Luscar, and Gregg River open-pit coal mines and the hamlets of Cadomin and Robb, south of Hinton. Information on human use, gathered through field cameras, was merged with bear activity to better understand how creating access for humans affected grizzly bears and what could be done to manage access in such a way that effects were mitigated. The project produced a dataset and map products and led to a graduate thesis predicting recreation use on trails around the Teck coal mine.

> "In a tangible sense, a lot of good work has been done in the Natural Disturbance and Grizzly Bear Programs that has produced data at a scale appropriate to the issues. Managing issues related to grizzly bear and natural disturbance is best achieved on a larger, multi-jurisdictional scale, and the Foothills Research Institute gives us that forum, as well as providing impartial, research-based advice." – Steve Otway, resource conservation manager, Jasper National Park, quoted in the 2010–2011 Foothills Research Institute annual report

In 2011, the program began a two-year study of grizzly bear response to oil and gas activity in the Kakwa area to help the energy sector better assess, manage, and mitigate its effects on grizzly bears in Alberta. The results also helped to evaluate cumulative effects assessment models. Also in 2011, Alberta Innovates approved the Climate Change Forest Productivity Project, a collaboration of fRI's Grizzly Bear, Mountain Pine Beetle Ecology, and Water Programs.

Keynote Studies, Collaborations, and Technological Advances

Grizzly Bear Health

In parallel to the management-related research, the program amassed a wealth of knowledge about the health of grizzly bears, including their physiological responses to stress, handling, and environmental change.

Since 1999, researchers had been assessing and monitoring the health of individual grizzly bears as part of standard handling and processing protocols with study animals. The approach used a combination of measures, including physiological function (heart and respiratory rates, body temperature), body condition, and a broad array of blood analyses. Findings from this grizzly bear health dataset appeared to have potentially serious implications for the long-term survival of grizzly bears in portions of their range. These findings and their relationships were not perfectly clear but gave cause for concern for wildlife managers and conservation biologists.

A collaborative project began in 2005 among the University of Saskatchewan, the University of Calgary, the Foothills Model Forest, and industry partners to monitor and track landscape change over time and determine whether grizzly bear health could be linked to environmental conditions. It was supported by partner funding, an existing grant with Alberta Innovation and Science, and a Collaborative Research and Development (CRD) grant from the Natural Sciences and Engineering Research Council of Canada (NSERC).

This research developed new techniques and technologies to assess grizzly bear response to changing landscape conditions and human use on a shared landscape. Research team members from the University of Waterloo and the University of Saskatchewan examined measures of chronic stress in both blood and tissue samples in relation to environmental conditions as model forest GIS maps and datasets.

The examined environmental and landscape variables included:

- Road densities
- Levels of road use (motorized/non-motorized; high, medium, and low)
- Resource selection function (RSF) models and grizzly bear food models (habitat quality)
- Degree of landscape fragmentation
- Forest seral stages within the home range
- Levels of human activity (mining, oil and gas development, etc.)
- Annual landscape change

Spanning eight years, the project developed the most comprehensive grizzly bear dataset in Canada. It developed new tools such as biopsy darting for collecting samples from

Opposite page: Researcher Terry Larson and an assistant record health measures from a sedated grizzly. The blindfold is to protect the bear's eyes from drying out while sedated.

grizzly bears. Samples were gathered from each population unit in the province. Researchers linked grizzly bear health status and long-term stress levels with landscape condition maps. This understanding improves predictions of future trends and population status for the species as landscapes continue to change and human use of these landscapes evolves, and it forms a critical component of future habitat stewardship and conservation efforts. The completion of this project provided government agencies and resource managers with a clear measure of the health of this important species while also ensuring wise management decisions for their long-term conservation.

Stenhouse noted the huge variability in grizzly bears' individual behaviours. For example, "there are specific bears that are meat eaters—they hunt, they take down sheep and elk and moose and calves all the time," he said. "There are other bears living in the same environment with those same elk and sheep and moose around that eat 90 percent vegetation. The individual behaviour is quite important. Mothers teach their cubs how to find food and what to eat."

The program also addressed the effects of capture and handling on bears' health, and one key finding dealt with the effects of snaring. An important, if somewhat controversial, paper examined the long-term effects of the captured handling on bears.[39]

> "The more times you capture, handle a bear, the more impact you can have, especially the use of snares. A snare is basically a wire or cable that snaps onto a bear's wrist and traps him when he steps on it. That technique is still used by some people, but we showed that it has rather major consequences to a bear.
>
> "All bears are individuals, with lots of individual behaviour, somewhat like dogs. You've probably seen some dogs that, when first chained up, will go to the end of the chain, pull once, and then just lie down. Other dogs will bark and pull and carry on every time. It's the same with a bear. A 600-pound bear hitting the end of a cable at full run can cause severe damage to himself. It's also very dangerous for people working on bears, because you never know whether the bear is caught by one toe, and they can inflict serious damage as an animal in panic mode. Bears can also chew off their toes. We have, through our program, built on what we learned, tried to improve all the time, and come up with new techniques to minimize impacts to the animals.
>
> "We found that the length of time the animal is held has a really important impact on the health and long-term viability of that bear. In the old days, you would check your snares once a day, so a bear could be trapped for up to 23 hours. We stopped all use of snares in 2010, and all our captures now are either helicopter darting in open habitats in the mountains and cutblocks, or the use of culvert traps. In a culvert trap, the bear is contained and less likely to damage itself by fighting a cable. To help minimize the time trapped even more, Bernie Goski found a company that built us a satellite trap alarm that we use to this day. An alarm comes to a satellite phone when the door on the culvert trap falls, and we can get to a snare site within 20 minutes to half an hour." –Gord Stenhouse, interview, 2015

A culvert trap used in bear capture.

Stenhouse, who is also an adjunct professor at the Western College of Veterinary Medicine at the University of Saskatchewan, said the program benefited from advances in drugs used to tranquilize bears for handling. "We can now actually process a bear and give it a reversal, and it can be up within 10 to 15 minutes walking away. In the old days, you could have a bear that would lie there for seven or eight hours just trying to recover from the

drug." He noted that after capture and tranquilizing, the bears undergo a series of procedures to protect their welfare while researchers gather scientific data, attach collars, and insert microchips. The same procedure and protocols are widely used around the world.

> "When we're sure the bear is stable, we get to work. We measure its pulse, respiration, oxygen saturation, temperature—all those things. We put in eye drops and put on a blindfold because when a bear is immobilized, they can't blink and their eyes can dry out. We put on the collar, we weigh and measure the bear. We get blood and tissue samples for health parameters, including measures of stress. We also take hair samples for stress measures and for DNA. We pull a small premolar tooth to age the bears, just like counting rings in a tree. The premolar is called a milk tooth, right behind the major canine, and the bears don't use it anymore. We also put in a microchip for animal identification, just like pets have. It's inserted subcutaneously just behind the main part of the nose, then sealed up with crazy glue. Those microchips have been useful over the years to identify bears that have been found shot illegally. If you're a poacher, you can't see that the animal has any markings on it.
>
> "We use some different and newer equipment. For example, we have oxygen tanks so that if a bear's oxygen saturation goes a bit low, we can give it oxygen through a nasal canal using a tube up its nose. We also use something called a vital sense monitor, a pill about the size of a large vitamin pill that we insert rectally. It measures body core temperature through a wi-fi connection. It's called a deep core temperature, and the bear just poops it out when they leave. There are all sorts of advances in techniques and technology that have gone along with making sure that these animals are treated properly." –Gord Stenhouse, interview, 2015

Geographic Information System

The model forest GIS role in the Grizzly Bear Program started out as a technical support effort, but the scope and scale of the research soon required a dedicated GIS analyst. The GIS team continues to create and develop new tools that allow users to automatically calculate measures such as the effect of planned harvest activities on current resource selection function (RSF) values; a comparison of road placement options relative to grizzly bear RSF values; RSF scores over time as forest regeneration occurs; and how grizzly bear mortality risk may change as a function of access construction on the landscape. Other products include:

1. On a watershed basis, analysis of RSF ranking, security (safe harbour) status, and levels of risk in relation to DNA results
2. Delineation of two general conservation areas on the basis of RSF, road densities, risk, and safe harbour areas
3. Review of RSF values at a population level in comparison to provincial data
4. Analysis of temperature data, denning, links to habitat selection, and camera collar data
5. Putting into operation graph theory output to produce the characteristics of the landscape where key travel routes occur
6. Creating and maintaining environmental condition datasets for the health research group study of environmental factors relating to bear health
7. Comparative analysis of grizzly bear use of second-pass cutblocks with first-pass blocks to determine selection rates related to stand age and forest structure
8. Spatial modelling of grizzly bear movements, including known bear paths and

travel routes with landscape variables to create predictive models of primary movement corridors
9. Modification of existing models to predict RSF habitat in multiple 10-year increments, allowing the user to factor in long-term development plans (e.g., second-pass blocks)
10. Environmental change analysis; i.e., assessing the effects of changing landscape conditions on grizzly bear health indices

Mountain Pine Beetle and Grizzly Bears

In response to a request from the Government of Alberta, the Grizzly Bear Program began a new project in 2007 to better understand grizzly bear response to mountain pine beetle (MPB) outbreaks and management responses such as salvage harvests and prescribed burning. The project received funding support from the Forest Resource Improvement Association of Alberta and Alberta Sustainable Resource Development.

Grizzly bear response to mountain pine beetles and associated management actions was poorly understood, as no research or monitoring of these relationships had been done in either Alberta or British Columbia. Yet understanding the possible response and impacts of any new management strategy on this important indicator species would be a key component of sound sustainable forest management practices.

This project relied heavily on innovative technology developed by the program's remote-sensing team. The research plan required the development of map products, models, and software packages enabling the prediction of the impacts of MPB activities on grizzly bear populations and habitat use forward through time. The team also focused efforts on the production of annual landscape condition maps to coincide with grizzly bear GPS location data.

The project's study area was the Weyerhaeuser Grande Prairie FMA area and adjacent Willmore Wilderness Park. The methodology included:

- Development of a new spatially explicit model using existing data and knowledge to predict how MPB emergency harvest plans might impact grizzly bear habitat use and movements, and then collection of additional data to validate or modify it.
- Development, using remote-sensing specialists, of an operational plan to map and monitor mountain pine beetle activity and forest harvesting operations in selected FMA areas and bear management areas. This was done at a variety of scales, and monitoring would continue annually with the MPB activity and harvesting operations.
- Attempts to capture and collar at least five to seven adult grizzly bears in the bear management area to collect detailed bear response data to link with landscape change information and detailed MPB activity.
- Installing a camera system on all GPS collars to gather more detailed habitat use information and assist with understanding bear response to harvesting strategies.
- Development of a new GIS-based predictive model for testing and evaluation, using grizzly bear response data collected from MPB areas.

An interim report was presented in early 2008, and the program continued for a second year in the Kakwa area between Grande Cache and Grande Prairie. At the time, there were 10 GPS-collared grizzly bears providing data on habitat use and movements in the MPB study area. The goal was to maintain 10 active collars each season. Since some would be removed by bears during denning or fall off bears the following season, the capture of an additional five to seven bears was planned for 2008 to maintain the sample of 10 bears for collecting data. New camera/sensor systems were attached to each collared bear to gather more detail on grizzly bear movement paths between GPS locations, as well as habitat use and feeding information data.

In 2009, the program looked at the impact of accelerated forest harvesting plans as they would affect future habitat conditions for grizzly bears, and it documented current use of different-age pine stands by grizzly bears for food and cover. It continued data collection from radio-collared bears in the Kakwa study area.

The 2010, the fRI annual report noted that research efforts in the Kakwa study area were concluding for projects looking at grizzly bear response to mountain pine beetle and how environmental conditions relating to climatic factors were influencing grizzly bear denning behaviour and habitat selection in the non-denning period. Data collection continued in this study area as researchers tried to understand how oil and gas activity might influence grizzly bears that share the landscape. The project wrapped up in 2011, one year ahead of schedule, due to funding shortages.

Collaboration and Accomplishments

While conducting its own research, the Grizzly Bear Program also cooperated with other researchers external to the institute, as well as conducting grizzly bear census activities for the Government of Alberta.

- **Caribou-Wolf Predation Study**: University of Montana, University of Calgary, and Jasper National Park. Areas of collaboration included remote-sensing map production, data uploads from collared animals, linkages with field crews for vegetation sampling and predation investigation, animal health measures, and landscape change analysis.
- **Grizzly Bear Health Comparisons**: Working with veterinarians at the Calgary Zoo, biological samples on captive zoo grizzly bears were compared and contrasted with similar samples taken from free-ranging grizzlies. Bears in the Calgary Zoo were given health inspections every two years. This work was done in conjunction with the program veterinarian, based at the new Faculty of Veterinary Medicine at the University of Calgary.
- **Polar Bear Health Status**: In conjunction with research scientists with the Canadian Wildlife Service and the Ontario Ministry of Natural Resources, the research team analyzed biological samples taken from polar bears to evaluate long-term stress levels in different arctic populations of polar bears.

Recognitions and Progress, 2012–2017

Gord Stenhouse received the 2012 J. Dewey Soper Award from the Alberta Society of Professional Biologists, the society's most prestigious award. In 2014, *Alberta Venture* magazine named the program leader one of Alberta's "50 most influential people" for his steadfast dedication to grizzly bear conservation. He subsequently received the 2015–2016 Tree of Life Award from the Rocky Mountain Section of the Canadian Institute of Forestry for significant contributions to sustainable forest resource management. Stenhouse has also served, and continues to serve, as a member of the executive council of the International Association for Bear Research and Management.[40]

In 2014, the program began a new DNA-based inventory for grizzly bear population estimates, drawing upon the extensive DNA datasets obtained during the 2004–2008 grizzly bear population inventories and built on the knowledge gained during these analyses. As part of this work, in 2014, the program undertook the first grizzly bear count in the area of Jasper National Park south of Highway 16. There had not been sufficient funds to address this area during the previous bear count for the Yellowhead region in 2004. The count involved DNA analysis from 40 to 50 rub sites and about 75 lure sites, with each site visited four times for sample collection.[41]

In October 2015, the results from the Jasper count were included in the new census for Bear Management Area 3 (BMA 3), between Highways 11 and 16. The researchers identified 108 bears—16 in White Goat Wilderness, 29 in Jasper National Park south of Highway 16, and 63 elsewhere in the unit. Based on the program's analysis, the estimated total population in the unit was 139 bears. In the provincially controlled part of BMA 3, including extensive areas under active forest management, the estimated population had nearly doubled since 2004, from 36 bears to 75. However, 38 percent of this increase was possibly attributed to "problem bears" relocated from other areas of the province.

Despite extensive education programs, poaching remains the number one cause of grizzly bear deaths in Alberta. Stenhouse noted that five grizzly bears were killed by humans in the Yellowhead bear management area in 2015, and only one involved self-defence.

> "We might know a lot more scientifically, but the negative thing of poaching still occurs.
>
> "There was a bear that was shot this year (2015). There was a sheep hunter that was knocked down and bitten by a bear. He had left his meat out on a mountainside. He went back to retrieve it, and, of course, the bear had decided it was her carcass, not his. The bear also had a cub of the year. The bear was G23, one of my research bears. It didn't have a collar at the time, but we had followed it for many years and knew lots about it. When the rescue party went up to get to this guy, the bear came running out again, defending not only its cub, but probably the meat, too, at some level. Remember, fall is really important for bears. If they don't get fat, they don't have cubs, or keep them. This bear that was killed, she was 26 years old—a 26-year-old female, still having cubs. Do you know where she lived? All around Cadomin, the mine, she came up to the Gregg River Road.
>
> "If you look back on the history, this whole project started about learning about bears and mining and land-use activities. This bear had shown us for many years that she could live in and around this landscape. What ended her life was a human situation that probably shouldn't have occurred." –Gord Stenhouse, interview, 2015

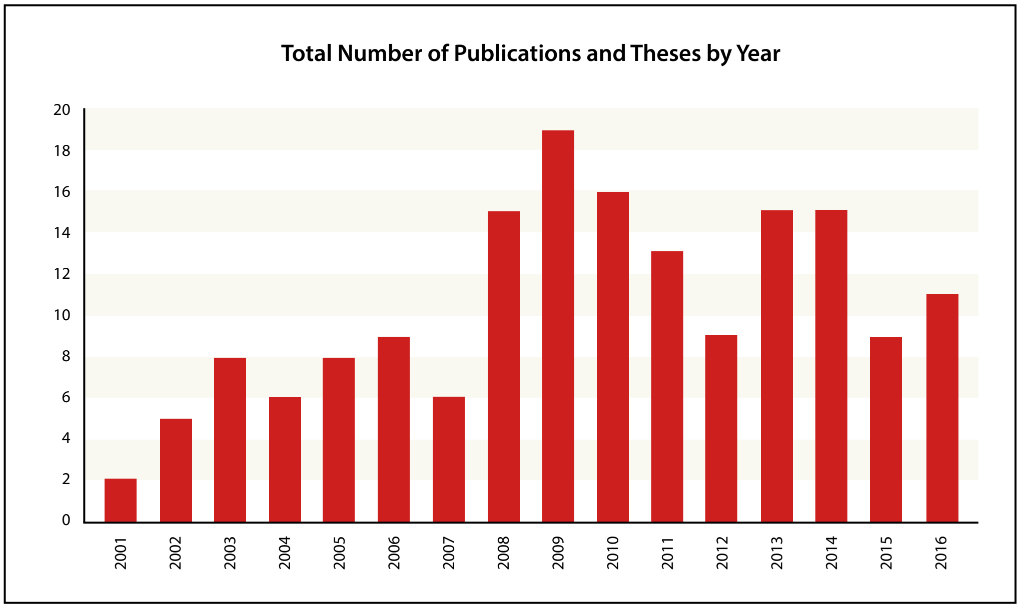
In May 2016, the provincial government announced a new draft Grizzly Bear Recovery Plan, which included $475,000 to fRI Research to improve understanding of grizzly bear populations.

In December 2016, the Grizzly Bear Program received a $1.4-million grant from the Natural Sciences and Engineering Research Council (NSERC) to support a combination of remote sensing, tracking technologies, and biological markers to investigate the environment, population performance, and health of grizzly bears in west-central Alberta. The research program will conduct studies in forestry, ecology, geography, and biology, and will involve 13 graduate students and post-doctoral researchers.

Over the 18-year life of this program to 2016, it has produced more than 175 publications, of which 166 were peer-reviewed, including 34 graduate theses. This is a remarkable achievement for any scientific organization, and one of which fRI Research and Gordon Stenhouse are rightfully proud.

In February 2017, fRI Research announced that Gord Stenhouse would begin a three-year transition to a new role as Hinton-based Wildlife Science Advisor with Alberta Environment and Parks. The government would continue to support his seconded position during the transition but would not renew the secondment. Later in the year, the fully seconded position was extended to 2020.

Figure 3-4. Peer-reviewed publications by year, Grizzly Bear Research Program, 1999–2016.



Gord Stenhouse in his office, 2017. All the peer-reviewed papers from the Grizzly Bear Program are mounted on the wall behind his desk.

Coarse-Filter Biodiversity – Natural Disturbance and Healthy Landscapes

Sustainability—the provision of ecological goods and services in perpetuity—is a concept that few would argue with. However, the strategies by which it is measured and achieved vary. For example, a fine-filter approach suggests that sustainability requires a commitment to the needs of a relatively small number of key species and functions. This assumes that meeting the needs of a small number of species and/or values can translate into overall ecosystem sustainability. The fine-filter model has dominated forest management policies and practices for decades in Canada, and it is the basis of the federal Species at Risk Act (SARA). Many of the fRI Research programs, such as the Grizzly, Caribou, and Mountain Pine Beetle Programs, provide knowledge and tools in support of fine-filter management models.

Coarse-Filter versus Fine-Filter Management Approaches

A coarse-filter approach adopts a fundamentally different perspective than a fine-filter approach. It suggests that sustainability is ultimately a function of the health and integrity of the entire ecosystem. Thus, ecosystem health becomes a management priority. This ecosystem-based management (EBM) approach suggests that if overall ecosystem function is maintained, then the ecological goods and services that we have come to rely on will also be conserved. This includes conservation of *all* fine-filter values, not just the ones we can identify or understand.

The difference between the two approaches is captured by Figure 3-5. A fine-filter approach manages from the bottom upwards. Values are translated into individual ecosystem elements, and then to the appropriate associated best management practices.

An EBM approach manages from the top down. The idea is that if the processes involved in this diagram are understood, we can manage the landscape for a desired future condition. Such a desired future includes climate change, cultural intervention, the probability

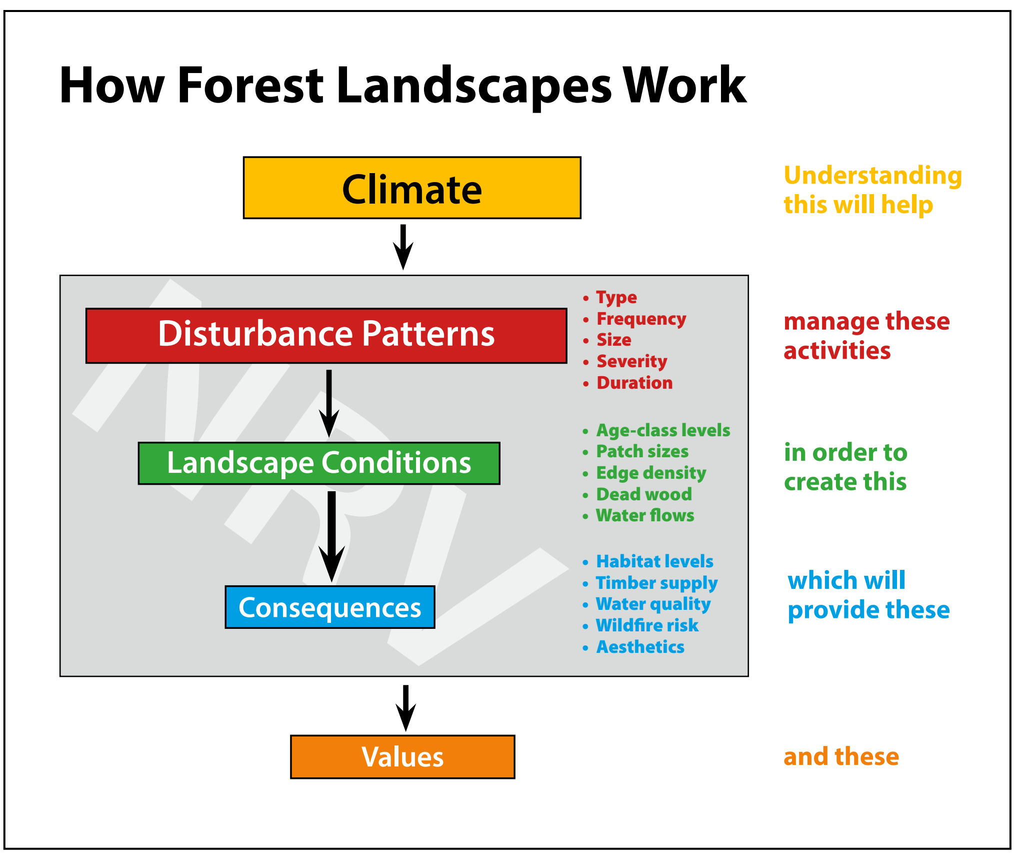


Figure 3-5. An illustration of how the natural range of variability functions in boreal Canada. Andison 2017.

of maintaining various species at their current level, natural disturbance risk, and the likely impacts on local and other human communities.

The most common manifestation of the EBM concept in forest management is to manage human disturbance activities using natural disturbance patterns as guides, variously called Natural Range of Variation (NRV), Emulating Natural Disturbance (END), and Range of Natural Variation (RNV). This interpretation is understandable given the importance of disturbance in Figure 3-5. It also acknowledges that disturbance activities are also the only point at which human intervention equates to "forest management," either through forest or fire management choices.

This coarse-filter approach complements the fine-filter focus on the habitats and populations of individual species. It addresses two key drawbacks with the fine filter: (1) the impossibility of directly managing for all of the vertebrate and invertebrate species on a landscape, and (2) the likelihood of picking "winners and losers" among selected species. A balanced forest management program would ideally contain both fine- and coarse-filter elements; i.e., an ecosystem-based management approach in which fine filters are used to evaluate the elements of future ecosystems against the requirements of selected values, such as the habitat needs of species of interest.

However, there is a challenge with the coarse filter, too. It is neither practical nor desirable to "emulate" a natural process like an insect infestation or the 2016 Horse River fire that swept through nearly 600,000 hectares in northeastern Alberta.

The model forest and fRI tackled the challenge of ecosystem-based management through the Natural Disturbance Program, renamed Healthy Landscapes in 2011. The program soon had impacts on some harvest practices and prescribed burning, and it began to have profound effects on forest management in Alberta and beyond. The goal, at both the stand and landscape levels, was to close the gap between natural ecosystems and managed ecosystems.

Scientists initially studied tree rings, fire scars, and other evidence to determine the long-term history of the forests. It was not long before the geographical reach of the research extended beyond the model forest area as the researchers studied new fire patterns and impacts across Alberta.

Early research confirmed that fire has long been the dominant natural disturbance agent in the foothills forests and boreal regions across Canada, although the nature and frequency of local impacts vary widely. Some locations might burn every few decades, and

Natural Disturbance Program researcher Kris McCleary and assistant use an increment borer to collect a tree ring sample for measuring tree age.

others only once in several centuries. Areas that escaped fires entirely were rare. Similarly, research also showed that historical conditions ranged widely as well; for example, the proportion of old spruce (more than 180 years old) in recent centuries ranged between 2 percent and 23 percent on the original model forest research area around Hinton.

Since the program's inception, more than 30 funding and academic partners have participated in 44 research, tool development, communication, demonstration, and educational projects across western boreal Canada. The Healthy Landscapes Program output has been used widely in virtually all Canadian jurisdictions, as well as by bodies such as the Forest Stewardship Council and the Canadian Boreal Forest Agreement. The program's research addresses past, present, and future patterns of climate, disturbance, and consequences. Its activities include interpretation, demonstration, tool development, communication, and education.[42]

The program has supported eight master's degrees, five doctoral degrees, four post-doctoral fellows, and 12 research associates. More than 30 undergraduate students have done laboratory and fieldwork.[43]

The Baskerville Effect

Gordon Baskerville (1933–2013) became interested in natural disturbance as a research scientist for the Canadian Forestry Service in New Brunswick from 1955 to 1974. He observed that the forest there had renewed itself through periodic infestations of spruce budworm, but this would no longer occur if pesticide spraying halted the budworm's return. Baskerville stated that the experience "left me with a strong personal bias towards gaining an understanding of natural system dynamics, at the temporal and spatial scales at which these function, before attempting human management interventions to regulate those dynamics to serve human purposes."[44] Baskerville continued to pursue this focus on forest dynamics as an assistant deputy minister in the New Brunswick government and a professor at the University of New Brunswick (UNB) until 1993, when he joined the forestry faculty at the University of British Columbia (UBC).[45] Before and after retirement in 1997, his writing, teaching, consulting, and public speaking had wide influence on forestry policy and practice across Canada. As he told a 1999 workshop in Hinton, "The need is to understand, and operationally mimic, the functional effects of natural disturbance, but at a socially acceptable scale."

Hugh Lougheed, Weldwood forestry manager, 2002. Lougheed played an important role in conceptualizing and implementing the Natural Disturbance Program. Much of this and other model forest research was used in his 1999 forest management plan for the 1-million-hectare Hinton FMA area.

One of Baskerville's undergraduate students at UNB was Hugh Lougheed, who took the course on forest dynamics and "got really keen on pursuing that." Lougheed graduated in 1984, got his master's degree at Lakehead University, and joined Weldwood as a planning forester in 1992. As he began work leading towards the 1999 forest management plan for the FMA area, he and his colleagues realized they could not rely solely on fine-filter tools like habitat suitability indices (HSIs) and habitat availability. He described the evolution to Peter Murphy in a 1997 interview:

> "We initially started with the fine-filter approach. We thought that that's how we would tackle sustainable forest management …. We started thinking about how we're going to run HSIs on 36 species, and we're going to have 20 tell us one thing, seven tell us something else, and another seven tell us another thing. So we needed to decide where we were going to go, which ones were important. It was a real concern then that we were just going to spin around in doing the analysis, and that we weren't going to be able to determine from the fine-filter approach what the strategies should be on the ground.
>
> "So we kind of backed off on that and said maybe we want to look at a coarse filter. So that's how we got looking at this natural disturbance project, and now the way we are looking at approaching the philosophy of the management plan is that we'll provide the habitat through the coarse-filter approach, provide a

representative area by seral stages, and then we'll do a fine-filter check. So we'll take key areas on the FMA area where we have specific wildlife issues, and we'll run the HSIs on those to determine, yes, in fact what we're providing through the coarse-filter approach does indeed satisfy the species needs. That approach, the coarse-filter and fine-filter combination, has evolved over time, just in starting off with one thing and then realizing that probably wouldn't work operationally and adapting. So the natural disturbance project is one that I'm quite keen on …. I think we're really on the cutting edge." –Hugh Lougheed, interview, 1997[46]

Establishing the Natural Disturbance Program

The Natural Disturbance Program—later Healthy Landscapes—started in 1994, the third year of the Foothills Model Forest. Managers were searching for a broader landscape management system to complement individual species management. Managing human activities in the forest in a manner that approximates the natural processes and disturbances at work such as succession, nutrient cycling, fire, flood, blowdown, insect attack, and disease was viewed as an effective coarse-filter biodiversity strategy as long as effects were kept within the natural range of variability. An understanding of natural variability is fundamental to the implementation of ecological management, not only for industrial forestry managers, but also for managers of protected areas for application in vegetation management (such as prescribed burning) and fire suppression planning.

Dan Farr, then a recent University of Alberta PhD, led the model forest's initial Natural Disturbance Program from 1994 to 1998. He said his group began investigating whether "we can somehow plan forestry activities to better emulate natural disturbance patterns of disturbance frequency, disturbance size, disturbance intensity … the matching of logging to fires as much as possible." In 1995, Lougheed then put him in touch with fire expert and "gifted modeller" David Andison, who was nearing completion of work towards his 1996 PhD at UBC. Andison came to Hinton to discuss research questions and data collection with model forest and Weldwood staff, beginning a relationship that continues today.

"I got a phone call, and they said, 'Why don't you come to Hinton and talk about this stuff.' I said, 'What stuff?' They said, 'Well, just natural disturbance.' I didn't know what they were talking about. I thought there was a project they were interested in. I thought, 'Well, that's fine.' I wasn't sure which one. I came, and I did a presentation on everything. I got some of Yves Bergeron's stuff and Sylvie Gauthier and Steve Cummings and the stuff that I had done. Everyone else that I knew was doing anything. I said, 'Here's a shopping list. What do you want to do?' It was Hugh, Dan, and I think Gord [Stenhouse] was in the room, too. They said, 'Dave, can you excuse us?' I went out in the hall. They said, 'Okay, come on back in.' I went back in and they said, 'Okay.' I said, 'Okay, what?' They said, 'All of it.' I said, 'What do you mean all of it?' and they said they'd make a new program. At the time, I didn't even know what a program was. That's how it started." –David Andison, interview, 2016

David Andison with Dan Farr at an FMF tour, Gregg Cabin, 2003. David Andison has been the scientific authority and lead researcher for the Natural Disturbance/Healthy Landscapes Program since its inception in 1994, and took over as program lead in 1998.

"We started to direct some of the model forest funding his [Andison's] way to do some of the early scoping. We hired folks to go and do some of the tree coring that was important to complete the forest age-class inventory for the model forest area. Then very early on, we started to include Jasper because they had a similar need to better understand disturbance regimes to support their prescribed fire program and their overall fire management program." –Dan Farr, interview, 2016

This coarse-filter thrust coincided with the thinking of the committee of government, industry, and non-government representatives then trying to develop an Alberta forest conservation strategy. The direction was evident in a 1996 draft they circulated.

> "The unmanaged forest, even without human influence, is subject to a variety of natural processes and disturbances such as succession, nutrient cycling, fire, flood, blowdown, insect attack, and disease. These processes vary in duration, frequency of occurrences, size of affected area, and severity. For each type of process, there will be a particular range of variability. The result is a mosaic of natural communities representing the range of natural variability in forest ecosystems. Each of these communities plays an integral role in maintaining the diversity and function of the forest ecosystem. An understanding of 'natural variability' is fundamental to the implementation of ecological management. To varying degrees, natural disturbances have been reduced in intensity, scale, and frequency through a variety of means such as fire and insect/disease suppression and abatement programs and flood control measures …. Ecological management proposes that we use human activities to maintain that range of natural variability." –Alberta Forest Conservation Strategy, draft, July 8, 1996

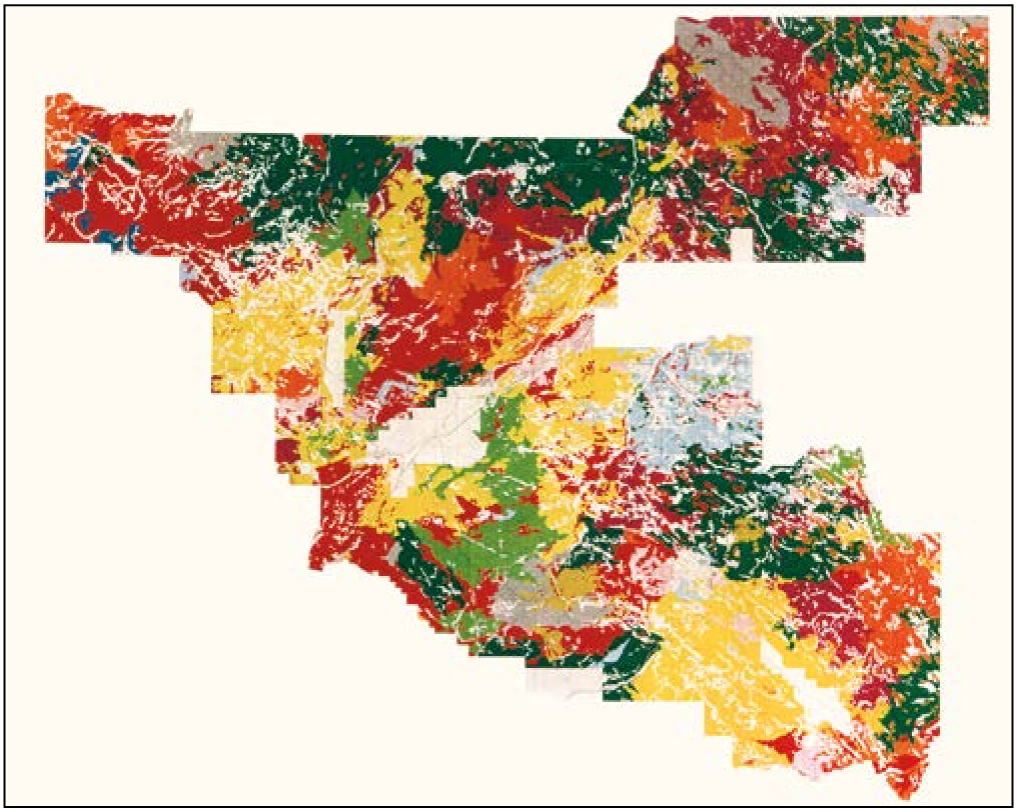
Understanding Historical Patterns

Andison's UBC doctoral dissertation, "Managing for landscape patterns in the sub-boreal forests of British Columbia," was a pioneering work in the emerging field of landscape ecology. He found that boreal landscapes are "much different and much more dynamic than previously thought." He concluded:

> "We cannot now, nor will we ever, completely 'mimic' natural patterns on these forest landscapes. Given this, we must take responsibility for understanding the magnitude of the changes that we will impose, and their impact on the ecological resources we are attempting to sustain. This research has taken that first step towards understanding those differences." –David Andison, doctoral dissertation, 1996[47]

According to the five-year plan for Phase II of the model forest, the Natural Disturbance Program would describe and summarize the patterns caused by historical disturbance (primarily wildfire, but also other agents such as insects, disease, flooding, wind, and ungulate herbivory). The program would also examine relationships among different disturbance processes operating at a range of scales, from landscapes to individual forest stands. The outcome of all this work would emerge as a coarse-filter biodiversity strategy based on the assumption that, in the absence of more specific data on alternatives, emulating natural disturbance patterns is the best possible means of achieving ecological sustainability. To that end, in the future, the program would also plan demonstrations of how management planning and operations benefit by this knowledge and more closely emulate natural disturbance processes. The four objectives of the program were set forward in Goal 4 of the Phase II proposal: *Develop forest management strategies that are in concert with the concept of ecological management*.

1. To continue research in the area of natural disturbance at the landscape and stand level and to expand efforts into areas such as Willmore Wilderness Park and Crown Forest Management Units
2. To develop forest management strategies that are in concert with the coarse-filter approach to forest management and that more closely approximate the range of natural variability and seral stage representation over the larger landscape



Map 3-6 North Western Pulp & Power fire-origin map of the Weldwood FMA, 1960. Colours represent various ages of forest from the oldest (red) to the most recent and youngest(grey) based on the elapsed time since they were originated by wildfires.

3. To evaluate "stand-level" requirements of ecological management for managed forests based on comparisons between natural fire-origin stands and those created by manmade disturbances
4. To provide better information to managers of protected areas on natural disturbance that can be used in vegetation management and fire-suppression planning

First Projects

The program focused initially on three projects: Landscape Disturbance Regime, Detailed Disturbance History of the Montane Ecoregion, and Island Remnants. The Landscape Disturbance Regime Project included data about the frequency, type, and rate of disturbance across approximately 2.75 million hectares of the model forest, including Jasper National Park, Weldwood's FMA area, and provincial lands east of the front range of the Rockies. In the early 1960s, company forester Jack Wright* had created a map of stand origin dates based on photo interpretation and field sampling. In 1997, the Natural Disturbance Program completed this map for the study area (excluding Willmore Wilderness Park) using similar techniques.

Dan Farr, Gord Stenhouse, and Jan Traynor display the Foothills Model Forest fire-origin map during a 1997 field tour near the Gregg cabin. They are standing at the boundary between two fire-origin stands, one originating in 1888 and the other in 1956.

The montane ecoregion in Jasper National Park and the upper foothills sub-region were shaped by a variety of natural disturbances such as surface fires, disease, and windfall. Because of their complex natural disturbance history, these areas could not be represented by stand-origin mapping alone. A detailed disturbance history of these areas provided Jasper National Park with a better understanding of the frequency and nature of fires and fire effects on tree population, understorey, plants, and animals.† Continuing research in natural disturbance by FMF would underpin key elements of the park's Firesmart-Forestwise vegetation management system (see Chapter 4).

The patterns of live trees that remain after individual wildfires are called "island rem-

* Jack Wright was management forester for North Western Pulp & Power from 1957 to 1976, when he succeeded Desmond Crossley as chief forester. Wright continued in that role until he retired in 1987.

† One of the students hired to collect core samples and fire scar evidence in Jasper National Park in 1997 was Ryan Tew, who became General Manager of fRI Research in 2016.

nants." This area of research focused on the area, size, number, and arrangement of island remnants in relationship to attributes such as fire size and topographic features such as slopes and streams. Island remnants offered a potentially useful template for land managers attempting to maintain patterns of forest age classes within the range of natural variability. A report published in December 1998 described the methodology and preliminary results from the analysis of 25 fires ranging from 28 hectares to 15,908 hectares and spanning three natural sub-regions. The most intact remnants (with 100 percent canopy closure) accounted for 0 to 9 percent of the fire areas, and 83 percent of these remnants were less than 10 hectares in size.[48] By 2009, the number of fires in this detailed fire database increased from 24 in the central foothills to 129 covering all of Alberta and central Saskatchewan thanks to additional support from almost 20 different research, government, and forest company agencies. So far, eight publications have used these data.

In 1998, Peter Achuff and Alan Westhaver began a study of vegetation succession in Jasper National Park. They sought to develop a model of vegetation change, including composition and structure for major vegetation types following disturbance. The focus would be on forest communities of the montane and subalpine natural sub-regions, including their non-forested, early successional stages.

Also launched in 1998 was the Bridgland Repeat Photography Project. This project was not part of the Natural Disturbance Program, but the model forest provided financial support to it (see Chapter 4).

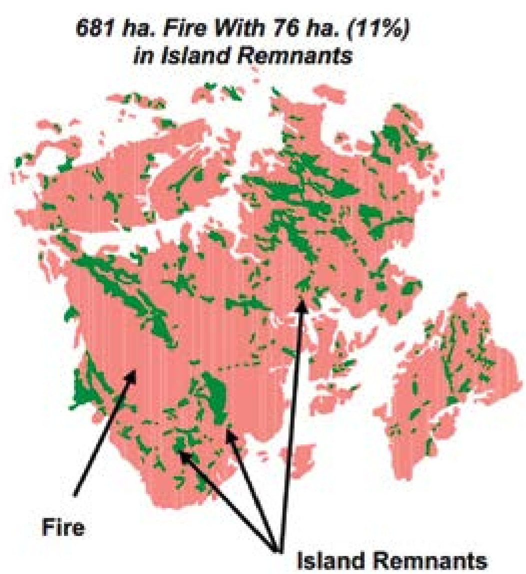
Knowledge into Practice

In 1999, the model forest hosted the first of many natural disturbance workshops. This one was facilitated by Gordon Baskerville. He continually reminded delegates to clearly distinguish between "form" and "function," and to ensure they understood the latter and how to emulate it. The workshop summary concluded: "All groups noted that collaboration between stakeholders and public education are critical to the successful implementation of management decisions based on the natural disturbance paradigm."[49]

By this time, natural disturbance research was finding its way into practice. Weldwood's 1999 forest management plan used historical patterns of natural disturbance to guide strategic decisions of where and when to harvest, with the goal of maintaining a mosaic of young, immature, mature, and old forests that would reflect historical ranges. The amount and location of "old-growth" forests would thus be maintained within the range of pre-industrial levels.

In Jasper National Park, managers used results from more detailed natural disturbance research to establish targets for their prescribed burning program. Park managers had become proficient at managing lightning-caused fires and controlling prescribed burns, but they had few tools at their disposal for determining "success" in ecological terms. The model forest research helped them begin to set those benchmarks.

In 2000, Andison began an extensive communications program that included presentations at public meetings and conferences, and discussions with industry and government. He also introduced the concept of "QuickNotes"—short, one-page summaries of activities and major findings from the program. The notes soon had a readership of more than 500 across North America. Eventually more than 40 QuickNotes would be produced by the program, and other program leaders were encouraged to produce their own QuickNotes.



QuickNote illustration—Island Remnants—from QuickNote #18, "Surviving as an Island Remnant," January 2003.

The model forest partnered with the Networks of Centres of Excellence (NCE) Sustainable Forest Management Network to host a conference in Edmonton, March 5–7, 2001, which was attended by 200 land managers from government and industry, as well as academics and scientists. It was titled "Natural disturbance and forest management: What's

Montane region of Jasper National Park, along the Colin Range, 2004. This image shows the results of some Parks Canada burns near the old Moberly Homestead on the east side of the Athabasca River, a Firesmart-Forestwise project to establish younger forest stands in the montane region.

happening and where it's going." Members of the model forest natural disturbance team presented six papers at this conference. Andison's opening presentation was entitled "Data, assumptions, and objectivity: Fire history research in action."[50]

> "Studying and quantifying historical fire history patterns is challenging on many different levels …. Even the simplest measurements such as fire frequency, sizes, and shapes are confounded by fire control, cultural disturbance, and inadequate data sources …. Many metrics largely assume that fire is always stand-replacing, climate is stable, and Aboriginal people's use of fire is minimal and quantifiable—none of which is necessarily true. Furthermore, a single landscape 'snapshot' is only a sample size of one, from which the extraction of the 'natural range of variation' is problematic. Data quality and quantity become even more critical for studying fire history patterns at finer scales, where detailed vegetation and terrain layers are as important as precise age data." –Dave Andison, conference presentation, March 5, 2001

In a 2003 publication, Andison said that modern timber harvesting "cannot closely mimic natural disturbances such as fire" due to factors such as log removal, heavy machinery, and construction of access roads; nor would simply enlarging harvest blocks equate with disturbance patterns. However, he said it was still possible to integrate natural patterns into planning. For example, he noted that Weldwood had generated 78 natural pattern metrics and integrated 20 of them into planning for the Hinton FMA area. He said the company committed to "implementing those pieces that are achievable over time."[51]

Expanding Scope and Locations of the Research

In 2000, the research program began a study of the 1998 Virginia Hills fire northwest of Whitecourt. Key aspects of the fire legacy included fine-scale heterogeneity, edge architecture, and island-remnant structural characteristics. The research proceeded from coarse to fine scales, providing context and direction for more detailed studies. "There still are green patches left after those fires," Andison noted in a 2016 interview. "I've never seen a fire with nothing left. The average across the whole boreal historically is about 40 percent."[52]

Al Westhaver of Jasper National Park also added two new projects to the natural disturbance work in 2000. The historic natural disturbance regime of Jasper's montane natural sub-region was largely the result of Aboriginal- and lightning-caused fire events. Decades of fire exclusion had major consequences for landscape and biological diversity. Restoring fire regimes characteristic of the montane zone was considered essential to maintaining or restoring biological diversity. Jasper was embarking on a program of prescribed burning to re-introduce disturbance to the montane. This program of ecological restoration would be conducted as a scientific experiment in order to enhance understanding of dynamic relationships between fire, vegetation, and native herbivores. One finding was the significant effect of elk browsing on aspen regeneration.[53]

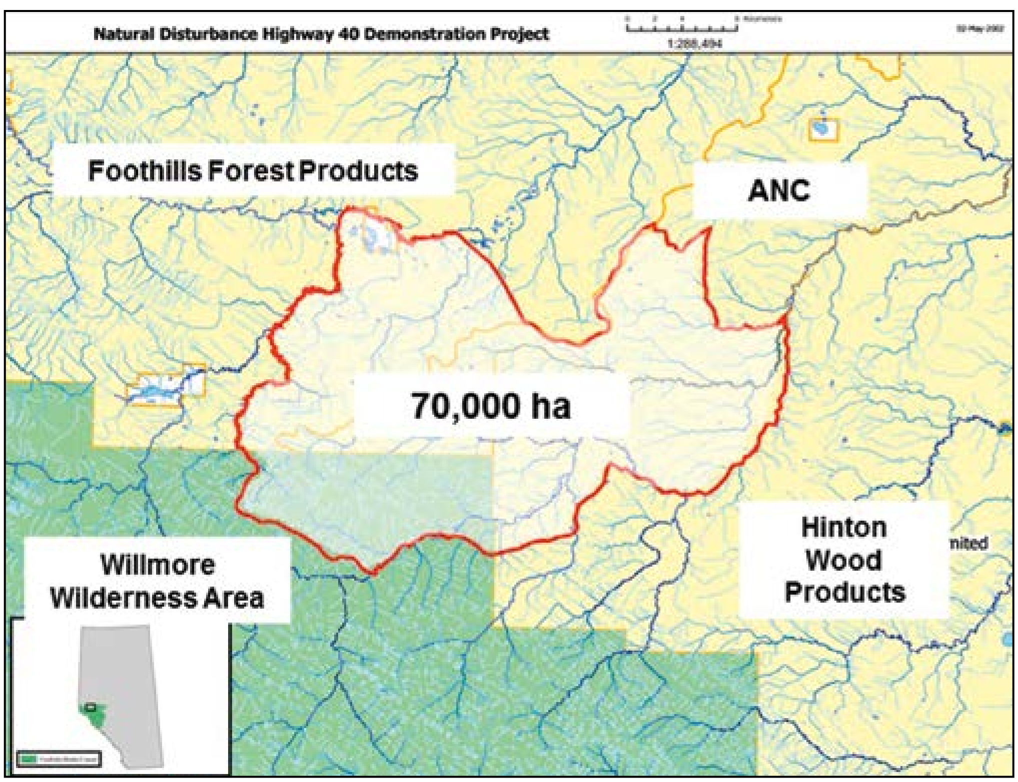
Sign explaining the ecosystem research project, game exclusion study, near the Jasper airport, Henry House Flats, 2001.

In the park, the exclusion of the major ecological disturbance factor—fire—during the preceding 70 years also provided an opportunity to study changes in vegetation structure in the absence of major disturbances. This project explored hypotheses regarding historic spatial and temporal landscape vegetation change in the absence of fire.

A 2002 report by Andison and Kris McCleary, *Disturbance in Riparian Zones on Foothills and Mountain Landscapes of Alberta*,[54] generated interest across Canada. The authors found that although riparian zones burn somewhat differently than uplands, "the fact that fire is an integral part of the ecosystems is inescapable." The report sparked a debate, which is still continuing, about the long-standing practice of leaving unharvested "buffers" around streams. The program continued to research issues such as coarse woody debris and the slow degradation of riparian areas in the absence of fire or harvest. As forester Tom Daniels of Sundre Forest Products observed in a 2016 interview, "The tendency to date has been very inflexible because many people view riparian areas as kind of sacred—'they're fragile, they're sensitive.'"[55]

The Highway 40 North Demonstration Project

The Highway 40 North Demonstration Project would have applied natural disturbance principles, including prescribed burning and dispersed harvest, in a 70,000-hectare area north of Hinton. The area included parts of three forest company tenures, active oil and gas



Map 3-7. Highway 40 North Demonstration Project.

exploration and well sites, pipelines and power lines, and a portion of Willmore Wilderness Park. It also had important caribou, grizzly bear, and bull trout habitat, was at high risk of wildfire and mountain pine beetle infestation, and included a well-travelled public corridor used for recreation. Planning and consultation continued from 2002 to 2008, but divergent priorities kept getting in the way.

The project represented the ultimate integration of natural disturbance research to this point in the program. It was to be the true test of using natural patterns as the foundation for creating a single "disturbance plan" for *all* cultural disturbance activity, across jurisdictional boundaries, and fully integrating prescribed burning with harvesting and road building to achieve the final product. Using this management philosophy, harvesting would become a tool instead of an objective.

Industry, the Government of Alberta, and Jasper National Park had been working cooperatively on caribou conservation in the area for many years through the West-Central Alberta Caribou Standing Committee. The FMA holders cooperated on a commercial thinning research and demonstration project in the area to increase lichen food resources for caribou, and they were also working on access plans for the area in cooperation with Alberta Sustainable Resource Development. Oil and gas exploration and development was rapidly increasing, and trapping was active in the area. Recreational use was concentrated in the Pierre Grey's Lakes area and was low elsewhere in the area, except for a staging area for trips into the Willmore Wilderness Area to the west. Finally, the chosen landscape was considered to be at very high risk from natural disturbance agents such as fire and mountain pine beetle, since it contained a large area of mature, contiguous, conifer-dominated forest.

The 10-person multi-disciplinary, government-industry planning team met 16 times over two and a half years. Together, they designed a single disturbance event just over 8,100 hectares in size that included leaving about 44 percent by area of undisturbed forest, including a significant portion of merchantable timber. The event roughly paralleled Highway 40, minimizing the number of new roads required and maximizing opportunities for public viewing. Concerns over the impact on woodland caribou were addressed by creating an adaptive management experiment that included collaring and tracking local animals, establishing multiple competing hypotheses, and securing experts to conduct the research—it

In 1998, forest companies established a number of commercial thinning sites along Highway 40 North. This site, north of the Berland River, was thinned by the Alberta Newsprint Company using a shortwood harvester.

would become the ultimate learning experience. The plan was prepared with the assistance of existing fire-pattern research and a spatially explicit landscape disturbance simulation model (LANDMINE) developed through the Natural Disturbance Program.

Sustainable Resource Development committed funds to an operational budget for the prescribed burning elements of the plan. However, approvals for harvest were not forthcoming in the caribou habitat areas, and Alberta Parks refused permission to burn in the Willmore Wilderness. Eventually, the project ended in 2008 without having been fully implemented.

Many challenges affected the implementation of the plan. The project timing coincided not only with the 2004 closure of the Weyerhaeuser Grande Cache mill (which meant that Foothills Forest Products eventually replaced Weyerhaeuser on the project), but also a provincial election. No guidance in the form of strategic or operational plans was available for Willmore Wilderness Park beyond the provisions of the Willmore Wilderness Act. The planning team also had to deal with unsolicited input and advice from individuals from agencies not involved in the project, the most serious of which, as noted by Andison, compromised the integrity of both the process and the plan. Finally, the rapid advance of mountain pine beetle had recently created uncertainty over the extent and location of harvesting operations throughout the Alberta foothills.

Despite the challenges of integrated planning, the three forest management companies involved were able and willing to create a plan for a single seamless disturbance event spanning all three jurisdictions; in fact, the Alberta Newsprint Company did implement aspects of the program in its harvest planning for the area. Weldwood (later West Fraser, Hinton Wood Products) subsequently proposed to implement its portion pending completion of the Caribou Recovery Plan for the area. The fourth land partner (Willmore) was either unwilling or unable to support adjacent disturbance activities and prescribed burning.

Andison's conclusion was that the group functioned as a "committee," with each member more interested in their agency's stated values, rather than as a "team" interested in designing a holistically robust disturbance design solution. He saw regulatory integration as the least successful element of the Highway 40 project.[56]

The NEPTUNE Model

By 2004, the Natural Disturbance Program had arguably compiled the most comprehensive knowledge base of intermediate- and fine-scale wildfire patterns in all of Canada, including the development of a new spatial language with which to interpret the results. Further, this knowledge had been captured within a GIS-based decision-support tool that allowed existing and future disturbance patterns to be compared to the range of patterns created by natural wildfires. With support from Hinton Wood Products and the Alberta Newsprint Company, Brian Maier and Carol Doering of The Forestry Corp. used this knowledge to develop a model called NEPTUNE (New Emulation Planning Tool for Understanding Natural Events).[57]

In 2006, Mistik Management in Meadow Lake, Saskatchewan; Alberta-Pacific Forest Industries in Boyle, Alberta; and Alberta Sustainable Resource Development joined the NEPTUNE partnership. Version 1.0 of NEPTUNE was released in the fall of 2006 and was operational at the designated locations of each partner; it later became available in an online format. As the model developed and the partnership base grew, a "wish list" of potential model upgrades was tracked and prioritized. Several items remained on the list, and, in fact, it continued to grow with time. For example, linked with other natural disturbance research, the model can be calibrated to other geographic areas and other disturbance types. The ultimate decision of which upgrades to pursue and when was left to the NEPTUNE members.

NEPTUNE is the first tool in Canada that allows the user to evaluate just how "natural" past or proposed disturbance activities are. The integration of natural disturbance patterns into planning activities is still evolving. Part of the learning curve involves understanding which and how natural disturbance patterns differ from current practices. What shape are natural disturbance events? What is the right amount of remnant to leave behind? How large are the remnants, and how should they be arranged in space?

This is not just a knowledge gap. We know a fair bit about the sizes, shapes, and internal residual structures of various wildfire pattern metrics. This is a management integration issue. More specifically:

1. How does the scientific knowledge of natural disturbance patterns manifest itself as definitive spatial entities that are "natural"? That is, how closely can managed disturbance patterns approximate those occurring in nature?
2. How do we capture and track the variability in the appropriate disturbance pattern metrics over time and space?

As a web-based GIS decision-support tool that creates "disturbance events" from spatial input and calculates disturbance-pattern metrics from spatial input data, NEPTUNE facilitates both needs. It compares the pattern results to those of pre-industrial, natural disturbance patterns from wildfire pattern research. The model currently produces a database with graphical and tabular summaries for:

- Disturbance event sizes
- Event shapes
- Numbers of disturbed patches
- Shapes of disturbed patches
- Percentage of event area in undisturbed remnants
- Sizes of remnants
- Density of remnants

Many wildfires in the boreal forest "spot" from airborne burning embers, creating multiple disturbed patches. To capture this spatial dynamic, NEPTUNE uses a simple buffering algorithm that gathers disturbed patches based on their distance from each other in space and time.

The NEPTUNE initiative was funded and managed as an independent entity through a non-profit shareholder agreement. By 2011, there were seven full partners involved in NEPTUNE: West Fraser, Alberta Newsprint, Alberta-Pacific, Mistik Management, Alberta Sustainable Resource Development, Parks Canada, and Saskatchewan Environment. NEPTUNE membership includes training, support, and a voice at the table with respect to upgrade priorities, distribution, training, and new memberships.

In Edmonton, on May 12–14, 2007, 25 people attended an intensive short course "primer" on natural disturbance led by Dave Andison. The course was a collaboration between the model forest and the Saskatchewan Institute of Applied Science and Technology (SIAST). A survey in 2007 found that 90 percent of the land management organizations in Alberta had used or were using information, knowledge, or tools created by the Natural Disturbance Program. Work began to extend wildfire pattern research to northern Alberta and northeastern British Columbia.

From Natural Disturbance to Healthy Landscapes

At the urging of Assistant Deputy Minister Cliff Henderson, Sustainable Resource Development Minister Ted Morton met with Dave Andison in 2008 to learn about using natural disturbance as the basis for landscape management. "He got it right away," Andison said.[58] "I find that with people who like the idea, it doesn't take two or three times. He got it immediately. Then he started talking about the possibilities and cumulative effects and integrated management, here's how caribou and everything else fits in. He got it just like that."

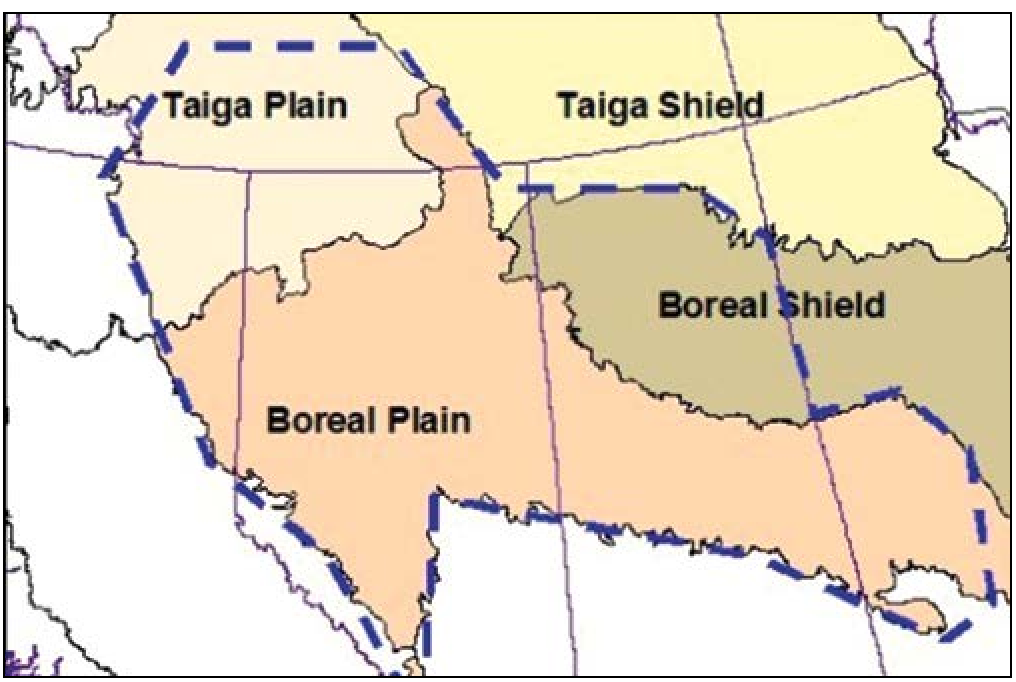
The ministry subsequently granted $200,000 for Andison to assemble a team of experts to develop a new, broader vision of what a natural disturbance approach might look like. The final report, *The Healthy Landscape Approach to Land Management*, laid out the conceptual groundwork for an entirely new type of land management approach, which was subsequently demonstrated using scenario planning models on the 11-million-hectare Upper Athabasca land-use area.[59]

Around this same time, the Natural Disturbance Program was experiencing some growing pains. The Athabasca study was one of several that expanded well beyond the original mandate and geographic limits of the program. The time to re-evaluate the program was at hand, culminating in a one-day visioning workshop in the fall of 2011 with over 50 participants. The resulting 2012 report outlined the rationale, goals, and objectives for a new, more comprehensive entity that would focus on understanding how forest ecosystems work and developing tools, demonstrations, and educational resources to help managers apply that knowledge to create better forest landscapes. This ultimately became the mandate of the new Healthy Landscapes Program. Within three years, membership had swelled from five partners in Alberta to more than 12 across two provinces, and it has since grown to more than 20 across five provinces and territories.

To help spread the Healthy Landscapes message, Andison began using a meeting facilitator, Jules LeBoeuf, who had a background in forestry and fire management, to help plan agendas and keep dialogue moving forward during sessions with partners and stakeholders. "Dave, he's such an intellectual and an academic and he's so passionate about his work," LeBoeuf said. "I think what happened was there was a realization that that's not enough. There's this relationship, human part that is equally important, and these two have to come together. Maybe that was a pivotal moment for Healthy Landscapes."[60] Andison said his favourite quote from LeBoeuf was, "If we can't make Healthy Landscapes work in this room, how do you expect to make it work out there in the real world?"[61]

Andison said that the problem in convincing people is that ecosystem integrity is "a composite, loosely defined concept that has no 'sexy' specific benefits to society" like conserving grizzly bears or caribou. "Maintaining ecosystem productivity, diversity, and resilience may be pivotal ecosystem characteristics, but they are not mainstream societal issues."[62]

One of the largest Healthy Landscapes projects, LandWeb (Landscape Dynamics in the Western Boreal), was launched in 2014. This simulation modelling project is the first



Map 3-8. The 125-million-hectare LandWeb study area spans boreal and taiga regions across Western Canada.[63]

of its kind and spans the western half of boreal Canada, with the intention of defining the historical range of landscape conditions before industrial influence. The modelling provides information about species' habitats, the risk of wildfire, and how natural disturbances such as fires and floods affect habitat. The project also intends to create data and modelling information that will help others to answer separate scientific questions related to such topics as climate change. The goal, Andison said, is "establishing ecological benchmarks for desired future landscapes for both strategic and land-use planning exercises across five Canadian provinces and territories."[64] An additional benefit of the LandWeb project is the development of a new research and management tool. Plans are underway to make LandWeb available online, free of cost to anyone.

> "The Healthy Landscapes Program now has company, government, and NGO partners in five provinces and territories. I think it is safe to say that we are, and have been, influencing policy across Western Canada for many years. We were 'beyond the borders' 15 years ago with regard to our partnerships and have the broadest membership of all of the [fRI Research] programs. We are now coordinating with the CBFA [Canadian Boreal Forest Agreement] to ensure that our research facilitates their national needs. Towards that, our research projects have generally set the bar. The fire pattern research (Alberta and Saskatchewan) and the NEPTUNE model both have the potential to become national in scale. The spatial language we developed has been adopted by the Saskatchewan government and many forest management companies in Alberta. Saskatchewan is developing an NFP [natural forest pattern] program, complete with policies based on our work. We are collaborating with virtually all of the EBM [ecosystem-based management] experts in Canada on one project or another. We are largely responsible for starting the discussion about EBM as a new management paradigm in many parts of western Canada. It is a discussion that continues today, and thus our renewed emphasis on education. The partnership strongly feels that communication and education around EBM and natural pattern management is *the* biggest issue with regard to accepting a new management paradigm, and that we are the ones most qualified to deliver that." –Dave Andison, personal communication, 2015

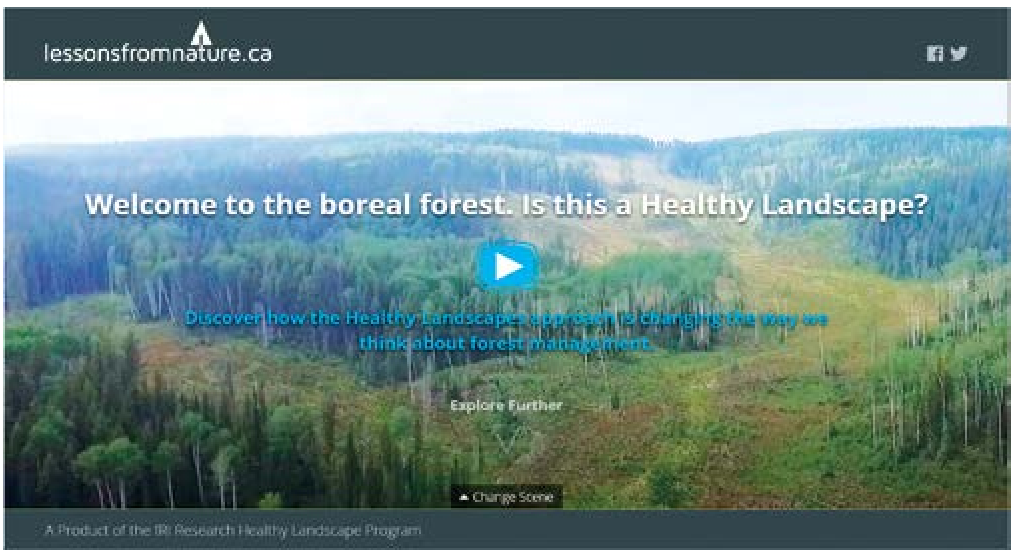
The practical results of the program have included significant changes in harvest patterns, including stand structure retention and a trend towards aggregated or "single-entry" harvests replacing the previous "two-pass" design.

In 2015, Andison worked with Alberta-Pacific and the regulators to design a pilot project to restore a heavily modified 325,000-hectare landscape in northeastern Alberta using a novel planning process based on a Healthy Landscape approach.[65] Although the parameters used in the scenario modelling exercise were real, the project was intended more as a demonstration to others as opposed to an actual planning exercise. Several pieces of that project are gaining traction with various partners, including Al-Pac, which is considering adopting much of the concept for planning in one of its forest management units.[66]

In March 2016, Alberta Agriculture and Forestry circulated a proposed structure retention directive specifying a minimum-allowable target for merchantable area retention at 10 percent of the harvested area.[67] The proposal was subsequently rescinded, but the process demonstrates well the challenge of translating concept to practice under the auspices of natural pattern emulation. No minimum structure retention is currently required in the planning manual, although average retention levels have ranged from about 1 to 5 percent in most Alberta forestry operations.

In 2016, the Healthy Landscapes Program launched an interactive website called lessonsfromnature.ca to help decision makers and the public discover new forest management research and applications. The site explores six of the most debated land management values in the boreal forest by pairing expert interviews with vivid drone footage of modern harvest sites. The website also includes interactive 360-degree views of the boreal forest and animations showing how forest management has evolved in the past 30 years. The site highlights the fact that wildfires are a natural, healthy part of the boreal forest and that lessons from these events are being used to develop more sustainable approaches to land management. Brief videos discuss core issues such as the management of old forests, the rate at which forests grow back after harvesting, and new ways of managing the cumulative impacts of multiple industries operating on the same land base. The site suggests that by using a more integrated approach based on natural processes, society can achieve better environmental, economic, and social outcomes.

> "This website is all about creating a common understanding of how combining a new way of thinking with leading-edge science can create more sustainable solutions for forest land management. We hope this site will stimulate many discussions and debates, and ultimately lay the groundwork for some innovative new partnerships." –David Andison, fRI Research news release, July 5, 2016



Lessons from Nature screenshot, 2016.

Andison's wildfire database on landscapes and vegetation now includes most of the forested landscapes in Western Canada from the Yukon to Manitoba, and work is underway to expand it even further.

In early 2017, the program launched a series of dialogue sessions designed to explore the sources of both support and discomfort with the concept and application of ecosystem-based management (EBM) principles. The professionally facilitated sessions are open to any stakeholders or members of the public, but they specifically target senior managers and policy makers. The idea of dialogue is to introduce an active listening component, as opposed to more of a workshop-style event where lectures are given on EBM. These sessions are designed to help individuals and organizations understand the nature of what is often a highly uneven acceptance level of EBM across Alberta and beyond.

Other new and continuing projects include development of a short course and a demonstration project, NEPTUNE and LandWeb modelling, wildlife mortality mapping, comparing natural and human-caused disturbance patterns, linking the natural range of variability to fine-filter values, examining factors in remnant survival, and research on historic fire regimes, water, and climate.

Andison's program is also engaged with the Canadian Forest Service's Eliot McIntyre in the development and application of a revolutionary and open-access cumulative effects modelling program, the Spatial Discrete Event Modelling System (SPaDES). This GIS-based modelling tool allows simultaneous analysis of multiple models and data on any defined landscape. Andison and McIntyre have developed a "LandWeb configuration" of SpaDES that incorporates Andison's natural disturbance and Healthy Landscapes models, along with all his landscape data collected over the years. Other cumulative effects models used in Canada are mostly non-spatial in nature, and this is a major breakthrough. Interestingly, one of the first projects of the Foothills Model Forest was to develop a cumulative effects model, but in the end, it proved too complex and was set aside. Now, 25 years later, perhaps that objective is about to be met if other programs and holders of such data and models can be encouraged to add their information to the process.

Practical Application of the Research – Experience on the Ground

The two-pass (or sometimes three-pass) harvest design had typified forestry operations in Western Canada since the 1950s, but it came under increased scrutiny in the 1990s for reasons ranging from aesthetic to ecological. The main intent of the design was to promote reforestation on the first portion of the harvest before returning 15 or 20 years later to harvest the remainder. The system also maintained vegetation cover for wildlife and helped to even out long-term wood supply for companies. Average cutblock size was about 20 hectares, with a seldom-reached maximum of about 150 hectares, and nearly all of the merchantable timber was removed during harvest.

The resulting checkerboard of cutblocks bore little resemblance to natural disturbance. In the foothills and across boreal Canada, there would typically have been many small fires and a smaller number of very large ones. The large disturbances would account for most of the area burned and would usually contain unburned single trees, clumps, and larger island remnants. The cutblocks were more uniform in size, with equal areas of standing timber left for the second "pass," years later. Because of this, and necessary access for reforestation and other treatments, the two-pass system also required keeping roads open for long periods of time; this increased access for hunters and predators, giving them clear sightlines across the treeless openings in early years of regeneration. The rectangular cutblocks looked unnatural and offended the sensibilities of recreationists and tourists. The checkerboard design also maximized the amount of forest edge and minimized the amount of interior forest—both critical habitat metrics for several key species.

An early attempt to address the two-pass wildlife issues was a 2,000-hectare "progressive clear-cut" between 1974 and 1978 in the Hinton FMA area. The cut was cooperatively planned with the Fish and Wildlife Division and the Alberta Forest Service, particularly because of concerns about the negative impacts of strip, block, and patch clear-cutting on ungulates due to the road network and on fish due to stream siltation. The experimental harvest was set up to assess the operational efficiencies of large clear-cuts, reduced environmental (siltation) impacts of roads by putting them to bed as the operation proceeded, and reduced hunting impact on ungulates due to reduced road access. Fish and Wildlife prescribed wildlife corridors and reserves, but it later rescinded most of them, a decision that baffled company managers.[68]

According to Jack Wright, the company's chief forester at the time, there was little influence on silviculture costs. Some roads had to be reopened, and about half the area required site preparation and planting. However, this may have been more a reflection of the reduced seed supply from pre-1955 "high-grading" tie operations in the area, as well as delayed lodgepole pine germination that seems characteristic of the Berland area. Subsequent oil and gas activity in the area led to new disturbances on the site.

