ABMP WINTER TRACKING VIA SNOWMOBILE

2005/ 06 PROTOCOL ASSESSMENT

INTEGRATING LOCAL PEOPLE IN BIODIVERSITY MONITORING

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Disclaimer

The views, statements, and conclusions expressed in this report are those of the authors and should not be construed as conclusions or opinions of the ABMP. Development of the ABMP has continued since this report was produced. Thus, the report may not accurately reflect current ideas.

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1 – Executive Summary

This report outlines the results of the 2005/ 06 ABMP assessment of the snowmobile based mammal tracking program. The 7 major points of the report are:

1) A total of 56 10-km transects were surveyed for a cost of approximately $51,750 dollars.

2) A total of twenty species were recorded on snowmobile, which is similar to previous tracking done at the University of Alberta via foot-based triangle tracking.

3) Direct comparisons between the snowmobile tracking and foot-based samples were not done. However, when we compared snow tracking data collected from 2002 to 2005 to snowmobile tracking data collected in 2006 we found little evidence that sampling on narrow linear features created large biases relative to randomly selected transects set through forest. Biases that were observed seemed to be caused by increased activity of animals like wolves moving along linear features.

4) Rare species such as cougars, wolverine, and caribou were more likely to be detected on snowmobile transects that transects done on foot. This might be due to the larger area covered by snowmobile but also could be a sampling artifact as different areas were sampled with different methods.

5) Differences in the number of tracks detected by university researchers, consultants, and trappers showed differences between some species. However, no systemic biases were observed whereby University researchers always counted more animals of all species than trappers or vice-versa

6) In the 22 sites in Conoco-Phillips/ Opti-Nexen study area sampled in 2006 we detected 15 species. Rare species that were detected included caribou and wolverine. Wolverine were located at ABMP transect 633 & 541. Caribou were detected at ABMP transect 699, 668, 639, & 634.

7) The recommendation of this report is that snowmobile based sampling is a cost-effective alternative for monitoring mammals in the ABMP program. A combination of seasonal ABMP staff and a select contingent of local trappers & hunters are recommended as the personnel for collecting the data.

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3 – Background

The Alberta Biodiversity Monitoring Program (ABMP) has chosen to include mammals as a taxonomic group in their biodiversity monitoring program (Moses et al. 2001). Some government and industry programs already exist in Alberta to monitor certain species of large to mid-sized mammals (Moses et al. 2001). However, there is a distinct lack of consistency in the methods used by these different programs, lack of a central repository for the data that is collected, problems with sampling methodologies changing over time, inconsistent sampling effort, and a distinct focus on a few species (i.e. ungulates). The end result is that these data have been difficult to use in assessing trends in mammalian biodiversity over time in Alberta (Charest 2005). The goal of the ABMP mammal sampling protocol is to correct these deficiencies and provide a long-term, consistent sampling method that is capable of tracking the widest array of mid- and large-sized mammalian species possible with a single cost effective method.

During Phase I of ABMP development, Moses et al. (2001) proposed that winter snow tracking be utilized as the key method for tracking abundance of mammals. The protocol recommended was modeled on the Finnish wildlife triangle program (Linden et al. 1996). This method relies on snow tracking to record the number of mammal tracks that accumulate in an area after a snowfall event. The Finnish snow tracking program has been in operation since 1989. Data in Finland are collected by government biologists, volunteers, and hunting groups interested in the conservation of that country's wildlife. Over 1500 triangles are monitored every 3-4 years, much like ABMP. The long-term value of the data collected by the Finnish program is becoming increasingly apparent given the number of published scientific studies that have begun to use the data to test fundamental ecological principles (Kauhala 1996). Data are also used in applied management for setting harvest quotas on animals such as moose (Lehtonen et al. 1998).

During Phase II of ABMP development, Bayne et al. (2005) used data collected by the Integrated Landscape Management group at the University of Alberta to test the efficacy of the Finnish Wildlife Triangle approach. In that report, they made some minor adjustments to the Finnish protocol. Overall, they felt that the protocol achieved the desired goals of ABMP in terms of breadth of sampling (i.e. number of species sampled) and the desired statistical precision and accuracy. The tracking protocol was deemed "expensive" because of the large number of people required to conduct the surveys in a short period of time and the extreme physical demands of the work. The "down-time" waiting for 3 days to elapse after a new snowfall was a major problem as it forced field crews to be continually on-call waiting for the right conditions to arrive. Bayne et al. (2005) recommended that two addition field tests be done to evaluate whether greater efficiency in the mammal tracking protocol could be achieved.

These two field tests were designed to:

1) Determine if ABMP could use local trappers and hunters to collect data on mammal tracks. They suggested that a system of "on-call" employees paid a stipend per mammal survey to collect the data might be effective. Such an approach was deemed desirable as it would avoid the need to amass an army of seasonal employees that will often not be working due to poor snow conditions;

2) Evaluate whether a non-random sampling design using snowmobiles on existing seismic lines and trails to count tracks could be effective. Snowmobile sampling was proposed as Bayne et al. (2005) thought that a single observer might be able to conduct track surveys at more than one ABMP site per day and it would also be easier to visit ABMP points after a standardized number of days since the last snow fall (hereafter DSS). The variability caused by visiting transects with a variable period of time since last snowfall adds additional variation and complicates the statistical analyses.

3.1 – Goals of this report

This report outlines the results from field trials done in the winter of 2005/ 06 by the Integrated Landscape Management (hereafter ILM) group at the University of Alberta to test the snowmobile approach for detecting tracks. We describe the approach taken to engage trappers and hunters to collect the data, evaluate the "quality of the data" collected, discuss costs, and evaluate strengths and weakness of this model of data collection. The results from the trappers are compared to surveys done by 1) university employees and 2) a private consultant. The same methods were used by all three groups of trackers in an effort to compare cost efficiencies and data collection issues between groups.

