Foothills Model Forest Grizzly Bear Research Project
Habitat Mapping and RSF Modeling Component
In Participation with the Habitat Stewardship Program for Species at Risk

First Quarter Progress Report and Update
For the period ending September 30/03.

1. Project Name: Foothills Model Forest Grizzly Bear Research Project: Habitat Mapping and RSF Modeling Component

2. Recipient Organization: Foothills Model Forest, Hinton, Alberta.

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4. Reporting Date: For the period July 1- September 30, 2003

5. Reporting Period: 2nd quarter progress report and update

6. Signature: _____

Project Background and Rationale

In 1999, three co-PIs (Stenhouse, Franklin, Boyce) began a research project entitled "Grizzly bear management and conservation: understanding the links between population, behaviour, habitat, and landscape structure with geospatial tools". Our overall goals were to develop the appropriate remote sensing tools to enable grizzly bear habitat maps to be produced and updated annually for the Foothills Model Forest Grizzly Bear Study, to use these information products to validate the resource selection models and the habitat analyses, to begin modelling work to create data layers of historical greenness and land cover and in future scenarios, and to complete studies on fragmentation and habitat connectivity. The remote sensing goals in this project were more focused. We have successfully identified and tested the appropriate data layers that can be derived by

remote sensing technology for grizzly bear ecological studies. To summarize, the remote sensing team developed an approach to grizzly bear habitat mapping and modeling with the following steps:

- Satellite images are processed geometrically and radiometrically (atmospheric correction, normalization, data fusion) prior to derivation of specific land cover classes and greenness measures;
- Image classification training and validation of available satellite imagery is based on the IDT approach (using imagery, GIS, and DEM data), which is powerful strategy that enables new image processing modules to be incorporated (e.g., segmentation);
- An appropriate change detection model for the image data and relate landscape change to the selected landscape metrics has been selected and applied;
- Specific habitat models using remotely sensed data within land cover classes (e.g., crown closure, species composition, LAI) have been tested;
- Methods to derive spatially-accurate historical and future landscapes have been developed and validated;
- The structure and fragmentation of grizzly bear management units and home ranges was tested using landscape metrics and parsimony comparative work.

This work occurred between 1999 and 2002 and has provided the research team with a validated approach with which to move these tools to other grizzly bear habitats in Alberta. As part of the current HSP supported program the research team has embarked on an effort to move these methods and tools beyond the boundaries of the previous study area boundaries (1999-2002 10,000 km2) to a more extensive landscape of approximately 100,000 km2 (see figure 1). As the Foothill Model Forest Grizzly Bear Project expands to this larger study area, it is clear that we require a mapping strategy far more comprehensive than previously employed by researchers investigating smaller landscape units. We are confident that the new approach developed will serve management and conservation needs for this species. We are therefore mapping biophysical elements at multiple scales will provide a better representation of environmental conditions. Our past

