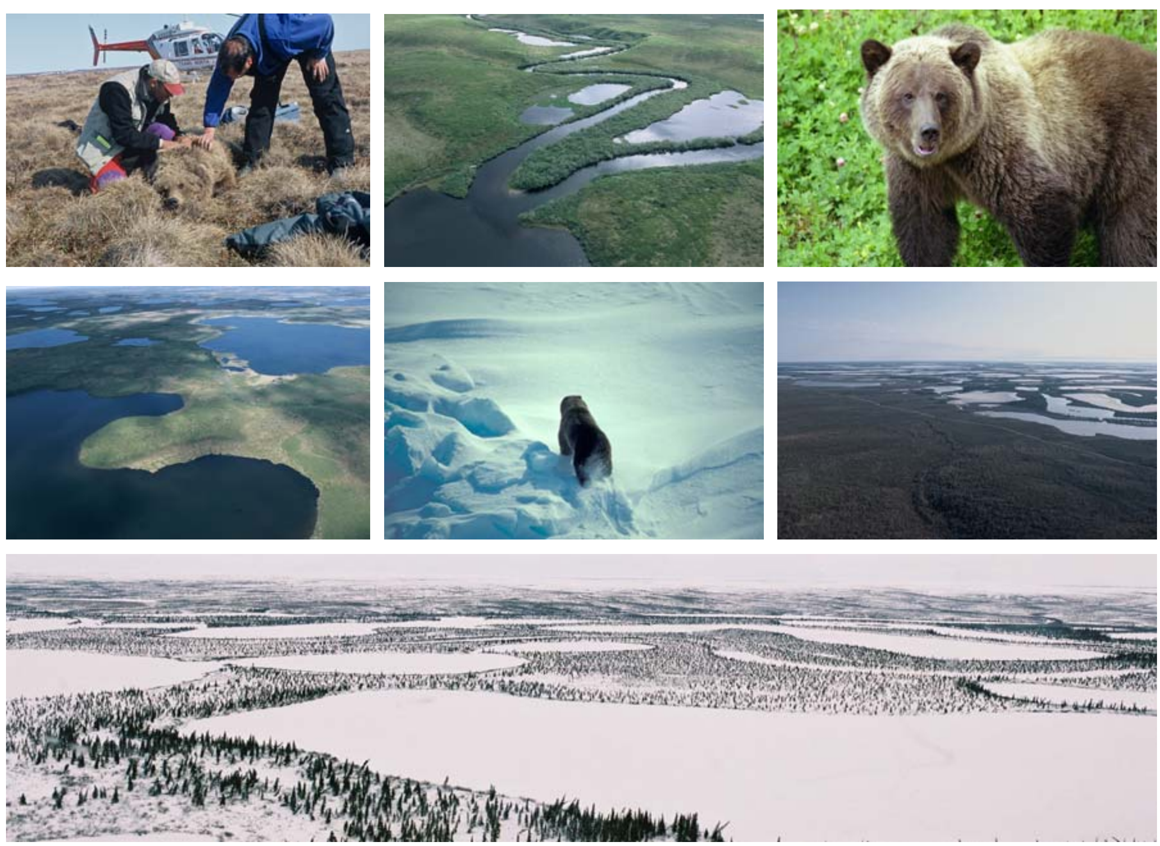
ECOLOGY OF GRIZZLY BEARS (<u>Ursus</u> <u>arctos</u>) IN THE MACKENZIE DELTA OIL AND GAS DEVELOPMENT AREA

2005 Annual Report



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3.0 EXCUTIVE SUMMARY

THE MACKENZIE DELTA GRIZZLY BEAR RESEARCH PROGRAM (2005 – 2006)

In December 2002, the University of Alberta and the Government of Northwest Territories, Department of Environment and Natural Resources (formerly Resources, Wildlife, and Economic Development), Inuvik Region, initiated the MACKENZIE DELTA GRIZZLY BEAR RESEARCH PROGRAM. This collaborative study focuses on management issues and questions related to grizzly bear ecology in the Mackenzie Delta region and the construction of the Mackenzie Valley pipeline. Research activities include the collection of baseline ecological information, quantification of fine-scale habitat use and movement patterns, delineation of annual and seasonal grizzly bear distributions, and the identification of key habitats and resources. A key role for the University of Alberta in this venture was to bring an “at arms length” perspective to issues relating to grizzly bear management and future hydrocarbon-extraction activities and the projected increase in human land use. The collection and analysis of grizzly bear data with the highest level of scientifically rigor is required to develop mechanistic tools for wildlife and land-use managers to integrate grizzly bear conservation into land management at the pre-development stages.