4 - Description of the Snowmobile-Based Tracking Protocol

The snowmobile protocol has identical objectives as the Finnish triangle design done on foot but is designed to simplify data collection. The goal of both protocols is to be able to detect changes in the relative abundance and/or occurrence of winter-active mammals over time. The report provides details on the snowmobile protocol, summarizes species detected, and compares these species lists to data collected via the Finnish triangle approach outlined in previous ABMP reports.

4.1 – Transect Design

The ABMP sampling grid consists of a series of points spaced every 20 km apart across the province of Alberta. In the original Finnish triangle tracking method, the triangles were centered on ABMP locations. However, such an approach will not work with the snowmobile protocol because this method relies on existing networks of trails and seismic lines on which to count animal tracks. Deciding which linear features to survey is a critical component of the new protocol. The approach used during the pilot study was to select a transect that ran through (as close as possible) the centre of each ABMP location. Each transect was 10 km long. These transects were selected *a priori*. The goal of transect selection was to create the longest straight line that ran as close as possible to the ABMP point location. Approximately 5 km of trail was surveyed on either side of the ABMP point. Straight line transects were not always possible and trackers were given "on the ground" decision rules as to where to go when a pre-selected transect was not passable. In the results we discuss the frequency with which deviations from the original transect occurred and the cause of those deviations.

The on the ground rule set given to trackers was:

1) Follow the pre-defined transect whenever possible.
2) If forced to change the route, avoid selecting lines that cause the route to double-back
3) If forced to change route more than once, always try to turn the opposite direction from your last turn.
4) Return to your pre-defined transect whenever possible.

These rules were given to avoid biases related to trackers avoiding some habitats over others due solely to access. Ideally, the tracker would not deviate from the pre-assigned routes but with out trail maintenance ahead of time this was not practical.

4.2 – Data Collection Protocols

The approach used to collect data was as follows:

1) Using a pre-defined set of coordinate routes stored in a Global Positioning System (hereafter GPS), trackers moved along the transect at a speed of no more than 10 km per hour on their snowmobile. They recorded both the waypoints at the ends of each segment (see below) as well as turning on the GPS route to show the path they took. The benefit of using the route function is that it is easily integrated into a Geographic Information System and provides a check that the tracker actually surveyed the area they said they did.

2) Within each 250 m segment along the transect, the occurrence of tracks of mammal and bird species seen in the snow were recorded. Multiple tracks by the same species in the same segment were not counted. Instead the basic unit of measurement in the snowmobile protocol was the presence/absence of species per 250 m segment. Thus, there are 40 segments per transect. This approach provided a measure of relative abundance of each species based on the proportion of segments out of 40 where species were detected. Tracks of all mammal and bird species were recorded and included animals as small as mice to as large as moose. Tracks were recorded as crossing the transect if they were observed within 1 m (3 ft) on either side of the snowmobile.

3) The end points of each segment were recorded using the GPS to determine the distance for each segment. GPS waypoints were recorded within the GPS at the beginning of the transect and again at the end/beginning of the next 250 m segment. Trackers wrote down the waypoint number and UTM coordinates on the data sheet as well to ensure data

redundancy in case of equipment failure.

4) Tracking data were recorded by hand onto datasheets. Before starting the survey, date, year, days since last snow (DSS, survey number, start and end time for the survey, air temperature, snow depth, general weather (cloudy, clear, overcast), and a description of snow conditions (e.g., powder, wet, crust, windblown) were taken.

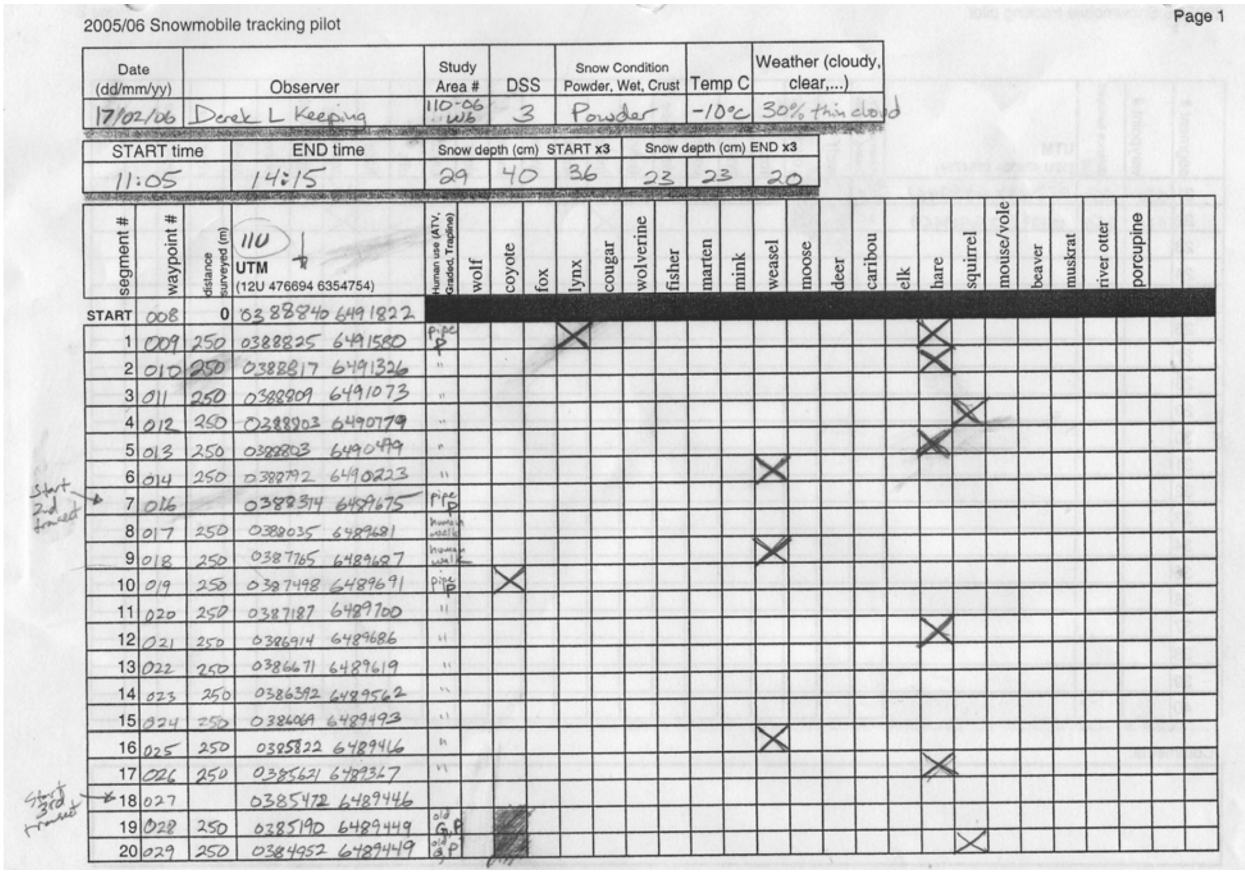
5) Sometimes animals move along the linear feature rather than across the feature. This results in a higher proportion of segments having tracks than would be expected from a random sample. To minimize possible biases related to such movement, trappers were required to distinguish segments where they saw a track that was unique to that segment versus those where they believed the animal was moving from segment to segment along the linear feature. Wolves did this quite regularly. On the data sheet, this was coded by using an X in the species detected box if the animal simply crossed the line (see Figure 1). If the animal moved along the line, we shaded the entire box referring to that segment and did so in subsequent segments until the animal left the line. If a track path was lost and then the species occurred again along the transect, we assumed it was a "new animal" and simply checked the box for that segment
.