Progressive clear-cutting was not practised again in the Hinton FMA area, and the other large-scale experimental logging proposed in 1968 for the Tri-Creeks Experimental Watershed was also discontinued when it came time to harvest in the late 1970s.

In the 1990s, the Government of Saskatchewan decided to allow forest companies more

Progressive clear-cut area in 1975 and 30 years later (2005) when the site was fully occupied with a new crop of pine and spruce. *Courtesy Hinton Wood Products*

The Mistik Management aggregated harvest in Saskatchewan, 2003.
Below: the same area in 2016.

flexibility in harvest design. Mistik Management consulted with experts, including Dave Andison, and designed an aggregated harvest with significant structure retention in its FMA area in west-central Saskatchewan. More than 2,600 hectares were harvested between 2001 and 2003. The road requirement was reduced from 122 kilometres to 50 kilometres.[69] A delegation from Alberta-Pacific flew over the operation in 2002, and the foresters were impressed to see what was feasible. "To this day, it is the epitome of what natural-disturbance-inspired harvesting means," Andison said in 2015. "I dare you to fly over it today and recognize it as a cutblock."[70]

The 1999 Weyerhaeuser Prince Albert forest management plan also adopted an approach that it called natural forest pattern emulation (NFPE). This approach led to a 3,000-hectare harvest in a planning unit over a four-year period. Structure retention ranged from 1 to 10 percent depending on forest type. Two more years of access were needed for road reclamation and silviculture. "The area is no longer accessible due to the removal of the main 25-metre bridge, ensuring that human access will be extremely limited," Brian Christensen of Weyerhaeuser told a 2008 conference. "The effective decommissioning of all access and the single-phase harvest system used in the operating area provide for favourable habitat for woodland caribou that continue to utilize the area."[71]

In northeastern Alberta, Alberta-Pacific introduced the natural disturbance approach at the stand level soon after its forestry operations began in 1994 by varying the shape, size, and number of interior residuals among harvest areas. Average structure retention was about 5 percent, compared to the then-prevailing 1 percent retention elsewhere in the province. In its 2006 forest management plan, Al-Pac moved to an aggregate approach based on "disturbance events"—amalgamating cutblocks harvested in a 10- to 15-year time period and within 200 metres of each other to create larger disturbance areas that more closely approximated a fire event. Individual cutblocks would be no larger than 500 hectares, but the total disturbance event potentially could be as large as 20,000 hectares.[72] Although large by forestry standards, such an area "equates to the lower range of disturbance events in the NDS [natural disturbance system] landscape," Al-Pac reported.[73]

Daishowa-Marubeni International meanwhile increased its average structure retention in northern Alberta from 4 percent in 2009 to 16 percent in 2013.[74] The company's 2013 forest management plan established 15 percent as a minimum retention target for future harvests. Companies harvesting primarily coniferous stands have generally aimed for lower retention levels. For example, average retention in the Hinton FMA was 3 percent in 2012.[75]

Ecosystem Condition: Biodiversity Monitoring

Biodiversity monitoring occurs on many different scales and in a variety of timeframes. Some elements are contained in forest companies' management and stewardship documents and in the reports of parks, fish and wildlife, forestry, environment, and other federal and provincial government agencies. However, Foothills Model Forest partners recognized in the 1990s that there was no comprehensive system for monitoring biodiversity across jurisdictions on a wider scale. The initiative begun at the model forest led eventually to the establishment of an independent institute with a province-wide mandate.

In 1997, the model forest embarked on the project to develop a protocol for monitoring forest biodiversity in Alberta. Wildlife biologist Dan Farr, the project lead, sought out others in the province with similar monitoring requirements as a strategy to develop an efficient and cost-effective research plan. Partners included the Alberta Conservation Association, Alberta Environmental Protection, Alberta Research Council, Canadian Forest Service, University of Alberta, Parks Canada, and several Alberta forestry companies.

In 1999, the research design and protocols were tested on two areas, one near Lac La Biche and one in the model forest land base. Alberta Research Council staff counted plants, insects, and birds, while University of Calgary partners measured landscape composition using satellites and other remote-sensing devices. One year's work produced some interesting results such as the 71 species of wasps caught in traps. Insects are an important part of biodiversity because they mediate ecosystem functions such as decomposition, assist in maintaining soil structure and soil fertility, and influence populations of other organisms (insects, vertebrates, and plants).

Until March 2000, the model forest, along with other partners, continued to support the program as the protocol was developed, and by February 1998, the Board had agreed to contribute most of Farr's time to this initiative. At this point, David Andison replaced Farr as program lead for the Natural Disturbance Program. When the project report was received, the Board noted that the 20-kilometre grid proposed for sampling intensity, which might be statistically appropriate at a provincial scale, was not sufficiently intense to produce meaningful results at the scale of the 2.75-million-hectare land base of the model forest research area. The cost of implementation, estimated at $350,000 per year, could not be justified. The Local Level Indicators Program, initiated in 1997, held promise for monitoring at a working forest level, and it continued to move forward (see Chapter 4).

Farr then left the model forest to work with an Alberta Biodiversity Monitoring Program steering committee to secure partners and funding for an Alberta-wide program. On a contract with the model forest, he completed the design phase of the monitoring protocol in 2001. After another six years of lobbying and prototype development, the Alberta Biodiversity Monitoring Institute was established in 2007 as an independent non-profit institute and began its province-wide monitoring. The program continues today and was a significant element in the development of the Alberta Land-use Framework.

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CHAPTER FOUR

CCFM Criterion Two

Ecosystem Condition and Productivity

The Forestry Program

"The sustainable development of our forest ecosystems depends on their ability to maintain ecological functions and processes and to perpetuate themselves over the long term. Relative freedom from stress (stability) and relative ability to recover from disturbance (resilience) within a forest ecosystem indicate ecosystem condition. Productivity refers to the ecosystem's ability to accumulate biomass, which depends on the degree to which nutrients, water, and solar energy are absorbed and transferred within the ecosystem." –Canadian Council of Forest Ministers, 2005[1]

The Model Forest Program in Hinton built on a foundation of forestry and wildlife research that had been underway since the 1950s. The 1988 decision by (then) Weldwood of Canada to integrate these values into a wildlife-forestry program on its million-hectare industrial forest was the pillar upon which the 1992 Foothills Forest proposal was based and which contributed to its selection as the number one proposal of the 50 evaluated. As it passes its 25-year anniversary, this work continues to inform improved forest management practices in Alberta and beyond.

Forestry research underpins the economic viability of sustainable forest management and is a crucial complement to the environmental and social components. With most of the annual allowable cut (AAC) allocated to forest companies by the early 1990s, Alberta needed better knowledge of forest resources and processes, growth and yield rates, effects of management systems, impacts of other uses and users, and responses to wildfire and insects. Research projects focused initially on managed forests in the Alberta foothills, but many results proved applicable to adjacent parks and to other forests across Alberta and in neighbouring provinces and territories.

First Steps

When Natural Resources Canada announced the $100-million Partners in Sustainable Development of Forests Program in February 1991 under the *Green Plan*, there were three funds that offered opportunities for forestry research.[2] The $54-million Canadian Model Forest Program, the $33-million Enhanced Science and Technology Program, and the $13-million Improved Biomonitoring and Information Systems Program all held potential for forestry research of interest to the Foothills Forest proponents, particularly the Weldwood representatives on the planning team. The programs favoured proposals that included partnerships, and efforts advanced on all fronts to seek out such partnerships.

The Model Forest Program initially promised eight (the final number was 10) "working models of sustainable forest development" that would function as living laboratories for the most advanced scientific methods, techniques, and forestry practices, including new


Weldwood
LODGEPOLE PINE
HARVESTED 1982
SCARIFIED 1983
NEXT HARVEST 2068

approaches to collaborative landscape management and decision making. They were also intended to demonstrate Canada's leadership in forest management.

The Improved Biomonitoring and Information Systems Program was established for expansion of the data and information available on Canada's forests, including forest health biomonitoring networks, the expansion of permanent sample plot systems to monitor forest health, decision support systems, and enhancements to the national forestry database in which all provinces were cooperators.

The Enhanced Science and Technology Program offered funding for forestry practices, including engineering projects, forest fire technology development, integrated pest management technology development, ecological reserves, and ecological land classification. Non-forestry funding under this program included bio-energy projects, environmentally acceptable forest products and processes, and climate change research.

The Enhanced Science and Technology Program emphasized partnerships in research. Forestry Canada, with this in mind, began contacting the Hinton organizing committee with some potential silvicultural research opportunities on the proposed model forest land base, as did the Forestry Engineering Research Institute of Canada (FERIC) with forest operations research.

In October 1991, a delegation from Hinton went to Edmonton to scope out potential projects and collaborators at the University of Alberta, the Canadian Forest Service (CFS), and the Alberta Research Council. From these meetings, a forestry research program began to coalesce for the Foothills Forest proposal. Meetings with Jasper National Park also identified a number of forestry-related projects considered important, mostly in the areas of land base mapping, ecosystem classification, and fire management and prevention.

As plans progressed, Canada and Alberta announced the signing of a new Canada-Alberta Partnership Agreement in Forestry, a $30-million fund that might also be tapped into for forestry projects under the Model Forest Program.

In Alberta, the Alberta Forest Service (AFS) raised concerns about the amount of site disturbance attending forest operations. A joint committee of the AFS and the Alberta Forest Products Association was developing guidelines for allowable site disturbance, which would soon lead to a major study across Alberta, conducted by soil scientist David McNabb, on reducing the impacts of site disturbance and rutting in forest operations. At Hinton, responding to similar concerns, Don Laishley brought in Professor Hamish Kimmins, a renowned University of British Columbia forest ecologist, to review Weldwood's silviculture and forest operations. There is no doubt that his observations and a 1993 follow-up report by Kimmins and retired CFS silviculture researcher Lorne Brace led to the inclusion of a forestry program in Phase I of the Foothills Forest proposal and its later refinement in 1994.[3]

The 1992 Foothills Forest proposal included projects covering resource information and decision support systems, integrated resource management, and innovative forest operations. New information and new skills would be moved into operational practice as they were developed and proven effective. Forestry research was concentrated in three general areas:

1. Resource information and planning systems
2. Innovative forest operations
3. Innovative silviculture

By 1994, the committee had settled on the final suite of projects that would be addressed in Phase I of the Model Forest Program, and work was advancing, including the development of landscape planning and forecasting models, as well as conventional research into forestry practices and their effects on ecosystems, stand development, and the environment. Some of the more notable projects are discussed below.

The overall goal of the Foothills Forest was to develop an integrated resource man-

Opposite page: Forests, and their careful management, have been the mainstay of the Hinton economy since NWP&P established Alberta's first large scale management program in 1956.

agement strategy on the 1,218,000-hectare research land base on the Eastern Slopes of the Rocky Mountains that represented a balance of integrated resource management objectives. Issues were wide-ranging, encompassing prime watersheds serving the needs of large off-site populations, international tourism, delicate montane ecosystems, mining, oil and gas exploration and extraction, municipal and regional land-use zoning, and forestry operations under a multi-agency management authority.

Wildlife issues alone represented a formidable challenge to be incorporated within the decision support system (DSS). A recent inventory, combined with expected distributions, had identified 284 terrestrial vertebrate species, of which 218 were birds, 59 mammals, two reptiles, and five amphibians. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1991) had classified six of these species as vulnerable. There were 24 species of fish, 12 of which were sought by anglers.

> "I think the model forest at Hinton remained focused on more practical research because it was funded by a cooperative of funding agencies: industry, timber, oil patch, operational side of the government, the provincial government. It wasn't funded by lofty, just not close to getting the job done kind of agencies. It was funded by agencies and people that had their feet on the ground and needed to know more about what they were managing to get the job done. The research could be quite targeted, and I think it has been very targeted." –Cliff Henderson, retired assistant deputy minister of the Forest Management Division, Alberta Sustainable Resource Development, interview, 2016

Resource Information and Planning Systems

Forestry Manager David Presslee (1950–2000) was a passionate advocate of research informing forest management and initiated many trials and studies on the Weldwood FMA area.

Forest management was expected to be a major beneficiary of the revolution in information technology. The Foothills Forest was poised to take advantage of this revolution, given the history of the sponsors and partners already using geographic information systems and the extensive data that had already been collected for areas within the model forest research land base.

To this point, landscape forecasting in forest management plans had primarily dealt with timber and allowable annual cut development. The new challenge was to develop sim- ilar forecasts while integrating other values such as wildlife, fish, water, recreation, and public values into the mix, thus examining the influence of proposed forest management activities on these other values and making changes where needed. This required two major initiatives—the development of a data model to contain and analyze these multiple values and the development of a decision support system (DSS) that would allow the analysis and projection of values over time as a planning approach. Both were groundbreaking and formidable. A cadre of senior Weldwood foresters—Sean Curry, Hugh Lougheed, Brian Maier, and David Presslee—were the creative team that conceived and spearheaded these projects.

Extending and Upgrading the Digital Inventory for the Foothills Forest Area

Many of the decisions that must be made by resource managers are based upon spatial relationships between various resources on the land base, and the key to any spatial forest-level analysis is a correct and complete inventory. A spatial inventory for the entire Foothills Forest land base was completed in 1993, based on aerial photography interpretation, sample plot measurement, and other information sources. This inventory provided the foundation that would support the proposed DSS and all the associated models that would be created over the ensuing four to five years, such as the Landscape Planning Model. Database queries could be run to determine the amount and distribution of forest cover types and ecosystem associations across the Foothills Forest area, providing the baseline information needed to support long-term management goals. This seamless digital forest-cover mapping for the original land base of the Foothills Forest was continually refined and updated with new data. When Willmore Wilderness Park was added to the land base in 1997, the Phase 1 inventory was digitized and eight townships interpreted to the Alberta Vegetation Inventory (AVI) standard.*

Adaptation of the ArcForest Data Model to Multiple Resources and Values

A data model creates a stable, consistent format for storing information, allows applications and models to be developed with available information, and ensures compatibility between applications. The development of a data model is a very complex task if the model is to be both functional and flexible. ArcForest, a commercially available model from the Environmental Systems Research Institute (ESRI), seemed to offer a great opportunity for use as the shell for the Foothills Forest data model, saving considerable time and effort that would have been required to build a similar model from the ground up. Curry, Maier, and GIS analyst Carol Doering took on the project of configuring ArcForest to fit the data needs of the Foothills Forest, with ESRI as a contributing partner. Despite issues with ArcForest, a robust data model was developed and used in a 1999 forest management plan that encompassed one million hectares of the research land base.

The completion of this project led to solid partnerships between the Foothills Model Forest (renamed from Foothills Forest in 1994), Weldwood of Canada Ltd., The Forestry Corp., Alberta Environmental Protection, Lands and Forest Services, the Environmental Systems Research Institute, and the GIS staff from a number of forest industry and consulting firms. The major accomplishments from this project were the development of the Data Scoping Model (1993), the Logical Data Model (1994), and the testing of of two Universal Transverse Mercator (UTM) Map Sheet Areas.

> "During my three years at FMF, I would say there were three notable successes: a comprehensive data model, development of the GIS training lab, and recovery of GIS functionality for both FMF and Weldwood after the devastating office fire in 1993."
> –Carol Doering, Foothills Forest GIS analyst 1993–1995, questionnaire response, 2015

> "Foothills Model Forest was the first to attempt this type of development on a landscape with a large number of resources and values that had to be integrated, tracked, and managed in a GIS environment. The tools that came out of it are standard practice now for most forest companies." –Sean Curry, program lead 1993–1999, interview, 2015

Ecologically Based Planning – The Foothills Forest Decision Support System

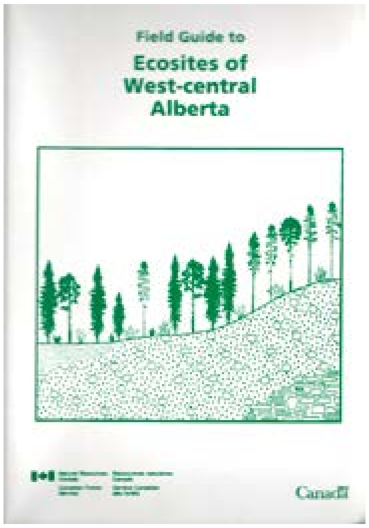
At the GIS'94 symposium in Vancouver, Sean Curry, Hugh Lougheed, and David Presslee described the key elements of the Decision Support System (DSS) Project underway at Foothills Forest,[4] intended to achieve the major goal of an integrated resource management strategy for the research land base, which was predominantly an industrial forest.

The historical approach to forest management planning was not amenable to multi-resource inventory and forecasting since it was primarily focused on forest growth and yield with simulated harvest and reforestation to produce estimates of sustainable annual cuts over long planning horizons. Inventories did not generally provide adequate information on other resources or the means to analyze the impacts of forest management strategies on those values, but new information from natural resource research and evolving public expectations about sustainable forest management were forcing the reevaluation of these traditional management approaches. Philosophies such as sustaining biodiversity, managing forest structure, protecting watersheds, maintaining long-term site productivity, monitoring the impact of global climate change, and addressing issues related to public values were all factors to be considered when calculating a sustainable timber supply.

* The Alberta government began its forest inventory program in 1949. The initial inventories included a broad-scale survey of most provincial forests (Phase 1) and a more detailed survey of the foothills region (Phase 2). A new round of updated surveys (Phase 3) began in 1970. In 1991, the government and the holders of forest management agreements (FMAs) adopted a standard called the Alberta Vegetation Inventory (AVI) as the minimum requirement for subsequent surveys. The AVI includes information about human use, water bodies, soils, and non-forest cover types in addition to tree stands.

A range of model forest projects were underway to develop this missing information, and the results would be incorporated into the DSS.

Ecosystem Classification



The updated 1996 field guide set the stage for large-scale ecological site classification across the model forest study area.

A new approach to forest inventory required a different methodology from conventional forest inventories that primarily dealt with forest cover types. The kind of understanding needed was at a level that transcended and integrated a number of resources into a foundation that would underpin all the resources. This foundation was the ecosystem association.

Sean Curry, working with David Presslee and Ian Corns of the Canadian Forest Service (CFS), initiated a project to design and implement an ecologically oriented classification and inventory of the model forest land base, initially using the *Field Guide to Forest Ecosystems of West-Central Alberta* (1986)[5] developed by Corns and Rick Annas. Classifying the landscape using this type of system creates a common, ecologically based foundation upon which resource-use decisions can be based. The challenge was to bring existing forest and soils classifications across the model forest land base (primarily Crown Management Units and Weldwood's FMA area in 1994) into a common, spatially correct set of forest cover types based on their ecosite classification. Permanent sample plots were also classified.

Updating the Field Guide

At Weldwood, Presslee was conducting a major field test of a preharvest assessment and planning system using the 1986 forest ecosystems field guide, and he observed that the guide had some serious flaws when it came to the Foothills Forest upper foothills and subalpine landscapes. Presslee recommended, and then oversaw, a complete update to the guide through the Model Forest Program. This separate project, which produced the *Field Guide to Ecosites of West-central Alberta*, was completed in 1996.[6] The revised guide continues to be used today.

The classification results were also incorporated into the NAIA* predictive ecosystem mapping tool, a joint venture of the Alberta Research Council (ARC), Hughes Aircraft of Canada Ltd. Spatial Data Division, Forestry Canada, and a number of forest companies. NAIA was refined into the Ecological Land Data Acquisition Resource (ELDAR) system through ARC's collaboration with the Northern Forest Centre of the Canadian Forest Service, the Foothills Model Forest, and the McGregor Model Forest in British Columbia. In 1997, ARC licensed marketing of ELDAR to Timberline Forest Inventory Consultants Ltd.[7]

* Though often capitalized, NAIA was a made-up name, not an acronym or initialism. Former Alberta Research Council biologist R. Keith Jones said the name was "meant to convey an affinity to Gaia," the Earth goddess in Greek mythology.

Managed Stand Ecosite Project

The 1996 field guide worked well for mature stands; however, there was no similar guide for immature stands. Dave Presslee and Ian Corns initiated the Managed Stand Ecosite Project to redress that shortfall, producing the *Field Guide to Ecosites of West-central Alberta: Supplement for Managed Stands* (Corns et al. 2004), with the cooperation of a number of Alberta companies. This predictive field guide was valuable in many ways as a tool to forecast the development of understorey vegetation for wildlife habitat, as well as post-harvest stand development by ecosite and regenerated stand performance in timber supply analysis.

Jasper National Park Ecosite Mapping Project

Jasper National Park added its land base to the model forest research area in 1995. A common ecological land classification for the expanded model forest land base was a critical need for such priorities as looking at the cumulative effects of regional land use in planning and management. Individual managers could look at how management activities within their respective areas related to neighbouring jurisdictions. The common classification would become the foundation for joint management initiatives to address common regional issues such as fire management, grizzly bear and caribou management, mountain pine beetle, watersheds, fisheries, and access concerns.

In 1997, George Mercer, Jasper National Park's model forest liaison officer, began working with Ian Corns and others to adapt the park's biophysical inventory into the west-central ecosite classification system.

> "Working on the common Ecological Land Classification gave me the opportunity to meet and work with some of the top land classification experts in western Canada, if not North America, and opened my eyes to the challenges of being able to "speak the same language" when it came to dealing with landscape-level issues and species that operated at those scales." –George Mercer, author and retired national park warden, personal communication, 2016

Mercer is now retired and living on the Saanich Peninsula of Vancouver Island. He is writing a series of novels drawn from his experiences working in the national park system. The first three novels, *Dyed in the Green*, *Wood Buffalo*, and *Jasper Wild* are available in bookstores across Canada.

Landscape Forecasting

The second phase, and the heart of the DSS framework, was a landscape forecasting model capable of simulations of the full range of both natural and anthropogenic changes to forest structure over an extended planning horizon on the order of 200+ years—twice the normal stand-level rotation. Initially, this model was intended to provide spatially explicit inventory projections of various values at desired time intervals in relation to the schedules set out in management plans, but difficulties with computer-generated simulations of some patterns such as cutblocks led to a combination of spatial and non-spatial attributes in planning at that time.

Assessment Models

A set of assessment models comprised the third phase of the DSS. Each inventory "snapshot" was to be assessed by a model that determined resource values resulting from the various changes over time.

Socio-economic Analysis

The final phase of the DSS was to be a socio-economic analysis evaluating the resource values for each management scenario. Tradeoffs among competing resources and relationships between compatible resources were to be demonstrated by examining resource values within and between different scenarios. Interactions between disturbances and resource values would also be discovered and additional scenarios developed, with explicit recognition of the losses or gains in choosing any scenario set forward when a final selection was made.

Application of the Decision Support System

The very last piece of the DSS—the modelling tool itself—was left unfinished.

> "The most notable disappointment was the failure to develop the DSS as planned. The plan to develop a DSS was a lofty goal, but it was exciting! However, I don't think that potential was anywhere near realized …" –Carol Doering, GIS manager 1993–1995, questionnaire response, 2015

Brian Maier of Weldwood, who was involved in the planning for the Foothills Forest proposal and initially worked with Carol Doering on scoping out the DSS tool, acknowledged this "failure" but suggested that the proponents may have been overly sanguine about what was possible given the technology and the state of knowledge at the time.

> "I think in the early '90s, our understanding of what a decision support system (DSS) was, or could accomplish, was a bit naïve. I think most of us thought (at the time) that implementing ArcForest would provide the framework over which there would be this 'system' that would do some magic around assessment of resource values and resource allocation. But we found out that this was far too complicated. First, the ArcForest framework was too rigid to even adapt to Alberta's AVI-style inventory, and the product was not easily adapted to put in different forest growth models. So with the framework questionable … how does one implement a useful DSS? As research proceeded in the various programs, it became clear that a useful DSS is really a set of decision support tools (DST) which, in combination, provide an overall 'system' for resource assessment, evaluation, allocation, and monitoring. I wonder why we didn't see this earlier."
> –Brian Maier, questionnaire response, 2015

In the end, Maier noted, "the DSS 'failed' because we did not implement a physical data model and application code to provide a 'system' that would allow a certain level of resource analysis and allocation. In a perfect world, the DSS should have allowed us to 'plug in' tools such as Woodstock, or NEPTUNE, or any other analytical tool."

The Forestry Corp.

Brian Maier left Weldwood in 1994 to become one of the owners, and the GIS manager, of a new consulting company, The Forestry Corp. (now FORCORP Solutions). As an active partner with the model forest, the firm provided data management, program coding, and GIS assistance for the Watershed Program, particularly the development of the WRNSFMF Model (Water Resource Evaluation of Non-Point Silvicultural Sources for the Foothills Model Forest). Later, it helped the Natural Disturbance Program in support of the tools and systems developed for the model forest, such as NEPTUNE (New Emulation Planning Tool for Understanding Natural Events) and the OnFire Annotated Research Database. Also, it helped develop the mountain pine beetle decision support tool. The company's commitment to the Model Forest Program was tangible, contributing 10 days per year of free consulting services above their paid service over many years in support of these and other developments.

However, the conceptual framework of the Foothills Model Forest DSS was adopted for Weldwood's 1999 *Detailed Forest Management Plan* DFMP), authored by Hugh Lougheed. This plan was the first methodical attempt by a forest company (or government) to incorporate multiple resource values into an analytical framework and develop a system to evaluate chosen resource strategies on a range of resources. For this, Lougheed turned to the Woodstock Forest Modelling System, a commercially available software tool that could be adapted for the purpose.

> "The [1999] *Detailed Forest Management Plan* (DFMP) followed the process envisioned by the DSS. Inventory, landscape forecasts, and resource values (visual quality, habitat, range of natural variability, hydrology) were iteratively and collectively assessed in developing a compartment harvest schedule that satisfied target parameters. Each step of the process required developing new information, models, or analytical approaches, which can be fairly unique to each forest situation. The take-away for me is that the process was successfully implemented in an operational environment (the plan was developed in a collaborative manner—IRMSC,* FRAG,† and ultimately approved). I recall a conversation

* Integrated Resource Management Steering Committee

† Forest Resource Advisory Group

with a young fellow from CPAWS[*] who participated in the 2004 ForestEthics[†] (Berman, Lafcadio) tour of the FMA. He said the plan clearly identified the 'state of knowledge,' acknowledged the unknowns, developed a course of action to implement the plan, but also addressed those key unknowns (referenced in the 'commitment matrix')." –Hugh Lougheed, Ontario Ministry of Natural Resources, personal communication, 2016.

As Brian Maier later noted:

"So, we are all correct in what we are saying. Carol [Doering] is correct in that it was a 'failure' from the perspective that we didn't implement the chosen framework. But we didn't implement it after a fairly exhaustive review that concluded that the framework was too rigid, would be onerous to manage, and (at the time) did not have the necessary flexibility to plug in models. But Hugh still adopted a set of tools that allowed the forest planning to be successfully completed by using the framework of a DSS (i.e., integrated information management with respect to resource data and resource values with an operational environment)." –Brian Maier, personal correspondence, 2017

Across the Rockies, the McGregor Model Forest was developing a sophisticated Scenario Planning Tool for landscape forecasting, and there were some discussions about combining this with the Foothills DSS; however, this was unfortunately never realized. Subsequent events make this speculation moot because in 2006, the provincial government produced its new *Alberta Forest Management Planning Standard*, which set out the planning approach to be used, along with the indicators to be measured, based on the Canadian Standards Association forest certification standard.[8] Soon after, the government modified its planning requirements in response to recommendations by the Forest Industry Sustainability Committee,[9] a group of forest industry representatives and members of the Alberta Legislative Assembly. The Government of Alberta assumed more direct control over which fine-filter species habitat models were to be used and how, wildlife habitat supply, wildfire threat assessment, watershed analysis, and pest surveys. Although FMA holders are still (in 2018) required to incorporate many of these values into their resource analysis, the tools to be used and the interpretation of outcomes are largely determined by the provincial government. This is somewhat complicated by the segregation of responsibilities, previously contained within Alberta Sustainable Resource Development, into the new departments of Environment and Parks (wildlife, land management) and Agriculture and Forestry (forest management, fire protection). However, the concept of incorporating natural disturbance into forest management plans, as described in Chapter 3, remains a priority.

"The relationship between government and industry has changed significantly since 1999—there is now less room for innovation as the government wants all plans and the reports of all plans to look the same. The 2014 *Forest Management Plan* for the Hinton FMA, however, fully incorporated, for the first time, the concept of managing within the natural range of variability [NRV] based on a full analysis of the Hinton FMA by Dave Andison. It looked at hundreds of different NRV variables over 200 years, with a wider range of seral stage definitions and landscape projections at five different points of time. The coarse-filter NRV strategy is a better, more defendable way of developing a long-range plan. Analysis of fine-filter species over that time clearly supported the concept 'manage for natural patterns on the land base and you will, by default, be managing for biodiversity.' While we have issues with the way the Province is applying fine-filter models and analysis, we continue to find the work of fRI Research very useful in adapting our forest practices to enhance habitat and

* Canadian Parks and Wilderness Society

† ForestEthics (now known as Stand) is a U.S.-Canadian environmental advocacy organization founded in 1999. It waged campaigns in the 2000s against various forest operations and products, including pulp from Hinton. Tzeporah Berman and Lafcadio Cortesi were representatives of this group.

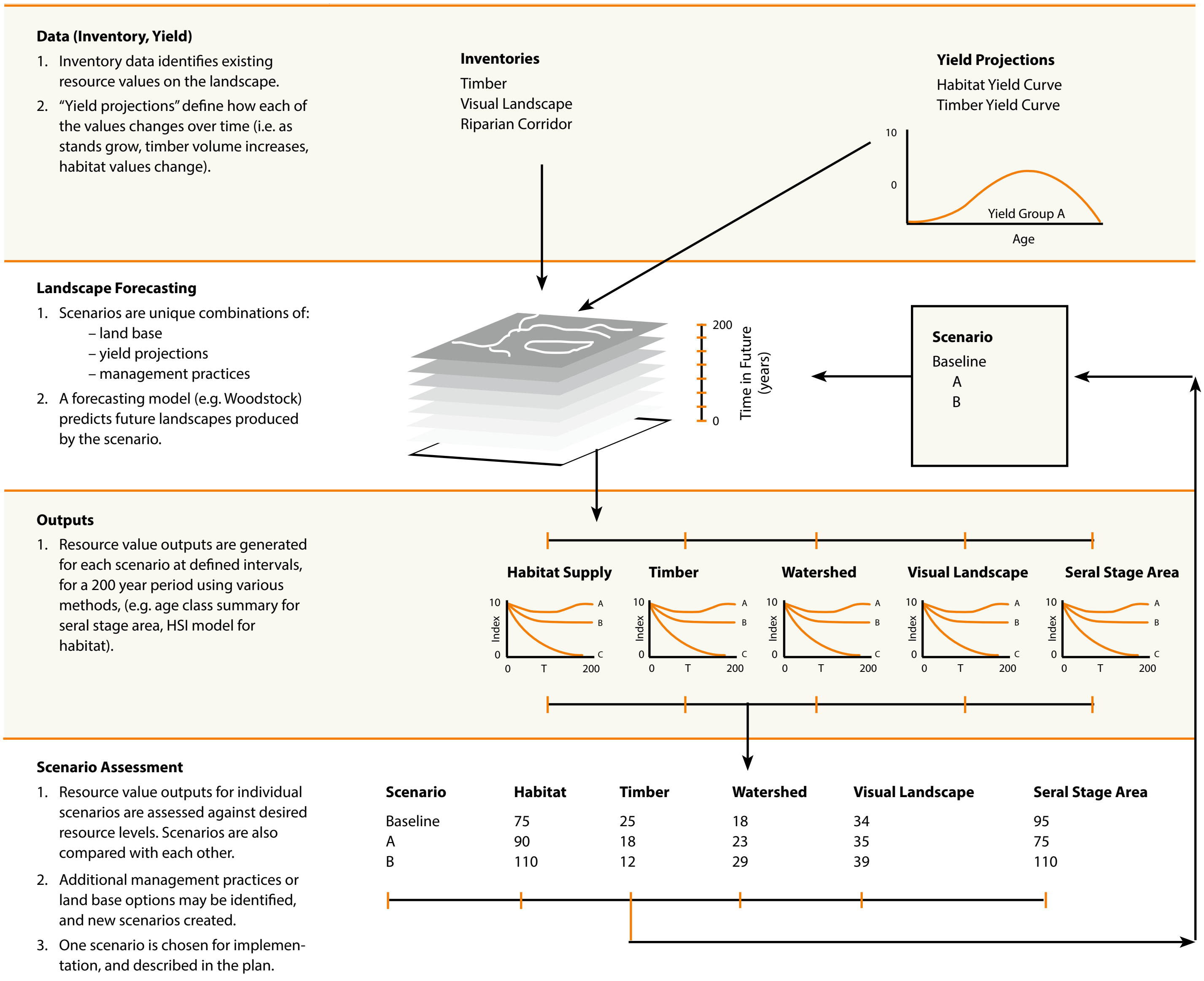


Figure 4-1. Resource analysis concept from the 1999 Detailed Forest Management Plan, Weldwood of Canada Ltd., Hinton Forest Resources.

security for grizzly bears on the FMA." –Aaron Jones, management forester, Hinton Wood Products, personal communication, 2016

Innovative Forest Operations and Innovative Silviculture

In partnership with the University of Alberta, Forestry Canada, and the Alberta Research Council, a number of forestry and operational research projects were advanced in the first five years of the program. Some of these were already underway when the model forest began, others were designed and implemented as model forest projects, and some (e.g., the site impacts work) were contributions to the larger research projects of other agencies.

Table 4-1 provides a list of these projects. Some reports may be found on the fRI Research website, while others exist as master's or PhD theses on various university websites or in associated research agency records.

The largest project was the Shelterwood Practices study at $174,000, established on the Weldwood FMA. Before the trial, the site was occupied by a mature spruce-aspen mixedwood forest. In a shelterwood system, the old stand is removed in a series of cuttings to promote the establishment of an essentially even-aged new stand under the shelter of the old one. The primary goal is to protect and shelter new regeneration established on the for-

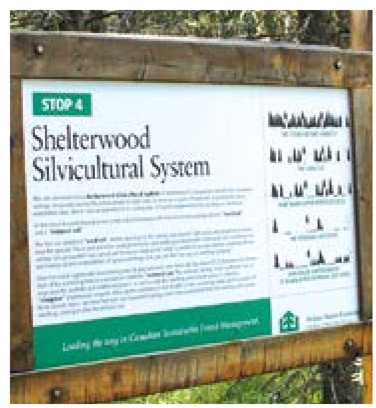
Project	Working Group Coordinator	Research Agency – Lead Researcher	Budget
Effect of Timber Harvesting Methods on Terrestrial Lichens and Understorey Plants in West-Central Alberta	Rick Bonar	University of Alberta – Ken Kranrod	$40,000
Effect of Management on Genetic Diversity of Lodgepole Pine and White Spruce	Rick Bonar	University of Alberta – Ellen MacDonald	$40,500
Validation of Basal Diameter Ratio Competition Index for Pine/Aspen	Bill Rugg	Canadian Forest Service – Dan MacIsaac	$25,500
Chipper Residue Disposal Impacts	Bill Rugg	Canadian Forest Service – Doug Maynard	$62,500
Aspen Regrowth/Competition after Mechanical Release of Conifers	Bill Rugg	Canadian Forest Service – Stan Navratil	$63,500
Tree Growth and Stand Yield Impacts of Basal Girdling by Small Mammals in Pole-sized Lodgepole Pine	Bill Rugg	Canadian Forest Service – Imre Bella	$40,500
Shelterwood Practices to Enhance/Protect White Spruce Regeneration	Bill Rugg	Canadian Forest Service – Stan Navratil; University of Alberta – Vic Lieffers	$174,500
Environmental Impacts of Forestry Practices on Boreal Mixedwood Ecosystems	Bill Rugg	Canadian Forest Service – Ian Corns	In-kind
Modelling Soil Compaction, Decompaction, and Tree Growth on Alberta Forest Soils Following Harvesting	Bill Rugg	Alberta Research Council – Dave McNabb	$67,000
Horse Grazing Impacts and Strategies	Sherry Maine	University of Alberta – Barry Irving	$47,200

Table 4-1. Forest Operations and Silviculture Research Projects, 1992–1997.

est floor until overstorey shading inhibits growth, at which point another removal may be required. In this project, two different intensities of overstorey removal were applied, and white spruce was planted using different site preparation techniques to study the resulting survival and growth of the trees. At the time of the "final" report, only three years had elapsed, perhaps too soon to confidently say which treatment was the most effective.

Plans to establish a second installation in the Cache Percotte Forest, as originally proposed in 1991 by the Hinton Training Centre, went to the design phase in 1994 but were unfortunately cancelled in 1995. Such a demonstration in Hinton's backyard would have been a remarkable public communications opportunity. As was the case with many other model forest and fRI-funded projects, especially post-graduate theses, a final report was not delivered to the model forest; this one was published in the *Forestry Chronicle*.[10] This shortfall in reporting has recently been corrected by fRI Research, and now all projects funded by fRI Research must produce a final report to the organization.

Although most of the projects were completed, there were several that would have benefited from follow-up remeasurements; e.g., the lichen, shelterwood, and environmental impacts studies. With the cancellation of the forestry program at the end of Phase I, this follow-up was left to the agencies doing the original studies and, in most cases, did not happen. In 2016, plans were afoot to revisit the lichen study under the new Caribou Program at fRI Research.



In the 1990s, Weldwood established a silviculture interpretive trail near the McLeod River Campsite south of Hinton. A shelterwood cut was one of the features.

Another interesting project, managed by Weldwood's Sherry Maine, had grad student Barry Irving doing a study on the potential of coordinating forest regeneration with horse grazing. Local outfitters John Groat and Bill Gosney assisted, John with his horses and expertise and Bill with his expertise. The study was inspired by long-standing arguments between outfitters, the forest service, and Weldwood and its predecessors. The resulting master's thesis and 1998 report to the FMF[11] concluded that with proper coordination and planning, horse damage could be minimized in regenerating cutblocks. Damage, when it occurred, was generally confined to trampling or scarring and occurred primarily during the summer months, particularly if trees were less than 50 centimetres high or growing on moist sites.

> "My biggest disappointment of my program was how it [the forestry program] just fell off the radar screen. A lot of time, effort, and money went into establishing numerous research trials, and although some short-term results were beneficial, the long-term results would have really told the story. I feel that we probably missed a great opportunity to expand our knowledge by not continuing monitoring these projects." –Roger Hayward, Foothills Forest operations forester 1992–1994, questionnaire response, 2015

> "I recall that the projects that I had been supervising—that didn't get extended when there was another extension to the FMF program—were continued by Weldwood. FMF was taking another direction and were not going to continue 'operational projects.' There wasn't going to be room for me at FMF at that point, so I took my cue and went to the U of A to do my forestry degree."
> –Kent MacDonald, Foothills Model Forest operations forester 1994–1997, personal communication, 2016

Enhanced Forest Management – The 1997 Proposal

Enhanced forest management (EFM) is undertaken to increase the productivity of stands above that of unmanaged stands or stands managed to basic forest management standards. It includes silvicultural activities that increase the growth of stands, such as juvenile or commercial thinning, introducing and managing exotic species, tree improvement, and fertilization.

In the mid-1990s, Alberta was in the midst of an unprecedented expansion of the forest industry. Public pressure for management of a broader range of values, including new protected areas, in a sustainable forest management framework raised concerns about the industry's competitiveness and ability to maintain annual allowable cuts. In response, a joint industry-government task force was struck to examine the opportunities for sustaining or increasing annual allowable cuts through intensive management, and the group presented their report in January 1997.[12] The Foothills Model Forest turned its attention to an enhanced forest management program in Phase II of the Model Forest Program, based on the contents of the draft task force report (1996). Sean Curry recommended to the Board that the Foothills Model Forest act as a host agency for an emerging EFM cooperative in Alberta. This co-op proposed a $313,000 annual program (self-funded) and needed an agency that could host as well as coordinate the program.

This was consistent with the intent of Canada's Model Forest Program to include "working forests," with the production of fibre as one of the traditional resource outputs. Research work in this subject area would not only look at the traditional growth and yield response derived from a variety of management actions, but would also evaluate the effects that such practices had on a broader range of values, an important element in determining the sustainability of such practices into the future. Although the projects were not yet determined, conceptually, the plan was to:

1. Test and evaluate the pre- and post-harvest implications of various enhanced silvicultural treatments on a variety of forest values through a series of operational trials, research trials, and pilot projects
2. Evaluate the environmental, economic, and social cost/benefits of such treatments

Curry was asked to provide more details on how this collaboration might work to the advantage of both the model forest and the EFM cooperative, but Curry left Alberta soon after. Both the cooperative and the model forest EFM program foundered. In February 1998, with no further activity of the EFM co-op, the Board decided to proceed with an EFM

Program in collaboration with an existing program at Weldwood and with support from the provincial government. That spring, the FMF received a $3.2-million grant from the Provincial Environmental Enhancement Trust Fund, which provided some flexible funding to at least initiate the EFM Program, which Bob Udell recommended to the Board.

Local Level Indicators of Sustainable Forest Management

> "I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be". –Lord Kelvin, 1883

Development of local level indicators of SFM, based on the 1995 CCFM's *Criteria and Indicators (C&I) of Sustainable Forest Management*, was a requirement of all model forests in Phase II. The local indicators were intended for use by land-based partners in their management plans to measure their performance in implementing SFM "on the ground."

Relationship between Goals and Indicators

A *goal* in the context of SFM is a broad, general statement that describes a desired state or condition related to one or more forest values. Other definitions were:

- **Value:** a principle, standard, or quality considered worthwhile or desirable
- **Objective:** a clear, specific statement of expected quantifiable results to be achieved within a defined period of time related to one or more goals; commonly stated as a desired level of an indicator
- **Indicator:** a measurable variable used to report progress toward the achievement of a goal

The model forest proposed organizing indicators within the criteria categories identified by the Canadian Council of Forest Ministers:

1. Conservation of biological diversity
2. Maintenance and enhancement of forest ecosystem condition and productivity
3. Conservation of soil and water resources
4. Forest ecosystem contributions to global ecological cycles
5. Multiple benefits to society
6. Accepting society's responsibility for sustainable development

In 1998, W.R. (Dick) Dempster facilitated a workshop to set this initiative in motion.[13] The committee clarified the definitions of goals and how to define the interest each partner had in a particular goal. The following classification of goals was recognized as useful:

1. **Owned** goals of a partner are fundamental to the internal values, mandate, mission, or charter of the partner organization and not imposed by external authority or societal values. The partner will normally wish to set indicators and objectives, and to take a lead role in forecasting and monitoring performance against these goals.
2. **Adopted** goals originate externally but are accepted by, or imposed upon, a partner. The partner will normally wish to agree on indicators of performance and be willing to modify conflicting objectives and share in the cost of forecasting and monitoring performance.

Dick Dempster facilitating the 1998 workshop, with Weldwood's Marsha Spearin, who was also secretary to the model forest Board, taking notes.

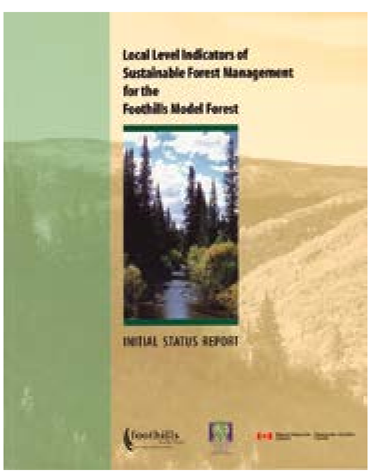
3. **Recognized** goals are accepted as valid aims of others. However, the partner may be unwilling to modify conflicting objectives and to incur uncompensated effort in forecasting and monitoring performance.
4. **Disputed** goals are not accepted by the partner as valid aims. The partner will likely contest any activities in pursuit of this goal but otherwise not willingly participate in monitoring.

Representatives from Alberta Environmental Protection, the Canadian Forest Service, Jasper National Park, and Weldwood collectively participated in the goal-setting exercise and developed a set of commonly held goals that formed the basis for the development of local indicators. In developing the Local Level Indicators Program, the committee agreed to focus on Categories 1 and 2 as *common goals* for which indicators would be developed. An initial suite of 30 priority indicators were selected. The project was coordinated by Rick Blackwood until he left FMF in 2000, and then by Rick Bonar, Mark Storie, and Gord Stenhouse. Christian Weik did the heavy lifting to coordinate and produce the first report in 2002. The report, *Local Level Indicators of Sustainable Forest Management in the Foothills Model Forest*,[14] was undertaken to provide information on the state of the forest and on forest land uses, and provided initial benchmark reporting on a "starter" set of 39 indicators, including data collected up to and during the year 2000. It was expected that more indicators would be reported upon in the future.

This indicator set was used in the *Northern East Slopes Integrated Resource Management Strategy* and assisted Weldwood in its development of indicators for its successful Canadian Standards Association certification bid, as well as for its 1999 Forest Management Plan, and Jasper National Park was using the indicators report for updates to its management plan. A 2008 follow-up report included more indicators and measurements, and was coordinated by GIS manager Debbie Mucha.[15] Mark Storie, former General Manager, said the process had many indirect impacts on government policies, including his later work with Alberta Environment and Parks.

> "There were a lot of government people that were on this [indicators] working group. I think for the government, it got them thinking about how to measure things and how to connect these things together. Even though this report didn't maybe get used a lot, I think it's sort of helped people wrap their minds around the concept. They were able to sort of talk the same language. I think in that respect, I think this was successful." –Mark Storie, interview, 2015

In 2006, when Alberta Sustainable Resource Development produced the *Alberta Forest Management Planning Standard*,[16] the *Local Level Indicators Report* was consulted. The values, objectives, indicators, and targets (VOITs) were prescribed in Annex 4, and this list became the ongoing standard for new management plans in the province.



The 2002 Local Level Indicators Report.

> "From a regional director's perspective, FMF research programs such as the Grizzly Bear, Water, and Caribou Programs provided the scientific background to enhance decision making by regional planning and compliance staff. FMF research also guided decision making by the Northern East Slopes regional executive team. Programs such as Natural Disturbance and Local Level Indicators contributed to building cooperation and dialogue with the forest industry, particularly in the development of a linked forest management planning process. At a provincial level, the Local Level Indicators Program contributed to the development of *Alberta's Forest Management Planning Standard* and the adoption of CSA Z809 as a standard." –Jerry Sunderland, former Board member and regional director, Northern East Slopes, questionnaire response, 2015

A group picture of the 1999 Growth and Yield Tour—about to throw snowballs at Bob Udell, taking the picture—at the Muttart Forest near Nojack.

The Foothills Growth and Yield Association, 2000

In June 1999, the Foothills Model Forest contracted Dick Dempster with a two-year mandate to develop a lodgepole pine growth and yield cooperative to investigate enhanced forest management and growth and yield. Dempster reviewed background work, consulted with industry and government, and reviewed a number of research installations throughout the Eastern Slopes. Growth and yield needs were assessed. Later in the fall, Dempster, Bob Udell, and Thomas Braun of Weldwood, with the invaluable assistance of Stan Lux of the CFS, organized a field tour of historic (mainly CFS) lodgepole pine growth and yield research trials in Alberta. In October, Dempster proposed and the Board approved steps to establish a cooperative program. Dempster held a workshop with potential cooperators, including nine Alberta FMA holders who saw a critical need for cooperative forecasting and monitoring of managed stand growth and yield and who agreed to partner in advancing this initiative.

On April 1, 2000, the members of the Foothills Growth and Yield Association (FGYA) entered into a formal agreement with commitments for participation, personnel, industrial funding, project development, dissemination of information, and protection of rights and privileges. Its mandate was to:

- Forecast and monitor managed stand growth and yield in the foothills natural sub-regions of Alberta, particularly of lodgepole pine, the predominant commercial tree species of the foothills
- Promote cooperation, knowledge, shared responsibility, and continuous improvement in the sustainable management of lodgepole pine
- Facilitate the scientific development and validation of yield forecasts used by members in the development of their forest management plans

Nine companies, all holders of major forest tenures, participated as voting members and sponsors:

- Alberta Newsprint Company
- Blue Ridge Lumber
- Canfor
- Millar Western Forest Products
- Spray Lakes Sawmills
- Sundance Forest Industries
- Sunpine Forest Products
- Weldwood of Canada
- Weyerhaeuser Canada

The Land and Forest Division of Alberta Sustainable Resource Development and the Foothills Model Forest were non-voting members, and the FMF was the coordinating agency, providing accounting and administrative support. The FGYA established ties with other agencies having shared interests, including the Canadian Forest Service, the Alberta Research Council, the University of Alberta, the B.C. Ministry of Forests, and various industrial cooperatives. Besides program planning and management, it centralized fieldwork coordination, technical meetings, field tours, data analysis, and dissemination of information.

This remarkable enterprise paved the way for a series of subsequent collaborations that would seek out the model forest to host their programs, provide administrative and accounting services, and offer opportunities for collaborative effort with groups such as the Foothills Stream Crossing Partnership (FSCP), the Foothills Landscape Management Forum (FLMF), Tree Improvement Alberta (TIA), the Alberta Forest Growth Organization (AFGO), and the Forest Growth Organization of Western Canada (FGrOW).

Since work began in 2000, the FGYA has learned much about the establishment and growth of managed lodgepole pine stands. In 2011, the FGYA produced its 10-year report on projects, showing remarkable progress on a number of fronts, from which we have extracted some of the ensuing text, supplemented with additional information to 2016.[17]

> "I think that the FGYA has played a really important role in providing information about managed stands that has been lacking in Alberta and has done it in a way that is bringing important tools, such as the FRIPSY [Foothills Reforestation Interactive Planning System] regeneration model, to the hands of practitioners to change forest management practices." –Sharon Meredith, director of FGrOW, interview, 2016

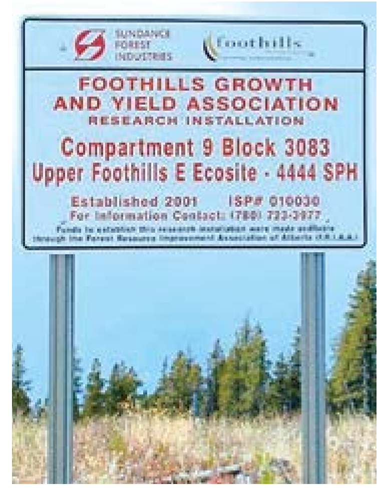
Shared Directions

In the beginning, the FGYA focused research into forecasting the development of post-harvest managed stands. This was particularly important since the pending refinement of regeneration standards in Alberta would need to be linked to growth and yield. However, FGYA members also recognized that experimentation and assessment of fire-origin stands continued to be relevant and necessary for yield forecasting and sound silvicultural decision making in post-harvest stands, as well as the ability to predict responses to potential interventions such as thinning and fertilization.[18]

Given this, the association directed research into priority areas:

1. Responses to planting, vegetation management, and density regulation treatments in post-harvest regenerated stands.
2. Mortality, forest health, and risk management in post-harvest regenerated stands, including the effects of climate change. This includes the impact of

mountain pine beetle on forest health and post-beetle regeneration and stand management strategies.
3. Investigations of spacing, tending, nutrition, and thinning in post-harvest regenerated stands, including the application of results from density and nutrition management trials in fire-origin stands.
4. Impacts of density management on wood quality over time, through work undertaken by the Canadian Wood Fibre Centre with the FGYA assisting in field measurements.



Regenerated lodgepole pine plot sign, Sundance Forest Products. *Courtesy FGrOW*

"Gordon Baskerville, former dean of forestry at the University of New Brunswick, said it best—and frequently—'What gets measured, gets managed.' The forest management planner who sets out to determine appropriate and sustainable harvest levels across time is beset by uncertainty without the scientific foundation with which to assess or measure the productive capacity of lodgepole pine ecosystems, and the rates at which both fire-origin and regenerated stands establish and grow across a range of conditions and management regimes. This is the challenge that brought together and sustained the partnership of the Foothills Growth and Yield Association." –From the FGYA 10-year report, by Dick Dempster and Bob Udell, 2011

Projects and Field Trials

By 2010, the FGYA had established seven projects throughout nine forest management areas covering most of the foothills region. The new trials, backed up by earlier and supporting studies, greatly improved the ability of foresters to use early surveys and other available stand information to quantitatively project regeneration performance in relation to site quality and silvicultural treatments.

Regenerated Lodgepole Pine (RLP) Trial, (2000)

This trial was the first major effort of the association and continues as its flagship project. Most of the earlier silvicultural research on lodgepole pine in Alberta focused on fire-origin stands. This left a major gap in our knowledge of the growth and yield of regeneration following harvest. The effects of site quality, stand conditions, and reforestation treatments on the establishment and performance of both natural regeneration and planted stock are complex and difficult or impossible to assess without controlled experimentation.

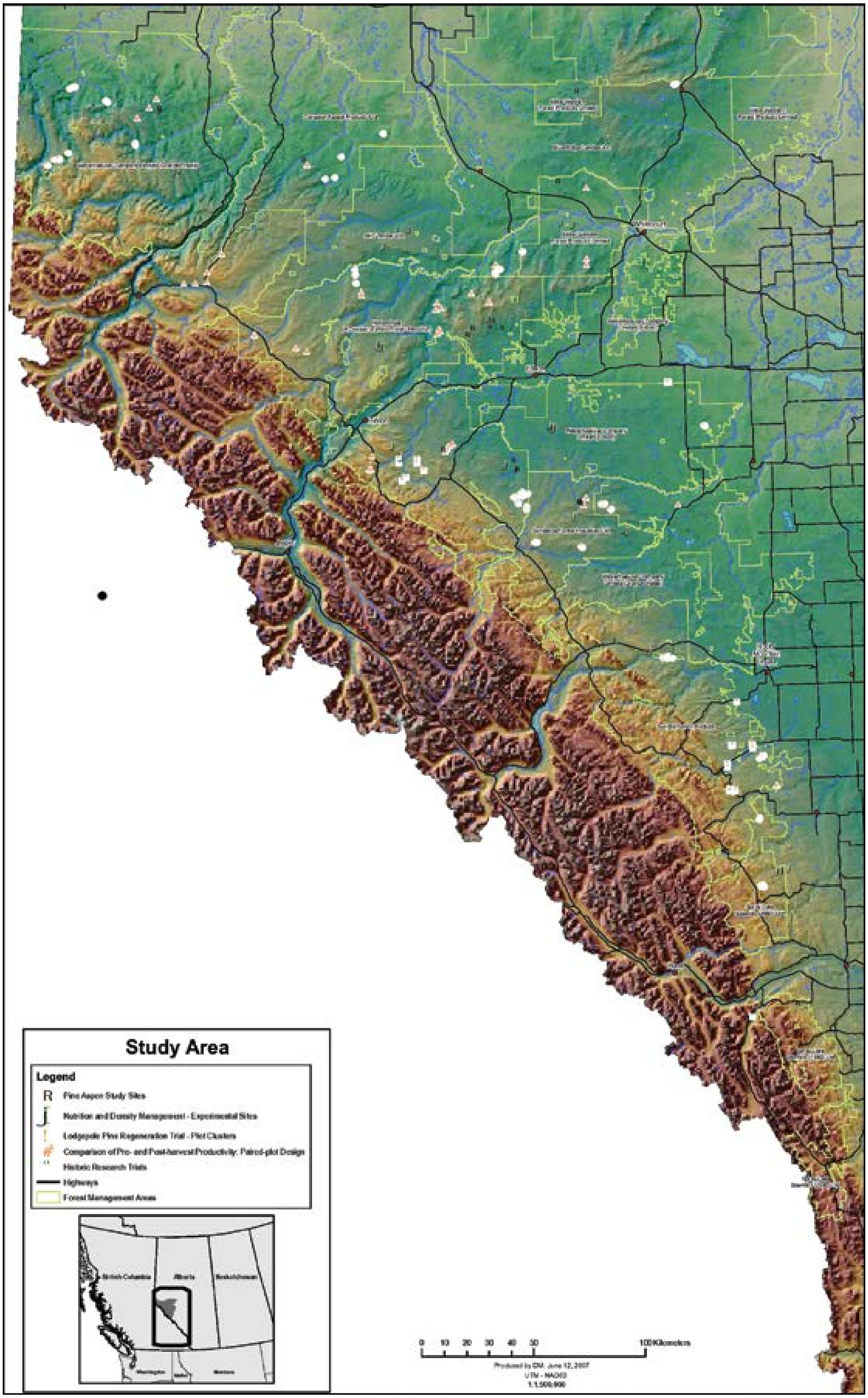
Beginning in 2000, the FGYA installed 408 field plots across the forested landscape of Alberta to annually measure, monitor, and forecast the development of lodgepole pine regenerated after harvesting under different management regimes (see Map 4-1). FGYA member companies installed the plots and began measuring them every second year, with mortality checks in the intervening years and other treatments when scheduled (weeding, weeding and spacing, spacing only).

Prediction of Regeneration Performance

Analysis and reports from the RLP project have provided a basis for: (a) forecasting early development of lodgepole pine stands against the *Reforestation Standard of Alberta* (RSA); (b) linkages between initial stand conditions and achievement of yield targets at rotation; (c) identifying what silvicultural treatments are required to meet RSA and yield targets; and (d) prediction of tree mortality and risk of regeneration failure from climate variables, thereby not only improving short-term prediction of crop performance, but also providing a basis for assessing the impacts of future climate change.

By 2015, the RLP Trial had been measuring the same plots from establishment stages through the full 14-year regeneration phase as prescribed in the RSA, and it developed FRIPSY (the Foothills Reforestation Interactive Planning System), a decision support tool

Map 4-1. FGYA experimental and monitoring sites in Alberta, 2010.



based on the RLP Trial's 14 years of measurements. For the first time, planners could confidently predict lodgepole pine establishment and performance results based on site, stand, site preparation, planting, and vegetation management factors. The resulting performance forecasts include stand variables used in the government-approved Growth and Yield Projection System (GYPSY),[19] a major development for silviculturists and forest planners. The two models are now integrated to provide a tool for forest management planning by linking post-harvest treatment options to final stand performance and AAC contribution, a remarkable achievement.

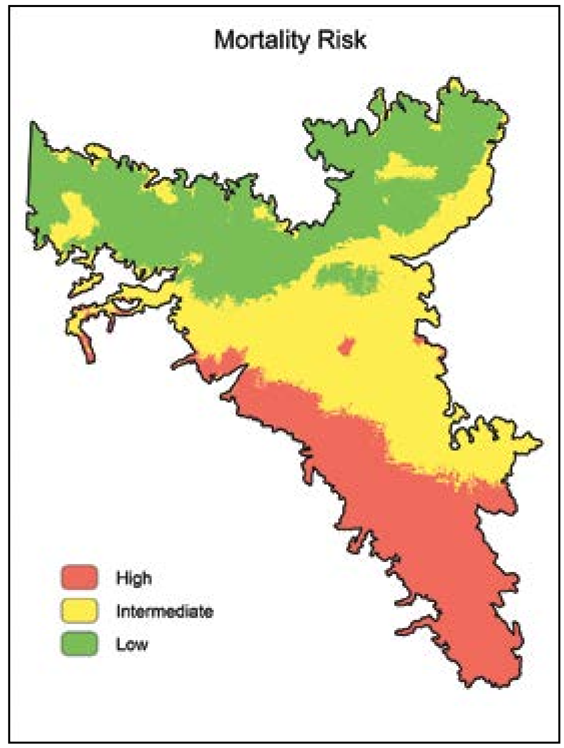
The measurement program will continue as these plots grow towards maturity.

Climate Impacts

In 2016, the FGYA, now renamed the Foothills Pine Project Team of FGrOW, continued to examine the strong linkages already identified between site, climatic factors, and the health and mortality of lodgepole pine, with the assistance of improved and map-based tools to predict mortality and health risks. Climate change is complicating the forecasting of growth and yield, and this problem is not confined to uncertainty introduced by the mountain pine beetle epidemic. Mean annual temperatures in the study area increased 0.8°C over the 25 years leading up to 2010. This trend, in conjunction with a reduction in precipitation, has led to higher drought indices, and appears to be increasing the susceptibility of young lodgepole pine not only to direct climate injury, but also to mortality from root disease, root collar weevils, and other pathogens.

Mortality trends indicated from the RLP Trial in 2010 were compared to those collected in an earlier study by CFS researcher Bill Ives[20] and show remarkable consistency. More recent data and in-depth climate modelling suggest the apparent trend of increasing mortality with temperature is actually the result of stress induced by increased evapotranspiration (drying) during warm, frost-free periods. However, although mortality and disease increase with summer evapotranspiration, they also decrease with increasing spring temperatures, which may be allowing improved water uptake.[21] This has complicated the prediction of mortality and disease response to climate change, but the development of a model predicting the combined effect of both summer evapotranspiration and spring temperature has provided a basis for mapping the risk of juvenile mortality (see Map 4-2). Furthermore, the RLP study is showing that appropriate silvicultural treatments can play a major role in reducing these risks. The most effective strategies appear to be site preparation methods that improve soil-water relations and encourage abundant natural regeneration. On many sites, the ingress of natural regeneration is more than sufficient to offset high mortality.

Map 4-2. Risks of juvenile pine mortality related to average spring temperatures and evapotranspiration in Alberta's lodgepole pine growing range. *Courtesy FGrOW*



Planting and Natural Regeneration – Ingress and Mortality

The final stocking level of a regenerated forest stand depends on the net outcome of two competing influences: ingress (or the establishment, over a period of time, of regenerated trees) and mortality. Research by the FGYA has been consistent with the findings of earlier studies by Desmond Crossley[22] and W.D. Johnstone[23] that were, in light of current research, remarkably prescient.

Normally, sites are prepared for natural regeneration or planting by mechanical treatments using heavy drags to break up the stumps and residual branches and expose mineral soil for natural seeding or by site-specific "scalping" or "mounding" to prepare planting sites.

Natural regeneration establishment is influenced by site factors (including climate) and treatments (such as mechanical site preparation). Even with early and optimum treatment

This image clearly shows ingress occurring in a post-harvest, naturally regenerated stand of lodgepole pine. Note the different ages of pine trees in the foreground. Ingress may continue for over 15 years. *Brian Carnell Photography*

to favour germination, ingress occurs over a protracted period of time (Figure 4-2). Substantial amounts of ingress occur on some site types after conventional regeneration surveys are required, the results of which must be used to judge establishment success. In the past, this survey deadline has perhaps contributed to a reluctance to rely on natural regeneration for meeting reforestation targets. However, the Foothills Pine Project team and other studies of ingress and mortality are clearly demonstrating the value of regeneration established at densities exceeding 10,000 trees per hectare. At this level, a 3-percent annual mortality rate will not reduce overall forest cover or volume yields before competition-induced mortality takes control of the stand, as it does earlier in fire-origin stands.

The contribution of planted stock to final yields at rotation is likely to be lower than previously expected on some sites because of high and increasing levels of mortality in the planted trees, accompanied and offset by high rates of ingress of natural regeneration. In fact, the concept of "hot planting" without site preparation is almost certainly a recipe for

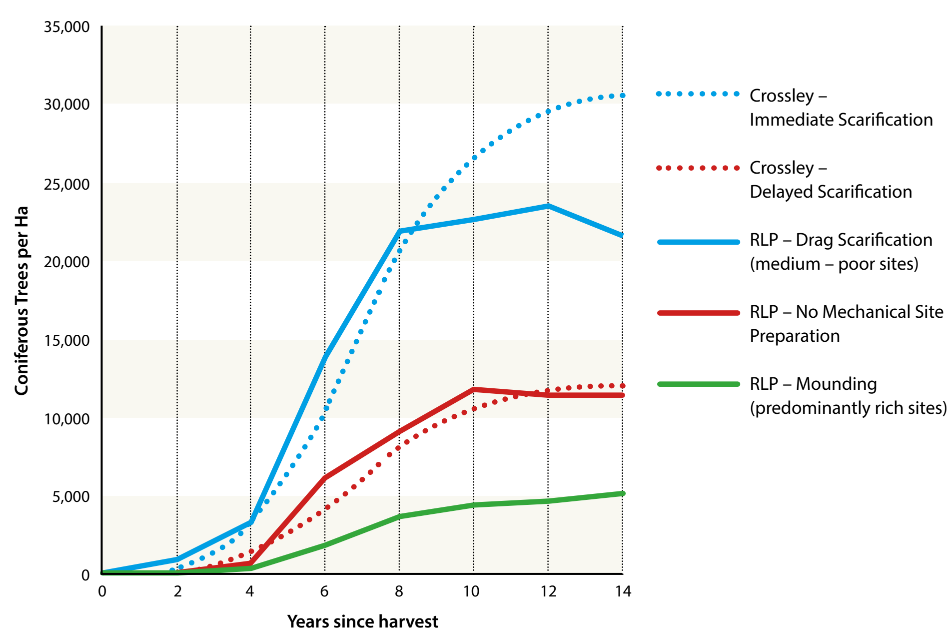


Figure 4-2. Natural regeneration ingress trends for lodgepole pine—two studies, similar findings.

failure. Recent analysis of the RLP Trial data has shown that site preparation is reducing the incidence of *Armillaria* root disease in lodgepole pine. This pathogen is a soil fungus that poses a great risk to regeneration on untreated sites.

Figure 4-2 shows the results of comparing average densities from the Regenerated Lodgepole Pine (RLP) Trial to those from an earlier study by Crossley (1976)[24] on successfully restocked cutblocks. RLP Trial results for non-scarified sites closely follow the trend reported by Crossley for cutblocks where scarification was delayed. The results following drag scarification are similar to Crossley's trend for immediate scarification except that densities are shown to decline at older ages. The decline in the RLP Trial is the expected result of self-thinning mortality at high densities. (Crossley's trend line was based on trees alive at 14 years and does not incorporate trees that died previously.)

> "The sustainability of lodgepole pine is the basis on which most attributes and values of the foothills forest ecosystem depend: grizzly bears, caribou, water, fish, landscapes, timber, you name it. Ensuring regeneration and growth following disturbance is fundamental to maintaining the ecosystem. It requires understanding and quantifying forest growth and the factors influencing forest health. Our latest research is really rewarding. It is not only helping in the prediction of future timber yields, but has identified ways that we can reduce reforestation risks associated with pathogens and climate change. I hope that the successful collaboration between industry, government, fRI Research, and FGrOW that grew from the pioneering efforts of the Foothills Model Forest and the FGYA will continue to support sustainable forest management in Alberta."
> –W.R. (Dick) Dempster, R&D associate, FGrOW, interview, 2016

Comparison of Pre- and Post-Harvest Stand Development

The purpose of this project, begun in 2002, was to gain and share knowledge of how stands that regenerated after harvesting differ from natural stands. An initial study was conducted to compare productivity in mature fire-origin stands with productivity in stands regenerated following harvest. Comparisons involved contemporaneous sampling of "paired plots" in adjacent regenerated and parent stands in combination with analysis of time-series data from permanent sample plots measured before and after harvesting.

Because of limitations inherent in the paired-plot design and the projections made using these data, results from the initial study were subsequently compared and validated with data from long-term spacing trials. In both cases, it was clear that the regeneration established through reforestation was growing at rates that substantially exceed those of the older adjacent stands established through fire.

Tending, Thinning, and Fertilization

Tending and spacing can be beneficial on some sites by increasing vigour, reducing competitive stress, and removing dead, dying, and susceptible trees. But on other sites, they can be detrimental because they increase access by damage agents and limit the number of potential crop trees. Similarly, fertilization and thinning have the potential to increase productivity, but they can increase susceptibility to pathogens and (as demonstrated by the nutrition and density field trial) extreme climate events, the incidence of which may be increasing with climate change.

The paired-plot study indicated that regeneration practices following harvesting, which maintained or improved site occupancy without overstocking, were likely to increase productivity relative to that of untreated fire-origin stands. This conclusion was supported by analysis of the 1963 Gregg River Spacing Trial, one of the historic research trials.* The best opportunities for spacing or pre-commercial thinning of lodgepole pine appear to be on

* In 2017, the historic Gregg River Spacing Trial was heavily impacted by mountain pine beetle. A final measurement was taken, and the trials will continue to be maintained to study stand recovery following beetle attack.

The Gregg River Spacing Trial photo series 1965 (left) and 1999 (right) provides dramatic evidence of the value of proper spacing. At 43 years of age, these trees are already merchantable, whereas those in the adjacent untreated stand originating at very high stocking levels from the same 1956 forest fire will not be merchantable for decades into the future.

poorer sites. On rich sites, thinning may be ineffective or counterproductive, particularly in view of increased risk of mortality related to climate and pathogen damage.

In 2006, the FGYA, in cooperation with the Foothills Model Forest and the Alberta Forest Genetic Resources Council, hosted a conference on post-harvest stand development. Information integrating growth and yield, genetics, silviculture, and forest health was shared by 25 international speakers and 150 delegates.

Historic Research Trials

Thanks to the foresight of earlier researchers, there is a wealth of information about the response of lodgepole pine to silvicultural treatments from more than 20 historic field trials, the earliest dating to 1941, when German prisoners of war were put to work doing some of the thinnings at the Canadian Forest Service's Kananaskis Research Station. Many of these reports were buried in the CFS archives in Edmonton, but Stan Lux of the CFS was instrumental in digging them out and relocating the trials. This led to the previously noted 1999 field tour that visited the plots listed in Table 4-2. This tour was instrumental in building the partnership that soon afterward became the Foothills Growth and Yield Association (FGYA).

In 2002, the FGYA began maintaining and remeasuring these trials on a five-year schedule under an agreement with the Canadian Forest Service and the Alberta government (see Table 4-2). The results are used to assess density management strategies, the reliability of growth and yield models, and the effects of silvicultural treatments on wood quality. All the trials were fully documented, and interpretive signage has been placed at the most valuable and accessible locations.[25]

Table 4-2. Historic Research Trials Included in the FGYA/SRD/CFS Project.

Research Trial	Year Established	Research Trial	Year Established
Pre-commercial thinning, Mackay	1954	Juvenile spacing of 25-year-old lodgepole pine, Teepee Pole Creek	1967
Spacing trials, 7-year-old fire-origin stand, Gregg River	1963–1964	Strip thinning of lodgepole pine, Teepee Pole Creek	1966
Spacing trials, 28-year-old fire-origin stand, Gregg River	1984	Heavy thinning of 77-year-old stand, Kananaskis	1941
Thinning and fertilization of 40-year-old stand, McCardell Creek	1984 -1985	Various thinnings based on European practices, Kananaskis	1938–1939
Mechanical thinning treatments, Swan Lake	1977	Commercial thinning in an 88-year-old stand, Kananaskis	1950
Ricinus thinning	1975	Commercial thinning in an 85-year-old stand, Strachan	1952
Fertilizing after thinning 70-year-old lodgepole pine, Clearwater	1968	Fertilization and thinning of 26-year-old lodgepole pine, Edson (Takyi Trial, SRD)	1980

FMF General Manager Tom Archibald at the historic Gregg River Spacing Trial 2010.

