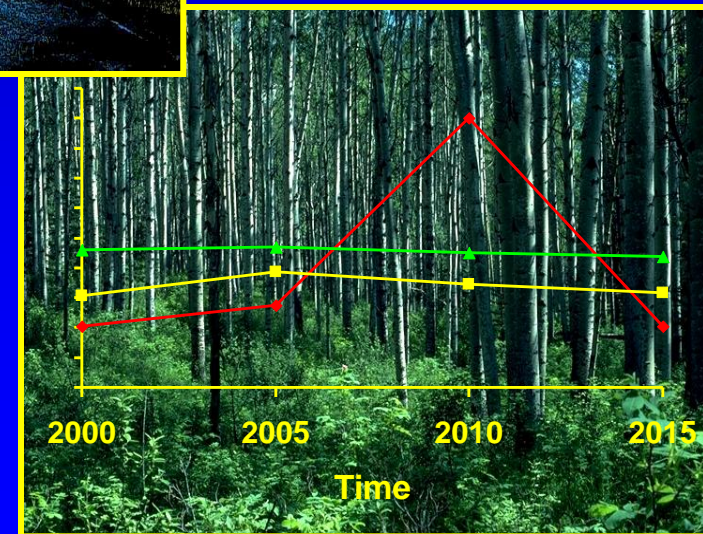
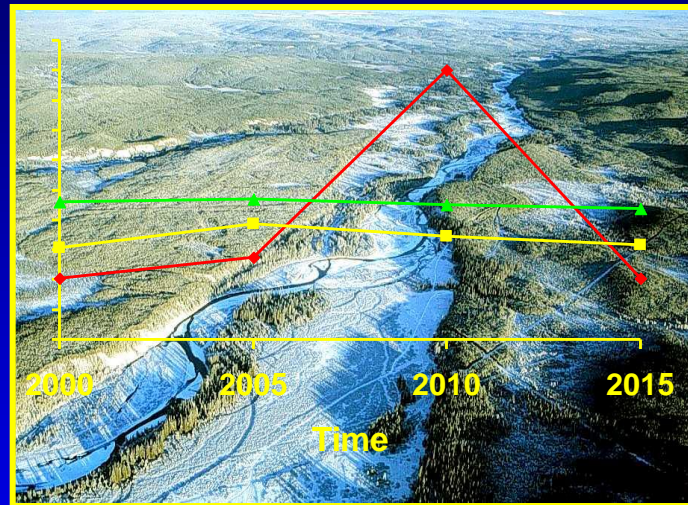
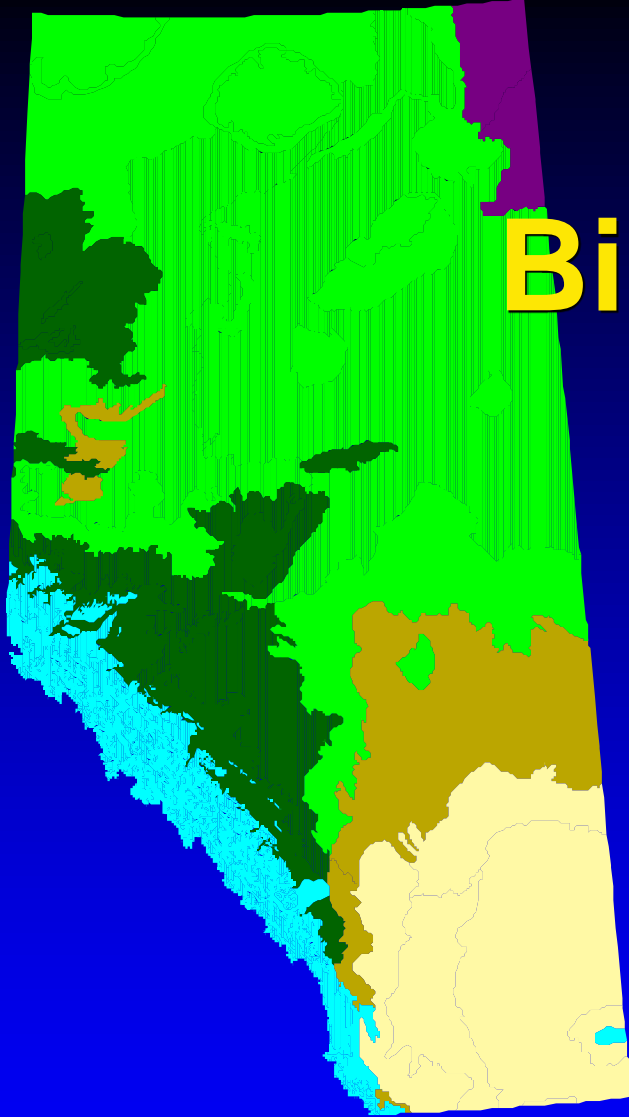


Monitoring Forest Biodiversity in Alberta



Development of a province-wide program

Today:

- **Rationale: Why do we need this?**
- **Brief history of program development**
- **Current organizational structure**
- **Program goal & supporting principles**
- **Technical issues**
- **Implementation**
- **Next steps**

Thanks to...

- Stan Boutin, AIPac
 - Phil Lee, ARC
 - Dave Morgan, LFS
 - Luigi Morgantini, Weyerhaeuser
 - Rick Schneider
 - Chris Shank, NRS
 - Brad Stelfox
 - Harry Stelfox, NRS
 - Bob Wynes, DMI
- Alberta Conservation Association
 - Alberta Environmental Protection
 - Alberta-Pacific
 - Daishowa-Marubeni
 - Foothills Model Forest
 - Prince Albert Model Forest
 - Weyerhaeuser Canada

What is biodiversity?

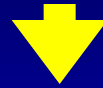
- No universally accepted definition
- But...
- Canadian Council of Forest Ministers:
 - “Biological diversity” (biodiversity) refers to the variability among living organisms and the ecological complexes (ecosystems) of which they are a part. It is measured or observed at three different levels - ecosystems, species and genes.”

Why monitor biodiversity?

- **is part of an adaptive approach to management with uncertain outcomes**
- **could help prevent creation of a prescriptive regulatory environment**
- **can support national and international biodiversity commitments**
- **can assist efforts to achieve forest product certification**

Adaptive management cycle

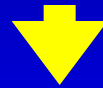
Management goals



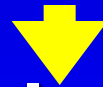
Design management plan



Implement management plan



Monitor: are objectives being met?



