**September 2001**

# Foothills Model Forest
# Grizzly Bear Research Project
# Program Update from 2001 Field Program
## *(year 3 of 5 year program)*

**Prepared for:**

**Alberta Environment**

**Research Needs and Priorities Committee**

**Sustainable Ecosystems Users Group**

***Prepared by Gordon Stenhouse***

Note: this report is intended as an update of field activities only and the reader is referred to Appendix A for a complete listing of publications to date resulting from this research effort.

## Introduction

In 1999 The Foothills Model Forest initiated a major 5-year grizzly bear research project in response to a number of management challenges. These challenges were related to the ongoing and increasing human use of grizzly bear habitat along the eastern slopes of Alberta. This research program focuses on management issues and questions by assessing grizzly bear populations, bear response to human activities, and habitat conditions to provide land managers with tools to integrate grizzly bear "needs" into the land management decision making framework. This approach is intended to allow resource managers to gain a better understanding of grizzly bear ecosystems and grizzly bear response to human activities and to implement appropriate actions designed to conserve grizzly bears in this region. This program is directly linked to the 2000 management framework document entitled *"Grizzly Bear Conservation in the Alberta Yellowhead Ecosystem – A Strategic Framework"*. The research questions being pursued represent management questions for which data are needed. This program is linked directly with the Regional Carnivore Management Group who is charged with taking research findings and translating them to land use management activities in grizzly bear habitat in this region. Results from this program will be useful for successful grizzly bear management throughout Alberta, and other areas of grizzly habitation throughout North America, as it will provide tools and techniques that address landscape level conservation issues.

## Long Term Program Objective:

**To provide resource managers with the necessary knowledge and planning tools to ensure the long-term conservation of grizzly bears in the Yellowhead Ecosystem.**

## Program Goals:

The knowledge obtained from this study will be used to:

1. Provide information that will support management programs to provide stable/increasing grizzly bear populations over time,
2. Identify habitat and landscape conditions that contribute to or limit viable and regionally connected grizzly bear populations,
3. The development of a set of validated, user friendly, GIS based computer models for the Northern East Slopes Region, that will provide predictive capability when resource managers are making land use planning decisions in known grizzly bear range.

The key elements of the FMF Grizzly Bear Research Project are:

- **Movements:** gather animal data to document grizzly bear travel corridors within the research study area, document home range patterns and den sites, assess habitat use at a number of spatial and temporal scales, and document bear response to human activities at a landscape scale. This program element involves fitting a sample of the grizzly bear population with GPS radio collars in order to collect detailed movement and response data.
- **Status, Trends and Animal Health:** provide data and develop methodologies to allow managers to assess and monitor grizzly bear population parameters over time (i.e. productivity, survival rates, mortality rates, sex ratios, health, etc.). These data will also form an integral component concerning model validation and ongoing development. This element will be one indicator used to assess program success. This program element is currently focusing on DNA inventory techniques that we see as the most promising methodology available for this task.
- **GIS:** utilize existing GIS based grizzly bear cumulative effects models in selected research study areas to provide an overview of grizzly bear habitat issues at the current time. These data will be used in research study design and research study area selection. Continue to test and develop these CEA models with animal data collected through the field efforts and to integrate other resource planning tools (forestry, mining, etc.) to allow predictive capability of the effects of changing landscape conditions over time on grizzly bear populations. An array of GIS based tools is being

used within all program elements and offers all collaborators the ability to link specific data sets with land conditions in a spatial and temporal manner.

- **Remote Sensing/Habitat Mapping:** we are striving to be able to effectively map grizzly bear habitat within the study area, using remote sensing tools. The mapping products will be tested to determine their degree of predictability of grizzly bear occurrence and will also be tested against other grizzly bear habitat maps that are currently available. The goal will be to have a tool that could be used to map all grizzly bear habitat in Alberta. This program element is also being used to measure and quantify landscape change through the acquisition and processing of annual satellite imagery for the study area.
- **RSF modelling:** this program component focuses on moving our understanding of bear response to human activities and landscape conditions beyond what is possible with the existing CEA grizzly bear models. This approach will allow us to develop predictive probability equations, which can link landscape conditions to grizzly bear occurrence and also to populations. These equations provide a more rigorous approach to understanding these relationships and they are also statistically defensible.
- **Communications:** an important element of this program will involve the continued and ongoing communication of research results and program findings to all partners and interested stakeholders. This element will be critical to maintain and enhance the partnerships formed and ultimately will be vital in achieving the program objective.