6) When trackers encountered tracks to which they could not easily assign a species, they collected additional information. Trackers followed the tracks off transect for up to 200 m on either side of in search of clear prints and/or additional sign like scat to aid in making a positive identification. If the track still could not be identified after this additional tracking, trackers recorded notes and rough sketches of the track. In addition, track dimensions and the depth that the animal sunk into the snow were recorded. Details of the approach used are outlined in Bayne et al. (2005).

5 – Approach used to engage trapper/ hunter support

Trappers were chosen as our target trackers due to their locality to northern ABMP study transects, knowledge of track identification, and a strong interest from the Alberta Trappers Association to be involved in surveying fur-bearer and other mammal populations with ABMP.

Figure 1 - Field datasheet used in snowmobile tracking protocol.



2005/06 Snowmobile tracking pilot

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Date (dd/mm/yy)	Observer	Study Area #	DSS	Snow Condition Powder, Wet, Crust	Temp C	Weather (cloudy, clear,...)
17/02/06	Derek L Keeping	110-06 Wb	3	Powder	-10°C	30% thin cloud

START time	END time	Snow depth (cm) START x3			Snow depth (cm) END x3		
11:05	14:15	29	40	36	23	23	20

segment #	waypoint #	distance surveyed (m)	11U UTM (12U 476694 6354754)	Human use (ATV, Graded, Trapline)	wolf	coyote	fox	lynx	cougar	wolverine	fisher	marten	mink	weasel	moose	deer	caribou	elk	hare	squirrel	mouse/vole	beaver	muskrat	river otter	porcupine		
START	008	0	0388840 6491822																								
1	009	250	0388825 6491580	pipe P				X											X								
2	010	250	0388817 6491326	"															X								
3	011	250	0388809 6491073	"																							
4	012	250	0388803 6490779	"																X							
5	013	250	0388803 6490499	"															X								
6	014	250	0388792 6490223	"										X													
Start 2nd transect 7	016		0388314 6489675	pipe P																							
8	017	250	0388035 6489681	human walk																							
9	018	250	0387765 6489687	human walk										X													
10	019	250	0387498 6489691	pipe P		X																					
11	020	250	0387187 6489700	"																							
12	021	250	0386914 6489686	"															X								
13	022	250	0386671 6489619	"																							
14	023	250	0386392 6489562	"																							
15	024	250	0386069 6489493	"																							
16	025	250	0385822 6489416	"										X													
17	026	250	0385621 6489367	"															X								
Start 3rd transect 18	027		0385472 6489446																								
19	028	250	0385190 6489449	old G, P																							
20	029	250	0384952 6489449	old G P																X							

The Alberta Trappers Association (ATA) is a group that represents the interest of trappers in Alberta and has the stated mandate of "promote the harvesting of wild furbearers in a humane and sustainable manner thereby benefiting the wild fur resource for all of Albertans". ATA is increasingly concerned about their ability to achieve this mandate and want to be involved in conservation and biodiversity monitoring in Alberta.

With help from the ATA, trappers were approached by Cris Gray from the Integrated Landscape Management group about doing the survey. Trappers were selected based on their reliability as assessed by ATA. Twelve individuals, with traplines widely spread across northern Alberta (see Figure 2 for locations they surveyed), were brought together for a training workshop at the Westlock ATA office in November 2005. At this meeting, Cris Gray led a two-day workshop in data collection techniques used by ABMP and the use of GPS units for collecting data. Her presentation is provided as an electronic appendix (Appendix 1). The emphasis of the workshop was discussions of difficult track ID and how ABMP protocols deal with these issues when collecting data. At the end of the two days, individuals went away with maps of their ABMP transect where they were to perform the survey.

Trappers had the flexibility to perform the survey as it fit with their own schedule, as long as the survey guidelines were met (between 3 and 8 days following a fresh snowfall of at least 2 cm between December and March). This factor was seen as one of the advantages of using data collectors local to the survey area as they would be better able to track local weather. The long exposure time (up to 8 DSS) was used to ensure that we would get maximal participation. In the future, we recommend that a DSS interval of between 3 to 6 days be utilized if possible (see Bayne et al. 2005).