Evaluate



Adjust



Biodiversity conservation...a management goal?

- **Federal Government**

- National Forest Strategy
- Canadian Biodiversity Strategy
- National Parks Act
- CCFM Criteria and Indicators



- **Provincial Government**

- Alberta Forest Conservation Strategy
- Interim Forest Management Planning Manual
- NRS Fish Conservation Strategy

- **Private sector**

- Mission statements, ground rules

Canadian Council of Forest Ministers

- *“Gauging sustainable forest use requires monitoring species and communities in all forest age classes. Ideally, a pool of species for each forest type would be chosen and monitored to assess the functioning of an ecosystem.”*
- Criteria and Indicators of Sustainable Forest Management in Canada: Progress to Date (1997)

AB Forest Management Science Council

- *“Effective ways of monitoring ecological integrity, including the conservation of biodiversity, should be developed at the provincial level and applied.”*
- Sustainable Forest Management and its Major Elements (1997)

Isn't "coarse filter" management enough?

- Managing within the range of variability generated by **natural disturbance** is a reasonable approach to conserving biodiversity
 - landscape pattern
 - stand structure
- Remains an untested **assumption** until validated or rejected
- Monitoring is prudent



Program development

- **Informal meeting to identify common ground among large FMA holders (Dec 96)**
- **Second meeting (industry, gov't, university) to provide forum for broader discussion (Jan 97)**
- **Draft framework - Rick Schneider (Aug 97)**
- **Provincial review of programs - Phil Lee (Feb 98)**
- **Interim Steering Committee (Feb 98)**
- **Workshop (Mar 98)**
- **Steering Committee, Technical Committee (Jun98)**

Benefits of coordination

- Financial benefits
 - single coordinated program would be more efficient than multiple isolated programs
- Technical benefits
 - ability to compare data across a wide range of lands with different disturbance histories (natural & anthropogenic)
 - **wide range of probable “effect sizes” would improve statistical power & ability to correlate cause & effect**
 - common methodology & standards permit sharing

Evolution...

- **Steering Committee**
 - = “End Users” that intend to implement a **biodiversity monitoring program**
 - Land managers (e.g. government, forest industry)
 - Research / development agencies (CFS / FMF)
 - **Direct all aspects of program development**
- **Technical Committee**
 - = **FMF, ARC, gov’t, universities, consultants**
 - **ad hoc**
 - **Prepare Program Framework Document**

Steering Committee

- **Alberta Environmental Protection**
 - Land and Forest Service (Evelynne Wrangler)
 - Natural Resources Service (Harry Stelfox)
- **Canadian Forest Service**
 - Foothills Model Forest (Daniel Farr)
 - Northern Forestry Centre (David Langor)
- **Forest Industry**
 - Alberta-Pacific Forest Industries (Stan Boutin)
 - Daishowa-Marubeni International (Bob Wynes)
 - Millar-Western Industries (John Pineau)
 - Weldwood of Canada Ltd., Hinton Division (Chris Spytz)
- **Parks Canada** (Chuck Blyth)
- **Provincial Museum of Alberta** (TBA)

Technical Committee

- Steven Franklin, U of Calgary
- Phil Lee, ARC
- Craig Johnson, FMF
- Garry Scrimgeour, ARC
- Chris Shank, NRS
- Brad Stelfox, FOREM
- Neville Winchester, U of Victoria
- Others

Program goal

- To detect changes in biodiversity that may be caused by human activities, particularly forestry, fire management and petroleum development.
- Near-term objective: to develop and test a comprehensive monitoring protocol.