***It is important to emphasize that the foundation dataset for this research effort is movement data obtained from GPS collars on individual grizzly bears within the study area. All program elements listed above rely on this data to explore and explain relationships between bear behaviour and physiology with human activities and landscape conditions. All program elements require data and products from other program collaborators and thus this research effort is truly a larg- scale integrated undertaking between specialists from many disciplines.***

## 1. Grizzly Bear Movement Data - Stenhouse and Munro

The grizzly bear capture/collaring program continued during the 3rd year of the Foothills Model Forest Grizzly Bear Project. Overall there were 24 individuals who participated in our spring capture operations this year. We again used two different techniques to capture grizzly bears within this program. In areas of forest cover we utilized a baiting and snaring approach with teams of biologists, park wardens, conservation officers and veterinarians conducting this ground based approach. In areas of alpine and subalpine habitat or other areas where open conditions predominated we used helicopter darting to capture grizzly bears. The reader is referred to Stenhouse and Munro (1999 and 2000) for full details of capture procedures and protocols. All handling of bears in this research project adheres to the standards of the Canadian Council on Animal Care and the necessary permits are in place from the; University of Saskatchewan Animal Care Committee, Alberta Environment Animal Care Committee, and Jasper National Park.

Den emergence was again closely monitored this year in hopes of quick and early recapture of denning bears to maximize data collection opportunities. Although a full analysis has not been completed comparing these data with the first two years of den emergence it appears that den emergence was later than in previous years. It is unclear whether this was related to reproductive status of these bears or rather a function of environmental or physiological parameters.

Capture efforts were again successful this season with 29 individual grizzly bears being captured between April-June (Table 1). Of these 23 adult bears were fitted with GPS radio collars this season. As in previous years two types of GPS collars are being used; Televilt GPS simplex collars which allow remote data upload capabilities, and ATS (Advanced Telemetry Systems) GPS collars which store data on board and can be remotely triggered to drop off. Of the 23 collars in use 16 collars are Televilt and 7 are ATS collars. Although we have maintained our standard 6 locations/day program for the majority of the GPS collars in use, a small subset of collars are collecting 12 locations /day or a fix every 2 hours during. This season the majority of Televilt GPS collars were

also fitted with timed drop off mechanisms to allow for collar and data retrieval. Retrieval of used collars is important from a project management standpoint as these collars can then be refurbished at a fraction of the cost of buying new GPS collars.

Table 1. Total Number of Grizzly Bears Captured 1999-2001

| Year | Total Captured | F | M |
|---|---|---|---|
| 1999 | 23 | 12 | 11 |
| 2000 | 25 | 15 | 11 |
| 2001 | 29 | 20 | 9 |
| Total | 77 | 47 | 31 |

Grizzly bears which were captured but deemed to small to radio collar were processed and had a VHF ear tag attached to aid in potential future capture activities and to monitor bear mortality within the study area. One of the most important statistics related to this approach of having a "back-up" VHF radio beacon (ear tag transmitter) is the fact that of the 23 collar bears in 2001, 18 were recaptures or bears that we had captured and collared previously.

Our capture and collaring efforts were again restricted to the core study area originally defined in the first year of this research program (1999). Figure 1 identifies not only the core study area but also shows the expanded study area boundary in which we have significant amounts of bear movement data and where the remote sensing and habitat mapping work is also focused. Although we are aware that there are bears in the area outside the core study area a conscious decision has been made to limit capture efforts to the core study area only.