The area of study includes the Mackenzie Delta, Richards Island, and the lower Tuktoyaktuk Peninsula, the region between the Caribou Hills and Husky Lakes, and the area surrounding and north of Sitidgi Lake (c.a. 28,000 km^2). The Department of Environment and Natural Resources with support from the Inuvialuit Game Council, the Wildlife Advisory Council (Northwest Territories), and Hunters and Trappers Committees from Aklavik, Inuvik, Paulatuk, and Tuktoyaktuk, initiated a study in fall 2001 to look at the influence of seismic activity on denning bears. To develop tools for assessing the potential influence of future hydrocarbon-extraction activities on grizzly bears requires the fine-scale quantification of movement and habitat use patterns. To meet this need a radio-collaring program was initiated using the latest Global Positioning System (GPS) technology. Since 2003, 37 grizzly bears have been fitted with GPS radio-collars that record location information at 4-hour intervals over a 24-hour period. Each collar is equipped with a release mechanism that is pre-programmed to cause the collar to “drop-off” at a predetermined date and time. In July 2005, one collar deployed in 2004 that had a 1-year life span and the 4 remaining collars out of 10 deployed in 2003 that had 2-year life spans dropped-off successfully and were recovered for refurbishment and re-deployment. The other 6 collars released remotely in July 2004. Of the 11 collars deployed in 2005, we had 0% collar failure. During the 2005 active season we monitored the movements of 25 grizzly bears collared in 2004 and 2005. Two bears were harvested, 3 collars malfunctioned, and one collar was dropped early in the active season reducing the number of research bears to 19 for the 2005 active season. The collars scheduled for release in 2005 and those from the harvested bears were returned and additional location data was downloaded before sending the collars for refurbishment. Manual download of retrieved collars resulted in a mean increase of 28% in the total number of locations and a 1.3 time increase in the number of locations per day. We will attempt to recover the dropped collars during the 2006 field season for store-on-board data download, refurbishment and subsequent re-deployment. We are dedicated to community involvement and training and have taken the initiative to create learning opportunities for students, northern residents and professionals to develop wildlife investigative techniques and skills. In 2005, we provided pan-territorial training in wildlife capture and handling to a biologist from Nunavut and employed 2 high school students as research technicians through the University of Alberta's Women in Scholarship, Engineering, Science Technology (WISEST) program.

In 2006, collars deployed in 2004 that had 2-year life spans will drop-off for recovery in July. Results from research activities in 2005 include delineation of fine-scale distribution of research bears monitored within the development area for the 2005 active period (April to November); movement patterns were quantified; extent and probability of potential disturbance were delineated; and the development of mechanistic models of habitat selection continues; additional training sites were surveyed for the construction of an accurate vegetation classification model; and the collection of grizzly bear food sources continued in order to develop an accurate representation of the region's stable isotope signature. We received project support from stakeholders and funding agencies. In 2006, a less intensive monitoring program will be initiated with a reduced number of bears (8 – 10) monitored annually. Data collected from these bears will be used to monitor bear response to increasing development activity and to assess the predictive ability of models created during the pre-construction phase. In addition, a less invasive method that does not require the handling of bears will be piloted during the coming field season that uses darts to sample a skin sample for genetic analysis. This progress report details the actions taken, methods, and preliminary results for 2005-2006 and discusses plans for the upcoming 2006-2007 fiscal.

4.0 INTRODUCTION

Two-thousand and six marks the 4th year of a 4-year research program that was started in December 2002 by the University of Alberta and the Government of the Northwest Territories, Department of Environment and Natural Resources (formerly the Department of Wildlife and Economic Development), Inuvik region. Construction of the proposed Mackenzie Valley pipeline will result in landscape scale implications for wildlife in the region, including the barren-ground grizzly bear (*Ursus arctos*) (Holroyd and Retzer 2005). Under COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2002), the barren-ground grizzly bear is listed as a species of "special concern". Historically, past extirpations of grizzly bears in other jurisdictions have been characterized by a lack of planning in the preliminary stages of development (Banci *et al.* 1994) and increasing pressure from anthropogenic activities in the coming years could have deleterious effects for grizzly bears inhabiting the Mackenzie Delta region (Servheen 1990). Grizzly bears in the Inuvialuit Settlement Region (ISR) are co-managed under the Inuvialuit Final Agreement (IFA) by the following agencies and land claim organizations (Nagy and Branigan 1998): the Government of the Northwest Territories, Department of Environment and Natural Resources; the Inuvik, Paulatuk, and Tuktoyaktuk Hunters and Trappers Committees; the Inuvialuit Game Council; Wildlife Management Advisory Council (Northwest Territories); and Heritage Canada/Parks Canada. The mandate of the IFA is to protect and preserve Arctic wildlife, environment, and biological productivity and in doing so ensure that grizzly bears and bear habitat are protected and that harvesting rights are reserved (DIAND 1984). Within the development area there is a need to assess the potential effects of increasing local and regional hydrocarbon-extraction activities in the pre-stages of development and to monitor the response of grizzly bears during the construction and extraction phases.

The Mackenzie River that flows through the development area drains into the Beaufort Sea through the Mackenzie Delta. This Delta and the surrounding region form the northernmost edge of the grizzly bear's geographical range (Banfield 1974, Black and Fehr 2002). Grizzly bears in this region have a shorter active period and 6 to 7 months of winter dormancy (Nagy *et al.* 1983). When combined with a delayed and rapid phenological chronology within the region it is easy to understand that it can be difficult for grizzly bears to meet their requisite resource needs. Depressed recruitment and low resiliency of the species means that they are also especially vulnerable to anthropogenic disturbance at the population level (Weaver *et al.* 1996). There is a need for current fine resolution information on this north-coastal population to enable us to anticipate how these grizzly bears will respond to hydrocarbon-exploration and -extraction and the associated increase in anthropogenic activity to follow.