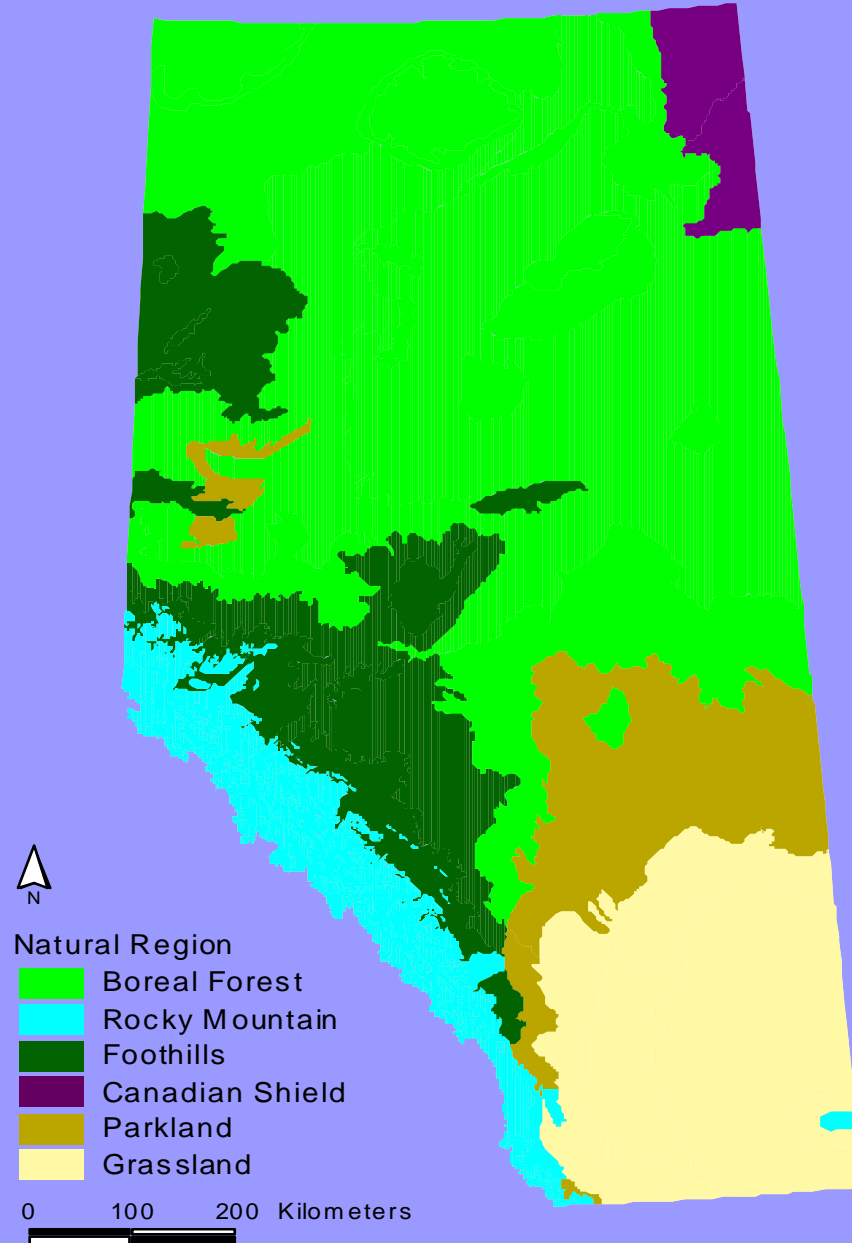
Supporting principles

- 1. Support *existing* commitments for biodiversity conservation**
- 2. Common methodology across all jurisdictions within Alberta's forested natural regions**
- 3. Aquatic and terrestrial attributes**
- 4. Wide range of taxonomic and trophic levels**
- 5. Multiple spatial scales**
- 6. Reference data required**
- 7. Estimates of natural variability required**
- 8. Transparent development and implementation**

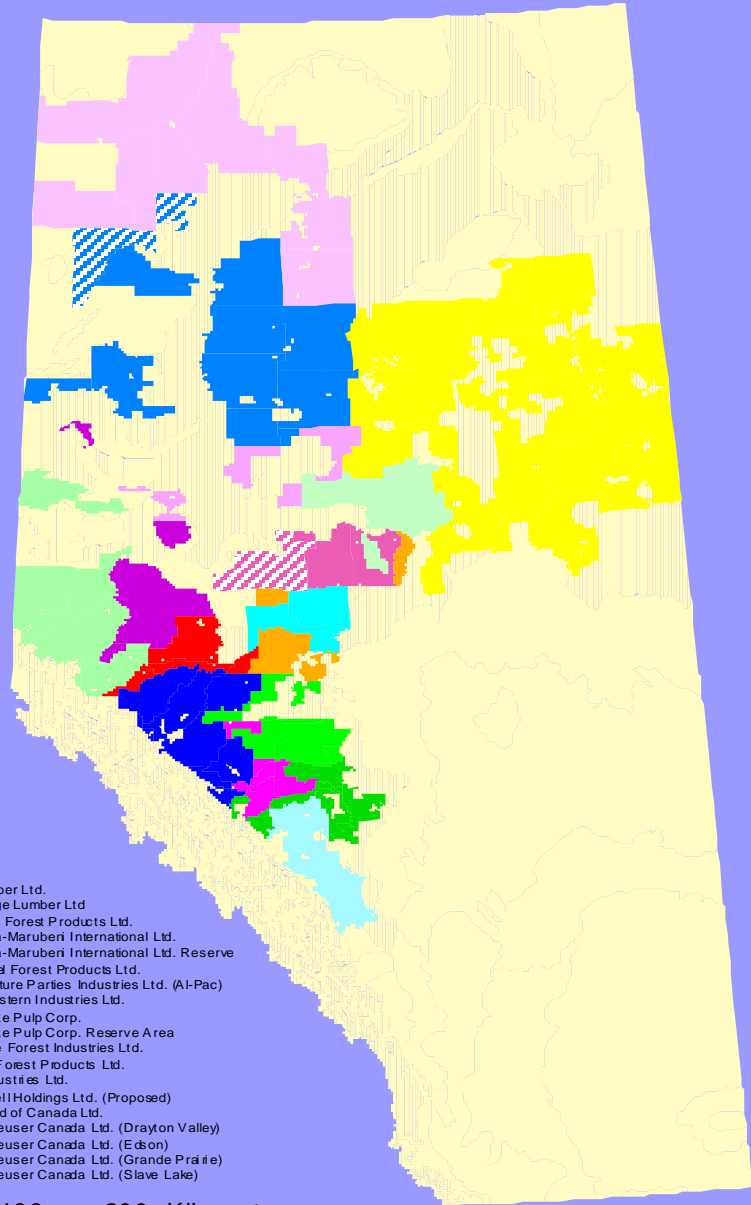
Common methodology

- **Efficient, cost-effective**
- **Enhanced ability to detect real changes as opposed to differences in methodology**
- **Ability to interpret monitoring data across meaningfully large areas**
 - **change within one area can be compared to changes within other areas**
- **Differences in management approaches among areas would improve ability to correlate cause and effect**