Most of the 12 trappers interested in the project had full-time jobs with trapping as a secondary source of income. To encourage participation and ensure surveys were done, we provided a stipend of $500 for each survey completed. This stipend was paid per transect, regardless of whether it was done by one or two people and whether the route was pre-surveyed for accessibility. All costs related to gas, vehicle maintenance, and safety equipment were the responsibility of the trapper. A couple of the older trappers worked together for safety reasons and a couple others did the survey with their children or grandchildren (to train the next generation and get help with the GPS). In all cases trappers understood the rate was per survey no matter how many people were involved and no complaints were raised. The GPS units were provided to the trappers by ILM (they were returned at the end of the season). Only 3 out of the 12 trappers had experience using GPS technology. Training on how to use GPS was done by Cris Gray at the workshop using the Garmin Etrex unit. This model was selected because of its' user-friendliness, its' bright yellow color ensured it could be found if dropped, and the economy that could be achieved when purchasing many units. During the workshop the use of the GPS was described in detail in the class and then hands-on training was provided out of doors. Cris Gray went into the field later in the season to visit 2 individuals for GPS review. As well 2 or 3 trappers had their local fish and wildlife officers help them with GPS use. At the end of the season, an evaluation form was sent to each participant to evaluate the training session and the data collection protocol.

6 – Results

Overall, the ILM-ABMP program in 2005/06 surveyed 50 unique transects with 6 transects resampled (n = 56; Figure 2). The transects that were chosen for this pilot were not drawn at random from all ABMP transects due to differing study objectives during this pilot period. Thus, the results should not be used to infer anything about the overall ABMP statistical population of transects at this time. Specifically, 1) Conoco-Phillips/ Opti-Nexen monies were used to hire a private consultant (Fiera Consulting) to survey ABMP locations in NE Alberta in a systematic fashion using the snowmobile protocol (n = 22); 2) Monies from ABMP and the ILM group were used to sponsor the trapper based surveys. These surveys were also done at ABMP locations (n = 9 transects + 6 repeats = 15 transects); and 3) Monies from Environment Canada – Northern Ecosystems Initiative were used to hire a university employee to survey transects in the north-west corner of Alberta along a gradient of human impacts. These transects were not ABMP locations but used the same protocol for sampling (n = 19).

6.1 - Species detected

We detected 20 species in 56 transects using the snowmobile approach (Table 1). The species were similar to those detected using the Finnish triangle approach from 2001 to 2005 with the exception of domestic animals that were never detected via snowmobile. This probably is due to the location of transects surveyed rather than any systemic identification problem. Logistic regression was used to determine if the frequency of occurrence of each species was significantly different between the Finnish foot tracking data and the snowmobile methods. A generalized linear model using a binomial family error term and logit link with robust standard errors was used to assess if relative abundance (proportion of 1 km segments) where species was detected differed between methods. The variables included in each model were: tracking method, DSS, and northing.

6.1.1. – Comparing snowmobile tracking to foot-based triangles

Snowmobile tracking had a higher probability of detecting cougars ($\chi^2 = 4.8$, $P = 0.03$), elk ($\chi^2 = 5.7$, $P = 0.02$), grouse ($\chi^2 = 30.8$, $P < 0.001$), marten ($\chi^2 = 3.6$, $P = 0.06$), mink ($\chi^2 = 68.1$, $P < 0.001$), weasel ($\chi^2 = 4.6$, $P = 0.03$), and wolf ($\chi^2 = 6.2$, $P = 0.01$). In contrast, otter ($\chi^2 = 4.1$, $P = 0.04$), deer ($\chi^2 = 6.0$, $P = 0.02$), and lynx ($\chi^2 = 4.1$, $P = 0.04$) were less likely to be detected by snowmobile than by the triangle method done on foot. Several caveats must be placed on this analysis. First, the same locations were not sampled with both tracking methods. Thus, the differences may simply be due to annual or spatial variation. Lynx detection rates with the different methods were not different when year was also included as a variable. In 2002 lynx reached the height of their cycle. Second, the sampling frame was different as few transects sampled in 2006 were in agricultural areas while 10 to 20% in previous years were in agricultural areas. This likely explains the difference in deer occurrence as deer are far more common in agricultural areas. We suspect that otter detections are biased by sampling on seismic lines or trails. Trails used for snowmobiles rarely crossed waterbodies whereas the foot-transects crossed waterbodies in proportion to their availability in the landscape. The increased detectability of elk, cougar, and wolf likely reflect the increasing probability of intersecting a track due to the larger area covered by snowmobile than by foot (note that the snowmobile transects were more or less straight for 10 km, whereas the foot tracking was in a smaller triangle that was 3km on a side). It is not obvious why grouse, marten, mink, and weasel had higher occurrence in the snowmobile sampling. They may prefer habitat around linear features and/or use these corridors for movement or the sampling during 2006, may by chance have included more of their preferred habitat than the sampling during previous years. Wolves moved along the seismic lines and trails more than any other species. Wolves were detected at 26 transects and at 14 of these, trackers recorded them moving along the linear feature. At one transect, the wolf moved almost the entire length of the transect (35 out of 40 segments). Not surprisingly since snowmobile sampling occurred along seismic lines and trails, higher detection rates during the snowmobile sampling occurred relative to foot tracking. In contrast, lynx were recorded as moving along linear features in only 6 out of 30 transects. The longest stretch of movement along a linear feature for lynx was only 4 segments.

Table 1 - Summary of species occurrence and relative abundance as estimated by snowmobile tracking. Occurrence is the percentage of transects (10 km long) where each species was detected. The percentage of 250 m long segments within a transect where a species was detected is the measure of relative abundance. Coefficients from a generalized linear model examining frequency of occurrence and relative abundance relative to DSS are shown. Those coefficients marked with an asterix are significant at $P < 0.10$. DSS ranged from 2 to 9 with a median of 4.