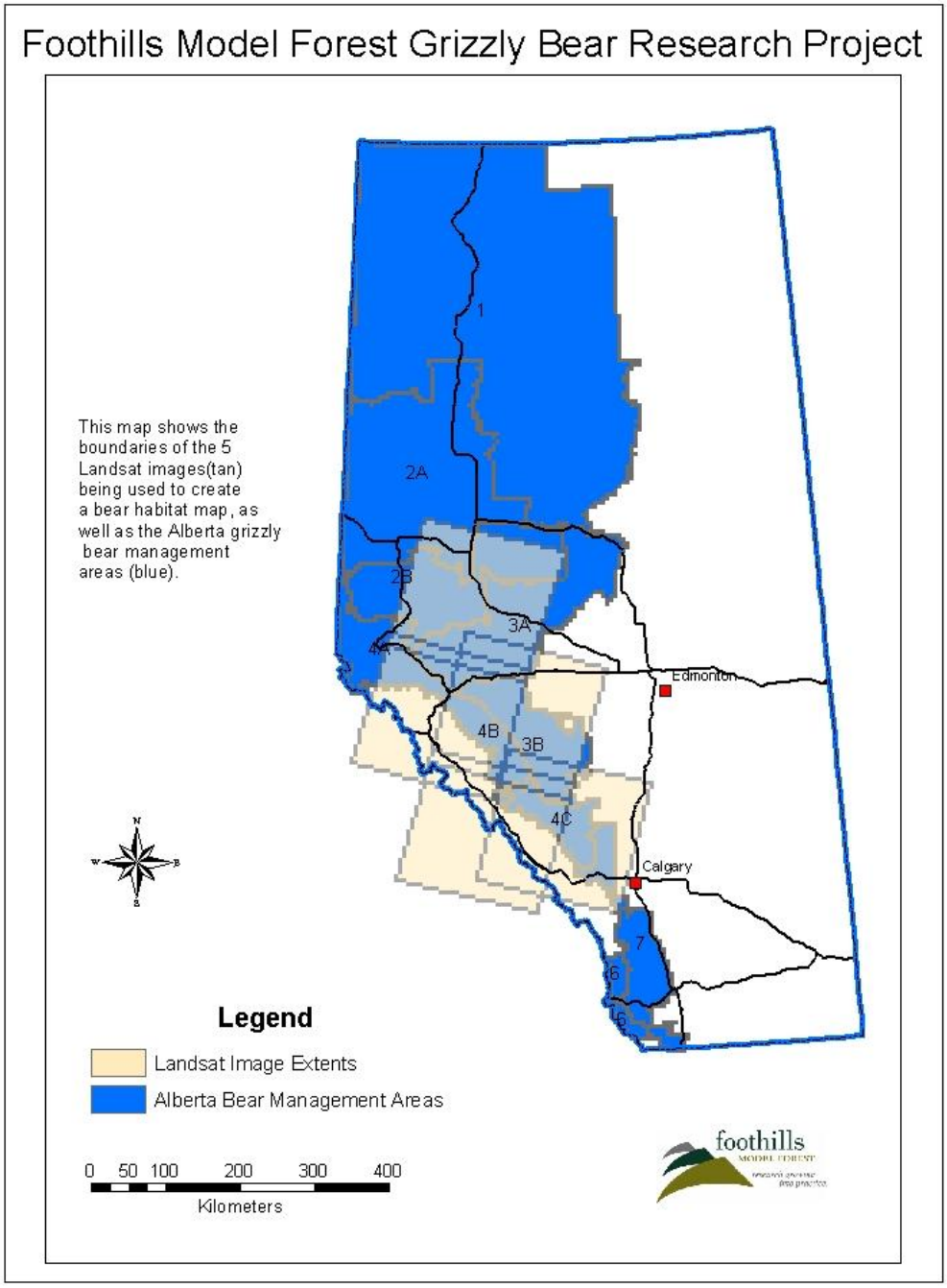
investigation has shown that grizzly bears respond to a broad blend of environmental factors that vary across both space and time, and that the flexibility afforded by multi-scale observations will be critical.

As previously identified our strategy will result in the creation of a hierarchical vegetation information database composed of products on three levels (Figure 2):

1. Cover Type. The broadest information level in the system, cover types will capture the broad (1000s of hectares) physiographic entities that make up the Phase III grizzly bear range. There are two potential sources for this information: (i) the Natural Regions and Subregions of Alberta (Government of Alberta, 2002) or (ii) the AVHRR-derived Land Cover Map of Canada (Natural Resources Canada, 1995).

2. Stand. The intermediate data level, stand information will be made up of moderate-sized (10s-100s of hectares) vegetation units composed of similar physiognomy. These data will be produced through classification of Landsat ETM+ imagery and ancillary data, and will include various structural elements derived from fragmentation analysis.

3. Tree/Gap. The most spatially-detailed information in the system, tree/gap-level data will be composed of fine (<1 hectare) continuous estimates of LAI, species, and crown closure across the entire study area. These data will be derived from empirical models based on Landsat ETM+ imagery and ancillary data.