Natural Regions of Alberta



Forest Management Agreements

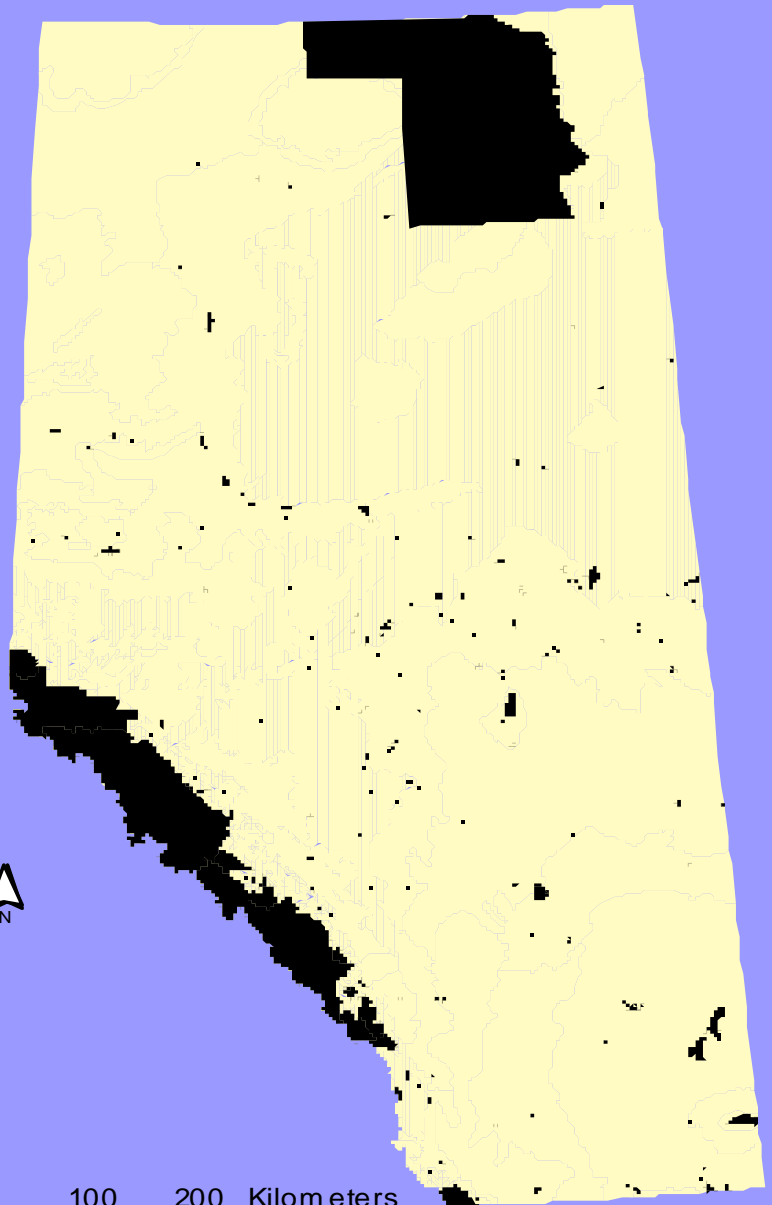


- FMA
- ANC Timber Ltd.
 - Blue Ridge Lumber Ltd.
 - Canadian Forest Products Ltd.
 - Daishowa-Marubeni International Ltd.
 - Daishowa-Marubeni International Ltd. Reserve
 - High Level Forest Products Ltd.
 - Joint Venture Parties Industries Ltd. (AI-Pac)
 - Millar Western Industries Ltd.
 - Slave Lake Pulp Corp.
 - Slave Lake Pulp Corp. Reserve Area
 - Sundance Forest Industries Ltd.
 - Sunpine Forest Products Ltd.
 - Tolko Industries Ltd.
 - Vanderwell Holdings Ltd. (Proposed)
 - Weldwood of Canada Ltd.
 - Weyerhaeuser Canada Ltd. (Drayton Valley)
 - Weyerhaeuser Canada Ltd. (Edson)
 - Weyerhaeuser Canada Ltd. (Grande Prairie)
 - Weyerhaeuser Canada Ltd. (Slave Lake)

0 100 200 Kilometers



Protected Areas

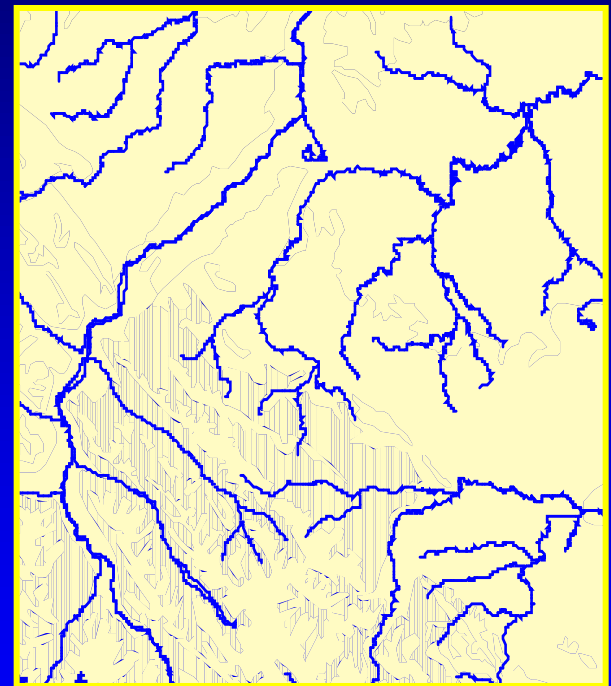


0 100 200 Kilometers



Aquatic & terrestrial

- Human activities occur across entire ecosystem
- Biodiversity monitoring in aquatic systems is relatively advanced
 - e.g. U.S. EPA
- Separate monitoring methods required, but integration between aquatic & terrestrial monitoring is desirable



Multiple taxonomic & trophic levels

- Range of probable “response times” (to management actions)
 - variable sensitivity of population processes to management actions
- Range of ecological processes may be affected by management actions, each affecting different suite of taxa, e.g.
 - direct effects of soil disturbance
 - indirect effects of modifying successional paths

Multiple scales

Landscapes / Watersheds

- Methods = remote sensing
- Attributes = landscape pattern
(as generated by disturbance)