5.0 PROJECT GOALS AND OBJECTIVES

The primary goals of this project are to update baseline ecological information of grizzly bears in the Mackenzie Delta development area, describe annual and seasonal home range size and distribution, examine fine-scale movement patterns, quantify foraging patterns, and identify key habitats. These data form the foundation for models to assess the potential for anthropogenic disturbance and the increased risk of grizzly bear mortality from development-related activities. The following are the major project objectives:

1. To develop mechanistic models of habitat selection for grizzly bears in the Mackenzie Delta and to assess the influence of possible scenarios of increased development;
2. To describe the spatial-temporal movement patterns of grizzly bears in the Mackenzie Delta and develop mechanistic models to assess the cumulative influences of human activities on movement and connectivity;
3. To assess how oil and gas exploration, development, and production activities will affect grizzly bear survival; and
4. To determine seasonal changes in diet composition and trophic position of grizzly bears in a sub-artic ecosystem.

6.0 THE STUDY AREA

Within the context of this study research activities are focused primarily in the oil and gas development area of the Mackenzie Delta and the surrounding region, NWT. Human populations are centered in the villages of Tuktoyaktuk and Aklavik and the town of Inuvik and numerous camps are scattered across the region. In summer, access is limited to float plane, helicopter, and boat or barge travel and in winter by snow machine or by the winter ice road to Tuktoyaktuk. The study area includes the alluvial flood plain known as the Mackenzie Delta, Richards Island, and the lower Tuktoyaktuk Peninsula, the region between the Caribou Hills and Husky Lakes, and the area surrounding and north of Sitidgi Lake (approximately 28,000 km^2: Figure 1). This area is characterised by long, cold winters and short, cool summers. Temperatures range from -57^{o}C to 32^{o}C and the area can remain snow-covered from mid-October to mid-May with snowfall occurring at anytime during the year (Nagy *et al.* 1983,

Figure 1: The Mackenzie Delta showing the study area boundary and the proposed pipeline corridor.

Black and Fehr 2002). The Delta itself empties into the Beaufort Sea and is the largest Arctic delta in North America (MacKay 1963, Black and Fehr 2002). The study area features landscapes that range from flat alluvial plains in the west to rolling tundra in the east (Nagy *et al.* 1983, Black and Fehr 2002). There are numerous lakes scattered across the region and broad habitat characterizations for the area include boreal forest, forest-tundra transition, and tundra ecosystems (MacKay 1963). Pingos, a low hill or mound caused by hydrostatic pressure in areas underlain with permafrost, are a characteristic feature of the landscape (Black and Fehr 2002).

Some common herbaceous bear food found in the throughout the study area includes lingonberry (*Vacinium vitis-idaea*), crowberry (*Empetrum nigrum*), cloudberry (*Rubus chamemorous*) and kiniknik or bearberry (*Arctostaphylos* spp.) (Porsild and Cody 1980, Milburn 2002). Better drained areas are dominated by blueberry (*V. uliginosum*) and lingonberry whereas sedge (*Carex* ssp.) meadows predominate poorly drained areas (Porsild and Cody 1980, Milburn 2002). Other common herbaceous foods found in the region are hedysarum (*Hedysarum alpinium*), horsetail (*Equisetum* spp.), Arctic lupine (*Lupinus arcticus*), coltsfoot (*Petasites palmatus*), willow catkins (*Salix* spp.) and milk-vetch (*Astragalus* spp.) (Porsild and Cody 1980, Milburn 2002). Fireweed (*Epilobium angustifolium*) grows at anthropogenically-disturbed sites.

Mammalian prey species include semi-domesticated reindeer (*Rangifer tarandus tarandus*), barren-ground caribou (*Rangifer tarandus*), moose (*Alces alces*), brown lemmings (*Lemmus sibiricus*), collared lemmings (*Dicrostonys hudsonicus*), Arctic ground squirrels (*Spermophilus undulates*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), snowshoe hare (*Lepus americanus*) and microtines. The Beaufort Sea is host to bearded seals (*Erignatuhus barbatus*), ringed seals (*Phoca hispida*), belugas (*Delphinapterus leucus*), and Arctic Char (*Salvelinus alpinus*). Snow geese (*Chen caerulescens*), tundra swans (*Olor columbianus*), and willow ptarmigan (*Lagopus lagopus*) nest in the area and freshwater fish can be found in the lakes, rivers and streams.

7.0 CAPTURE AND COLLARING

The 2005 grizzly bear capture program was conducted from May 10th – 24th. Pan-territorial training in wildlife capture and handling technique was provided for a visiting biologist from Nunavut. Searching was stratified so that equal effort was applied to the whole study area. Grizzly bears were immobilized by aerial darting from a Bell 206 Jet Ranger II helicopter. Once located, the capture team assessed the bear's sex and age, and calculated the volume of immobilizing agent needed. All bears were immobilized using Telezol® (8 mg/kg) (Woodbury 1996). Prior to initiating a capture event the ability to immobilize the bear safely and rapidly was assessed. Eleven grizzly bears were fitted with GEN III: TGW-3680 Global Positioning System (GPS) /Argos-linked satellite radio-collars (Telonics Inc., 932 E. Impala Ave., Mesa, AZ, 85204-6699, Service Argos, Inc., P. O. Box 6756, Lynnwood, WA 98036-0756). GPS collars were programmed to acquire location information 6 times per day or 1 location every 4 hours. This relocation frequency resulted in an estimated life span of 36 months. Therefore, collars will be removed by the pre-programmed CR-2A collar release mechanism in summer 2008. Relocation information was imported into a Geographic Information System (GIS) software application, ArcGIS 9.1 (Environmental Systems Research Institute, Redlands, California, USA) for home range size delineation and distribution using 100 % minimum convex polygons (MCP) and fixed kernel utilization distribution (95% and 50%) and movement analysis (Seaman *et al.* 1999, Kernohan *et al.* 2001).