Regional Yield Estimators

In 2002, the association cooperated with Alberta Sustainable Resource Development to link growth and yield models to the Alberta Vegetation Inventory, thus enabling the department to report credibly on both the current state of provincial timber resources and their rate of growth.

Enhanced Management of Lodgepole Pine

In 2004, the association, in a cooperative research agreement with the University of Alberta, began a project to address gaps in the knowledge required to enhance lodgepole pine growth and yield through nutrition and density management in both fire-origin and post-harvest stands. It included two sub-projects: pine nutrition and density management in young and mid-rotation stands, and pine-aspen density management following harvest and reforestation.

The pine-aspen study explored the competitive effects of aspen, spruce, and pine on pine growth.

Data from the pine nutrition and density study were analyzed to assess the effects of thinning and fertilization on snow damage, the effect of fertilization on diameter growth and root carbohydrate concentrations, and foliar nutrient uptake in fertilized post-harvest stands.

Monitoring and Feedback – A Framework for Continual Improvement

Sustainable forest management is dependent on the monitoring of actual forest growth relative to that which has been predicted and periodically adjusting forest management plans accordingly. The Foothills Pine Project Team (formerly the FGYA) is supporting the application of this principle in Alberta by several ongoing monitoring commitments:

- The Regenerated Lodgepole Pine (RLP) Trial is being used to monitor the growth of harvest-origin lodgepole pine relative to regeneration standards and the predictions of growth and yield models.

- The historic research trials and the FGYA's nutrition trial are being used to monitor the responses of managed stands to more intensive management practices, and also to validate growth and yield models.
- Observations and results from the first 15 years of the FGYA, some of which were based on comparisons between similar-age fire-origin and post-harvest stands, will be validated by ongoing monitoring of the growth of regenerated and managed stands. Of particular interest are the trends towards higher productivity observed in managed stands, apparently resulting from control of density and stocking.
- Permanent sample plots belonging to FGYA members are being used to monitor how stands respond to mountain pine beetle attack.

Post-Harvest Stand Development Conference, 2006

In the early 2000s, Alberta had a number of growth and yield organizations working on various coniferous species and combinations. These included the Foothills Growth and Yield Association, the Mixedwood Management Association, and the Western Boreal Growth and Yield Association, sited at the University of Alberta, working to develop the Mixedwood Growth Model (MGM) for pine, spruce, and mixed species.

In 2006, the FGYA, Foothills Model Forest, the Forest Resource Improvement Association of Alberta (FRIAA), and the Alberta Forest Genetics Resource Council sponsored a large conference in Edmonton to discuss the latest advances in knowledge of post-harvest stand development. Speakers from across North America and breakout groups made recommendations for further research and model development.[26]

Among other things, the proceedings from the conference identified two major challenges for Alberta's forest growth and yield community:

1. Alberta's growth and yield cooperatives should pursue increased cooperation and program alignment to maximize the efficiency of resources.
2. Alberta's growth and yield and forest-genetics/tree-improvement communities should work closely, with a view to incorporating the effect of genetic gains into growth-projection models.

These recommendations resonated with Alberta Sustainable Resource Development, which had been stressing this need for some time. Also, some forest industry managers were expressing dissatisfaction with paying dues to support a number of growth and yield organizations that, although they were addressing different species, were still dealing with the same forest resource.

Alberta Forest Growth Organization, 2009

For some time, senior management in Alberta Sustainable Resource Development had been urging the forest industry to bring its various growth and yield organizations under one umbrella. This was also being promoted by industry members, who were growing weary of the perceived inefficiency of time and resources, including money, flowing to a number of such initiatives in Alberta.

In 2008, Richard Briand of West Fraser and the FGYA and Gitte Grover of Alberta-Pacific and the Mixedwood Management Association responded to this imperative and spearheaded a drive to create an organization that would bring together a number of agencies, including industry, government, and the University of Alberta to prioritize, coordinate, and secure long-term funding for growth and yield research, as well as policy development. Such an organization would address the troubling failure to make the obvious connection between the rates of forest growth and sustainable harvest.

In the face of climate change and the rising importance of carbon budgeting, accounting, and trading, all of Alberta's resource management sectors (forestry, agriculture, oil and gas, electricity, water, mining) needed reliable estimates of forest yield and forecasting of forest growth to achieve and demonstrate long-term environmental sustainability, as well as to provide a foundation for potential offsets and trading.

The goal of the proposed Alberta Forest Growth Organization (AFGO) was to further establish a credible foundation for understanding and forecasting the growth of Alberta's forests. Seed funding was in place from the Forest Resource Improvement Association of Alberta (FRIAA) as well as industry contributions. AFGO housed the program at the Foothills Research Institute, where it found administrative and financial services, as well as the help of the Communications and Extension Program to plan a proposed conference on the role of Alberta's forests in climate change mitigation.

FRIAA funding was acquired and operations began in 2009–2010 under Executive Director Barry Waito, former woods manager for Louisiana Pacific in Manitoba. AFGO hosted a fall conference in 2010 entitled "Carbon Emissions and Climate Change – The Role of Forests in Alberta." Training on the Canadian Forest Service climate change model was proposed for members, along with discussions and opportunities around carbon and how growth and yield would fit into carbon trading or sequestration. AFGO also worked with Climate Change Central on the development of the Afforestation Protocol, as well as initial development of Enhanced Forest Management (EFM) Protocols.

In 2011, AFGO continued to move forward on the carbon-related work as well as the EFM Protocols development. Some work was underway on a needs assessment for growth and yield (G&Y), as well as working with non-AFGO companies to move towards a provincial-level G&Y program. Industry and government were both reviewing future plans and work in this area, and at that point, a number (including SRD) had suspended their programs.

In 2013, the Provincial Growth and Yield Initiative (PGYI) was established through AFGO to collectively obtain data on tree growth through repeated measurements of permanent sample plots to develop, calibrate, and validate growth models for forest management yield curve development.

The PGYI consisted of four components:

- Jointly collect new, or pool existing, permanent sample plot data to fill gaps for natural stands and provide information for managed stands
- Develop a centralized database to house the information in a standardized format and to provide quality control for data standards
- Develop standards for data collection and submission
- Develop a best practices manual to facilitate uniformity and consistency of data submitted by different companies and the Government of Alberta

In 2014, AFGO held a workshop at the University of Alberta. The resulting report, *A Vision for Growth and Yield in Alberta*, described current issues and important areas of new research, along with suggestions on how to meet the needs. It identified gaps in growth and yield information and tools, and made recommendations for how to fill these gaps, setting the stage for its successor, the Forest Growth Organization of Western Canada (FGrOW).

Forest Growth and Yield Organization of Western Canada (FGrOW), 2015

Building on the success of AFGO's PGYI and the vision document, there was growing impetus towards a larger collaboration. FGrOW started operations in April 2015 under Director Sharon Meredith. That year, three growth and yield organizations moved to

FOREST GROWTH
ORGANIZATION OF WESTERN CANADA

Sharon Meredith with a young pine killed by root collar weevil, FGrOW field trip, 2016.

FGrOW: the Alberta Forest Growth Organization (AFGO), the Foothills Growth and Yield Association (FGYA), and the Mixedwood Management Association of Alberta (MWMA). The Western Boreal Growth and Yield Association (WESBOGY) and Tree Improvement Alberta joined in 2016.

The intent of the amalgamation was to increase efficiencies and attract more funding to growth and yield research in Western Canada. FGrOW's mission statement described its intent to play a lead role in growth and yield research and related policy development in Western Canada. Also, it would promote communications among members, within the forest industry, and with other industries interested in growth and yield. By working closely with the University of Alberta, it established the scientific credibility that would allow it to act as the "one window" for growth and yield information in Western Canada.

Members of the founding associations placed a high value on the continuation of existing projects and research, but also recognized the advantages of coordinating efforts to increase opportunities to attract funding and to raise the profile of growth and yield in Western Canada.

This new organization turned to fRI Research to serve as a coordinating agency. Project teams were established based on the programs of the four founding associations to carry on with existing research, as well as explore new needs and opportunities. Currently, these teams include the Foothills Pine Project, the Mixedwood Project, Policy and Practice Project, Tree Improvement Alberta Project, and the WESBOGY Project. The project teams are responsible for developing a work plan, timeline, and budget for each of their projects, an extensive network in western Canada (see Map 4-3)..

Sharon Meredith said in 2016 that FGrOW aimed to become "a recognized authority on growth and yield." Peer-reviewed publications would lend scientific credibility, making its work more defensible to the government and therefore easier to implement in forest management plans. However, there was also a need to bridge the gap between scientific results and "what that means in terms of what practitioners should be doing on the ground."

FGrOW's vision is to become the leader in cooperative growth and yield research, model development, and data management in Western Canada. The advancement of this science will support policy development and improved forest practices.

> "Part of the reason, in my view, that people so often fall short in making that next step of communicating to practitioners is because the people who are doing the research don't understand what the practitioners want to know. From our perspective, it's critical that we meet the needs of industry. We won't exist if we're not doing that." –Sharon Meredith, FGrOW director, personal communication, 2016

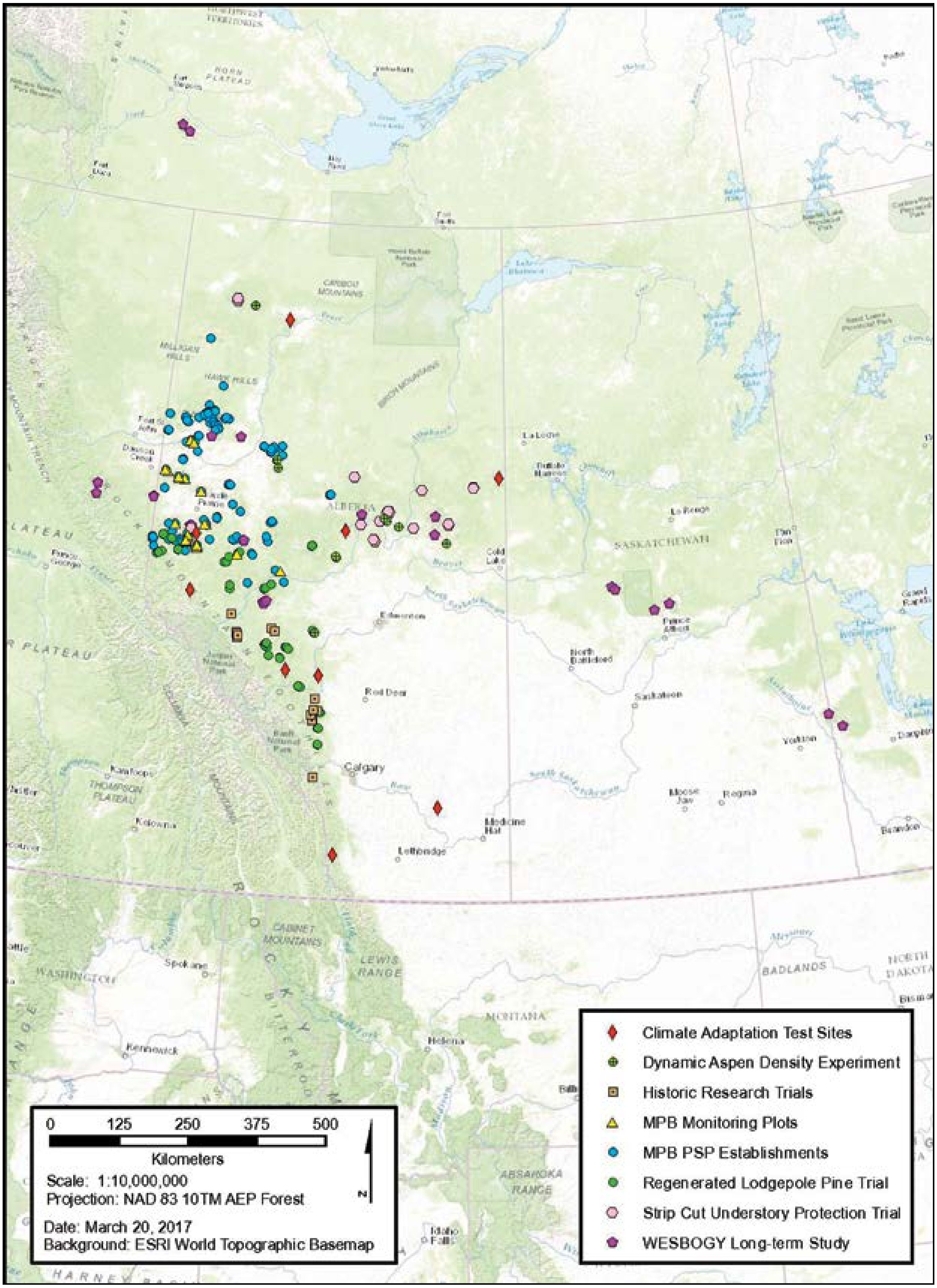
As of March 31, 2017, FGrOW has 20 voting members representing both industry and governments. The University of Alberta and the Canadian Wood Fibre Centre of the Canadian Forest Service are associate members.

Wildfires can – and increasingly seem to do - consume everything in their path, including fuels on the forest floor, ladder fuels (low hanging branches, understorey trees), up to and including the crowns of the trees. *Courtesy Bill Tinge*

Wildfire Research, 1999–2007

Although wildland fire is the essential forest renewal process in Canada, there is a risk to life and property that attends this natural process and in turn requires that these processes be mitigated where such threats exist. For much of the 20th century, an aggressive program of fire prevention and suppression was successful in reducing the impacts of wildfire on communities and values. However, this program allowed forests to grow old well beyond their historic range of natural age-class variation. This has long been a concern to land managers in both industrial and protected areas, with implications not only to wildfire behaviour, but also to the maintenance of biodiversity dependent on the full range and variability of age classes.

FGrOW Research Trial Locations



Map 4-3. FGrOW research trial locations, Western Canada, 2017.

The first major wildfire-related research at the model forest was the Natural Disturbance Program, established in 1994 to describe and summarize the patterns caused by historical disturbance (primarily wildfire, but also other agents such as insects, disease, flooding, wind, and ungulate herbivory). The program would also examine the relationships among different disturbance processes operating at a range of scales, from individual forest stands to landscapes. These studies were expanded to include some of the major fires mentioned below.

In Jasper National Park, this research was particularly important as it clearly showed that decades of aggressive fire protection and exclusion (including prohibitions on the Aboriginal practice of burning for cropland and habitat enhancement) had resulted in a pattern of montane and subalpine vegetation that greatly exceeded its historic ranges of age and was narrowing the resulting range of ecosystem variability. The loss of immature and semi-mature age classes was adversely affecting biodiversity in the park, with the loss of species dependent on these habitats. Further, the old forests surrounding infrastructure and the town of Jasper in the Athabasca Valley and elsewhere in the park were increasingly at risk from catastrophic fire that, once unleashed, would be almost impossible to control.

A repeat photography study of changes in the montane vegetation of Jasper National Park by Jeanine Rhemtulla, a master's student at the University of Alberta, partially sponsored by the model forest, clearly showed the impacts of fire exclusion on the park landscape since 1915.[27] Rhemtulla, along with Eric Higgs and Ian MacLaren, returned to the sites that had been photographed in 1915 by surveyor M.P. Bridgland in Jasper National Park. Bridgland's pictures are the only comprehensive, systematic collection of historical photographs available for the park, and their locations were carefully documented. Repeat photography with the same format camera and covering the exact same view revealed changes in the landscapes over the previous 80 years and clearly showed the impacts of management and development, particularly when fire, the natural agent of forest renewal, was excluded through almost 100 years of aggressive forest fire prevention and control programs in the park.

This research supported two strategies that the park was taking to reduce the risks of uncontrolled wildfire and loss of infrastructure. The first was its prescribed burn program, which had the goal of returning at least half of the park's forests to their original range of seral stages and ecosystems, and the second was the implementation of the FireSmart-Forestwise Program of controlled thinning and understorey cleaning around the Jasper townsite, as well as in the montane ecosystems in the forests in the immediate area where much development had occurred since the early days of the 20th century.

Beginning in 1999, Parks Canada took steps to restore the traditional montane savannah with a series of prescribed burns in the Athabasca Valley north of the Jasper townsite. A self-guided interpretive trail was installed at the Palisades picnic site and, in 2002, Parks

Left: The 1915 image looking north towards Henry House Flats in Jasper National Park, taken by Dominion land surveyor M.P. Bridgland, shows an open landscape of mature forest interspersed with grassland and younger forest—the results of natural fire and periodic burns by Métis settlers in the valley.

Right: The 1999 repeat photography image of the same area by J.M. Rhemtulla and E.S. Higgs show the results of 70 years of fire exclusion from Jasper National Park. Mature and overmature forest dominates the valley bottom and adjacent hills.

A Parks Canada prescribed burn underway at Henry House Flats, April 17, 2016.

Canada, the model forest, and the Canadian Forest Service installed research trials, with fenced exclusion plots, on the Henry House Flats area to look at post-fire effects on the savannah-pine montane ecosystems. Visits to this research trial became very popular for both tourist and scientific tours.

As Alberta entered the 21st century, wildfire seasons were lengthening and the severity of individual fire events was increasing significantly. Rapid population, recreational, and energy sector growth, combined with heavy accumulations of forest fuel and a trend towards warmer climates, placed many Alberta communities at increased risk from wildfires (see Figure 4-3).

Five major fires (Chisholm, Dogrib, Lost Creek, Flat Top, and Horse River) early in 21st century Alberta were dramatic examples of the "wildland-urban interface" (WUI) problem and the unprecedented challenges of trying to manage such catastrophic events. For example:

1. In May 2001, the 120,000-hectare Chisholm fire destroyed 10 homes in the hamlet of Chisholm and threatened the larger community of Slave Lake.
2. The Dogrib fire began in September 2001 south of Nordegg and burned 10,000 hectares, most of this happening on October 15 when high winds sent the fire across the landscape towards Bearberry, a fire run that burned 9070 hectares in only 13½ hours.
3. The 2003 Lost Creek fire in the Crowsnest Pass burned 20,000 hectares and forced the evacuation of two towns.

These fires were the harbingers of fire management challenges that would continue to grow in the new century, such as the 2011 wildfire that burned over 500 residential structures in Slave Lake and the 590,000-hectare Horse River fire of May 2016 that wreaked havoc on the Fort McMurray urban area, destroying 2400 structures and forcing the evacuation of 80,000 residents.

Figure 4-3. Trends in severity ratings, 1990–2016.

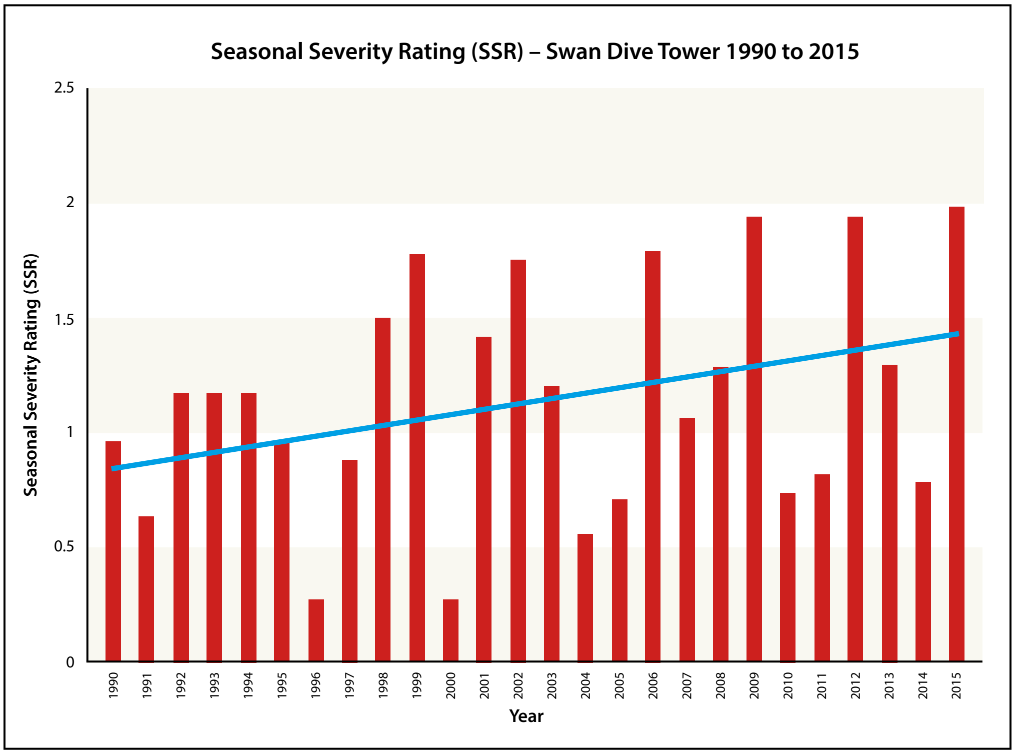


Figure 4-3 shows the increasing frequency of "peaks" in severity ratings (rate of spread times fuel consumption), as well as a disturbing upward trend in the index. It suggests major increases in difficulty of control, with implications for staffing, resources, and financial commitments. The safety of fire-control personnel, industrial workers, and residents is also a concern with this trend.

The $3.2-million Provincial Environmental Enhancement Fund grant of 1999 presented an opportunity for the model forest to directly support research on wildfire intensity, fire spread, and impacts on forests and communities. This initial investment led to expanded research on the 2001 and 2003 major wildfires in Alberta, which was supported by grants from the Government of Alberta.

Wildfire management is a cornerstone of public safety and sustainable forest management. These studies have contributed to enhanced community protection and a more sophisticated approach to understanding the ecological contribution of wildfire at the landscape level, and to more informed management practices. Some highlights follow.

Projects and Field Trials

The Canadian Wildfire Growth Model (Prometheus), 2001

A new wildfire growth model was developed, coordinated by Cordy Tymstra of the Alberta Land and Forest Service, with the cooperation and financial support of a number of companies and resource agencies across Canada, including the Foothills Model Forest. An early version of this program was "test driven" and performed well on the Chisholm fire during the summer of 2001. The model forest continued to support the development until 2002, when the project was transferred to the Canadian Interagency Forest Fire Centre for completion. The tool is now widely used and very effective for a number of purposes. It is routinely used to predict fire spread and assist in the deployment of attack resources, and Alberta Agriculture and Forestry uses it as one of the tools for planning and developing public information programs for FireSmart projects in the wildland-urban interface.

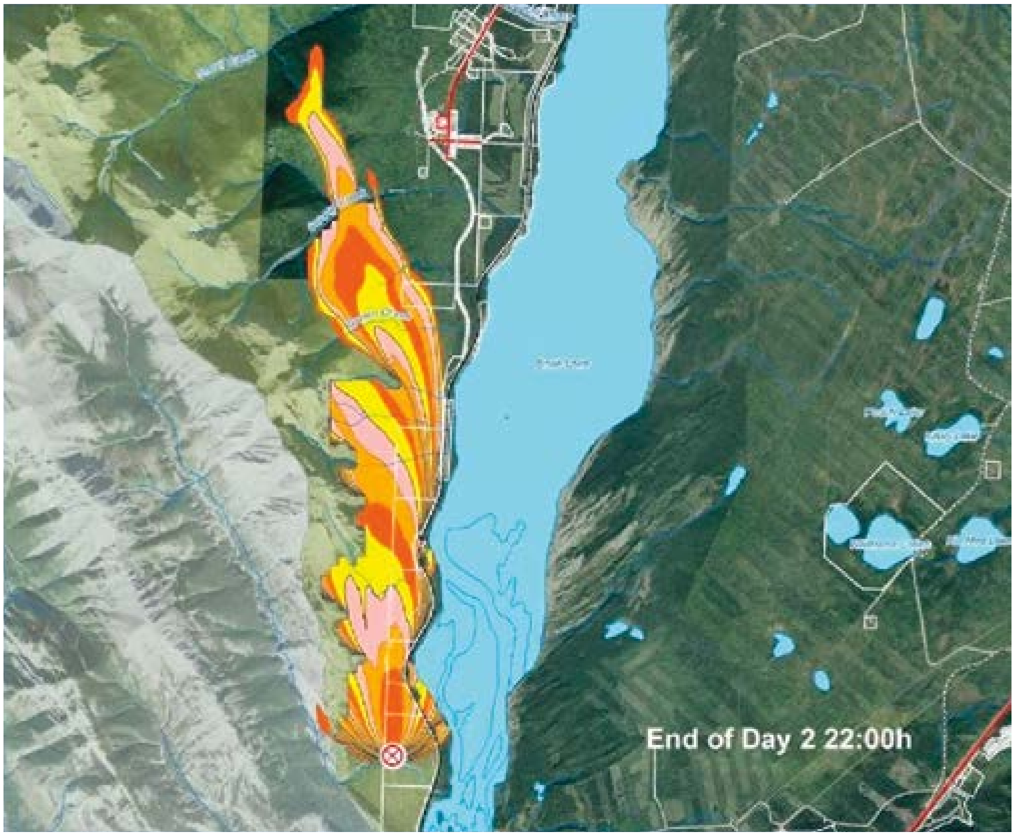


Figure 4-4. A Prometheus simulation of fire spread from a campfire to the community of Brule. The projection illustrates where containment lines would be required and also where sprinkler lines would protect the community. *Courtesy Dennis Quintilio and Associates*

Convection column from a wildfire in the Yukon, 2014.


Al Westhaver and Cliff Henderson in the FireSmart Treatment Area, FMF Board tour, Lake Edith, 2002. *Courtesy Bob Udell*

Chisholm Fire Research Initiative, 2001–2002

The Chisholm fire of 2001 displayed fire behaviour unparalleled in Alberta's recorded history, and documentation of the fire's history was also one of the most complete. The convection column reached 45,000 feet (13,716 metres), and aerosols and particulate matter reached the stratosphere as the fire intensity exceeded 225,000 kilowatts per metre, nearly double the previous record for Alberta.

The interaction of natural processes, subsequent losses to property and timber, and concerns about soil and watershed damage made this wildfire a unique opportunity to carry out a coordinated, multi-partnered, multi-scale research project. The Foothills Model Forest was asked by Alberta Sustainable Resource Development (ASRD) to take on the coordination and management of the research program, with ASRD contributing $300,000 to the initiative over two years, and the FMF providing $70,000 from the Provincial Enhancement Fund surplus. Former Board member, fire instructor, and Canadian Forest Service fire researcher Dennis Quintilio managed the research program over a two-year period through partnership agreements with the University of Alberta, the Canadian Forest Service, and Alberta Sustainable Resource Development. Four projects were implemented, and two led to PhD theses.

One project delved into the role of the aspen fuel type in slowing the rate of spread and intensity of fires. Interestingly, this project included remeasurement of CFS aspen burn trials established by Dennis Quintilio in the 1970s. The study showed that fire behaviour in aspen stands is very dependent on stand age and coarse woody debris. Another project looked at the impacts of fire and harvesting on the amount, distribution, and sizes of coarse woody debris and its rates of decomposition, as well as the associated nutrient turnover.

Concern over declining numbers of the deadwood-dependent wood-boring saproxylic beetle in the boreal forest led to another project that looked at the cumulative effects of wildfire and post-fire harvesting of burned areas. The research showed that the combined impacts of fire and salvage logging reduced beetle numbers more than fire or harvest alone. Another study looked at the impacts of fire intensity on forest floor mosses in boreal spruce forests and the impacts of fire on the subsequent establishment and survival of tree species seeding in after fire.

In the fall of 2004, an international conference of the Canadian Institute of Forestry and the Society of American Foresters included a tour of the Chisholm fire, hosted by the model forest, and all of the research project results were presented.

FireSmart-ForestWise Program, 2002

Although fire agencies had been quick to recognize risks, progress at implementing known prevention solutions and creating "FireSmart" communities had been slow. In many cases, the public cited concern about the impacts of standard fuel management practices on wildlife and on the aesthetic qualities of the landscape around homes or communities, as well as concerns about secondary environmental impacts resulting from manual and mechanical fuel treatments as reasons *not* to implement hazard reduction measures.

In conjunction with the Foothills Model Forest and the Municipality of Jasper, Al Westhaver, Jasper National Park's vegetation/fire specialist, planned, managed, and implemented a unique community wildfire protection program for the wildland-urban interface (WUI) that included the Jasper townsite and adjacent Athabasca Valley developments. In 2002, he conceived and led the model forest's FireSmart-ForestWise Project to develop, implement, and evaluate effective solutions for reducing wildfire threats—solutions that were ecologically based, optimized benefits for wildlife, and were supportable by the public. The mechanical and risk-reduction aspects of FireSmart programs in Alberta were well known at the time, but the environmental and cultural aspects were new territory. This project was a partnership between FMF, the Municipality of Jasper, the University of Calgary, ATCO Electric, Jasper National Park, local businesses, and others.

Using the adaptive management approach, the project merged ecological restoration and wildfire protection objectives by melding knowledge from wildland fire behaviour, forest ecology, and wildlife biology with Westhaver's experience as an ecosystem manager. This multi-faceted program, managed under the Natural Disturbance Program, included outreach and engagement, forest restoration and fuel reduction treatments, prescribed burning, and demonstration. Equally significantly, it delved into the scientific pillars upon which a more widely accepted national FireSmart program could be developed, including wildlife habitat assessments, silviculture methods, and the environmental impacts of fuel management.[28]

Six small demonstration sites were used to show the intent and impact of the program, and were well received by the community. Then in 2004, the operational program was implemented on areas around Jasper and the Lake Edith cottages, about 350 hectares. The program, in addition to the thinning, brushing, and pruning operational elements, included monitoring the effects of treatments on habitat structure and wildlife use, and demonstration and knowledge/technology transfer. A strong emphasis on communication and outreach focused on keeping stakeholders informed, engaging the public in community protection and restoration activities, and carrying messages beyond the model forest boundaries. It was a resounding success and led to Westhaver's 2006 MSc thesis at the University of Calgary and a set of ecologically based fuel treatments that accommodate wildlife, habitat, and the aesthetic values of residents in WUI areas. The lessons learned offer much to agencies wishing to implement such strategies in other communities. By the project's completion in 2011, nearly 1200 hectares of forest surrounding developed areas near the Town of Jasper had been treated.

> "The onus was squarely on our shoulders to find ways of managing the vegetation to reduce fire intensity in ways that were effective in terms of fire behaviour, but also were ecologically based and done in ways that reduced the risk, and also optimized or improved ecological conditions for wildlife or habitat and aesthetic qualities. We knew that the historic structure and composition of forests for thousands of years in the valley bottom of Jasper was the result of fire. Our search was to combine and find the crossover points between ecological

Pine thinning for FireSmart protection at Lake Edith, 2004. Sale of the salvaged wood partially offset the costs of the FireSmart project.

> restoration and protecting communities from wildfire. I think it's pretty safe to say that in Canada, the model forest was a pioneer in terms of working with type prescriptions and designing the whole FireSmart Project as an adaptive learning experiment. It's still to come into its own, and the guidelines that I came up with still need to be really published in practical form to be included in the FireSmart manual at some point …. Working with the model forest was the highlight of my career." –Al Westhaver, interview, 2016

Although "retired," Westhaver continues to provide services in the fields of wildland fire behaviour, community wildfire protection, FireSmart training, and environmental assessment through his Fernie-based consulting company. Most recently, he authored reports on lessons learned from the Fort McMurray wildland-urban fire disaster of 2016 and the FireSmart status of homes reconstructed following the fires of 2003 in Kelowna and 2011 at Slave Lake; the research work was sponsored by the Institute for Catastrophic Loss Reduction.[29, 30] Westhaver is currently a faculty member of the RX-510: Advanced Fire Effects course at the National Fire Resource Institute in Tucson, Arizona.

Dogrib Fire Research

The Dogrib fire occurred very late in the fall of 2001 west of Sundre and provided an opportunity to document the effects of both the fire and subsequent salvage logging on elk habitat in the area. The model forest supported a PhD candidate at the University of Alberta to carry out the research.[31] Traditionally, elk overwintered on the rangeland around the Ya Ha Tinda Ranch where Parks Canada overwintered their horses, competing with the horses and also bringing wolves with them. The vegetation following the fire provided good forage for elk, who moved over to the burned areas, thus easing the burden on the rangeland.

Another study examined post-fire riparian dynamics. Riparian areas burn, but not always at the same time and in the same manner as upland fires, and the dynamics are different. When the upper landscape burns and the riparian areas remain, they provide good habitat for wildlife, and vice versa. However, the exclusion of both fire and harvest from riparian zones is propelling them towards an unnatural state with unknown results on species that rely on them—fish, fur, and fowl.

The Dogrib fire rages across the hills, October 2001. *Courtesy Dennis Quintilio*

Lost Creek Fire Research, 2003–2006

The 2003 fire season had devastating consequences in many areas of Canada, including the 22,000-hectare Lost Creek fire in the Crowsnest Pass area of Alberta, where over 1,500 residents were evacuated. Following this fire, a Research Advisory Committee was formed by Alberta Sustainable Resource Development (ASRD) in the Crowsnest Pass area to work with ASRD and the Foothills Model Forest to develop a research program that would support the reduction of wildfire risk in the future, along with better fire management should such events occur.

The first project undertaken in 2004 was a social science project in which Tara McGee from the University of Alberta and Bonita McFarlane from the Canadian Forest Service examined public perceptions of wildfire risk and the extent to which risk-reduction activities such as the Partners in Protection Program were known, understood, and applied in the communities directly affected by the Lost Creek fire. Interestingly, although the level of awareness rose following the fire, intent to do anything about risk reduction did not necessarily follow. However, the study pointed to improved strategies for government agencies to increase awareness, support, and involvement in community-level FireSmart planning.[32]

The next project was proposed by Marie-Pierre Rogeau in 2005 in support of a management plan being developed for Forest Management Unit C5. Through the study of historical fire regimes and patterns, along with fire risk and potential severity, Rogeau was able to provide guidance on the design and prioritization of management activities in the unit to more closely emulate the patterns and processes of natural disturbances, as well as reduce risk to the forests and communities in the area.

Community concern about environmental damage from the significant number of bulldozer fireguard lines supported the addition of a reclamation study sponsored by ASRD and Shell Canada.

> "We had only one land base other than Willmore that had no management plan—C5—and it was chosen as a prototype pilot project, based on the Harvard modelling approach. We sent all the parameters down to Harvard and got two questions back. The first was 'What is the health of the forest in British Columbia?' The second was 'What will be the population of Calgary in 2040?' Talk about context. That's what you want to start thinking about if you're going to build a landscape management plan in the south. The first question was 'Is the pine beetle going to come over the rocks?' Which it did. The second was 'Is Calgary going to outvote the local communities on any of the objectives that you set that might fit the landscape?' That was our lesson on context. I think the model forest drove that kind of thinking, and it was pretty innovative in that regard. Now here we are into the Land-use Framework, which we've still got issues with, but it will go down to sub-regional plans. It's got public consultation and all the players at the table. The model forest, quite frankly, was the forerunner in that way of thinking." –Dennis Quintilio, Wildfire Research Program lead, interview, 2016

Dennis Quintilio continues to provide fire management, fire reviews, and prescribed burn planning services in Alberta and elsewhere through his company Dennis Quintilio and Associates.

The Wildfire Research Program also provided support for the Mountain Legacy Project, University of Victoria professor Eric Higgs's repeat photography series duplicating M.P. Bridgland's 1913–1914 photogrammetric surveys of the Crowsnest Pass area. Bridgland's glass plate images showed early fire patterns of the area, which were then compared to the same landscape after nearly 100 years of forest protection and fire exclusion. This project can trace its origins back to Higgs and Rhemtulla's earlier repeat photography project at Jasper.

Mountain Pine Beetle (MPB) Research, 2001–Ongoing

The Alberta Incursion and Early Activities

The mountain pine beetle (MPB), *Dendroctonus ponderosae*, is the most destructive native insect pest of mature lodgepole pine forests in western North America. In the early 2000s, the largest documented pine beetle infestation in the province's history destroyed large parts of British Columbia's mature pine forest, with major impacts on the forest industry and communities dependent on it.

The MPB has been variably present in southern pine forests of Alberta, where an outbreak in the 1970s prompted a vigorous response from the provincial government, with the felling and burning of infected sites. The most recent beetle infestations in northern Alberta began with the detection of small populations along the British Columbia border in 2001, and they have since grown exponentially. Strong winds during beetle emergence in 2006 and 2009 carried the insects more than 400 kilometres from central British Columbia as far as north-central Alberta. The damage to Alberta's pine resource since then has been significant and continues to expand, but concerted management efforts by government and industry have had a significant impact on the rate of spread.

Extreme MPB kill on the Chilcotin Plateau, British Columbia, 2005. *Courtesy Lorraine Maclauchlan*

Mountain pine beetle. *Courtesy Canadian Forest Service*

Much was at risk in the pine-dominated industrial forests along the Eastern Slopes of Alberta, either by reduction in fibre quality and mean annual increment or by losses due to increased threat of wildfire in affected areas. Alberta had 6 million hectares of lodgepole pine forest, a $9-billion forest industry, and 38,000 workers and communities dependent on it. Partners within the Foothills Model Forest sought reliable predictive models to rate the risk of damage by MPB and to predict potential MPB spread across the landscape. This information would be used to develop mitigation strategies.

Developing a MPB Susceptibility and Risk Rating Model for Alberta, 2002–2004

MPB research at the model forest dates back to 2002, when a Mountain Pine Beetle Working Group was established at the beginning of Phase III. Al Westhaver of Parks Canada led the working group, which collaborated with ASRD, Weldwood, and Parks Canada to calibrate the B.C. susceptibility-risk rating system and spread modelling to Alberta conditions. Terry Shore and Bill Riel of the CFS Pacific Forestry Centre, with input from Les Safranyik, CFS researcher emeritus, were the researchers in charge. Alberta, with its shorter growing seasons, colder temperatures, drier conditions, and other factors is so different from British Columbia that existing models developed and calibrated for B.C. were deemed unreliable for Alberta.

The project was sited within the Natural Disturbance (ND) Program at the model forest. Although the ND Program had focused on fire to date, this project was expanding the scope and operational applications of the ND Program by incorporating a non–fire disturbance agent that had major potential to influence landscape and stand-scale patterns of tree mortality in the FMF.

The January 2004 final report clearly showed that early and aggressive intervention had great potential to slow a pine beetle outbreak and reduce its impacts.[33] It also showed where such outbreaks were likely to occur, thus providing a guide for such pre-emptive actions as fell and burn, prescribed burning, and harvesting. Subsequent research by the Foothills Research Institute proved that the aggressive interventions indeed slowed the rate of advance of the beetle into Alberta.

This ultimately led to new questions, research, and modelling, and the report also contributed to the 2006 spread control strategy announced by the provincial government.

Spread Control Strategies Implemented

The Government of Alberta initiated its *Mountain Pine Beetle Action Plan*, an aggressive control strategy, in 2006. Ten years later, costs had reached $420 million. The strategy has three main elements, with the choice of tactics being either harvest or prescribed burns:

- Level 1: Single tree treatment, usually cut and burn.
- Level 2: Infected stand treatment, usually cut and burn.
- Healthy Pine: Pre-emptively reduce the number of highly susceptible stands, either through harvesting and utilization or prescribed burning. The strategy also includes collaboration and cooperative mitigation measures with all adjacent land managers such as Jasper National Park. This strategy is proposed to continue through 2026.

It was clear that a decision support system was needed to prioritize sites for treatment, and this was initially developed by the province in 2007 through consultation with the CFS.

Establishing the Mountain Pine Beetle Ecology Program (MPBEP) at the Foothills Research Institute

Projects and Field Trials

Alberta has much to learn about how stands will respond to mountain pine beetle attack, salvage, and recovery strategies. Important decisions have to be made about where, when, and how to treat attacked stands in order to minimize the loss of timber, habitat, and other values from the forest. Because of the significant threat of this pest, a dedicated program of research was required.

> "We draw a huge amount of benefit from the Mountain Pine Beetle Ecology Program. The amount of research that comes out of there from genomics,

Mountain pine beetle on a "pitch tube." When beetles attack a healthy pine tree, it exudes resin as a defence mechanism to "pitch" the beetles out.

right up to adjustments to the data in the decision support system, the stand susceptibility index, bringing in experts from across Canada and even from the U.S. to help advise how they think mountain pine beetle would grow and spread, is fantastic. We constantly adjust the model, and that's how we allocate our scarce resources in combatting mountain pine beetle on the ground." –Darren Tapp, executive director, Forest Management Branch, Agriculture and Forestry, interview, 2016

In March 2007, the Foothills Research Institute proposed a Wildland Fire Research Program for focused research and investigation into the effects of mountain pine beetle infestations on forest ecology and wildland fire management in the foothills and mountains of Alberta. Areas of concern included fire intensity and frequency; vegetation change in unsalvaged infested stands; effects on the growth and yield of lodgepole pine; post-beetle silviculture strategies, including choices of species for regeneration; effects on groundwater hydrology; and many other unanswered questions.

The provincial government provided an annual grant of $300,000 for a three-year term to develop and implement a research program to investigate these and other issues. Additional funding came from the Forest Resource Improvement Program (FRIP), as well as various partners, including in-kind contributions by university* and other researchers. Foothills established the new Mountain Pine Beetle Ecology Program (MPBEP) under its Landscape Dynamics Theme and appointed Don Podlubny, who had just retired as the Foothills Research Institute's General Manager, to lead it. Since the inception of this program, it has supported seven master's degrees and five PhDs.

Podlubny struck a large activity team, which developed four objectives to guide project prioritization and selection, by seeking to;

1. Maximize the ecological integrity of the affected forest landscape
2. Adjust practices to minimize disturbance factors affecting the landscape
3. Understand and mitigate related disturbance factors such as wildfire occurrence and intensity and hydrology changes
4. Plan for resource management, incorporating the changes to the forest ecology and landscape

To address the many questions posed by partners and regional planning groups, the MPBEP became the centre for information exchange and enabled the research community to provide science-based information to industry and government. The University of Alberta and the Foothills Growth and Yield Association implemented the first two major projects in the program.

In an October 2008 letter, Executive Director Doug Sklar of the Forestry Division endorsed recommendations from Podlubny, stating that the MPBEP "should function as a 'science information forum' (i.e., to facilitate knowledge transfer and collaboration among researchers and managers, identify research needs, and work with the Strategic Directions Committee to inform the public about MPB research)." He also supported the implementation plan to add members to the MPBEP and establish an ad-hoc Science Advisory Committee.[34] From this point on, the MPBEP gained momentum, initiating and supporting a series of important research projects. Over the years, the program has become more sophisticated and impactful thorough the definition of research themes and associated critical questions, and has focused on the communication of research results through the hosting of MPB Research Forums, the most recent having been held in May 2016.

Don Podlubny led the program until April 2012, and then Keith McClain, newly retired from Alberta Sustainable Resource Development, took it over.

* The largest in-kind research support came from the University of Alberta. There were also significant in-kind contributions from the University of British Columbia and other universities.

Projects and Field Trials

Regeneration Management in a Mountain Pine Beetle Environment, 2007–Ongoing

The Foothills Growth and Yield Association (FGYA) was already working on the MPB challenge as the FMF initiated the MPBEP program, concerned about the potential impact of mountain pine beetle attack on habitat, regeneration, and timber supply, as well as post-beetle stand development in Alberta. The FGYA organized a tour of mountain pine beetle–affected areas in the Prince George Forest District of British Columbia in 2007, and held a mountain pine beetle–silviculture workshop in 2009 with guest speakers from B.C. and New Brunswick. Among the British Columbia findings that informed the development of the FGYA mountain pine beetle research program were:

- The development of effective silviculture strategies for mitigating timber supply impacts will require knowledge of how much secondary structure exists (i.e., trees, saplings, and seedlings likely to survive attack in pine-leading stands) and how this structure will perform in the future.
- Salvage will not always be feasible or desirable, and controlling burning while seed from dead timber remains viable will probably be necessary in unsalvageable stands that lack appropriate secondary structure.
- Knowledge of the potential of attacked stands to naturally regenerate without salvage and conventional site preparation is crucial but scarce.
- The "shelf life" of killed timber time it remains commercially viable varies from five to 20 years and depends on site, utilization, and market factors, some of which can be predicted.

Initially, the FGYA assembled the best currently available information on pre-attack conditions, the "shelf life" of killed trees, the growth response of residual stands, and regeneration dynamics. From this, the FGYA developed a new MPB research project aimed at developing a decision support tool (DST) for the management of beetle-attacked forest stands and post-beetle mitigation and recovery methods. The tool was completed in 2013, with information available at the time. Since then, much more has been learned through other work under the MPBEP.

In 2007, the FGYA set up a network of 240 permanent sample plots in Alberta, maintained by its members and reserved from harvesting to allow the monitoring of stand development following MPB attack. By 2015, changes to 63 plots attacked before 2010 had been recorded, along with preliminary analyses on infection rates, mortality, and fall-down. This monitoring and assessment will assist the development of treatment options for stands attacked by mountain pine beetle, including regeneration in non-salvageable stands attacked by the beetle.

Effects of Mountain Pine Beetle Attack on Hydrology and Post-Attack Vegetation and Hydrologic Recovery in Lodgepole Pine Forests in Alberta, 2007–Ongoing

Uldis Silins and Ellen MacDonald of the University of Alberta have led a multi-year project entitled "Effects of mountain pine beetle on hydrology and post-attack vegetation and hydrologic recover in lodgepole pine forests in Alberta" to study the impacts of MPB on stand hydrology and ecology to improve post-beetle understandings and management strategies. Project research objectives include:

1. Determining the initial effects of variable intensity of "red attack"* on the stand water balance, including rain/snow interception, forest floor evaporation, soil moisture storage, groundwater recharge, water table response, and understorey light regimes and microclimate

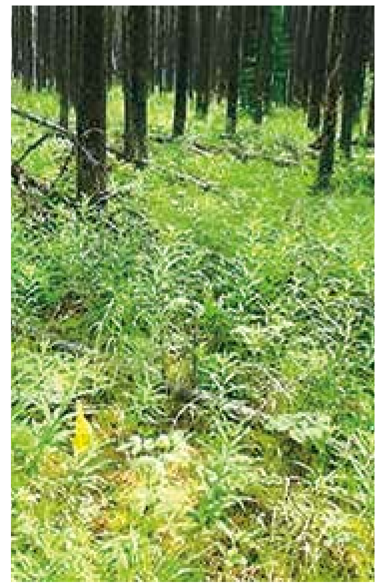
* The beetles must attack in large numbers to overcome the defences of a healthy tree. Once killed, but still with green foliage, the host tree is in the green-attack stage. The foliage of the host tree changes colour gradually. Twelve months after attack, over 90 percent of the killed trees will have red needles (red-attack). Three years after attack, most trees will have lost all their needles (grey-attack) (British Columbia Ministry of Forests 1995). http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/26604.pdf

FGYA tour group with British Columbia Ministry of Forests hosts and Alberta Sustainable Resource Development guests, Prince George region, May 2007.

A mature pine stand devastated by mountain pine beetle.

Robb Fieldsite Hydrological Recovery Study.

Vegetation recovery at the Hydrological Recovery Trial. *Courtesy Ellen MacDonald*



2. Exploring relationships between MPB-driven changes in understorey microclimate and moisture regimes with initial understorey vegetation response (recruitment, growth, leaf area), including opportunities for natural regeneration and early performance of underplanting with several tree species
3. Incorporating new relationships from 1) and 2) into existing forest water balance models developed for lodgepole pine for broad landscape scaling of hydrologic effects of MPB attack along several hydro-climatically distinct Eastern Slopes forested regions in Alberta

Because, as yet, the beetle had not invaded the study area, the researchers simulated MPB attacks by killing trees in large plots with glyphosate herbicide. Partially killed stands transpired almost 10 percent more than healthy stands because healthy trees in the partially killed stands increased their water use by 33 percent, masking the lack of transpiration by killed trees. Modelling of large-scale impacts showed very large groundwater recharges, but in the early stages (green-red attack) there was no groundwater response. Understorey vegetation changes early after MPB attacks did not change much from pre-attack composition. Salvage harvest sites changed significantly. Lodgepole regeneration was not good; it was most successful in the salvage harvested sites. They anticipate the most dramatic hydrologic effects after pine needles fall (grey-attack stage).

Phase II of the project began in 2014, looking at hydrological and vegetation responses in the grey-attack stage. Recovery of ecosystem processes is key to future forest productivity and the landscape's ecology. At this point, the fRI Water Program joined the research initiative to delve into the hydrological elements of the project.

Research Theme 1: MPB Biology and Management		
Critical Questions	**Projects**	**Principal Researcher**
What is the efficacy of current control measures applied to MPB in Alberta?	Development of monitoring tools to detect MPB at low densities on the eastern and northern edges of beetle expansion into Saskatchewan and Northwest Territories (Phases 1 and 2)	Nadir Erbilgin, UofA
	Assessing the effectiveness of Alberta's forest management strategies against the MPB	Alan Carroll and H. Nelson, UBC
What drives local and long-distance dispersal, establishment, and population dynamics of MPB in novel host environments?	Cold tolerance of MPB: Implications for population dynamics and spread in Canada	Katherine Blieker, CFS
	TRIA (Turning Research into Action): Dynamics of endemic MPB populations in novel habitats	Alan Carroll, UBC
What critical establishment thresholds can be defined to guide operational management of MPB infestations in novel habitats?	Stand dynamics after MPB attack	W.R. Dempster, FGrOW

Research Theme 2: Hydrological Impacts of Mountain Pine Beetle		
Critical Questions	**Projects**	**Principal Researcher**
What are the specific thresholds in MPB-affected watersheds that are indicative of pending negative conditions such as changes in water quality and quantity, deterioration in aquatic habitat, and flood potential?	Assessing the effectiveness of Alberta's forest management strategies against MPB	Allan Carroll and H. Nelson, UBC
What is the range of hydrological impact at stand and watershed levels from variable MPB attack? Can hydrological recovery be effectively determined?	Assessing the effectiveness of Alberta's forest management strategies against MPB	Allan Carroll and H. Nelson, UBC
	Effects of MPB attack on vegetative redevelopment in lodgepole pine forests of west-central Alberta: Phase 2: Ecological responses in the grey stage and regionalization of data for MPB	Ellen MacDonald, U. Silins, and A. Anderson, UofA

Research Theme 3: Dynamics of Natural and Managed Lodgepole Pine following Mountain Pine Beetle Attack		
Critical Questions	**Projects**	**Principal Researcher**
What are the vegetation dynamics in managed and natural pine-dominated stands across Alberta's ecosites following variable MPB-caused mortality?	Stand dynamics after MPB attack	W.R. Dempster, FGrOW
	Assessing the effectiveness of Alberta's forest management strategies against MPB	Alan Carroll and H. Nelson, UBC
	Effects of MPB attack on vegetative redevelopment in lodgepole pine forests of west-central Alberta: Phase II: Ecological responses in the grey stage and regionalization of data for MPB	Ellen MacDonald, U. Silins, and A. Anderson, UofA
	Beyond Beetle: Natural and facilitated lodgepole pine regeneration after MPB outbreaks in Alberta	Ellen MacDonald, V. Lieffers, and N. Erbilgin, UofA
What site parameters (e.g., ecosystem services, stand dynamics) ought to be evaluated to determine candidacy for treatment (including salvage) versus those that ought to be left for natural succession? What are the thresholds of these parameters by ecosite that suggest treatment success?	Beyond Beetle: Natural and facilitated lodgepole pine regeneration after MPB outbreaks in Alberta	Ellen MacDonald, V. Lieffers, and N. Erbilgin, UofA

Critical Questions	Projects	Principal Researcher
What operational measures can be taken to restore landscapes severely altered by MPB to ensure the flow of ecosystem services?	Stand dynamics after MPB attack	W.R. Dempster, FGrOW
How is wildlife habitat for grizzly bear and caribou affected by landscape change due to MPB, and what rehabilitative measures can be taken to restore their critical habitat?	Stand dynamics after MPB attack	W.R. Dempster, FGrOW
	Effects of MPB attack on vegetative redevelopment in lodgepole pine forests of west-central Alberta: Phase II: Ecological responses in the grey stage and regionalization of data for MPB	Ellen MacDonald, U. Silins, and A. Anderson, UofA
	Beyond Beetle: Natural and facilitated lodgepole pine regeneration after MPB outbreaks in Alberta	Ellen MacDonald, V. Lieffers, and N. Erbilgin, UofA
	MPB Attacks Alberta: Assessing trade-offs in food supply for two species at risk (field support)	L. Finnegan and G. Stenshouse, fRI Research
How does fire risk and fire behaviour change following MPB?	Assessing the effectiveness of Alberta's forest management strategies against MPB	Alan Carroll and H. Nelson, UBC
	Beyond Beetle: Natural and facilitated lodgepole pine regeneration after MPB outbreaks in Alberta	Ellen MacDonald, V. Lieffers, and N. Erbilgin, UofA
How will the anticipated increase in soil water affect the choice of rehabilitative options, and what are the potential implications to the flow of ecosystem services?	Effects of MPB attack on vegetative redevelopment in lodgepole pine forests of west-central Alberta: Phase II: Ecological responses in the grey stage and regionalization of data for MPB	Ellen MacDonald, U. Silins, and A. Anderson, UofA

Research Theme 4: Social and Economic Implications of a Changing Landscape

Critical Questions	Projects	Principal Researcher
What are the characteristics of resilient communities that are able to ensure their social and economic stability in the midst of a landscape changing due to MPB, and what steps can be taken to enhance the resilient capacity of communities?	Community resiliency affected by MPB	Lael Parrott, Okanagan Campus, UBC
How is fibre quality related to shelf life of MPB-killed trees across ecosites across Alberta, and what are the subsequent implications for manufacturing?	Understanding wood degradation in MPB-killed lodgepole pine, which will allow industry to optimize harvesting of at-risk forests	Kathy Lewis UNBC

Table 4-3. Research Themes, Critical Questions, and Projects – Mountain Pine Beetle Research Program, 2016.

Endangered Species Research

In western North America, the mountain pine beetle (MPB) is considered the most destructive biotic agent of mature pine forests. The consequences of accelerated harvesting relative to future food supply for species at risk—notably caribou and grizzly bears—were not known. In 2007, Alberta Sustainable Resource Development asked the model forest's grizzly bear research team to study grizzly bear response to mountain pine beetle outbreaks and management actions, providing funding for a four-year project. In 2009, the project expanded into the remote and somewhat inaccessible Kakwa area, where the research team proposed to track landscape change every two weeks—a much finer resolution than ever before. Food sampling was tracked over two years across west-central and northwestern Alberta to determine whether or not MPB-killed stands, compared to alternative management strategies to control MPB infestations, would negatively impact caribou and grizzly bear habitat.

In 2016, work continued on this study, with an expansion of parameters to include the impacts of MPB and salvage on the habitat needs and availability for caribou, as well as grizzly bears. Remote sensing now tracks changes to habitat every two weeks, and MPB salvage, as well as harvest plans, are used to forecast change into the future.

Public and Expert Understandings of MPB in Alberta, 2008–2010

This project to examine the influence of the media on public and expert knowledge of the mountain pine beetle in Alberta was led by Bonita McFarlane of the CFS. The MPBEP initiated the project to better understand the relationship between the media, the messaging, and public understanding with the goal of improving communications and information exchange between the public, resource managers, researchers, and the media. The control program was a large and expensive undertaking, and public support was critical to the Government of Alberta.

The research team identified the messaging from the provincial government about beetle damage and the control program and how those messages were communicated to and received by the public via the media. The researchers then surveyed three areas in Alberta to examine the resulting knowledge and opinions about MPB by three different public groups. The report and recommendations, issued in 2010, were welcomed by the Government of Alberta to improve its communications approach and indeed to help shape operational policies.

MPB Research Forums

In 2014, the MPBEP initiated its annual MPB Research Forum. These forums are designed to integrate the knowledge gained from ongoing projects and to disseminate it to forest practitioners, policy makers, and community leaders. The forums have been well received and well attended, with strong support from industry, government, and researchers. As the research continues, some initial findings are worthy of note, as discussed in a 2016 symposium hosted by the Mountain Pine Beetle Ecology Program.

University of British Columbia professor Allan Carroll's work on the effectiveness of Alberta's control strategies showed that the spread of mountain pine beetle exceeded forecasts, but that the single-tree treatments strategy of Alberta Agriculture and Forestry was proving effective and critical (see Figure 4-5). Further, he noted that Alberta pines, both lodgepole and jack, have evolved in an environment traditionally absent of the mountain pine beetle. As such, they are evolutionarily naïve to such attacks and are not very successful in their attempts to repulse the attacks. Given these circumstances, spread to the east is probable, and the key to control strategies is early detection and aggressive control. Jack pine forests stretch from central Alberta to Ontario and Quebec, and are the foundation for much of Canada's forest industry. Mountain pine beetle is an unknown pathogen

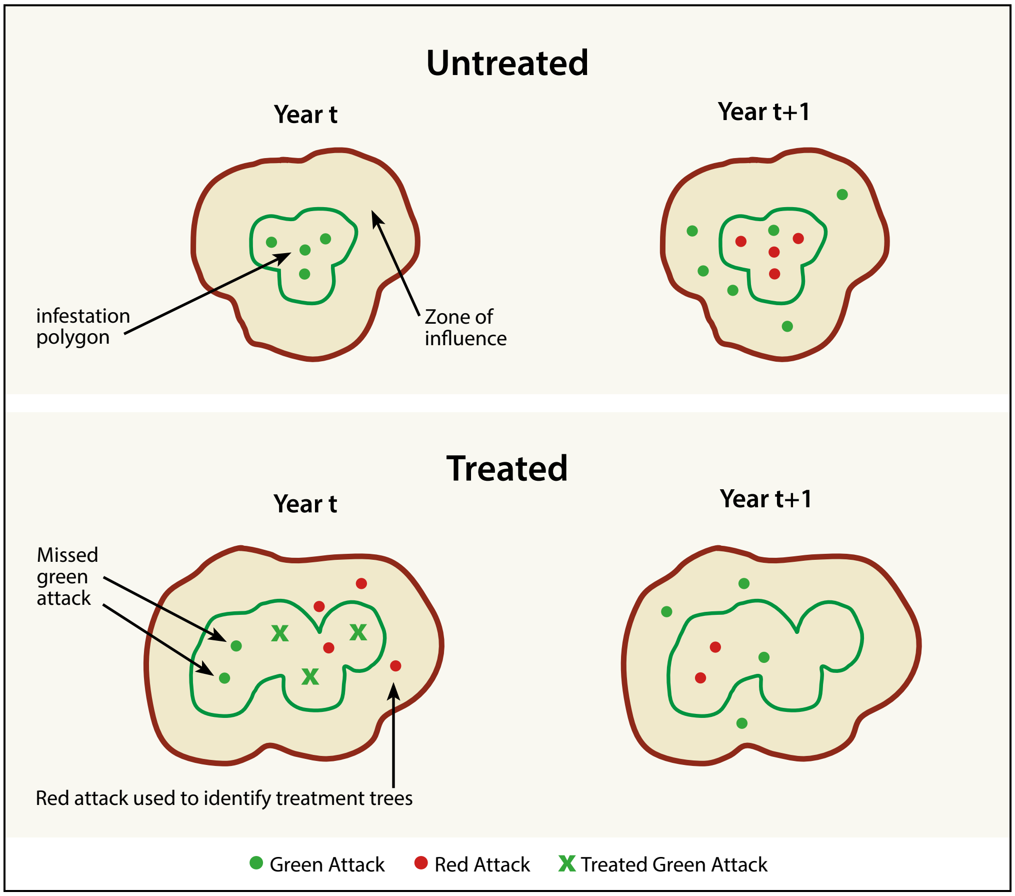


Figure 4-5. Schematic illustrating the method for evaluating the effect of treatment on reducing the intensity of new MPB attacks in the surrounding zone of influence in the year following the initial attack. *A. Carroll 2016*

to them, aided and abetted by climate change. Prolonged periods of –40°C temperatures, which traditionally controlled the beetle, are increasingly rare occurrences. In 2016, Carroll developed and calibrated a landscape model that can be used to evaluate alternative MPB strategies.

Continuing Research into the Next 25 Years

In 2014, the Mountain Pine Beetle Ecology Program (MPBEP) launched a four-year project to assess the ability of the beetle to persist in native lodgepole pine, lodgepole–jack pine hybrids, and jack pine forests. "The question we're attempting to answer is, once the mountain pine beetle arises in these new pine habitats, and after it's finished killing large-diameter trees, which it only does when it's in outbreak mode, can it persist in its sub-outbreak state—the endemic state?" explained Allan Carroll. "To do that, we need to survey as many areas as possible to determine whether there are differences associated with different stand conditions."

> "We know through work done with the research funding granted to the Mountain Pine Beetle Ecology Program that mountain pine beetle has made the transition from the lodgepole pine into jack pine. Which means that theoretically, it could spread all the way to Newfoundland through the boreal forest, and that would be really devastating. That kind of evidence has led Saskatchewan, primarily, to be very concerned. Saskatchewan does commit significant funding to Alberta to combat mountain pine beetle on the eastern edge in Alberta every year. I think we are on the third or fourth year now where they have given us money, and we've been using their money to help knock down trees and arrest the spread of mountain pine beetle. I don't know if we will ever get rid of it now; it's an

endemic species here now." –Darren Tapp, executive director, Forest Management Branch, Alberta Agriculture and Forestry, interview, 2016

"Many of the species that are affected by mountain pine beetle have certain fundamental resistance strategies, like exuding sap and pitching out the beetles. Jack pine have not co-evolved with beetles. As they are attacked, they are unable to mount a resistant response by producing sufficient resin to pitch out the invading beetles." –Keith McClain, interview, 2016

To guide the research program, well-defined terms of reference were developed in 2012, along with a research prospectus that defined four research themes and critical questions (see Table 4-3).

Research themes and related projects are:

Theme One: Mountain Pine Beetle Biology and Management
Three priority questions, four projects

Theme Two: Hydrological Impacts of Mountain Pine Beetle
Two priority questions, three projects

Theme Three: Dynamics of Natural and Managed Lodgepole Pine Stands following MPB Attack
Six priority questions, 13 projects

Theme Four: Social and Economic Implications of a Changing Landscape
Two critical questions, two projects

With research themes and critical questions as a guide for making research investments, a number of research projects were funded and initiated annually.

The MPBEP work continued in 2016 with a well-rounded suite of projects examining the many aspects of MPB on the forests, wildlife, hydrology, and economy of Alberta. Some examples of the ongoing research, communications, and recent findings include:

- fRI Research's Water Program lead, Axel Anderson, is conducting studies on the University of Alberta installation near Robb, as well as other sites impacted by the beetle, and preliminary findings suggest that at less than a 50 percent kill, hydrology will be unaffected.
- fRI Research's Caribou and Grizzly Bear Programs have established over 700 monitoring sites in the pine forests of western Alberta. New remote-sensing tools, combined with ground checks, are tracking changes on these sites as they are impacted by the pine beetle harvest and control operations. The studies are showing that all these activities have an effect on both caribou and grizzly bear habitat, but the net impacts are as yet undetermined.
- In 2016, the MPBEP released the Pine Beetle Smartphone App. Anyone can download the app from http://www.pinebeetleapp.ca/, and if they spot a beetle-infested pine tree, they can use the app to take a picture and upload the data to fRI Research's servers. The locations of MPB infestations will be shared with interested parties, including government and industry, so that they can improve their management plans.
- Katherine Bleiker's work on cold tolerance and seasonality has indicated that the beetle is here to stay in Alberta. Winter temperatures that would once have limited the survival of the species can no longer be relied on, and it is very likely that endemic populations will persist well into the future.

- The Beyond Beetle Project examines natural and facilitated lodgepole pine regeneration after MPB outbreaks in Alberta. It has been finding very low levels of natural regeneration becoming established in beetle-damaged pine stands. Spruce was the most common repopulating species but is still at levels far below acceptable stocking. There is a growing opinion that some form of intervention will be required to establish new stands following beetle attacks.

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CHAPTER FIVE

CCFM Criterion Three

Conservation of Soil and Water Resources

"Canada's forests play a key ecological role in the conservation and protection of surface and subsurface waters. Forests act as filters for pollution and are prime habitat for many aquatic and riparian species. Forest management activities modify forest soils through disturbance, erosion, and compaction. The use of management techniques to protect soil and water can minimize these impacts. However, when improperly carried out, forestry activities—particularly road construction and maintenance—can have negative effects on water quality, water quantity, and soil integrity."
–Canadian Council of Forest Ministers, 2005[1]

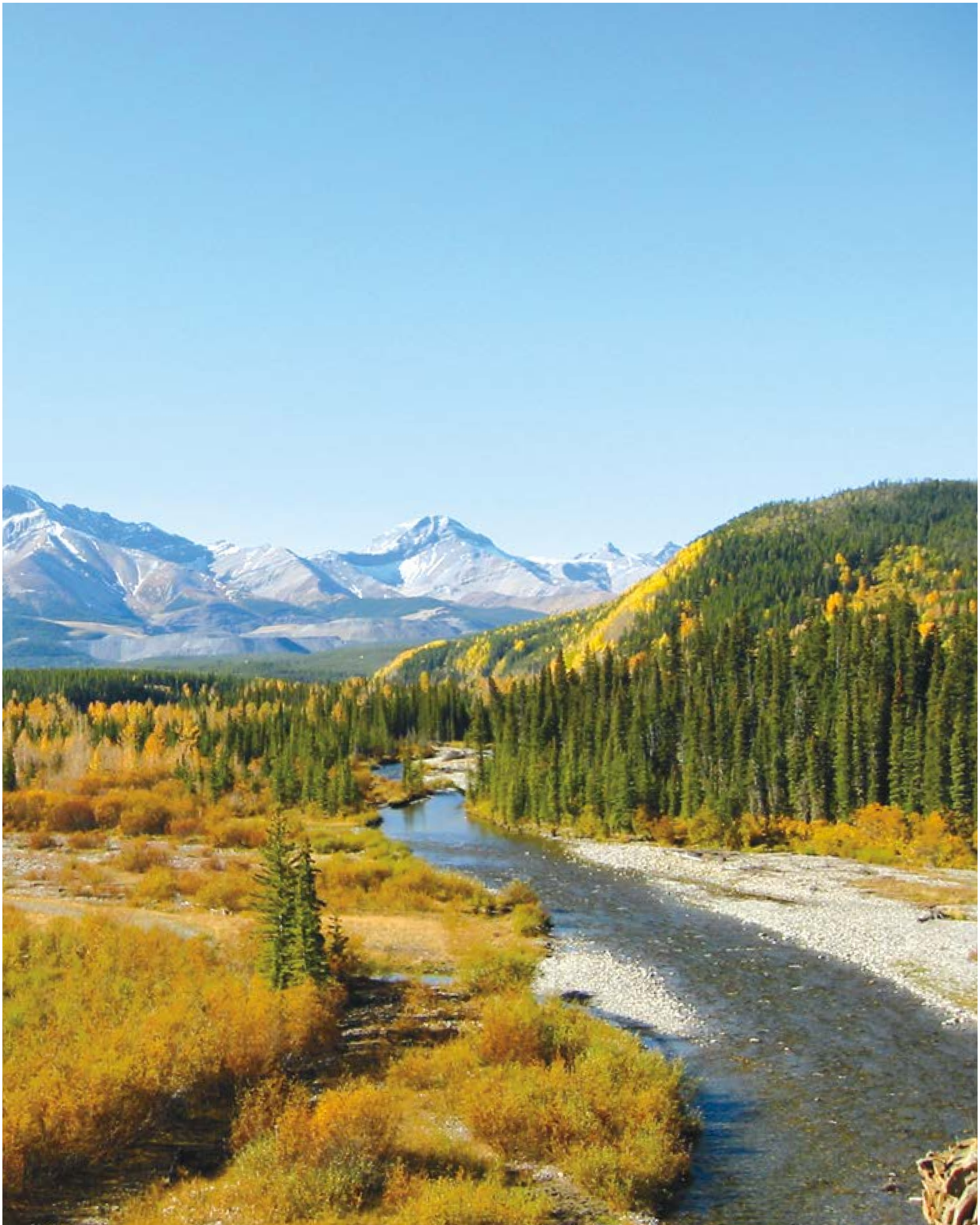
Soil, water, and trees are basic components of the forest ecosystem. They enable essential ecosystem services such as retaining precipitation, regulating water flows, preventing erosion, and providing habitat for fish and other fauna and flora. This chapter describes how the model forest and fRI Research have helped to understand, manage, and mitigate the effects of natural and human-caused disturbance on these components and services. Some aspects of soil conservation, such as compaction, are mainly silvicultural issues (covered in Chapter 4) or have been addressed independently by forest companies, government agencies, consultants, and academics. We have included fisheries research in this chapter because there is so much overlap with the water research, which involved many of the same people and programs. Research on fisheries and aquatic ecosystems is also an important component of the biodiversity conservation research described in Chapter 3.

Achievements of the water and fisheries programs have included watershed models, mapping methods, fisheries inventories, demonstration projects, long-term flow and yield studies, and the establishment of the Foothills Stream Crossing Partnership to monitor and mitigate the impacts of stream crossings on water quality and fish habitat.

Historical Context

As noted in Chapter 1, the critical role of foothills forests in water conservation was recognized in the late 19th century, and this was an important factor in the creation of Crown forest reserves and national parks on the Eastern Slopes of the Rockies. The main concern in Alberta was the headwaters of the North Saskatchewan and South Saskatchewan Rivers. In Alberta, these headwaters extend from the Brazeau River subwatershed down to the U.S. border, and they are the source of vital water supplies for agriculture and major populated areas of the three Prairie Provinces.* In the first half of the 20th century, federal and provincial authorities protected these headwater areas by undertaking fire prevention and control efforts, barring most settlement, and regulating forestry, hydroelectric development, coal mining, and oil and gas exploration. One impact of forestry in this era was the clearing and disturbance of scattered riparian areas for log drives to downstream mills. The last of the

* The entire Saskatchewan River watershed extends from the Continental Divide to Lake Winnipeg. It is a major farming and ranching region, about the same area as France, and today has a population of more than 3 million.