Species	% of Transects Where Species Detected	Average Relative Abundance % (± 1SE) (n = 56)	Occurrence & DSS Coefficient	Relative Abundance & DSS Coefficient
Wolf	52%	10.2 ± 2.3%	-0.23	-0.24*
Coyote	75%	20.8 ± 3.1%	-0.04	0.07
Fox	24%	1.4 ± 0.5%	0.31	0.05
Lynx	57%	5.8 ± 1.0%	-0.01	0.15*
Cougar	5%	0.2 ± 0.1%	-0.31	0.07
Wolverine	7%	1.1 ± 0.9%	0.27	0.17
Fisher	29%	1.5 ± 0.5%	-0.43	-0.08
Marten	71%	6.8 ± 1.3%	0.07	-0.01
Mink	18%	1.1 ± 0.4%	0.36	-0.01
Weasel	98%	22.7 ± 2.1%	0.73	0.01
Moose	79%	17.3 ± 2.4%	0.16	0.03
Deer	61%	21.1 ± 4.0%	-0.25	-0.26*
Caribou	7%	1.1 ± 0.7%	0.15	0.23
Elk	7%	1.1 ± 0.6%	-0.42	-0.30
Hare	91%	27.6 ± 2.7%	0.36	0.12
Squirrel	93%	40.9 ± 3.6%	0.14	0.15*
Mouse	93%	26.8 ± 3.3%	0.16	-0.05
Beaver	0%	0%	.	.
Muskrat	0%	0%	.	.
Otter	9%	0.6 ± 0.3%	-0.14	-0.03
Porcupine	2%	0.1 ± 0.1%	0.22	0.21*
Grouse	82%	10.8 ± 1.3%	0.10	0.20*

Table 2 - Percentage of transects where a species was detected based on the snowmobile and foot-tracking method. The relative abundance of species, based on the percentage of 1-km segments within a transect, where the species was detected is also shown for the two sampling methods.

Species	% of Transects Where Species Detected by Snowmobile	% of Transects Where Species Detected on Foot	Average Relative Abundance % (± 1SE) using 1km Segments by Snowmobile (n = 56)	Average Relative Abundance % (± 1SE) using1km Segments on Foot (n = 208)
Wolf	52%	36%	16.7 ± 3.1%	8.0 ± 0.9%
Coyote	75%	82%	36.1 ± 4.1%	43.1 ± 2.2%
Fox	24%	16%	3.5 ± 1%	3.1 ± 0.6%
Lynx	57%	67%	15.8 ± 2.6%	31.8 ± 2.3%
Cougar	5%	0.1%	0.7 ± 0.4%	0.1 ± 0.1%
Wolverine	7%	1%	1.5 ± 1%	0.2 ± 0.1%
Fisher	29%	36%	5.2 ± 1.5%	10.5 ± 1.3%
Marten	71%	52%	19.6 ± 3.0%	17.5 ± 1.6%
Mink	18%	3%	3.3 ± 1.1%	0.5 ± 0.2%
Weasel	98%	88%	52.7 ± 3.1%	46.3 ± 2.1%
Moose	79%	89%	35.0 ± 3.9%	47.1 ± 2.1%
Deer	61%	88%	35.2 ±5.2%	63.0 ± 2.6%
Caribou	7%	3%	2.0 ± 1.3%	1.0 ± 0.4%
Elk	7%	2%	2.5 ± 1.3%	0.7 ± 0.4%
Hare	91%	94%	54.2 ± 4.2%	69.2 ± 2.3%
Squirrel	93%	98%	65.5 ± 4.2%	65.3 ± 2.0%
Mouse	93%	89%	50.9 ± 4.2%	65.3 ±2.0%
Beaver	0%	3%	0%	0.4 ± 0.2%
Muskrat	0%	0%	0%	0
Otter	9%	18%	2.0 ± 0.9%	2.9 ± 0.5%
Porcupine	2%	5%	0.2 ± 0.2%	0.7 ± 0.2%
Grouse	82%	31%	29.5 ± 2.9%	11.9 ± 1.5%

6.1.2. – Comparisons among research groups using snowmobiles

A major factor influencing track counts in the ILM triangles done on foot was DSS. DSS was less of an issue using snowmobiles given the smaller number of significant relationships between track counts and DSS. The number of DSS via snowmobile tracking was less variable than the foot based triangle tracks and data were. This is a desirable property and shows the benefits of having people living close to transects do the surveys as effect of DSS can be standardized more effectively.