A premolar tooth was extracted for ageing using cementum annuli (Sauer and Free 1965) and bears were classified as belonging to one of the following age and sex classes

- adult male and solitary adult female (≥ 5 years old);
- sub-adult (subad) male or female (3-4 years old); or
- adult female with cubs (family).

Hair, tissue, blood, fat, milk, and a fecal sample were also collected for genetic, dietary, and health analysis. Morphological and demographic information were recorded for all captured bears and body condition was assessed.

During the 16-day capture program 20 grizzly bears were captured, of which 11 were fitted with GPS radio-collars. A total of 25 grizzly bears, 20 females and 5 males, were monitored during the active period between April 1st and November 30th. Eight of the 20 adult females had 1 – 3 cubs between the age of yearling and 3-year old with them when captured and were classified as a family group. A total of 9,323 locations were recorded for all GPS-collared grizzly bears during the 2005 active period. The mean number of locations per day for 2005 was 3.7 compared to 3.8 in 2004. Seven of the grizzly bears collared in 2005 were female (64%) and 4 were male (36%). Of the 7 collared females 2 were classified as family groups that consisted of an adult female with a female yearling and the other was an adult female with two 2-year old male cubs. There were no capture-related mortalities during the 2005 capture program.

8.0 HOME RANGE DELINEATION AND MOVEMENT PATTERNS

All grizzly bears monitored in 2005 were included in the home range analysis. This includes bears collared in 2004 that were fitted with GEN III collars with 2-year life spans and all grizzly bears collared during the 2005 capture program. Two female grizzly bears collared in 2004 were harvested in the spring of 2005 and their collars recovered for store-on-board data download. A comparison of data transmitted by the Argos Inc. automatic distribution service (ADS) and data downloaded manually from the recovered collars resulted in an average 28% more location data, demonstrating the benefit of retrieving dropped collars and collars from harvested animals. Four collars deployed in 2004 slipped-off or malfunctioned shortly after the bears emerged from their dens and only transmitted sporadic or unreliable data. The datasets for these bears were incomplete for the 2005 active season and therefore were omitted from further home range analysis. ESRI's Arcview GIS 3.1 and ArcGIS 9.1 GIS software was used with the Animal Movement Analysis extension to determine home range estimates from GPS locations for the 2005 active season (Hooge and Eichenlaub 1997). One-hundred percent minimum convex polygons (MCP) were created to delineate home range distribution for grizzly bears inhabiting the development area (Figures 2). Ninety-five and 50% fixed kernel home range estimates determined using least-square cross validation allowed for core areas of activity to be identified (Seaman *et al.* 1999) (Figure 3).

The mean home range size for male and female grizzly bears, based on 100% MCP calculations was 2,898 km^2 and 1097 km^2, respectively. The mean core area of use based on 95% fixed kernel home range estimation using least-square cross validation was 1619 km^2 for male grizzly bears and 625 km^2 for female grizzly bears. The mean core area of use based on 50% fixed kernel home range estimations