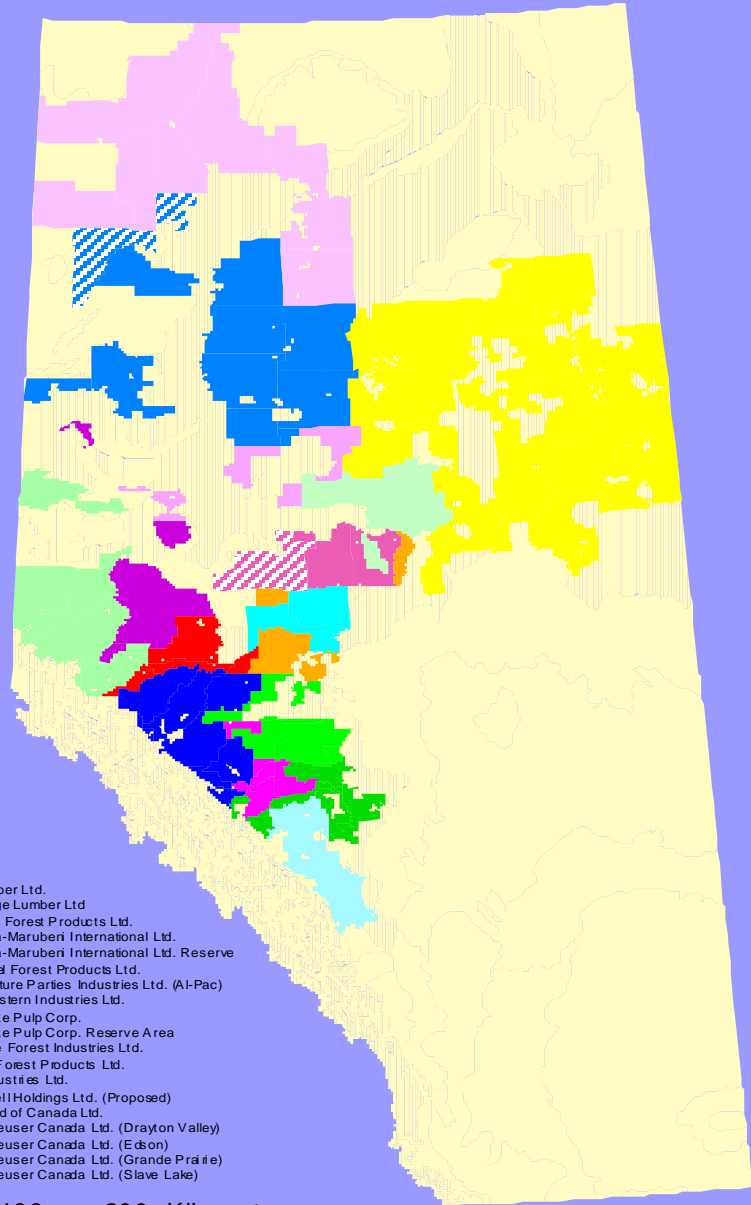
Sites

- Methods = water & ground plots
- Attributes = species occurrence,
composition of assemblages

Reference data

- Permit comparisons between lands with & without a management activity of interest
 - “treatment” vs “control”
 - (“range of treatments”)
- Two approaches:
 1. Compare impacted lands before and after impacts (**historical reference data**)
 2. Compare impacted & non-impacted lands concurrently (**concurrent reference data**)
 - e.g. parks

Forest Management Agreements

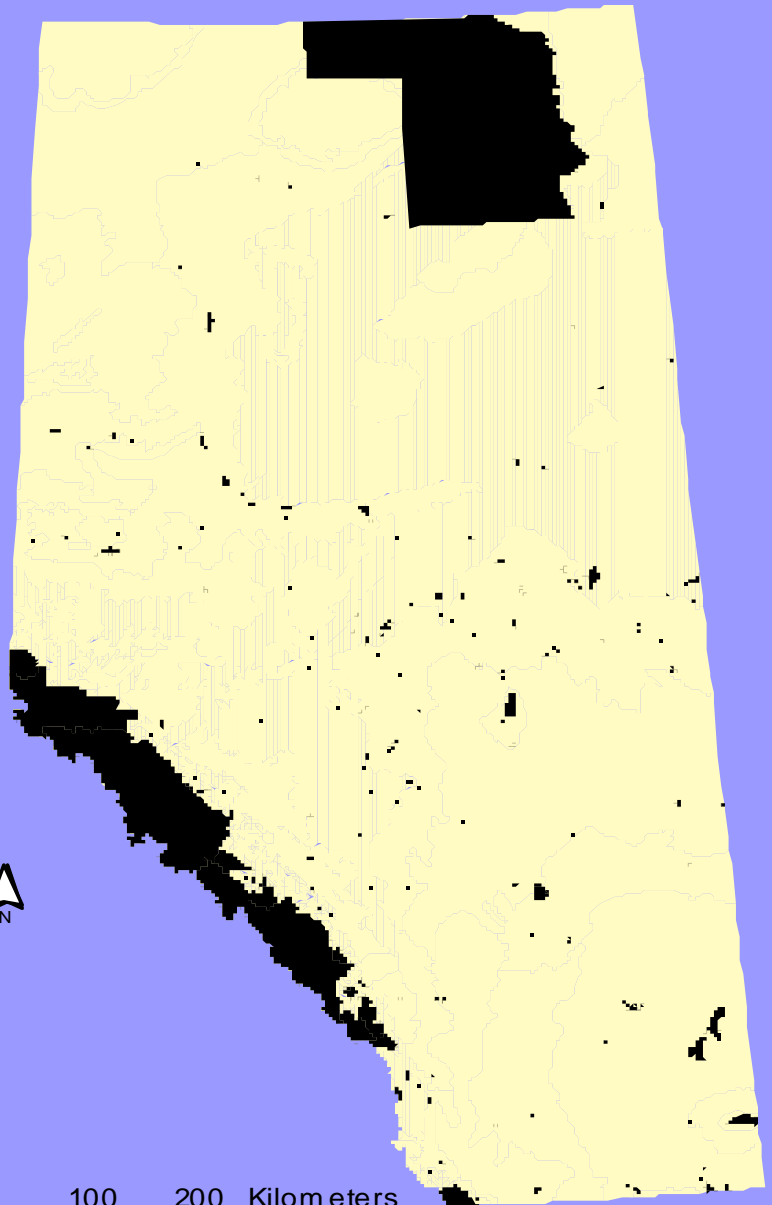


- FMA
- ANC Timber Ltd.
 - Blue Ridge Lumber Ltd.
 - Canadian Forest Products Ltd.
 - Daishowa-Marubeni International Ltd.
 - Daishowa-Marubeni International Ltd. Reserve
 - High Level Forest Products Ltd.
 - Joint Venture Parties Industries Ltd. (AI-Pac)
 - Millar Western Industries Ltd.
 - Slave Lake Pulp Corp.
 - Slave Lake Pulp Corp. Reserve Area
 - Sundance Forest Industries Ltd.
 - Sunpine Forest Products Ltd.
 - Tolko Industries Ltd.
 - Vanderwell Holdings Ltd. (Proposed)
 - Weldwood of Canada Ltd.
 - Weyerhaeuser Canada Ltd. (Drayton Valley)
 - Weyerhaeuser Canada Ltd. (Edson)
 - Weyerhaeuser Canada Ltd. (Grande Prairie)
 - Weyerhaeuser Canada Ltd. (Slave Lake)

0 100 200 Kilometers



Protected Areas

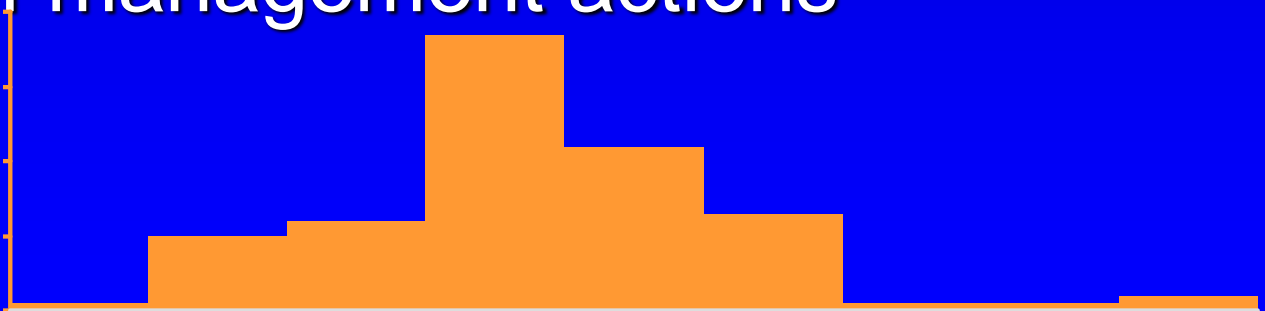


0 100 200 Kilometers



Range of variability

- All monitored attributes possess inherent variability
- Change *per se* should **not** trigger review of management actions
- Change beyond the known or estimated range of natural variability **should** trigger review of management actions