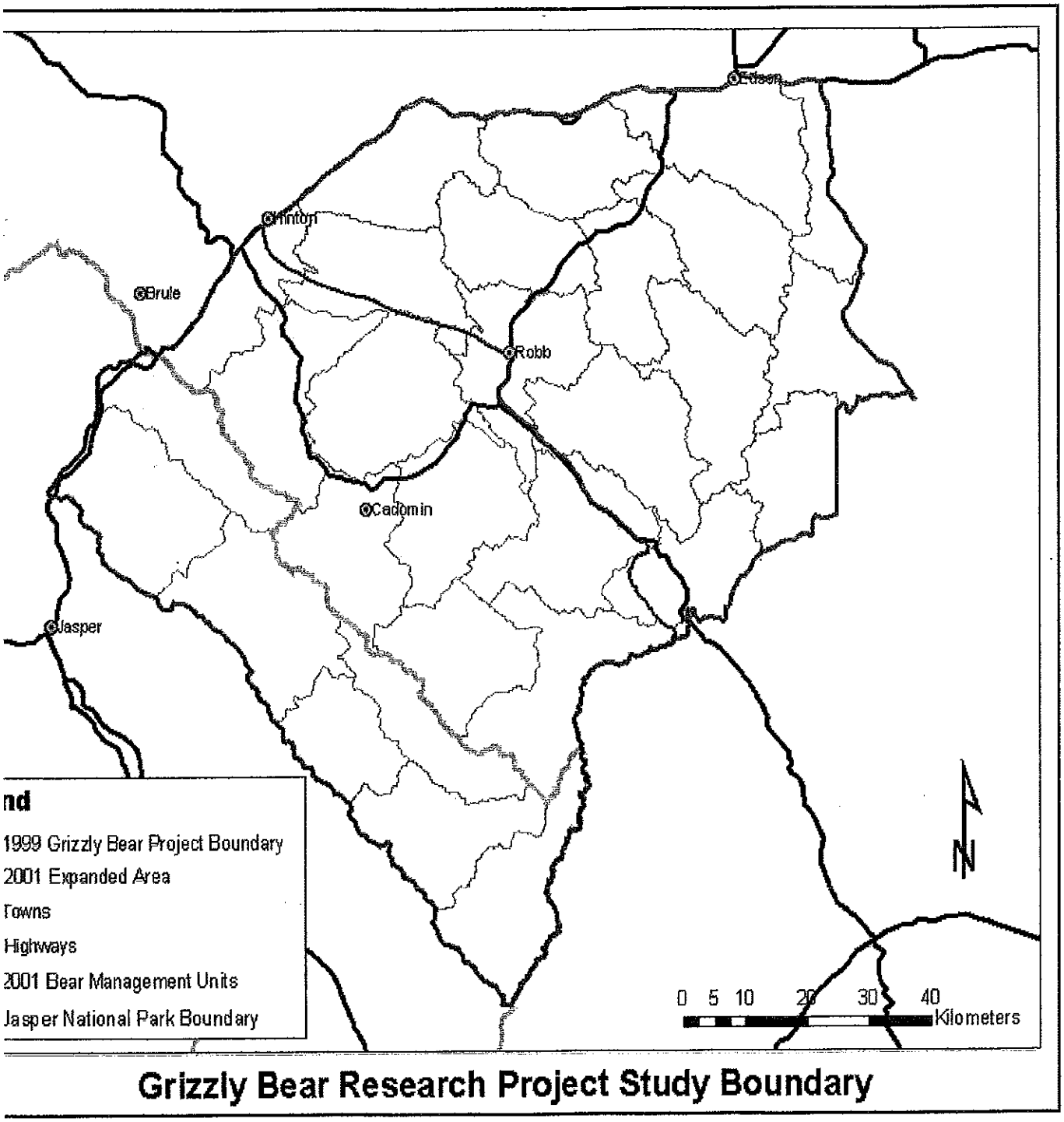


Figure 1. Foothills Model Forest Grizzly Bear Research Study Area

The distribution of our GPS radio collars remains an important consideration of our research program since we want to determine how different levels of human activity may impact grizzly bear movement and behaviour. Our the past 3 years we have strived to have at least one bear collared in each of the 16 Bear Management Units (BMU) with the core area. In the first two years we achieved this objective in all but one BMU. This season we were able to collar one bear in each of the identified BMU's .

We have been pleased to see significant cub production on den emergence this past season, from 10 of our study females either producing or still having their cubs in association with them on den emergence. There were 6 females that produced new cubs (COYS) this season and we suspect that for 4 of these females this was their first litter. Although data collection is still ongoing it appears that the cub survival has been good to date. Final information on cub survival will only be tallied at denning.