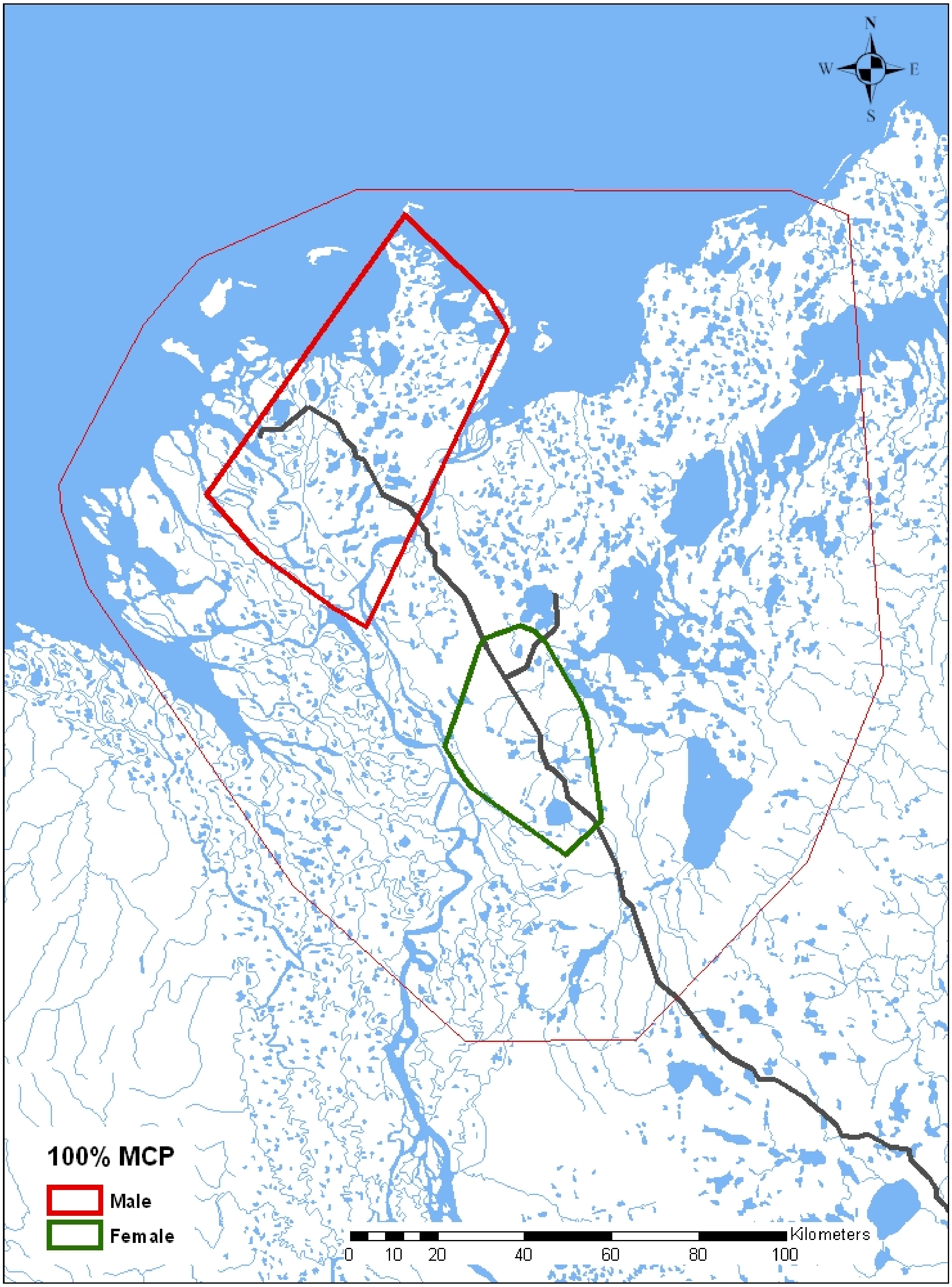


Figure 2: Example showing 100% minimum convex polygon home range size difference for male and female grizzly bears in the Mackenzie Delta study area.