Drawn By: J. Cranston
Date: Sep. 2, 2003

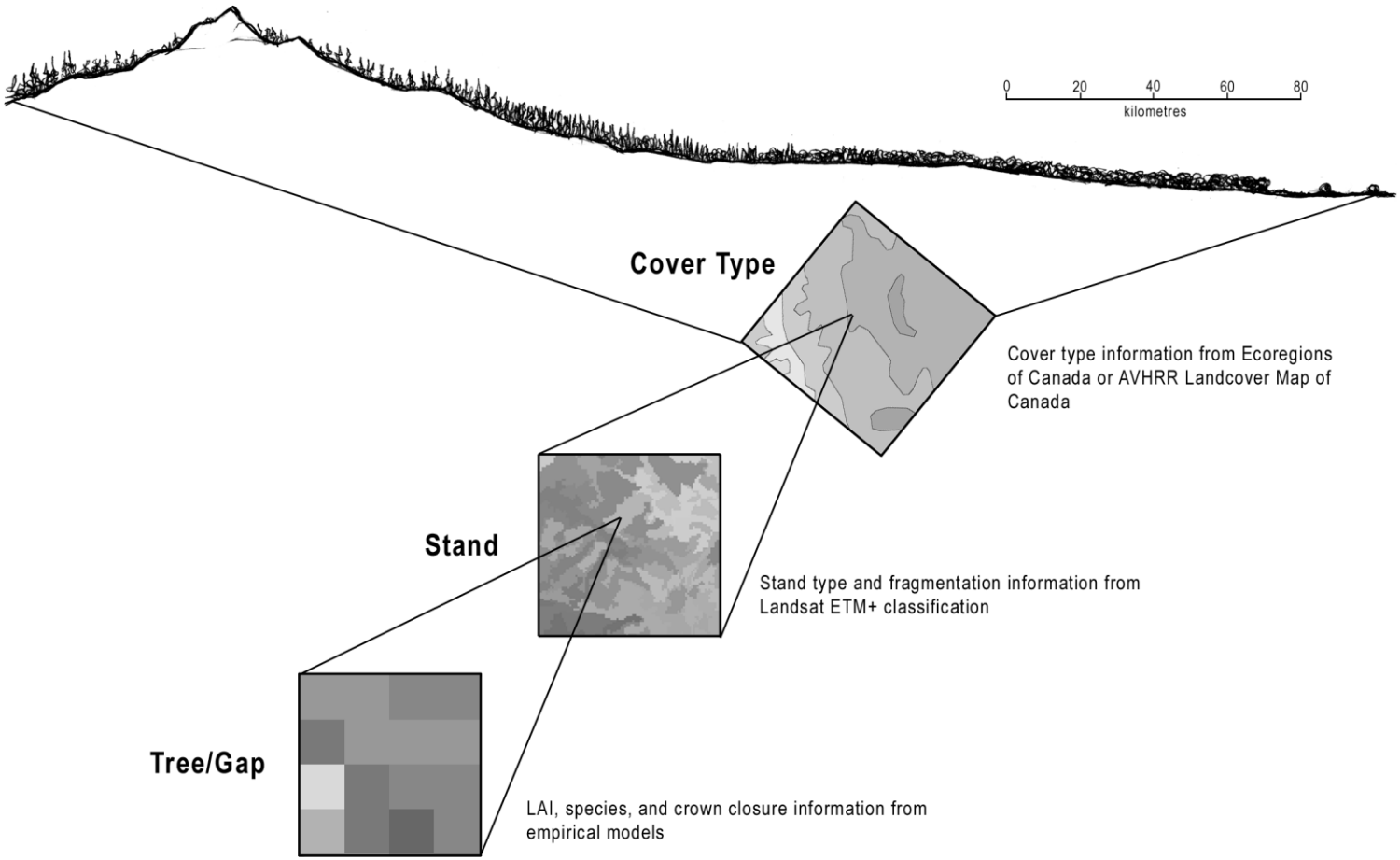


Figure 2: The multiscale structure of vegetation information for mapping and monitoring grizzly bear habitat across the Phase 3 study area.

Project Update

Remote Sensing Progress Report

Researchers at the University of Calgary and the University of Saskatchewan have collaborated to make progress on a variety of remote sensing initiatives as part of the Foothills Model Forest Grizzly Bear Project. Each initiative fits into the overall objective of characterizing land cover and vegetation for the purpose of grizzly bear habitat mapping over large areas. The underlying premise is that mapping biophysical elements at multiple scales will provide a better representation of environmental conditions than products used by previous studies and, presumably, a more powerful dataset for subsequent habitat modelling.