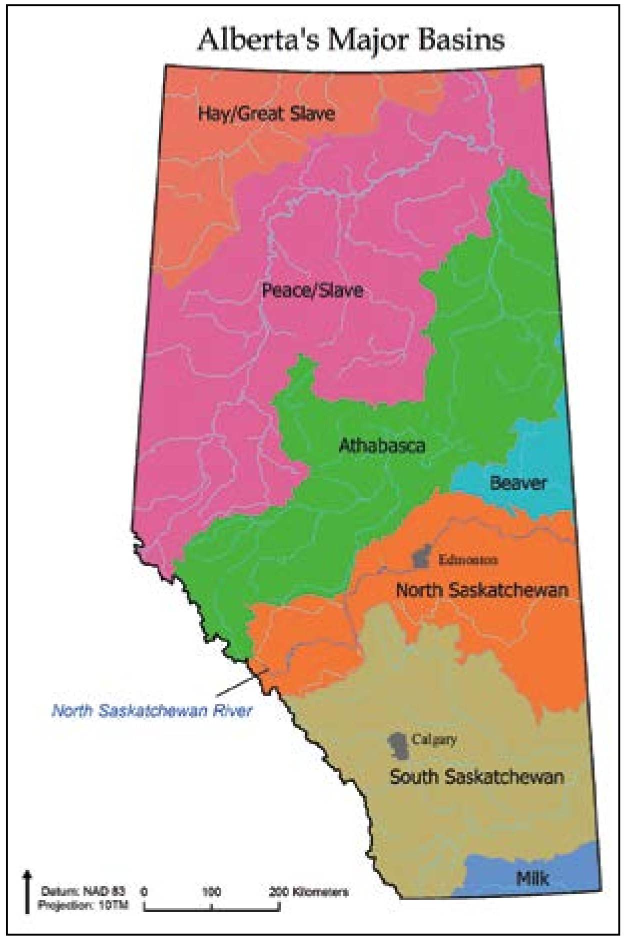


major log drives occurred in the early 1950s. By this time, roads and railways enabled safer and speedier delivery of logs without the effort and uncertainties of river driving, which included logjams, stranded logs, dams, and log drivers no longer willing to work under those wet and dangerous conditions.[2]

Opposite page: The foothills of Alberta are a critical source of water for the Canadian Prairies.

In 1946, R.B. Miller, professor of zoology at the University of Alberta, began surveys of trout streams in the South Saskatchewan watershed. The Alberta Biological Station was established in 1950 and undertook intensive studies of trout management in the Sheep River area. M.J. Paetz became the Alberta government's first fisheries biologist in 1952 and continued Miller's surveys, soon extending them to include the North Saskatchewan, Athabasca, and Peace River watersheds.

From 1948 to 1973, the Eastern Rockies Forest Conservation Board operated under a 25-year agreement between the Alberta and federal governments. It had a legislated mandate to provide policy and planning for watershed management in the Rocky Mountains Forest Reserve; i.e., the headwaters region of the Saskatchewan River watershed. The board analyzed the hydrologic characteristics of the area and provided priorities and guidelines for the management of renewable and non-renewable resources to optimize water quality and quantity. The conservation board focused considerable effort on the prevention and control of wildfires, which it considered a major threat to water resources at a time when road building, forestry, recreation, and energy exploration were having greatly increased impacts. E.S. Fellows, the board's chief forester, explained in 1951 why erosion was a key indicator of success or failure in conservation efforts:[3]



Map 5-1 The Major River Basins of Alberta.

> "Disturbing the vegetal cover through logging, grazing, cultivation, road building, or other means materially affects the capacity of the soil to permit the passage of water through it, and upsets those other factors which assist in this process. Thus, one of the sure signs that man has acted unwisely in such cases is the start of accelerated erosion. When this happens, we know that water is flowing over the surface of the ground, instead of soaking steadily into it to emerge again as springs or seeps …. It is for this reason that those whose interests lie in the conservation of water develop a keen eye for erosion. They are not primarily concerned with the loss of soil or even with the silting of streams or reservoirs, important though those are, but with the fact that water is moving out of control. They have then ceased to 'conserve' water; it is being wasted inasmuch as it cannot be used most effectively." –E.S. Fellows, Banff forestry conference, 1951

One of the board's research projects was the Marmot Creek Experimental Watershed Study,* begun in 1962 in Kananaskis, which included experimental harvests to increase water yield. The study found that the optimal block size for this purpose would be too small to be practical or economical for commercial operations.[4]

In 1948, the Government of Alberta also established the Green Area. These Crown lands, withdrawn from farming, included all the other foothills and boreal forest areas (Athabasca River and Peace River watersheds), as well as the Eastern Slopes feeding into the Saskatchewan River basin. The Alberta Forest Service and the Alberta Fish and Wildlife Service had primary responsibility for soil and water conservation in this vast area. Research from the conservation board, universities, and the Canadian Forest Service helped to support the regulators' efforts.

* The federal-provincial Marmot Creek Experimental Watershed Study continued until 1987 and was revived in 2005 by researchers from the University of Saskatchewan.

The Hinton Ground Rules

In the Hinton area, awarding of Alberta's first forest management agreement (FMA) in 1954 marked the beginning of large-scale, long-term harvesting in the Green Area. The FMA holder, North Western Pulp & Power, began road building in 1955, harvesting in 1956, and pulp mill operations in 1957. Company and government foresters then negotiated Alberta's first operating ground rules, contained in a three-page document dated March 11, 1958.* The ground rules required leaving unharvested buffers around streams and lakes, and there were brief statements about operable slopes (to address erosion) and rules for stream alteration and crossings (water flow and quality). The company would also need government approval for its annual operating plans and long-term forest management plans.[5]

* The ground rules were revised in 1967 to add provisions about erosion control and stream crossings. Revisions have continued at regular intervals since 1973, with the document eventually growing to more than 100 pages. Based on the original Hinton model, ground rules were subsequently developed for all logging operations in Alberta.

Both Reginald Loomis and Desmond Crossley, the lead foresters for the government and the company, respectively, in the early forest management planning at Hinton, were concerned about watershed protection. This reflected their own experience as well as historic concerns in Alberta about the role of the foothills in water supply. Loomis was adamant about protecting headwaters. "I've always felt that forest cover was a damn good way of having water seep down and flow out much, much more slowly," Loomis told Peter Murphy in the late 1980s.[6] From the beginning, the layout and approval of cutblock designs reflected watershed concerns. The scarification used to prepare sites for regeneration, which was pioneered at Hinton, helped to control surface water runoff, the biggest potential cause of erosion, Crossley noted in a 1984 interview with Murphy.[7]

> "Research in both the United States and Canada has proven that clear-cutting in strips or patches definitely results in increases in water yield. In uncut stands, some of the precipitation never reaches the ground and evaporates back into the atmosphere. This is particularly evident with snow when a great deal is hung up in the foliage, particularly when it is coniferous. Clear-cuts, of course, do not offer any obstruction, and increase in snowpack does result in an increase in runoff during the spring melt, which, in turn of course, increases the possibility for soil erosion. Fortunately, this can be controlled by the scarification program. Close observation of our cutovers during the initial years revealed no serious erosion anywhere on the lease. This can be credited to the rough and untidy nature of the surface debris. As the melt progresses and water starts moving down the slope, it is continually encountering soil ridges, upturned stumps, and broken chunks of slash. During each interruption, it drops its silt load. This leaves little pans of silt of varying sizes and depths that result in excellent micro-sites for the establishment of subsequent regeneration. Haul roads through the cutting areas, however, could seriously affect erosion and stream siltation. This was a bone of contention between [company woodlands operations] and the Forest Service, but could be avoided by putting the roads 'to sleep' during the scarification process."
> –Des Crossley, interview, 1984

Another key factor in the ground rules negotiations, and in subsequent forest management planning, was the treatment of streamside areas. Crossley never accepted the government's case for riparian buffers, which he considered an unnecessary reduction in annual allowable cut (AAC).

> "The government insisted that we leave a permanent strip of timber on both sides of every permanent stream. This would remove many acres as a source of wood supply and therefore reduce the AAC. We were not in favour of this restriction, but Fish and Wildlife officers were concerned with the effect on fish. Apparently, the fishing fraternity think that overhanging trees provide the shade that is necessary to keep the water cool for good fish habitat. This is probably

Early scarification on the North Western Pulp & Power FMA area, contractor Dick Corser's D-9 at work 1958.

true in most of our country, but our streams were generally of glacial origin, and at this elevation in the foothills of the Rockies, the waters are too cold to result in the best habitat …. Fish never grow to much size as a consequence. The habitat could be improved by allowing more sun to reach the stream's surface. The residual strips that we were forced to leave, if not harvested, are going to blow down eventually, many falling into and across the stream and destroying the fishing potential. Nevertheless, our concerns were not accepted." –Des Crossley, interview, 1984*

The operating ground rules set aside arbitrary buffer zones, the width dependent on the size of the stream. Other merchantable timber in a block would normally be cut, but the actual streamside ecosystems, or "riparian zones"—generally the flats on both sides of the stream influenced by periodic flooding—usually exceeded the width of the mandated buffers, and there were subsequent challenges with reforestation. A company experiment in the early 1990s treated the whole riparian area (buffer and non-buffer) as a "special management area" in which some timber harvesting took place, but wildlife habitat was the primary object of management.[8] Subsequent practices would include some partial cutting in riparian zones.[9]

Because of the water-related concerns, Crossley encouraged the Canadian Forest Service (CFS) to conduct watershed and hydrology studies on the FMA area. From the 1960s to the 1980s, R.H. (Bob) Swanson and other CFS water researchers focused on the Hinton FMA area and produced more than 20 scientific papers, addressing topics such as:

- Soil infiltration and erosion
- Impact of clear-cutting on water yield, quality, and flow
- Erosion and sedimentation at stream crossings
- Chemical and physical water quality after disturbances[10]

One influential report was *Watershed Management Guidelines for Logging and Road Construction* by University of Alberta professor Richard Rothwell, published by the CFS in 1971.[11] Data gathered by Swanson, Rothwell, and others became a rich source for subsequent model forest and fRI studies.

* Biologists later found that forested riparian areas have an additional value because they maintain species biodiversity by providing thermal cover and food sources for overwintering animals, as well as key habitat for many species of birds. Some downed woody debris in streams is now seen as desirable for fish habitat. However, recent research on natural disturbance patterns indicates that riparian ecosystems would benefit from some management intervention, including harvesting or prescribed burning, so in a sense, some of Crossley's views have come back into vogue (see the natural disturbance discussion in Chapter 3).

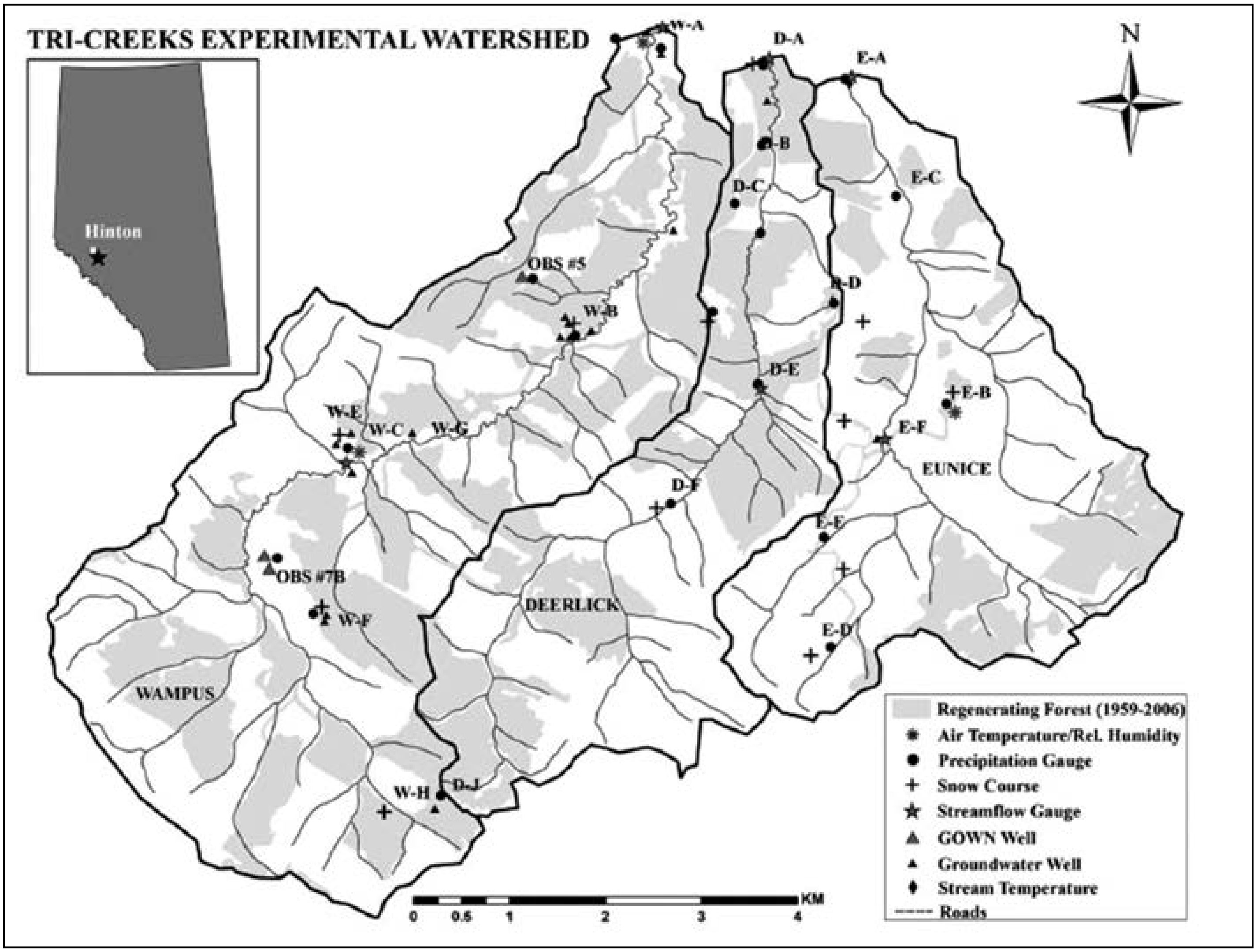
The protection of riparian buffers in Alberta contrasted starkly with practices in British Columbia, where industrial-scale logging up to the stream bank was common practice in the 1970s and 1980s. Richard McCleary, who worked in the B.C. Interior before coming to work for the model forest in 1999, said that "it was refreshing to see the legacy from a half a century of riparian protection in the forests around Hinton where tall trees lined the banks along deep, meandering streams and fallen trees created logjams and hiding places for fish. In contrast, especially where valley-bottom cedar or spruce forests had been clear-cut in B.C., stream channels were wide, shallow, and devoid of logjams for fish. I also noticed that the foresters in the Hinton area had worked hard to keep the roads a healthy distance from the stream, typically outside of the floodplains. Their efforts minimized impacts from road-related landslides into streams."[12]

The Tri-Creeks Experimental Watershed

The debate about riparian buffers and the effects of harvests on fisheries led to an ambitious and multi-faceted research project involving North Western Pulp & Power, Alberta Fish and Wildlife, Alberta Forest Service, the CFS, and university scientists. Though discussions of the research topics had been underway since at least 1960, the proposal for the Tri-Creeks Experimental Watershed Study appears to have originated in 1965 with Gordon Haugen, an Edson-based provincial fisheries biologist.[13] Based on U.S. experience, Haugen and his colleagues were concerned about the adverse effects of logging on area streams and trout populations. The project became part of the Alberta Watershed Program during the International Hydrological Decade, 1965–1974. The provincial government officially ended the Tri-Creeks program in 1987, although some hydrological and fisheries data collection continued. In 2015, fRI Research began monitoring and remeasurements in the Tri-Creeks research study area.

The partners settled on a research design that incorporated three watersheds: a control (Eunice Creek, with no new disturbance), an experimental treatment (Deerlick Creek, clear-cut without streamside buffers), and conventional treatment (Wampus Creek, clear-cut with ground-rule buffers). These creeks, about 40 kilometres south of Hinton, were chosen because they had similar physical and biological characteristics and were close to each other. They are tributaries of the McLeod River, which eventually flows into the Athabasca River.

First-pass harvest, Tri-Creeks Experimental Watershed area, 1984.



Map 5-2. Tri-Creeks Experimental Watershed (2006) showing three sub-watersheds and harvest patterns. *Courtesy Canadian Institute of Forestry*

Research projects included establishing extensive instrumentation to record stream flows, water temperatures, and weather events. The Alberta Research Council and the University of Alberta carried out surficial, bedrock, soil, and groundwater surveys. Provincial biologists inventoried fish populations (primarily rainbow trout), their characteristics, stream-bottom material, and channel patterns at permanent sampling stations; they also measured and classified stream fauna. An invertebrate research project determined what species were present, described the life histories of common species, and documented community history. Provincial biologist George Sterling later did studies to compare spawning success and recruitment of rainbow trout before and after logging.

The first cuts of a two-pass harvest design were carried from 1979 to 1984 on Wampus and Deerlick Creeks, removing about half of the merchantable timber and covering about 40 percent of the watershed areas. There were a few small cutblocks in the Eunice Creek area prior to the study. The results included some increase in water yield and water temperature in Deerlick Creek, the one without streamside buffers, compared to the others. Both of the harvests and associated road building led to increased sediment, although the buffer seemed to reduce the amount entering Wampus Creek. Most of these results were not considered scientifically significant because of the short monitoring period before the project was terminated. The second pass of the harvest design did not occur as planned. Flood events in 1969 and 1980 interrupted the project's data collection and seemed to have greater impact on fish populations than harvesting. Data continuity and consistency of collection were issues, as responsibility for these activities was not always clearly defined within the field organizations based out of the Edson Forest headquarters.

After the initial harvest in Deerlick (1981–1983), another 4 percent was harvested in 1990–1992, and Eunice was cut in 1990. Second-pass harvesting began in Eunice and Deerlick Creeks in 2015 and was proposed for Wampus Creek in 2017.

The data are now being re-examined and may yet provide valuable insights. Current research is focused on understanding the effect of forest cover change (e.g., as a result of mountain pine beetle attack) and harvesting on the stream flow regime and fish populations.

Sterling et al. in 2016[14] observed that fish populations were healthy 25 years later in the two harvested watersheds, but not in Eunice Creek. Management implications from the experiment were difficult to discern. "Harvesting on frozen soils minimized soil erosion and stream bank disintegration," the authors said. "However, post-harvest erosion was not minimized due to poor road construction, maintenance, and reclamation practices."

Northern River Basins Study

From 1991 to 1996, the Northern River Basins Study (NRBS) undertook an inter-jurisdictional, multi-disciplinary study of the Peace, Athabasca, and Slave River basins. It was launched cooperatively between the federal, provincial, and territorial governments initially in response to widespread concerns voiced by northern residents about the present and future state of regional river systems following the approval of the Alberta-Pacific pulp mill at Athabasca, Alberta. Most of the issues, research findings, and recommendations dealt with industrial water use and pollution.

The NRBS research program included 150 projects dealing with hydrology, water use, water quality, fisheries, and wildlife. It concluded that, on the whole, the condition of aquatic ecosystems in the northern basins was good. Dioxin and furan levels in fish were declining, and most basin residents had access to good-quality drinking water. The governments pledged to continue research and address problem areas.[15] Some of the research continued under the Northern Rivers Ecosystem Initiative from 1998 to 2003.[16]

In November 2003, the Province of Alberta released its water conservation strategy, *Water for Life: Alberta's Strategy for Sustainability*, which included a significant research component. This added impetus to the water and fisheries research at the model forest.

Model Forest Watershed and Fisheries Programs

The successful proposal for creation of the model forest in 1992 included as one of its goals the development of "cooperative management strategies for watershed, fish, and aquatic ecosystems," which would involve fulfilling four objectives:

1. Convert provincial fisheries information to digital format
2. Conduct resource and recreational use surveys and design angling management strategy
3. Improve timber management standards for stream crossings and riparian zones
4. Analyze Athabasca rainbow trout and bull trout habitat use and ecology

The detailed proposal for the model forest proposed to develop an Aquatic Systems Decision Support System module by 1996. This would include the development of methods and a database for inventory and an effects-assessment of harvesting and silviculture on aquatic and water resources. This would then provide the basis for monitoring and predicting the sustainability of water and aquatic resources. Bob Swanson's earlier CFS research in the Hinton area and elsewhere gave this initiative a sound footing, and Swanson was also involved in developing the proposal.

Another part of the proposal considered watershed, fish, and aquatic ecosystems, including inventories of fish populations and the development of strategies for conservation, including species of concern such as the Athabasca rainbow trout and bull trout. Long-term fish habitat and monitoring would also be implemented. From this work, improved protocols, standards, and guidelines for watercourse crossings would be developed, including riparian habitat measures.

As the model forest's planning developed, and the realities of limited funding set in, this work would have to be scaled back and spread over a longer term, but in the ensuing years, most of the initial objectives were met and even exceeded.

The plan to "characterize aquatic ecosystems in the Foothills Forest" acknowledged the need to bring watershed and aquatic ecosystem management into planning for sustainable forest management. Building on existing knowledge of watershed management and aquatic ecosystems in the region, the model forest would gain a better understanding of the interrelationships and potential conflicts that existed. Funds were allocated for bull trout research and watershed modelling.

Initially led by Sean Curry, the Fish and Watershed Program immediately undertook the digitization of existing fisheries data and began planning how to achieve the other objectives. Rick Bonar led a project to inventory and develop management strategies for major river corridors within the Foothills Forest, including recreation, watershed management, riparian zone management, and management of adjacent upland areas. Another early project studied bull trout spawning and rearing.

FMF fisheries biologist Cam Davis inspects a hanging culvert, 1998. Hanging culverts such as this one are major impediments to fish passage.

An inventory of stream crossings, which had already been done for most of the Weldwood FMA area, was completed for the entire model forest area in 1993. Continuing work by the model forest and Weldwood's implementation of that research into monitoring and mitigation of stream crossing impacts led eventually to the creation of the Foothills Stream Crossing Partnership and adoption of a partnership approach to watershed husbandry by other land users within the Foothills Model Forest research area and, later, across Alberta. The issues included bridge design, construction disturbance, bridge deck openings that allowed dirt to fall off vehicles into streams, and "hanging" culverts (due to outflow erosion) that prevented fish passage.

Watershed Assessment Model

The model forest held a three-day workshop on January 10–12, 1994, facilitated by Rich Rothwell, forest hydrologist and professor of forest science at the University of Alberta, and fisheries biologist Jim O'Neil. The workshop produced a strategic plan for a Watershed Assessment Model (WAM) that would "characterize and predict responses of critical hydrological and aquatic resource parameters to a range of forest management scenarios" and integrate with the model forest's geographic information system (GIS) and decision support system. Attendees noted there were impacts on fish and water resources from past practices (harvesting, roads, and energy sector activities) and from overfishing, abetted by increased road access into the model forest area. "In most cases, these problems arise at and within the zone of influence of stream crossings," the workshop summary said.[17]

In July 1994, the model forest hired Janice Traynor as the Fish and Watershed Program coordinator. Traynor, a University of Alberta forestry graduate with a master's degree in forest hydrology, had worked for the research branch of the Alberta Forest Service and other agencies and consulting companies. She began developing the WAM based on the workshop conclusions and previous work by the U.S. Forest Service, Bob Swanson of the Canadian Forest Service, and Rich Rothwell, among others. The goal was to simulate the outcome of different land management alternatives in time and space so that both negative and positive impacts could be identified and incorporated into decisions. This tool would, and did, assist land managers in maintaining the integrity of aquatic ecosystems and associated hydrological values as a prerequisite for supporting viable, stable fish populations. Rich Rothwell and Edson-based provincial fisheries biologist Carl Hunt supervised the program for the model forest.

Additional workshops in January and March 1995 brought together biologists, hydrologists, and land managers to discuss the issues and refine the program objectives. A regional hydrology study in 1995–1996 characterized the yield, flow, and other parameters of water in the model forest area. Several other studies dealt with sedimentation—including the development of a tool for field measurement—and the impact of sediment on fisheries. Another workshop and update session was held in March 1996 for guidance from previous participants.

Traynor worked with Swanson, Rothwell, and the model forest GIS staff to adapt a U.S. Forest Service model called WRENSS (Water Resource Evaluation of Non-Point Silvicultural Sources) so that it could be used with Alberta foothills hydrological data. This was a key component of the WAM, and Traynor said that it continued to be used and developed by Rothwell, The Forestry Corp. (now FORCORP Solutions), Weyerhaeuser, and others in their consulting and planning work as recently as 2012. The model enabled users "to evaluate potential impacts of forest harvest plans or to provide direction on how to best implement plans to limit water quantity impacts," Traynor said.[18]

The WAM made it possible to calculate various watershed or stream parameters, including stream order, watershed area, basin area, stream length, stream gradient, site gradient, sinuosity, elevation, density of linear features (roads, etc.), and density of point features (road-stream crossings, etc.).

> "The stream flow response portion of WAM was, in my mind, the most significant ongoing portion of WAM. The hydrological response report, watershed and climate characterization, and the conversion of the WRENSS framework to use more Alberta-appropriate values allowed this information to be used in planning ….
>
> "A big part of [the model] was looking at where the snow is going to accumulate, where it is not, and how that was going to be impacted by elevation and topography and orientation. How much snow will then be captured, basically. The models predict what volume of snow will be deposited in openings, and when the snow melts, where the runoff will come. Based on these factors, the models predict whether the snow will all melt at once and be a strictly cumulative peak, or whether it will melt over time because of shading and where it's located—aspect, slope, etc.—so that it'll be a gradual increase over time. This is the information that the model provided, and all that has an impact on flood and potential maximum culvert sizes." –Jan Traynor, personal communication, 2017

One of the important parts of the WRENSS model was a calculation of snow accumulation and the timing of snowmelt, which allowed stream flow quantities and timing to be predicted. The Foothills Model Forest adaptation was called WRNSFMF (Water Resource Evaluation of Non-Point Silvicultural Sources for the Foothills Model Forest). Using the calculated inputs of slope, elevation, climate, aspect, forest types, and harvest patterns, WRNSFMF modelled the prevailing wind and topography impact on the pattern of forest openings to identify where snow would be redistributed and the pattern of snow accumulation and snow scour. This information was combined with regeneration and local stream flow estimates to predict the future stream flow response to harvest. Adjusting a harvest plan to vary the size and aspect of blocks would show a response in the quantity and timing of stream flow.

Traynor left in 1997 when the model forest Board decided not to continue the watershed modelling beyond her initial three-year contract, and she finished the final report on the project in June 1997 as a Forestry Corp. project.[19] She said that working on the GIS aspects of the WAM project got her interested in the technology, and this led her to then study for an advanced diploma in GIS from the British Columbia Institute of Technology. Then, in 1998, she began a new career as a geospatial analyst with The Forestry Corp., where part of her work involved the continued application of tools that had originated at the model forest. She later moved to similar work with the B.C. Oil and Gas Commission, where she currently works.

The first few years of the program produced some impressive results that would serve the province and industry well in ensuing years, including:

a. Development of hydrological, aquatic, and fisheries databases for the Foothills Model Forest region and their inclusion into the GIS of the model forest
b. Development of ArcInfo hydrological models, regional hydrologic equations, and a customized computerized model of Water Resource Evaluation of Non-Point Silvicultural Sources for the Foothills Model Forest (WRNSFMF)
c. Development of a Watershed Assessment Model (WAM), a prototype of which was in operation
d. Development of a Regional Hydrology Model and an operational manual for the Foothills Model Forest
e. Establishment of habitat parameters for Athabasca rainbow trout, bull trout, mountain whitefish, and Arctic grayling
f. Development of recommendations for the rehabilitation of bull trout in Alberta

After Traynor's departure, Rick Blackwood, assisted by model forest biologist Craig Johnson and George Sterling of Alberta Fish and Wildlife, undertook a reassessment and upgrading of the WAM, using The Forestry Corp. Meanwhile, at The Forestry Corp., Traynor continued her work on the WAM, adapting it to the boreal landscape, with funding from Manning Diversified. The improved foothills and boreal models would see wide use in Alberta for many years to come, including the development of a management plan for the Forest Management Unit C5 in the Crowsnest Pass area, Manning Diversified's operations, and many other applications.

One additional refinement was the HAGGIS (Hydrology Attributes Generated from GIS) program. This tool enabled users to generate and report attributes specific to a particular point. Parameters such as flow, flood volume, and peak flows could be calculated automatically using HAGGIS. Forest harvest plans could also be formatted for input directly into the WAM using this tool. HAGGIS was later tested against precise real-world measurements in the model forest.

In a later investigation of the potential stream flow response of stands killed by mountain pine beetle, Rich Rothwell adjusted the hydrologic response curves within WRNSFMF to reflect the predicted hydrophobic soils after needle fall and used this to estimate potential stream flow changes.

Jasper National Park employed the WAM for a somewhat different purpose, using watersheds to delineate bear management units, which had previously been based on arbitrary boundaries. The Alberta Water Resources Branch also made use of the model.

Fish and Aquatics

The state of fisheries is closely related to hydrological issues such as sedimentation, water flows, and barriers created by hanging culverts. By the mid-1990s, the numbers and size of sport fish (Athabasca rainbow trout, bull trout, arctic grayling, and mountain whitefish) had been declining in the region for about 20 years, and this was attributed to the combined effects of industrial activity, poaching, and legal angling.[20] Angling pressure continued to increase along with road access to previously remote areas, although subsequent changes to fishing regulations reduced some of the impacts. The model forest worked with the Alberta Conservation Association (ACA),* the Hinton Fish and Game Association, Trout Unlimited, Weldwood, provincial biologists, academics, and other partners to assess fisheries and aquatic habitats and develop management strategies.

Fisheries biologist Craig Johnson began work on a fish and stream inventory in August 1995. He and fellow biologist Hilary Jones deployed field crews that used block nets and electrofishing to collect data from 481 sites by year-end 1997. A float electrofisher was added in 1998 for sampling larger streams. During this work, the team developed an index of abundance based on the electrofishing catch rate. The completed inventory provided the foundation for the long-term monitoring of fisheries in the model forest area. The information was made available to partners through maps, binders, and databases. The team also produced a manual describing how to collect data in a consistent and meaningful manner. “That’s something that had never been done in Alberta before,” Johnson said.[21] The studies documented 29 fish species in the model forest area. These included the four native sport fish species: Athabasca rainbow trout (a subspecies unique to the area), bull trout (identified as a species of management concern),* arctic grayling, and mountain whitefish. Johnson noted that the local rainbow trout are among the slowest-growing trout in North America, which made it particularly important not to impede their movement up and down streams.

In partnership with the Alberta Conservation Association, the group also produced a manual of photographs and descriptions of fish habitat for Eastern Slopes streams in Alberta. This visual guide would aid fish and stream inventories by ensuring both consistent and precise data collection and allowing organizations to confidently share and exchange information.

* The Alberta Conservation Association (ACA) is a delegated administrative organization (DAO) supported largely by hunting and fishing licence fees, with a mandate to conserve, protect, and enhance fish and wildlife populations and their habitats. It conducts and supports research activities, which have included various model forest and fRI Research projects. The funding model is similar to that used by FRIAA for forestry projects, although ACA scientists are also directly involved in some research.

* In 2014, Athabasca rainbow trout and bull trout were classified as “threatened” under the Alberta Wildlife Act.

Electrofishing, 1998.

Sport fishing is an important pastime for many Alberta residents and visitors such as this fly fisherman near Nordegg, 2002.

The results of this research and inventory work were beginning to show up in regulation and the work plans of the partnership. In 1998, Alberta Environment used the Foothills Model Forest fish inventory when establishing new angling regulations for Alberta's Eastern Slopes. It was also used for land-use planning. Weldwood, on its Hinton FMA, was using the fish inventory database to support the planning of harvest areas and roads. This information helped the company decide on streamside buffers, types of stream crossings to be used, and other stream, watercourse, and fish protection measures.

The biologists' findings, along with earlier research and the work of the watershed program, in addition to changes in road construction that were already being adopted by Weldwood, would soon be mandated in other Alberta forestry operations, road construction, and energy sector activities. The changes included more use of bridges instead of culverts, solid decks and side rails on bridges, construction methods involving little or no disturbance of banks and stream beds, use of larger culverts, and regular inspections of culverts. The findings were presented at workshops and incorporated into publications on riparian management and stream crossings.

> "Our study indicates that certain culverts were barriers to most of the resident fish. Important ramifications are restricted fish passage and changes to populations through habitat fragmentation. These research findings are significant for future conservation of fish populations in the Foothills Model Forest and are now being used by Weldwood in its culvert remediation project. They are also of high value for any resource industry or government agency developing roads on the Eastern Slopes of Alberta." –Foothills Model Forest 1997–1998 annual report

In 2000, the model forest installed a fish trap to monitor bull trout and mountain whitefish spawning migrations from the McLeod River up MacKenzie Creek. This area was a major focus as a result of issues raised concerning the proposed Cheviot coal mine, and it was the first opportunity to provide a detailed description of the spawning population. While the trap operated, biologists captured 167 bull trout during their migration. Later, 1,124 mountain whitefish were captured, with nearly 40 percent arriving in one day. Fish populations were also monitored in several other watersheds (Pinto, Emerson, Lambert, Anderson, Teepee, Antler, Wampus, and Deerlick).

Craig Johnson, 2000.

In December 2001, Dorothy Majewski, director of habitat in the prairie region for the Department of Fisheries and Oceans (DFO), came to Hinton for a two-day visit with Weldwood and the Foothills Model Forest. She was accompanied by two DFO biologists out of the Edmonton office, Bruce McCollough and Ryan Sherman. The visit helped clarify the federal approval process relative to stream crossings and fish habitat management in Weldwood's operations and elsewhere in the model forest area. (Provinces own and manage water resources, wildlife, and fish on their lands in Canada, but federal jurisdiction over fish habitat and navigation gave the national government considerable regulatory authority over inland waters until new laws were enacted in 2012.)

Craig Johnson left the program in 2003 to work for the Alberta Conservation Association in Edson, and then for the provincial government in various locations. George Sterling, who had returned to Edson in 1998 as a biologist for Alberta Fish and Wildlife, said that Johnson and his team "really brought the inventory up to snuff in terms of our current understanding and what fish populations were like in the stream—that really supported our management objectives in terms of regulation."

The fish inventory work continued until 2007. By that time, partners in the program had invested approximately $1.1 million in electrofishing at 1,460 sites since 1996. The model forest summarized the fish distribution information from these inventories in a spatial model that was transferred to the partners, including the Government of Alberta, and it is now part of the government's Fish and Wildlife Management Information System (FWMIS).

In 2003, Rich McCleary, who had joined the model forest in 1999 as a biologist working for Johnson, became the next leader of the Watershed and Fisheries Program. McCleary had a master's degree in forestry from the University of Montana, and he had previously been doing hydrology-related work in the Banff area and the B.C. Interior before coming to Hinton. "There was a refocusing of the work," McCleary said. "Monitoring and inventory didn't resonate with the Board anymore. There was a shift towards trying to identify what the key constraints and problems were in forestry that could be advanced through some innovative work."

Rich McCleary in his element—an instructional day with Hinton elementary school students.

Indicators of Healthy and Sustainable Aquatic Habitats

In 1998, the Watershed and Fisheries Program began to study the the status of fish populations in a historical context and to examine how industrial activities and angling had affected both fish populations and their habitats. In addition to increasing understanding of the effects of human activities on aquatic systems, the program also developed a set of indicators to be used in long-term studies and in the newly established Local Level Indicators Program of the Foothills Model Forest (see Chapter 4). Work would continue on local level indicators over the next several years. In 2005, the Watershed and Fisheries Program was assigned the lead for the development of two indicators: stream crossings and water yield. In 2006, the Foothills Stream Crossing Program began working with its member organizations to develop the stream crossing indicator. Meanwhile, the water yield indicator was developed in cooperation with West Fraser, Jasper National Park, and Alberta Sustainable Resource Development.

Remediation of stream crossings then became a major focus for research and the development of management strategies. "Craig [Johnson] had laid the foundation for a major initiative to address the most obvious and prolific water-related impact in the foothills," McCleary said. "Craig was doing a lot of work on crossings, and he was always talking about crossings, every time he had a chance, about the fish migration barriers the culverts cause, about sedimentation from the road runoff."

McCleary worked with model forest fish biologist Scott Wilson and Chris Spytz, a biologist with Weldwood (after 2004, the Hinton Wood Products division of West Fraser), to develop a method for prioritizing and addressing stream crossing problems. Their paper on the planning process was presented at a 2003 conference and published in 2004.[22] The proposed systematic, multi-stakeholder approach was incorporated into the Foothills Stream Crossing Program in 2005 and became the template for similar efforts across Alberta. Jasper National Park also used the methodology for the Highway 16 crossing of the Talbot Lake outlet stream. In the meantime, a local project provided a test for some of the concepts.

Hardisty Creek Restoration

Hardisty Creek runs through Hinton into the Athabasca River, draining a 3,000-hectare watershed south of the town. In 2001, a local environmental organization, the Athabasca Bioregional Society, conceived a project to remediate the impacts of decades of development on the creek. "Our intent was to foster bioregional (watershed) awareness and education of ecological realities using solid conservation science, but also to engage people to actively participate with environmental projects," recalled society member Connie Bresnehan.[23] "What could be a better fit?"

The project's goals were:

1. Restore fish habitat within the Hardisty Creek watershed.
2. Extend fish connectivity by repairing stream crossings. There were seven crossings along the creek, and six of them were preventing fish passage.
3. Educate the citizens of Hinton and area to be more aware of their relationship to water and the greater ecosystem.

McCleary and Spytz served as scientific and technical advisors as the project evolved through a series of meetings in 2002. It was officially launched in 2003 as part of the United Nations International Year for Fresh Water. In addition to the model forest and the bio-

The CNR crossing on Hardisty Creek, before and after restoration.

regional society, the partners were Alberta Sustainable Resource Development, Alberta Transportation, Fisheries and Oceans Canada, the Hinton Fish and Game Association, the Town of Hinton, and Weldwood (Hinton Wood Products after 2004). The project received support from many community members and businesses, as well as other sources such as the Alberta Conservation Association and Alberta Ecotrust.

The first phase in 2003 also involved the Canadian National Railway (CNR), which restored fish passage at a stream crossing constructed in 1927. In the decades following construction, erosion at the outlet had created a waterfall that blocked upstream fish migration. The CNR built a long rapid with large boulders to create resting places for fish making the journey upstream.

Detailed plans for other fish passage and fish habitat restorations were completed in 2003, and work began in the area near the town's Kinsmen Park in 2004. The largest component was the development of a demonstration site in Hinton. The site centres around two

Hardisty Creek interpretive sign, 2015.

hanging culvert restorations—the CNR remediation and the culvert restoration at Kinsmen Park done in 2005. Local residents assisted by planting soil-conserving vegetation along the remediation area. The project also included educational signage and interpretive trails. The crossing restoration work continued through 2007.

As part of its commitment to the project, West Fraser removed two culverts on the mill property, replacing them with a single-span concrete bridge, and the company replaced an old crossing on the Robb Road with a large, new half-culvert that retained the stream bed. The investment in a bridge provided immediate and lasting benefits. Shortly after the culverts were removed, McCleary and his crew captured a bull trout more than 1 kilometre upstream from the new bridge within the Hinton townsite. Local people told stories of bull trout in Hardisty Creek in the 1970s, but none had been reported for decades.

In 2006, the Hardisty Creek Restoration Project was the recipient of the Forest Stewardship Recognition Award from Wildlife Habitat Canada. This award is presented annually to individuals, organizations, and companies for outstanding stewardship in Canada's forests. The project was also a finalist for a provincial Emerald Award in the Community Projects category, and it received an Environmental Effort Award from Green Streets Canada.

"Our watershed stewardship project has provided a conservation success story for our community and is an example of what can be done by a little grassroots watershed group with a will to make a difference," Connie Bresnehan wrote on a website.

"We can use Hardisty Creek as an example of what should go on throughout the foothills," McCleary said in 2005.[24] However, Rick Bonar observed in 2015 that the project was not a total success. The CNR remediation washed out and again became a fish barrier, which had still not been addressed in 2017. Worst of all, Alberta Transportation refused to mitigate the major hanging culvert under Highway 16, apparently intending to wait until it reached the end of its engineering lifespan.[25]

Other Demonstration, Collaboration, and Extension Work

In 2005, McCleary developed detailed plans for another demonstration site at the Anderson Creek crossing on the Robb Road, where Weldwood had recently replaced a fish-passage-blocking culvert with a bridge, including stream bank modifications and the addition of woody debris into the stream channel.

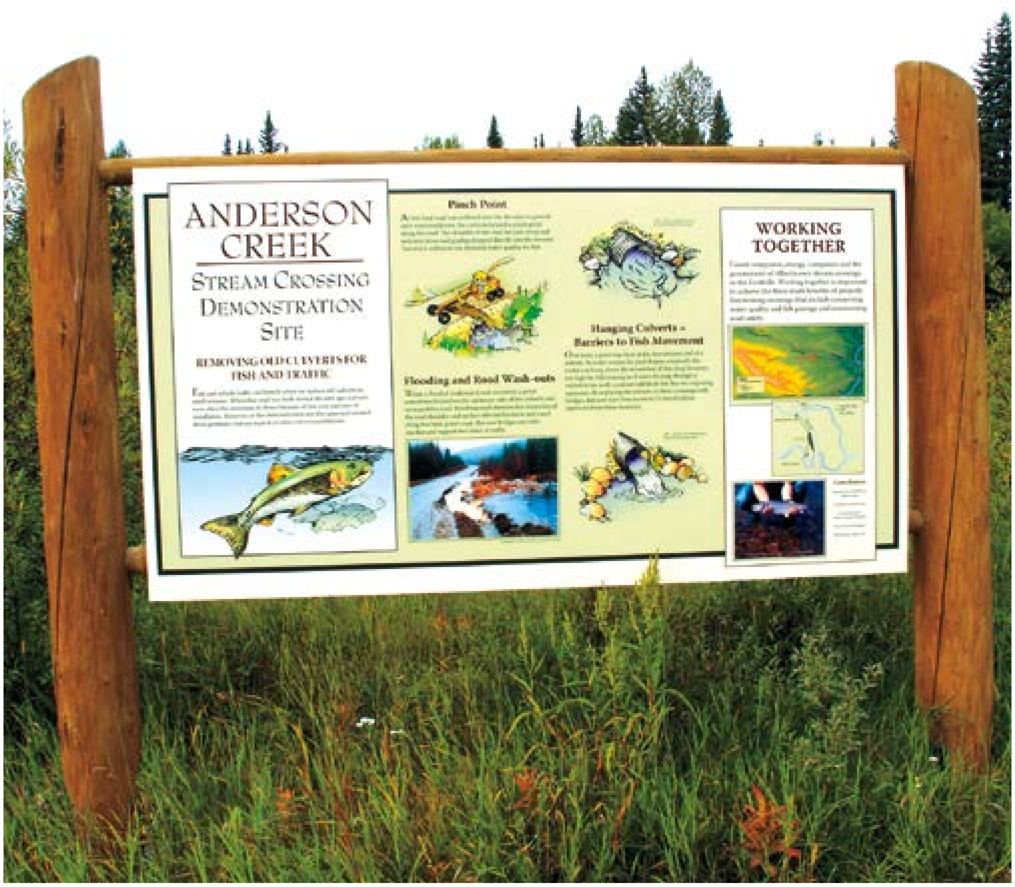
Development of communication and extension activities was an important component of the program. McCleary's strategy, developed with assistance from the model forest communications staff, was to liaise with organizations with a professional training mandate, including the Training Section of Alberta Sustainable Resource Development, the Northern Alberta Institute of Technology's satellite institution in Peace River (the Boreal Forest Research Centre), the Woodland Operations Learning Foundation (WOLF), and the University of British Columbia Department of Geography. During 2004, the model forest was appointed a seat on the WOLF Program Advisory Group to provide input on curriculum pertaining to water quality and stream crossings.

Foothills Stream Crossing Partnership

The Hardisty Creek Restoration Project was a microcosm of the challenges facing many watersheds with multiple crossing owners. Everyone needed to be on board; otherwise, a company might fix all its crossings and still have fish blocked by someone else's hanging culvert or eroded bridge outlet downstream.

McCleary and Spytz found there was a lot of interest in the collaborative approach advocated in their March 2003 conference presentation. With strong support from Rick Bonar in his dual roles at Weldwood and the model forest, the pair began working with the Alberta Chamber of Resources on a plan to apply their systematic methodology in the entire model forest. "We had numerous meetings with the Canadian Association of Petroleum Producers in Calgary," McCleary said.

This bridge over Anderson Creek provides free water flow and unobstructed fish passage. Some revegetation of the adjacent stream bank, together with the addition of large woody debris to the creek bed, is improving water quality and fish habitat.



Interpretive signs at Anderson Creek explain the remediation program.

Foothills Stream Crossing Partnership

The approach resonated with a new Government of Alberta strategy, Water for Life: Alberta's Strategy for Sustainability, announced in November 2003. The strategy stated that the long-term conservation of Alberta's water required action and collaboration by many partners at the regional and watershed levels. It emphasized that citizens, communities, industries, and governments required knowledge and tools to make good decisions.

The crossing issue was also a major topic among the more than 200 participants at the "Forest Land-Fish Conference II: Ecosystem Stewardship Through Collaboration,"[26] held in Edmonton in April 2004. The three-day conference was sponsored by the model forest in conjunction with the Alberta Conservation Association, Alberta Sustainable Resource Development, Arc Incorporated, Fisheries and Oceans Canada, Millar Western Forest Products Limited, and Trout Unlimited Canada. It provided an opportunity for interested researchers, resource managers and regulators, industry, and special interest groups to share knowledge aimed at improving management practices at the forest-water interface.

Forest Land-Fish Conference II poster.

Water research, including findings from the Hardisty Creek project, led to the creation of the Foothills Stream Crossing Association in 2004, with initial members including Hinton Wood Products, several energy companies, and the model forest. It was renamed the Foothills Stream Crossing Program (FSCP) in 2005, and the Foothills Stream Crossing Partnership in 2012.

By February 2005, seven companies had committed $28,000 to move forward with the project. The first official meeting of the steering committee was held on April 5, 2005, in Calgary, and was attended by Hinton Wood Products, Foothills Model Forest, Fisheries and Oceans Canada, Alberta Sustainable Resource Development, Alberta Environment, and representatives of energy companies.

A memorandum of agreement formalized the partnership in June 2005. The members committed to:

1. Develop an industry-driven program to manage stream crossings
2. Develop a standard process and a common protocol to assess stream crossings (both initial and maintenance)
3. Pool funding to conduct stream crossing assessments
4. Together, prioritize stream crossings that should be repaired
5. Pool resources to fix stream crossings and improve their performance (safety, sedimentation, fish passage)

Jerry Bauer, retired Canfor woods manager and a Grande Prairie forestry consultant, was then contracted to manage the program. This initiative developed a common approach to assess and repair stream crossings to ensure fish passage across the model forest's land base—a challenging task involving 2.75 million hectares, 208 watersheds, more than 2,500 stream crossings, and more than 30 stream crossing owners. The organization was based in Hinton at the model forest, which provided research and support services.

Detailed planning and first-round inspections got underway with a small trial run in 2005 and 300 inspections in 2006. (These were in addition to the inspections already conducted by Hinton Wood Products in its own program.) Another presentation was made in January 2006 to a forum sponsored by the model forest and the Alberta Chamber of Resources. Ngaio Baril was hired as an inspector in 2006, and she became the Hinton-based project coordinator in 2008.

Over the next 10 years, the partnership inventoried more than 1,300 crossings belonging to more than 40 companies and government agencies, and prioritized them into high, medium, and low risk. All FSCP partners in high-risk watersheds have participated in the design of remediation plans that outline the strategies, timing, and the justification for the order in which the crossings are mitigated.

During 2006 and 2007, the program team and the Woodlands Operations Learning Foundation developed the 60-page *Stream Crossing Inspections Manual*, the final version of which was published in December 2007.[27] The types of crossings to be inspected ranged from major bridges and culverts to fords and former crossing sites. Even informal crossings, such as those created by recreational ATVs, could be included if they were on a company's disposition. (Energy company pipeline crossings were added later.)

The inspection reports included detailed information about the crossing sites and categorized them as red, yellow, or green depending on whether they posed barriers to fish and how urgently they required remediation. Companies would then participate in the design of remediation plans. After regulatory approval, companies generally hired their own contractors to perform the actual remediation work.

> "It is a huge benefit to the companies. By working with other companies in the watershed, our members can plan to fix fish barriers in a sequential order up the watershed and sedimentation problems from the top of the watershed down. This greatly increases the efficacy of money and time spent, while encouraging dialogue between stakeholders." –Ngaio Baril, quoted in the 2009–2010 fRI annual report

By 2008, the program was fully up to speed. A total of 125 inspections were carried out during the year, and remediation plans were submitted to federal and provincial authorities for 87 crossings. As the program developed, forestry companies generally conducted their own inspections using the protocol, but the program would also hire field crews as needed to perform inspections for others, mainly in the energy sector.

Success soon led to wider adoption. In addition to inspections and re-inspections in the Hinton area, the program carried out 300 inspections in the Grande Cache area in 2010. The program's annual spending reached $425,000 in 2011. In 2012, the renamed Foothills Stream Crossing Partnership carried out inspections for a company in the Swan Hills area, and in 2013, it expanded into an area south of Grande Prairie. Other inspections since then have included crossings in the Waterton, Calgary, Sundre, Fox Creek, and Whitecourt areas.

> "I believe the reason that it grew was because it really is an amazing product that has been overdue, and the companies realized that they just really don't have the ability to manage the data involved in stream crossings and inspections on their own. We have developed a very good protocol system of inspections. We have it on a tablet now, within an app. There's an online database, so they can remotely access the data from wherever they are, using a password. I think also our strong connection with the regulators has really assisted and added value to the service. It's just incredibly difficult for any company to replicate this. As well, working together with other companies was something that they saw value in, and we follow a watershed approach to our remediation. That puts the onus on all the companies that exist in that watershed. There is a lot of value in that. The regulators really liked it." –Ngaio Baril, interview, 2015

In 2012, the partnership also trained a crew from Aseniwuche Winewak Environmental Services in the inspection protocol so that the Aboriginal enterprise could carry out crossing inspections for member companies of the Foothills Landscape Management Forum. The partnership also provided Fisheries and Oceans Canada personnel with training in the inspection protocol. By 2015, forest companies including West Fraser, Canfor, Blue Ridge, Millar Western, Weyerhaeuser, and Spray Lakes were using the program, along with a number of oil and gas companies. Baril's inspectors were working from Waterton Lakes to the Grande Prairie region.

FSCP manager Ngaio Baril, 2017.

On March 4, 2015, Alberta Sustainable Resource Development released the *Watercourse Crossings Remediation Directive*.[28] This directive endorsed and mandated the approach taken by the Foothills Stream Crossing Partnership and recommended that organizations wishing to meet the requirements of the directive take steps to use the same protocols through discussion and perhaps contracts with the FSCP. "At present, there is only one service provider capable of delivering the necessary elements outlined in this Directive—the Foothills Stream Crossing Partnership (FSCP)," the directive stated.

Jerry Bauer retired on January 1, 2017, and Ngaio Baril took over as program manager. By then, the Foothills Stream Crossing Partnership had overseen more than 13,000 inspections of about 8,000 individual crossings and developed watershed-based remediation plans that foster collaboration among owners to maximize riparian health. Later in the year, the organization received the Shared Footprint Award at the 2017 Emerald Awards.[29]

Although Alberta Transportation and the CNR were involved in early discussions of the program, as of 2017, they had not joined the partnership, nor had the major transmission pipeline companies. The omission of their large numbers of crossings is a serious drawback in the effort to address issues on a watershed basis.

An Innovative Watercourse Crossing Sets a New Standard

> "I got a call from Fisheries and Oceans asking if I had any priority crossings that could use some money. The money was actually coming from the Wabamun CN rail spill. They had a judgement against them, and they had to pay $2 million to some type of environmental thing. They said they had a hundred grand to do a crossing repair. I picked this one at Hardisty Creek because of all the work that had been done in town on Hardisty Creek …. West Fraser chipped in … I think it was another $270,000, and we got some grant money for the signage." –Ngaio Baril, interview, 2015

The Hardisty Creek culvert under the Robb Road, south of Hinton in 2009, before replacement, and the new, reinforced arch, which provides free and unobstructed flow and fish passage. Interpretive signage has been placed at the site.

The Inspection Procedure

"First you have your basic crossing information. You have the location, the type, who's doing the inspection. That's our first sheet on our application. You push a button, and it pops up, and you enter that information. The next information is your fish habitat section. That's where we walk 50 metres upstream, and we take a look at certain characteristics of that channel to determine if it's potential fish habitat or not. Then the next section is actually looking at the crossings. If it's a bridge, we have to measure the length. We look underneath and say what kind of armouring it has. Does it have rip-rap or silt fencing? Things like that. Then we go on to the sedimentation section, and that's where we take a really good look at whether there's sediment or erosion entering the channel. Then what is the rating of that—is it low, medium, or high? Then we go look at fish passage. If it has a hanging culvert, we have a lot of measurements to do along that. Then in the end, we give overall remediation suggestions. The output from that is an inspection report. The really valuable outputs are the fish passage risk rating, which would either be high or low; the sediment erosion rating, which would be high, medium, or low; and the safety and performance, which is high, medium, or low. They might do 10 of these a day." –Ngaio Baril, interview, 2015

Inspectors Kelly Skaug (left) and Lorenna Hamre (right) record features of a culvert on Anderson Creek, 2014.

A stream crossing program demonstration project in 2009, partially funded by funds from the Wabamun judgement, installed a new type of stream crossing that minimized erosion and sedimentation and involved no intrusion onto the stream bed. The new crossing replaced a fish-blocking culvert on West Fraser's Robb Road at Hardisty Creek south of Hinton. This was the first geotextile-reinforced soil (GRS) structure in Alberta. The geotextile-reinforced arch used local fill compacted into welded wire cages and kept separate from the water by a plastic geotextile. The cages formed supports for a simple arch capable of carrying a roadway. An interpretive site was developed at the location, and as word spread, the design was adopted by numerous stakeholders in the region.

"It is less expensive than a traditional culvert or bridge and is very strong," said Baril, who estimated that the cost of a conventional bridge at the same site would have easily been a million dollars. Construction of the demonstration project was an easy process, once the crews understood the system. It drew strong interest from members of the community, non-profit research groups, federal and provincial government agencies, the media, and industry. Young people were part of a program to plant willows at the site while learning about riparian values.

Baril reported that the use of this technology has spread far and wide in Alberta since this demonstration project. The crossings are economical and easy to install, far cheaper than a bridge, and work much better than a culvert because they maintain the stream bed intact. Fisheries and Oceans brought FSCP personnel in to observe and comment on others using the technology across the province, and WOLF has included this system in a new stream crossing protocol course.

Riparian Research and Stream Classification

Development of stream crossings and sustainable forest management in general requires a thorough understanding of riparian ecosystems and watercourse processes. From 2003 to 2010, the model forest and fRI continued to build on the already large knowledge base about sedimentation, large woody debris, stream channel assessment, water yield, and related topics.

In 2003, the model forest produced a GIS-based watershed and stream classification system for the Northern East Slopes region. This provided detailed information (more than 100 descriptors of riparian areas and watersheds) for about 100,000 kilometres of streams. Biologists used this information to develop computer models predicting the presence or absence of fish. Industry and government could use the tool for designing and building roads to ensure appropriate stream crossings, to determine the time of year that industrial activities should occur, and to plan stream crossing remediation.

The model forest hosted a stream classification workshop in January 2004. Classification—for example, between ephemeral and permanent watercourses—is important because it helps to determine whether a stream may be fish-bearing. Regulatory requirements such as buffer widths and crossing requirements are based on classification. Calculations of forest companies' annual allowable cut are affected by the classifications. Rich McCleary said that until then, the system had been "fairly arbitrary and difficult to apply consistently."[30]

In 2005, the Fish and Watershed Program produced the second version of a handbook for riparian area management, the *Handbook for Describing Riparian Areas*.[31] It was an important tool to assist in the sustainable management of riparian forests within the subalpine, upper foothills, and lower foothills natural sub-regions of Alberta. It could be used to help forestry technicians develop harvest and silviculture prescriptions that would maintain the range of ecological functions that occur within riparian areas. Two key riparian management objectives included soil conservation and maintaining large woody debris recruitment. If companies could use this information to guide riparian harvest and silviculture activities, this would achieve these two objectives, and a wide range of riparian functions would be conserved.

Three tools were presented to help achieve these objectives: a review of landforms and soils, stream classification, and riparian valley classification. These tools provided a means to compile pertinent findings from completed studies and also to gather additional field information using methods that have proven useful in this study area. The reports generated using this procedure would also assist other parties in the management process, including forest managers and regulators responsible for reviewing proposed riparian management plans.

To address the needs and knowledge gaps, the model forest developed a strategy in 2004 to calibrate existing riparian management and assessment tools currently used by the B.C. Forest Service and the U.S. Forest Service for use in Alberta foothills. These tools included a stream channel assessment procedure and a landscape simulation model.

A related project with the model forest's natural disturbance program involved cross-dating tree rings in large woody debris to determine the year of death of individual trees near or in a stream system. The conventional streamside inventory method revealed little about the stand or age dynamics of the riparian forest, or the type, severity, or size of the initiating disturbance (fire, flooding, beaver, erosion, gap dynamics, or wind). The dating information would assist in developing management criteria for riparian zones.

This new research project began in 2005 in partnership with the University of British Columbia (UBC) and the Forest Resource Improvement Association of Alberta. In 2006, Alberta Newsprint Co., Hinton Wood Products, Spray Lake Sawmills, and Sundre Forest Products provided additional support. The three-year study would address specific knowledge gaps regarding sediment and large woody debris processes in foothills streams.

In 2005, the model forest Board granted approval for Rich McCleary to spend 75 percent of his time on the riparian project. Through this work, McCleary would complete the research component of his PhD requirements at UBC. The study areas were the model forest land base and the burn areas from the Chisholm and Dogrib wildfires. Initial work included permitting, instrument development, and pilot field studies.

During the first full season of field research in 2006, McCleary installed stream flow and sediment flow monitoring stations at seven stations across four different watersheds. Minimal sediment movement occurred due to an unusual drought. To provide a long-term record of water quality and sediment production from small streams, the program completed coring of lake sediments from three different water bodies, including Jarvis Lake and two ponds. The Jarvis Lake sample provided long-term information on sediment yield from small foothills watersheds.

Under the supervision of UBC professor Marwan Hassan, a specialist in geomorphology, McCleary used LiDAR data to complete a detailed terrain analysis and automated stream channel detection for the Dutch Creek watershed near Nordegg. "We recognized that that the LiDAR data could help us take this whole issue of stream classification to a whole new level," McCleary said. He, Hassan, and other colleagues then worked on statistical methods for predicting the distribution of stream channels across large areas.

> "Our overall process had three basic steps. In the first step, we used the LiDAR to create a very accurate representation of the land-surface with the vegetation stripped away. This model, called the bare-earth, was derived from a swath of laser pulses sent from a low-flying helicopter. The target spacing between pulses was about 1 metre, with each pulse providing a measure of elevation accurate to within 0.3 metres. Prior to the availability of LiDAR, elevations were derived from air photo interpretation with a 25-metre spacing with accuracy likely in the range of 5–10 metres in elevation; thus, the 25-metre terrain models were inadequate for our advanced analyses. Next, we used computer programs that simulate rainfall and subsequent runoff pathways across our LiDAR-derived terrain model to identify high points, drainage divides, and possible stream channel locations.

An important intermediate product in our study was the artificial channel network or map of potential channel locations. Next, we broke the network up into segments that were small enough to provide specific information for any stream crossing or cutblock. Our final map for the Hinton FMA area contained 1.2 million channel segments, averaging 90 metres in length. Each segment had multiple descriptors, including the upstream drainage area, channel slope, and floodplain width. Each segment also had its own little watershed defined. We used each of these watersheds to calculate the average relief for each of their respective 1.2 million channel segments. Relief proved important because in steeper watersheds, rain and snow-melt runoff is quickly routed through the shallow soil profile into stream channels, whereas in flat watersheds, runoff tends to travel through deeper groundwater pathways associated with wetlands. Thus, steeper watersheds have a higher density of stream channels than flatter watersheds. Hydrologists have also established relationships between drainage area and a number of important runoff descriptors, including total annual runoff, mean annual flood, and 1-in-100-year flood.

"In our second step, we used the first cut of our channel network map to guide a major field campaign that entailed classifying each segment into one of four categories: 1) error–no channel; 2) swale or draw without an open channel; 3) an immature stream with an unconsolidated mud bottom channel bed; or 4) a fluvial stream with a gravel bottom and fish habitat elements, including riffles and pools. The procedure for completing this field classification was extensively tested by foresters and fish biologists from the provincial government and West Fraser. The procedure was detailed in a document titled *Field Manual for Erosion-based Channel Classification* and is now used by Hinton Wood Products, as well as the Government of Alberta. This protocol provided an alternative to the existing Alberta Ground Rules classification that was problematic for a number of reasons, including its reliance on observations of stream flow, which changes continually through the seasons and between years. Between 2008 and 2009, we performed almost 850 field visits to unique locations on the channel network map. At each of these locations, we applied the new channel classification procedure to determine the appropriate category.

"The third and final step of the project was to use the information from the 850 field locations to predict the channel type across the entire set of 1.2 million channel segments. I found that by using three descriptors of each channel segment, including drainage area, reach slope, and watershed relief, I could predict the channel class with an accuracy of around 62 percent. While there was obvious room for improvement in the future, the resultant maps represented a major advancement in the tools available for watershed and forest management. In previous maps for Alberta and most jurisdictions around the world, the vast majority of headwater streams were simply missing.

"Once the project was completed, I continued to work with a team of international scientists to describe how this type of watershed-mapping application can be used to advance conservation and resource management around the world.*" –Rich McCleary, personal communication, 2017

Parallel research related stream characteristics to fish distribution. Hassan and McCleary led field workshops for staff from Hinton Wood Products and Alberta Environment, and the program provided its maps of predicted fish distribution to the Foothills Stream Crossing Program member companies to assist with their identification of remediation priorities. They published a paper in 2008 on automated processes for predicting fish distribution in small streams.[32]

* The international collaboration is described in this paper: Benda, L., D. Miller, J. Barquin, R. McCleary, T. Cai, and Y. Ji. 2016. "Building virtual watersheds: a global opportunity to strengthen resource management and conservation." *Environmental Management* 57(3), 722–739. doi:10.1007/s00267-015-0634-6.

> "When I started that [riparian] research project, I had a vision to get into modelling the large woody debris and the sediment and everything. What I ended up doing was really realizing that the foundational piece for all of this was the general classification system. I put all my energy into that to make sure that that was going to come to fruition, and it did." –Rich McCleary, interview, 2016

McCleary said that the method could have had wider application in Alberta, but by 2011, the provincial government was committed to a different approach called wet area mapping, developed initially at the University of New Brunswick. McCleary, Professor Hassan, and Rick Bonar had a meeting with provincial officials and "were told in no uncertain terms that our ideas were contrary to the way the province was going." NetMap, the software package based on McCleary's work, continues to be used by Hinton Wood Products in combination with wet area mapping. The software is publicly available from www.terrainworks.com. In the United States, the Willamette National Forest is using NetMap to prioritize road restoration and removal projects, and the Oregon Department of Forestry is using it to plan timber management.[33] In 2017, West Fraser continued to petition the Alberta government for endorsement of the erosion-based stream classification and associated map products as the default products for use in the company's detailed forest management plan.

Barry White, director of forest management in the Forest Management Branch of Alberta Agriculture and Forestry, noted in 2017 that (1) the Netmap work in the Hinton Region, conducted under the auspices of fRI Research, was a significant contributor towards the province adopting the Netmap model to investigate cumulative impacts; and (2) Rich McCleary's dissertation was very well received by the province and formed the basis for a new effort towards the development of an enhanced stream layer for forest management.[34]

McCleary's work on fluvial geomorphology is also used extensively in Alberta in the stream crossing assessment work of the Foothills Stream Crossing Program to assess the importance and value of the associated streams for fish habitat.

> "We look at the habitat characteristics of the stream. We collect and bank full channel width and depth, so we get an idea of channel size. We check the dominant substrate type. Then we get into Rich McCleary's work with fluvial geomorphology that he did in the foothills here, where he looks at: Is the channel uniform? Uniform means, is the widest point three times the size of the narrowest point? Does it go like this? [She gestured to describe an hourglass shape.] If it does, then that indicates there's not enough power in that system to actually create a uniform, nice channel that you think of as a stream. It's often headwaters that look like that. Are there organic bridges? That's where a log has fallen over a stream and has rotted to the point that it is growing woody debris. That also indicates there's not enough power in that channel to blow out that rotting log at any point. We look at various things like that and determine if it's fluvial or non-fluvial. Then I would select all the high fish-passage-risk crossings, with all the fluvial characteristics that we've given it, and then from there, you develop a pretty good list of high-priority crossings that need to be repaired." –Ngaio Baril, interview, 2015

McCleary said the three most important accomplishments from his time at the model forest and fRI were the Foothills Stream Crossing Program, the Hardisty Creek Watershed Restoration Project, and the stream classification system. He also said (personal communication, 2016) that he learned three lessons from the experience:

1. Before embarking on a research project, establish relationships with organizations and individuals who will be using the new knowledge at the

end of the day. Communicate with them every step of the way. Listen to their feedback. Bring them along.

2. Every good project will have at least one outspoken critic. If you don't have one, there's probably not much at stake. When you identify your critic, don't blow them off. Understand where they are coming from. If there is a technical issue, fix it. If there is a difference in values or beliefs, respect them. If they have competing ideas, understand them, then determine if you need to beat them, join them, or if you need to peddle your ideas and talents elsewhere.
3. Every project has a shelf life. The economy and funding will cycle. Project promoters can come and go. The issue of the day will change. Take every opportunity along the way to test and demonstrate the relevance of your project during the development stages. If you lose your relevance, you're dead.

McCleary received his doctorate from UBC in 2011, and since 2013, he has been a regional aquatic ecologist with the B.C. government, based in Kamloops.

A New Water Program

A workshop on March 29, 2010, began the development of a new direction for fRI's water research. In June 2010, Rich McCleary advised that he could not continue with the program on a full-time basis, and his departure marked the end of the Watershed and Fisheries Program. The Board decided to continue with a new Water Program, and later in the year, the Board asked Alberta Sustainable Resource Development to consider a secondment to lead the initiative. Axel Anderson, a forest hydrology specialist, was seconded for three years in March 2011 to take over the newly renamed Water Program, and as of 2017, the secondment was still in place.

Based on workshops and other input, the new program would focus on water quantity and quality, with research expanded to at least an Alberta-wide scale. Anderson, who has a PhD in forest hydrology from the University of British Columbia and is also an assistant professor at the University of Alberta (UofA), developed a five-year plan focused on cumulative effects and the integration of long-term research.

"We decided we would look at watershed processes as an underlying theme on which to build our assessment procedures," Anderson said.[35] The initial focus was the Eastern Slopes region in southern Alberta, building on research done by UofA professor Uldis Silins following the 2003 Lost Creek wildfire in the Crowsnest Pass area. The first stage of the study dealt with watershed impacts and recovery after the fire and post-fire salvage harvesting. The second stage compared the effects of harvest strategies in burned and unburned watersheds. Initial results were described in a 2016 paper by Silins, Anderson, and others.[36]

Another study area has been the Simonette River, just south of Grande Prairie, in the transition zone between the foothills and boreal ecosystems. "It's related to, how do we deal with cumulative impacts in forested environments in Alberta?" Anderson said. "How do we manage for them? How do we assess them? Those are the fundamental applied questions that we've really tackled."

> "What we ended up doing was identifying risk-based approaches—trying to identify the value or the consequence and then the hazard—then breaking it up into three bins of processes. One was riparian and channel stream components. One was change in hydrology, which also results in changes in vegetation, and what that might do for change in yields, floods, that type of thing. Then the last one was erosion and sedimentation. Then within each of those three bins, what we've been trying to do is either do assessments or partner with agencies

Axel Anderson at the Southern Rockies Watershed Project, 2016. Forest operations, particularly the development of roads and landings in the Alberta foothills, can have major implications for water quality. Axel Anderson's research is helping to identify issues and provide solutions for these challenges.

> that have an assessment procedure, which would be either a GIS tool or on-the-ground field card. The Stream Crossing Program would be an excellent example of what an assessment procedure should be." –Axel Anderson, interview, 2016

The Fiddle River enters the Athabasca River near the top end of Brule Lake at the eastern portal of Jasper National Park. *Brian Carnell Photography*

Anderson said he has been working with graduate students and post-doctoral fellows, plus field crews, to follow up on components of the three "bins." The end result would be tools and knowledge to inform decisions about land use and forest management.

Another big thrust of the new program has been to digitize, integrate, and reassess the vast amount of data from watershed science conducted in Alberta by federal, provincial, and academic researchers since the 1960s (including studies described earlier in this chapter). One of the most important study areas to date has been the Tri-Creeks watershed. Anderson said this research is particularly important because of the endangered status of the Athabasca rainbow trout. "They never answered some of the fundamental questions around change in hydrology and change in forest harvesting with Tri-Creeks," he said. UofA doctoral student Amy Goodbrand has been looking at the effects of forestry and a simulated mountain pine beetle attack on water flows in the Tri-Creeks watershed.

> "From a hydrology perspective, you need that long data set. That's why these long-term sites are very valuable, because if you don't capture that [human-influenced] variability from natural background variability, you can't understand the potential incremental impact of harvest, or mountain pine beetle, or some forest change on those parameters. Yeah, without the long-term site, it's nearly impossible to try that. That, in my mind, is really the value of those sites." –Axel Anderson, interview, 2016

Anderson said the program is also trying to understand the resilience of watersheds in the Alberta foothills. "They tend to buffer the impacts of disturbance more than we would expect from what we understand from neighbouring jurisdictions," he said. "At a 50-percent harvest level, we would normally expect to see fairly significant changes to the flow parameters that we'd be concerned about. We're just not finding that here. We don't know why, so it's a pretty hard thing to actually implement into management and policy." A researcher is looking into the potential effects of underground geology on the flows.

Much of the program's research is directed towards peer-reviewed publication, which helps to build confidence among users in industry, government, and the general public. Topics have included watershed resiliency and restoration, modelling tools for surface erosion, implications of mountain pine beetle rehabilitation strategies, watershed assessment procedures, cumulative effects, geomorphic road analysis, harvest impacts on water flow, and mitigating culvert impacts.

Vic Lieffers, former chair of the UofA Department of Renewable Resources and an fRI Board member from 2011 to 2016, said Anderson was an asset to both institutions, as well as the government. "Axel has done some nice work while he's working with graduate students in our department," Lieffers said. "He's got an office here, and he's got a formal relationship with us. It's working out really well. That's a really, really good relationship. He's also doing some really nice work."

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CHAPTER SIX

CCFM Criterion Four

Role in Global Ecological Cycles

"Because of their size, forests play a major role in the functioning of the biosphere. Global ecological cycles are a complex of self-regulating processes responsible for recycling the Earth's limited supplies of water, carbon, nitrogen, and other life-sustaining elements. The world's forests are critically dependent on, and make substantial contributions to, these global processes.