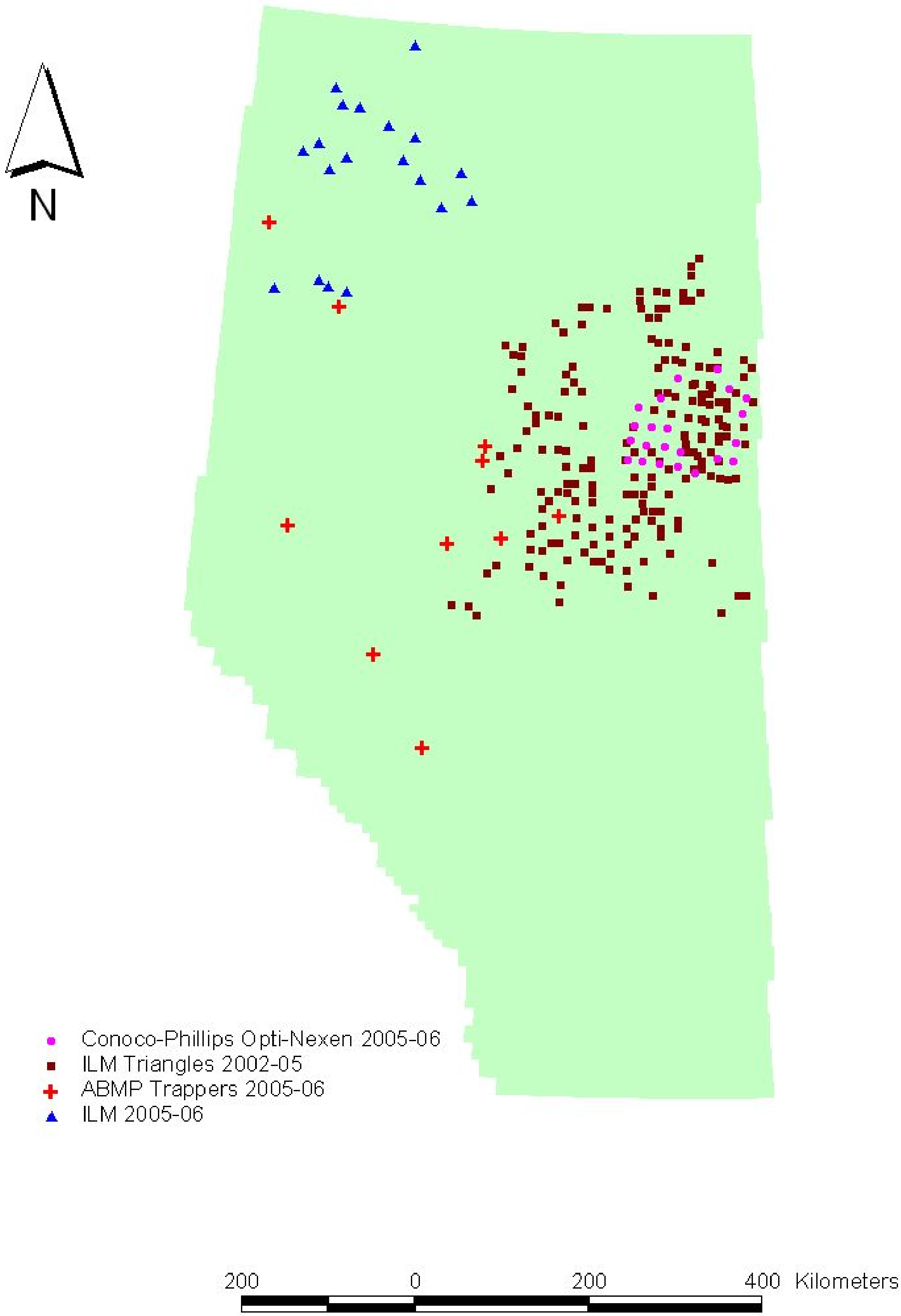
A generalized linear model using a binomial family error term and logit link with robust standard errors was used to assess if relative abundance (proportion of 250 m segments) where species was detected differed between the three different group of observers (controlling for DSS and northing). Trappers detected a higher proportion of segments with wolves, fox, elk, cougar, and grouse than the other two research groups. In contrast, Fiera staff were more likely to detect wolverine and caribou, and less likely to detect deer and fisher. University researchers were less likely to detect mice. The patterns observed likely resulted from the non-random spatial allocation of these research groups across the pilot study area. Elk, cougar, lynx, fisher, and fox were more likely to be detected in the western portion of the study area where most of the trappers were located. Caribou and wolverine were more likely to be detected in the east where Fiera Consulting did most of the work.

An indirect comparison of observer effects was possible by comparing repeated visits to the same transect. A logistic regression with a robust cluster (to account for lack of statistical independence) was used to determine if after controlling for DSS there was difference between the first visit done by the trapper and the second visit done by Cris Gray. The percentage of segments with detections did differ between the first and second visit for four species that were reasonably common. Wolves, fox, and weasel were more likely to be detected in the first visit by trappers. Deer were more likely to be detected in the 2^{nd} visit by Cris Gray (Table 3). Such differences could reflect: 1) a difference in tracking ability among observers; 2) species avoiding lines once a snowmobile has passed; 3) a time of year effect whereby animals move away from lines later in the winter; and/or 4) a change in the ability of snow from first to second visit to retain tracks.

Table 3 - Relative abundance (% of 250 segments where species was detected) between Visit 1 by various experienced trappers and Visit 2 by ILM technician Cris Gray at the same transects (n = 12 transects).

Species	Average Relative Abundance % (± 1SE) using 250m Segments (Trappers)	Average Relative Abundance % (± 1SE) using 250m Segments (Cris Gray)
Wolf	38.3 ± 5.3%	9.4 ± 1.6%
Coyote	52.5 ± 5.7%	30.5 ± 4.9%
Fox	6.3 ± 1.7%	2.1 ± 0.9%
Lynx	2.5 ± 0.4%	7.5 ± 1.3%
Cougar	0.8 ± 0.3%	0.4 ± 0.2%
Wolverine	0	0
Fisher	5.0 ± 1.2%	3.9 ± 0.9%
Marten	3.8 ± 0.7%	0.7 ± 0.2%
Mink	0.8 ± 0.3%	0
Weasel	15.8 ± 2.0%	6.8 ± 0.6%
Moose	25.8 ± 2.9%	28.2 ± 4.5%
Deer	49.2 ± 6.4%	62.8 ± 5.8%
Caribou	0	0
Elk	4.6 ± 1.7%	2.2 ± 0.9%
Hare	24.6 ± 3.5%	16.9 ± 2.5%
Squirrel	45.0 ± 5.8%	38.5 ± 5.3%
Mouse	35.4 ± 5.6%	20.5 ± 2.7%
Beaver	0	0
Muskrat	0	0
Otter	0.8 ± 0.3%	0
Porcupine	0	0
Grouse	9.2 ± 2.4%	8.7 ±0.7%

Figure 2 - Locations of 50 transects surveyed in 2005-2006 relative to ILM tracking program between the years 2002-2005.



6.2 – Cost Analysis

6.2.1. – Fiera Consulting in Conoco-Phillips/ Opti-Nexen study area

The cost per transect accessed by snowmobile was approximately $725, while the cost of transects accessed by helicopter was $2800 per transect. These cost estimates included travel time, mileage, field surveys, accommodation, meetings, preparation, equipment rentals/repairs, and data management. These estimates, however, do not include the in-kind support from ABMP and the Integrated Landscape Management group. ABMP provided a snowmobile to Fiera Consulting while the University of Alberta and Alberta SRD division provided low-cost accommodations. Costs per transect are expected to increase an average of $150 when room & board costs are included.