The 2001 field season presented the first opportunity for field crews to determine the reliability of timed drop off mechanisms for collars attached to bears in 2000. Of the 10 collars to remotely drop off with these timers 9 were successful while 1 failure occurred. The field crews were able to recover all dropped collars, 4 of which dropped in the den during the winter period. We were also successful in recapturing the bears whose collar did not drop as programmed and recovered the collar and reinstrumented this bear. Recovering these collars provided more data than was often uploaded and allowed for the refurbishment of the collars for future use.

Data collection from the collars deployed in 2001 have been occurring on our regular monthly schedule. This work has been progressing well and we have been able to document additional road crossings of Highway 16, the Athabasca River and Highway 40. Some of our Televilt GPS collars have experienced premature low battery mode, but have still provided us with important data. The supplier is replacing the defective collars for us and we hope to be able to recapture and recollar some bears in October 2001.

Planning for field activities is now underway which will see the research team capturing and collaring a number of specific bears and obtaining important physiological data to investigate body condition and reproductive status. In addition a concerted effort will also be made to relocate our ATS collared bears and remotely trigger these collars to drop off allowing the recovery of movement data from the 2001 season from these bears. We will also be recovering timed drop off collars prior to denning and documenting all known den sites for our spring 2002 field effort.

**2. Anthropogenic stress and health in grizzly bears**
**- Dr. M. Cattet and Dr. N. Caulkett, Canadian Cooperative Wildlife Health Centre, University of Saskatchewan) and Gordon Stenhouse**

Within the broad scope of the Foothills Model Forest Grizzly Bear Research Project, we are addressing three specific research objectives. These are:

- To characterize the physiological response of grizzly bears to different anthropogenic stressors;
- To identify health consequences of stress in grizzly bears by determining the effects of stress on reproductive function; and
- To determine if the stress response and health of grizzly bears is associated significantly with existing levels of human activity and landscape change within their home range.

In general, anthropogenic stressors represent a broad category of human-caused factors that could be perceived as stressful by grizzly bears. Some of the stressors that we have focused our attention on in this study over the past 3 years include drugs used to immobilize grizzly bears and methods of capturing grizzly bears, and more recently we have been looking at environmental features and indices of human activity within the home ranges of individual grizzly bears.

To evaluate the effects of these stressors, it has been necessary to also characterize the stress response of grizzly bears or, in other words, to determine the physiological changes

that occur in grizzly bears in response to different stressors. Some responses to stress are immediate and of short duration (acute stress), while others can be more prolonged in duration lasting weeks, months, or longer (sub-acute and chronic stress). To characterize the spectrum of stress responses from acute to chronic, we are collecting a wide range of measurements from all captured grizzly bears that include body condition and physiological function (pulse and respiratory rates, body temperature, etc.). We are also collecting blood samples from all bears and the analysis of blood for hematology, serum biochemistry, stress compounds, and reproductive hormones is providing us with broad and unique information on stress and its potential effects on the health of grizzly bears.

In the spring and summer of 2001, thirty-three grizzly bears were either located from a helicopter, or captured by leg-hold snare, and immobilized using remote injection equipment. Pulse and respiratory rates, and rectal temperature, were recorded for all bears at the onset of handling and every 15 minutes afterwards during the 75 minutes of handling. Blood was collected from the femoral vein into sterile tubes for the determination of hematology and serum biochemistry. Bears were also measured in various dimensions and weighed in a sling suspended beneath a load scale to allow the determination of body condition.

Over the past three months, the physiological data and blood data from 2001 have been combined and analyzed with similar data collected during the first two years of the Foothills Model Forest Grizzly Bear Research Project. Collectively, the results from this data have lead to the following advances in research:

- A new drug combination, xylazine-zolazepam-tiletamine (or XZT), can be used to effectively and safely immobilize grizzly bears without significant risk to their health;
- Relative to capture by helicopter, capture by leg-hold snare results in more prolonged stress and greater impact upon the health of grizzly bears; and
- The body condition of grizzly bears can be assessed easily and rapidly from two parameters, straight-line body length and total body mass, measured routinely during the handling of captured bears.

We are presently awaiting the results of analyses of blood serum for the concentrations of different stress compounds (total cortisol, free cortisol, and cortisol binding protein) and reproductive hormones (estrogen, progesterone, testosterone, and others). The analyses are being completed by Dr. Matt Vijayan at the University of Waterloo (stress compounds), and Dr. Janice Bahr at the University of Illinois (reproductive hormones), and their results will be made available later this fall. These data will be then combined with existing remote sensing and Geographic Information Systems (GIS) data to determine if the stress response and health of grizzly bears is associated significantly with existing levels of human activity and landscape change within their home range.