"The indicators for this criterion deal with the role of forests and the forest sector in the global carbon cycle. Forest management can have substantial impacts on the role of forests in the carbon cycle." –Canadian Council of Forest Ministers, 2005[1]

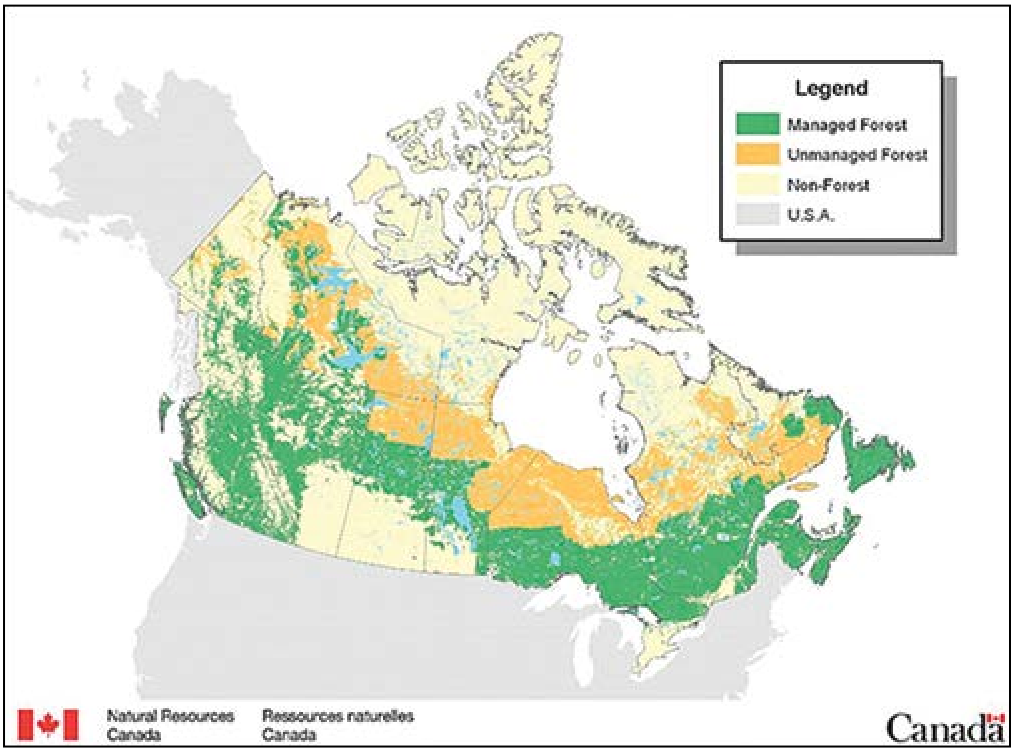
Foresters are both actors and audience in the unfolding climate drama. How forest lands are managed can increase or mitigate the accumulation of climate-altering carbon compounds in the atmosphere. Meanwhile, the changes in climate pose numerous present and expected future challenges for every aspect of forest management: biodiversity, forest productivity, wildfire extent and frequency, insect infestations, diseases, drought, hydrology, and fisheries. Foothills Model Forest and fRI Research have contributed to our knowledge of both types of causes and effects.

Sources and Sinks

Forests in Canada and around the world store vast amounts of carbon in soils and vegetation, and carbon is also stored in wood products. Photosynthesis removes carbon dioxide from the atmosphere in growing forests. When the vegetation burns or decomposes, the carbon is released back into the atmosphere as carbon dioxide, methane, and other greenhouse gases. Thus, forests can be either "sinks," sequestering carbon, or "sources," releasing it.

To meet national and international commitments, the Canadian Forest Service (CFS) has attempted to quantify the balance between sources and sinks in Canada's managed forest lands—the 65 percent of forest areas subject to human intervention such as harvesting, wildfire suppression, prescribed burning, or insect management. The resulting Carbon Budget Model of the Canadian Forest Sector (CBM-CFS) has shown that longer average periods between establishment and disturbance, more rapid reforestation of disturbed sites, and retention of carbon in forest products can increase carbon sequestration in managed forests. However, a greater amount of carbon is released to the atmosphere in many years due to natural disturbances such as wildfire and the effects of insect infestation.

The left scale of the graph in Figure 6-1 is the greenhouse gas (GHG) emission or removal in Canada's managed forests in millions of tonnes of carbon dioxide equivalent (Mt CO_2e) per year. A positive number indicates a net emission of carbon dioxide in Canada's managed



Map 6-1 Canada's managed and unmanaged forests. *Courtesy Canadian Forest Service, Natural Resources Canada*

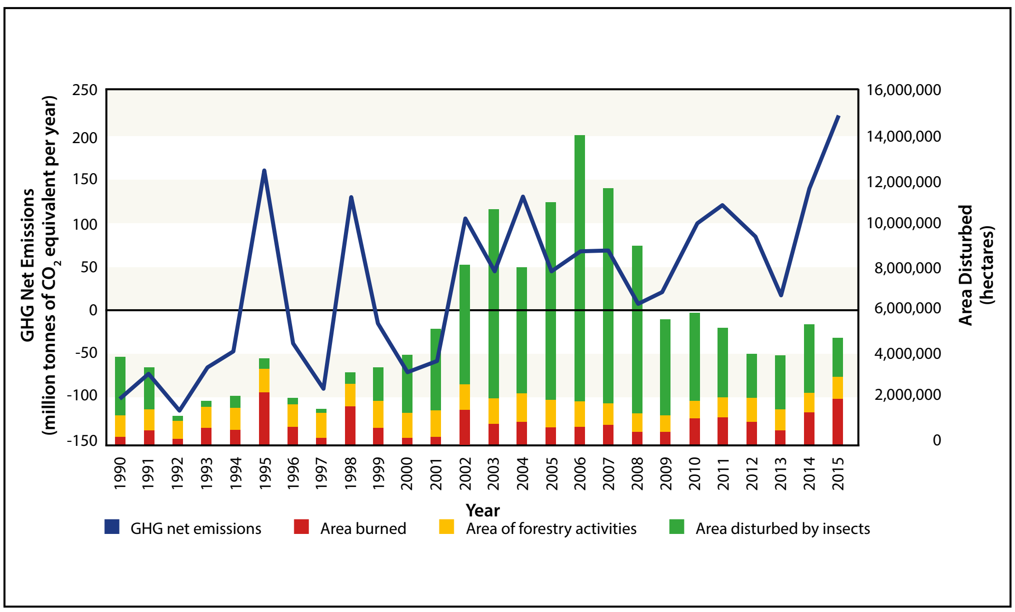


Figure 6-1 Net carbon emissions in Canada's managed forests, 1990–2015. *Courtesy Canadian Forest Service*[2]

forests for that year, while a negative number indicates a net removal. The right scale is the area of managed forest disturbed in hectares for each year between 1990 and 2015 by each of three causes: (1) forestry activity, (2) wildfire, and (3) insects. Wildfires were the main cause of the net emissions in 1995, 1998, and every year since 2002.

In 2015, there would have been a sink of about 26 Mt CO_2e due to forestry activities such as harvesting and regeneration, as well as the retention in harvested wood products, but this was offset by emissions of about 247 Mt CO_2e due to natural disturbances (mainly wildfire and insect damage), leading to a net source of 221 Mt CO_2e.

Historical Context

The greenhouse effect of heat-trapping gases in the atmosphere, without which Earth's average temperature would be about 33°C cooler, has been known since the 19th century. Greatly improved data collection and analysis since the 1950s identified rising concentrations of carbon dioxide and other gases that could increase the greenhouse effect and alter global climate.[3] Carbon dioxide concentrations rose from an annual average of 280 parts per million in the late 1700s to 400 parts per million in 2015—a 43-percent increase. Almost all of this increase can be attributed to human activities.[4]

Concerns about potential climate change were a major topic at the first World Climate Conference in 1979 and attracted more public and governmental attention in the 1980s. Climate change was identified as a key sustainability issue in the *Brundtland Report* in 1987, which led to the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC issued its first assessment report in 1990. Canada and other nations adopted the United Nations Framework Convention on Climate Change at the Earth Summit in Rio de Janeiro in 1992, and it came into force in 1994. The Kyoto Protocol, committing signatories to greenhouse gas reduction targets, was adopted in 1997, signed by Canada in 1998, and ratified by Parliament in 2002. However, the targets were never met, and Canada officially withdrew from the protocol in 2011. A newly elected Canadian government signed the Paris Agreement in 2015; the agreement's provisions aim to limit average global temperature rises to less than 2°C and to help less-developed nations combat climate change.

Carbon Budget of the Foothills Forest

Climate change was not identified as a research topic in the successful 1992 proposal for the Foothills Forest, but it was added during detailed planning discussions in early 1993. The Board accepted a proposal by two CFS researchers, Mike Apps and David Price, to develop a carbon budget and energy conservation plan for the model forest. This project would modify and localize the national Carbon Budget Model (CBM-CFS) to develop estimates of the current and historical carbon budgets for the Hinton FMA area. Mike Wesbrook of Jasper National Park coordinated the working group, which had a budget of $51,000. In addition to Apps and Price, the other team members were Weldwood forester Sean Curry and research scientist Werner Kurz, the lead author of the original CBM-CFS published in 1992.*

* In 2017, Werner Kurz continues to lead the development of the National Forest Carbon Accounting System for Canada. He is the lead author of numerous publications on land use, carbon, and mitigation, including six reports for the Intergovernmental Panel on Climate Change.

The 1992 iteration[5] of the CBM-CFS considered forest growth, soil processes, ecosystem disturbances (including harvesting), and carbon stored in wood products. It then tracked the transfers of carbon among the identifiable carbon pools, from and to the global atmosphere, to derive an estimate of the net gain or loss of carbon by a forested area. Research at the model forest and elsewhere sought to strengthen the reliability of the model by using more accurate input data and improving its internal representations of key processes. In the longer term, there was the possibility of incorporating carbon modelling into timber supply analyses and decision support systems.

The Hinton FMA area provided an excellent opportunity to test the model. Weldwood's data since the 1950s included detailed records of permanent sample plots, inventories, harvests, and fire history.

The researchers first reconstructed the 1953 "natural forest" and its carbon status on the FMA area and then used the CBM-CFS to study the carbon budget. Their findings, published in 1996 and 1997,[6] found that management of the forest for timber production had not adversely affected carbon storage over the 45-year period from 1953 to 1988 compared to an "unmanaged" forest with a 50-year fire return interval. The comparable rotation period for commercial harvest was about 80 years. The main explanation for this conclusion was that successful protection of the forest against wildfires, combined with sustained-yield harvesting, had retained as much carbon in vegetation, soils, and products as was lost from the older stands during initial harvesting. Rapid and effective reforestation of harvest sites was a key factor; in the absence of these silviculture activities, the overall gain became a loss.

"If the assumptions made here are correct, then for the managed forest ecosystem, the present-day storage in forest products is about 2.5 percent of total ecosystem carbon, potentially increasing to 5 percent over the next 200 years," the authors said.

The added effects of growth and yield increases due to silvicultural treatments were not assessed using the model and database, but they were noted to be clearly important. The potential impacts of changing climate on the forest—and on its future carbon uptake—were also not assessed, although the authors said that improved understanding of these possible impacts was crucial. A shortage of CFS staff precluded field comparisons of biomass production between stands regenerated following harvesting and those regenerated following wildfire; this was noted as another question to pursue.

Results of the study were incorporated into the 1999 revision of the national model and contributed to national and international policy discussions regarding implementation of the Kyoto Protocol.

> "The initial application of the [CBM-CFS] on a regional basis can be attributed to a willingness on the part of Foothills Model Forest to look beyond the conventional interpretation of the forest inventory of this area of the province, into the previously unknown realm of atmospheric carbon sources, sequestration, and sinks. The results of this early work provided valuable insights into the potential role of the forested landscape and the resource-based industry in mitigating climate change." –Director General Boyd Case, CFS Northern Forestry Centre, letter of support for the Premier's Award for Foothills Model Forest, 2000

Foothills Model Forest shared the carbon budget findings widely with its government and industry partners, and it was one of the recipients of the 2006–2007 Canadian Forest Service Team Merit Award, presented under the category of Collaboration and Partnership and recognizing its work in transferring the Carbon Budget Model to various end-users.

By 2015, the much-improved CBM-CFS had been adapted for use around the world in areas ranging from small projects to entire nations. The model was applied at the national scale in Russia and Korea and to 26 other countries through the Joint Research Centre of the European Union. The model was also used at the regional scale in Mexico and Poland.[7] David Price of the CFS said that the model was "scale-independent," so it could be applied to anything from a small woodlot to an entire nation. There were elements that could be turned on or off for specific regions, depending on local requirements and data availability. The model is freely available, and Price said that it has likely been used in ways that the original authors never imagined.[8]

The CFS is currently working on the fourth-generation version of the CBM-CFS. It will be spatially explicit, with the goal of representing large regions at a one-hectare resolution. It is up and running for several regions in British Columbia and Ontario. Alberta is on the priority list for early development.[9]

Carbon Credits

After 1997, the model forest Board held a number of discussions about possible follow-up research, such as the implications for forest management and the evaluation of possible carbon credits that forest companies might sell to energy companies. In 2000, funds were allocated for projects in those areas.

CFS researcher Adam Wellstead and University of Alberta economist Grant Hauer, with support from Weldwood's management forester Hugh Lougheed, considered Weldwood's carbon budget as a possible case study for sequestration and carbon credit trading.

They identified many uncertainties that would have to be addressed, including risk factors such as wildfire and insect damage, and policy considerations such as accounting rules and institutional limitations. No final report was published, but Hauer described the findings at a research workshop in 2003.[10] "Correctly forecasting disturbance rates" was identified as a key factor in designing any potential carbon trading scheme for managed forests, and even minor unplanned disturbances such as a 0.35-percent average annual wildfire burn rate would quickly turn carbon credits into losses.

Forecasting Forest Productivity

In 2000 a CFS team, led by David Price and Werner Kurz, received model forest funding for a study of climate change impact on forest productivity in Western Canada. This would pick up where they left off in the 1995–1997 project. The new study was part of a project called ECOLEAP-West that aimed to assess the possible impacts of a warmer climate on the productivity of forests in the Alberta foothills and Saskatchewan southern boreal regions. Because local climate is a major determinant of site conditions, yield forecasts are likely to be inaccurate if appreciable changes in climate occur. A key objective of the project, therefore, was to develop and test process-based models to estimate forest productivity and to compare the estimates with those obtained using local growth and yield models.

Climate change was regarded as likely to have both direct effects on the physiological processes contributing to wood production (e.g., photosynthesis) and on the regeneration and survival of the different species that make up natural forest vegetation. The study focused on these effects, although it was recognized that a warmer and drier climate is also likely to increase the risks of serious losses due to fires and pest and disease outbreaks. Analysis of 20th-century Alberta tree-ring and sample plot data showed that warmer periods generally led to faster growth, but extreme high temperatures curtailed growth, apparently due to drought stress.[11]

The productivity project included spatial modelling of forest productivity and the application of new methodology to estimate forest productivity by combining existing sampling methodology with remote sensing. From this data, process models would be validated against observed changes to project changes in ecosystem carbon storage under various scenarios of climate change. The end result was expected to provide data of value to land managers and also to social scientists assessing the social and economic impacts of climate change at both the regional and national scales. The findings would also be used to provide additional validation of larger-scale models being tested at the national scale.

The project proved much more complex and time-consuming than anticipated, although work continued well after funding was exhausted. Changes in personnel and other factors for researchers led to multiple delays. One preliminary finding in 2004 confirmed the "significant correlation between local climate and tree growth."[12] However, local variability made analysis challenging. The researchers also developed a new methodology for mapping, but they were unable to get it published in peer-reviewed journals. A final report was produced in 2014.[13] "Overall, the project was not successful in accomplishing the major objectives," the report said. Among the reasons was "underestimating some of the challenges in interpreting available data."

Growth and Yield Research

In 2000, the Foothills Growth and Yield Association (now renamed the Foothills Pine Project and part of the Forest Growth Organization of Western Canada) began a long-term research project on growth and yield rates in post-harvest regeneration that could eventually improve projections of future carbon storage. Led by Dick Dempster, the project (described in Chapter 4) installed and planted 102 one-hectare permanent sample plot clusters throughout the Eastern Slopes as part of a large, replicated field trial designed to monitor the stand development of lodgepole pine in relation to site, planting density, weeding, and thinning. Monitoring and analysis of the sites continued and produced recommendations to improve regeneration success.[14] The organization also held workshops on the possible use of regeneration rates for carbon sequestration credits.

Dempster's research showed a complex relationship between moisture, temperature, and disease. "Results suggest that physiological stress related to evapotranspiration is the most prevalent cause of overall juvenile mortality and susceptibility to *Armillaria* root disease in planted pine," he reported in a 2017 article.[15] "Mortality and disease not only increase at higher rates of drying during the growing season, but an opposite effect is also demonstrated whereby they decrease with increasing spring temperatures. Mechanical site preparation aimed at countering mortality and disease of planted stock with improved soil conditions appears to have good potential for ameliorating adverse climatic effects in juvenile stands."

Impacts of Climate Change on Forests

One obvious effect of climate change has been the devastation caused by mountain pine beetle in British Columbia since the early 1990s and in Alberta after 2006. The severe drought in Western Canada in 2001–2002 and large wildfires since then have raised further questions about the impacts that today's forests would face from future changes in temperature, moisture, and storm severity. Ted Hogg, a member of the CFS climate team at the Northern Forestry Centre, recently (2017) listed the uncertainties facing attempts to forecast the impacts of climate change on forests and forest management. Some predicted effects such as increased nitrogen and carbon dioxide could accelerate growth, while others such as fire, drought, pests, and disease would have the opposite effect.

In 2008, the Foothills Research Institute received a $1.5-million grant from the Alberta Forestry Research Institute (AFRI) that enabled a broad study of climate impacts on Alberta forests. The grant included $615,000 devoted specifically to climate research, of which $300,000 went to the CFS for its Northern Forestry Centre Tree-Ring Lab. The tree-ring analysis identified the effects of past cycles of wildfire, insects, and disease that could be correlated with climate conditions. Most of the remaining funds went towards a study of future climate impacts on vegetation condition, forest hydrology, insect infestation, and phenology (cyclic and seasonal phenomena). Gord Stenhouse, fRI Grizzly Bear Project manager, coordinated a study team of researchers from the institute, the University of Alberta, and the University of British Columbia. Their report, *Future of Alberta's Forests: Impacts of Climate and Landscape Change on Forest Resources*, was published in 2013.[17]

The AFRI grant also supported mountain pine beetle research, international collaboration, and water research. These areas also related to climate impacts, as did many other fRI projects.

The first step in the AFRI-funded project was to develop scenarios of possible future climate conditions and disturbance patterns. This included describing what changes, by type and location, were already occurring over the study area and how forest resources and species habitats were affected by the changes. The drivers of change included climate, wild-

"Greening" or "Browning"?

Opportunities	Risks
Growing season	Drought
Soil temperature	Fire
Nutrient cycling	Flooding
Nitrogen deposition	Extreme weather
Carbon dioxide fertilization	Insects and diseases, including exotics

Table 6-1. Major Factors Likely to Affect Productivity, Biomass, and Carbon Uptake of Northern Forests Under Global Climate Change. *Courtesy Canadian Forest Service*[16]

fire regimes, forest harvesting, and exploration and development activities for oil and gas. Team participants (and other researchers on request) were provided with the combined GIS layers and simulations as the basis for their reports.

A second study evaluated the impacts of climate and forest changes on streamflow in the upper parts of the Oldman River watershed in southern Alberta using a conceptual hydrological model. Three climate change scenarios covered a range of possible future climate conditions (for the 2020s, 2050s, and 2080s). The model projected less than 10 percent increase in precipitation in winter and about the same amount of precipitation decrease in summer. These changes in projected precipitation resulted in up to 200 percent (9.3 mm) increase in winter stream flow in February and up to 63 percent (31.2 mm) decrease in summer flow in June.

A third study investigated climate change vulnerability for grizzly bears in the southern Canadian Rocky Mountains using projected changes to 17 of the most commonly consumed plant food items. The study used presence-absence information from 7,088 field plots to estimate ecological niches and to project changes in future distributions in each species. Model projections indicated differing individual responses among food items. Many food items persisted or even increased, although several species were found to be vulnerable based on declines or geographic shifts in suitable habitat, including alpine sweet vetch (*Hedysarum alpinum*), a critical spring and autumn root-digging resource at times of the year when little else is available. Potential habitat loss was also identified for three fruiting species of lower importance to bears: crowberry (*Empetrum nigrum*), grouseberry (*Vaccinium scoparium*), and wild strawberry (*Fragaria virginiana*). The study noted that a general trend towards uphill migration of bear foods may result in higher vulnerability to bear populations at low elevations, which are also those that are most likely to have human-bear conflict problems.

The final study examined the links between climate, tree species stress, and infestation by the mountain pine beetle. It showed that climatic stress lasting two or more years rendered lodgepole pine highly vulnerable to infestation. After two years, "beetle occurrence is much greater and remains at that rate regardless of [the number of] additional stressful years."

The CFS, provincial agencies, and fRI Research have continued to examine these potential impacts and others such as spruce budworm and gypsy moth infestations.

The Board decided in 2010 to end climate change as a separate program. Henceforth, climate research would be integrated into other relevant programs. For example, projecting future climate impacts has become an important component for the Healthy Landscapes Program (see Chapter 3).

Adaptation

In 2012, 14 forest companies and Alberta Sustainable Resource Development (now Agriculture and Forestry) established Tree Improvement Alberta (TIA), a consortium to manage the Tree Species Adaptation Risk Management Project. Hosted by fRI and funded initially by $3 million from the Climate Change Emissions Management Corporation, the project aims to adapt the Alberta forest sector to climate change through genetics and tree improvement. The goal is a strategy that uses climate-tolerant genotypes of conifer and deciduous species to sustain forest fibre production and non-fibre forest benefits. The first stage of research focused on lodgepole pine.[18] The research team, led by Laura Gray at the University of Alberta, concluded the following in 2016: "The results indicate that local populations perform well, but that some transfer opportunities exist …. An alternate adaptation strategy could be the selection of families within breeding regions to enhance resilience to climate change."

In 2016, TIA became a project team of the Forest Growth Organization of Western Canada (FGrOW).

Opposite page: Armillaria impacts on juvenile forest stands, West Fraser forest management area. *Courtesy Foothills Pine Project*

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CCFM Criterion Five

Economic and Social Benefits

"Forests provide substantial commercial benefits, including timber, non-timber forest products, water, and tourism, and significant non-commercial benefits, including wildlife, recreation, aesthetics, and wilderness values. Although not always measurable in monetary terms, all these activities are highly valued by Canadians and provide significant benefits to Canadian society. The distribution of these benefits among civil society is a key aspect of social equity. Sustainable forest management requires that forests be managed to provide a broad range of goods and services over the long term. These aspects of sustainability are examined under three elements in this criterion: economic benefits derived from Canada's forests, the distribution of benefits, and the sustainability of benefits." —Canadian Council of Forest Ministers, 2005[1]

The business adage "what gets measured, gets managed" applies equally to forestry. Sustainable forest management required better tools to measure and manage economic and social values beyond the conventional costs and benefits of timber harvests. The Foothills Model Forest worked with the Canadian Forest Service (CFS) and the University of Alberta to develop new methods and models for evaluating the economic and social effects of management on forest landscapes affected by a wide variety of uses and users. More than $1.2 million was invested in widely cited social science research during the first three phases of the model forest. It was the most extensive socio-economic research carried out by any of the Canadian model forests.[2] Results of this research have been, and are being, used in corporate and government policies and plans across Canada and in some subsequent work of fRI Research. Publications arising from the program can be found on the fRI Research and Canadian Forest Service websites.

Achievements of the program included:

- An economic model of the regional economy
- Data and modelling of mineral extraction, tourism, and recreational activities
- Surveys of public values and attitudes to forest management
- Examination of public involvement processes
- Development of indicators of community sustainability

Tom Beckley, who joined the Northern Forestry Centre as the first research sociologist in the CFS, led the model forest's program from its inception in 1994 until he moved to the University of New Brunswick in 2000. He noted that significant academic papers arose from, or were influenced by, the work of the Foothills Model Forest, and he said the work had wider influences on policies and practices in government and industry.

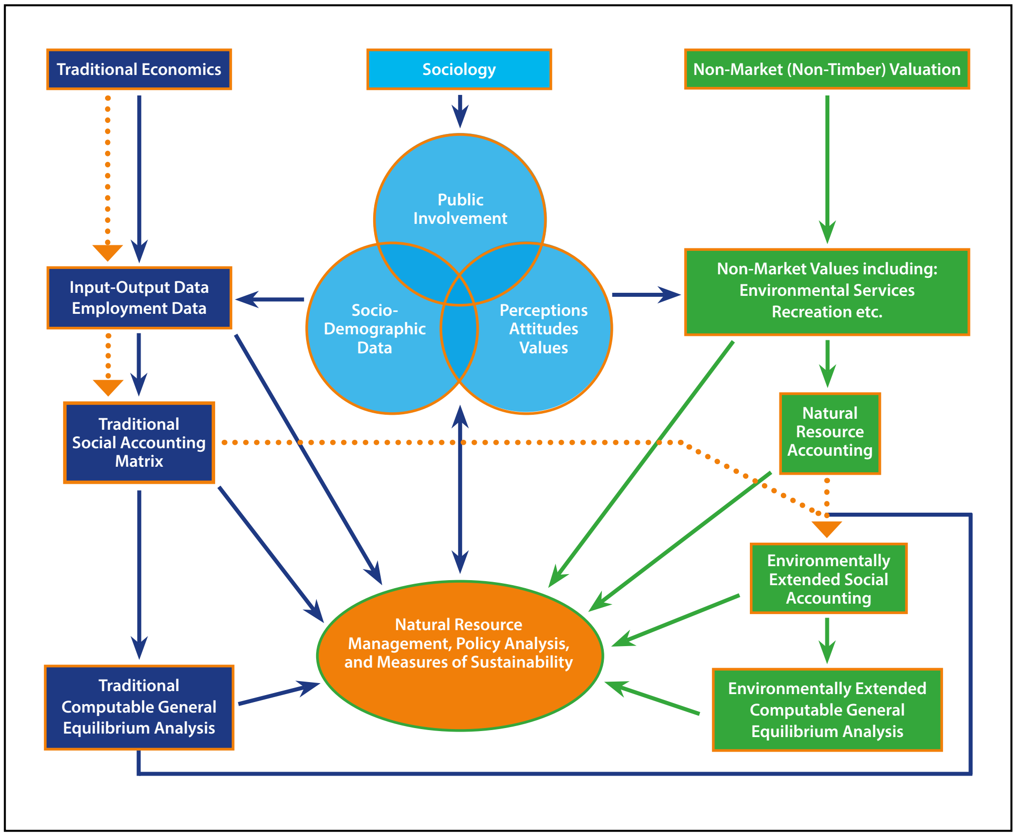


Figure 7-1. "Linking the social sciences to inform policy." From page 3, *Social Science Research in the Canadian Model Forest Network*, November 2002, William A. White, Canadian Forest Service, Edmonton, AB.[3]

"I was involved in a few national initiatives at the time, including the creation of the CCFM indicators, the FSC [Forest Stewardship Council] Boreal Standard, and the Kyoto sector tables. For the previous two initiatives especially, my input was very much informed by the work that we were doing in FMF. I was new to the country, new to the job, new to the phenomenon of such remote, resource-dependent communities, and the work we did on the social dynamics in Hinton and Jasper really shaped my thinking about the types of things that it would be important to measure and monitor in the social sphere in order to create a well-rounded vision of sustainability. Those were some interesting times." –Tom Beckley, personal communication, 2015

William White, an economist with the Northern Forestry Centre (now retired and an adjunct professor at the University of Alberta), then led the model forest's program from 2000 to 2007. He and his team prepared a diagram in 2002 to illustrate the relevance of social sciences to natural resource management (see Figure 7-1).

Bob Newstead was the Prairie Region coordinator of the Model Forest Program for the CFS. In a May 2015 interview for this project, he said that the social science collaboration between the CFS and the model forest was a "perfect alignment" of capabilities and interests. When some of the early results were presented at an international meeting, Newstead said, "People's mouths fell agape at how this program would allow these researchers to express themselves and to gather data on the ground in such a touchy environment where human interaction and industrial activity were not at their peak of collaboration."

Boyd Case, director of the Northern Forestry Centre, also praised the contribution to sustainable forest management.

"The CFS Socio-Economic Research Network, headquartered at the Northern Forestry Centre in Edmonton, has undertaken, and in many cases completed, several unique social and economic studies and surveys pertaining to the current status and longer-term importance of the fibre and non-fibre forest resources of the FMF. Economic dependency and community sustainability determinations based on both the visitor and resource sectors are now understood. Recreational user surveys and predictive models are in place. Public attitudes towards resource development and sustainability will serve as baseline information and indicators of the differing perspectives among communities with regard to resource 'values.' Finally, the CFS-FMF record of post-graduate education and on-the-job training, as well as our co-publication of results, speaks volumes for the solidarity of our collaborative research initiatives." –Boyd Case, letter in support of the Premier's Award, 2000

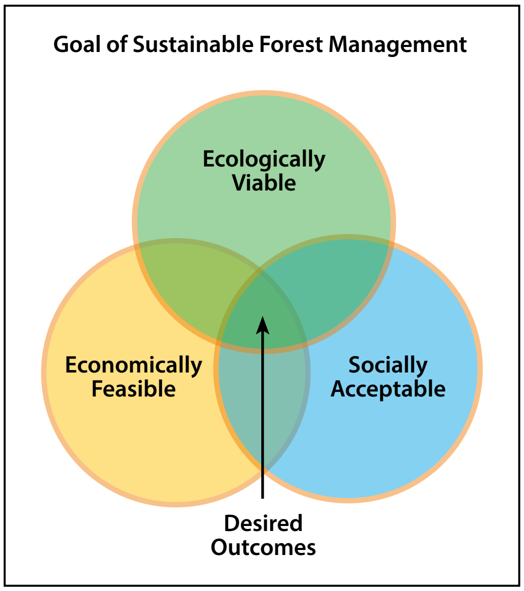


Figure 7-2. Sustainable forest management strives to achieve a balance between conditions that are economically feasible, ecologically viable, and socially acceptable. Where the three overlap in this diagram is where the desired outcomes are achieved.

Social science research examines two of the three priority elements that must be part of any sustainable forest management (SFM) system—i.e., the economic and social elements. This "triad" concept of sustainable forest management holds that SFM succeeds when all three elements of environment, economics, and society's other needs from the forest are properly addressed in the course of management. Former deputy minister Bob Fessenden often referred to this as the "three-legged stool" of sustainability (see Figure 7-2).

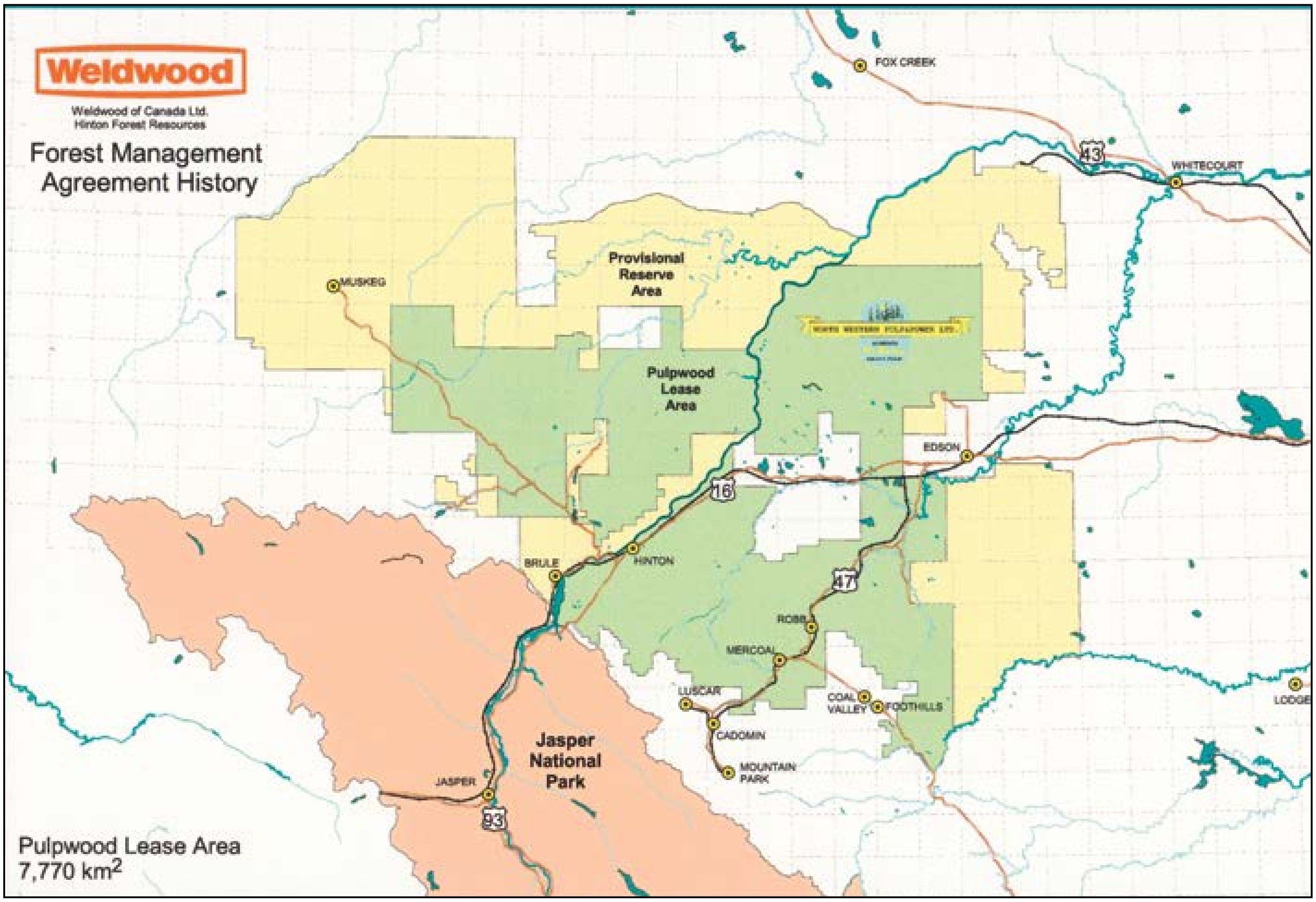
Historical Context

As described in Chapter 1, uses of the landscape around Hinton had multiplied since signing of the original forest management agreement (FMA) in 1954. By the early 1990s, the FMA area hosted major coal mines, extensive oil and gas exploration and production, recreational activities, tourism, and transportation facilities. Different mixes of uses, users, and management were found in adjacent Jasper National Park, Switzer Provincial Park, and Willmore Wilderness Park, but the landscapes shared a number of common management issues and challenges. Hinton had a population of about 10,000 in 1991, and Jasper's was about 5,000. (The town populations have remained relatively stable since then.)

In their insightful examination of the evolution of adaptive and sustainable forest management in the Hinton area, as reflected in successive forest management agreements signed between the Hinton agreement holder and the Government of Alberta, Peter Murphy and Marty Luckert discussed the changing nature of land use and priorities as they were identified in those agreements.[4] The first agreement made no provision for other uses of the land, although the provincial government had the option to withdraw land for other uses (provided it was replaced). Murphy and Luckert noted that the "single most distinguishing feature of that agreement, covering an active industrial forest of 3,000 square miles and a further 3,000 square miles in reserve, was its intent to '*reserve for the sole use of the licensee for the purpose of growing continuously and perpetually successive crops of forest products to be harvested in approximately equal annual or periodic cuts adjusted to the sustained yield capacity of the lands*' [emphasis added], as defined in the Forests Act of 1949." This is a classic description of a "regulated forest."

From that forestry-only land-use allocation, as discussed in Chapter 1, successive forest management agreements in Alberta moved further and further away from this single-use purposing. Not only were other land uses built into the provisions of FMAs, but they were also set forward in various government policy initiatives such as the 1984 *Eastern Slopes Policy* and, more recently, the Land-use Framework unfolding in the province.

Internationally, the 1987 *Brundtland Report* (*Our Common Future*) set in motion a series of meetings and policy initiatives that, in Canada, culminated in the Canadian Council of Forest Ministers' 1995 report, *Defining sustainable forest management: A Canadian*



Map 7-1. The North Western Pulp & Power pulpwood lease area and reserve, 1955.

approach to criteria and indicators, which is still in effect and intermittently updated. All these initiatives pointed to a clear need to address the economic, social, and environmental elements of sustainable forest management. In forestry up to then, most research had focused on the environmental aspects of traditional forest management. Socio-economic research, addressing other two-thirds of the "triad" of sustainable forest management, became a new and expanding field of research in Canada. The Canadian Model Forest Program, purposely built around working forests and a diversity of stakeholder involvement, was uniquely positioned to help advance this research, and Foothills Model Forest, in partnership with the CFS Northern Forestry Centre and the University of Alberta, became an important centre for socio-economic research.

Near Hinton, social science research was already underway in the spring of 1992, before the model forest was established. Researchers from the CFS, the University of Alberta, and the University of Utah were already conducting a major study of moose hunting in the Hinton FMA area and surrounding management units.[5] The team, led by Peter Boxall of the CFS, used focus groups, questionnaires, and surveys to delve deeply into hunters' attitudes towards forest management and related issues such as access, noise, regulations, Aboriginal hunting, and ATV use. The most common reasons given for hunting were companionship and meat. Forestry was seen as positive in some senses, because it increased habitat and access, but many hunters were skeptical of reforestation success, did not like the post-harvest condition of cutblocks, and felt "left out" from management decisions. The study also noted the significant contribution of hunting to the local economy. It set the stage for subsequent research under the model forest umbrella.

Socio-Economic Research at the Model Forest

Launching the Program

At first, Don Laishley, Weldwood's forest resource manager and chair of the model forest Board in the early years, was skeptical of the need for a Socio-economic (later renamed Social Science) Program. However, he was also serving as a member of the National Roundtable on the Environment and the Economy. The insights gained through this exposure, as well as his earlier enthusiasm for a forestry-wildlife program on the Hinton FMA, reshaped his views regarding the need for this type of non-traditional research. He became an enthusiastic champion for socio-economic research in the model forest. After a series of planning meetings, the program got underway in 1995. A number of projects were started during the period 1995–1997, although the spending was modest. Because of in-kind contributions of researcher time by the University of Alberta and CFS research staff, only $34,800 showed up as direct expenditures.

The team compiled a socio-demographic profile of communities in the model forest area, especially Hinton. Seventy in-depth interviews helped to determine the perceptions and attitudes of residents regarding the sustainability of resource uses in the model forest area. A literature review on the human dimensions of wilderness was also completed to influence future research needs in the Willmore Wilderness. Foothills Model Forest and the Fox Creek Development Association partnered to investigate tourism opportunities that focused on Aboriginal culture and its historic and present-day connection to the forest.

In one survey, Hinton residents were also asked, "Do you think forest management in Hinton is being done sustainably?" and they answered as follows:

- Yes Definitely: 36 percent
- Yes Qualified: 34 percent
- No Definitely: 25 percent
- No Qualified: 5 percent

To help quantify spending patterns, the researchers conducted a household expenditure survey of 1,008 respondents in July 1996. The results found that 23 percent of all income earned within the model forest was spent outside the area. Major purchases such as automobiles, vacations, and appliances accounted for much of the leakage.

Recreational Use – Campers and Hunters

Camping was chosen as an indicator of recreational use in the model forest area. CFS researchers Bonita McFarlane and Peter Boxall began surveying campers in 1995 to determine their characteristics and preferences. The survey distinguished between random camping and the use of designated sites; local and out-of-region campers; one-night and extended visits; and those choosing parks versus other Crown lands. The diversity indicated a wide variety of needs and issues that managers would have to address. Random camping was a particular concern because of environmental damage and wildfire risk. The authors said that random camping was likely under-sampled because of the difficulty in getting to more inaccessible sites that could only be reached with off-highway vehicles.[6]

McFarlane and Boxall then used a mail survey in 1996 to examine forest values and attitudes of campers and hunters in the model forest area.[7] They found that these forest users were more "biocentric" in their values—placing nature at the centre—especially if they were younger, female, or had lower income. Many of their attitudes aligned with the stated goals of sustainable forest management. "Our results suggest that a holistic approach to resource management that considers non-timber uses, manages for a variety of species (biodiversity), employs alternative harvest methods to clear-cutting, provides input from local communities into forest management decisions, and gives some protection, especially

In 1999, during a period of high fire hazard, a random camper's unattended campfire resulted in this burn on the Wildhay River flats. It was prevented from becoming a major wildfire only by the quick response of Weldwood and Alberta Sustainable Resource Development.

Random camping at the old NWP&P Logging Camp 33 site near the Gregg River in a 35-year old lodgepole pine-reforested area.

for endangered species, may be acceptable to hunters and campers in the model forest." However, many of the campers and hunters did not think current management practices were sustainable. The main exception was households with a member dependent on the forest sector for their economic livelihood.

"Knowledge of forest-related facts was not associated with attitudes," the authors reported. "However, our study measured knowledge of general forest-related facts. Specific knowledge of the principles and practices of sustainable forest management may have a greater effect on the beliefs about sustainability than the knowledge items used in our study. Specific messages to communicate new forest management strategies and the efforts to achieve sustainable management being undertaken in the model forest might be appro-

Gas-drilling site north of Hinton.

West Fraser's Hinton operation has been the main contributor to the Hinton economy since operations began in 1956.
Brian Carnell Photography

priate in changing beliefs about sustainability of current management. Based on our results, communication messages that emphasize the importance of industrial development based primarily on jobs and economic development may not be very successful with these stakeholders. Forestry initiatives and communications will have to demonstrate incorporation of ecosystem functions and enhancement of a variety of benefits, not just economic, to be acceptable to these stakeholders."

A computer decision support system was developed to help land managers predict where campers would congregate if a change in management or policy affected current camping spots. The socio-economic group hosted two workshops for individuals involved in campground management to test the software. Workshop participants had many positive comments about the software and stated they would use it for future planning.

Another study concerned wilderness users in Willmore Wilderness Park. Ninety-one percent were from Alberta, with the majority living outside the model forest area. Hiking was the predominant use, followed by horseback riding and mountain biking.

Community Economic Modelling

One of the first projects for Bill White and his economist colleagues from the CFS and University of Alberta was developing a computable general equilibrium (CGE) model of the regional economy. The model incorporated available data such as input and output pricing, labour market and population statistics, income distribution, and the costs of capital and land. Using the model, researchers were able to test the impacts of policies and economic events.

One study used the CGE to examine the impact of a 1-percent decrease in use of land by the agriculture, forestry, and energy sectors—a theoretical result of new environmental policies.[8] The results showed that the impact would be greatest on the energy sector and that the severity would depend significantly on the rigidity or flexibility of wage structures. The authors noted that the analysis did not include a value for environmental benefits from such a policy change, nor the potential long-run benefits from the expansion of recreation and tourism activities.

Another study examined the direct, indirect, and induced economic impacts of changes in the forestry, mining, and oil and gas sectors of the model forest area, using hypothetical impacts including a $5-million expansion in the forestry sector and a $60-million expansion in the mining and oil and gas sectors.

In 1999, the CGE model was used to analyze the potential effects of changes in timber availability and pulp prices, using the examples of a 6-percent decrease in annual allowable cut and a 10-percent decline in the price of northern bleached softwood kraft pulp.[9] Both were considered possibilities, one due to environmental policies and recreational activities, and the other due to changes in world pulp markets. Not surprisingly, either event would affect output, employment, and wages in the forest sector. Expansion in other sectors would not be sufficient to offset the impacts on the regional economy, and there would be a significant decline in regional household income. The severity of the effects would depend on the rigidity or flexibility of wage structures. "If community stability is a major objective to be pursued, public agencies should be aware of the consequences of the changes in the forest sector in the FMF region," the authors said.

The CGE model continued to be used and refined during Phases II and III of the model forest, and it was an important tool in developing local level indicators of sustainability for various company plans and the *Northern East Slopes Strategy*. CGE results were also compared with other economic models, such as input-output accounting and the social accounting matrix.[10] Results depended largely on the quality of data available. CFS researchers Bill White and Mike Patriquin said such regional economic models were valuable because resource-dependent, export-oriented economies have different characteristics compared to more diversified economies.

* Janaki Alavalapati received his master's degree in rural sociology and his doctorate in forest resource economics, both from the University of Alberta. He subsequently moved to positions in forestry faculties at the University of Florida and at Virginia Tech, and in 2015, he was named dean of Auburn University's School of Forestry and Wildlife Sciences

Tourism and the Environment

University of Alberta researchers Janaki Alavalapati* and Vic Adamowicz studied the relationship between the tourism sector and resource industries by testing the effects that a 1-percent environmental tax would have on either or both. They found that a tax-induced decline in the resource sector might be offset by an increase in tourism activity due to reduced environmental damage. However, they said the underlying assumptions needed further examination. For example, the model assumed that all environmental degradation was due to the resource sector, but there could also be damage and emissions from tourism,

The town of Jasper is heavily dependent on tourism as its economic driver. *Brian Carnell Photography*

The Teck Coal plant south of Hinton in 2009, showing active and reclaimed mining areas. The reclamation has provided ample habitat for bighorn sheep, elk, and grizzly bears, which are often seen by travellers and are a tourist attraction. *Brian Carnell Photography* as well as increased wildfire risk.[11] (Another study also found that although tourism created many jobs, the revenues and wage rates were considerably lower than in the resource sector.)

Together with White and Patriquin from the CFS, Alavalapati and Adamowicz showed in a 2003 paper that CGE economic analysis could be extended to include environmental factors or "natural capital."[12] They added non-market benefits of nature (recreation and tourism), carbon-equivalent emissions, and carbon sequestration to the conventional CGE framework for the model forest area and calculated the net economic value of $3.74 million to model forest residents from nature-related activities. Other CFS and model forest research (described in Chapter 6) helped them to value carbon emissions at $9.92 million and sequestration at $5.84 million. They were then able to test the regional effects of two theoretical scenarios, a 22-percent reduction in coal mining exports and a 7-percent increase in tourism activity. In the coal example, the environmental benefits slightly outweighed the economic costs in jobs and income. The increased tourism scenario would add to jobs and income, but the benefits would not offset the negative effects of increased vehicle traffic and transportation emissions. The authors cautioned that better data and further study were needed to identify and quantify the relationships.

Public Involvement

In 1999, Tom Beckley reviewed the mechanisms used by natural resource companies to solicit input from the public.[13] These methods included advisory groups, public hearings, and open houses. He also considered alternatives such as surveys, focus groups, and workshops. John Lilley had examined examples such as the deliberations of the Weldwood Forest Resource Advisory Group (FRAG) and the public hearings for the proposed Cheviot coal mine. Beckley said an effective process:

- Facilitates two-way information flow
- Is flexible in scope
- Is representative of the target population
- Is open to new input and new participants
- Provides guidance to managers
- Allows for frank and open discussion
- Is cost-effective in relation to the information received
- Gives something back to participants

Beckley concluded that no single tool met all the criteria. For instance, advisory groups facilitate two-way communication and are flexible in scope, but they tend to be less open to new input and participants. On the other hand, surveys can be effective at soliciting input from a representative sample of the target population and can be cost-effective, but they are often less flexible than advisory groups and do not generally give much back to participants.

John Parkins, Bonita McFarlane, and Richard Stedman then surveyed members of forest company advisory groups, including FRAG, and a sample of the general public in Alberta. The public sample included urban residents, model forest residents, and other rural Albertans. The researchers found strong support for public involvement in general among all of those surveyed, as well as for the specific mechanism of advisory groups. However, the study found that the members of advisory groups differed from the general public in socio-economic characteristics, attitudes, and sources of information. Urban and rural people also showed differences in sources of information. Model forest residents and advisory group members tended to consider the forest industry as a more reliable source of information than environmental groups, whereas other urban and rural Albertans considered environmental groups to be more reliable sources.[14]

In 2006, Parkins followed up with a new project to assess the quality and effectiveness of public participation processes in the model forest. Data were gathered from public processes within the major sectors of the regional economy, including oil and gas activity, mining, forestry, recreation, and the national park. Methods included unstructured face-to-face interviews with sponsors of public processes in key jurisdictions and economic sectors, with laypeople involved in public processes, and with those who had dropped out of such processes for various reasons. In addition to these interviews, the study included a standardized survey component.

Wildfire Risk Reduction

Bonnie McFarlane, senior human dimensions specialist at the CFS, undertook a social science analysis of wildfire risk reduction in Jasper National Park after the Foothills Model Forest initiated the Firesmart-Forestwise demonstration project in Jasper National Park in 2002. Previous studies of the human dimensions of wildfire had examined public attitudes toward fire, policy, and fuel-reduction preferences, as well as information needs in communities outside protected areas. Results were contradictory, depending on such things as the level of awareness of community members, perceived risk from wildfire, and views on prevention versus protection. The contradictory results suggested the futility of attempting to extrapolate results across geographical areas with differing land management objectives and varied ecological, social, cultural, and political systems.

In addition, little was known about public perceptions and preferences related to fire management in protected areas, and no studies seemed to have been done that examined perceptions of wildfire risk to humans and ecological integrity in protected areas. For fire management programs and ecosystem restoration efforts to be successful, there was a need to develop an understanding of risk perception, attitudes, knowledge of fire and fire management, and support for risk-reduction activities in protected areas in Canada.

The objectives of this study were to:

- Examine park residents' attitudes towards fire, perception of risk associated with residing in or near a national park, acceptability of risk, knowledge of fire and mitigation measures, familiarity with ecological integrity principles, and preferences for fire management

In 2002, researcher and Firesmart project manager Alan Westhaver took the model forest Board and program leads on a tour of the Firesmart project around Lake Edith. On the left side of the road is an untreated area with heavy undergrowth and "ladder" fuels that would conduct any ground fire up into the tree crowns. On the right is the treated stand with no links between the tree crowns and ground fuels. Pictured L–R: Al Westhaver, David Andison, Bob Demulder, Dennis Hawksworth, Jim Beck, and Bob Newstead.

- Examine the influence of park managers and municipalities and other relevant agencies on risk reduction
- Develop recommendations to assist Parks Canada, municipalities, and fire management agencies in developing communication strategies, engaging the public in mitigation activities, and improving community preparedness

This project used personal interviews that included park residents and representatives from Parks Canada, the municipality of Jasper, and other relevant organizations. The study assisted in identifying factors that contribute to the adoption of risk-reduction activities and that contribute to successful community preparedness. The results demonstrated that although experiencing a fire increased resident awareness, it did not induce risk-reduction behaviour. Community leaders showed a greater interest in mitigating risk than local residents.[15]

Natural Resource Accounting: Non-Timber Values

By 2002, the program had developed an inventory of the non-commercial values of the forest, which include activities such as camping, hiking, hunting, and fishing, as well as ecosystem functions such as maintaining biodiversity and water quality. This is defined as natural resource accounting and was incorporated into the proposed Northern East Slopes Pilot Project and the model forest's local level indicators of sustainability. The natural resource accounting could potentially be incorporated into forest management plans, thereby quantifying multiple forest values. (In 2008, however, the provincial government relieved companies of most of the responsibility for this aspect of planning, which was incorporated into programs such as the Land-use Framework.)

The model forest had been studying fish and grizzly bear ecology and biology for several years, creating a better understanding of how human activities affect fish and grizzly bear populations. In Phase III of the model forest, the Social Science Program began to explore whether society would be willing to curtail industrial and recreational uses of the forest if it meant maintaining the ecological conditions required for healthy fish and grizzly bear populations.

Grizzly bear watching is an important feature in the tourist industry of the mountain parks and foothills of Alberta. *Sylvie's Photography*

Bonnie McFarlane undertook a study in 2004 to understand public attitudes and opinions on grizzly bear management. Her research found the following:

- Residents of the Foothills Model Forest (residents of Hinton and surrounding communities) and Edmonton had positive views towards grizzly bears but were not well informed about the animals.
- There was support for making some sacrifices of industrial development and economic opportunities to enhance grizzly bear conservation.
- Jasper residents were better informed, had more positive views of grizzly bears, and were more supportive of reduced industrial activity than the other Albertans studied.
- Opposition to some of the management options appeared to be driven primarily by specific interest groups, including hunters, recreational off-road vehicle users, and model forest residents employed in the mining sector.

Social Impacts in Resource-Based Communities

Based on the first round of research, the program developed six indicators of community sustainability: population, income, poverty, real estate, human capital, and employment. This led eventually to a major report in 2001 by John Parkins and Tom Beckley: *Monitoring community sustainability in the Foothills Model Forest: a social indicators approach*.[16] Parkins and Wayne Crosby updated this report in 2008.[17]

In 2005, Parkins led a study of the relationship between drug and alcohol issues and the economic structure of resource-based communities. This project was undertaken with the Town of Hinton and other service agencies in the region. The researchers examined the extent to which local conditions (e.g., shift work) contributed to certain social and health problems.[18] The results indicated that the reasons for substance abuse went beyond boredom and money and were rooted in the cultural, social, and economic life of the community.

> "Even after identifying a variety of solutions, research participants pointed out several complicating factors which may make implementing solutions difficult. These factors include the denial associated with addiction, which often leads to individuals hitting 'rock bottom' before they seek help; the labour shortage, which has employers desperate and turning a 'blind eye' to employees with substance use or addiction issues; the negative and detached community attitude towards individuals with substance addictions and the low level of empathy and community-wide support to help these troubled individuals; and challenges within the justice system such as inadequate policing resources and penalties to deter alcohol- and drug-related crime. These barriers must also be considered when developing a community response to the substance abuse issue." – 2007 QuickNote on the Beyond Boredom Project[19]

The CGE economic impact model was used by the Town of Hinton to predict the social and economic impacts of major potential initiatives; e.g., the Cheviot coal mine and the proposed $700-million Cougar Rock development near town (which did not proceed).

An update of previous work on regional economic indicators highlighted the increase in oil and gas activity and the volatility of the coal sector. Social indicators revealed a declining and aging population. Incomes remained high, but the gap between rich and poor increased. School enrolment increased over previous studies.

The program's *Indicators of Community Wellness*, published in 2004 (largely based on 2001 census data), showed some significant trends and differences between communities, including:[20]

- **Population and Migration:** Over 20 years, the number of residents aged 65 to 74 increased by 400 percent in Hinton, posing significant challenges in the areas of housing, recreation, and medical resources necessary to service this group.
- **Employment:** From 1996 to 2001, the unemployment rate for males and females in the Hinton area significantly increased, but this trend appeared to be reversed, as shown by Help Wanted signs all over town and some businesses closing or restricting hours because of lack of staff.
- **Income Distribution:** Residents of the Foothills Model Forest had, on average, higher incomes than the rest of Alberta, but there was a growing disparity in household incomes, or a "hollowing out" of middle class families in the community. By contrast, Jasper had a lower median income than the provincial average—a reflection of the cyclical and traditionally lower-paying tourist trade.
- **Poverty:** The region had a much lower incidence of low income than the provincial average, although Jasper again fell outside this observation as poverty rates for individuals and families were rising.
- **Human Capital:** Educational attainment was an important indicator of the capacity of the community to adapt to changing social and economic conditions. Within the Foothills Model Forest, this attainment was fairly low, with the exception of Jasper, when compared to the rest of the province. However, nearly half the population of the model forest between the ages of 15 and 24 years of age was enrolled in full-time education in the years 1996–2001.
- **Real Estate:** In marked contrast to its income and poverty levels, Jasper continued as the most expensive community in which to buy a house or pay rent, with housing expenses the highest relative to median income. From 1996 to 2001, the last of the five full five-year census periods examined, these payments decreased in the rest of the Foothills Model Forest. However, the strains placed on the communities outside Jasper as a result of the burgeoning resource sector were also reflected in rising housing costs and other associated social challenges.

Community Vulnerability – Mountain Pine Beetle

Mike Patriquin, Adam Wellstead, and Bill White constructed an index in 2005 to assess Hinton and Jasper's socio-economic vulnerability to mountain pine beetle attacks. The economic diversity of the area and other factors led to the conclusion that these communities had relatively low vulnerability. However, this was early in the spread of the beetle infestation into Alberta.

John Parkins and Norah MacKendrick also published a paper in 2005 comparing vulnerability between communities in the model forest and 11 communities affected by mountain pine beetle in the British Columbia Interior.[21] They found that "vulnerability is not simply a function of physical exposure to beetle activity, but also of various social, economic, and political factors that contribute to community adaptive capacity. Therefore, some communities located in areas with high levels of beetle activity have less than expected vulnerability owing to various capacities inherent in the community, while in others with low to moderate levels of activity, vulnerability was somewhat elevated owing to a relative absence of these capacities."

Image 7-9 In 2018, the impact of mountain pine beetle can be seen in the high mortality of pine in key tourism sites near Jasper such as Whistlers Campground. *Courtesy Dennis Quintilio*

Commitment to, and Value of, Social Science Research

Funding for the Social Science Program was a large proportion of the model forest budget during the early years of the program, as championed by Don Laishley, who represented the Board on the socio-economic activity team. At the beginning of Phase II in 1997, the funding from the Canadian Forest Service for Foothills Model Forest was reduced from $1 million per year to $500,000 annually. The model forest shareholders (Alberta Government, Weldwood of Canada Ltd., and Jasper National Park) then committed to replacing this money so that the core funding would remain at $1 million annually.

At the March 1997 Board meeting, it was agreed to allocate core funding to cover administration and support costs, and then divide the balance among four key theme areas: Information, Research, and Knowledge; Integrated Resource Management; Socio-economics; and Forest Resource Improvement. As a result, when the Board met in June 1997 to allocate funds, the budget for socio-economic research was reduced from the proposed $250,000 annually to just over $140,000. In protest, Don Laishley immediately resigned his position as Board liaison to the Social Science Program, which was then taken up by Jeff Anderson and Colin Edey. Funding continued at a high level during Phase II ($958,400), and then declined to $299,500 during Phase III (2002–2007) as other priorities took over. Only $10,000 was spent in 2007–2008, and nothing after that.

Besides core funding, additional funding would come in Phases II and III from the Provincial Environmental Enhancement Fund ($150,000), as well as continuing federal and university support, which was substantial. The salaries of the CFS researchers as well as University of Alberta academic staff conducting the bulk of the research were covered by their organizations. The model forest funding went towards field staff, student researchers, and expenses. In total, the model forest invested just under $1,268,000 in socio-economic research, largely led by the Canadian Forest Service social science research team under program leads Tom Beckley and Bill White.

The Social Science Program came to an end, as did federal funding for the Model Forest Program, in 2007, and the model forest became an independent institute soon after. As John Parkins, Tom Beckley, and others later observed, much of the benefit from the model forest's Social Science Program came in the form of its publications, which provided analytical tools and insights that were widely used and cited across Canada and internationally. Parkins pointed specifically to the revised criteria and indicators (C&I) published by the Canadian Council of Forest Ministers in 2005.[22] "I served on the national committee that revised these indicators, and my research in the foothills allowed us to recommend strongly that we take a different approach to measuring community well-being and resilience," he said. "The C&I now includes economic diversity, education, income, and poverty, and I think the [model forest] and the social science group can take some credit in putting forward this approach to measuring community sustainability."

Jerry Sunderland, a model forest Board member from 1995 to 2003, saw the benefits of socio-economic research in his roles as the Government of Alberta's regional director for the Northern East Slopes and executive director of forest operations. "On a personal level, the Socio-economic Program contributed to my understanding of what and how forest management could contribute to sustainable development in the region and province," Sunderland said in a 2015 questionnaire response. "Indicators developed through the program were very useful in helping me, as a regional director, to integrate decisions that often had conflicting environmental, economic, and social components."

The research team had proposed to continue its work on many of the human dimensions of land use management in the region. The area faced risks not only from mountain pine beetle and climate change, but also from uncertain markets, fire, and other factors. Understanding the potential social and economic impacts of these risks on communities and public acceptance of management and policy strategies could assist communities in adapting to and mitigating the impacts. Data from the 2006 census was soon to be released, enabling researchers to update social and economic indicators for the region. Water had been noted as an important issue for the area, and questions about its value, trade-offs, and public attitudes merited continued research.

The strategic plan for the 2007–2012 program at FMF was built on the assumption of continued funding under the new Forest Communities Program, and part of this new funding would go towards continuing the Social Science Program, investigating the economics and sociology of resource-based communities. Unfortunately, FMF was not chosen for the new program and the strategic plan had to be reworked. No other funding partners stepped forward to support this initiative, and it was "left on the cutting room floor" when the plan was reworked, according to Rick Bonar, who had chaired the Board since 2005. "The economic research was very sound and potentially useful, but it didn't have one or more partners strongly behind it saying, 'I need this, and I'm going to use it to make decisions.' Most of the sociological research was in that bucket, too," Bonar said in a 2015 interview.

Several years later, the fRI Board asked Keith McClain to investigate reviving the socio-economic program. As he reviewed the earlier work, McClain was impressed by what had been accomplished and how widely it had been used across Canada. He talked to the researchers and others and thought there was real potential to revisit the work with new data. The results could be useful to his mountain pine beetle research and many of the other fRI programs and associations. He hosted a meeting in 2014 to examine the possibilities. "It was a plenary session out at the Cache Percotte Forest, with the Board and all the leads for the programs," he recalled.[23] "I talked about the socio-economic program. I said, we have opportunities here, but who in this room would like to pay for it? Not one hand went up, not one hand."

> "It was my suggestion as well that each program identify some aspect of their program that relates to social economics. Maybe we could compile all these things and actually have a project of some sort. Anyway, that didn't raise an eyebrow at all, so that didn't go anywhere. I don't know if socio-economic research really is something that just needs to be left to the universities, and we simply engage the university when the need arises. I think that's the way it's going to be handled from now on ….

> "Things aren't like they used to be where we had the capacity to rely on the Canadian Forest Service. Those relationships have all changed. Not for the worse—they just have changed. Working with the university is another opportunity. Even there, circumstances have changed. You have to be darn sure that the problem is well-defined beforehand [and] that someone's willing to put that money into it. I don't know any funding partner right now that wants to fund … a social-economic program …. The only real agency that could do this would be government. I don't see government stepping towards it either."
> –Keith McClain, interview, 2015

However, McClain noted that there continues to be a socio-economic component in the mountain pine beetle program, which is being conducted in cooperation with the University of Alberta. Also, John Parkins (now at the University of Alberta Department of Resource Economics and Environmental Sociology) began a project in 2017 with Dave Andison's Healthy Landscapes Program to determine the barriers to the implementation of ecosystem-based management.

Lisa Risvold became familiar with the socio-economic research during her time as communications coordinator for the model forest and fRI from 1998 to 2008. She said the program's findings and methods proved valuable in her subsequent role as senior coordinator of community and Aboriginal affairs for Teck Resources Ltd. coal mines in the Hinton area. "I use that information on a day-to-day basis in my current role," she said.

> "In essence, it is my job to work with First Nations and communities of interest to understand how mining will impact their interests and values—to minimize impacts and to maximize benefits, to work on community sustainability, and what do sustainable communities look like. There are the indicators of sustainability: education, pay equity between men and women, real estate, the price of real estate. Those are things that I consider, I would say, on a weekly, if not daily basis. If you're talking about when coal prices are going down, okay, what is the impact to our community? What do we need to look at it? What demographics do we need to understand? At Teck, there is a goal that we are a more diverse workplace. A way to help that to gain traction within a corporation was to say, a sustainable community, men and women make a similar amount of money. When that doesn't happen, here are some social consequences. When it does happen, here are the benefits. So, advancing workplace diversity, whether it's gender, whether it's with visible minorities, in a way so that Teck truly represents the communities we operate in." –Lisa Risvold, interview, 2016

Risvold said that Teck has been able to revisit the model forest socio-economic indicators using more recent census information. She added that it is important to recognize that sustainability is not just ecological, "it's social, it's economic, and it's cultural …. Now, more than ever, it's cultural and traditional values. Not having that well-rounded picture and those other values considered when you're making ecological decisions creates tremendous challenges. In my current position, when we're questioned on grizzly bears, we give them information from fRI Research; it's great science, but those other values are not considered, and there's a gap. That gap, I would say, will continue to widen until those values are integrated into the research—not just in the outreach, but in the research. People need to be involved and engaged, especially First Nations."

John Parkins said in 2017 that the program has had a lasting impact. "Our work, like the CGE models and the MPB [mountain pine beetle] assessments, are cited and used by people around the world. This is a legacy of the FMF Social Science Program that can be celebrated."[24] Bill White added that "much of the environmental sociology work that goes on in Canada now can be traced back to FMF. The growth of programs at the UofA and UNB [University of New Brunswick, under Tom Beckley] and the students that have come from those programs lead out in this field, and the influence of their students is widespread."[25]

"Over time, I think you're going to see society put more value on forest land for ecosystem services and recreation and away from fibre values," said R.J. (Bob) Fessenden, former forestry professor and former deputy minister of Alberta Sustainable Resource Development, in a 2015 interview. "I think the forest industry is going to have to come to grips with that as an overarching trend …. As populations increase and as values change, I think you're going to see shifts in terms of what society wants from that landscape, but we're always going to need somebody to manage the landscape for whatever outcomes …. [fRI Research] is a place that can work out some of this stuff. The socio-economic is really important as a context."

In 2017, fRI Research General Manager Ryan Tew said that although there is no longer a dedicated program, socio-economic factors continue to be included in the work of other programs such as Mountain Pine Beetle, Grizzly Bear, and Healthy Landscapes.

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CHAPTER EIGHT

CCFM Criterion Six

Society's Responsibility

"Sustainability involves not only the values related to the forest resource itself but a human dimension as well. Forest operations take place on lands that are often public and located close to or within the boundaries of Aboriginal* territories and communities. Furthermore, many rural communities, both Aboriginal and non-Aboriginal, depend on the forest sector for their economic and social well-being."
–Canadian Council of Forest Ministers, 2005[1]

Sharing is the common theme of the model forest and fRI Research activities that fall under this criterion.

Two-way knowledge sharing was the explicit goal of the Aboriginal Involvement Program (AIP) from 2002 to 2009, although it faced many challenges and never reached its full potential. Aboriginal involvement also occurred through other programs such as the Caribou Program's work with the Aseniwuche Winewak Nation (described in Chapter 3). The model forest and fRI Research contributed in many other ways to the well-being and resilience of forest communities by fostering informed decision making. Achievements included:

- Partnerships and engagement with a broad spectrum of stakeholders and users
- Creating and providing administrative services for associations to implement science-based management
- Extensive communications and technology-transfer initiatives
- Documenting the evolution of the landscape and its management

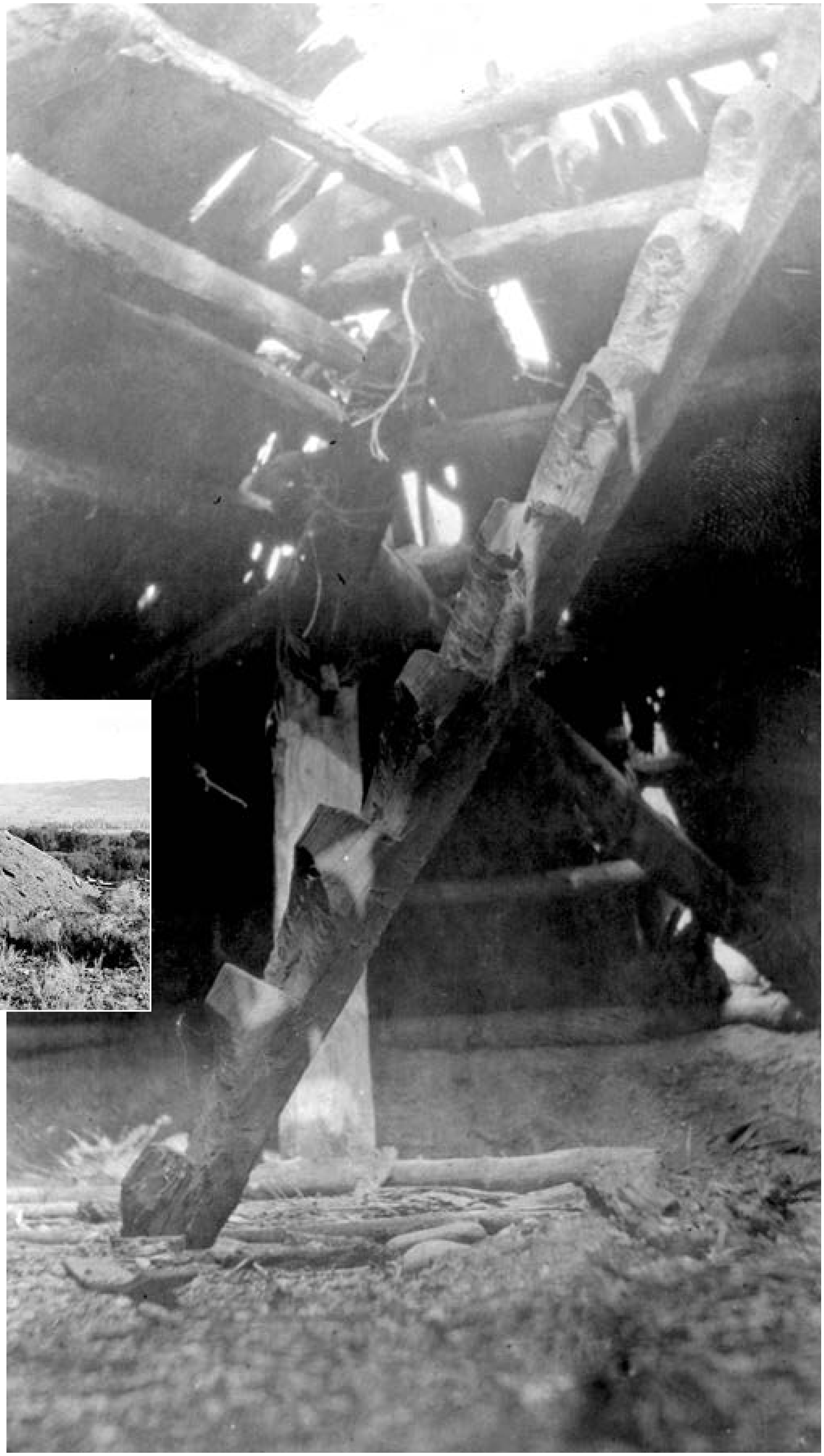
Part A of this chapter addresses Aboriginal involvement. Part B describes the other contributions to community building and knowledge exchange.

Part A: Aboriginal Involvement

By the 1990s, depending on the area included, between 7 percent and 14 percent[2] of the foothills population identified as Aboriginal, the majority of whom were Métis.† Due to the dispersed locations and varied interests of these people, the model forest had little direct engagement with Aboriginal people during the first seven years. Engagement was seen as mainly the responsibility of companies and the federal and provincial governments. Discussions in the late 1990s led to creation of the Aboriginal Involvement Program, which ran from 2002 to 2009 and developed tools for information exchange and capacity building. Multiple interests and changing representation hindered implementation of these tools, as did the introduction of new government policies after 2005. Positive results included

* The term "Indigenous" has replaced "Aboriginal" in much Canadian usage since adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Although the UN issued the declaration in 2007, Canada was one of four countries that initially objected to it—along with the United States, Australia, and New Zealand—and there was little change in usage here. The usage began to change after July 2015 when the Government of Alberta announced plans to incorporate UNDRIP provisions into law and policy. The federal government followed suit and withdrew Canada's objector status in May 2016. Since then, governments across Canada have been implementing UNDRIP in accordance with the Canadian Constitution. This book retains the term "Aboriginal" in most instances because it was the common usage during most of the period under discussion, including references such as program names, policy titles, and quoted documents.