To make significant reductions in the cost of helicopter surveys, it is important to maximize the number of transects surveyed in a single day. It may be possible to reduce helicopter time on a per study site basis by using a larger helicopter that could carry four technicians, and thus completing four transects per helicopter day, rather than only two. However, larger helicopters cost more per hour, and would incur more flight time per day moving four technicians.

The total cost of utilizing Fiera consulting to do 22 transects was $24,250. Fiera Consulting was the only group able to do more than one transect per day which reduced their cost per transect. However, they were the only group that was working off the systematic ABMP grid making it easier to get from one site to another in the available day light hours. University sites in the NW were typically more than 20 km apart making it difficult to get to more than one site per day. Trappers could have done more than one site per day but to ensure maximum participation this was not requested of them.

6.2.2. –U of A Project to Integrate Local People in Track Monitoring

To coordinate the University of Alberta's trapper project, Cris Gray was paid a monthly salary of $4000 for a period of 5 months. Cris's job was to gain the support of trappers, train them in ABMP protocols, organize the training meeting, and be on-call to help trappers with any questions. Cris did repeat surveys at 6 transects already surveyed by trappers to assess repeatability. She also collected data at new sites in NW Alberta (see below). In addition to her salary, Cris spent $3,400 for accommodations, food, fuel, snowmobile rental & truck rental.

Trappers were paid $500 per transect. A total of 9 full transects were done by trappers. Another trapper only finished a partial transect due to poor snow conditions which is not included in the analysis. The training workshop for trappers cost $2,725. A total of $7,725 was spent to collect the data at the 10 transects (the partial transect was given payment), resulting in a cost per transect of ~$775. The costs of Cris Gray's time to organize and supervise the trappers is not included in this per transect estimate. It was estimated that approximately 50% of Cris's time was spent on activities directly related to organizing the trappers. If the training cost and the cost of the 6 repeat surveys are attributed entirely to the trapper protocol, then each transect cost $1108 to survey.

The University of Alberta also hired a winter field technician for a period of 3 months. He and Cris Gray completed an additional 19 transects. Costs for this technician included a monthly wage of $2200 plus the costs of renting a truck ($4,900), periodic snowmobile rentals ($2,000), and miscellaneous supplies ($1,000). Including the remaining 1.5 months of Cris Gray's time, resulted in a cost per transect of ~$1075. A number of in-kind costs are not included here including free accommodations at the forestry bunkhouse. There was significant down time for this technician due to inappropriate snow conditions. Out of a three month period, our technician was only able to spend about 40 days working on the tracking per se. During his down time from tracking he was given a number of other tasks including data entry and processing.

The total cost of this year's winter tracking was ~$67,150. A total of 56 complete transects were done for this amount, translating into an average per transect cost of about ~$1200.

6.2.3. – Cost estimate for potential winter-tracking protocols

Table 4 compares the estimated costs of using trappers versus employees and snowmobiles versus foot-tracking to collect tracking data at 375 ABMP locations per year. Assumptions of this cost analysis are:

1) Two employees are required to survey 1 triangle per day on foot;

2) A total of 1.5 transects per day can be surveyed by employees and trappers on snowmobile;

3) Trappers find the $500 sufficient to conduct the surveys in the long-term;

4) Each trapper would be willing to do 3 transects per year;

5) A total of 375 transects need to be done per year;

6) Sufficient trappers are found to get into all transects;

7) Approximately 35 days from January to the end of March are suitable for tracking;

8) All sites can be visited by snowmobile.

9) Each employee requires a snowmobile and one truck per two employees

10) Employees are in the field for ¾ of the time.

11) The coordinator goes to 10 local ATA meetings to train trappers in the protocol with cost of meeting including coordinators costs along with lunches for participants.

Table 4 - Dynamic spreadsheet outlining annual costs per year of various approaches to collecting winter tracking data. This table can be activated by double clicking on the table if you have Excel. Cells in orange are estimated costs derived from the 2005/06 pilot study described above and previous experience. Cells in pink are calculated based on these constants. The final table of costs will change if assumptions on costs in orange are changed.

of Sites To Survey
375
Monthly Wage Employees
$2,500
Months
3
Truck Rental Costs Per Month
$1,400
Snowmobile Rental Costs Per Month
$1,200
Total Mileage Costs per Truck (dollars per km)
$4,000.00
Trapper Stipend
$500
of Good Tracking Days
35
Daily Room & Board Costs per Team of 2
$200
Supervisor Salary ($4000 per month * 5 months)
$ 20,000
of Sites Per Day on Snowmobile
1.5
Sites Done By One Trapper
3
Sites Done Per Day on Foot
1
Days in Field
68

Number of Employees

Trapper
83
Snowmobile
7
Foot
21

COST	Trapper	Employee	Foot Tracking
Wages	$187,500	$ 52,500	$ 157,500
Room & Board	$ -	$ 47,250	$ 141,750
Snowmobile	$ -	$ 25,200	$ 75,600
Truck	$ -	$ 28,700	$ 86,100
Supervisor Costs	$ 20,000	$ 20,000	$ 20,000
Meeting Costs ($1000 per meeting)	$ 10,000	.	.
GPS Costs (One time cost)	$ 16,600	$ 1,400	$ 4,200
Training Costs	$0	?	?
Other Equipment Costs	$0	?	?
TOTAL	$ 234,100	$ 175,050	$ 485,150

7 – Recommendations

7.1 - Efficiency of Foot versus Snowmobile

For the past 5 years, the Integrated Landscape Management group has been using winter tracking as a tool for monitoring mammals in Alberta's boreal forest. Conducting surveys on foot is time consuming, physically demanding and expensive. It would cost at least 2 times as much to use the foot-based triangle approach than a snowmobile survey.

Snowmobile based approaches are more efficient the foot-tracking as: 1) there do not seem be any severe biases in terms of species detected relative to tracking on foot, except perhaps species that live close to water (otter, beaver, etc); 2) the variance in proportions of 1km segments where species were detected is lower for the snowmobile method; and 3) the financial costs are lower. For large ranging species, snowmobiles also seems to be superior method as the larger area covered increases the probability of detecting animals like wolves, elk, cougars, caribou etc.