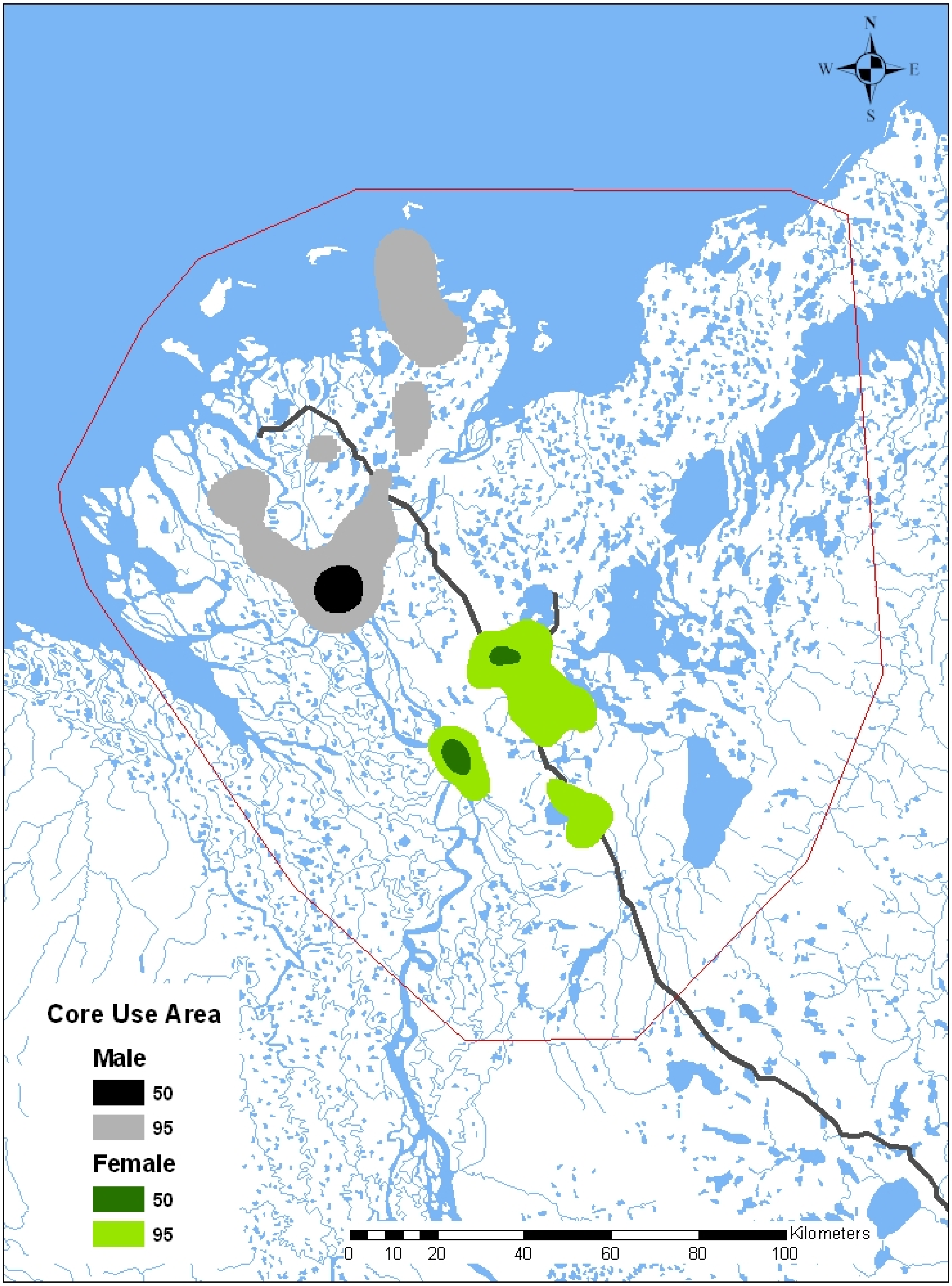


Figure 3: Example showing 95% and 50% kernel home range delineation for male and female grizzly bears in the Mackenzie Delta study area.

was 113 km^2 for male grizzly bears and 81 km^2 for female grizzly bears.

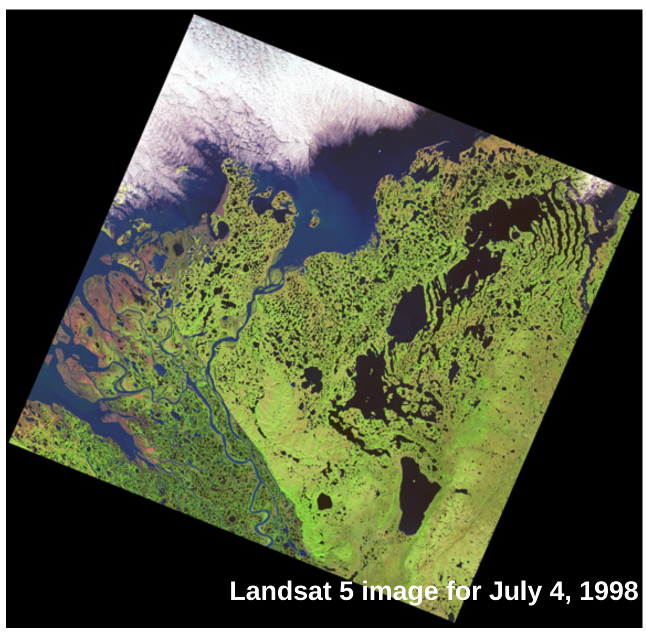
Movement patterns were plotted using ArcGIS 9.1 and Hawth's Analysis 3.71 tools extension (Beyer 2005) software with the Animal Movement Analysis extension (Figures 4) (Hooge and Eichenlaub 1997).

9.0 DESCRIBING PATTERNS OF GRIZZLY BEAR HABITAT USE

Habitat selection for grizzly bears is being quantified using resource selection function (RSF) analysis (Manly *et al.* 1993). The RSF is a tool that provides insights with predictive properties for understanding species-habitat relationships (Boyce and McDonald 1999). To develop the RSF we are estimating model coefficients with the following model structure from Manly *et al.* (1993):

$$w(x) = \exp(\beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i)$$

where $w(x)$ is the resource selection function and each x_i represents a measured variable at a resource site and the value of the β-coefficient is determined from the logistic regression analysis. With RSF models the function is proportional to the relative probability of a habitat being used by an animal (Manly *et al.* 1993, Boyce *et al.* 2002). The advantages of taking a RSF approach over other methods is the use of empirical data to estimate model responses instead of more qualitative descriptions of habitat use by animals (Manly *et al.* 1993, Nielsen *et al.* 2002). In addition, RSF models are more objective, probabilistic, and offer more exploratory ability than other methods. RSF models are being developed to describe habitat selection patterns of grizzly bears in the development area and to identify important habitats.



To create mechanistic models of grizzly bear habitat selection requires that environmental and anthropogenic components of the study area be accurately represented and quantified. Where possible, this information was acquired from pre-existing sources including Natural Resources Canada, the National Topographic Database, and Government of the Northwest Territories. For our analysis the vegetation characteristics of the landscape had to be quantified at a level of resolution

Figure 4: Example of male and female grizzly bear movement patterns.

and classification accuracy not presently available. Ducks Unlimited has been working in the lower Mackenzie Delta to construct a vegetation classification model for that region (Ducks Unlimited 2002). Because some of the region that Ducks Unlimited has classified overlaps the development area we were able to use this information to build a vegetation classification model for the Upper Mackenzie Delta and surrounding regions. In 2005, using the same methods described by Ducks Unlimited (2002) we surveyed approximately 200 model training sites, which added to the 155 and 185 surveyed in 2003 and 2004, respectively. To develop the vegetation classification model the study area was divided into 2 sections, the Kendall Island Migratory Bird Sanctuary and the surrounding region (personal communication: Cindy Squires-Taylor, Government of Northwest Territories). Five percent of the Kendall Island Migratory Bird Sanctuary and 30% of the surrounding area remain to be classified. The mean classification accuracy for the training sites (sites used to develop the model) is 91%. We are having some difficulty in classifying some habitat types (e.g. dwarf shrub and tussock tundra) because there were either no sites or too few sites available in a particular area or there are numerous subclasses for a particular class. We are presently working to resolve these deficiencies. When completed, the vegetation classification model will have the highest possible classification accuracy available and will be applicable to other studies of northern wildlife species such as barren-ground caribou, wolves (*Canis lupus*), and wolverine (*Gulo gulo*).