Technical Issues

- Overall design
- Field data: protocols & attribute selection
 - Aquatic sites
 - Terrestrial sites
- Landscape pattern & land use
 - data sources & information content
- Integration
 - integration of field protocols, analysis of program efficacy vs program cost

Overall design

2 components:

① Remote sensing of landscape pattern

- periodic assembly and analysis of remotely sensed data (satellite / air photo / other)

② Large-scale sampling network

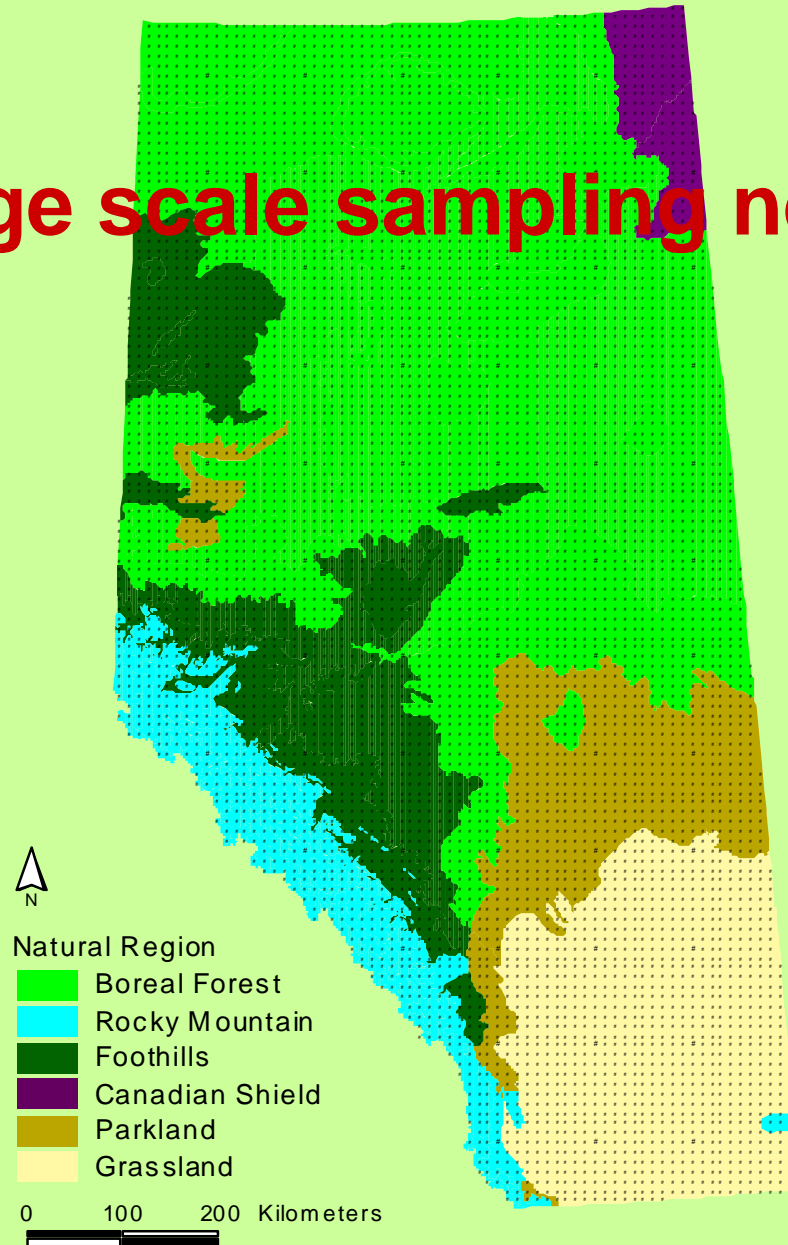
- field data
- repeated visits to a systematic network of locations
- sample a range of biota at each