### 3. Microsite Habitat Selection

Robin Munro, Scott Nielsen, Gordon Stenhouse and Mark Boyce

Although habitat can be analysed at many scales, it is often broadly classed into 2 levels: (a) macrohabitat selection, i.e. the selection of general broad scale vegetation classes (IDT map) and (b) microhabitat selection, which tends to focuses on uncovering specific understory vegetation structures within the broader habitat classes. Currently, Scott Nielsen and Mark Boyce are examining selection at the broader scale. As of May 2001, we have initiated a new component within the FMF Grizzly Bear Research Project designed to examine bear selection at the microsite level. The importance of this selection level is two-fold. Firstly, microhabitat work is important for understanding the mechanism of selection at the broader scale and the seasonal importance of different habitats. Because some populations may ultimately be regulated by food, selection at this scale will likely have a direct effect on individual bear fitness. Thus a clear understanding of why specific broader habitat classes may or may not be important to grizzly bears is important essential for the effective management and conservation of the species. Secondly, it enables researcher to collect valuable data on the diet of grizzly bears in our area. Bears must satisfy their nutritional requirements for the entire year in approximately 7 months it is, therefore, not surprising that there is a strong relationship between food

quantity and quality and reproductive rates. Consequently, knowledge of their diet is critical if we are to understand the ecology and behaviour of grizzly bears.

**Field Methods 2001**

Four "representative" female grizzly bears (3 foothills bears and 1 mountain bear) have been selected and fitted with GPS collars, which have been programmed for 6 locations/day, and bi-monthly uploads. Data locations obtained from the 4 bears are sub-sampled such that one location per day is randomly selected. These locations are visited and 20 $m^2$ plots are established at these sites. At each plot the general aspect, slope, and elevation are determined. Additional general forestry information is also collected for its potential use in habitat characterisation. This includes estimation of canopy cover (spherical densiometer) and basal area by species (prism sweep). As well any bear sign present is also identified and quantified (ie count of diggings etc.). Within the 20 $m^2$ plot, a 20 m long transect is laid out in a N/S direction. At each 5 m mark along this transect a 1 $m^2$ plot is established (n=5). Within each of these smaller scale plots cover and abundance of each plant species (with the primary focus being on bear foods) is determined through ocular estimation. To measure availability, random plots have been established throughout each of these bear's home range area. An attempt was made to stratify these random points by habitat type (following the IDT classification map; Franklin et al.) and stand age. In order to compare the use to random locations, the plot design and data collection at the random sites were consistent with the use plots.

Using logistic regression analysis we will build models based on both individual bear and "population" level selection. These will provide us with probability functions that relate to the likelihood of given habitat being selected and the presence and abundance of the vegetation/habitat features. From these equations, maps predicting the probability of use of a given area can be derived. To explore the link between micro-habitat scales of selection and macro-habitat scales, RSF model coefficients (see below) for the habitat and landscape features will be compared against the model coefficients derived from the micro-site/vegetation model coefficients.

Scat samples will be sent to Bruce Davitt at the University of Washington lab for diet content analysis.

**Current Status and Activities**

To date 176 use and 190 random plots have been completed. In addition, 135 scat samples have been collected for diet analysis. Data collection will continue into October. Preliminary analysis of this season's data will be conducted in the winter months. In order to explore temporal variation in bear micro-site selection this program is expected to continue until the completion of the overall FMF research project in 2004.

**4. Resource Selection Functions – University of Alberta**

Scott Nielsen, Dr. Mark Boyce, Robin Munro, Gordon Stenhouse

**2001 Field Program Objectives.**

1. Micro-site grizzly bear resource selection
2. Distribution of grizzly bear food resources
3. Spatial and temporal variation in berry production
4. Microclimate measurements (as related to objectives 2 and 3)
5. GPS Collar Testing