10.0 DIET COMPOSITION AND TROPHIC POSITION

Understanding spatial-temporal foraging patterns of a species is fundamental for the effective management of wildlife species (Fuller and Sievert 2001). Unlike other grizzly bear populations, the northern boundary for Mackenzie Delta bears is the Beaufort Sea. The north coast offers a potential alternate source of protein derived from marine sources. Using stable isotope analysis on hairs and claw shavings we are determining the proportional diet composition and trophic position of research bears to develop a better understanding of the ecology and requirements of this Arctic population. Because the stable isotope signatures will vary geographically we are developing a regionally distinct isotopic baseline for the bears that inhabit the Mackenzie Delta area. To build this baseline model requires that all potential food sources be collected and their stable isotope values determined (Hilderbrand *et al.* 1999, Jacoby *et al.* 1999). To date we have collected samples from the following food sources [*n*]:

Herbaceaus

- Hedysarum [2]
- Artic Lupine [2]
- Blueberry [1]
- Bochnikia (*Bosshnikia rossica*) [2]
- Cloudberry [5]
- Coltsfoot [4]
- Crowberry [7]
- Fireweed [2]
- Grass [2]
- Horsetail [3]
- Lingonberry [3]
- Milk-vetch [2]
- Prickly rose (*Rosa acicularis*) [2]
- Red bearberry [7]
- Sedges [1]
- Willow catkins [2]
- Muskrat pushups [3]

Terrestrial

- Beaver [1]
- Caribou [1]
- Muskrat [3]
- Ptarmigan [3]
- Moose [2]
- Assorted northern small mammals [19] [e.g. Northern red-backed vole (*Clethrionomys gapperi*)]

Marine

- Arctic char [1]
- Bearded seal [3]
- Ringed seal [3]
- Beluga whale [3]
- Bowhead whale [3]

To complete this model, samples of Arctic ground-squirrel, snowshoe hare and freshwater fish species will be collected during the 2006 field season.

Sixty-three whole hair samples and longitudinal samples of claw unguis were collected from research bears captured in spring 2003 – 05 and prepared for growth section stable isotope analysis (Nakamura *et al.* 1982). Hair and nail are metabolically inert and are not reabsorbed or turned-over so the stable-isotope signature represents a temporal index an individual's diet during the period of protein assimilation (Nakamura *et al.* 1982, Schwertl *et al.* 2003). Because the isotopic signature represents both what the bear has ingested and what has been assimilated we can estimate the proportional contribution and nutritional importance of different diet sources (Herrero *et al.* 2001). By sectioning the hair and claw shavings from base to tip we are examining seasonal changes in foraging patterns and the importance of different diet components during the active season (Mizukami *et al.* 2005). Seasonal diet change will be used to stratify grizzly bear seasons for subsequent analyses.

Through the University of Alberta's Women in Scholarship, Engineering, Science technology (WISEST) program 2 high school students were employed as research assistants and prepared grizzly bear tissue and food samples for stable isotope analysis related to diet composition and trophic position. All samples were cleaned with distilled water to remove debris. Hair and claw samples were washed 3 times in 2:1 methanol: chloroform solution for 10 minutes each to remove lipids before being allowed to dry for 24 hours (Hilderbrand *et al.* 1996, Jacoby *et al.* 1999, Hobson *et al.* 2000). Whole hairs from each bear are being analyzed to determine the mean isotopic signature. For growth section analysis hair and claw are cut into 1.0-cm segments or 20 days of growth (Christensen *et al.* 2005). Hair and claw samples are ground with mortar and pestle and liquid nitrogen.

Animal tissue samples were cut into small pieces with scissors and freeze dried at -50 ^{o}C for at least 24 hours. The samples were soaked in 2:1 methanol: chloroform solution for 24 hours, rinsed and decanted 2 times to remove lipids. Tissue samples were air dried in a fumehood. Using mortar and pestle tissue samples were homogenized into a powder and freeze dried at -50 ^{o}C for another 24 hours.

Sub-samples (1.0 $\pm$ 0.1 mg) are combusted and analysed for isotopic measurement using an isotope ratio mass spectrometer. Results are reported as ratios in parts per thousand (‰) relative to the PeeDee limestone (δ^{13}C) standard or atmospheric nitrogen (δ^{15}N) as follows:

$$\delta X = \left[\left(R_{sample} / R_{standard}\right) - 1\right] \times 1000$$

where X is ^{13}C or ^{15}N and R is the ^{13}C:^{12}C or ^{15}N:^{14}N ratio (Peterson and Fry 1987, Jacoby *et al.* 1999, Hobson *et al.* 2000).

Distinctive isotopic signatures for ^{13}C or ^{15}N of various grizzly bear food sources are being used to determine the relative contribution to their diet using mixing models, which are based on mass balance equations. Mixing models are mathematical solutions limited to solving for n + 1 distinct isotopic sources when n stable isotopes are used (Phillips 2001). The program "isosource" developed by Phillips and Gregg (2003), which is a probabilistic model, will be used to identify a range of possible dietary inputs when the number of source exceeds n + 1 isotopes (www.epa.gov/cgi-bin/eparintonly.cgi).