† For Yellowhead County, 8.3 percent of the population identified themselves as Aboriginal in the 2016 census. Of these, more than two-thirds were Métis, and many of the others were "non-status Indians," a legal term that refers to any First Nations individual who for whatever reason is not registered with the federal government or is not registered to a band that signed a treaty with the Crown. For the Town of Hinton, the Aboriginal proportion in 2016 was 12.4 percent, of whom about half were Métis. About 2.5 percent of Jasper residents identified as Aboriginal, two-thirds of whom were Métis.



Interior, Shuswap pit house, Kickwilli Hules, 1907. *British Columbia Archives, Royal B.C. Museum, E-08451*

Shuswap pit house, Nicola Valley, date unknown. *British Columbia Archives, Royal B.C. Museum, G-00754* improved communications—"getting to know each other"—and stronger relationships within and between communities.[3] Since the AIP ended in 2009, some fRI Research programs have continued to engage Aboriginal people and communities as part of their projects.

The following account draws heavily on previous research[4] by Peter Murphy, professor emeritus of forestry at the University of Alberta, and a 2010 report on the Aboriginal Involvement Program by Hinton Wood Products forester and Aboriginal affairs coordinator Aaron Jones, who was a member of the program's steering committee.

Historical Context

Fire has not only shaped the foothills landscape but has destroyed most signs of early human use. However, excavated archaeological artifacts are telling us more about the early peoples of the area. Evidence from a few campsite remains in the Athabasca Valley indicates an Aboriginal presence near the Snake Indian River west of Hinton as early as 10,000 to 11,000 years ago, but there is little to suggest permanent settlement. The valley then seems to have served more as a corridor for people hunting or just passing through. The geography may have focused migration patterns along the major east–west trending river valleys,[5] as in recent times. Travel in those days was often a leisurely affair, and a party might tarry for weeks, months, or even years if the hunting, fishing, and gathering opportunities were plentiful.

Archaeological studies at Patricia Lake in Jasper National Park have found obsidian flakes from the Mount Edziza area of the Coast Range, nearly 1,000 kilometres to the west. They were brought there some time between 4,000 and 2,400 years BP (before present) during what is referred to as the Shuswap cultural horizon. This period was characterized by the use of semi-subterranean pit houses as winter residences. Results of excavations also suggest possible affiliation with the later Plateau cultural horizon 2,400 to 1,200 years BP. The area of influence of the Plateau culture is generally between the Coast Range and the Rockies.[6]

The Hinton area was at the edge of the territories occupied by three distinct Aboriginal peoples: Athapascan language groups of the Dene in the boreal forest to the north and east, Algonkian language groups of the Stoneys to the south and east, and Salishan language groups of the Shuswaps to the west.[7] The main Aboriginal cultural influence in this region over the last 300 years has been the Plains people to the south. In the early 1800s, the Beaver people dominated the Alberta foothills between the Athabasca and Peace Rivers, a few Shuswaps lived in the Jasper and Mount Robson areas,[8] and Stoneys, or Assiniboines, prevailed to the south. At this time, the Cree were increasing their presence in the west and were influential in this region.

The Iroquois, originally from the Ontario-Quebec area, played a prominent role in the fur trade and were much more influential in the exploration of western North America than their usual portrayal as trappers and guides, in support roles, would suggest. The North West Company (NWC) brought Iroquois, also referred to as Nipissings or Algonquins, west to serve as canoemen and trappers. Some stayed on as "freemen" once their three-year contracts had been served, often taking women as wives from local tribes such as the Cree.[9] They seem to have been present in this region at least by the late 1790s, certainly in the early 1800s.

The Iroquois also dispersed to other areas. James Hector* in 1859 remarked on the Iroquois in the upper Smoky River Valley region, where they were well established, hunting and growing vegetables. In some areas, the success of the Iroquois rankled local tribes, but that antagonism seems not to have been evident in the Upper Athabasca region, and many descendants of the original Iroquois remain.[10]

The first people were hunters and gatherers, and they moved to take advantage of seasonal opportunities for food. They depended largely on bison in the prairie, parkland,

* James Hector was a Scottish geologist, naturalist, and surgeon who accompanied John Palliser's expedition as it explored Western Canada from 1857 to 1860. It was the government's first scientific survey of the region.

and montane areas, and on moose in the forested areas. Moose was an important staple throughout the forested area, providing meat, clothing, footwear, coverings for lodges and boats, and sinew for sewing. Hides were smoke-tanned, and surplus meat was dried. The same traditions of hunting and gathering remain today. Finds of bison skulls and evidence of wallows in meadows indicate that the animals were present or migratory along most of the river valleys. In the mountain region, bighorn sheep were also a staple food.

The Role of Fire

Fire made human life possible in these forests, for cooking and heat for year-round living. The ability to carry fire or fire-making materials was essential for survival. Recurrent forest fires, both natural and human-caused, also created the earlier plant succession stages and the mosaic of habitats necessary to sustain the plants and animals on which Aboriginal peoples depended, such as berries, birch for bark and syrup, willows and aspen for browse for the large herbivores, and deciduous species used by beaver for food and dam building. Canoes were built entirely from native materials. The lodgepole pine, a fire-origin species, was favoured for tepee poles and travois, and was traded with neighbouring tribes on the prairies. Most of these forest products were derived from the forest plant communities that developed after recent fires.

The frequent fire cycles also played a major role in Aboriginal life in this area. Although burned-over areas soon support a wealth of plants and animals, the immediate aftermath can be bleak and barren, another reason for people to keep moving, perhaps to return later when wildlife feasted on new growth.

Aboriginal Use of Fire

There is growing evidence that Aboriginal peoples significantly affected the landscapes through their use of fire, but that use appeared to be tempered by an understanding of the ecosystem, their place in it, and the need to contain fires to the areas they wanted to burn. For example, they would burn stream and river margins for ease of travel, to provide grass for horses, to encourage willows for moose and aspen for beaver, to create open areas on which to camp, and to stimulate berry production. They would also burn meadows to encourage grass and sedges, and they would burn some stands of living trees to create sources of dry wood for campfires.[11]

In a 1980 interview, Edward Moberly, grandson of former Hudson's Bay Company factor Henry Moberly, described burning on the Henry House Prairie east of Jasper in the early 1900s: "[In] the spring, that's the first thing everybody does is burn the meadows …. This way the meadow doesn't grow in—willows and things doesn't come in. It's always the same size and it's always clean … they watch the wind very close—that's the main thing." Undoubtedly wildfires were also accidentally ignited.

Some place names reflect open areas in the landscape. Maskuta Creek, previously called Prairie Creek, means "meadow creek" in Cree;[12] Wild Hay River indicates open, grassy areas. It is likely that spring burning was done by Aboriginal peoples at times along most of the rivers and streams in the region. This included the Beaver and members of the eastern tribes of Iroquois, Nipissing, and others who came west with the fur traders in the 18th and 19th centuries. Those practices stopped around 1910, when the federal government took over management of the land.

National Park Evictions

After the establishment of Jasper National Park in 1907, the federal government and park officials undertook to remove people who were living in the park, viewed at the time as "squatters" who would detract from the pristine image that the government had created for the park.[13] Most were Métis families of Iroquois and European descent who had arrived in the early fur trading days, including the descendants of John Moberly and

This 1915 view of Henry House Flats, north of Jasper, taken by Dominion Land Surveyor M.P. Bridgland, shows the open nature of the forest landscape in the Athabasca valley resulting from homesteads and burning by Aboriginal peoples. *Digital image © 2000 University of Alberta*

Suzanne Kwarakwante Cardinal.[14] In 1909, the records showed seven farms operating in the upper Athabasca valley. The resident families and others, described as "the natives of the Jasper valley, the self-reliant mixture of Métis, Cree, Stoney, and Iroquois—the Cardinals, Caracontés [Karakontis], Callihoos, Plantes, Gauthiers, Finlays, and the Moberlys"[15] and Joachims—lived off the land by hunting, fishing, gathering, raising garden crops, and growing oats and hay for their cows and horses.[16] Some of the cleared areas created by these settlers are still visible in photos taken five years later by surveyor M.P. Bridgland.

The homestead of Ewan and Madeline Moberly in Jasper National Park has been restored as an interpretive site by Parks Canada.

In 1908, government commissioner J.W. McLaggan was sent to serve the eviction notices and to negotiate a settlement.[17] The heads of the six Métis families accepted a cash settlement and were told they could move anywhere they wanted, outside the park boundaries. John Moberly moved to Prairie Creek, Isadore Findlay went to Shiningbank Lake about 40 kilometres northeast of Edson, and the others chose Grande Cache.

Aboriginal People in the FMA Area

The original forest management agreement area in 1955 did not include any permanent Aboriginal settlements or reserves, but there were quite a few Aboriginal people among the population. These included descendants of Métis families who settled in the Entrance area early in the 20th century, as well as other Aboriginal people who came to work in the sawmills, railways, coal mines, and related businesses such as trucking.

In the 1996 census, 725 Hinton residents (about 7 percent of the population) listed themselves as Aboriginal, and others lived in surrounding parts of the forest management area. These included the "Smallboy Camp," a group from the Ermineskin First Nation who moved in the early 1970s from near Nordegg, Alberta, onto Crown land in the southern part of the forest management area.

There were always some Aboriginal people among the forest company's employees and contractors, and the company made a specific effort to recruit Aboriginal people around the time mechanical skidders replaced horses in company operations in 1968. Many Aboriginal people were also among the 1,300 firefighters certified by the Forest Technology School during the 1960s.

The first formal relationship with an Aboriginal community began in the early 1970s. About a dozen families, originally from the Rocky Mountain House area, had been logging timber berths in the northwestern part of the forest management area since the 1950s. In 1972, they formed a co-operative (which later became the Fox Creek Development Association Limited) to perform contract logging for the company. In the 1980s, as the company moved to newer harvest methods, the Fox Creek group—most of whom had moved into Hinton—continued to use power saws and cable skidders, which enabled them to work on steeper terrain and sensitive sites not accessible to heavy equipment. In 1994, when hand logging with power saws had been largely discontinued, Fox Creek Development got out of the harvest business and became one of the company's leading silvicultural contractors.

Fox Creek Development generally employed about 14 or 15 workers in logging, and this increased to about 20 workers doing silvicultural work in the late 1990s. Fox Creek Development also performed campground maintenance for Weldwood (now Hinton Wood Products), and it supplied an eight-person firefighting crew to the government when needed. Including non-company projects, Fox Creek Development has provided part-time work for up to 45 Aboriginal people in the Hinton area. The company has continued to work in stand tending, cone collection, and slashing and falling work; it also manages and maintains 23 campgrounds and eight trail systems for the Forest Recreation Management Association (FMRA), mostly within West Fraser's Hinton FMA area.

In 1997, as part of its commitment to sustainable forest management, Weldwood established an Aboriginal Round Table to further develop its relationship with Aboriginal people in the area. The consultative body included representatives of 11 Aboriginal communities and groups and was chaired by Ritchard Laboucane, company logging operations manager, who is himself Métis. Key projects included developing an employment strategy, planning a youth career fair, raising cultural awareness, initiating a project to gather traditional ecological knowledge, and exploring opportunities beyond Weldwood's forest management area.

Foothills Model Forest Aboriginal Involvement Program

Michel Audy was Jasper National Park superintendent (1994–1996) and a Foothills Model Forest Board member or alternate (1992–1997). In 2016, he responded to a questionnaire that asked, among other things, about his greatest disappointment as a member of the model forest Board. His answer, and the reasons for it:

> "Aboriginal peoples, although an important partner, were not involved in the process, at least during the years that I sat on the Board …. Over the course of its first five years of activity, the FMF Board discussed whether to involve Aboriginal groups and, if so, how. The Board decided to not involve Aboriginal partners at this stage because it had difficulty in identifying Aboriginal interests and possible involvement with the FMF. These uncertainties stemmed in part from actions undertaken by various groups at this time. For example, in 1990, an eclectic group of representatives from various Aboriginal communities around Edson, Hinton, and Grand Cache had coalesced into an unofficial organization—Mountain Cree Métis—and staged a two-month protest at the JNP East Gate. The purpose was to seek redress for the alleged unfair relocation of Métis settlers from the Jasper area by Parks Canada in the 1910s. Also, the Smallboys were occupying land in the Hinton area, and at least one land claim (Alexis Band) was pending, with possible legal ramifications for land use." –Michel Audy, questionnaire response, 2016

In his review of Phase I (1992–1997) of the Foothills Model Forest, consultant Hugh Walker[18] noted the absence of Aboriginal participation in its activities and programs. The work plan for Phase II (1997–2002) identified Aboriginal involvement as a possible program area to explore.

Chief Jimmy O'Chiese, 2008.

Ritchard Laboucane's Aboriginal Round Table at Weldwood provided one starting point. The Fox Creek Development Association and the Nakcowinewak First Nation had both expressed interest in joining the model forest or becoming involved in its programs. The model forest Socio-Economic Program and the Fox Creek Development Association partnered in 1998 to investigate tourism opportunities that focused on Aboriginal culture and its historic and present-day connection to the forest landscape.

In 1998, Laboucane and model forest General Manager Rick Blackwood also began discussing the issue of traditional land use studies proposed by various Aboriginal groups. There was considerable overlap among their maps, but there seemed to be little interest in a joint study. The model forest Board decided it would support taking a role if the project could be comprehensive, covering the entire land base, and if it were adequately funded. Discussions along these lines continued for two years, until December 2000, when Laboucane and Chief Jimmy O'Chiese of the Foothills Ojibway Society presented a proposal for developing a traditional study project.

Laying the Foundations

An elders gathering in Hinton on October 19–20, 2001, organized by O'Chiese and Laboucane, then laid the foundations for the model forest's subsequent involvement. The objective of that gathering was to foster better relationships among Aboriginal communities, industry working on the land base, and the model forest. Aboriginal communities wanted to help industry and the model forest better understand and respect their traditional values and cultural practices.

The participating Aboriginal elders proposed that their communities work together with industry in an effort to conserve traditional values and cultural sites, and that direction provided the inspiration for the Aboriginal Involvement Program. A steering committee met five times in 2002 to flesh out the program. The committee agreed that funds should come from the model forest, the provincial government, the federal government (through Parks Canada), Weldwood, and any other industries interested in the project. Communities that had already completed cultural studies would be invited to include their information.

Terry Garvin, who had just co-authored the Northern Forestry Centre's *Guide to*

Conducting a Traditional Land Use Study (2001), developed the proposed protocol for the program's traditional cultural studies. Bob Phillips, an experienced Aboriginal relations consultant, was hired in January 2003 to coordinate the program during its first two years. Later in 2003, the model forest Board added its first Aboriginal member, Rachelle McDonald of the Aseniwuche Winewak Nation, who would serve several terms until 2015; five other Aboriginal representatives would eventually serve various terms on the Board.*

Garvin and Phillips visited Aboriginal communities in the region to make presentations to chiefs, councils, and elders, and to train interviewers. They sought out interviewers who were middle-aged, to better relate with elders, and who were bilingual in the appropriate language.

At its core, the program had four key objectives. They were to:

1. Undertake traditional cultural studies within the model forest area
2. Provide technical support and capacity to Aboriginal communities
3. Develop a mutually acceptable Aboriginal referral process for land-use planning
4. Improve working relationships between industry and Aboriginal communities

Working out the details of protocols and documentation for use by communities and industry was a time-consuming process and continued through 2004. By the end of the year, the first guiding-principles documents were signed by the Foothills Ojibway Society and the Aseniwuche Winewak Nation. The Alexis Nakota Sioux Nation and Sunchild First Nation continued to participate in the program, but the other First Nations and Métis groups did not. Bob Phillips resigned as program coordinator, and contractor Terry Garvin took over coordination until Brad Young was hired in mid-2005. The Nakcowinewak Nation signed an agreement in September 2005. Lack of support from the energy sector limited funding; one reason was that oil and gas companies did not want to pay for studies in Jasper National Park, where they had no operations.

A new complication arose in May 2005 with the release of *Alberta's First Nations Consultation Policy on Land Management and Resource Development.* The policy was intended to define the Government of Alberta's role in the consultation process and to set out Alberta's expectations of First Nations and industry. The policy paper specifically noted that the actual First Nations consultation guidelines were still to come. Meanwhile, the model forest program was trying to identify sites, build a database, and develop a working and acceptable referral system. In the absence of final consultation requirements, it was difficult to get industry partners and additional Aboriginal communities to join the program.

The Bighorn Chiniki Nation (represented through the Wapta mno-tha Society) and Sunchild First Nation joined the program in 2006. However, the Alexis Nakota Sioux Nation had a change of leadership and subsequently withdrew from participation. Repeated delays raised concerns about the cultural study being conducted by the Nakcowinewak Nation, which dropped out of the program in 2007. GIS technician Melissa Pattison was hired in 2006 to develop and manage the program database and to provide GPS and GIS training to participating communities. A two-day meeting with Aboriginal participants in October 2006 identified their multiple concerns and frustrations, due in part to the large number of referral requests they were receiving from industry and their limited capacity to address these.

The Referral Process

When the cultural studies began in 2005, the issue of where to store all the collected data still had to be solved. After numerous meetings, program participants eventually agreed that all data collected would be stored in a GIS database at the model forest (Foothills

* The Board decided to include up to three Aboriginal representatives—status, non-status, and Métis. Rachelle McDonald served from 2003 to 2007 and again from 2013 to 2015. The other Aboriginal Board members were Rod Alexis of the Alexis Nakota Sioux Nation (2004–2006), Eileen Sasakamoose of the Alexis Nakota Sioux Nation (2004–2006), Stan Lagrelle of the Sunchild First Nation (2006–2011), Jimmy O'Chiese of the Foothills Ojibway Society (2006–2014), and Edward Frencheater of the Sunchild First Nation (2008–2012). Cole Pederson, former director of Alberta Aboriginal Relations, joined the Board in 2012.

Aboriginal Coordinator Brad Young at the International Model Forest Network field tour, 2008.

Research Institute after 2007). Each Aboriginal community would designate, in writing, two representatives who had access to their data. Two persons from the model forest were also given access to enter and manipulate the data. This was a significant step, as participating Aboriginal communities had to trust that their data would remain secure and confidential.

Once the protocol was established for how the studies would be conducted and where the data would be stored, the next step was to develop a referral process. A referral system is a process whereby industry refers its proposed development (e.g., cutblocks, roads, well sites) to an Aboriginal community and that Aboriginal community is able to review the proposed development and determine whether or not it infringes on a traditional right, a traditional use, or a cultural site.

The referral process seemed simple, yet it took years to develop. This is how it would work:

1. Each traditional site within the database would be surrounded by a 400-metre buffer zone.
2. Companies wanting to develop a site would submit their plans, and staff would digitize the proposed development plans.
3. If the proposed development project fell within the buffer zone, it would be flagged and a referral report generated. The reports would be specific to the proponent, the individual Aboriginal community, and the individual sites. Importantly, no details regarding the type or exact location of the site would be provided to the proponent.
4. The proponent would then receive a text-based referral report listing the project, activity timelines, communities whose sites would potentially be disturbed by the project, and contact information for community liaisons.
5. Communities would receive the same text report identifying the industry project and activity timelines. However, in place of community contacts, the sites that would potentially be disturbed would be listed. Also, a map overlaying the development project and the potentially disturbed community sites would be provided. Only the individual community's own specific sites would be reported and mapped.
6. It would then be up to the proponent to contact the affected communities. The proponent and the communities would work together to mitigate any impact to traditional or cultural values or sites.

In this "one-window" system, the proponent would only have to submit a proposed development to one body, the Foothills Research Institute. The institute would then run the proposed development against all the known sites identified in the traditional cultural studies. This would save time and resources for both the proponents and the Aboriginal communities.

The system was successfully demonstrated in 2006 on the Hinton Wood Products FMA area. The model forest hosted a meeting with partners and potential partners in March 2007 to inform them about the program. No representatives of the provincial government attended.

Government of Alberta Position

The Government of Alberta released the final guidelines for First Nations consultation in November 2007. However, the guidelines did not address consultation requirements for Métis and non-status Aboriginal groups and communities.* Among the Aboriginal Involvement Program participants, only Sunchild had First Nation status.

Participants in the program realized that the referral system that they had jointly developed was unique and a departure from the status quo. They felt that the best way to

* In 2015, this omission was partially addressed with release of the *Government of Alberta's Policy on Consultation with Métis Settlements on Land and Natural Resource Management.* A broader Métis consultation policy was still under development in 2018.

demonstrate the system was to propose a pilot project to the Alberta government using this "one-window" system.

Brad Young, the program coordinator, gave a presentation on July 24, 2008, to the government's Aboriginal Consultation Coordination Group (ACCG) regarding the "one-window" referral process and potential pilot project. The ACCG was a cross-ministry group of representatives from the ministries of Energy, Transportation, Sustainable Resource Development, Justice, Environment, Infrastructure, Culture and Community Spirit, Municipal Affairs, and Aboriginal Relations. Young got backing from the group and funds to help implement the project. Based on this support, Sunchild, Foothills Ojibway, and Bighorn began additional traditional cultural studies in December 2008. The Aseniwuche Winewak Nation had withdrawn from the program in September 2008 to pursue its own consultation initiatives. Sunchild withdrew from the program in early 2009 because it was engaged in litigation against the government and resource companies.

The final draft of the *Foothills Aboriginal Engagement Pilot* was completed in spring 2009 and presented to 19 government representatives from five ministries at a workshop on June 12. The government subsequently decided not to endorse the project. The program was also unsuccessful in its request for federal funding, and Brad Young subsequently resigned as coordinator. By the end of the year, the program's funding was exhausted, and the fRI Board put the program on indefinite hold.

The decision by the government to not support the pilot project essentially ended the program. Without the government's support and influence, the "one-window" referral process would not be utilized by all companies in the pilot area and therefore would end up creating confusion for the government, industry, and Aboriginal communities. However, it must be noted that the program and the pilot project concept were almost dead by the time the government made its decision; the program's membership had dwindled to just two members, the Foothills Ojibway and the Bighorn Chiniki Nation, both without official First Nation status in the eyes of the provincial government.

Benefits and Lessons

Over the eight-year lifespan of the program, there were five traditional cultural studies undertaken—not all successfully—by five different Aboriginal communities: the Aseniwuche Winewak Nation, the Foothills Ojibway Society, the Sunchild First Nation, the Nakcowinewak Nation, and the Bighorn Chiniki Nation (through their Wapta mno-tha Society). These five studies identified 2,188 sites and trails. Sites included such features as gravesites, ceremonial sites, berry-picking areas, medicine-gathering areas, mineral licks, and cabins. Trails included walking trails, wagon trails, pack trails, horse trails, and historic trails. In addition, the research collected more than 850 documents such as written reports describing a site and its history or reports documenting interviews about a site. Documents also included photos of sites or audio files of individuals talking about particular sites. About two dozen elders were interviewed, and these interviews were translated and archived.

A total of $1.33 million was spent funding the Aboriginal Involvement Program over the course of its eight-year lifespan. This included funding to the participating Aboriginal communities to carry out their respective traditional cultural studies, to the model forest and the Foothills Research Institute for administration costs, and to Aboriginal communities to cover the costs of attending program meetings and conferences. The tangible benefits included the identification of traditional sites, the employment of Aboriginal people, and the development of a workable and mutually agreeable referral system. Intangibles may end up being a legacy as least as important as the actual deliverables. Intangible benefits of the program included, but were not limited to, the following:

- Getting to know each other – Working closely with a number of Aboriginal communities over an extended period of time allowed all participants to get

Aboriginal gravesite with "spirit houses" near Jarvis Lake in Switzer Provincial Park.

to know one another better. This allowed a better understanding of the issues facing all parties (government, Aboriginal communities, and industry) and consequently more willingness to work together to address these issues.

- Trust and respect – As the years went by, all the participants in the program, little by little, began to trust and respect one another more.
- Cataloguing and identification of finite traditional knowledge – Much of the information gathered through the traditional cultural studies came from interviews with elders. Often when an elder passes away, the traditional knowledge possessed by that elder dies as well. The funding for the studies meant that some information was gathered, stored, and archived that might otherwise have been lost.
- Contacts – Contacts and relationships were made that probably would not have been formed in the absence of the program.

Between 2002 and 2009, participants attended more than 50 program meetings, made presentations to various government and industry groups, attended relevant conferences and workshops, learned new skills around GPS and GIS, identified and catalogued traditional and cultural use sites, and developed a world-class referral system.

The Aboriginal Involvement Program showed what could be accomplished when industry, government, and Aboriginal communities work cooperatively to search for solutions to difficult problems. They developed a robust, effective, reliable, and respectful consultation and referral system that would identify and help to conserve traditional sites and values while still maintaining the sensitivity of those sites and addressing the issue of Aboriginal capacity. The differences between this process and a more typical government-led process were significant:

- Government consultation guidelines have mostly been created by government officials with only "input" from Aboriginal and industry representatives and, as a result, have not been well-supported by Aboriginal communities. The consultation process developed through the Aboriginal Involvement Program was created cooperatively and because of this was supported by all the participating parties.
- The process of arriving at a mutually acceptable referral and consultation system within the program was very slow in the making—eight years. This was a reflection of the reality of working through a very complicated issue with multiple parties, all of whom had slightly different ideas and interests.
- The issue of Aboriginal capacity is real. That is, Aboriginal communities need to have enough people available to review the volume of development referrals they receive. The referral process developed by the Aboriginal Involvement Program recognized this reality and tried to address it through an administrative fee system. Although government has recognized this issue to some extent (through a specific consultation capacity funding program), AIP participants said that the funding provided was insufficient to address the need.

> "We started up with the best of intentions and came up with this referral system that actually worked pretty damn well. It was going to connect developers with Aboriginal communities, not necessarily to exchange information, but exchange when you needed to talk something out. We had assembled a critical mass, and then we were going to run a pilot of an actual operational implementation of it. The government got cold feet. To this day, I don't know why the government got cold feet. They said, 'No, we're not proceeding.'… This was a way to make consultation more efficient and effective. The Aboriginal communities liked it. The industry liked it. Government initially liked it, and then it was, 'No, we don't like it any more.'" –Rick Bonar, fRI Research president, interview, 2015

Subsequent Aboriginal Involvement

In 2010, Alberta Aboriginal Relations provided $70,000 to implement a Traditional Ecological Knowledge Study, but the fRI Board decided not to proceed with the project and returned the funds. The Board suggested embedding future Aboriginal projects in other programs. In 2013, Melissa Pattison returned program data to the originating organizations, and no copies were retained.

As described in Chapter 3, the Aseniwuche Winewak Nation has worked with the Foothills Landscape Management Forum since 2012 to reduce caribou mortality on Highway 40 and increase public awareness of caribou recovery efforts.

Part B: Knowledge Exchange and Informed Decision Making

"Demonstration" was a major theme of the Canadian Model Forest Program, and it involved two overlapping activities. First, the federal government expected that the model forests would demonstrate to Canadians and the world that our forest lands were being managed sustainably. Simultaneously, the model forests would apply science to develop and deploy the best practices for sustainable forest management and share this knowledge with practitioners and decision makers. As a result, "communications and technology transfer" became core activities of the Foothills Model Forest, and this has continued under the Foothills Research Institute and fRI Research banners.

Over the first 25 years of this institution, the communications staff used almost every medium of print, electronic, and direct communication to reach audiences that ranged from schoolchildren to university professors, from forestry professionals to cabinet ministers, and from local communities to international forums. The methods have included newsletters, annual reports, press releases, websites, tours, expert speakers, workshops, conferences, posters, audio-visual presentations, brochures, short reports (also known as QuickNotes), long reports, academic theses, peer-reviewed publications, and books. In addition, a great deal of communication and technology transfer has occurred indirectly through Board members, partner organizations, research collaborations, and meetings with government officials and other stakeholders.

Translating knowledge into practice also led to the creation of multi-stakeholder organizations that use the administrative and GIS services of fRI Research and share its science-based stewardship goals. These are the Forest Growth Organization of Western Canada (FGrOW, described in Chapter 4), the Foothills Landscape Management Forum (FLMF, described in Chapter 3), and the Foothills Stream Crossing Partnership (FSCP, described in Chapter 5). The model forest also collaborated extensively with partners in the Yellowhead Ecosystem Working Group (YEWG), the *Northern East Slopes Strategy*, and the Highway 40 North Demonstration Project (see Chapter 3). In addition, the institute has operated the Alberta Land-use Knowledge Network since 2011 as a resource for the Alberta Land-use Framework.

Another knowledge-sharing initiative has been the Adaptive Forest Management History Program (later renamed the Forest History Program), which grew out of the need to understand how preceding conditions, events, policies, people, and actions led to the current state of the landscape and its management.

Continual changes in information technology and communications media added to the challenges throughout the first 25 years. After 1997, the Internet became an increasingly important tool for communications and knowledge transfer.

Historical Context

In 1900, a group of influential citizens from government and industry established the Canadian Forestry Association (CFA),[19] the nation's first and oldest conservation organization. Though emphasis has varied, it has continued to pursue the founding objectives:

- Advocate and encourage judicious methods in dealing with Canada's forests
- Awaken public interest in the dangers resulting from undue destruction of timber along rivers and streams
- Consider and recommend improvements regarding the development of forested public lands
- Promote tree planting in treeless areas, along streets, and in parks of villages, towns, and cities
- Collect and disseminate information on forestry issues for the benefit of the Canadian public

One notable project of the CFA from 1919 to 1973 was the Tree Planting Car, a joint project with the two national railways. The "travelling schoolhouse" criss-crossed the Prairies each summer, teaching farmers and townspeople to plant shelterbelts, fruit trees, and ornamentals. Its lecturers also gave educational presentations for schoolchildren. After 1933, it doubled as the Conservation Car and also toured parkland areas to promote the wise use of all renewable resources, including forests and trees. The railcar hosted more than 1.5 million visitors and travelled more than 400,000 kilometres.[20] Greg and Gladys Stevens joined this project in 1962 and continued by motor vehicle for another 10 years after the railway car was retired.

> "For 21 years, Greg, as Smokey the Bear, and Gladys, as Bertie Beaver, travelled across the prairies speaking to more than 600,000 children, teachers, parents,

The Canadian Forestry Association's Tree Planting Car, parked on a Canadian Pacific siding, 1924. *Glenbow Museum and Archives NA-1889-2*

> and other adults about conservation, the forest, and the need for its protection. Driving a truck, hauling a trailer, or being hauled in a forestry conservation railway car over thousands of miles of rail or pavement, gravel, mud, and streams, they survived many highway hazards, flipping over once, and three train wrecks. He [Greg] received numerous awards, including the Alberta Achievement Award, the Alberta Teachers Association Environmental and Outdoor Education Merit Award, the Calgary Board of Education Lamp of Learning Award, and was the first Western Canadian to receive the Tourism Industry Association of Canada Governor General's Conservation Award in 1983." –Obituary of Greg Stevens, *Winnipeg Free Press*, November 14, 2001[21]

Other CFA initiatives have included sponsoring forestry conferences, National Forestry Week, tree-planting programs, Envirothon* competitions, and Forest Capital of Canada events in various locations. The association published *The Canadian Forestry Journal* until 1959, and since 2000, it has produced the Canada's Forests Teaching Kit Series. In 1986, the provincial affiliate, the Alberta Forestry Association, published *Alberta Trees of Renown: An Honour Roll of Alberta Trees*.[22]

The CFA's professional counterpart, the Canadian Institute of Forestry (CIF), was founded in 1908, one year after the University of Toronto established Canada's first Faculty of Forestry.† The institute's journal, *The Forestry Chronicle*, began publication in 1925 and continues to provide a major means of peer-to-peer communication about policy issues, scientific research, and best practices in Canada. CIF conferences and regional section meetings provide forums for knowledge exchange among professional foresters in industry, academia, government, and non-government organizations. Since 2011, the CIF and CFA have pooled resources to develop and deliver educational programs and services.

From 1948 to 1973, the federal-provincial Eastern Rockies Forest Conservation Board undertook public education in the foothills region regarding wildfire risks, forestry, land use, water resources, and erosion. From 1958 to 1971, the provincial Department of Lands and Forests published a bimonthly magazine called *Land-Forest-Wildlife* (*Land-Forests-Parks-Wildlife* after 1967). W.H. (Bill) MacDonald, the department's "publicity officer," edited the magazine for nine years and also published booklets on specific topics such as fishing.[23] Various short-lived publications followed, but there were few government or non-government conservation publications of similar scope for general audiences until the Alb-

* Envirothon is an environmentally themed competition for high school students in Canada and the United States. The annual competition includes problem-solving presentations and written field tests. Winning provincial and state teams go on to a bi-national competition. The U.S. sponsor is the National Conservation Foundation. The competition dates back to a 1979 Environmental Olympics in Pennsylvania, and Canadian provinces became involved in 1992. Topics include environmental ecology, forestry, soils, land use, and wildlife.

† Canada's other faculties of forestry are at the University of New Brunswick (established 1908), Laval University (1912), University of British Columbia (1921), University of Alberta (1970), Lakehead University (1971), University of Moncton (1985), and University of Northern British Columbia (1993).

erta Conservation Association launched the semi-annual *Conservation* magazine in 2003.

At Hinton, one of the first employees of North Western Pulp & Power in 1955 was former forest ranger Robin Huth, who soon moved from timber cruising to managing public relations and later industrial relations. Huth joined the Hinton Chamber of Commerce and became president of the Home and School Association. He and the company's chief forester, Des Crossley, established the first Alberta chapter of the Junior Forest Wardens* to involve young people in forestry. Until he left the company in 1964, Huth wrote regular columns for the *Hinton Herald* newspaper.[24] He later wrote *Horses to Helicopters: Stories of the Alberta Forest Service*, published in 1980, and a memoir, *Outdoor Junkie*, published in 2006.

Crossley and other company foresters such as Jack Wright and Jim Clark were active in the Rocky Mountain Section of the CIF, and Crossley also served as national CIF president in 1966–1967. They advocated for creation of the Faculty of Forestry at the University of Alberta in 1970 and the establishment of the Forest Industry Lecture Series there in 1976–1977. Crossley produced more than 40 publications in his career, including an invited paper, "Application of Scientific Discoveries and Modern Technologies in Silviculture," for the Sixth World Forestry Congress in Madrid in 1966 and his major paper for the Alberta Forestry Association, "Toward a Vitalization of Canadian Forests," in 1985. He also served at various times on the Senate of the University of Alberta, the regional advisory board of the Canadian Forest Service, the advisory committee of the provincial Environmental Conservation Authority, the federal Arctic Land Use Research Advisory Council, and the Alberta Forest Service Research Advisory Council.

In 1986, the Government of Alberta embarked on an ambitious program to expand and modernize the province's forest industry. This effort was led from 1986 to 1993 by Al Brennan as executive director of a new Forest Industry Development Division in the Department of Forestry, Lands, and Wildlife (Department of Environmental Protection after 1992). Brennan's division produced publications, speeches, and presentations to inform the public and investors about the potential opportunities in Alberta's forest resources. The effort succeeded, but the new mills and forest management agreements (FMAs) also attracted unprecedented levels of attention and controversy.

Directors of the Alberta Forest Products Association (AFPA) recognized by 1990 that they could not rely solely on government public relations to assure the public about the industry's sustainability. The AFPA recruited Michael Voisin,† who had faced somewhat similar challenges while working in the Ontario chemical industry, to become the association's director of communications. Voisin's experience and advocacy helped AFPA member companies to develop the FOREST*CARE* Codes of Practice, a monitoring and improvement program backed by third-party certification. Soon after Voisin's arrival, the AFPA also partnered with the Friends of Environmental Education Society of Alberta (FEESA)‡ to produce educational materials and programs. At the same time, the association commissioned Robert Bott to write a 64-page educational booklet on the Alberta forest industry, *Our Growing Resource*, published in 1992.

In January 1991, the Rocky Mountain Section of CIF held a technical session in Calgary on the "Forestry-Media Relationship" to address the profession's public image. Two journalists and an academic told about 70 attendees that foresters needed "intelligent responses" to "help media separate fact from fiction." Voisin outlined the FOREST*CARE* Program, which was then being formulated, and said it would show the public and the media that the forest companies were "responsible and good corporate citizens."[25]

Later in 1991, FEESA tested the concept of 12-day professional development institutes for teachers. With support from government and industry, one institute focused on forestry and the other on water issues. The institutes gave teachers first-hand exposure to industrial operations and introduced them to experts and practitioners from industry, government, academia, and non-government organizations. This approach gained financial backing in 1992 from the Canada-Alberta Partnership Agreement in Forestry, which led to a series

* The Junior Forest Wardens originated in British Columbia in 1930, where they were initially called Junior Forest Fire Wardens. The outdoor-oriented program, for youth aged 6 to 18, was administered by the provincial government in Alberta from 1961 to 2007. The national and provincial organizations continue today.

† Michael Voisin left the AFPA in 1994 to become director of communications for Weldwood Canada at the corporate head office in Vancouver. In that position, until 1998, he continued to play an active role in communications for the company's Hinton operation, the model forest, and the Alberta forest industry. After a stint in Ontario, he returned to Alberta in 2003 as director of business and public affairs for Alberta-Pacific Forest Industries. He retired in 2015.

‡ FEESA was founded in 1985 by educator Jim Martin (1949–2016) to provide teachers and students with "bias-balanced" knowledge of environmental issues. The organization was known as FEESA, An Environmental Education Society, until 2004, when its name changed to Inside Education. Martin served as executive director until 2005, after which he founded and led the Centre for Environment-Economy Learning. In 2011, he received an Alberta Emerald Award for individual commitment to environmental protection.

of Forestry Education Institutes in 1992, 1993, and 1994. The institute programs included sessions in Hinton with participants from Weldwood and the model forest. Participants included school teachers, administrators, consultants, post-secondary instructors, and educational staff from government and industry. In addition, the Canada-Alberta Partnership provided funding for FEESA to produce three educational videos (two 60-minute and one 45-minute) on forestry-related issues.

Communications and Technology Transfer

The controversies surrounding Alberta's forestry-related developments in the early 1990s paralleled those occurring across Canada. These public and political concerns were significant drivers of the federal *Green Plan*, the Model Forest Program, and the creation of the Foothills Forest in 1992 (as described in Chapter 1). This background explains why communications and technology transfer were considered high priorities as the model forest launched. However, it took time for research and demonstration programs to take shape and produce results. The communications and knowledge-sharing efforts became more focused and effective as research progressed and the institute matured; this was aided by rapid development of the Internet after the model forest's first website launched in 1997.

The successful Foothills Forest proposal in 1992 envisioned a large-scale "public awareness and education" component as well as technology transfer and training through the Forest Technology School and other institutions. Some of the goals proved overly ambitious, due in part to the changing priorities of the Forest Technology School, renamed the Environmental Training Centre in 1993 and known as the Hinton Training Centre since 2003. The school continued to provide facilities for the model forest and fRI Research, but the envisioned technology-transfer role did not go much beyond some early GIS training and later work with the Grizzly Bear Program. The school also rejected using its Cache Percotte forest south of Hinton as a demonstration site.

Communications is a core service activity distinct from the applied research programs, although the communications group has conducted some research at times. There have been various titles, sometimes used interchangeably: Communications and Technology Transfer Program, Communications and Extension Program, Communications Program, and Communications Services. Achievements have included:

- Producing publications such as annual reports, newsletters, and news releases
- Working with FEESA and Inside Education on programs for teachers and students
- Providing public education for area residents and tourists

Display at the first model forest open house, 1994.

- Organizing conferences, meetings, and tours for politicians, professionals, and others
- Assisting research programs with their publications, presentations, courses, and seminars
- Establishing and maintaining relations with Canadian and international model forests, the CFS, the Government of Alberta, and other government, industry, and professional organizations
- Facilitating information exchange among the Board, partners, researchers, and stakeholders
- Creating and updating the website, including several major revisions since 1997
- Extending outreach to executives in industry and government

Pat Golec, Sundance woodlands manager, in a Foothills Growth and Yield Association reforestation plot, 2008.

The Communications Program's emphasis on education and outreach—a major part of the federal Model Forest Program—diminished after the establishment of fRI as an independent institute. The focus shifted almost exclusively to communication aimed at practitioners, scientists, and decision makers in industry, government, and academia. Kevin van Tighem, former model forest Board chair (2002–2004), said in his 2015 questionnaire response that keeping the public informed is a vital component of scientific research.

> "I do think we were right to have a program emphasis on public communications, not just tech transfer communications, but I think we had a structural/locational challenge we couldn't overcome. An informed public is critical to social licence for innovation and improved practices—if those who elect politicians, make spending decisions, and set public policy priorities are uninformed or misinformed, then the learnings from the Foothills Model Forest or other applied science programs have little hope of being translated into improved practice." – Kevin van Tighem, questionnaire response, 2015

Getting Started

Pat Golec,* the first communications coordinator, was a forester and was given the title of "technology transfer officer." Golec produced the first five-year communications plan and developed quarterly newsletters for the public (*FootNotes*) and for the model forest's partners (*InForM*, short for Integrated Forest Resource Management). She led a significant educational effort, including a connection with FEESA, which brought one of its teachers' institutes to Hinton in 1993. During this period, the model forest also brought local high school students to the Cache Percotte forest to get insights from Northern Alberta Institute of Technology (NAIT) forestry students.

As part of her technology-transfer role, Golec was involved in establishing the partnership with the Chihuahua Model Forest (see Chapter 2). She also worked on developing an ecotourism component for the Foothills Forest based on wildlife viewing and habitat interpretation. Fox Creek Development Association prepared an ecotourism report, but the subsequent request to implement the program was rejected because the Board considered it a commercial venture outside the model forest mandate.

One successful early initiative of the model forest was the Speakers Bureau, composed of foresters, forest technicians, biologists, other scientists, and representatives of partners in the Foothills Forest. The speakers made 47 presentations in 1993 and 1994 to audiences that ranged from school classes to tourism groups to oil conferences. Among the audiences were the Russian Parks Service, the Hinton Fish and Game Association, the Hinton Amateur Radio Association, Junior Forest Wardens, a German media group, and a Chinese delegation.

* Pat Golec left the model forest in 1994 to join Sundance Forest Industries in Edson, eventually rising to the position of woodlands manager. After Sundance was bought by West Fraser in 2012, she returned to Hinton as forestry manager. She retired in 2016.

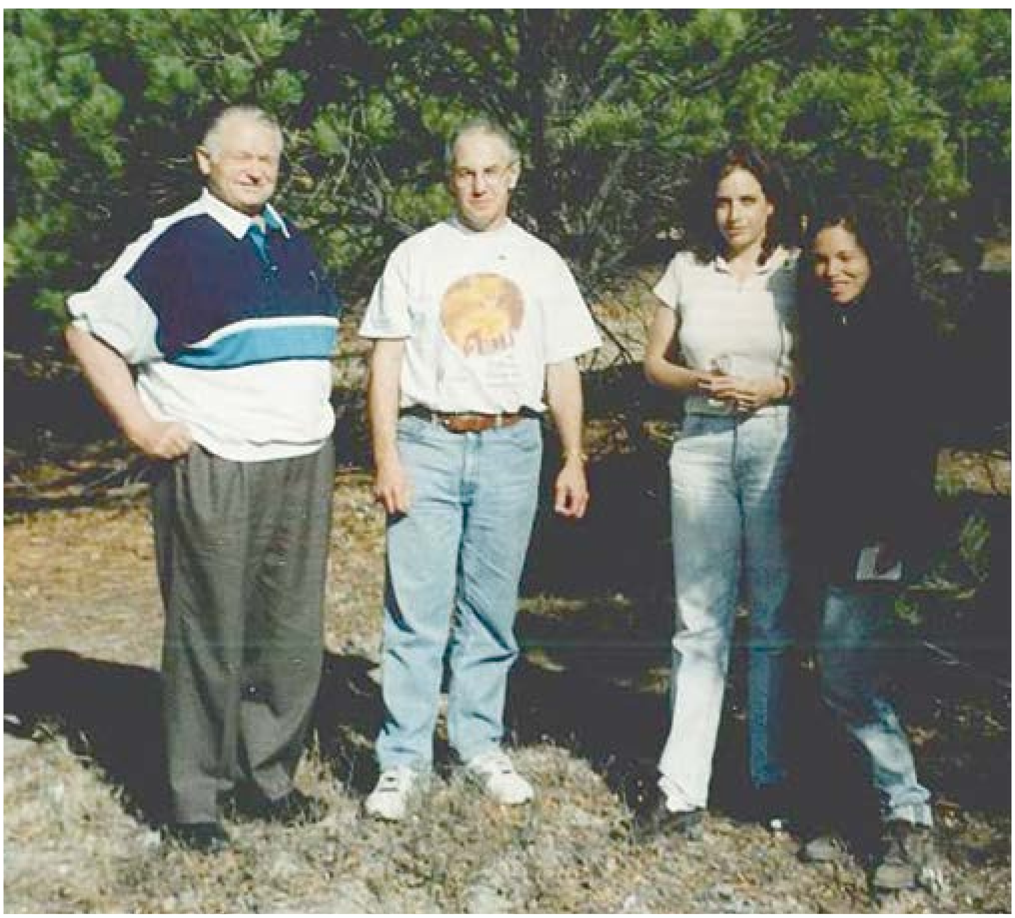
Part of communications was arranging visits and tours. Notable visitors in the early years included Joe Clark, MP for Yellowhead; Frank Oberle, federal forestry minister; Titus Allooloo, minister of natural resources for the Northwest Territories and chair of the Canadian Council of Forest Ministers; a 14-member German parliamentary commission; and representatives of the two Mexican model forests. Foothills Forest also held the first of a series of annual open-house events in 1994 at the Parks West Mall in Hinton.

The agreement adding Jasper National Park to the model forest in 1995 broadened the opportunities for public education through displays, publications, presentations, and events. Anne McLellan, federal minister of natural resources, and Ty Lund, Alberta minister of environmental protection, attended the signing ceremony for the agreement. Minister Lund, who was a strong advocate for the model forest, also joined a delegation that toured the Chihuahua Model Forest in 1996.

Golec left the model forest after two years and was replaced by Bryan Millar, a biologist, who continued the communications and educational initiatives in 1995. However, he resigned in April 1996 to accept another position.

By the end of the first four years, the model forest had provided more than 100 formal tours and presentations, which were generally well received. During this period, it got a moderate amount of media coverage, locally and in Edmonton, and it also invested in print advertising. However, public opinion surveys in 1994 and 1995 and a consultant's report in early 1996 found that awareness of the model forest remained low and that it was not having much impact on the views of the intended audiences.[26] With advice from Mike Voisin at Weldwood, the Board reviewed the Communications Program in 1996 and hired a new coordinator, Hilary McMeekin, who had a degree in communications and had been working in public relations in Calgary. The challenges she faced were considerable, according to another external evaluation conducted during 1996.

Minister Ty Lund, along with Canadian Agent Cliff Mathies and Chihuahua Model Forest communications staff, 1996.



> "Thus far, the Communications Program has generated 'soft' results and has not been as effective as had initially been expected in demonstrating the diversity of expertise, technology, and people available to the Foothills Model Forest who can be brought together to demonstrate to the general public the relevance of the forest and its resources to the quality of their lives, particularly their economic and social well-being. It also has not taken advantage of the opportunity of addressing the concerns of special interest groups who have been more vocal in their demands for a greater and more meaningful say in resource use and management decisions or other members of the public who are skeptical about resource management. Moreover, attempts should also have been made to improve internal communications. Effective communication has to be both external and internal to the Foothills Model Forest. The model forest has successfully developed a broad array of partners, sponsors, and stakeholders, some of whom have different interests, expectations, visions, and aspirations with respect to forest resource use and management. These differences inevitably result in difficulties in the process of consensus building. The activities would benefit by focusing more adequately on the opportunities of consolidating, building upon, and communicating those interests, visions, and expectations to the full partnership in an attempt to improve internal communications, accommodation, and consensus building." –Hugh Walker, *Evaluation of the Foothills Model Forest*, November 1996

McMeekin described the program then as "getting the fundamental tools together."[27] She put an increased emphasis on communications with partners and stakeholders and established a formal partnership with FEESA. Two FEESA institutes, involving a total of 55 teachers, came to the model forest in 1997. This relationship continued in the following years and reached an estimated 540 teachers (potentially influencing 30,000 students). The model forest also provided experts and expertise for program development as FEESA developed EduKits and other resources for elementary and high school students, including information on the pileated woodpecker, woodland caribou, long-toed salamander, and red squirrel derived from model forest research. There was also a *Trees and Forest EduKit.*

McMeekin began development of the FMF.ab.ca website, which was launched in October 1997. However, she only stayed in Hinton for a year, until the summer of 1997, when she returned to Calgary to get married and resume her career there. The Board launched a search for another communications professional but found little interest, mainly due to Hinton's location and competition from the oil and gas sector in Alberta. One successful candidate, recruited from Vancouver, showed up in January 1998 and left after six days. Jasper National Park loaned education specialist Sue Wolff, on a part-time basis, to assist the model forest during and after the search.

With no qualified applicants stepping forward, the Board then decided to take a chance by hiring Lisa Risvold, who had a communications degree from the University of Calgary but had been working in other fields since graduation. Although she lacked public relations experience, Risvold had deep roots in the community. She was born and raised in Hinton, and her father was then mayor, director of the Environmental Training Centre, and chair of the model forest Board.

Risvold dived into the job and soon got up to speed with assistance from Wolff, model forest staff, and others such as Patsy Vik in the Edson office of Alberta Environment. Although Risvold left to pursue another job opportunity between 2001 and 2003, she returned and again led the program until 2008 (with some time off for maternity leave in 2007). Other communications staff in this era included Fiona Ragan-Braun, Anna Kauffman, Greg Nelson, Fran Hanington, and Donna LeLacheur; environmental educator Joan Simonton also worked on contract with the model forest and fRI from 2006 to 2012.

Communications staff from sponsoring partners provided additional help and advice. The list of tasks included:

- Internal relations
- Education relations
- Community relations
- Media relations
- Partner relations
- Network relations (national and international model forests)
- Government relations
- Technology transfer
- Website maintenance and development

Extending the Reach

"We now are going to focus on what we have done, not who we are," Jeff Anderson, then representing Jasper National Park, said during a discussion of communications at the Board's June 1998 meeting. "The time has come to really focus on what we have learned and how it is being applied to the practice of sustainable forest management." The renewed federal mandate of the Model Forest Program called on them to "demonstrate practical application" and "promote the dissemination of the results and knowledge … at local, national, and international levels." The major increase in provincial financial support in 1998, offsetting diminished federal funding, also made it important to demonstrate the "value proposition" for Albertans.

As the model forest moved into Phase II, more research programs reached the stage where there was real news to report. Wildlife programs helped to address issues raised during environmental hearings on the Cheviot coal mine proposal. The scientific findings generated high levels of interest from media, the public, and non-government organizations; the research was also highly valued by partners in industry, government, and academia. Natural disturbance research gained profile as it was applied in Jasper National Park's prescribed burning and in Weldwood's 1999 *Forest Management Plan*. Socio-economic, climate change, and forestry programs had more specialized audiences, but the products were widely cited and used at every level from the local to the international.

Watershed biologist Rich McCleary leading a school class along the Hardisty Creek Trail.

By the end of 2000, the model forest website had received 650,000 visits since 1997, and it was estimated that its information reached 1 million people in 1999–2000 through print ads, presentations, newsletters, annual reports, summer interpretive programs, and posters. These efforts led to about 1,200 requests for additional information. The model forest worked with Alberta Environment on the Fish in Schools (FinS) Program, aimed at teaching elementary school children about fish and aquatic stewardship.

Hinton was named Alberta's Forestry Capital for 2000, and the model forest helped create the major legacy, an interpretive park adjacent to Parks West Mall. Member of the Legislative Assembly Ivan Strang, who believed strongly in the work of the model forest and promoted it tirelessly to his legislature colleagues, brought Sustainable Resource Development Minister Mike Cardinal and Environment Minister Halvar Johnston for a two-day visit to Weldwood and the model forest, which included presentations and a helicopter tour. Lisa Risvold and General Manager Mark Storie represented the model forest.

From 1999 onwards, the Grizzly Bear Program established itself as the "poster child" for applied research, and program leader Gord Stenhouse was a good communicator with both media and technical audiences. For many in the public, the species was emblematic of wilderness, and the research had important management implications for government and industry. Among scientists, the program was considered a world leader in the field.

In July 2001, the model forest partnered with Jasper National Park and the Jasper Yellowhead Museum and Archives to present "A Terrible Beauty," a grizzly bear exhibit seen by about 5,500 people. This was part of the "Year of the Bear" initiative. This exhibit won the Jasper National Park Heritage Communications Award. Renamed "Within Growling Distance," the exhibit went on tour in Alberta and other parts of Canada in 2003. Interpretive programs on grizzly bear research were also featured at Whistlers Campground during the summer; the model forest tried a natural disturbance presentation at the campground with less success. The summer interpretive presentations were extended to Switzer Provincial Park in 2004.

In 2002, when poachers killed a grizzly bear known to area residents as "Mary" and her cubs, the incident got wide media coverage and brought national attention to the model forest Grizzly Bear Program, including a CBC television documentary. Also in 2000, a Japanese television crew visited the model forest as part of their *Pole to Pole* documentary.

The external evaluation of Phase II communications in 2002 noted the wide range of

Grizzly bear exhibit at the Jasper Yellowhead Museum and Archives.

outreach efforts, and its main recommendation going forward was to put more effort into reaching urban audiences. The communications plan for Phase III included the continuation of most initiatives with an increased emphasis on practitioners in industry and government. In Phase III (2002–2007), each research program was required to devote 10 percent of its budget to technology transfer. The Natural Disturbance, Water, and Forestry Programs had already had considerable success with seminars and workshops. Risvold said she found that face-to-face communication was by far the most effective, while print advertising was the least effective.[28]

> "For us, the Internet and our website, that was the foundation of the communications and the transfer program because it was the most economical. It just made getting information easy for people. It also allowed us to monitor and evaluate the effectiveness of our communications and the transfer program through website hits and going and seeing what information people are downloading. If we put out the newsletter and we're directing people back to our website, are they going back to our website for the more detailed research report? You could see where visitors were coming from. You could see over time the website hits just continued to increase. We had an email distribution list, when that was new. Face-to-face communication—like tours, whether it was with a teacher or foresters or government policy-makers—is definitely the most effective way of communicating. But the website is the most economical. It works. It is the most effective. If you could take a million people on a tour of the model forest every year, you would want to do that. But because that's not practical, the website gave us that opportunity to interact with people. We also didn't want to inundate people. We were very thoughtful as to how often should we be reaching out to people. We didn't want to spam. We wanted to remain relevant. There was a lot of thought given to that." –Lisa Risvold, interview, 2016

Since 2001, David Andison had been reaching a key audience of practitioners with his Natural Disturbance QuickNotes—short, application-oriented, bimonthly research summaries. The notes were very popular with users, and their distribution extended across Canada and into the United States; they were used as teaching material and as reference documents for policy and guideline development in several provinces. Other programs were encouraged to follow suit, but results varied, with no program coming close to Andison's output and reach. Some researchers preferred to put their efforts into full-length reports and articles, which could include their detailed methodology and were more suited to academic audiences.

Communication with partners and government agencies took on more importance in Phase II and Phase III as research extended beyond the model forest land base in areas such as grizzly bears, caribou, natural disturbance, fire management, water, and forest growth and yield. Initiatives such as the Highway 40 North Demonstration Project and the *Northern East Slopes Strategy* involved multiple jurisdictions and industrial participants.

One example of "research into practice" was the evolution of the Water Program from conference presentations and workshops to demonstration projects to the creation of the Foothills Stream Crossing Partnership. Risvold said a highlight was the three-day Forest Land-Fish II Conference—Ecosystem Stewardship through Collaboration, held in Edmonton in April 2004, co-sponsored and organized by the model forest and the Canadian Model Forest Network. The conference included more than 60 scientific papers and posters, and the proceedings were made available on the Internet.

Risvold said workshops were a very effective way to transfer knowledge in the more technical fields such as forest genetics and growth and yield. "We did outreach, so we interviewed people in advance of formalizing the workshop or the conference agenda to get

Lisa Risvold's model forest van advertised the Model Forest Program wherever it went.

feedback prior," she recalled. "We just wanted to make sure that it was going to be very meaningful and effective, that it was worth people's time." She said that it was also important to have materials developed as follow-up, items that were "actionable" and could be put into practice. Kevin van Tighem, Board chair from 2002 to 2004, said there was strong support for communications during this period.

> "During the time I was involved in the FMF, it had a high profile because the Board of Directors saw the importance of communication with the public and politicians. They realized political decisions occurred which may have an effect on resource development, and some of these decisions are influenced by stakeholders and not just based on science. The FMF had an excellent reputation and, because of the value placed on influencing policy, the FMF had excellent representation by directors on various government committees and multi-stakeholder consultations." –Kevin van Tighem, questionnaire response, 2015

The growing international reputation of the model forest was evident in the number of international visitors in 2004, including:

- Russian representatives from the Komi Model Forest Project and the Russian Academy of Sciences
- A Japanese delegation touring Western Canada through the Canadian Council of Forest Ministers International Forestry Partnership Program
- Cuban foresters from government and research institutes
- American and Canadian foresters and students attending the annual general meeting and convention of the CIF and the Society of American Foresters
- The Montréal Process Working Group, which represented 12 countries

In 2004, the Natural Disturbance Program partnered with the Saskatchewan Institute of Applied Science and Technology to offer a "primer" in natural disturbance; in the following year, Risvold worked with Andison and the institute to expand this into a short course entitled "Introduction to Natural Disturbance." The program's research had already had a significant impact on Saskatchewan's early adoption of landscape-level harvest planning (see Chapter 3). This was an example of model forest research extending beyond provincial

Lisa Risvold holds a bull trout from the Mackenzie Gap fish trap monitoring project, circa 2000.

borders—an increasing trend as programs matured and produced results with applications far outside the land base. The course was also delivered in Edmonton in 2007.

In 2004, the model forest newsletter shifted away from being a "newsy" product targeted at a general audience and became a knowledge-transfer tool, providing readers with highlights of programs, research, and directions in which the organization was headed.

The Standing Policy Committee of the Alberta Legislative Assembly toured the model forest in 2005. The Government of Alberta also invited the model forest to take part in a provincial presentation at the Smithsonian Folklife Festival in Washington, D.C.

In 2006, the Communications and Extension Program launched the Executive Series to create better linkage between scientists and decision makers. Over the next three years, the Executive Series facilitated meetings between the model forest's program leaders and senior people in industry, government, and non-government organizations.

The final annual report of the model forest era, for the year 2006–2007, concluded that the knowledge and tools developed at the Foothills Model Forest were used to empower resource managers and influence public and corporate policy. It said that this commitment would continue in the next phase of the program, to address the ever-increasing needs of the existing and expanding partnerships. By this time, the Communications and Extension Program had delivered successful interpretive programs to more than 12,000 people in partnership with Jasper National Park and William A. Switzer Provincial Park. A Geographic Information Systems (GIS) Day was being presented to six school classes annually.

Looking back, Risvold said that one of the model forest's best investments was the partnership with FEESA (Inside Education after 2005).

> "The teacher tours were hugely effective. If you want to reach the public, investing in tours for teachers, providing them with resources that they can easily use in their classroom because they perfectly match the Alberta curriculum, getting them out into the field … it was high in changing attitudes—180 degrees. The uptake was that 75 percent to 90 percent of teachers then used that information when they were in their classrooms, year in and year out. For $10,000 or $15,000, if you look at the multiplier effect of that, it was hugely impactful and worth every dime." –Lisa Risvold, interview, 2016

Focus on Partners

When the Foothills Model Forest became the Foothills Research Institute in 2008, it completed a transition that had been underway for several years to a primary focus on the needs of the partners who paid for the research and used the results. Public education, mainly through summer campground presentations, continued until 2012. The five-year business plan for Phase IV (2007–2012) included a commitment to "providing science-based tools and knowledge [that are] understandable and available to natural resource managers, policy makers, and the public" and "collaboration through open communication." There would be an emphasis on technology transfer and "informed decision making."

Lisa Risvold stayed through the transition, including developing a new logo and beginning work on a new website, before departing for a job with an area coal company. She was replaced in the fall of 2008 by Sean Kinney, who came from a background in business development and electronic communication. Science writer Ben Williamson joined the communications team in 2015. Terri McHugh became the communications manager when Kinney left in 2016.

The fRI website, which had been upgraded and relaunched in September 2009, was given another major update and revision in 2013. The model forest also undertook a project around then to create a library and digitize documents from the early years of the model forest. Kinney said he looked for cost-effective ways to get knowledge to partners, such as running webinars or organizing field tours. More of the communications work now involves

Model forest interpreter Greg Nelson carried the model forest's programs into the Whistlers (Jasper) and Gregg Lake (Switzer) parks campgrounds for several summers, a very popular attraction.

An open house to celebrate the beginning of the 2012–2017 phase of the program was a good excuse to showcase the programs. It also brought the program leads together for this photo opportunity. Back row L–R: Gord Stenhouse (Grizzly Bear), Axel Anderson (Water), Bob Udell (Forest History), David Andison (Healthy Landscapes), and Keith McClain (Mountain Pine Beetle). Front row L–R: Wayne Thorp (FLMF), Sharon Meredith (FGYA), Debbie Mucha (GIS), and Kirby Wright (LUKN).

doing video interviews and packaging presentations for web delivery. He cited examples such as the first-time live-streaming of a workshop for the Forest Growth Organization of Western Canada that ran simultaneously in Grande Prairie, Slave Lake, and Edmonton. "We didn't have the budget to test things out, and it worked," he said. "It's pretty cool to be working for an organization where we had the flexibility to do these sorts of things." He also devoted quite a bit of effort to innovations in internal communications.

Soon after the shift from model forest to institute, partners began pushing for more peer-reviewed publications, and there was a move away from shorter reports and QuickNotes. Various explanations have been offered for this trend. One possible reason is the credibility that peer-reviewed literature appears to have in regulatory and legal proceedings. Dave Andison, in particular, was disappointed in the change because he felt the QuickNotes were of more practical use to the people who could put the knowledge into practice. Terri McHugh said in 2017 that Communications Services was working on ways to address both needs, aided by the writing skills of Ben Williamson.[29] Sharon Meredith, director of the Forest Growth Organization of Western Canada, also highlighted the need for communications between researchers and users.

> "I think that the FGYA [Foothills Growth and Yield Association] has played a really important role in providing information about managed stands that has been lacking in Alberta and has done it in a way that is bringing important tools to the hands of practitioners to change forest management practices. Part of the reason, in my view, that people so often fall short in making that next step of communicating to practitioners is because the people who are doing the research don't understand what the practitioners want to know. From our perspective, it's critical that we meet the needs of industry. We won't exist if we're not doing that."
> –Sharon Meredith, interview, 2016

One novel combination of technology, science, and public involvement is the Scat App designed by the Communications Program for the Grizzly Bear Program. Residents and visitors in Jasper National Park can volunteer as Scat Seekers and are given kits containing little vials with barcode labels, rubber gloves, and collection sticks. When they spot some bear scat, they put a sample in the vial and scan it with their smartphone, which logs the location, date, time, and barcode. The data go into the system, and the sample is sent to a lab in Norway for DNA analysis. The citizen science is both educational and a cheap way to gather data.

Another recent innovation has been the "value statements" for partners and stakeholders. These are one-page, two-sided summaries: *Value for Forestry*, *Value for Government*, and *Value for Energy*. Each has brief descriptions of the programs and products relevant to that sector, along with some numbers about participants and funding, and the resulting bottom-line benefit. For example, the forestry and energy sectors gain "social licence," while government improves "stewardship." In addition, the annual reports remain a primary means of presenting programs and directions to a wide variety of audiences.

Former Board chair and Hinton mayor Ross Risvold,* in his 2015 questionnaire response, said that stepping away from a public communications effort was a "big mistake."

> "If you don't have successful communications, you are starting to act like fish in a bowl, and it will be too late to recover when you want and need public and political support. It's like cutting your nose off and very short-sighted. Public and political support doesn't turn off and on like a light switch. Environmental NGOs understand and are very successful in their communication and government relations. This isn't speculation but fact. Scientists and many resource individuals by nature don't think this is critical. They seem to prefer to stand in a circle

* Ross Risvold was a founder of the Foothills Model Forest, and he went on to become mayor of Hinton and a major force working with elected officials from Canadian resource, remote, and rural (R3) communities. He was involved and served on various panels provincially, nationally, and internationally on issues such as climate change, resource and environmental management, and the sustainability of communities.

> and pat each other on the back and say what a good job we do. This is a critical mistake. As I've said previously, you can't operate in a vacuum, and if you do, it's at your peril. Again, look at environmental NGOs' success in communication and influencing—very successful, even though much of the information they use is rhetorical science. You don't have to like it, but that's the way it is." –Ross Risvold, questionnaire response, 2015

Land-use Knowledge Network (LuKN)

The Land-use Knowledge Network (LuKN) was established to serve as a knowledge resource for the provincial Land-use Framework. Sean Kinney and contractor Kirby Wright began work on the Land-use Knowledge Network plan in 2009, received provincial funding in 2010, and brought it online in 2011, with Wright leading the program and Neil MacAlpine taking on the task of building relationships for the network around Alberta. Terri McHugh was hired in 2011 to be the content coordinator for the website. McHugh, who had degrees in history and human ecology, as well as work experience in museums and libraries, took over leadership of the program from Wright in 2013. She said the network was a good fit for fRI Research.

> "The Land-use Knowledge Network is all about providing an easy-access information tool for people. I think it was a way of not only fulfilling the goals of the Alberta Land-use Knowledge Network in terms of what the Land-use Framework required of it, but also finding ways to take that means of communication and applying it to fRI Research. In the end, that's what happened. The structure of the LuKN website became the backbone of the new fRI Research website, with an emphasis on strong content cataloguing in the background.
>
> "The Alberta Land-use Knowledge Network definitely is much more like a public knowledge library. One of the things that's quite different about what we do is we don't store the information itself. We point people to where the information lives, but we don't have an electronic version of every paper that we have catalogued on the site. We just provide a link to its permanent electronic home. It is intended to be information that anybody who is involved in land use can access. It's not necessarily highly technical. It could be very simple. It could be public-oriented, to explain to landowners how a particular policy might affect them. Or some very specific information about reclamation, for example, that NAIT [the Northern Alberta Institute of Technology] might have created. It's definitely more public-oriented." –Terri McHugh, interview, 2016

A major project of the LuKN was the creation and management of "Growing Insights," a massive open online course (MOOC) about urban agriculture that the LuKN created and ran. It ran twice, once for anyone who was interested, and once specifically directed at the municipal planners in the province through their professional organization, the Alberta Professional Planners Institute (APPI). This was a successful experiment in looking for new ways to share high-quality information with a wide range of people and build connections among practitioners around the province.

One thing that did not work out was making the network revenue generating. People expected free access to information, and the network had to stay that way. As a result, it is a very frugal operation, but it has won a loyal following among users. Groups such as agrologists and municipal planners really appreciate someone publicizing their conferences and making videos available to a wider audience.

A digital billboard/banner for "Growing Insights," used in newsletters and on the homepage of the website hosting the course.

Adaptive Forest Management History

The Forest History Program at fRI Research had its roots in a speech by Bob Udell, "Building AAC on a Tenured FMA," at the Grande Prairie Forestry Show in 1995. At the end of the speech, Professor Les Reed of the University of British Columbia (a former assistant deputy minister of Forestry Canada) rose to ask why no one to date had set forward the remarkable legacy of forest management on the industrial forest at Hinton. In 1996, Weldwood launched a project to record the natural and management history of its Hinton forest management agreement area, with Peter Murphy and Bob Udell as lead authors and Bob Stevenson as photo historian. At the suggestion of Foothills Model Forest Board member Dennis Quintilio, the project moved over to the model forest in 1997 and was expanded to add more reports and to encompass the entire model forest land base. Bob Bott joined the writing team for what was to become the first published book in the Forest History series.

Program lead for the Forest History Program has been Bob Udell, former president of the Foothills Model Forest (1992–2005). To date, the program has produced a series of reports, books, and other media covering all aspects of sustainable forest management, drawing on the history of the original model forest land base.

The program also helped sponsor a 1999 repeat photography project of M.P. Bridgland's 1915 photographic survey of Jasper National Park, which has been widely used by historians and geographers. The success of this project encouraged another Bridgland repeat

The 2004 CIF/SAF plenary speakers. L–R: Charles Kay, Char Miller, Tom Maccagno, Cliff White, Bob Udell (moderator), and Peter Murphy.

photography project in the Waterton Lakes and Upper Red Deer River regions. This work continues and is known as the Mountain Legacy Project. The Foothills Model Forest and fRI Research also produced a comprehensive series of maps to support the various reports in the series.

In October 2004, the Rocky Mountain Section of the CIF hosted the Joint Annual Meeting and Convention of the CIF and the Society of American Foresters, “One Forest Under Two Flags,” with more than 1,500 delegates. The Forest History Program organized, and Bob Udell moderated, a plenary session called “The Roots of the Present Lie Deep in the Past,” with eminent speakers from both Canada and the United States: Peter Murphy (UofA, Forest History Society), Cliff White (Banff National Park), Tom Maccagno (Alberta Métis historian), Charles Kay (Utah State University), and Char Miller (Trinity University, on leave while writing the 100-year history of the U.S. Forest Service). A voice-over slide presentation is available on the fRI Research website.

The Program’s Publications to Date

The Forest History Program has produced a variety of reports and books since work began in 1996.

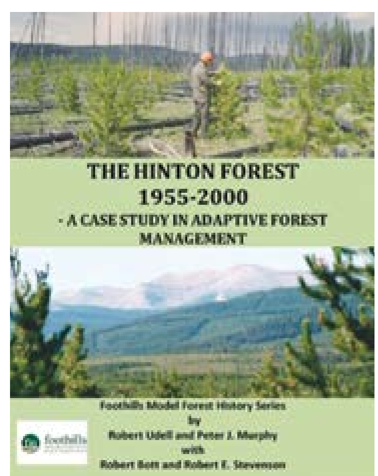
The Development of Adaptive Management in the Protected Areas of the Foothills Model Forest by Michael den Otter (2000, Foothills Model Forest website). In 1999, the model forest supported Michael den Otter in his master’s thesis under Professor Marty Luckert at the University of Alberta. Peter Murphy served on the supervision committee, and Bob Udell was a liaison link to the FMF. Den Otter examined the evolution of adaptive forest management in the parks and protected areas of the Foothills Model Forest, and upon completion of his thesis in 2000, he adapted it for publication.

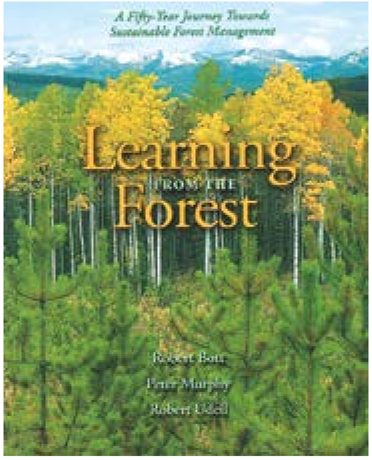
He examined the histories of Jasper National Park, Switzer Provincial Park, and Willmore Wilderness Park, and the evolution of adaptive management within each managing agency.