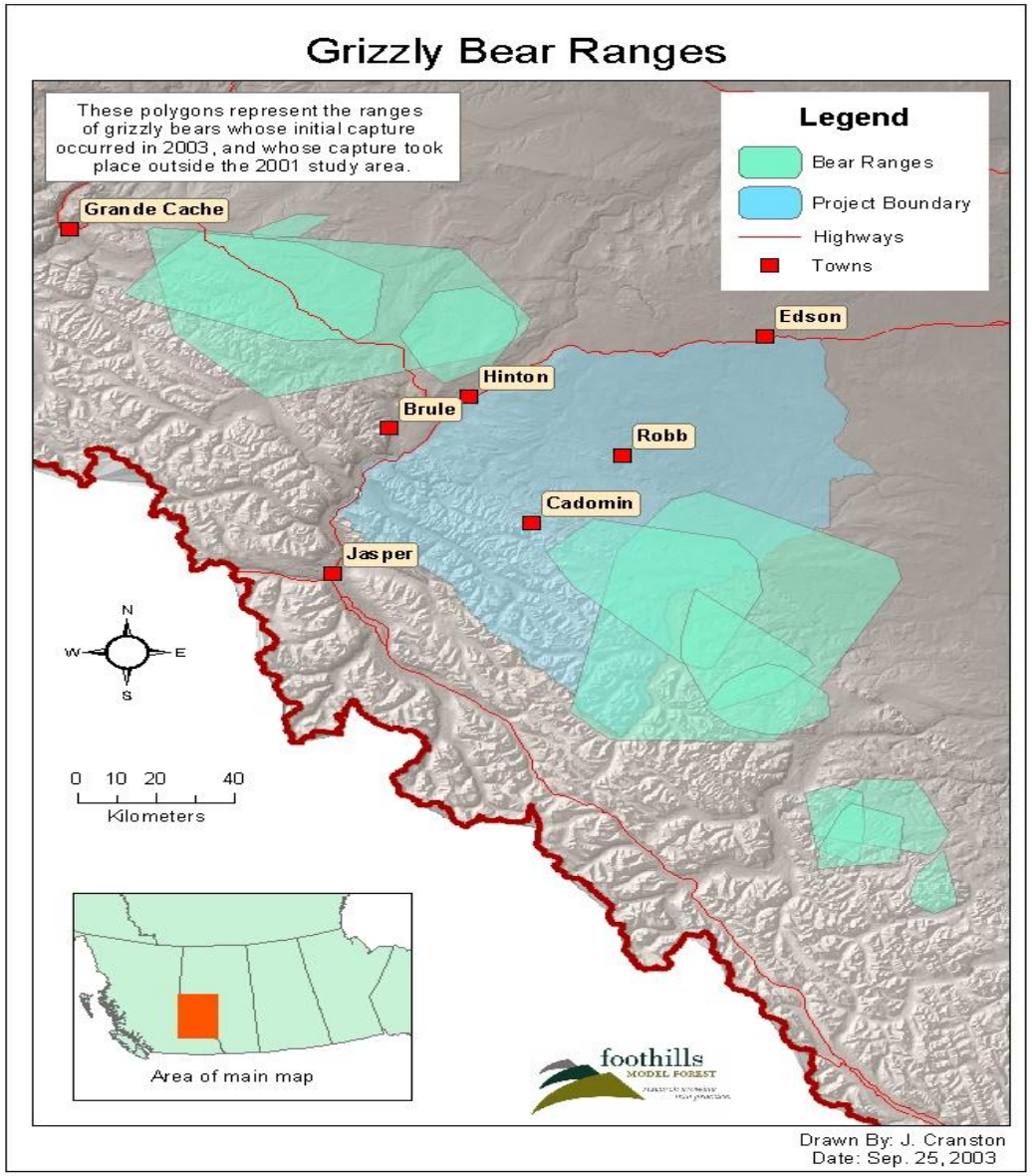
At the broadest spatial scale, personnel from the University of Calgary cooperated with field crews from the University of Alberta and Jasper National Park to collect training data to be used in a 13-class landcover map of the Phase III study area derived from satellite imagery. Field activities in the 2003 season were coordinated with researchers at the University of Alberta (part of the AGCC landcover initiative) and Parks Canada (part of the Jasper Caribou study). This coordination has resulted in more effective gorund based field sampling that could have been achieved working independently and this larger more comprehensive data set will improve the final mapping product. The various field teams worked with coordinated field protocols and sampling methods to help achieve common goals over this large study area. The U of C crew acquired about 150 new field sites, which are currently being aggregated with those of the cooperating agencies, and the database of ground truthing sites from previous activities in the core area. Field sampling work was completed on September 1, 2003.

The actual classification work will take place in Arturo Sanchez's lab at the University of Alberta, with guidance and colaboration from Steve Franklin's personnel from the University of Saskatchewan and Ron Hall at the Canadian Forest Service. Delivery of the initial product is tentatively scheduled for December, 2003. We plan to run diagnostic tests on this image and have it available to begin the preparation of data sets for the completion of RSF models in February 2004.

Additional activities revolve around the characterization of more detailed vegetation attributes such as Leaf Area Index (LAI), crown closure, and the distribution of major tree species. For example, a significant effort has been made to increase our understanding of the 'greenness' index: a habitat quality indicator commonly used in previous grizzly bear habitat studies. Field activities in 2002 and 2003 have been used to characterize the structural and temporal variation of vegetation across a sample of field sites across the core study area. The work has yielded insight into the three-dimensional layering of leaf biomass across key vegetation communities, and the structural changes associated with 'greening up' over the course of a growing season. By linking these with multitemporal, satellite-derived vegetation indices, we intend to produce annual maps showing the distribution and seasonal variability of LAI over the Phase III study area. The first such map will be delivered January, 2004. Additional products that characterize crown closure and major tree species are currently in progress, and should be complete by March, 2004.