11.0 SUBPOPULATIONS AND EXTENT OF INFLUENCE

Localized disturbances related to hydrocarbon development and extraction could result in landscape-level influences on the grizzly bear population and there is a lack of methods available to partition these effects. The influence of disturbance can extend beyond the anthropogenic footprint and the extent of magnitude of the influence across the landscape will not be homogeneously distributed (Archibald *et al.* 1987, McLellan and Shackleton 1988, Mace *et al.* 1996).

The distribution of grizzly bears across a landscape will be aggregated within particular geographical areas, depending on environmental conditions, topographical features, and the spatial affinity of individuals (Wells and Richmond 1995, Bethke *et al.* 1996). To evaluate the effects of disturbances on rates of reproduction, mortality, immigration, and emigration and the spatial and temporal dynamics of individuals within populations requires an understanding of the geographical boundaries of the areas used (Derocher and Stirling 1995). We used radio-telemetry data from 1974 – 78 and 2001 – 04 to identify subpopulations of bears living in the Mackenzie Delta region (Bethke *et al.* 1996, Schaefer *et al.* 2001). A better understanding of the spatial distribution of subpopulation structure will allow managers to more effectively monitor changes in bear resource availability, distribution, movement and population dynamics in response to development and anticipate the probability and extent of influence from a disturbance. We used a geographical information system (GIS) approach, which is readily available to wildlife agencies and land-use managers, to visualize subpopulation boundaries, map the extent of development influence and calculate the probability of influence from a disturbance. We illustrate the ease of interpretation and the applicability of our approach with the projected development of the Mackenzie Valley gas pipeline. This component of the research program was presented at the International Conference on Bear Management and Research in September 2005 and is presently under review for submission to the international journal *Ursus*.

12.0 PARTNERS AND GRANT APPLICATIONS

In addition to the support provided by the Government of the Northwest Territories, Department of Environment and Natural Resources (Inuvik Region) and the University of Alberta, the following granting agencies and potential industrial partners were approached in 2005 (Table 1):

- Alberta Cooperative Conservation Research Unit (ACCRU)
- Department of Indian and Northern Affairs/Canadian Circumpolar Institute (NSTP/ C/BAR)
- Polar Continental Shelf Project
- World Wildlife Fund/Endangered Species Recovery Fund
- Western Northwest Territories Biophysical Study

To date ca. $41,200 has been approved as in-kind support from Polar Continental Shelf and from the Alberta Cooperative Research Unit. A two-year grant in the amount of $16,000 was awarded from the

Table 1: Summary of partner contributions for the 2005 – 2006 operational season.

Partners	In-kind or Cash	Amount	Status
Alberta Cooperative Conservation Research Unit (ACCRU)	In-kind	6,800	Pending
Department of Indian and Northern Affairs/ Canadian Circumpolar Institute (NSTP/C/BAR)	Cash	4,990	Pending
Polar Continental Shelf Project	In-kind	80 hours of Helicopter time	40 hours Approved
World Wildlife Fund/ Endangered Species Recovery Fund*	Cash	16,000	Approved
Western Northwest Territories Biophysical Study	Cash	62,500	Pending
Total	**In-kind**	**41,200**	
	Cash	**83,490**	

* 2nd year of funding of a 2-year grant ($8,000 per year)

Endangered Species Recovery Fund in 2005 of which the second instalment of $8,000 will become available in spring 2006.

13.0 SUMMARY OF RESEARCH PROGRESS IN 2005 AND PLANS FOR 2006 – 07

- No handling mortalities/injuries have occurred over the term of the research project (2003 – 05)
- 11 grizzly bears (7 females: 4 male) were collared in the 2005 spring capture program and pan-territorial wildlife capture and handling training was provided to a visiting Nunavut biologist .
- All the collars have a 3-year life span and are fitted with a release mechanism programmed to "drop-off" on July 1, 2008.
- The initial 4 collars deployed in 2003 that were equipped with release mechanisms successfully dropped from the animals without having to re-capture.
- In 2006, 15 collars deployed in spring 2004 are scheduled to "drop-off" and will be recovered for refurbished for re-deployment.
- During the 2006 spring capture season 8 to 10 bears will be collared to monitor bear response during the initial stages of pipeline construction and to assess the predictive ability of habitat selection and movement models. These collars have a 2 year life span and will be scheduled to release on July 1, 2008.
- Samples collected from all bears for ageing, diet, genetic and health analyses included: a premolar tooth, hair, claw shavings, fat, milk, and faeces.
- Home range size (100% Minimum Convex Polygon and Kernel Home Range Estimation) and movement parameters were calculated for all research bears.
- Remaining potential food sources (i.e. moose, snowshoe hare, Arctic ground-squirrel, and freshwater lake fish species are being collected for development of a baseline isotopic signature for the study area.
- Procedures for analysing stable carbon and nitrogen isotopes on hair and claw shavings were developed and two students were employed to process samples as part of the University of Alberta's Women in Scholarship, Engineering, Science Technology (WISEST) program. Samples were sent to the Mass Spectrometer Lab at the University of Saskatchewan to be processed.
- The Vegetation Classification Model for the development area (35,000 km^2) is near completion.

14.0 LITERATURE CITED

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