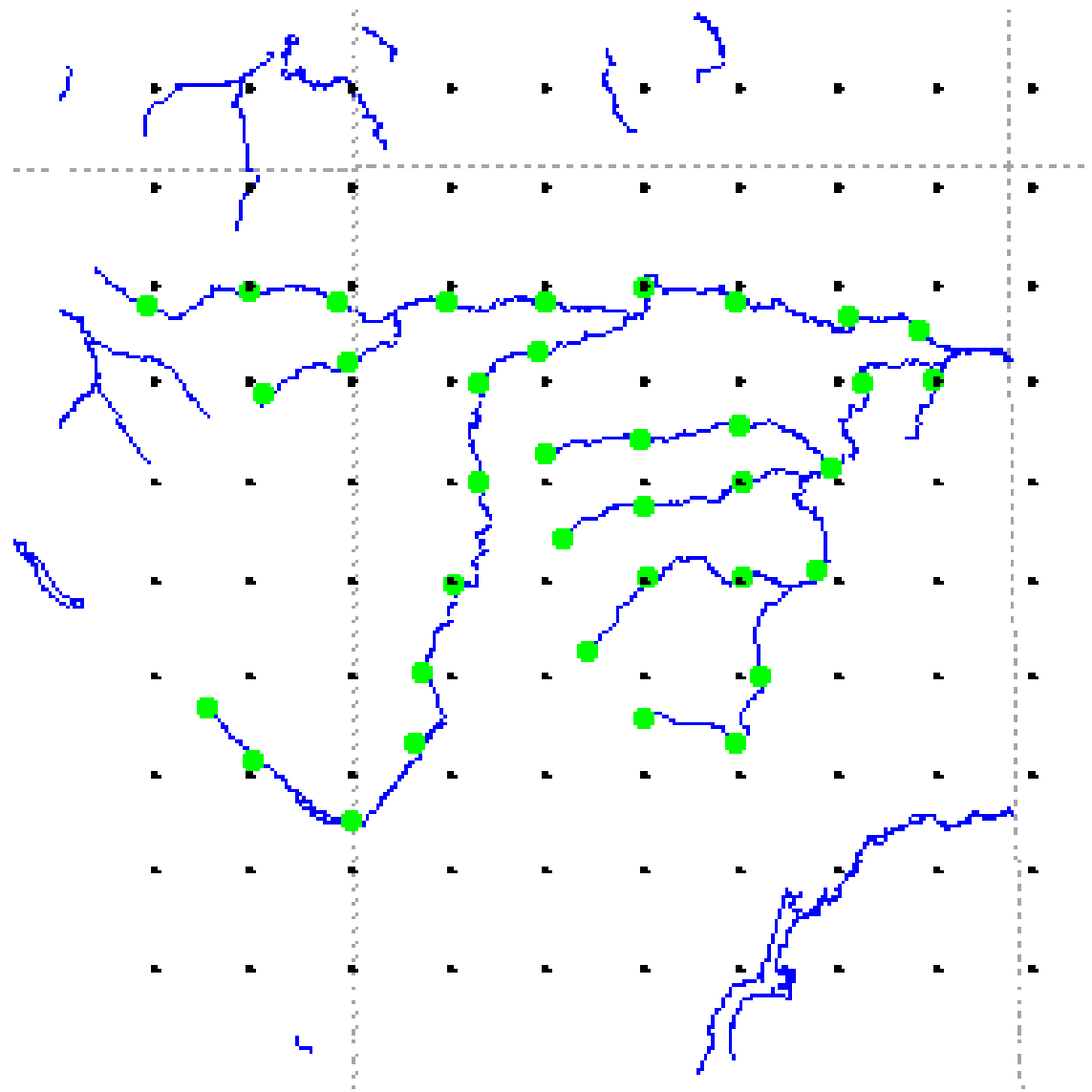
An aerial remote sensing image of a river landscape. A prominent blue river winds through a green landscape, characterized by numerous oxbow lakes and meanders. The terrain is a mix of green vegetation and brown patches, possibly indicating different land uses or soil types. A white line, likely a road or boundary, runs diagonally across the scene. The text "Remote sensing of landscape pattern" is overlaid in yellow.

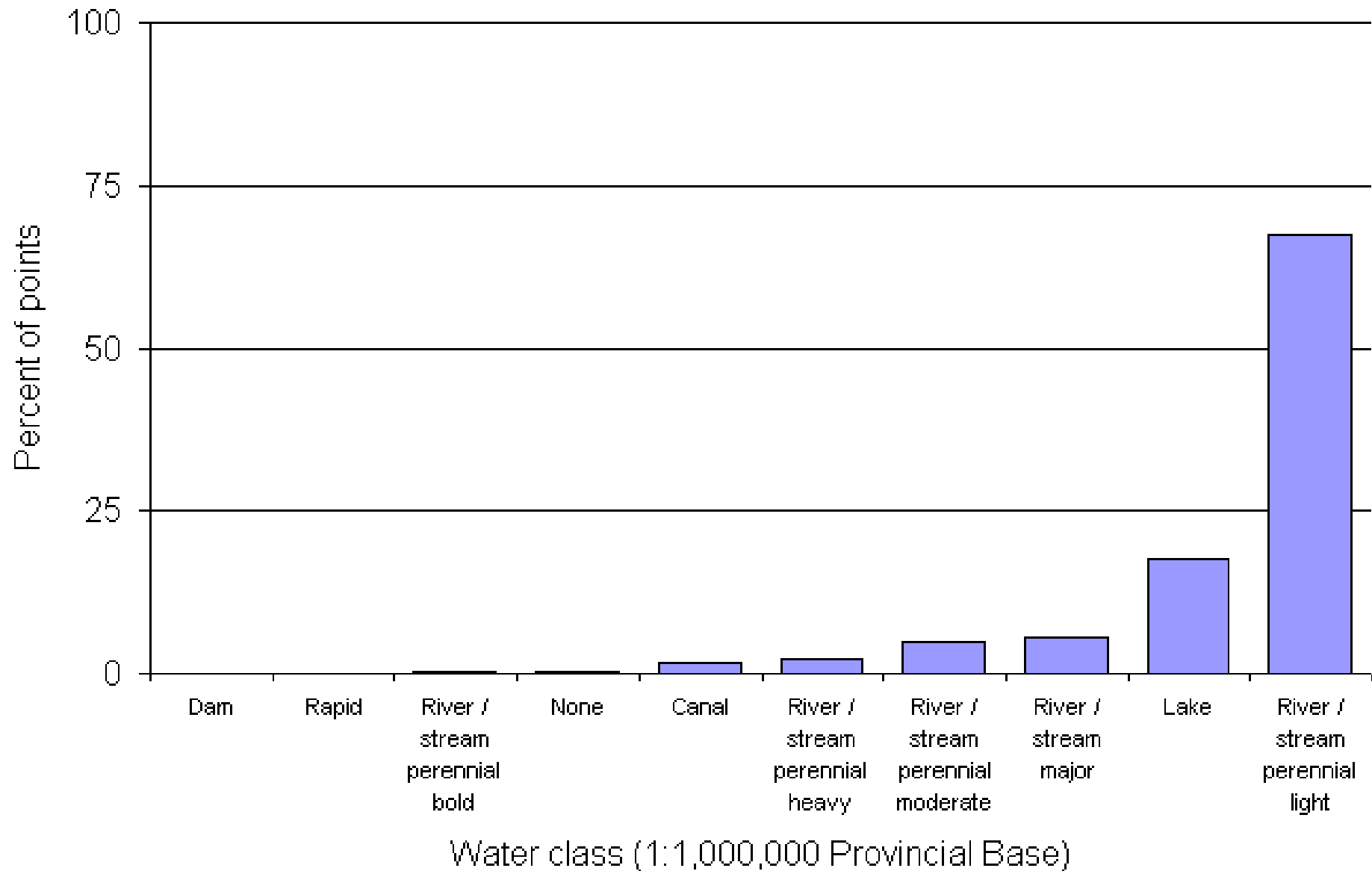
Remote sensing of landscape pattern

Plot Network: 10 km Grid

Large scale sampling network







Field data

- Seeking attributes that will provide “signals of change” in ecosystem composition, structure, and function
- Likely: Indices of community structure and composition
 - “Index of Biotic Integrity” - US EPA
- Unlikely: Population size of individual species