As the RSF modelling and the Graph Theory analysis depend on the completion of the large-scale habitat map there is no specific activity to date to report in these program components. However a final report and analysis has been completed on a 10,000 km2 area showing grizzly bear movement corridors utilizing the graph theory approach. The two PhD students for this work (Nielsen- RSF (UofA) and Schwab-Graph Theory (Wilfrid Laurier University)) have been confirmed and are awaiting the final map products to begin their work. The habitat mapping/remote sensing team are aware of the urgency and necessity to complete the mapping products on schedule to facilitate the timely completion and delivery of the RSF and graph theory models.

A complimentary research component (not funded with HSP funds) involved the capture and radio-collaring of a small sample of bears in the study/mapping area. This work has been successfully completed and we now have 13 new collared grizzly bears gathering habitat use data. This new data set will be an important component in testing the utility and accuracy of the new habitat maps and models within this overall research effort. Data from these "new bears" is continuing and the spatial distribution of grizzly bear location data is provided in figure 3.


Grizzly Bear Ranges
These polygons represent the ranges of grizzly bears whose initial capture occurred in 2003, and whose capture took place outside the 2001 study area.
Legend
Bear Ranges
Project Boundary
Highways
Towns
Grande Cache
Edson
Hinton
Brule
Robb
Cadomin
Jasper
N
W
E
S
0 10 20 40
Kilometers
Area of main map
foothills
MODEL FOREST
Drawn By: J. Cranston
Date: Sep. 25, 2003

Specific Activity (from Workplan)	**Anticipated Results and Deliverables** (from Workplan)	**Activity Status**	**Performance Indicators** (from Workplan)	**Progress in this quarter, and for year-to-date**
reate a seamless habitat p for an area of 100,000 km2 along the eastern slopes of Alberta	Final habitat map	Imagery has been purchased, and processing is continuing on schedule	Image purchased and processing underway Field work was completed on schedule and budget Collaboration with other researchers continues	All imagery has been assembled into a seamless layer, geometrically and radiometrically corrected. Ground truth training data is now being utilized to conduct the land cover classification.
compilation of detailed human use layer is underway by GIS team members	In support of RSF extractions from final habitat mapping products	Ongoing with 65% completed to date	To support the successful completion of the habitat map and to allow RSF model construction	Ongoing with 65% completion to date
Initial discussions with eholder groups made to arrange spring 2004 workshops	In support of spring 2004 workshop planning	Ongoing with CAPP and AFPA in agreement	To support successful completion of training workshops to present final map and model products	Ongoing with 2 of the 3 major stakeholder groups in agreement

1b. Have any activities been dropped, added, expanded, or scaled back?
After having acquired the satellite imagery for the study area, and recognizing the benefits of the habitat mapping efforts to other researchers (eg. Parks Canada) it was decided to expand the mapping effort from the original 30,000 km2 to 100,000 km2 which represents the full extent of the imagery purchased. This expansion in area will not have an affect on budgets or schedules, but will increase the processing and map preparation time. Other research teams are assisting in the data gathering stage as indicated previously. The project team believes that this new area can be completed as originally scheduled.

1b.2. Has the timetable for completion of any activity been altered? NO.

DEBITS

		Projected Amount			Actual Amount		
Expenditure Type	**Paid To**	**Cash**	**In-kind**	**Total**	**Cash**	**In-kind**	**Total**
Image purchase & processing	University of Calgary	29,000		29,000	29,000		29,000
Subtotal	**First Quarter**	**29,000**		**29,000**	**29,000**		**29,000**
Image classification	University of Calgary	40,000		40,000	30,000		30,000
Ground truthing costs (these costs have not been completed as of October 1/03)	University of Calgary	42,000		42,000	19,061		19,061
Field crew salaries	FMF Contractors	10,000		10,000	10,000		10,000
Food , fuel and truck rental	FMF Staff & various suppliers	6,000		6,000	5,283		5,283
Subtotal	**Second Quarter**	**98,000**		**98,000**	**64,344**		**64,344**
Subtotal	**Third Quarter**						
Subtotal	**Fourth Quarter**						
TOTAL DEBITS		**127,000**	**0**	**127,000**	**93,344**	**0**	**93,344**