**Overview of Methods and Field Efforts.**

To evaluate small-scale differences in resource selection by grizzly bears as well as understand distribution of bear foods and production of berries that may influence selection of habitats, we have established a three-year field program that evaluates grizzly bear resources across four grizzly bear home ranges (G-03, G-20, G-12, and G36) in the foothills and mountains of west-central Alberta. The field sampling protocol being employed is designed to balance information gathered in the field on both grizzly bear use locations (GPS radiocollar points less than 2 weeks old) and random available points within each bears home range. Following the query of appropriate points in a GIS, GPS waypoints were downloaded onto a Garmin II+ unit. Researchers (2 to 3 individuals)

then navigated to these predetermined locations and established 20-metre transects. At all random available locations, permanent stakes were placed in the ground at the 0-m and 20-m positions for future re-location and re-monitoring. Such re-monitoring will be crucial for understanding berry dynamics using repeated-measures analyses. Along each transect, researchers described the general habitat (as it relates to the Calgary IDT map), groundlayer species cover, shrub cover and density, canopy measurements, tree basal area, hiding cover, berry production, environmental variables (soil temperature, slope, aspect, elevation, etc.), and the presence of bear sign. When *Hedysarum* digs are located within the immediate area, the densities of those digging locations are quantified within a $400m^2$ area centred on transect midpoints. When present, scat samples were collected and labelled for future analysis. Notes were also made on the activity of the animal (bedding, feeding, etc.), with the presence of ants, ungulates or small mammals along transects marked. In addition to these smaller transects, larger ($900\text{-}m^2$) berry productivity plots were established at four sites to help facilitate an understanding of the patterns and dynamics of *Sherperdia canadensis*, as well as provide baseline samples of *Sherperdia* productivity for comparisons with future berry years.

This season, we also investigated microclimatic patterns at 26 stations throughout the Yellowhead Ecosystem using temperature dataloggers positioned at 20 cm heights (average height of most *Vaccinium* species). These temporary weather stations will be used to derive spatially explicit climate models at scales finer than can be derived from current permanent weather stations. In particular, growing-degree-days is being examined as a possible correlate for berry production and presence of bear foods. Temperatures at these stations were recorded at 90-minute intervals between May 1$^{st}$ to August 31$^{st}$ in lower elevation sites ($\leq$1549 m) and June 1$^{st}$ to August 31$^{st}$ at higher elevations (>1550 m).

GPS collar bias testing continues this late summer, as we again focus on comparing the performance of Televilt and ATS GPS radiocollars within different habitat and terrain conditions. At these sites, we measure typical forestry attributes and attempted fixes across 24-hour sampling periods. Although frequently ignored, GPS collar bias remains

an important issue in need of investigation before management decisions are based on models derived from potentially biased collar data.

**2001 Field Accomplishments.**

In total, over 375 microsite habitat selection plots were established this field season. At each site, we not only collected information on habitat selection by grizzly bears, but also information on berry productivity for 23 species of low shrubs. With berries being the principal food source for bears in the area, it is a logical next step to understand how levels of berry production can vary between years and how these changes influence not only selection of habitats, but also levels of fitness. To establish such relationships, berry productivity will be re-monitored on permanently marked plots (available random plots outside JNP) in the 2002 and 2003 field seasons as well as the four 900m$^2$ *Sherperdia canadensis* plots scattered across the study area. Modeling the distribution of bear foods will also be accomplished using the information gathered this summer, as well as with existing plant inventories and research plots. A good deal of the variation in distribution patterns of these species can be explained through microclimatic patterns and thus, we have established a series of microclimatic stations to quantify growing-degree-days.

**Activities in Progress.**

Currently, we are working on developing food-based habitat models for the study area and resource selection functions (RSF) at both the individual and population-levels. Food-based habitat models will be compared with Landsat TM derived habitat maps (IDT map Univ. of Calgary) as well as Cumulative Effects Assessment (CEA) models formerly developed for the area. Landsat derived maps, although quite useful for relating bears to human-perceived and managed habitats, are not based on the resources in which bears are actually using to maintain their fitness, while CEA models are not statistically rigorous. Comparisons will focus on the effectiveness of these maps/models in predicting grizzly bears in the foothills and mountains of Alberta as well providing potential mechanisms for exhibited selection patterns. It should be noted that all these maps and models are

important for understanding human-bear relationships. Some map layers will simply be more useful for addressing particular questions then others.

RSF models are currently being developed using both habitat layers and information on human development (density of roads, cut-block information, etc.). Such models will be produced at multiple temporal levels and at both the individual and population-level. Critical to producing models with appropriate inference, we are examining approaches to overcoming bias associated with GPS collar error, autocorrelation, and pseudo-replication.