To support this study, a map series showing the boundary changes of Jasper and Willmore parks was produced.

The Evolution of the Forest Management Agreements by Peter Murphy and Martin Luckert (2002, Foothills Model Forest website). Eric Huestis and Reg Loomis of the Alberta Forest Service envisaged the concept of forest management agreements as early as 1949, and the Hinton operation was the first in Alberta to capitalize on this opportunity. FMAs are periodically renegotiated, and by examining their evolution and change over time, insight is gained into the changing views of society and regulators on how forests should be managed and what the appropriate rights and responsibilities of tenure holders should be. Using a common set of criteria for comparison, Peter Murphy and Marty Luckert examined this evolution using the series of forest management agreements and amendments from 1952 to 1995.

The Hinton Forest: A Case Study in Adaptive Forest Management 1955–2000 by Peter Murphy and R.W. Udell, with Robert Bott and Robert Stevenson (2002, Foothills Model Forest website; 2014, ebook on the Foothills Research Institute website). In 2002, Bob Udell, Peter Murphy, and Bob Stevenson wrote this comprehensive review of the Forest Management Program at Hinton from its beginnings in 1955 to the 1999 forest management plan. The evolution of forest management, from sustained yield to sustainable management of all values inherent in the forest, is described through the comparison of planning, practice, and adaptation from a wide range of perspectives—inventory, silviculture, multiple values and uses, protection, research, harvesting, and the planning and management cycle for sustainable forest management. Originally posted on the model forest website as a series of chapters, the book was reworked and partially updated in 2013, enhanced with photos, and made available in its entirety on the fRI website.





Learning from the Forest: A Fifty-Year Journey Towards Sustainable Forest Management by Robert Bott, Peter Murphy, and Robert Udell, with Robert Stevenson (2003, Fifth House Publishing; 2014, ebook on the fRI Research website). In 2003, the Forest History Program, together with Fifth House Publishing, produced this book for practitioners, decision makers, university students, and others interested in land management. The book examines the antecedents, scientific basis for, and evolution of the Forest Management Program on the West Fraser Hinton Forest, providing an in-depth discussion of the range of forestry practices, including inventory, silviculture, multiple values and uses, protection, research (including Foothills Model Forest), harvesting, and the planning and management cycle for sustainable forest management.

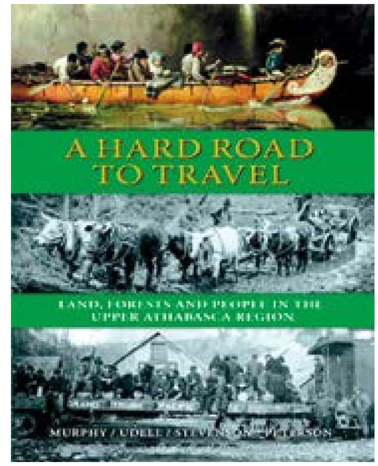
It describes how foresters of industry and government collaborated to develop a forestry program not by creating rule books or codes of practice, but by developing broad goals and objectives and allowing the company to establish a program that met agreed-upon outcomes. The book has provided high value to the company in explaining to customers and the public the history, science, stewardship ethic, and legacy of the Forest Management Program at Hinton.

A Hard Road to Travel: Land, Forests and People in the Upper Athabasca Region by P.J. Murphy, with R.W. Udell, Tom Peterson, and R.E. Stevenson (2007, Foothills Model Forest and The Forest History Society). This book is one of the most popular books in the Forest History series. Local historian Tom Peterson joined the writing team to provide advice on the broad and colourful history of exploration and development in the area from Aboriginal times to the present.

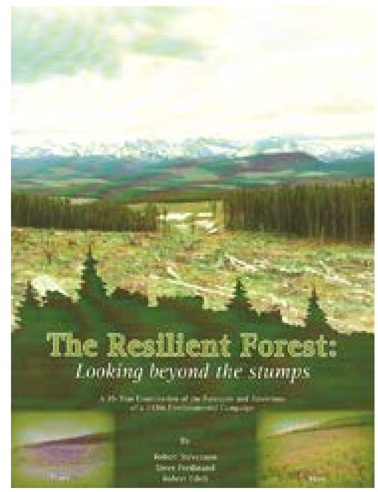
This book provides an in-depth look at the remarkable human and ecological history of west-central Alberta from prehistoric times to the arrival of large-scale industrial forest management in 1955. The authors combed archives and museums to come up with over

The authors of *Learning from the Forest* celebrated their book's publication with a barbeque at Bob Stevenson's farm in 2003, L-R Bob Udell, Bob Stevenson, Peter Murphy, Bob Bott.

150 photos to illustrate the book. Through examination of historical records, a series of 28 maps, most original for this book, have been provided to supplement the text.

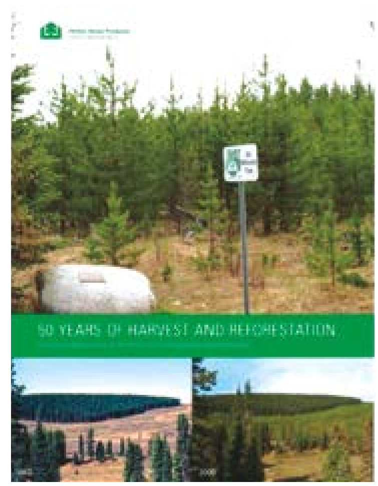


The Resilient Forest: Looking Beyond the Stumps—A 35-Year Examination of the Forecasts and Assertions of a 1970s Environmental Campaign by Bob Stevenson, Steve Ferdinand, and Bob Udell (2007, Foothills Model Forest). This project describes a saga that began in 1971 when the environmental organization Save Tomorrow – Oppose Pollution (STOP) commissioned one of its members, Arnim Zimmer, to visit North Western Pulp & Power's Hinton forestry operations and examine environmental and forestry practices there. His 1972 report, the pictures it contained, and his presentation to the minister of Forestry, Lands, and Wildlife caused a flurry of activity and negative publicity in the media at the time. Consternation over this report provoked the Alberta Forest Service to dispatch Silviculture Program Manager Kare Hellum to locate every site identified in Zimmer's damning report and investigate his assertions of environmental degradation, deforestation, and wasteful practices. Hellum's report effectively refuted most, if not all, of Zimmer's assertions, but good news is never as popular as bad, and the negative seeds planted in the public's minds lingered.



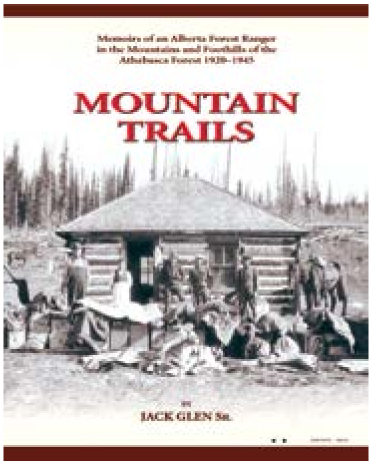
In 1997, Weldwood supported a repeat photography project by Steve Ferdinand and Bob Stevenson; they found all the blocks and sites reported by Zimmer and took new pictures of them as close as possible to the original photo points. This presented some line-of-sight problems, as young, reforested stands up to 10 metres in height blocked the view from many of the original points, and the authors had to use helicopters to capture the perspective. Subsequently, the company conducted an ecological assessment of the sites to examine the soil conditions, reforestation status, and growth performance of the stands. In 2006, these sites were again visited, with ground photo points established and new photography from both ground and aerial perspectives. The final report incorporated this new material.

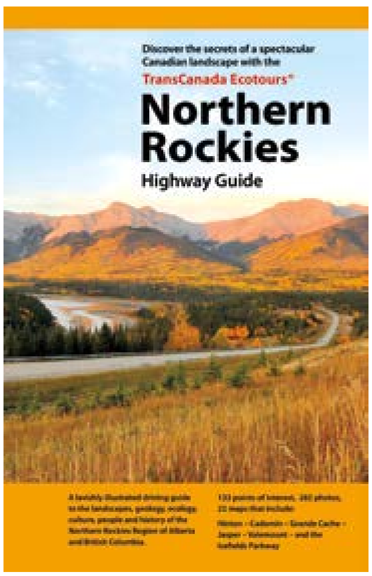
50 Years of Harvest and Reforestation: A Historical Photo Review of the Hinton Forest Management Agreement Area by Robert Udell (2007, Foothills Research Institute website). This report is a pictorial and historical record through time of harvest areas on West Fraser's Hinton forest management area. Drawing upon his own records as well as the archival records of West Fraser and others collected through the Foothills Model Forest Adaptive Forest Management History Program (now the Forest History Program), the author selected 36 blocks from the 1950s to the 1990s for repeat photography.



A continuing pictorial record was thus established, along with a discussion of significant and interesting events associated with the times and represented by the blocks themselves. Most of the blocks, with the exception of some aerial and landscape images, were visited on the ground, and photo points were established with the GPS coordinates recorded for future retrospectives.

Mountain Trails: Memoirs of an Alberta Forest Ranger in the Mountains and Foothills of the Athabasca Forest 1920–1945 by Jack Glen Sr. (1969), adapted by Rob Mueller, Bob Udell, Peter Murphy, and Bob Stevenson (2009, Foothills Research Institute and Alberta Sustainable Resource Development; 2014, ebook on the fRI Research website). This publication is an adaptation of the memoirs of Jack Glen, who was a ranger at Entrance from 1920 to 1942. Glen witnessed and participated in much of the early development in the forests around Hinton, particularly in the Athabasca Forest District. His memoir was originally published as a series of articles in the *Western Producer* in 1969. Mrs. S. McCreedy was the Alberta Forest Service librarian at the time and kept the articles, which Peter Murphy arranged to have reproduced in 1997. They are a fascinating read about the life and times of a federal forest ranger who saw the transition to provincial resource ownership in 1930. Jack Glen's family provided the original manuscript upon which the memoir was based, as well as Glen's photo collection from the time.





TransCanada Ecotours Northern Rockies Highway Guide by Fred Pollett, with Bob Udell, Peter Murphy, and Tom Peterson (2012, Foothills Research Institute). This self-guided auto-based EcoTour through the foothills and mountains of the Northern Rockies tourist region was written by Fred Pollett, the godfather of the Canadian Model Forest Program, with the help of Bob Udell, Peter Murphy, and Tom Peterson. The book cites much of the earlier work of the Forest History Program, adding more recent knowledge from other sources, including the research at the Foothills Research Institute. The Forest History Program developed the EcoTour as part of its continuing effort to educate, inform, and stimulate the imaginations of people who travel through and stay to visit the landscapes in this area.

This is the latest, and most comprehensive, book in the TransCanada EcoTours series. Canada's highways are countrywide corridors through an ever-changing museum rich in natural and human history. The TransCanada EcoTour Program was developed initially by the Canadian Forest Service in the 1970s and continues today as a bias-balanced window into the country's landscapes and the natural and human factors that have shaped and are shaping them. This is the ultimate guidebook to the landscapes, ecology, culture, and history of the Northern Rockies region along major highway corridors and important byways from Hinton to Valemount, Grande Cache to Cadomin, and Jasper to Lake Louise. Rich photography, detailed maps, historical context, and discussion of current issues illustrate the journey.

A 50-Year History of Silviculture on the Hinton Forest 1955–2005: Adaptive Management in Practice by Bob Udell and Peter Murphy, with Hinton Wood Products Silviculture Superintendent Diane Renaud (2013, ebook available on the fRI Research website). Des Crossley, who originated the Forest Management Program at Hinton, was a distinguished CFS researcher, frustrated at his inability to see his research knowledge adapted into practice. When given the opportunity and challenge to do so at Hinton, he leaped at the chance and set in motion a remarkable and innovative silviculture program never before seen in Alberta. A first draft of the comprehensive history of this silviculture program at Hinton from 1955 to 1999 was developed by retired CFS researcher Lorne Brace. It was extensively modified, and images and maps were added. This important document provides insight into the science, philosophy, and practice of silviculture as it has emerged under an adaptive forest management framework. The book is available as a download from the fRI website.

Learning from the Landscape–The fRI Research Story: Building Knowledge and Tools for Forest Stewardship and Sustainability 1992–2017 by Robert Bott and Robert Udell (2018, fRI Re-search). This publication details the evolution of applied science at the Foothills Model Forest and fRI Research.

Projects Still Underway in 2018

Whirlpool Logging: As the fifth phase of the research program ended, Peter Murphy continued his work on the early history of the Upper Athabasca Region. He was completing an important study on the unique history of the Whirlpool River valley that focused on the railway-tie logging of the 1920s, but also included the river's links to the history of the Aboriginal peoples in the area, the development of the fur trade, and the early development of Jasper National Park. From June 9 to November 9, 2017, this story was featured in an exhibit in the main feature room at the Jasper Yellowhead Museum and Archives.

Columbia Trail: Peter Murphy and Tom Peterson continued to work on mapping the actual location of the historic fur trade route, the Columbia Trail, from the first Jasper House site on Brule Lake to its terminus at the Columbia River in British Columbia. Their interest in this was sparked by the comprehensive research and literature review they completed in conjunction with writing *A Hard Road to Travel.*

Harry Edgecombe: Working with the Edgecombe family, Peter Murphy was preparing a book to celebrate the life of Harry Edgecombe, a long-serving Alberta Forest Service ranger who finished his career as an instructor at the Forest Technology School in Hinton.

Peter Murphy's *"Whirlpool Logging"* display at the Jasper Yellowhead Museum and Archives was seen by a large number of visitors and received high praise. The display included a large image of the river valley with historical highlights, produced by fRI's GIS group, using 2014 SPOT satellite imagery.

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Opposite page: Long Beach Model Forest Land and Seascape. *Courtesy Bob Udell*

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SECTION THREE

Reflections, and a Look to the Future

CHAPTER NINE

Where Are They Now?

Canada's Original Model Forests*

The Canadian Model Forest Program lasted through three five-year phases from 1992 to 2007. By then, there were 11 model forests and three special project areas, ranging in size from 100,000 to nearly 8 million hectares. In this chapter, we take a look at the events that triggered the Model Forest Program and the key elements and current status of the nine model forests which, along with Foothills, made up the original 10 Canadian model forests.

* The authors thank representatives of the original 10 model forests for their review and comments on drafts of this text. We also want to recognize Fred Pollett (retired) and Brian Bonnell of the Canadian Forest Service for their extensive review of this chapter.

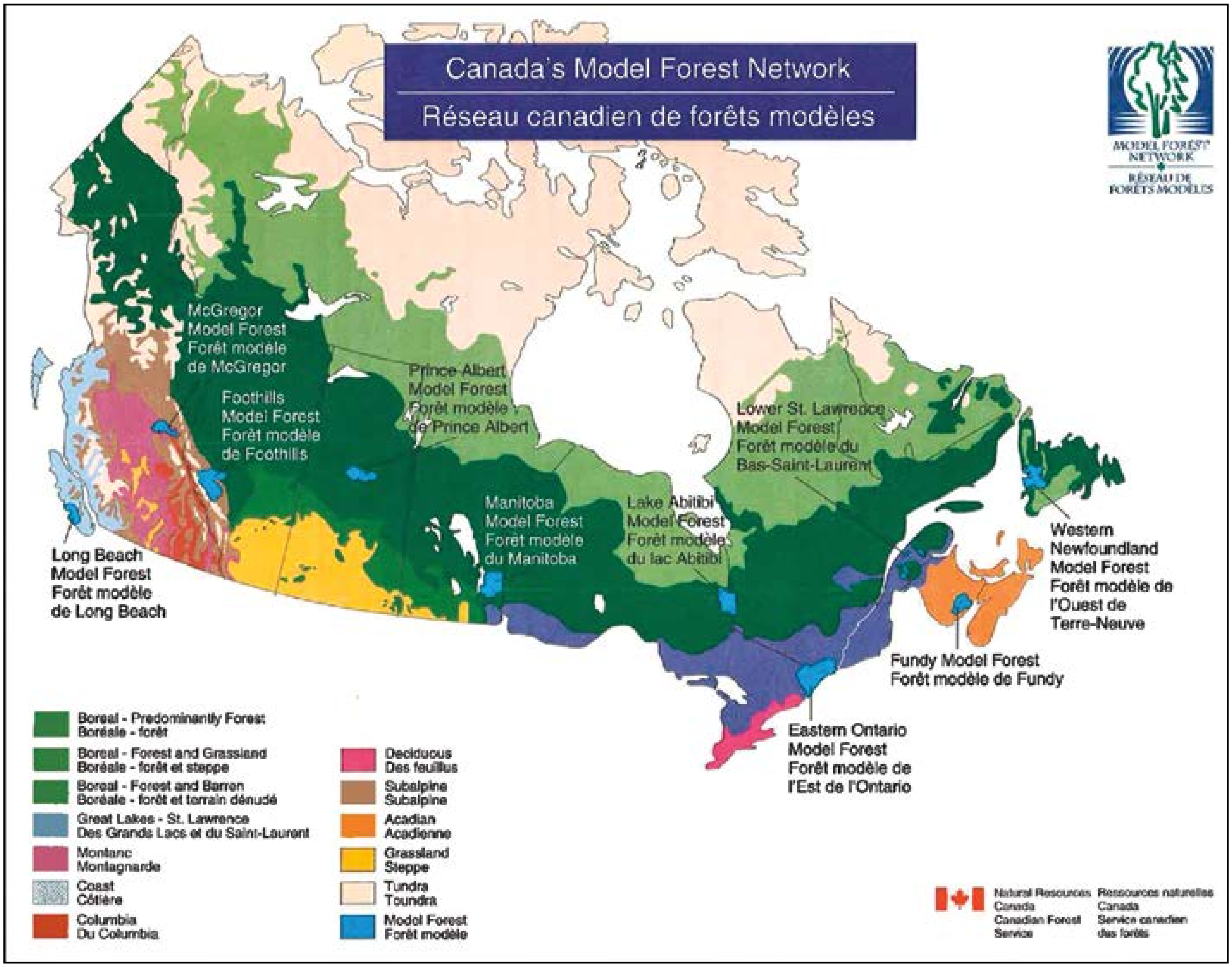
Establishing the Canadian Model Forest Program

In Canada, the challenge of sustainable forest management had particular urgency in the late 1980s. With 10 percent of the world's forests and as the world's largest exporter of wood and paper products, Canada clearly had a special responsibility, both to its own citizens and to the world at large, to manage its forests sustainably. During this time, the Canadian forest community developed a new *National Forest Strategy* and the *Canada Forest Accord*, incorporating the principles of sustainable development into an overall action plan. As well, new legislation was formulated in some provinces to protect sensitive areas and ensure that forest managers sought input from relevant stakeholders in the preparation of forest management plans.

The publication of the *Brundtland Report* in 1987 inspired the Progressive Conservative government of Prime Minister Brian Mulroney to produce *Canada's Green Plan for a Healthy Environment* in 1990. The *Green Plan* was developed in Environment Canada under the rising star of Minister Lucien Bouchard. Canada was under fire from environmental groups for its forestry practices at the time, and the government wanted some projects that would demonstrate its commitment to sustainable forest management as part of the *Green Plan*. Forestry Canada, by then its own department under Frank Oberle, was asked to develop some proposals for consideration, and the result was the $100-million Partners in Sustainable Development of Forests Program described in Chapter 1, including the $54-million Model Forest Program.

Funding during the first phase of the program was unencumbered. Proposals had to represent a broader area, at least at a landscape level, but beyond that, proponents were given a relatively free hand to develop new approaches and new ways to deal with the move towards sustainable development. It was not designed to have successes or failures but to try new ideas.

Art May, president of Memorial University, chaired the selection committee that recommended nine model forests. Minister Oberle pointed out a need for a model forest representing the large boreal region of Ontario and Quebec, and the Lake Abitibi Model Forest joined the final group, bringing the total to 10.



Map 9-1. Canada's Model Forest Network, 1992. *Canadian Forest Service*

Underpinning the Canadian Forest Service

In November 1993, the Mulroney government was defeated by the Liberals led by Jean Chrétien, and the *Green Plan* did not survive for long. It was cancelled in 1995, and funds remaining unspent were turned over to the Canadian Forest Service (CFS). This funding was unfettered, meaning that although the intent was that it be used for the Model Forest Program, the department had the means and authority to redirect the money as deemed appropriate, including support for its own work.

There was a huge government downturn in 1995–1996, and all programs came under heavy scrutiny. The CFS conducted a review of its programs, and the Model Forest Program came out on top. Still, money was needed to keep key CFS research programs and research centres functioning, so the pot of funds from the Model Forest Program handover began to be bled off to support this ongoing work. As Fred Pollett reported in his July 2016 interview: "We already had a 57-percent cut in budget. I was the one managing the cuts. If we didn't have that *Green Plan* money coming in, I think we would've literally closed up shop."

The CFS continued to fund the Canadian Model Forest Program through the remainder of Phase I and through Phase II (1997–2002) and Phase III (2002–2007) before bringing it to a close. And it is clear that the Model Forest Program in its own way supported the CFS for this same period.

A Brief Look at the Other Nine Original Model Forests

Opposite page: Interior view of the coastal rainforest characteristic of the Long Beach Model Forest.

This section of the book reflects the status of the other nine original model forests at the initial time of writing, in 2016. As will be seen at the end of the chapter, circumstances changed in 2017, and the effect on the programs we describe in the following text is as yet unclear.

Long Beach Model Forest (LBMF)/Clayoquot Forest Communities – Coastal Temperate Rainforest

The 400,000-hectare Long Beach Model Forest (LBMF) was located on the west coast of Vancouver Island, with Clayoquot Sound to the north and Barkley Sound to the south. The area is highly representative of Canada's coastal temperate rainforest and characterized by rugged coastline, lush forest vegetation, mountains, and islands. Forest, mining, and fishing activities are important to local lifestyles and to the economy, particularly for the First Nations communities. As demand for these diverse resource values increased, a balance between sustaining natural old-growth forests and economic activities was needed. Throughout the 1980s and into the 1990s, the area became known for logging protests and blockades of logging roads.

When it was established, the LBMF partnership proposed to demonstrate sustainable development through planning the use of the timber resource while taking into account the requirements of other non-timber values. The newest forest management techniques, as well as the latest concepts in consensus management, were to be incorporated into this model forest, with new forest practices tested and adapted for use throughout the model forest area. Public education and the training of interest groups, industry, other resource agencies and forest managers was a high priority.

There were 50 projects approved under six broad headings: Cultural Values (heritage and socio-economic); Ecological Research and Restoration; Resource Data and Maps for Communities; Demonstration and Interpretation; Public Information Related to Sustainability; and Youth Leadership.

Research was also central to this site. Some of their most important achievements and

The Long Beach Model Forest included the Pacific Rim National Park as well as provincial crown lands.

Model Forest representatives from across Canada convened at Long Beach in May 1994 for one of the first Model Forest Network meetings. L-R Thomas Bouman (PAMF), Peter Bessau (McMF), Jacque Robert (CFS), Bob Newstead (CFS), Eric Turk (LAMF).

lasting impacts were a result of the research undertaken. Although there was difficulty in implementing many of the approved projects, much of the proposed research was actually carried out, in addition to activities focusing on First Nations and youth.

Although it experienced many challenges, the site also had some major successes, particularly with the engagement of First Nations, youth training, and research. Some of the work has created a legacy that is still visible today. For example, the LBMF helped develop mapping, GIS, and data management capabilities in First Nations and other communities in the region. This assisted those groups to become more active in the forest management planning process.

The model forest was instrumental in developing a community internship initiative with emphasis on First Nations youth, to provide employment, build capacity, and strengthen the understanding of resource management issues in local forest-dependent communities. The model forest also studied the effectiveness of existing protection measures on riparian areas and developed recommendations that were used to help develop guidelines for operations in such areas.

Where is it now?

Funding for the LBMF ended in 2002, and the partnership dissolved. In 2007, a new partnership formed under the Forest Communities Program (FCP) of Natural Resources Canada, and the site became a member of the Canadian Model Forest Network. The Clayoquot Forest Communities Program (CFCP) was organized as a collaborative partnership between five Nuu-chah-nulth First Nation communities in Clayoquot Sound and Ecotrust Canada, a mission-based charitable organization whose purpose is to build a conservation-based economy. The Nuu-chah-nulth communities had just completed the purchase of the tree farm licences in the area, which they managed according to the Forest Stewardship Council (FSC) standard, and Ecotrust was the manager for the First Nations' forest company, Iisaak Forest Resources. Among the projects and priority programs were activities to develop local green economy opportunities especially for First Nations, examine non-timber forest product possibilities in the region, adopt co-management principles, obtain "more value from less wood," design culturally appropriate housing and buildings, explore a regional ecotourism strategy, recognize ecological goods and services, and explore climate change and carbon modelling. The FCP ended in 2014, and the CFCP partnership dissolved. Ecotrust Canada[1] reported on key successes, including:

- The revival of the Wild Side Trail, used both for tourist hikes and for educating the public about identifying and gathering wild foods. A community garden was created, and the Ahousaht community kitchen was upgraded and optimized for the cooking of wild foods. This initiative inspired subsequent developments within and beyond the area. The province created its First Nations community garden program partly based on learnings from the project, while the community gained jobs and new relationships with businesses and regional tourism associations.

- The Clayoquot Biosphere Trust, which adopted "Healthy Food, Healthy Communities," a core program that continues to run today in many communities.
- The creation of the Hahuukmin Tribal Park with constructive, First Nation–led dialogue as the basis for soft economic and cultural development. The Hahuukmin Tribal Park is a success story, serving as a model for the development of other tribal parks across Canada and abroad.

McGregor Model Forest (McMF)– Montane Forest

The McGregor Model Forest (McMF) was located in the montane and subalpine forest regions of north-central British Columbia. As was the case with the Foothills Model Forest, the McGregor Model Forest had strong forest industry partnership and emphasis on developing research and tools for on-the-ground sustainable forest management planning and practice. In fact, Northwood planning forester Hugh Lougheed, who later became a champion of the Natural Disturbance Program at Foothills, played a major role in writing the McGregor proposal. The study area was Tree Farm Licence (TFL) 30, covering 180,767 hectares, mostly Crown land, but including 731 hectares that were privately owned by the licensee, Northwood Pulp and Paper. In 2002, at the beginning of Phase III, the study area was expanded to 7.7 million hectares.

Although timber management is the primary focus of any tree farm licence operation, other resource uses such as cross-country skiing, hiking, wildlife viewing, hunting, and fishing were integrated into the planning of TFL 30.

The McMF proposed to develop the systems, technologies, knowledge base, and processes by which to enhance integrated resource management and achieve sustainable development of the forest and its many resources through:

1. Linking the development of long-term landscape-level plans with shorter-term, site-specific plans
2. Developing socio-economic indicators to quantify management objectives such as biodiversity, recreation, and visual resource values, and by doing so, to make possible their comparison in the evaluation of alternative management options
3. Developing the knowledge base for how different ecosystems respond to various forestry practices and designing "best management practices" to ensure the conservation of soil, water, and site productivity
4. Applying technologies developed in the Model Forest Program to TFL 30 operations and obtaining feedback to calibrate and support the ongoing development of these technologies and processes
5. Providing outreach information and education programs to audiences within and external to the McGregor Model Forest

In the first 10 years of its program,[2] the McMF developed a very positive relationship with the Model Forest Program in Russia, twinning with the Gassinski Model Forest from 1994 to 1998, and through continuing programs with the Canadian International Development Agency. It also had strong ties with several universities and colleges, including the University of Northern British Columbia and the University of British Columbia.

Much effort was spent on developing its landscape planning system—*The McGregor Approach*—for developing forest management plans using three interlinked components: scenario planning, strategic and operational planning support, and indicators and adaptive management. This system was highly regarded and was influential in some of the recommendations of the Alberta Forest Management Science Council's 1997 report[3] regarding landscape-level forest management planning. Through this work, the McMF became significantly involved in several new B.C. Ministry of Forests initiatives including the Enhanced Forest Management Pilot Project in the Robson Valley District and the Morice and Lakes Timber Supply Areas Innovative Forest Practice Agreements.

During Phase II of the Model Forest Program, in a controversial decision, the model forest spun off a consulting firm, Tesera, to further develop and commercialize the scenario-planning system.

The McGregor Model Forest established and maintained a strong tradition of research focused on the impacts of natural disturbances on boreal landscapes and communities, completing a multi-year study on windthrow risk modelling and a socio-economic study for communities currently affected by the mountain pine beetle epidemic.

It also facilitated the development of a computerized wildlife threat rating system and developed models for assessing insect impacts. The model forest also focused on wildlife research on species of concern, with projects investigating the impacts of logging road networks on grizzly bears and the use of habitat by woodland caribou in the northern Rockies.

McGregor played an important role in assisting with the public consultation on the Mountain Pine Beetle Tree Removal Program for the City of Prince George, and was front and centre in helping a group of forest-dependent communities to form a coalition to build capacity and address the long-term economic implications of the mountain pine beetle epidemic.

Where is it now?

The McMF partnered with leaders in B.C.'s resource sectors in 2007 and successfully secured a five-year funding agreement (2007–2012) from Natural Resources Canada's Forest Communities Program.[4] It formed the new Resources North Association, and worked with three sub-regions in the Prince George, Mackenzie, and Vanderhoof–Fort St. James areas to develop local partnerships with communities to promote integrated resource management across sectors (forests, mining, oil and gas, and outdoor recreation) on a 25-million-hectare landscape. Resources North continued its program in northern British Columbia and was an active member of the Canadian and International Model Forest Networks until September 2015. With the completion of the Forest Communities Program and no significant new projects or funding on the horizon, the Board of Directors made the decision to conduct a voluntary shutdown of its operations. Several of the projects for which Resources North was administering trust funds have been transferred to the charitable non-profit Fraser Basin Council.

Prince Albert Model Forest (PAMF) – Boreal Forest

The original size of the Prince Albert Model Forest (PAMF) was 367,000 hectares, located 70 kilometres north of Prince Albert, Saskatchewan. The partnership included forest industry, federal conservation and provincial resource management agencies, and First Nations, encompassing a wide spectrum of philosophies, cultural backgrounds, social values, management intents, legislation and policies, and economic goals. The Prince Albert Model Forest placed heavy emphasis on transforming their model forest into an exemplar of Indigenous peoples' participation in natural resource development and conservation. Three levels of First Nations' governing bodies were partners in the model forest: the Montreal Lake Cree Nation, the Prince Albert Grand Council, and the Federation of Saskatchewan Indian Nations.

The model forest land base included Weyerhaeuser Canada's forest management licence agreement area, managed lands of the Montreal Lake Cree Nation and the Lac La Ronge Indian Band, Prince Albert National Park, and Candle Lake Provincial Park.

The partnership proposed to develop a process and tools to set aside the extant system of independent, single-purpose objective setting among agencies and groups, and replace it with integrated resource management planning. The diverse landscape and ownership presented a challenge for developing collaborative planning, studying natural and managed ecosystem processes, and experimenting with new ideas both in the short and long term. The Prince Albert Model Forest would be the land base upon which the methods, processes, socio-economic and ecological forecasting tools, and forestry-related technology would be developed and tested. This collaboration, and the science and technology transfer arising from it, was intended to provide the foundation for long-term relationships on much larger forest lands in the province of Saskatchewan.

As Phase III drew to a close, the model forest lost its major industrial partner when Weyerhaeuser closed its pulp mill and sawmill in 2006. It has not yet, as of 2018, reopened, although the facilities were subsequently bought by Domtar (in 2006) and Paper Excellence (in 2011).

The PAMF achieved some remarkable accomplishments during its history. It developed the first integrated resource management plan in the Canadian Model Forest Network and conducted extensive baseline and sustainable forest management research on the Prince Albert Forest Management Agreement area. It developed and delivered an integrated management approach for the Candle Lake Subwatershed.

The model forest was also integral in the creation of the Sturgeon River Plains Bison Stewardship consortium. Its Caribou Research Program included work with the Buffalo River Dene Nation for three years, including training community members in field collection.

The Prince Albert Model Forest developed Canada's second alley cropping (an agroforestry technique) demonstration site at the Saskatchewan Conservation Learning Centre and initiated the Saskatchewan Resource Rangers program in 2006, coordinating the first seven years of the program.

It also created the International Model Forest Network's first trilateral agreement for collaboration among PAMF, the Vilhelmina Model Forest in Sweden, and the Alto Malleco Model Forest in Chile, and developed a collaborative research exchange with the Vilhelmina Model Forest.

The model forest assessed the current and future impacts of climate change on the boreal forest of central Saskatchewan using a forest ecosystem simulation model to determine forest productivity under both current and future climatic conditions, and then to translate these results into wood supply impacts. A similar project was also undertaken in the grassland–mixed boreal–boreal forest transition zone.

In addition, the PAMF facilitated Pasquia Porcupine community engagement and traditional ecological knowledge gathering to contribute to land management decisions supporting woodland caribou recovery efforts.

As well, it helped assess FireSmart management strategies at the landscape level in Prince Albert National Park and its surrounding communities, developing and communicating new strategies and techniques to help local stakeholders reduce their risk of losses due to forest fire.

Where is it now?

The Prince Albert Model Forest received Forest Communities Program funding for 2007–2012, and expanded its area to 4,382,417 hectares, from North Battleford in the southwest to Pelican Narrows in the northeast, including 12 First Nations communities. With this new funding, the model forest continued its main initiatives, including strengthening the

Nipawin Biomass Ethanol New Generation Co-op; building an Aboriginal Caucus as part of the model forest, enhancing traditional cultural and language instruction for Aboriginal youth; and participating in collaborative work on climate change and related issues with the Vilhelmina Model Forest in Sweden, as well as cultural exchanges with the Alto Malleco Model Forest in Chile.

As it continues today, the goals of the model forest are to:

- Support the forest sector by assisting communities and industries in skill development and certification
- Assist community sustainability through projects and research that balance cultural integrity, healthy ecosystems, and sound economics
- Assist communities to plan for the effects of climate change and other landscape management factors, including participatory GIS
- Engage communities in supporting boreal woodland caribou research
- Offer a platform for action that is cross-sectoral, works at multiple scales, and has a global perspective for building projects at the local, grassroots level with a network of knowledge, experience, and expertise
- Facilitate long-term collaboration between diverse interests and priorities in a neutral forum
- Provide tools and guidance to assist on multiple scales and on a range of topics

In support of these goals, the Prince Albert Model Forest and FPInnovations are providing business support, trade, and economic development assistance to the Saskatchewan forest industry through the multi-year Saskatchewan Forest Sector Support Project, including a Forest Industry Skills Development Program. It also maintains the Woodland Caribou Technical Committee, community engagement, and a traditional knowledge program.

On the public engagement side, it has an ongoing Beardy's and Okemasis Resource Ranger Sustainable Community Garden Project, conducts the science teachers' Forestry Boot Camp 101, and facilitates the Public Advisory Group for the Sakâw-Askiy Forest Management shareholders.

It also continues international research collaborations with the model forests of Vilhelmina, Sweden; Alto Malleco, Chile; Kyoto, Japan; and the Baltic Landscapes Network.

Manitoba Model Forest (MMF) – Boreal Forest

The 1,047,000-hectare Manitoba Model Forest (MMF) is located 100 kilometres northeast of Winnipeg, along the southeast shoreline of Lake Winnipeg. It was the principal supply area for Abitibi-Price's newsprint mill at Pine Falls. The forest's 1 million hectares contain a patchwork of boreal ecosystems, commercially important stands, protected areas, essential wildlife habitat and species (including a threatened herd of woodland caribou), and aquatic ecosystems. A multitude of other forest values and uses (recreation, wild rice production, hunting, fishing, and traditional Aboriginal pursuits) also characterize the area, which includes several Métis and four First Nations communities.

The original model forest was based on an existing Manitou Abi partnership that was already working on incorporating principles of integration and sustainability with the help of GIS technology and the results of a recent comprehensive environmental assessment. It would build on the existing stakeholders' partnership, which would oversee research into and the evaluation of advanced practices and innovative management approaches, fostering an improved understanding of the boreal forest and its ecology, management, values, and uses to managers, technicians, stakeholders, and the public.

The partnership's vision was to build on these unique attributes to create and demonstrate an operationally viable, ecologically sustainable, and broadly supported model of boreal forest management. In its first five-year phase, the main themes were variable-retention logging to mimic natural (fire) disturbances, eastern Manitoba woodland caribou management studies, moose management studies, stream monitoring, and forest management practices. The model forest studied new technologies to increase operational efficiencies, such as the use of Differential Global Positioning System (DGPS) capabilities in tree harvesters, enabling operators to navigate along the edges of defined buffer zones and generally position themselves with respect to geographic features such as roads and streams displayed on a background map of the cutting area. It developed the *Manual for Environmentally Responsible Forestry Operations in Manitoba*, which was subsequently adapted by the Lake Abitibi, Waswanipi Cree,* and Bas-Saint-Laurent Model Forests for use in Ontario and Quebec.

* The Waswanipi Cree Model Forest is the Aboriginal Model Forest established in 1997 in the boreal forest of northern Quebec, southeast of James Bay. It incorporated the traditional knowledge and culture of the Cree people in the development of sustainable forest management practices related to capacity development, community-level indicators, and wildlife. Its work fostered creation of the Cree-Quebec Forestry Board in 2002, and since 2007, its projects have been continued by the Cree Research and Development Institute.

The Manitoba Model Forest also sponsored a chair in forest ecology at the University of Winnipeg, whose incumbent was responsible for providing advice to model forest partners and also for conducting research in the model forest area.

In later phases of the Canadian Model Forest Program, emphasis was focused on developing local level indicators of sustainable forest management, refining the natural disturbance template for forest harvesting, and developing partnerships and projects on community economic development and monarch butterfly habitat protection and restoration in the Mariposa Monarca (Monarch Butterfly) Model Forest in Mexico.

The Manitoba Model Forest continued its long-standing work to understand the behaviour and habitat needs of woodland caribou, a threatened species in eastern Manitoba, through active research, monitoring, and management activities. The model forest's Stream Monitoring Network and Database Project built knowledge and understanding of the dynamics of stream-water quality and flow in response to short-term disturbances, long-term stresses, and landscape features. The project also provided an opportunity for First Nations youth, trained as research assistants, to learn technical skills related to water monitoring.

Industrial membership was a continuing challenge. Abitibi's pulp mill at Pine Falls changed hands twice until, in 2010, Tembec closed it permanently.

Mike Waldram, the long-time manager of the Manitoba Model Forest, was an enthusiastic advocate for Aboriginal involvement in forest management and the Manitoba Model Forest. He died in 2006, and the Canadian Model Forest Network announced the establishment of the J. Michael Waldram Memorial Forest Scholarship, granted annually through the Canadian Institute of Forestry, and open to all Canadian Aboriginal youth enrolled in at least their second year in a natural resource management program at a Canadian university or college.

Where is it now?

The Manitoba Model Forest received Forest Communities Program funding (2007–2012) to continue its programming in eastern Manitoba and to expand its activities into western Manitoba, including areas of the Manitoba escarpment north of the Riding Mountain Biosphere Reserve. It continued to support an existing First Nations Traditional Area Advisory Committee, assisted First Nations in developing and revising land-use plans, examined opportunities for ecotourism and non-timber forest products, created the Winnipeg River Learning Centre, and strengthened ties for ecotourism with the Reventazon Model Forest in Costa Rica.

It remains a member of the Canadian and International Model Forest Networks. In 2014, the Manitoba Model Forest assumed the administration of the Canadian Model Forest Network, with the national office moving to Pine Falls, Manitoba. The General Manager of the Manitoba Model Forest also acts as the General Manager of the Canadian network. The MMF is currently leading an international project of model forest development on the island of Java, Indonesia. With the closure of the mill in Pine Falls, the Manitoba Model

Forest is currently focusing its efforts on forest-based education of teachers and students, exploring alternative forest-based economic opportunities, and continuing its long-standing work on the management of wildlife species, including moose and caribou.

Lake Abitibi Model Forest (LAMF) – Boreal Forest

The Lake Abitibi Model Forest (LAMF), covering 1.2 million hectares of boreal forest in northern Ontario, was located on the Quebec border, in close proximity to the community of Iroquois Falls and adjacent to the communities of Smooth Rock Falls, Cochrane, Matheson, Kirkland Lake, and Timmins. The original proposal brought together the forest resource users of the region, working together to achieve a common goal of sustainable development of forests. This area contained the first forest management agreement granted in Ontario, to the Abitibi Pulp and Paper Company (renamed Abitibi-Price in 1979). Three forest companies, Abitibi-Price, Tembec, and Norbord, managed approximately 95 percent of the Crown land in the model forest area.

Abitibi led the team developing the model forest proposal and was the first industrial partner. Norbord later joined as a softwood consumer. The emerging collaborative approach to forest management included the involvement of 15 local partners to ensure that decisions on the landscape would take into consideration the needs of all forest users. The Lake Abitibi Model Forest's project areas included community-level socio-economic development models, ecological processes, and education. The forest was also a pilot site for the development and testing of the Operational-Scale Carbon Budget Model.

The LAMF was quite successful in exploring various silvicultural models and tools, which were accepted by the province in terms of allowable harvest methods. In partnership with Abitibi Consolidated, the Canadian Forest Service, and Laurentian University, it developed the Harvest with Regeneration Protection (HARP) system for timber harvest operations in peatland black spruce forests to encourage natural regeneration, including a guide and video. The model forest also developed a practical field guide for equipment operators that focused on minimizing soil disturbance in the clay and organic soils of Northern Ontario.

A community development impact model (the Regional Community Constellation Impact Model), developed through the Lake Abitibi Model Forest, provided community decision makers with the ability to estimate key socio-economic impact data based on anticipated changes in the benefits derived from the forest. This model was also modified for use within local First Nations communities.

Highway Sign entering the LAMF Research Area.

Along with the Western Newfoundland Model Forest, the Lake Abitibi Model Forest was a pilot site for testing the development of the Canadian Carbon Budget Model. The beta version was tested in 2003 before the completed tool was launched in 2005.

Working with the Northeastern Ontario School Board, the LAMF developed an education program for elementary school teachers and students called "Mysteries of the Boreal," an educational tool intended to stimulate the interest of students in the stewardship of their forest resources while giving them a broad understanding of the issues involved in sustainable forest management.

The Lake Abitibi Model Forest collaborated with the Ontario Ministry of Natural Resources (OMNR) to test a variety of tools designed for provincial-level assessment of indicators of sustainable forest management, with the model forest working as the testing ground before OMNR distributed the tools to the rest of the province.

Where is it now?

A proposal for funding under the Forest Communities Program (2007–2012) was unsuccessful; however, the model forest continued to operate at a reduced scale, working on various projects and presenting conferences and educational programs. It remained in the Canadian and International Model Forest Networks until 2014. On December 5, 2015, Res-

Model Forest Network Meeting and field tour, LAMF 1996.

olute Forest Products (formerly Abitibi-Price) announced the permanent closure of the newsprint mill in Iroquois Falls, putting the whole future of the town at risk and seriously impacting surrounding communities, both socially and economically. With the withdrawal of all its funding, the model forest became inactive.

Eastern Ontario Model Forest (EOMF) – Great Lakes–St. Lawrence Forest Region

The 1,534,100-hectare Eastern Ontario Model Forest (EOMF) was strategically located in a highly populated area of about 1 million people. The landscape of the model forest covered a wide range of land uses. The majority of the land (88 percent) was privately owned, with the remainder in public ownership. Productive forest lands comprised 38 percent of the area, and the model forest presented a unique opportunity to develop and demonstrate sustainable forestry programs on private as well as public lands in the Great Lakes–St. Lawrence forest ecosystem.

The initial proposal was developed by a team representing resource management agencies, private landowners, and industry interested in a broad array of forest values. The model forest proposal built on the strengths of existing forest programs in Eastern Ontario and proposed to address weaknesses that could inhibit the development of sustainable forestry.

As the program got underway, a Stewardship Council was formed to foster a democratic form of public participation and facilitate the formation of partnerships. A strong public awareness and education program was emphasized to develop a stewardship land ethic among residents of the model forest area.

The main program themes included small private woodlot management and the development of an FSC certification system for woodlot owners; exploration of agroforestry possibilities, including non-timber forest products (NTFP); organization of an “urban forestry network”; design and implementation of an eco-industrial wood products centre; and organization of demonstration woodlots and public programs based on them.

The development of accurate resource information and landscape-based planning was emphasized, along with a technology development and transfer program. The EOMF had a strong GIS program that allowed it to examine issues and programming at a landscape scale, as well as provide some services to landowners and resource management agencies, including tools needed to accelerate the evolution of sustainable forestry from concept to operational practices. The model forest was also a key participant in the advancement of the Canadian Model Forest Network's Private Woodlot Initiative (2002) and spearheaded the development of the Eastern Ontario Urban Forest Network (EOUFN), a working group consisting of local communities, municipal agencies, and interested individuals who wanted to promote healthy and sustainable urban forests. This was followed in 2005 by the establishment of the Canadian Urban Forest Network with EOMF as a founding chapter, and it was used as an example for other regions.

An important project to the model forest's Aboriginal partner, the Mohawk Council of Akwesasne, was the development of a process to preserve existing black ash populations that had been devastated by a blight in the 1970s and to re-establish the species in areas from which it had disappeared. Black ash was important to the Mohawks and other eastern First Nations for traditional basket-making, and the handbook that came out of the project was well received.

The EOMF was one of the first members of the Model Forest Network to produce a *State of the Forest* report (1999) based on adapting the CCFM framework, criteria, and indicators to the diverse landscape and ownership pattern of EOMF.

The main forest industry partner, Domtar, which owned the pulp and paper mill in Cornwall and provided a log market for many of the small woodlot members of the EOMF, closed the mill permanently in 2006.

In 2003, the EOMF received Forest Stewardship Council (FSC) certification on 1700 hectares of forest land, and by 2013, the area certified had surpassed 55,000 hectares.

Where is it now?

The EOMF was successfully funded under the Forest Communities Program (2007–2012). As one of the model forests in the Canadian Model Forest Network, as well as one of the almost 60 members of the International Model Forest Network, the Eastern Ontario Model Forest remains very active today, working with government, landowners, industry, First Nations, non-government organizations, and others to develop new ways to sustain and manage forest resources in a diverse landscape.

In its continuing program, the EOMF is:

- Extending forest management certification programs for different groups of woodlot land owners
- Working with local communities on several bioenergy-related fronts
- Spearheading several complementary efforts to foster and reward the provision of ecological goods and services by private landowners in Eastern Ontario
- Carrying out vegetation surveys on private and public lands to develop habitat models for species at risk
- Raising awareness of invasive species and providing support for landowners on how to combat these species through its "Caring for Your Land" workshop series and manuals
- Continuing its work with First Nations on forest health challenges, including the emerald ash borer, black ash regeneration and preservation, the Naturalized Knowledge Systems principle, and sharing "Life Skills on the Land" teachings with school-aged children

The model forest has a very active communications and outreach program in Eastern

Ontario, producing and disseminating various information products and newsletters, such as the *Forestry Forum*, which is issued three times a year. Given its proximity to Ottawa, the EOMF is often called upon to host international delegations and visitors from abroad.

Bas-Saint-Laurent Model Forest (BSLMF) – Great Lakes–St. Lawrence Forest Region

The original proposal for the Bas-Saint-Laurent Model Forest (BSLMF) was entitled *Une Forêt Habitée* (*An Inhabited Forest*). At only 113,600 hectares, it was small and was situated within a forest tract of Eastern Quebec that included industrial lands as well as private woodlots.

The BSLMF was based in Rimouski, Quebec, and lasted from 1992 to 2007. All of the area was privately owned. Of that, the former Abitibi-Bowater Inc. owned 40 percent, which had been heavily cutover three times. In 1993, Abitibi agreed to delegate the management of its private woodlands in the area to the model forest to develop and test the concept of a tenant farm system (*le métayage*) in a forest setting. Twenty tenants were selected and individually allotted 1,000-hectare units of forested lands to be managed as small woodlot businesses. The terms and rents were set by the model forest, and the project was supported by cooperatives organized by the tenant groups to deal with wildlife and recreational activities.

The proponents:

1. Developed a system of integrated resource management applicable to small private forests
2. Established a "tenancy" formula for large private forests and adjacent Crown lands
3. Explored new ways of establishing common objectives that respected the needs of individuals, social groups, and forest ecosystems, harmonizing the interests of the various partners and reconciling differences
4. Established an ongoing record of the model forest's activities so that the lessons and experiences of the project remained available for future generations
5. Set up mechanisms to ensure that the project facilitated research for the benefit of all

With the support of the Fondation de la Faune du Québec (Quebec Wildlife Foundation) and others, a novel approach to wildlife management on private lands was developed, educating private landowners about the importance of incorporating habitat protection and management strategies into the management plan for their properties.

The Bas-Saint-Laurent Model Forest project was conducted in seven subwatersheds. One of the services provided to woodlot owners within the areas was the production of a kit that included text, photographs, and maps to give the owners a detailed portrait of their property and associated wildlife habitats. The kit also highlighted the main issues facing wildlife and offered recommendations to remedy these challenges.

The BSLMF also initiated a beaver management pilot project in 2002, examining the effectiveness of existing beaver management techniques to deal with issues such as impacts on riparian habitat, plugged culverts, and flooding. From this came a beaver management plan and video to show private woodlot owners strategies for monitoring beaver activities and mitigating negative impacts.

Eric Turk (President, Lake Abitibi MF) and other delegates on a Model Forest Network field tour of woodlot management, BSLMF, September 1997.

Where is it now?

The original 1993 agreement between Abitibi and the BSLMF contained a provision that the company could cancel the agreement and reassert control of its lands if the Model Forest Program was terminated. The CFS ceased funding the program in 2007, and a few months later, Abitibi sold off its private land holdings, which included the tenant farm areas. With the loss of the land base upon which to conduct the program, the model forest was not approved for the 2007–2012 Forest Communities Program, nor did it continue as a member of either the Canadian or International Model Forest Networks. In the 15 years of the program, the BSLMF completed its work in organizing and implementing the tenant owner approach, and it worked well, with many more applicants from local residents than forest units available.

Fundy Model Forest (FMF)* – Acadian Forest Region

The 419,000-hectare Fundy Model Forest (FMF) was championed by a consortium of forest industry, academia, provincial resource agencies, and Fundy National Park. It was centrally located in southern New Brunswick near the province's three major cities and comprised a diversity of ownerships, including industrial freehold land, Crown land, a national park, and many small private woodlots. Forest utilization had always been a focus of the area, with intensive silviculture treatments ongoing since 1969. The model forest's long-term goal was "to achieve, enhance, restore, and sustain a healthy Acadian forest ecosystem by building capacity for sustainable forest management and conservation of natural biodiversity."

* During the 15 years of the Model Forest Program, especially in documents involving the other model forests, the Foothills Model Forest was often abbreviated as FtMF to avoid confusion with the FMF abbreviation for Fundy Model Forest.

The area was important to thousands of local recreation enthusiasts and visiting tourists. The significance of forestry to the economy of the local area, coupled with the diverse ownerships and the nearby presence of a large and keenly interested public—all impacting a sensitive ecosystem—provided a management challenge.

Over the years, major themes emerged, including:

- Enhancing management for private woodlots in rural areas
- Developing restoration measures for Acadian forest ecosystems
- Documenting impacts from forest management practices on two watershed tributaries of the Petitcodiac River
- Exploring forest biomass feedstock potentials
- Helping establish the Nova Forest Alliance in 1998 as part of its partnership-building role (Nova Forest Alliance joined the Network as Canada's 11th model forest in 2002)

The FMF also encouraged the formation of the Fundy Biosphere Reserve in 2000, which was organized along the lines of creating multiple partnerships.

Partnering with industry, academia, and government, the Fundy Model Forest established the Hayward Brook Watershed Study to examine the potential impacts of forest activities on various forest values such as the effectiveness of different riparian buffer zone widths in protecting wildlife habitat and water quality. Other goals of the project included testing the effects of selection harvesting within the forested buffer strips and examining how certain plants and mosses responded in areas that had been clear-cut. One of the most inclusive monitoring sites in the region, it was designed to evolve into a long-term monitoring site for potential impacts related to forest activity. The study continues today.

Through its watershed work, the model forest developed a video for operators, industry landowners, and contractors on best management practices to encourage and describe best practices when operating in proximity to water bodies. It addressed issues such as the importance of proper planning, road and trail construction, tree harvesting and silviculture, and fuel and chemical use and storage.

The model forest developed an integrated and sustainable forest management planning process for a case study area of 113,000 hectares that was inclusive of the four major land ownerships (private woodlot, industry, and provincial and federal governments) in the model forest. This multi-year project included extensive public consultation and the development of a series of alternative scenarios for consideration by the partners. The land management partners then incorporated various elements of the chosen scenario into their plans. The process incorporated the development of criteria and indicators, and the land management partnership chose 14 of the 53 indicators to incorporate into their planning and monitoring programs.

As the model forest program drew to a close, the Fundy Model Forest produced a very good booklet on the progress and achievements of the first 15 years (1992–2007).[5]

Where is it now?

The Fundy Model Forest received Forest Communities Program funding (2007–2012) to expand activities throughout the province (some 7,290,800 hectares). Its main goals were to work on community profiles and analyses to identify gaps in local forest sector economies and develop pilot projects; undertake pilot projects for ecological goods and services payments to owners of private lands; and enhance cooperation with stakeholder organizations. It remains a member of the Canadian and International Model Forest Networks and is supported by the private sector and government. The model forest continues to operate with a focus on forest-based research, species at risk, outreach and education, and communications in support of the forest sector. Budgets are looking up, with funding primarily from the private sector and with support from all levels of government.

Western Newfoundland Model Forest (WNMF) – Boreal Forest

This balsam fir forest originally covered about 707,100 hectares of boreal forest on the west coast of Newfoundland (including Gros Morne National Park). It was centred around, and had its office in, Corner Brook, NL. Western Newfoundland Model Forest (WNMF) was the primary source of raw material, with an accepted annual allowable cut (AAC) for Corner Brook Pulp and Paper Ltd. Lesser amounts of fibre went to the Abitibi mill (closed in 2008) in Grand Falls. Besides employment, the WNMF provided many other values to the more than 35,000 residents of the area. It contained some of the richest and most varied wildlife habitat in the province, and included a concentration of the threatened Newfoundland pine marten. The model forest was heavily used for many forms of outdoor recreation, was a supply of commercial sawlogs and domestic fuel wood for use by residents, and contained the water supply for several communities in the area.

Traditional forest management in this area concentrated on timber production and largely ignored or left to chance other resource values. Because of this, conflicts between timber management and those other resource values arose with increasing frequency. The impacts of forestry on wildlife management and the endangered pine marten were of particular importance. In response, the WNMF proposed to develop a process that adequately addressed all aspects of resource management.

The model forest then set out to develop the tools necessary, but not currently available, for integrated resource management; to develop a planning process, incorporating public involvement, to effectively utilize these tools; and to test and demonstrate this process in the model forest area. Costs and trade-offs between conflicting resource values would be evaluated and means of resolving conflicts would be investigated. Other themes included capacity building and professional development through five local community networks linked with Regional Economic Boards, as well as pine marten habitat conservation in old-growth forested areas.

A primary focus of the Western Newfoundland Model Forest was to support planning teams through the development of tools to enhance management of the province's forest ecosystems. From the outset, the involvement of the Newfoundland Forest Service and Provincial Wildlife Division in the WNMF helped move the model forest forward and implement its tools and knowledge beyond the forest boundaries. The Western Newfoundland Model Forest Partnership was effective in developing local level indicators of sustainable development. This knowledge was used by the International Model Forest Secretariat in collaboration with other model forests, most notably in South America.

The WNMF adapted a suite of assessment models originally developed in Alberta to the forests of Newfoundland and Labrador, assisting forest managers to evaluate a variety of management scenarios and impacts on future forest conditions. One component examined ecosystem diversity and landscape structure indices, and another focused on species-specific Habitat Suitability Models (HSMs). HSMs were developed for the Newfoundland pine marten, boreal owl, and woodland caribou. Biodiversity Assessment Project tools were adapted to other Newfoundland and Labrador ecoregions for use throughout the province and have been incorporated into provincial wood supply analysis since 2005.

The Western Newfoundland Model Forest established a Sustainable Development Chair at the College of the North Atlantic in Corner Brook. The incumbent was responsible for the promotion of sustainable development and the model forest concept through the education system.

The model forest convened and facilitated a working group representing a broad cross-section of views to address issues relating to the endangered Newfoundland pine marten. In October 1995, the Government of Newfoundland and Labrador announced its intention to establish a marten reserve at Little Grand Lake. The united position of the diverse working group members was a critical factor in the government's decision.

The WNMF established research projects to determine the influence of landscape fragmentation on the Newfoundland pine marten and to predict landscape-scale habitat occupancy. It also helped create a decision support system to assess different forest management strategies in terms of their impacts on biodiversity.

The model forest had an active watershed program that included the development of an inventory of all the forest access road stream crossings on the island and allowed the spatial linking of each stream crossing to the provincial GIS forest database. This was expanded in 2000 when, in the town of Steady Brook, residents established the first Steady Brook Watershed Monitoring Committee with the encouragement of the town council. A lack of resources impacted the committee's work, so in 2003, the town welcomed the offer of the Western Newfoundland Model Forest to coordinate the development of a watershed management plan, which was put into action in 2005. This was a pilot project to produce a watershed management methodology for other communities in Newfoundland and Labrador to follow.

The WNMF facilitated the development of a Special Project Area involving the Innu Nation and the Government of Newfoundland and Labrador, and facilitated a unique co-management partnership with the province to provide tools for implementing the Strategic Forest Management Plan for District 19, known to the Innu people as Nitassinan, or "our home."

Along with the Lake Abitibi Model Forest, the WNMF became a pilot site for testing the development of the Carbon Budget Model of the Canadian Forest Service, and won a Canadian Forest Service Award for this work.

Where is it now?

Renamed the Newfoundland and Labrador Model Forest in 2007, it remains a member of the Canadian and International Model Forest Networks. It received Forest Communities Program funding (2007–2012) to expand its reach into 2.5 million hectares and to form two new local community networks. This included co-management work under the 2001 Forest Process Agreement between the province and the Innu that led to the *Labrador/Nitassinan Ecosystem-Based Forest Management Plan* for Forest District 19, including Sheshatshiu, Happy Valley–Goose Bay. The model forest conducted feasibility studies for an integrated facility to produce prefabricated homes, dimensional lumber, and fuel pellets for biomass energy.

The Canadian Model Forest Network – Strategic Initiatives

During the initial phase of Canada's Model Forest Program, the Canadian Forest Service had a separate budget for representatives of the various model forests in the network to come together annually as a committee and discuss the progress and challenges of their model forests. From these meetings, consensus emerged on network initiatives with national importance wherein working collectively would be more effective than working in isolation.

In the ensuing 10 years (1997–2007), funding was set aside for work on network activities and strategic initiatives, and the development of strategic sustainable management tools that would assist the model forests in developing their own programs. Over the 15 years of the Model Forest Program, a number of strategic initiatives were chosen. This increased involvement on national-level efforts strengthened alliances between model forests and other sustainable forest management initiatives and helped bring model forest initiatives and successes to the nation's attention. Strategic initiatives included the development of local level indicators (LLI), enhanced First Nations involvement, carbon budgeting and climate change, and private woodlots.

Local level indicators, which were developed to address local and regional SFM issues, provided the framework for measuring progress towards sustainability. Through the LLI strategic initiative, the Model Forest Network undertook an extensive outreach initiative in order to share with industry, governments, and other agencies the progress of the network in developing these indicators, which could be used as measures for assessing progress towards sustainable forest management. In Phase II, individual model forests were also required to develop local level indicators for their own model forest research land bases.

The Enhanced Aboriginal Involvement Strategic Initiative sought to support and enhance the participation of Aboriginal groups and organizations in activities and resource management both within and outside the Model Forest Program. Through this initiative, Aboriginal groups and model forest partnerships jointly explored avenues for incorporating traditional and contemporary Aboriginal knowledge and approaches to resource management within sustainable forest management practices.

This work was supported by a network-wide communications team concentrating on sharing the lessons learned within the network and also initiating a number of outreach initiatives within the forest community outside the Model Forest Network. This team complemented the efforts of individual model forests and reached out to audiences at national and international levels.

The Canadian Model Forest Network in 2017

> "The Model Forest Program has been a very important component of sustainable forest management research and thinking. The ideas have diffused into policy and regulation." –Bob Fessenden, Assistant Deputy Minister (retired) of Alberta Sustainable Resource Development, interview, 2015

In 2017, of the original 10 model forests in the network, Prince Albert, Manitoba, Eastern Ontario, Fundy, and Western Newfoundland remain as members, and two new projects have joined—the Weberville Community Forest and the Lac-Saint-Jean Model Forest.

The Model Forest Program was never designed as an "evergreen" initiative by the Canadian Forest Service, but the concept endures in other forms and labels and delivery systems; for example, fRI Research. The program was designed to create change in forest and land management across Canada, and it is the opinion of the authors and others that this has indeed been the case.

On March 29, 2017, the Canadian Model Forest Network announced it was shutting down as a legal entity.

> "There have been many strategic efforts pursed in the last few years to keep the Canadian Model Forest Network functioning, but due to the absence of core funding, project funding, the inability of member organizations to contribute financially, and the weight of ongoing costs, a decision was made to dissolve the Canadian Model Forest Network, a not-for-profit organization. The dissolution will occur during the summer of 2017." —Brian G. Kotak, General Manager of the Canadian Model Forest Network, news release, 2017[6]

Although the Canadian Model Forest Network as a registered NGO closed down, the seven existing Canadian model forests continue on as an informal network. Individual model forests also remain vital members of the international network.

Endnotes

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CHAPTER TEN

Summary and Conclusions

"... what's past is prologue, what to come
In yours and my discharge."
–William Shakespeare, The Tempest (act 2, scene 1)

This chapter summarizes the lessons learned during the authors' examination of the evolution to date of the institution now known as fRI Research.

Continuing Challenges

If fRI Research did not exist, someone would have to invent it. The ever-growing human footprints on the landscapes of Alberta and across Western Canada, combined with the effects of climate change, guarantee a continuing need for scientific knowledge to inform decision making. Tools to monitor and manage cumulative effects—the elusive "integrated resource management" goal of Alberta governments since the 1970s and of research programs at this institution since the 1990s—are finally starting to emerge, but they still require many streams of data and lines of inquiry to enable implementation. In this sense, not much has changed since the beginning of this institution a quarter-century ago.

> "To develop and recommend an approach to sustainability and integrated resource management through research and technology developed by means of collaborative partnerships. This approach will achieve local, national, and international recognition." –Foothills Forest mission statement, 1993

Integrating multiple uses and values—environmental, economic, and social—is the Holy Grail of sustainable management. For the past decade, the still-unfolding provincial Land-use Framework* has been the latest and most ambitious iteration of this quest. At fRI Research, the Healthy Landscapes Program is working with the Canadian Forest Service (CFS) on the development and application of an open-access cumulative effects modelling program, the Spatial Discrete Event Modelling System (SPaDES), described in Chapter 3. This GIS-based modelling tool allows simultaneous analysis of multiple models and data on any defined landscape. Such spatial and temporal modelling could be the key to answering the most difficult question in resource management: What uses and impacts are sustainable on a given site, area, or region?

The original Cumulative Effects Project was led by Jasper National Park's model forest liaison, park warden George Mercer, from 1997 to 2000. It was an ambitious effort to identify umbrella indicators linking together impacts of human activities on the ecological health and biological diversity of shared landscapes. This approach to cumulative effects turned out to be premature—and unachievable with the technologies and knowledge available at that time. The project was rolled into the work of the Regional Steering Group for the *Northern East Slopes Sustainable Resource and Environmental Management Strategy*, which was appointed by the provincial government in 2000 and issued its report in 2003.

* Planning and consultations for the Land-use Framework began in 2004; the initial framework was announced in 2008, and it was given legislative authority a year later in the Alberta Land Stewardship Act. Implementation is supposed to occur through seven regional plans. As of April 2018, only two of these plans have been approved, for the Lower Athabasca and South Saskatchewan regions, where sub-regional planning is now underway. The North Saskatchewan plan is nearing completion. Plans have not been started for the other four regions. For updates, see: www.landuse.alberta.ca

The preceding chapters describe the evolution of the components needed to undertake a more comprehensive analysis and integration. Each of the research programs addresses its own complex matrix of issues and questions, most of which require continued monitoring and adaptation. There is already considerable overlap or integration among program areas. None of these achievements would have been possible without the strengths of the institution itself.

Meeting Needs

The successes of the model forest and fRI Research arose from meeting needs that were not otherwise being addressed. In the 1990s, both the federal and provincial governments were entering prolonged periods of budgetary restraint at the same time that they had urgent and growing needs for sound science on which to base decisions. Courts and regulatory bodies were demanding more rigorous scientific evidence in their proceedings. The forestry, oil and gas, and coal industries needed credible science to support their operations, guide adaptation as needed, and address the concerns of stakeholders. Non-government organizations, politicians, the public, and the media raised questions that could only be answered by science. In some cases, billion-dollar investments or the viability of communities and industries depended on the answers. The focus on meeting salient needs drove the model forest—and now fRI Research—to anticipate these needs and develop research and science to help meet them, or as Wayne Gretzky used to say, "skate to where the puck is going to be."

Addressing partners' critical problems appealed to researchers. As GIS coordinator for Weldwood and then as a principal of The Forestry Corp. (now FORCORP Solutions), Brian Maier worked closely with the model forest and fRI until he retired in 2014. "I think the one thing that I appreciated about the FMF/fRI approach is that the focus is applied research, so the projects always had a real-world problem to focus on," Maier said in a 2015 questionnaire response. "It was rewarding to know that when something was completed, it was actually going to be USED."

Jerry Sunderland, former Foothills Model Forest Board member and regional director for the Northern East Slopes, Alberta Environmental Protection, also emphasized the immediate application of the resulting knowledge:

> "From a regional director's perspective, FMF research programs such as the Grizzly Bear, Water, and Caribou Programs provided the scientific background to enhance decision making by regional planning and compliance staff. FMF research also guided decision making by the Northern East Slopes regional executive team. At a provincial level, the Local Level Indicators Program contributed to the development of Alberta's Forest Management Planning Standard, and the adoption of CSA Z809* as a standard.
>
> "Research and findings of the FMF Grizzly Bear Program contributed to the successful drafting of a joint federal-provincial *Grizzly Bear Management Framework*. The framework was endorsed by senior levels of the provincial and federal governments. The framework guided land-use decision making in the region and in Jasper National Park.
>
> "The partnership also contributed to a healthy debate regarding land-use outcomes and objectives in the 'buffer' outside the eastern edge of Jasper National Park. Harmonizing objectives helped to protect the integrity of the park while facilitating resource development. Ultimately, the dialogue translated to increased cooperation on initiatives such as the Cheviot [coal mine] Environmental Impact Assessment.
>
> "FMF has contributed to provincial land-use policy in the form of the Land-use Framework, and forest management policy related to natural disturbance, local level indicators, and socio-economic outcomes.

* *CAN/CSA-Z809-08 (R2013) – Sustainable Forest Managemen*t, first published in 1996, is Canada's national standard for sustainable forest management (SFM). This standard addresses the unique needs of Canada's forestry sector, its unique public ownership structure, and its various stakeholder communities: consumers, environmental groups, government, industry, First Nations, and academia.

> "On a personal level, the Socio-Economic Program contributed to my understanding of what and how forest management could contribute to sustainable development in the region and province. Indicators developed through the program were very useful in helping me, as a regional director, integrate decisions that had often conflicting environmental, economic, and social components." –Jerry Sunderland, questionnaire response, 2015

Much of the research was, and is being, put into practice. The many examples include Weldwood's 1999 Forest Management Plan and the subsequent plans for the Hinton forest management agreement (FMA) area, the Jasper National Park FireSmart-ForestWise Program, coal mine management and regulation, the Foothills Stream Crossing Partnership and related provincial policy, the Foothills Landscape Management Forum, grizzly bear and caribou recovery strategies, fishing regulations, watershed modelling, mountain pine beetle strategies, and the widespread adoption of ecosystem-based management in forestry.

Institutional Assets

The continuing strength of the model forest and fRI Research has been based, above all, on committed partners and adequate funding. The Board of Directors has provided leadership and guidance from a variety of perspectives; the Board's composition required consensus building and helped to ensure the relevance of research objectives. The support of governments—both federal and, especially after Phase I, provincial—has been crucial. The programs have attracted highly qualified staff and researchers, further enhanced by in-kind contributions from universities, industry, the Government of Alberta, Jasper National Park, and the Canadian Forest Service. The institution's independence, operating at arm's length from regulators and vested interests, has added credibility to the research. The industry and government shareholders, through their annual contributions to the institution, pay for the administrative costs (i.e., the core funding) to support the programs and projects.

The continuity of most of the major research programs and their datasets has been another asset. This is most evident in the wildlife, forestry, and water research, where good data to support fRI Research initiatives can be found back to the 1950s. Some of the natural disturbance research involves accessing data as far back as the early 20th century or, in the case of tree ring analysis, the 19th century.

The unique success of the Foothills Model Forest and its successors, among the 10 model forests in the national program, owes much to the Government of Alberta's decision to establish the Forest Resource Improvement Program (FRIP) in 1994 and, subsequently, a delegated administrative organization, the Forest Resource Improvement Association of Alberta (FRIAA) in 1997, to administer FRIP and other programs. This stable source of funding, directed by FRIAA's independent Board and reflecting multiple interests, has supported programs that meet partners' needs. FRIP recipients are selected and prioritized according to rigorous criteria.

The old adage, "Who pays the piper, calls the tune," certainly played a big role in the evolution of the institution. The federal government aimed for national and international objectives, which led to its funding for programs such as Local Level Indicators, Climate Change, and Socio-Economics, as well as localized objectives related to Jasper National Park. The Government of Alberta and the forest industry focused on aspects of sustainable forest management directly related to their operations, planning, and legal responsibilities. The oil and gas industry recognized broader "social licence" benefits as well as operational relevance. The coal industry, municipalities, and some government departments tended to support only projects directly related to their needs. The involvement of Aboriginal groups was limited by their inability to bring in funds as well as their dispersed interests and varied status in the region and, ultimately, by lack of support at the political level. The involvement of non-government organizations was affected by both funding ability and diverging agendas. The lack of researchable questions was also a factor in the non-involvement of some organizations and interests.

From the outset, the Government of Alberta supported the model forest by seconding a key staff member as the general manager. This commitment continues today at fRI Research and includes the additional secondments of Gord Stenhouse for the Grizzly Bear Program and Axel Anderson for the Water Program. Local MLAs Ivan Strang and later Robin Campbell (as both MLA and cabinet minister) saw the value of the program to their constituency and to the province and were relentless in their promotion of it in the legislature. Strang organized several MLA tours of the research. Ty Lund, when he was the minister of Environmental Protection, was an enthusiastic supporter of the model forest, and he made sure the government's commitment was tangible through funding. He regularly had the model forest present its work to his standing policy committee in the legislature. In his short tenure as minister of Sustainable Resource Development, Ted Morton also saw the value of the work and made sure it was well supported.