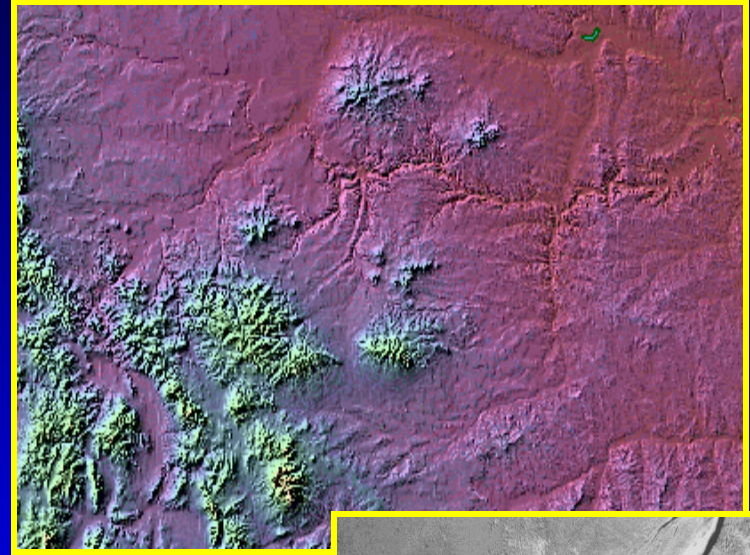
Field data

- Driven by feasibility of established protocols
- Constrained by large-scale survey approach
- Suite of attributes representing multiple taxa, trophic levels, & spatial scales
 - plants / animals / other
 - aquatic / terrestrial



Landscape pattern & land use

- Monitor changes in patch size, age, arrangement, land use
- Link to existing provincial & national reporting systems (NFI)
- Tool: remote sensing



Integration: Primary considerations

1 Cost factors, e.g.:

- Time required at each plot
 - including potential for >1 day / year
- Number of sample days available / year
- Cost of travel to plot

2 Effectiveness

- statistical ability to detect change between reporting periods (for each attribute)
 - require estimates of expected variability
 - power analyses

Number of plots sampled per year per crew

Days/plot	Available sample days per year			
	20	40	60	80
1	20	40	60	80
2	10	20	30	40
3	7	13	20	27
4	5	10	15	20
5	4	8	12	16

Number of plots sampled per year

Cost/plot	Available resources (in millions)		
	0.1	1	10
500	200	2,000	20,000
1000	100	1,000	10,000
2000	50	500	5,000
3000	33	333	3,333
4000	25	250	2,500

Natural Region

	Area (km ²)	Plot Density				
		100x100 km (10,000km ²)	32x32 km (1000km ²)	10x10 km (100km ²)	3x3 km (10km ²)	1 x 1 km (1km ²)
Boreal Forest	347,411	35	347	3,474	34,741	347,411
Rocky Mountains	46,284	5	46	463	4,628	46,284
Foothills	94,914	9	95	949	9,491	94,914
Canadian Shield	15,830	2	16	158	1,583	15,830
Parkland	62,636	6	63	626	6,264	62,636
TOTAL	567,076	57	567	5,671	56,708	567,076

Forest Management Agreement area*

	Area (km2)	Plot Density				
		100x100 km (10,000km2)	32x32 km (1000km2)	10x10 km (100km2)	3x3 km (10km2)	1 x 1 km (1km2)
ANC Timber Ltd.	3,738	0	4	37	374	3,738
Blue Ridge Lumber Ltd	4,390	0	4	44	439	4,390
Canadian Forest Products Ltd.	6,519	1	7	65	652	6,519
Daishowa-Marubeni International Ltd.	28,419	3	28	284	2,842	28,419
Daishowa-Marubeni International Ltd. Reserve	4,023	0	4	40	402	4,023
High Level Forest Products Ltd.	35,663	4	36	357	3,566	35,663
Joint Venture Parties Industries Ltd. (AI-Pac)	61,519	6	62	615	6,152	61,519
Millar Western Industries Ltd.	3,022	0	3	30	302	3,022
Slave Lake Pulp Corp.	4,337	0	4	43	434	4,337
Slave Lake Pulp Corp. Reserve Area	3,522	0	4	35	352	3,522
Sundance Forest Industries Ltd.	2,721	0	3	27	272	2,721
Sunpine Forest Products Ltd.	5,734	1	6	57	573	5,734
Tolko Industries Ltd.	3,798	0	4	38	380	3,798
Vanderwell Holdings Ltd. (Proposed)	581	0	1	6	58	581
Weldwood of Canada Ltd.	10,147	1	10	101	1,015	10,147
Weyerhaeuser Canada Ltd. (Drayton Valley)	4,273	0	4	43	427	4,273
Weyerhaeuser Canada Ltd. (Edson)	5,415	1	5	54	541	5,415
Weyerhaeuser Canada Ltd. (Grande Prairie)	13,547	1	14	135	1,355	13,547
Weyerhaeuser Canada Ltd. (Slave Lake)	7,207	1	7	72	721	7,207
Total	208,573	21	209	2,086	20,857	208,573

Implementation

- Monitoring program should be coordinated by a single agency
 - ensure that measurements and analyses are completely standardized
 - maximize cost effectiveness
 - ensure public acceptance of program and results
- Who could do it?
 - Existing agency
 - New agency

Implementation

- Periodically assemble remotely sensed data
- Collect data from the large-scale sampling network using defined protocols
- Summarize the data
- Conduct specified analyses
- Produce regular reports
- Store data and maintain an Internet web site
- Archive samples, if collected

Promising linkages

- National Forest Inventory (CFS)
 - Ground plots could be based on NFI layout
 - Consistent use of remotely sensed data to monitor changes in landscape pattern
 - Inclusion of photo-interpreted forest cover?
- Ecological Monitoring and Assessment Network
- Environmental Effects Monitoring
- Forest Health Network (CFS)
- Provincial Monitoring / Inventory Programs
 - Alberta, Saskatchewan

Next Steps

- Complete program framework document (Mar 1999)
- Test implementation and evaluation (Apr - Dec 1999)
- Program available for implementation (Jan 2000)