## 5. Remote Sensing and GIS activities – Dr. Steven Franklin (University of Calgary)

*Note: This program component has received an NSERC/Industry Collaborative Research and Development Grant – Project (File CRDPJ 236922) entitled "Grizzly bear management and conservation: understanding the links between population, behaviour, habitat, and landscape structure with geospatial tools"*

The objectives in the first year of the program component were fourfold:

1. To complete the field program needed to develop the classification of available satellite imagery for the 1999 and 2000 core and extended study areas;
2. To complete the 1999 image classification and landscape metric calculations for the core study area;
3. To acquire the necessary field data and spatial data layers to permit initial resource selection function models to be developed; and
4. To initiate research on the issues of landscape greenness monitoring, change detection, and habitat characterization.

### Summary of Progress

The University of Calgary deployed two field teams in 2001: Barb Schwab, Erin Bainbridge, and Charlene Popplewell with assistance from Rob Skakun and Chen Zhang

(five University of Calgary graduate students) collected more than 250 field samples in order to develop the image classification training data set to be applied to the 1999 and 2000 core and extended study areas. Julia Linke and Falk Huettmann focused on the collection of data to discriminate smaller disturbances (e.g., seismic lines). These observations, consisting of vegetation and physiognomic measurements, will be used in the Fall of 2001 and early 2002 to develop the classification maps and validate the accuracy with which bear habitat classes can be derived from the imagery. New imagery for the year 2000 were acquired and used to create greenness maps which correlate well with physiological conditions, such as leaf area and berry production. The imagery were processed geometrically and radiometrically (atmospheric correction) prior to derivation of greenness measures. The original 1999 core study area classification map was used as input to the calculation of landscape metrics for each of 16 bear management units. Charlene Popplewell completed her MSc thesis entitled: "Habitat structure and fragmentation of grizzly bear management units and home ranges in the Alberta Yellowhead Ecosystem. Barb Schwab continued her MSc research on the use of graph theoretic models to understand the connectivity of grizzly bear habitat and the general landscape structure as depicted in the satellite image classification maps. Julia Linke continued her work on a thesis designed to reveal the importance of the smaller landscape disturbances, not visible in Landsat imagery, on habitat structure. A new student, Kirk Montgomery (BES, University of Waterloo) started an MSc program at the University of Calgary in September 2001 to address the outstanding issues of landscape monitoring and change detection over time.

Currently work is underway in the following areas:

1. To develop and implement the field program needed to apply the IDT classification methods to newly acquired satellite imagery (year 2001) of the core and extended study areas;
2. To complete the 2000 and 2001 image classifications and landscape metric calculations for the entire study area;

3. To complete research on the optimal ways of updating the classification products with higher spatial detail imagery which show smaller disturbance features (e.g., seismic lines);
4. To complete research on the issues of landscape greenness monitoring, change detection, and habitat characterization from remotely sensed data.

**Participation and Scientific Contributions by GIS/Remote Sensing Team**

Steven Franklin supervised MSc thesis work at the University of Calgary and in the field by Charlene Popplewell, Barb Schwab, and Julia Linke. This involved consultation on the proposed field work sample design, actual collection of data, compilation of the observation database, and interpretation and analysis of results. Additional supervisory assistance for Ms Popplewell and Ms Schwab was provided by Dr Clarence Woudsma and Dr Mryka Hall-Beyer of the Geography Department. In May, all three students attended the International Bear Association Meeting in Utah; Ms Popplewell presented a poster there, and a second presentation was made at the 21st Canadian Symposium on Remote Sensing in Quebec City in August. These presentations formed the basis for a submission to the journal *Ursus* (decision pending). Dr Franklin also supervised Medina Hansen, who through a secondment was appointed the University of Calgary Research Associate on the project. She implemented the classification procedures and developed the greenness maps.