Strong leadership at the Board level and among partners and researchers played a big role in the evolution of the model forest and fRI Research. The list is long, and the names come up repeatedly in the preceding chapters. Many of the researchers have been leaders in their fields. Working on these programs and projects has contributed to the distinguished careers of some alumni as well as current researchers. Among those brought to mind are:

- Former general managers Rick Blackwood and Mark Storie, now respectively assistant deputy minister, Strategy, Alberta Environment and Parks, and regional director, Kananaskis, Alberta Environment and Parks
- Janaki Alavalapati, socio-economic researcher and doctoral candidate at the University of Alberta (UofA), now dean of Auburn University's School of Forestry and Wildlife Sciences in Alabama
- Current program leads Gord Stenhouse and David Andison, whose work is world renowned

Another strength arose from the dual role of Board members, bringing in the views of their respective organizations and carrying back the results of research. John Kerkhoven from the oil and gas industry and Darren Tapp from the provincial government were among the many current and former directors who cited the value of their participation. The interaction among representatives of multiple jurisdictions, industries, and organizations on the Board contributed to the weight and value of its decisions. The Board also opened up communications and collaboration across jurisdictions such as between Alberta Crown lands and Jasper National Park. Board involvement helped to keep project participants engaged and willing to share decision making. For example, Michel Audy of Parks Canada said that the collaboration had significant impacts on Jasper National Park's approaches to wildfire management, public engagement, and ecological planning, programs, monitoring, and reporting.

Program Highlights

The model forest's core land base, including Jasper National Park, provided an ideal laboratory to develop the concepts and practices for sustainable forest management. The area was large enough to encompass a variety of ecosystems at a landscape scale. Major efforts went into developing inventories where none existed and to adapt existing classifications to a common system that facilitates landscape-level analysis and actions. In gathering the information and knowledge to support this research, the geographic information system (GIS) grew from megabytes to terabytes. The resulting quantity, quality, and complexity of data on a wide spectrum of resource values within the 2.75 million hectares of the "core" research area are quite probably unmatched in any other region of North America at that scale.

The multiple jurisdictions and management objectives enabled useful comparisons and evaluations. There was a long enough history of human interventions and scientific research to provide baseline datasets. Each of the aspects of sustainable management, with the possible exception of Aboriginal engagement, could be examined in depth, and they were.

Biodiversity Conservation

The model forest and fRI Research have pursued both the prevailing approaches to the conservation of biological diversity—the "fine filter" focus on individual species and habitats and the "coarse filter" based on ecosystems and the range of natural variability—which complement one other; each contributes to adaptive, sustainable management. The model forest also developed an initial large-scale biodiversity monitoring protocol that later left the model forest and was refined into the protocol now used by the Alberta Biodiversity Monitoring Institute.

The Terrestrial Wildlife Program continued work begun by Weldwood and the UofA to develop habitat suitability models for more than 30 species, chosen as representative from among nearly 300 vertebrate species in the foothills region. Further studies of the species fine-tuned the models, and they are still used in forest management planning and elsewhere to ensure that adequate habitat is available for the various species types. The work provided new insights into species such as the pileated woodpecker and long-toed salamander.

The Grizzly Bear Program, begun in response to the Cheviot mine hearings, received more funding than any other single area during the 25 years of the institute's evolution, thanks in no small part to the fundraising efforts of the program lead, Gord Stenhouse, combined with the grizzly's status as charismatic megafauna. The findings were mostly good news for government and industry because they showed that many land uses were not incompatible with grizzly bear conservation. The program had a high profile with media and the public, led to new management strategies, and produced internationally acclaimed science. Caribou were more problematic, and the universities and the provincial government, through the West Central Alberta Caribou Standing Committee, conducted most of the research during the model forest era. This species—at the southern extreme of its range and declining in protected areas as well as industrial forests—later became a focus for fRI Research. Harlequin ducks have also been studied in an intermittent series of projects as funds became available.

The coarse-filter counterpart was the Natural Disturbance Program (later renamed Healthy Landscapes), which examined the historic patterns and rates of wildfires to determine the natural range of variability among ecosystems across the landscape and described how that information could be used to adapt and improve management systems. The program, led by David Andison, laid the groundwork for the ecosystem-based management (EBM) implemented across Western Canada since the early 2000s. Significant changes due to this research include stand-structure retention, aggregated ("single-entry") harvests using natural boundaries, and the use of much larger, landscape-level planning units.

Taken together, the biodiversity research programs support sustainable forest management based on planning, monitoring, and adaptation.

Forest Productivity

Research at the model forest and fRI Research has led to advances in forestry practices and understanding of forest ecosystems in areas such as management systems, forest productivity, community protection, and wildfire threat abatement. The research also continued and expanded the progressive forestry approaches applied on the Hinton FMA area since the 1950s.

The first step was building a comprehensive GIS data model, which became the basis for the development of decision support systems that included the multiple uses, resources, and values of the forest landscape. A common method of ecosite classification, extended to Jasper National Park after 1997, supported this effort, as did the local level indicators of sustainability and the development of inventories for provincial parks within the research land base. These information systems contributed to forest company and national park management plans and provincial land management strategies.

Some operational forestry projects shifted outside the model forest aegis because, if federally funded, they might have triggered environmental impact assessments. A shelterwood trial, conducted in 1993 and 1994 by the UofA and CFS, reported that site conditions improved for spruce regeneration. Vic Lieffers of the UofA recounted in a March 2016 interview, however, that a walk-through in 2015 showed that the stocking appeared to be "below expectation." Remeasurement might provide useful insights. No final report was received for this project, or for others, an issue we discuss later in this chapter.

Research on enhanced forest management, led by Dick Dempster, got underway in Phase II with funding from the model forest. The common need of both industry and government for a collaborative approach to growth and yield research became the basis for establishing the Foothills Growth and Yield Association (FGYA), which later became one of the founding members of the Forest Growth Organization of Western Canada (FGrOW). Measurements of growth and yield will continue as the sample plots grow toward maturity. Newer research areas include the effects of climate change and mountain pine beetle infestation.

The FGYA work led to development of the Foothills Reforestation Interactive Planning System (FRIPSY), a decision support tool based on the original project's 14 years of measurements. For the first time, planners can confidently predict lodgepole pine establishment and performance results based on site, stand, site preparation, planting, and vegetation management factors. As a result, it is now possible for planners to link post-harvest treatment options to final stand performance and annual allowable cut (AAC) contribution, a remarkable achievement.

Wildfire research was not only essential for the Natural Disturbance Program, it also led to focused studies of several major wildfire events and their effects, and then to recommendations for management, mitigation, and regeneration. The model forest collaborated with Jasper National Park to develop, implement, and evaluate effective solutions for reducing wildfire threats as well as restore representative ecosystems through the park's FireSmart-ForestWise program. This research, as well as funding from the model forest, also aided the development of Prometheus, a widely used wildfire growth model.

Alberta forests came under growing threat from the mountain pine beetle in the 2000s, leading to the creation of the fRI Mountain Pine Beetle Ecology Program (MPBEP) and the institute's designation as the provincial science centre for the research on the infestation. Key studies have included susceptibility and risk rating, control strategies, science information, regeneration management, effects on hydrology and endangered species, and social and economic impacts.

Water and Fish

One of the first model forest projects was developing a watershed assessment model that would integrate with the GIS and decision support system. Building on earlier work in the United States and Canada, the model incorporated hydrological, aquatic, and fisheries databases. Adaptations of it continued to be used in various planning applications as recently as 2012. Later model forest research produced a water yield indicator as part of the Local Level Indicators Program.

Fish inventories and habitat classification in the 1990s led to revisions in fishing regulations, the production of a manual on consistent data collection, and operational changes in forestry operations, road construction, and energy sector activities.

Watershed and fishery research inevitably focused on stream crossings—the critical points where roads, railways, pipelines, and cutlines cross flowing water and cause problems such as erosion, siltation, and blockage of fish movement. The Hardisty Creek Restoration Project, led by the Athabasca Bioregional Society with scientific support from the institute, demonstrated the effectiveness of coordinated remediation and also provided an opportunity for community engagement. Unfortunately, Canadian National Railway (CNR) has not maintained the streambed at the outlet below the railway's Hardisty Creek crossing, and it has reverted to a fish barrier.

The research showed that all of the owners of bridges, culverts, and fords in a watershed needed to collaborate and participate to provide effective fisheries and watershed protection. The resulting Foothills Stream Crossing Partnership brought together almost all the region's crossing owners in a robust program of inspection, prioritization, and remediation, which became the model for subsequent province-wide government policy. Although Alberta Transportation and the CNR were involved in early discussions of the program, as of 2018, they had not joined the partnership, nor had the major transmission pipeline companies.

Other model forest water research produced a GIS-based watershed and stream-classification system and a handbook for riparian area management. Subsequent fRI work developed a field manual for erosion-based channel classification that is used by Hinton Wood Products and the Government of Alberta. The program also used LiDAR imagery to create a watershed-mapping application called Netmap that has been adapted for multiple uses in other jurisdictions, although the Government of Alberta adopted a different wet-area mapping approach.

Since 2011, a new Water Program has focused on forest hydrology—the quantity and quality of water flowing from forest landscapes—on a province-wide scale. The program has undertaken research on the watershed effects of wildfire and mountain pine beetle disturbances, and it has reexamined earlier research, dating back to the 1960s, to develop long-term data sets that help illuminate cumulative effects. One study is examining the potential effects of underground geology on water flows in the foothills.

Climate Change

CFS researchers developed a carbon budget for the model forest that showed how management could increase carbon sequestration. This work contributed to the development of national and international carbon accounting models that continue to be used, adapted, and refined. The research indicated some potential for marketable carbon credits from forestry, but this option has not been pursued because the findings also underlined the offsetting risks and uncertainties associated with future wildfires, insect infestations, and drought.

In addition, the model forest and fRI Research have contributed to knowledge of past, present, and future climate impacts on forest growth and yield, wildfire patterns, insect and disease vulnerability, wildlife species and habitat, and hydrology. Tree Improvement Alberta, a consortium hosted by fRI Research and now part of FGrOW, is studying how genetics and tree improvement can assist adaptation to future climate conditions.

Social Science

Social scientists examined many facets of sustainability during the model forest era. The findings contributed to the development of local level indicators, advanced understanding of public values and engagement processes, and modelled the economic and social impacts of forestry, mineral extraction, tourism, and recreational activities. The work aided initiatives such as the FireSmart-ForestWise Program in Jasper National Park, and the program's publications continue to be used and cited at the local, national, and international levels.

After the model forest became an independent institute in 2007, the Social Science Program was dropped due to lack of funding partners. However, social scientists continue to be involved in programs such as Healthy Landscapes, Water, Mountain Pine Beetle, Caribou, and Grizzly Bear.

Society's Responsibility

Between 2002 and 2009, the Aboriginal Involvement Program worked with Aboriginal communities to conduct traditional land-use studies and developed a "one-window" system for referrals from companies planning activities that could affect Aboriginal traditional-use areas. The referral system was not adopted due to changing government policies and other factors, but the program forged new relationships and helped build capacity in Aboriginal groups. Aboriginal engagement has continued as part of the Caribou Program and other fRI Research activities.

Public education was a priority during the model forest era and included initiatives such as a speakers' bureau, an executive series targeting senior decision makers, presentations in Jasper National Park and Switzer Provincial Park, and materials and programs for teachers developed with the Friends of Environmental Education Society of Alberta (FEESA, renamed Inside Education in 2005). Since the launch of the model forest's first website in 1997, the Internet has become an increasingly important communications tool. The website now features a wide variety of multimedia presentations.

As more results flowed from research programs, more emphasis was given to transferring knowledge to practitioners and decision makers. The means of transfer include field trips, workshops, courses, conference presentations, short reports (QuickNotes), other reports, infographics, and peer-reviewed publications.

Applying research on the ground led to the formation of three organizations that develop and deploy science: the Forest Growth Organization of Western Canada, the Foothills Stream Crossing Partnership, and the Foothills Landscape Management Forum. They find their operations are streamlined and expedited by operating under the fRI Research administrative umbrella and deriving such services as GIS and funds management. In addition, fRI Research hosts the Land-use Knowledge Network as a resource for the Alberta Land-use Framework.

The Forest History Program has documented the evolution of the human presence and management on the landscapes in and around the core research area in west central Alberta. Its publications provide new insights into the landscapes, the ecology, the First Nations, early visitors, the fur trade, the federal and provincial policies and administration, and the challenges and successes of adaptive management strategies.

Missed Opportunities

The Board oversees the programs at the institution and ultimately must decide, in the interests of the partnership, which programs or projects continue and which do not. Still, despite the depth of Board and partner involvement, there were instances where a program's original intent or subsequent research pointed in one direction while partners chose to pursue a different course. For example:

- The Forest Technology School was a partner in developing the initial proposal and work plans for the Foothills Forest, yet the school did not follow through with its commitment (Chapter 1) to a leading role in model forest training, technology transfer, and demonstration projects.
- The Government of Alberta funded and actively supported the development of the *Northern East Slopes Integrated Resource Management Strategy* between 2000 and 2003, and the government asked the model forest, located within the region, to provide much of the supporting research and technology for it (Chapter 2). This major effort was largely discarded, and perhaps forgotten, a year later when the Land-use Framework process began. Al Sanderson, the director hired by the Government of Alberta to develop the initial strategy, asserted that the final report had a significant influence on the Land-use Framework.

- The Foothills Stream Crossing Partnership (Chapter 5) has been a great success and the model for province-wide policy, yet in some areas its work is less effective without active participation by Alberta Transportation, the railways, and other utilities.
- The Highway 40 North Demonstration Project (Chapter 3) held great promise as a demonstration of ecosystem-based management based on natural disturbance. All partners were at the planning table until the time came to move from planning to action, at which point Alberta Parks rejected all thoughts of prescribed burning within the Willmore Wilderness portion of the demonstration area.
- The Aboriginal Involvement Program (Chapter 8) seemed to have Government of Alberta support for a collaborative method to develop an effective referral process, along with compiling and storing traditional land-use information for the participating Aboriginal communities, yet final approval to implement the process was withheld (Chapter 8). The government later offered fRI Research funding for traditional-use studies, but by then the institution had moved on and did not have the resources and expertise to reactivate the program.
- The model forest and the Foothills Research Institute devoted major efforts to several watershed assessment, mapping, and classification projects, yet the Government of Alberta, in the case of one of the most significant classification and modelling advances, chose to go with a different direction and model (Chapter 5).

Former fRI president Jim LeLacheur said that the institution might have benefited from a "more robust communications strategy and program" to build public and political support for its programs and findings. Others, including forest hydrologist Rich McCleary and former director and Board chair Kevin Van Tighem, made similar points.

The model forest's collaboration with the Chihuahua Model Forest was another missed opportunity, due mainly to lack of support from the Mexican government, which led to its cancellation by the Government of Canada. This outreach also encountered resistance from some members of the model forest Board, who did not see it as value for money expended. Ultimately, had it continued, the collaboration would have been a good fit for the Foothills Model Forest and opened the door to greater international involvement. Other opportunities for cooperation and collaboration were passed up when the fRI Board withdrew from the Canadian Model Forest Network and, regrettably, the International Model Forest Network.

Other Challenges

Core funding for the work of the institute was negatively impacted following the 2015 Alberta election and restructuring of the government ministries. Although Alberta Environment and Parks continues to actively support the work of the institution through direct project funding (e.g., Grizzly Bear) and the secondment of Gord Stenhouse to the Grizzly Bear Program, the department has unfortunately suspended its core funding commitment.

The broader application of the Healthy Landscapes Program's ecosystem-based management to landscape-level management has been impeded by reluctance of the Government of Alberta to mandate it as a provincial approach. The provincial government continues to support the research, but there are indications that implementation is held back in some regions due to individual viewpoints of provincial government representatives.

From the outset, model forest research benefited from the participation and in-kind commitment of government and university researchers as well as graduate students. Unfortunately, until very recently, this research did not always result in a report that was specifically for the use of, and publication by, the model forest or fRI Research. We have been assured that this has now been corrected, and any graduate student or scientist conducting research as part of the institution's programs must produce a report for fRI Research.

Observations and Recommendations

There is no question that the remarkable enterprise that began as Foothills Forest and continues today as fRI Research is an unparalleled success story of Canada's *Green Plan* and the Canadian Model Forest Program. The research coming out of the nearly $100 million spent in the first 25 years has changed the face of forest management, particularly in Western Canada. This is not to say that there have been no hiccups along the way—or lost opportunities that could have added even more to this legacy—but the drive to succeed has been, generally, uninterrupted.

There are many reasons why fRI Research succeeded where others failed, and we have attempted to identify these as we talked to people who played leading roles in this 25-year journey, studied various publications and reports, reviewed questionnaires, and mined the Internet for further information. Along the way, we renewed acquaintances with old friends and colleagues and accumulated some 3,000 files of information about the program.

In the Introduction, we discussed the DIKW hierarchy—data, information, knowledge, and wisdom. The model forest and fRI Research have amassed large amounts of the first three. The challenge is always making that final step to wise decision making.

The drawn-out effort to develop and implement the Alberta Land-use Framework shows how difficult it is to move beyond "everything, all the time, everywhere" multiple-use management. This is even true in parks and protected areas where sustaining ecosystem values may conflict with wildfire management, recreational uses, transportation systems, or energy transmission. Citizens, industries, and governments at all levels face tough choices as they deal with issues such as water conservation, wildlife protection, recreational demands, wildfire safety, and the economic viability of energy and forestry industries and the communities they support. Politicians, regulators, bureaucrats, and corporate leaders need authoritative science from trusted sources to justify their decisions.

Holistic Approaches

As Dennis Quintilio noted (see Chapter 1), knowledge often tends to accumulate in vertical "stovepipes," or silos, with little communication among the disciplines and practitioners. The Boards and partnerships of the model forest and fRI Research have made progress toward greater integration of knowledge and practice into more sustainable frameworks. However, most of this has occurred within a bigger "stovepipe" consisting mainly of large forestry operations, upstream energy companies, and government officials with environmental or forestry responsibilities. Unfortunately, recent government and departmental reorganizations appear to have encouraged the reconstruction of the division between some of these silos, particularly between forestry officials and those responsible for wildlife and parks.

Notably absent have been the federal and provincial energy and transportation officials and regulators, the railways, and the energy transmission companies, all of whose decisions and actions have significant impacts on forest landscapes and ecosystems. For example, three of the biggest "clear-cuts" in Alberta are the Highway 63 right-of-way and the two utility corridors connecting the Fort McMurray oil sands region to southern Alberta—each of which disturbs hundreds of thousands of hectares, areas comparable to the largest wildfires.

The widening scope of many programs outside the original land base may create new opportunities for Indigenous involvement. Greater engagement with environmental and recreational non-government organizations could also provide useful perspectives and bring more "buy-in" for science-based land management decisions.

The omissions arise, in most cases, because those parties are unable or unwilling to provide funding, something that could best be addressed at the political level. Political support from members of the legislative assembly and federal and provincial Cabinet ministers played a big role at times in the past, and opportunities should be sought to reach those levels again.

Former Board member Jerry Sunderland suggested bringing back the federal role in fRI Research. "There are synergies in advancing sustainable resource development that can only be developed though national and international partnerships," he said. "The network should be strengthened, and federal funding should be applied to national issues, such as wildfire management." The CFS and Jasper National Park have been excellent partners, but there could be significant roles for other federal agencies. Fred Pollett, the "godfather" of the Canadian Model Forest Program, in his Foreword for this book, also encourages the institution to re-engage with the International Model Forest Network.

Continuity of Programs and Funding

Continuity of research—personnel, documentation, and datasets, including regular remeasurement—is a major factor in the institute's success in areas such as lodgepole pine growth and yield and the Grizzly Bear Program. However, start-and-stop research has hindered work in fields such as forest hydrology. The halted Climate, Social Science, and Aboriginal Involvement Programs have continuing relevance for sustainable management, and it is now more difficult to resurrect them if needed, although some of their work has been integrated into other programs.

The short-term nature of funding creates additional uncertainty about maintaining the crucial underpinnings for research, including support for key staff in administration, finance, communications, and GIS. Funding was reasonably certain with the federal commitment during the Model Forest Program and, when that was reduced in Phases II and III, the commitment of the shareholders to make up for the shortfall. The subsequent trend to year-by-year funding is a concern. Ideally, there should be something such as an endowment to ensure core funding on a continuing basis. Some programs and services could also generate revenues—perhaps there should be "fRI Consulting Inc."

It may also be time to reconsider the funding model for projects and programs and to apply a higher surcharge for administration. The UofA, for example, adds 20 percent for administration costs for exactly that reason, and it is not alone. Other research institutions in North America charge as much as 50 percent to cover administrative costs. fRI Research has a bit of an advantage over those institutions, since it is largely hosted at minimal cost by the Government of Alberta in the Hinton Training Centre, but even so, the current administration charges against projects may not be proportional to the costs of providing the services.

Public Education and Communications

The model forest had a significant public education component, including the speaker's bureau, school and campground presentations, community projects such as the Hardisty Creek restoration, and the teachers' institutes with FEESA. Newsletters, media releases, tours, and interviews also brought a moderate level of public awareness. Most of that effort ended as the institute put greater emphasis on communications with partners and practitioners. The shift was a "critical mistake," according to former Board chair and Hinton mayor Ross Risvold. "It will be too late to recover when you want and need public and political support."

The fRI Research website remains a significant public communications medium. It became arguably less user-friendly in recent years—in part because of the wide and ever-expanding scope of its contents—but a recent revision looks like an improvement. Also, the expansion of fRI Research findings and programs into social media such as Facebook is very encouraging (although some people have privacy and security concerns about using Facebook). The Land-use Knowledge Network aims for a broader audience, and we encourage fRI Research to continue build its public communications program. In 2018, fRI Research launched its first *fRI Research Brief* to its email and social media subscribers. This looks like a very promising public communications initiative.

Knowledge Sharing

Jim LeLacheur, former Board member and fRI president, and now retired as West Fraser's chief forester, said that scientific credibility is an important asset in addressing contentious issues.

> "Perhaps the greatest example of this was how the Grizzly Bear Program constantly rose above this controversial topic as a result of becoming the credible broker of knowledge on the subject locally, nationally, and, increasingly, internationally." –Jim LeLacheur, questionnaire response, 2015

Scientific credibility is heavily dependent on peer-reviewed publications, and the Board has given them heightened priority in recent years. Such publications, with their emphasis on methodology, are necessary and important for scientific recognition. There is, however, a concern that they do not meet the needs of practitioners who are less interested in methodology and more interested in details about results and application to improve practices. fRI Research needs to carefully manage this balance and ensure that the professionals with "boots on the ground" remain the primary focus of publications and technology development. The latter need is being addressed to some extent by workshops, courses, and other presentations, in person and on the website.

David Andison observed that it takes as much time and intellectual resources to produce practitioner-focused reports as it does to produce peer-reviewed publications. The writer's mind must be focused on one or the other, he said, and it would be difficult to do both even if time were not a factor, which it is. The QuickNotes report system that Andison conceived was a great example; the reports had a huge following, and the underlying research was the same, but the emphasis was on outcomes and interpretation. Sharon Meredith provided the perspective of a practitioner using the research.

> "Part of the reason, in my view, that people so often fall short in making that next step of communicating to practitioners is because the people who are doing the research don't understand what the practitioners want to know. From our perspective, it's critical that we meet the needs of industry. We won't exist if we're not doing that." –Sharon Meredith, FGrOW director, personal communication, 2016

The Grizzly Bear Program has had an emphasis on peer-reviewed publication from the outset to build credibility in the scientific community, and other programs are now encouraged by the institute to emulate this example. Most of these reports, published in scientific journals, cannot be posted on the fRI Research website because of copyright rules. In some ways, this absence degrades the perceptions of the scope of research conducted at fRI Research.

However, the Grizzly Bear Program also expends enormous resources on interpretation and the development of knowledge and tools for practitioners, as do the Healthy Landscapes Program and the Mountain Pine Beetle Ecology Program. The Grizzly Bear Program is currently developing a "best practices" report that will summarize the body of research to date with an emphasis on practical applications in planning and operations.

Jerry Sunderland suggested that internal peer review might be another way to add credibility to research results. "The fRI might consider adding a level of review through a peer-review panel specific to each program," he said in a questionnaire response.

In 2012, fRI Research established a Science Advisory Committee of four scientific experts to provide independent oversight of fRI Research programs, including maintaining the focus on practical problems facing managers and policy makers, strong science, and effective communication with the beneficiaries of the programs. Unfortunately, this does not appear to address the issue of publication prohibitions.

We reviewed the fRI Research publishing policy as part of our work on this book. The policy recommends publishing in open-access journals, a growing trend in academia, and we would prefer to see this made mandatory. We also suggest updating the policy to add two clear requirements: a) no fRI Research funding will be provided unless a report is produced for the use of fRI Research and its partnership, and b) peer-reviewed research papers should include reports for posting by fRI Research that provide clear descriptions of the reasons for the research, the knowledge gained as a result, and recommendations for application in improved resources management. Taking this one step further, it would be useful to consider adopting FRIP's funding grant policy, which withholds a portion of the funds granted to projects until the final report is delivered and accepted.

Evaluations and the Historical Record

Internal communications raised issues, too. At the end of each of the first two phases of the Model Forest Program, comprehensive evaluations and reports were developed that summarized the delivery of research against plans. The Phase III evaluation was never completed, although a framework was in place for it. These reviews were derived from annual work plans and reports by programs within the model forest, and they were very helpful in the development of this 25-year history, as were the annual work plans themselves. We recommend a formal five-year review as part of every strategic plan, with the criteria for the review to be included in the plan itself.

With the switch from paper-based annual work plans to digital work plans individually entered into databases, which began around the beginning of Phase V, as well as the move toward higher-level strategic five-year plans, it became very difficult to examine plans and deliveries for the various programs within the organization. We would strongly encourage a summary report every year that combines the work plans of each of the programs of fRI Research, including recaps of progress and achievements in the preceding years. This would, in our view, be of high value to internal audiences, including the Board, as well as the partnerships of the institution and forest historians of today and the future.

Application of Tools

As this book has described, the research findings and technologies developed in the first 25 years have been widely disseminated, and the results are evident as substantive changes in landscape and resource management practices. Times change, particularly when governments change, and separation of the forestry group from fish and wildlife in the new Alberta ministries since 2015 makes integrated management more of a challenge. (The separation of renewable-resource responsibilities from energy and transportation ministries has always been problematic.)

We also heard some concerns that the programs and tools of fRI Research are becoming less relevant to industrial users because current forestry-related guidelines from the Government of Alberta are more prescriptive in nature, leaving less room for adaptive management and flexibility in management approaches. One example of this is the *Local Level Indicators Report*, highly touted in 2003 by industry and the provincial government when released. While it may have influenced the Land-use Framework process that began a year later and the *Forest Management Planning Manual* released in 2006, that influence was not acknowledged except through our interviews with Al Sanderson and Jerry Sunderland. Jim LeLacheur addressed the issue of diminished influence in his 2015 questionnaire response. LeLacheur said that some politicians regard fRI Research as "little more that than a gentlemen's club for industry," and he added, "If this negative attitude gains momentum, the fRI partnership will diminish over time due to perceived ineffectiveness. Continual campaigning in the legislature is required …. Shareholders need to conduct a

Board effectiveness review and address this issue." We agree with LeLacheur's recommendation.

During most of the first 25 years, the model forest and fRI Research benefited from the enthusiastic support of local MLAs and provincial ministers such as Ty Lund, Ted Morton, and Robin Campbell, who championed the work of the institute in the legislature. The work of Board members and assistant deputy ministers, especially Cliff Henderson and Bruce Mayer, in maintaining this communication has been and continues to be very important. We recommend that fRI Research continue and expand its efforts to communicate the importance and the applications of its work to elected officials at every level of government.

International Linkages

In December 2010, Foothills Research Institute suspended its membership in both the Canadian Model Forest Network and the International Model Forest Network. Although the Canadian network itself suspended operations as of March 2017, the international network continues to thrive and expand, with the secretariat housed in Ottawa. The collaboration between the two bear research programs in Canada and Scandinavia has shown the benefits to both, and other opportunities may be available that would be hard to identify without participation in the network. We agree with Fred Pollett's recommendation in the Foreword to this book: "I also hope fRI Research creates strong links with the International Model Forest Network (IMFN). There is much the network can gain from your experience and much more that you can receive from the network." As part of an expanded outreach program, it would be useful to open a discussion with the federal government about possibilities for support to fRI Research to rejoin and contribute to this network.

People are the Key

It is important to recognize those who have played such a major role in the development of this remarkable research institution. Many individuals, too many to list, worked on a host of research projects and programs over the years, and some have gone on to distinguished careers which, we hope, were in part attributable to their experience working with this research institute. While it would be impossible to list everyone, we specifically want to list those who have served on the Board (Appendix 1), the excellent staff who have served, and who continue to serve, the needs of the research programs and partnerships (Appendix 2), and the program leads who have played such a major role in developing and managing the activities and products of the various programs of the organization over the years (Appendix 3).

Going Forward – the Next 25 Years

> "As we branch into new and exciting opportunities, the passion and expertise of our programs' researchers will continue to be this organization's most valuable asset as our partners face the challenges and pressures from our changing landscape. fRI Research will continue be the trusted, credible, and efficient research organization we have always been, and we owe that in large part to the legacy built on the foundation of 25 years of practical, applied research." –Jesse Kirillo, personal communication, 2018*

fRI Research has produced its strategic plan for the current five-year period (Appendix 4), and it is encouraging to see that the focus of the organization remains firmly fixed on those who will take its work and translate it into improved practices on the landscape. The vision statement, "Our world-class research improves land and resource management," is right on target. The mission statement also responds exactly to many of the points and recommendations contained in this historical review: "We develop understandable scien-

* Jesse Kirillo, an Edson-based external relations coordinator with Repsol Oil & Gas Canada, joined the fRI Research Board in 2013 and became president in January 2017.

tific knowledge and useful land management tools based on strong peer-reviewed science." We hope that the output remains peer-reviewed but practitioner-focused, with practical, coherent, and accessible reports on all research projects. If so, the future looks bright for fRI Research.

Final Thoughts

The publication of *Learning from the Landscape: The fRI Research Story* closes the loop on the Forest History Program at fRI Research. In writing it, we were impressed by how far research at the institute has progressed from traditional forestry research to where it now encompasses a broad spectrum of other resource values. Our first book in the Forest History series, *Learning from the Forest*, told the story of the evolution of adaptive management on the industrial forest that was the foundation of the model forest proposal at Hinton. Our hope is that this much bigger story helps to set the stage for the next chapter in the progress of a remarkable institution.

It has been a pleasure for us to work on this project, and we are grateful to our major sponsors in Alberta Agriculture and Forestry and the Forest Resource Improvement Association of Alberta. Both the Government of Alberta and FRIAA-administered funds have been major supporters of the work of the model forest and fRI Research over the first 25 years. Without their backing, it would never have been possible for fRI Research to achieve the status it enjoys in the Canadian forest research community. We are also grateful to the many people who made themselves available for interviews, responded to questionnaires, and helped us by reviewing chapters as we proceeded.

We have attempted to fairly reflect the opinions expressed to us and the extensive files we have reviewed. Naturally, as long associates with the model forest and fRI Research, our own views and opinions cannot help but be reflected in the report, and we take full responsibility for any inaccuracies, errors, or oversights.

Bob Udell and Bob Bott
April 2018

Attendees – 25th Anniversary Celebration October 2017

Axel Anderson
Tom and Katherine Archibald
Judy Astolos
Chantelle Bambrick
Ngaio Baril
Rick and Norma Bonar
Bob Bott
Mike Brackley
Richard Briand
Tom Burton
Robin Campbell
Shawn Cardiff
Brian and Lois Carnell
Mark Cookson
Risa Croken

Heather Daw
Dick Dempster
Carol Doering
Sabrina Doyle
Julie Duval
Dan Farr
Laura Finnegan
Nicole Galambos
Rob Galon
Cemil Gamas
Rob and Karen Gibb
Pat Golec
Kira Goodwin
Karen Graham
Ken Greenway

Dawna Harden
Cliff Henderson
Stan Holmes
Ron Hooper
Mackenzie Irwin
John Kerkhoven
Jesse Kirillo
Tammy Kobliuk
John and Sharon Kristensen
Terry Larsen
Jackie Lopatka
Tonni Lopez Guadarama
Beth MacCallum
Keith McClain
Rich and Kris McCleary

Cam McClelland
Rachelle McDonald
Steven and Terri McHugh
Tracy McKay
Sharon Meredith
Marcel Michaels
Gary and Crystal Miller
Julienne Morissette
Mariana Moore
Debbie Mucha
Kevin Myles
Bob and Joy Newstead
Barry and Nicole Nobert
Steve Otway
Rob and Shireen Ouellet

Isobel Phoebus
Dennis and Leanne Quintilio
Stacy Renard
Kelsey Ridley
Ross and Gail Risvold
Eric and Linda Rosendahl
Gordon Sanders
Gary Sargent
Anja Sorensen
Adam Sprott
Gord and Karen Stenhouse
Mark Storie
Ivan and Tammy Strang
Murray Summers
Darren Tapp

Ryan and Kimberley Tew
Robert Thibault
Ciaran Thompson
Wayne Thorp
Laura Trout
Bob and Joan Udell
Brian and Eileen Wallace
Christian and Leanne Weik
Lorne West
Ben Williamson
Dan Wismer
Susan Wolff

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Brian Carnell Photography

Appendix One: Board Members from 1992–1993 to 2017–2018

Names in bold are current members of the fRI Board as of March 2018

Rod Alexis	Alexis Nakota Sioux Nation		October 2004	June 2007
Jeff Anderson	Parks Canada, Jasper National Park		November 1996	June 1998
Michel Audy	Parks Canada, Jasper National Park		November 1994	March 1997
Rob Baron	West Fraser Mills Ltd., Hinton Wood Products		October 2012	June 2014
Jim Beck	University of Alberta, Department of Renewable Resources		November 1992	June 2005
Ron Bjorge	Alberta Sustainable Resource Development, Wildlife Management Branch	Alberta Environment and Parks, Wildlife Management Branch (2015)	September 2006	October 2015
Rick Bonar	Leading 16West Fraser Mills Ltd., Hinton Wood Products		November 2004	January 2017
Mark Boulton	**Suncor Energy Inc.**		**June 2016**	
Richard Briand	West Fraser Mills Ltd., Hinton Wood Products			
Nick Burt	Elk Valley Coal, Cardinal River Operations		June 2005	June 2007
Tom Burton	Alberta Association of Municipal Districts and Counties		June 2013	January 2014
Tom Burton	Alberta Association of Municipal Districts and Counties		January 2017	January 2018
Shawn Cardiff	Parks Canada, Jasper National Park		September 2006	June 2009
Shawn Cardiff	**Parks Canada, Jasper National Park**		**October 2017**	
Frank Cardinal	Alberta Environmental Protection, Fish and Wildlife Services	Alberta Environmental Protection, Fish and Wildlife Division (1994)	November 1992	March 1996
Kyle Clifford	Alberta Community Development, Parks and Protected Areas	Alberta Tourism, Parks, Recreation and Culture, Parks and Protected Areas (2007)	June 2004	September 2010
Phil Comeau	University of Alberta, Department of Renewable Resources		February 2006	September 2011
Mark Cookson	**West Fraser Mills Ltd., Blue Ridge Lumber Inc.**		**June 2014**	
Wendy Crosina	**Weyerhaeuser Company Limited, Canadian Timberlands**		**June 2014**	
Garth Davis	**ConocoPhillips Canada**	**Cenovus Energy (2017)**	**February 2011**	
Bob Demulder	Alberta Forest Products Association		April 2002	October 2003
Bob Demulder	Alberta Chamber of Resources, Integrated Land Management Program		October 2004	February 2008
Conway Dermot	Environmental and Forestry Services		October 2008	July 2010
Steve Donelon	Alberta Tourism, Parks and Recreation, Parks Division	Alberta Environment and Parks, Parks Division (2015)	March 2014	September 2016
John Doornbos	Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre		March 2014	January 2018
Colin Edey	Nova Corporation and CAPP	Nova Corporation/Gas Transmission (1998)	November 1992	December 1998
Cory Enns	Alberta Aboriginal Relations, Consultation and Land Claims	Alberta Indigenous Relations, Policy and Capacity (2015)	October 2014	January 2017
Bill Fairless	Alberta Land and Forest Service, Edson Forest		November 1992	March 1995
Alan Fehr	**Parks Canada, Jasper National Park**		**January 2016**	
Greg Fenton	Parks Canada, Jasper National Park		December 2007	December 2015
Gaby Fortin	Parks Canada, Jasper National Park		November 1992	November 1994
Terry Fredin	Elk Valley Coal, Cardinal River Operations	Teck Resources Ltd., Cardinal River Operations (2008)	December 2007	October 2011
Edwin Frencheater*	Sunchild First Nation		June 2007	May 2011

Appendix One: Board Members from 1992–1993 to 2017–2018

Name	Affiliation at Time of Membership	Last Affiliation (if changed)	Date Elected	Date Resigned
Alex Galbraith (Deceased)	Town of Hinton		April 2002	October 2004
Paul Galbraith	Parks Canada, Jasper National Park		December 1997	June 1998
Rob Gibb	Talisman Energy Inc.		December 2007	June 2013
Earl Graham	Alberta Association of Municipal Districts and Counties		February 2015	January 2017
Dr. Ken Greenway	**Alberta Environment and Sustainable Resource Development, Policy Division**	**Alberta Agriculture and Forestry, Forestry Division (2015)**	**October 2013**	
Pat Guidera	Alberta Sustainable Resource Development, Integrated Regional Services		April 2002	February 2004
Dawna Harden	**Alberta Indigenous Relations, Stewardship**		**January 2017**	
Don Harrison	Alberta Sustainable Resource Development, Forestry Division		June 2008	December 2008
Dennis Hawksworth (Deceased)	Weldwood of Canada Limited, Hinton Division, Forest Resources		November 1994	November 2004
Cliff Henderson	Alberta Land and Forest Services, Forest Management Division		June 1993	March 1995
Cliff Henderson	Alberta Sustainable Resource Development, Forest Management Division		June 2001	June 2008
Doug Hodgins	Parks Canada, Jasper National Park		June 1998	October 1999
Stan Holmes	**Weyerhaeuser Company Limited, Alberta Timberlands**		**March 2012**	
Ron Hooper	Parks Canada, Jasper National Park		December 1999	December 2007
William Hume	Luscar Limited, Cardinal River Coals Ltd.		June 1999	July 2000
Darcy Janko	Encana Corporation, Environment Services		October 2008	December 2010
John Kerkhoven	Petro-Canada Limited	Suncor Energy Inc., Foothills Gas (2009)	October 1999	June 2016
Jesse Kirillo	**Talisman Energy Inc.**	**Repsol Oil & Gas Canada Inc. (2015)**	**December 2012**	
Dave Kmet	Alberta Forest Products Association, Forestry		September 2006	October 2008
John Kristensen	Alberta Community Development, Parks and Protected Areas	Alberta Tourism, Parks, Recreation and Culture, Parks Division (2007)	February 2002	June 2007
Rick Ksiezopolski	Weldwood of Canada Limited, Hinton Division, Forest Resources		February 2000	June 2002
Stan Lagrelle	Sunchild First Nation		June 2007	May 2011
Donald W. Laishley	Weldwood of Canada Limited, Hinton Division, Forest Resource Department		November 1992	January 2000
Jim LeLacheur	Weldwood of Canada Limited, Hinton Division, Forest Resources	West Fraser Mills Ltd., Alberta Fibre Supply (2005)	June 2003	December 2012
Vic Lieffers	University of Alberta, Department of Renewable Resources		October 2011	June 2016
Roger Loberg	Weyerhaeuser Company Limited, Grande Prairie Lumber		March 2012	June 2014
David Luff	Canadian Association of Petroleum Producers		October 1999	February 2004
Dave Lye	Encana Corporation, External Affairs		December 2007	October 2008
Ellen MacDonald	University of Alberta, Department of Renewable Resources		June 2016	
Ken Mallett	Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre		February 2010	December 2012
Sandra Marken	ConocoPhillips Canada		December 2010	December 2011
Bruce Mayer	**Alberta Sustainable Resource Development, Forestry Division**	**Alberta Agriculture and Forestry, Forestry Division (2015)**	**September 2010**	

Appendix One: Board Members from 1992–1993 to 2017–2018

Name	Affiliation at Time of Membership	Last Affiliation (if changed)	Date Elected	Date Resigned
Keith McClain	Alberta Sustainable Resource Development, Forestry Division	Alberta Environment and Sustainable Resource Development (2012)	February 2004	March 2012
Keith McDonald	Alberta Environmental Protection, Natural Resource Services, Fish, Wildlife and Parks		November 1996	October 1997
Rachelle McDonald	Aseniwuche Winewak Nation		October 2003	October 2008
Rachelle McDonald	Aseniwuche Winewak Nation		October 2013	December 2015
Paul McLauchlin	**Alberta Association of Municipal Districts and Counties**			
Lloyd Metz	Luscar Limited, Cardinal River Coals Limited		February 2002	October 2003
Lloyd Metz	Elk Valley Coal, Cardinal River Operations		June 2004	June 2005
Julienne Morissette	Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre			
Shira Mulloy	Canadian Association of Petroleum Producers		February 2004	June 2006
Robert Newstead	Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre		October 1997	April 2002
Jimmy O'Chiese	Foothills Ojibway Society		June 2007	March 2014
Steve Otway	Parks Canada, Jasper National Park		September 2006	March 2014
Cole Pederson	Alberta Aboriginal Relations, Aboriginal Consultations		March 2013	October 2014
Don Podlubny	Alberta Sustainable Resource Development, Environmental Training Centre		February 2002	July 2002
Mike Poscente	Alberta Environment, Land and Forest Service	Alberta Sustainable Resource Development, Land and Forest Service (2002)	October 1999	April 2002
Dennis Quintilio	Alberta Environmental Protection, Forest Technology School	Alberta Environment, Integrated Resource Management Division (2000)	November 1992	October 2001
Fred Radersma	**Norbord Inc., Woodlands Alberta**		**December 2015**	
Salman Rasheed	Parks Canada, Jasper National Park		January 2016	October 2017
Travis Ripley	**Alberta Environment and Parks, Policy and Planning Division**		**October 2015**	
Ross Risvold	Alberta Environmental Protection, Forest Technology School	Town of Hinton (1998)	November 1992	October 2001
Noel Roberts	Norbord Inc., Woodlands Alberta		December 2015	
Dan Rollert	Weldwood of Canada Limited, Hinton Division, Forest Resources		June 2002	June 2003
Dan Rollert	West Fraser Mills Ltd., Hinton Wood Products		December 2009	October 2012
Gordon Sanders	**West Fraser Mills Ltd.**		**December 2012**	
Al Sanderson	Alberta Environment, Integrated Resource Management Division, Strategic Directions		February 2002	June 2004
Gary Sargent	Canadian Association of Petroleum Producers, Resource Access		September 2006	September 2009
Eileen Sasakamoose	Alexis Nakota Sioux First Nation		October 2004	June 2007
Tim Sheldan	Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre		June 2009	March 2014
Neil Shelly	Alberta Forest Products Association		October 2003	September 2006
Doug Sklar	Alberta Sustainable Resource Development, Forest Management Branch		June 2004	September 2010
Jim Skrenek	Alberta Environmental Protection, Natural Resources Service	Alberta Environment, Natural Resources Service (1999)	October 1997	July 2001

Appendix One: Board Members from 1992–1993 to 2017–2018

Name	Affiliation at Time of Membership	Last Affiliation (if changed)	Date Elected	Date Resigned
Jim Skrenek	Alberta Sustainable Resource Development, Fish and Wildlife Division, Wildlife Management Branch		February 2004	June 2006
John Spence	University of Alberta, Department of Renewable Resources		June 2005	June 2011
Ron Staple	Weldwood of Canada Limited, Hinton Division		November 1992	March 1993
Russ Stashko	Alberta Sustainable Resource Development, Fish and Wildlife Division, Northern East Slopes Region		October 2001	April 2002
Graham Statt	Alberta Tourism, Parks and Recreation, Parks Division		September 2010	March 2014
Robert Stokes	Alberta Sustainable Resource Development, Forest Management Division		June 2009	January 2011
Mark Storie	Alberta Tourism, Parks and Recreation, Learning and Stewardship		February 2011	December 2012
Murray Summers	West Fraser Mills Ltd.		June 2005	February 2009
Jerry Sunderland	Alberta Environmental Protection, Land and Forest Service, Northern East Slopes Region	Alberta Environment, Land and Forest Service, Northern East Slopes Region (1999)	November 1996	October 1999
Jerry Sunderland	Alberta Environment, Land and Forest Service	Alberta Resource Development, Land and Forest Division (2002)	June 2000	February 2004
Marc Symbaluk	Teck Resources Limited Cardinal River Operations		May 2011	December 2012
Darren Tapp	**Alberta Sustainable Resource Development, Forestry Division, Forest Management Branch**	**Alberta Agriculture and Forestry, Forest Management Branch (2015)**	**February 2011**	
Jon Taszlikowicz	**Canfor Corporation, Grande Prairie Division**		**June 2015**	
Glenn Taylor	Town of Hinton		February 2005	December 2011
Robert W. Udell	Weldwood of Canada Limited, Hinton Division, Forest Resources		November 1992	March 2005
Kevin VanTighem	Parks Canada, Jasper National Park		November 2000	February 2005
Brian Wallace	Parks Canada, Jasper National Park		June 1998	October 2004
Dwight Weeks	**Canfor Corporation, Grande Prairie, Forest Management Group**		**September 2015**	
Bill Werry	Alberta Tourism, Parks, Recreation and Culture		December 2007	June 2008
Lorne West	Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre		April 2002	September 2009
John Whaley	Alberta Association of Municipal Districts and Counties, District 3-Pembina		January 2014	February 2015
Mel Williams	Luscar Limited, Cardinal River Coals Ltd.		February 2001	December 2001
John Wilmshurst	Parks Canada, Jasper National Park		June 2009	December 2011

Appendix Two: Full Time Staff 1992–2018

Name	Position	Date Started	Date Completed/Resigned
Cliff Mathies	Admin Coordinator,	1992	1995
	Controller	1994	1995
	Chihuahua Model Forest	1995	1997
Rick Blackwood	Planning Forester	1992	1993
	Project Coordinator	1993	1996
	General Manager	1996	1999
Birdie Blackwood	Admin	1993	1996
Roger Hayward	Operations Forester	1992	1994
Melissa Todd	Biologist	1992	1994
Carol Doering	GIS Analyst	1992	1995
Pat Golec	Communications/Tech Transfer	1992	1994
	Tech Transfer	1994	1994
Jody Watson	Research Assistant	1993	1995
Kent MacDonald	Operations Forester	1994	1997
Dan Farr	Biologist	1994	2000
	Biomonitoring	1998	2000
Marianne Gibbard	Wildlife Technologist	1994	1995
Wayne Bessie	Habitat Biologist	1994	1996
Janice Traynor	Watershed Coordinator	1995	1997
Bryan Miller	Communications/Tech Transfer	1994	1996
	Partner Liaison (part time)	1994	1996
Craig Johnson	Fisheries Biologist	1995	2003
Hillary Jones	Fisheries Biologist	1995	1998
Hillary McMeekin	Communications	1996	1998
Tammy Kobliuk	GIS Program and System Administrator	1997	2000
Julie Duval	**GIS Specialist**	**1998**	**Present**
Gordon Stenhouse	**Wildlife Biologist Grizzly Bear Research Project (renamed to Grizzly Bear Program in 2012**	**1998**	**Present**
Lisa Risvold	Communications/Tech Transfer	1998	2001
Lisa Risvold Jones	Communications/Extension Program	2003	2008
Mark Storie	General Manager	2000	2002
Christian Weik	GIS Analyst	1999	2006
Karen Graham	**Wildlife**	**1999**	**Present**
Rich McCleary	Fisheries Biologist	1999	2008
Kris McCleary	Project Mgr, NDP	1999	2008
Glen Hurley	PEEF Projects Coordinator	1999	2000
	FGYA	2000	2000
Denise Lebel	Accountant	1999	2013
Sheri Fraser	Executive Assistant	1999	2006

Appendix Two: Full Time Staff 1992–2018

Name	Position	Date Started	Date Completed/Resigned
Robin Munro	Grizzly Bear Biologist	2000	2004
Fran Hanington	**Communications Assistant**	**2000**	**Present**
Anna Kauffman	Communications/Tech Transfer	2001	2003
Fiona Ragan-Braun	Communications/Knowledge Trnsfr	2000	2002
Don Podlubny	General Manager	2002	2007
Bob Phillips	Aboriginal Involvement Coord	2002	2004
Jerome Cranston	Grizzly Bear GIS Analyst	2002	2007
Greg Nelson	Extension and Interpreter	2003	2006
Debbie Mucha	GIS Specialist	2006	2014
Terry Garvin	Aboriginal Involvement Coord	2004	2005
Bogdan Strimbu	FGYA	2005	2006
Bernard Goski	Grizzly Bear Program	2005	2009
Brad Young	Aboriginal Involvement Program	2005	2010
Melissa Pattison	**GIS Analyst (with GIS Program, then Aboriginal Involvement Program and then FLMF)**	**2005**	**Present**
Joan Simonton	Environmental Education	2005	2012
Judy Astalos	Executive Assistant	2006	2011
Heidi Schindler	Fisheries Biologist	2005	2007
Tom Archibald	General Manager	2007	2012
Heather Daw	GIS Analyst	2006	2008
Ngaio Baril	Fisheries Technician	2006	2007
	FWP Coordinator, FSCP	2007	2012
Janice Makokis	Admin Asst, AIP	2006	2009
Angie Larocque	Admin Coordinator, GBP	2006	2010
Chantelle Bambrick	**Field Tech., Fish & Watershed Program**	**1999**	**2006**
	Information Researcher CLMA (renamed Foothills Landscape Management Forum in 2009)	**2006**	**Present**
Tracy McKay	**Wildlife Biologist, GBP**	**2007**	**2015**
	Wildlife Biologist, Caribou Program	**2016**	**Present**
Katie Yalte	GIS Analyst	2008	2010
Sean Kinney	Communications and Extension	2008	2016
Chris Stockdale	Natural Disturbance Program	2008	2010
Axel Anderson	**Water Program**	**2010**	**Present**
Darren Wiens	GIS Analyst	2010	2013
Jennifer Hancock	Executive Assistant	2011	2013
Terri McHugh	**Alberta Land-use Knowledge Network**	**2011**	**Present**
	Communications Services	**2016**	**Present**
	Operations Manager	**2017**	**Present**
Laura Finnegan	**Caribou Program**	**2012**	**Present**

Appendix Two: Full Time Staff 1992–2018

Name	Position	Date Started	Date Completed/Resigned
Bill Tinge	General Manager	2012	2016
Terry Larsen	**Wildlife Biologist, GBP**	**2012**	**Present**
Risa Croken	**Finance/Admin**	**2013**	**Present**
Kevin Myles	GIS Analyst	2013	2015
Cemil Gamas	**Accountant**	**2014**	**Present**
Karine Pigeon	**Wildlife Biologist GBP**	**2008**	**Present**
	Wildlife Biologist Caribou Program	**2014**	**Present**
Doug MacNearney	Biologist, Caribou Program	2014	2016
Joshua Crough	GIS Analyst	2014	2016
Anja Sorensen	**Wildlife Biologist, GBP**	**2014**	**Present**
Faye Hirschfield	Technician - Water Program	2014	2016
Kelsey Greenlay	**Technician – Caribou Program**	**2014**	**Present**
Sarah Milligan	**Wildlife Biologist – GBP**	**2014**	**Present**
Ben Williamson	**Science Communication Specialist**	**2015**	**Present**
Ryan Tew	**General Manager**	**2016**	**Present**
Dan Wismer	**GIS Analyst**	**2016**	**Present**
Barry Norbert	**Wildlife Biologist, Caribou Program**	**2016**	**Present**

Appendix Three: Program Leads 1992 – 2018

Name	Project/Program	Date Started	Date Finished/Left
Sean Curry	Ecological Classification	1992	1998
	GIS	1992	1996
	Inventory	1992	1994
	Habitat Curves	1992	1995
	Watershed	1992	1995
	Blocking Model	1995	1996
	Landscape Forecasting	1995	1996
	Cooperative Management Planning Tools	1996	1998
	Regional ELC Development	1997	1998
Rick Bonar	Habitat Inventory/ Modelling	1994	2001
	Wildlife Habitat	1992	1994
	Pileated Woodpecker Study	1992	1997
	Local Level Indicators	1999	2000
Kirby Smith	Caribou	1992	2005
	Lichen Studies	1994	1994
Mike Wesbrook	Carbon Budget	1992	1994
	Parks Projects	1992	1994
Bill Rugg	Silviculture	1992	1995
	Shelterwood	1992	1995
	Environmental Impacts	1992	1995
Dennis Quintilio	Communications	1992	1995
	Socio Economics	1992	1995
	Community Forest	1992	1995
	NAIT Programs	1992	1995
	Training	1992	1995
	ESA process/designation	1996	1997
	IRM Strategy prototype NES	2000	2003
	Chisolm Dogrib Fire Initiative	2003	2005
	Fire Research	2005	2007
Sherry Maine	Trapping fur bearer use	1992	1995
	Horse Grazing Impacts	1992	1995
Lee Funke	Communications	1994	1995
	Partner Liaison	1994	1995
	FEESA	1994	1995
	Public Involvement	1996	1997
Roger Hayward	Silviculture	1994	1996
	Operations Projects	1994	1996
	Environmental Impacts	1994	1996
	Forestry Research	1996	1997

Appendix Three: Program Leads 1992 – 2018

Name	Project/Program	Date Started	Date Finished/Left
Dan Farr	Natural Disturbance	1994	1998
	Yellowhead Ecosystem Working Group	1995	1995
	Wildlife and Ecosystems	1996	1997
	Alberta Forest Biodiversity Monitoring	1998	2000
	Harlequin Duck Program	1999	2000
Rick Blackwood	Socio Economics	1994	1997
	Communications	1995	1999
	Tech Transfer	1995	1997
	Public Affairs	1995	1999
	GIS	1996	1997
	Resource Management	1996	1997
	Local Level Indicators	1998	1999
	Carbon Budget	1998	1999
George Mercer	Yellowhead Ecosystem Working Group	1995	1996
	Carbon Budget	1997	1998
	Cumulative Effects	1997	1998
	JNP Projects	1999	2000
Tom Beckley	Socio Economics Program	1994	1999
Kent MacDonald	Forestry Research/ Enhanced Forest Management	1996	1998
Jan Traynor	Watershed and Fisheries	1996	1997
Craig Johnson	Watershed and Fisheries	1998	1999
	Fish Inventory/Monitoring	1998	1999
	WAM Revision/Completion	1998	1999
	Fisheries and Aquatics Program	1999	2003
	Harlequin Duck Program	2000	2003
Gord Stenhouse	Watershed and Fisheries	1996	1997
	Wildlife and Ecosystems	1996	1997
	Grizzly Bear Research Project (changed to Grizzly Bear Program in 2006)	1997	Present
Tammy Kobliuk	GIS Program	1997	1999
Hilary McMeekin	Communications	1996	1998
Ross Risvold	Tech Transfer	1997	2000
	Community Sustainability	2000	2002
David Andison	Natural Disturbance Program (becomes Healthy Landscapes Program in 2012)	1998	Present
Cordy Tymstra	Willmore Inventory	1998	2000
	Wildland Fire growth model	2000	2003
Alan Westhaver	National Parks Program	1998	2000
	Montane Fire Effects	2001	2003
	Historic Vegetation Change	2001	2003

Appendix Three: Program Leads 1992 – 2018

Name	Project/Program	Date Started	Date Finished/Left
	FireSmart Forest Wise	2003	2007
	MPB	2003	2004
Bob Udell	Adaptive Forest Management/History Program (became Forest History Program in 2012)	1998	Present
	FGYA	2008	2011
	Yellowhead Ecosystem Group	2009	2011
Sue Wolff	Communications	1999	2000
Bill White	Socio Economics Program	1999	2008
Christian Weik	GIS Program	1999	2006
	Harlequin Duck Initiative	2003	2005
	Local Level Indicators	2005	2006
Ritchard Laboucane	Aboriginal Involvement Program	2000	2003
Lisa Risvold	Communications/Tech Transfer	2000	2001
Lisa Risvold	Communications and Extension Program	2003	2008
Dick Dempster	FGYA	2000	2008
Mark Storie	Local Level Indicators	2001	2005
David Price	Climate Change	2001	2005
Anna Kauffman	Communications Program	2001	2003
Brian Amiro	Fire Effects Research	2002	2004
Rich McCleary	Fish and Aquatics Program (became Fish and Watershed Program in 2005)	2003	2010
Al Sanderson	NES IRM Pilot	2003	2003
Dave Kmet	Aboriginal Involvement Program	2003	2004
Garry Leithead	W Canadian Forest Partnership	2003	2004
Harry Archibald	NES IRM	2004	2005
Bob Phillips	Aboriginal Involvement Program	2003	2004
Dave Smith	MPB	2004	
Terry Garvin	Aboriginal Involvement Program	2004	2005
Don Podlubny	Local Level Indicators	2005	2005
Brad Young	Aboriginal Involvement Program	2005	2010
Debbie Mucha	GIS Program	2006	2014
	Local Level Indicators	2006	2008
Jerry Bauer	Foothills Stream Crossing Partnership	2005	2016
Wayne Thorp	Caribou Landscape Management Forum (renamed Foothills Landscape Management Forum in 2009	2006	Present
	Yellowhead Ecosystem Group	2011	2013
Don Podlubny	Mountain Pine Beetle Ecology Program	2007	2011
Sean Kinney	Communications and Extension Program (changed name to Communication Services in 2015)	2008	2016

Appendix Three: Program Leads 1992 – 2018

Name	Project/Program	Date Started	Date Finished/Left
Keith McClain	Circumboreal Initiative	2008	2011
	Mountain Pine Beetle Ecology Program	2012	Present
John Spence	Biophysical indicators for forest management (EMEND)	2009	2013
Barry Waito	Alberta Forest Growth Organization	2009	2015
Eric Higgs	Mountain Legacy Project	2009	2011
Axel Anderson	Water Program	2010	Present
Kirby Wright	Alberta Land-use Knowledge Network	2010	2014
Pat Wearmouth	FGYA	2011	2013
Laura Finnegan	Caribou Program	2012	Present
Sharon Meredith	FGYA	2013	2015
	Forest Growth Organization of Western Canada (FGrOW)	2015	Present
Daniel Chicoine	Tree Improvement Alberta	2013	2015
Julie Duval	GIS Program	2014	Present
Terri McHugh	Alberta Land-use Knowledge Network	2014	Present
	Communication Services	2016	Present
Ngaio Baril	Foothills Stream Crossing Partnership	2016	Present

Appendix Four: Strategic Plan 2017 – 2022

fRI Research is a true synergy of strong, sustainable, and respected research Programs and Associations. Our organization is built on partnerships, innovative ideas, and collaboration. We carry out world-class research to help our partners manage natural resources in a sustainable and responsible manner. Effectively communicating our results to our partners makes fRI Research successful at encouraging change through research.

Our Strategic Plan for 2017-2022 focusses our efforts on 5 goals, with 26 measurable, achievable, and aspirational objectives. A companion document – the Implementation Plan – will be created to establish the specific actions to be taken to meet the objectives. Using this roadmap, we know that fRI Research will continue to provide excellence in applied, partner-focussed research for land and resource management in Alberta and beyond.

Organizational Values

fRI Research takes pride in our long history of being a trusted source of excellent, unbiased science. fRI Research nurtures and develops our partnerships to foster a respectful, collaborative organization.

fRI Research's reputation and success are the result of the excellent people working at all levels of the organization.

Innovative and proactive, fRI Research is responsive to emerging needs. We work hard to be forward-thinking and to stay on the leading edge of our research areas.

fRI Research consistently focusses on practical, applied research to support good stewardship.

As an organization, fRI Research operates as efficiently as possible, based on the strategic direction and leadership of the board, in order to provide exceptional value to our shareholders, partners, and funders.

fRI Research's strength comes from being both a unified organization and a group of distinct but interrelated research programs and associations.

fRI Research is committed to sharing our research results through effective communication practices.

fRI Research fosters a culture of safety by creating and maintaining a safe working environment.

fRI Research Vision

Our world class research improves land and resource management.

fRI Research Mission

We develop understandable scientific knowledge and useful land management tools based on strong peer-reviewed science.

Goals

Goal 1: fRI Research is sustainable, flexible, and relevant to our partners.

1.1 **MANAGE** our business to achieve multi-year certainty in our funding model.

1.2 **MAXIMIZE** the return on our shareholder's funding contributions through efficient operations and by seeking leveraging opportunities.

1.3 **EXPLORE** additional funding mechanisms that will work alongside the shareholder funding model to help maximize research and sustainability.

1.4 **FOSTER** a culture of adaptability and flexibility to respond to the emerging needs of our partners.

1.5 **EXPAND** Board membership, including Indigenous and ENGO representation, to increase capacity within the Board and company.

1.6 **PROVIDE** a link between researchers and decision-makers through offering opportunities for knowledge-sharing and collaboration, building relationships, and strengthening our networks.

1.7 **SUPPORT** the relationship between fRI Research and our partnering Associations.

Goal 2: The people who work with and for fRI Research are engaged and valued.

2.1 **CULTIVATE** a satisfied and committed workforce.

2.2 **CREATE** a workplace where physical and psychological safety is paramount.

2.3 **UNDERSTAND** and respond to the changing demographics of the fRI Research workforce.

2.4 **DEVELOP** sound strategies for staff recruitment, retention, and succession within our organization.

2.5 **RECOGNIZE** and celebrate the expertise, dedication, commitment, and successes of our employees.

2.6 **ASSESS** the capacity of staff and the organization regularly to ensure efficiency and effectiveness.

Goal 3: fRI Research provides world-class science and useful tools to our partners.

3.1 **INCREASE** our capacity to create and respond to collaborative opportunities with partners to address shared land and resource management issues.

3.2 **MAINTAIN** our reputation as a place for high quality, peer reviewed, and objective scientific research.

3.3 **ENHANCE** our ability to attract excellent scientists to work, collaborate, and partner with fRI Research.

3.4 **PRODUCE** tools, research summaries, communication products, and forums on priority topics to increase knowledge transfer.

3.5 **DEVELOP** the capacity to be the go-to organization for innovative applied research in our areas and future areas of research interest.

3.6 **RESPECT**, value, and include Indigenous knowledge systems in the work of fRI Research.

3.7 **CONSIDER** both social and Indigenous dimensions and the effects of climate change in our areas of research.

3.8 **SHARE** our expertise to assist with environmental monitoring in our areas of research expertise.

3.9 **EXPLORE** partner interest in new research topics based on emerging issues, including:

3.9.1 Cumulative effects

3.9.2 Migratory bird conservation

3.9.3 The science of managing for multiple species

Goal 4: fRI Research communication initiatives keep our partners and the public informed and engaged.

4.1 **USE** knowledge mobilization strategies to get the results of our research to our partners.

4.2 **DEVELOP** the capacity, ability, and opportunity for people at all levels of the organization to promote and share knowledge and tools.

4.3 **INITIATE** communication and marketing activities to increase awareness of fRI Research with our target audience.

Goal 5: The work of fRI Research is well-understood and widely used for land and resource management.

5.1 **CREATE** science-based products for partners that support land and resource management. 5.2 IDENTIFY the value our partners continue to receive from working with fRI Research.

5.3 **DEMONSTRATE** the value that fRI Research has on land and resource management by documenting changes in policy, practices, and procedures based on our research products.

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Bold page numbers indicate photo or illustration

Author Biographies

Robert Bott

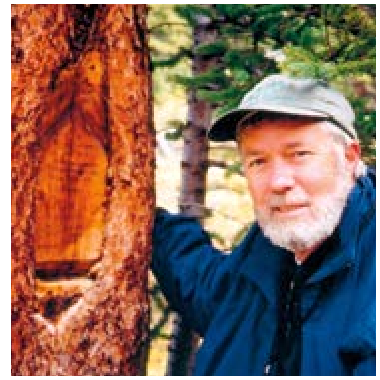
Summit of Mt. Hector, Banff National Park, 2006.

Robert D. (Bob) Bott is a Calgary-based writer, editor, and communications consultant specializing in energy, forestry, and the environment. He grew up in a former carriage house called "Tall Trees" on the edge of a mixedwood forest in what was then an outer suburb of New York City. Before moving to Calgary in 1974, he lived for five years in another mixedwood forest in Gatineau Park north of Ottawa. Over the next 44 years, he referred to Calgary residences as "base camp" while he explored the forests and mountains of Alberta and British Columbia on foot, skis, horseback, and bicycle. He wrote a few magazine articles in the 1980s about forest products companies, forestry, and land management in national parks. His in-depth exposure to the industry and the science began with a commission from the Alberta Forest Products Association (AFPA) in 1990 to write a 64-page educational booklet, Our Growing Resource, published in 1992 after extensive research, interviewing, site visits, and expert reviews. This project led to other AFPA assignments, which included consulting and editing during preparation of the FOREST*CARE* Codes of Practice (1993). He then wrote three editions of the corporate environmental report for Weldwood Canada, including the Hinton operations, and edited a report on integrated land management for the Alberta Chamber of Resources.

In 1997, Bott began the collaboration with Bob Udell, Peter Murphy, and Bob Stevenson that led to publication of Learning from the Forest: A Fifty-year Journey in Sustainable Forest Management (Fifth House, 2003), and he helped to edit some other publications of the model forest's Adaptive Forest Management History Program. Since 2000, he has also worked as a writer, editor, and consultant for Alberta-Pacific Forest Industries, including stakeholder engagement and the development of forest management plans, stewardship and sustainability reports, and a corporate history. From 2003 to 2009, he served two terms as a public member on the Board of Governors of the College of Alberta Professional Foresters. In addition to many energy-related publications, he was co-author and co-editor of Footprints: The Evolution of Land Conservation and Reclamation in Alberta (Canadian Land Reclamation Association, 2016). He began work on this project in 2015, by which time Udell had already compiled more than 2,000 files of source material.

Bob Udell

Robert W. (Bob) Udell was raised in the hamlet of Melissa, in the Muskoka Lakes region of Ontario and earned a BScF degree from the University of Toronto in 1966. Most of his career, with the exception of five years of Ministry of Natural Resources service in northwestern Ontario, was based out of Hinton as an industrial forester for North Western Pulp & Power and its successors. He authored two of the company's forest management plans (1977, 1986) before replacing retiring chief forester Jack Wright in 1987. He was a member of the Minister's Expert Review Panel on Forest Management in 1990 and served on a number of other industry and industry/government panels—provincial and federal—during his tenure at Hinton. Along with Al-Pac Wood Manager Bob Ruault, he served as an industry representative to an MLA panel, chaired by Wayne Jacques, that in 1996 issued the "Jacques Report," leading to major changes to Alberta FMA tenure rights, particularly renewal expectations.



At M.P. Bridgland's "Bulldog Camp" tree blaze, Jasper National Park, 2002.

In 1992, he co-chaired the committee to establish the Foothills Model Forest and became president of the model forest from 1992 to 2005. Growing up in the heart of the 1880s white pine logging country led to a lifelong interest in forest history, and in part, this reinforced his decision to start the Adaptive Forest Management/History Program at FMF in 1996. His ensuing association with Peter Murphy and Bob Stevenson and, more recently Bruce Mayer and Bob Bott, reinforced his interest in forest history, particularly in Alberta. He has co-authored many of the publications of that program. He was very active in the Canadian Model Forest Network during his time with Foothills Model Forest, and at the 2003 World Forestry Congress in Montreal, he presented a paper on the evolution of adaptive forest management at Hinton as described in the first book of the Forest History series, Learning from the Forest (2003).

In 2005, he was awarded an Alberta Centennial Gold Medal, and in 2006, he was the recipient of the Canadian Institute of Forestry's Canadian Forestry Achievement Award.

Bob Udell and his wife, Joan, won the "Ambassadors Award" for the Hinton Chamber of Commerce in 2006 for their work in the community. Bob was the founder and director (2005–2010) of the Foothills Male Chorus, a 30-man choir in Hinton. He also founded and sang bass in the Pathfinder Quartet, a men's quartet; the Pilgrims Octet; and the mixed-gender Blue Diamond Quartet. After moving to Cumberland, British Columbia, in 2016, he joined the Celebration Singers Choir, where he leads the bass section.

Learning From the Landscape

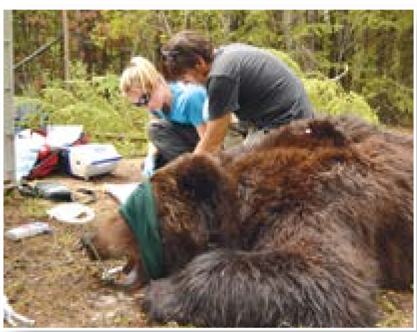
THE fRI RESEARCH STORY

An essential read for those with an interest in ensuring that the landscape and renewable resources of Alberta are sustainably managed. The authors report on a rich 25-year history of applied research at fRI Research, and its applications in improved practice. Both successes and shortcomings of this unique partnership are discussed, with many constructive routes forward offered. The future holds promise for fRI Research.

Jim LeLacheur, Retired Chief Forester, Alberta Operations, West Fraser Mills, Foothills Research Institute President 2005-2009

A great idea never implemented is simply an idea. A vague idea that inspires others to act, interpret, and implement can make a world of difference. This 25-year history of fRI Research is proof of the latter.

Fred Pollett, Retired Director General of Science, Canadian Forest Service, and Originator of the Canadian Model Forest Program



For over 25 years, fRI has been at the centre of a productive, and enduring relationship between private and public sector land-use managers, stakeholders and the public in pursuing ecosystem-based management objectives. Through its participation in the model forest and fRI, Jasper National Park has operationalized principles of ecological integrity in a way that captures the complexity of the concept and is measurable, of relevance to managers, and that can be understood and supported by its partners, stakeholders and the public.

Michel Audy, Parks Canada, A/Superintendent, Jasper National Park, 1993-1996, Board Member Foothills Model Forest 1994-97

From the outset, Foothills Model Forest (now fRI Research) worked to build a strong and diverse partnership - many with opposing views - towards a common vision of sustainable forest management, and development of tools and knowledge to help achieve it. After 25 years, the naysayers who thought this was a hopeless mission by such “strange bedfellows” have been proven wrong, and fRI Research continues to advance our understanding and application of sustainable forest management.

Rick Blackwood, Assistant Deputy Minister and Alberta Stewardship Commissioner (Environment and Parks), General Manager, Foothills Model Forest (1992-1999)

fRI Research — Informing Land & Resource Management

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