Dr Franklin assumed lead authorship and responsibility for three conference papers (Sixth Circumpolar Conference on Remote Sensing, 20th Canadian Symposium on Remote Sensing – the presentation received the Best Paper Award, 21st Canadian Symposium on Remote Sensing), and two journal papers now accepted for publication:

1) Franklin, Stenhouse, Hansen, Popplewell, Dechka, and Peddle: "An integrated decision tree approach to mapping landcover using satellite remote sensing in support of grizzly bear habitat analysis in the Alberta Yellowhead Ecosystem", *Canadian Journal of Remote Sensing*, in press;

2) Franklin, Peddle, Dechka, Stenhouse: "Evidential reasoning with Landsat TM, DEM, and GIS data for landcover classification in support of grizzly bear habitat mapping", *International Journal of Remote Sensing*, in press.

Dr Franklin also provided a linkage to other scientists, including Dr Derek Peddle (University of Lethbridge) and Mr Jeff Dechka (GeoAnalytic Inc.) who were involved in advising students, contributing research ideas, and analysis of results.

## 6. DNA and Population Monitoring Work

Gordon Stenhouse, Robin Munro, John Boulanger, and Dr. Sam Wasser

**Objectives:**

- To continue investigating DNA approaches to monitor grizzly bear populations
- To assess existing DNA data sets in relation to bear movement data
- To collect additional scat samples from selected portions of the study area to continue the development of laboratory techniques and protocols for increasing DNA extraction rates
- To publish scientific peer reviewed papers on the results of this work to aid wildlife managers who may be considering using these techniques.

**2001 Accomplishments to Date**

A team of 10 field staff from the University of Washington also worked within the study area in July and August and collected grizzly bear scat samples using 6 trained dogs in order to conduct further DNA analysis on questions related to individual recognition, stress and reproductive hormone levels. In total over 500 scat samples were collected this season in 30 9x9 km grid cells. These cells were selected based on our 1999 DNA hair snagging field effort and the results from those findings. Laboratory analysis of all scat samples are now underway at the University of Washington in Seattle.

We also had a dog team follow a travel route from one our GPS collared bears on a weekly basis for the period July-August. The team would have a GPS location file collected from the collared bear downloaded into their hand held Garmen GPS unit and would back track a travel route of an individual bear for a predetermined period of time. The objective of this effort was to provide scat samples from known individuals to allow for determination of both stress and reproductive hormone levels over a two month sampling window. These data will be compared with stress levels obtained during capture activities with these same individuals this past spring.

DNA laboratory analysis is underway at the University of Alberta on hair samples collected from grizzly bears captured during the spring capture period. Results of this analysis will be available in December and we will analyze these data to determine if the bear was previously identified in other DNA inventory work in the first two years of this project. It is also our intention to look at all our DNA samples with regards to genetic relatedness. This will require more in depth laboratory analysis that is not scheduled during the current year.

We have also recently completed a detailed analysis of our 1999 DNA hair data with our GPS data set that was gathered during this same time period. A scientific publication of the results of this work has now been submitted to the Journal of Applied Ecology for publication. Our results show a number of potential issues that managers must face when considering the use of DNA mark-recapture efforts for determination of population status for grizzly bears.

**Communications**

One of the key program elements within this research project is the communication of the results and findings to our program partners and interested stakeholders. During the first half of this fiscal year we have produced a set of posters which are designed to describe our program goals, the research methods, and the team of collaborators who are working with us on this project. A set of these posters is available on request.

To date these posters have been displayed at professional biologist meetings, regional trade shows, tourism displays in the National Parks, and to many of our program partners within their own organizations.

We have also spent a considerable amount of time and effort in seeing that the work completed to date receives wide distribution within the scientific community. This has involved the preparation of scientific papers for publication as well as presenting talks at professional meetings. A full listing of the publications/technical papers completed to date is provided in Appendix A.

The lead researcher of this project (Gordon Stenhouse) also serves as the technical advisor to the Regional Carnivore Management Group (RCMG) who is tasked with taking the research results and using them for management purposes. This relationship between research and management has resulted in ongoing and regular dialogue on research findings, direction, and progress.

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More information on the Foothills Model Forest Program can be obtained at www.fmf.ab.ca

Further information can also be obtained by contacting Gordon Stenhouse (780) 865-8388 or Gordon.Stenhouse@gov.ab.ca.

**Appendix A**

**FMF Grizzly Bear Project**

**Publication/Technical Paper List**

1. Stenhouse, G.B. 1999. The Foothills Model Forest Grizzly Bear Research Project. A research initiative in support of "A Framework for the Integrated Conservation of Grizzly Bears". Work plan for 1998-1999. 120pp.
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