Staff moral in either protocol is a major issue. In several areas of Alberta, our crews became physically exhausted having to walk the 9km day after day. Snow depth can reach extremes, particularly in the NW making it virtually impossible to walk a transect in one day. The snowmobile method reduces this stress but deep snow and travel constraints are always issues. Trying to save money by buying small snowmobiles is not recommended. Large snowmobiles capable of getting through deep snow are critical to ensure staff are able to finish their work in a timely and safe fashion.

7.2 - Trappers versus Employees

The difficulty of using a narrow sampling window to track mammals (i.e. using 3-6 DSS) is that certain winters will result in relatively few good tracking days. This makes the logistics of doing ~375 sites per year challenging. Assuming that on good snow days each observer could do 2 sites per day, 188 person days are required. This assumption is probably optimistic. Fiera consulting estimated they were spending 12-13 hours per day to get to finish ABMP transects and were often driving snowmobiles in the dark to get back to the truck. We suggest planning for a maximum of 1.5 transects per day on average (~250 person days to sample all annual ABMP survey points). A total of 29 days last year out of a 4 month period were deemed "good quality survey conditions". Given these numbers there would need to be a minimum of 7-8 full-time people to conduct the surveys. There will be extended periods of time that these people are on down-time. If the ABMP chooses to hire full-time staff for winter tracking then alternative work to make effective use of the down-time probably is needed. This could include setting trail to ensure that sites are ready when good snow conditions occur; and possibly other activities associated with the ABMP like data entry. Moving crews from areas of poor snow to areas of good snow is a logistical challenge and probably will not be effective.

In contrast, trappers / hunters do not suffer down-time issues. Trappers clearly have the capability to conduct the work and want to participate. Unlike most ABMP staff, trappers live close to the sites and are able to assess them when optimal snow conditions exist. Most of the trapper surveys were done in the optimal window of 3 to 6 DSS. Generally, trappers are likely to do these surveys on weekends as most have full-time jobs that preclude them from doing the surveys during the week.

7.3 - Refinements to Winter Tracking Protocols

Much of the variability in winter track data is caused by variation in snow conditions, particularly DSS. To make the winter tracking protocol the most efficient we recommend that efforts be made to standardize this time period as much as is possible. As described in Bayne et al.'s report (2005) 3 to 6 days seems to be the ideal window. Regardless, a correction for DSS must be included in all statistical analyses. Current analytical techniques being used to correct for DSS assume that tracks accumulate at a constant rate over time which may or may not be valid. Further work is required to assess this assumption.

Statistically, the use of proportion of segments where species are detected is more easily integrated into the ABMP – Biodiversity Index. That being said, the choice of 40 segments was arbitrary. More precise estimates of proportions could be made if presence-absence data was collected in smaller sized segments (i.e. 100m). Regardless of the size of the segments, the closer together segments are the more likely they are to be correlated (i.e. animals move along the linear feature and are detected in each of the subsequent segments). More consideration of the effects of animals moving along linear features is required to determine how such a bias will affect the ability to track changes over time but is outside the purview of this report.

7.4 - Caveats to winter tracking

Overall, the snowmobile protocol seems to be a significant improvement over the foot tracking approach for assessing track occurrence and abundance. However, it must be explicitly stated that both the snowmobile and foot-tracking method only document changes in relative abundance and do not directly translate into animal density estimates. A concern that will always occur with a tracking based method designed to detect change over time is that the conditions that allow tracks to be recorded may also change over time with no change in animal abundance. For example, years of no snow will preclude collection of data. Alternatively, in deep snow years animals may simply move less rather than being less abundant. This method can not separate these effects without more research to determine how track counts translate into animal density.

7.5 - Overall Summary of Recommended Data Collection Protocols

Based on the past 5 years of winter tracking experience, the Integrated Landscape Management group recommends that ABMP adopt the following winter tracking protocol

1) Data should be collected along randomly selected linear features as close as possible to ABMP locations.
2) Linear features should be sampled on snowmobiles capable of setting their own trail in deep snow conditions.
3) The number of segments along a 10-km snowmobile route where species are detected is recommended as the measure of occurrence and abundance for all large animals.

4) For smaller animals such as hare, mice, and squirrels a shorter transect done by foot whereby each track intercepted is counted may be better at assessing changes in the abundance of these species over time. This could be added at the start and end of each snowmobile transect, time permitting. We recommend a 1-km transect if this approach was to be used.
5) When snowmobile access is not possible, a randomly selected transect 10km in length should be surveyed on foot following the same data collection protocols (1m either side of transect, species detected every 250m)
6) The precision of the estimated proportion of segments with detections could be increased by using more segments (100m intervals). However, error in GPS technology and

odometers makes the accuracy of 100m segments suspect. If better GPS were available this accuracy could be improved and a shorter segment length could be used. However, the greatest expenditure of time with the snowmobile method is stopping to take GPS records. Segments should never be <100m as this would simply be the same as measuring every track and would take more time than exists.

7) All efforts should be made to limit the exposure time to 3 to 6 days since last snow. Regardless of the statistical approaches available to correct data, standardization of field protocols provides the greatest ability to reduce variability in a repeatable and defensible manner.

8) Engaging local people in collection of this data is highly recommended. A select group of trappers and hunters with appropriate skills will increase the quality of the data collected and potentially could reduce costs to the program if training is not required every year. Seasonal employees will tend be available for 1 to 3 years, requiring continual training. Trappers and hunters may be far more likely to come back year after year. The data collected will be of equal quality to those collected by field technicians and is more likely to be consistent over time. Most importantly engaging trappers provides an excellent public awareness tool.

9) It is unlikely that ABMP would be able to get enough trappers involved to collect all of the data needed. Ideally, a blend of trappers and seasonal employees would work best. An additional possibility is to engage Alberta Fish and Wildlife Officers in collection of data. Like trappers, they are familiar with tracks, live in the areas of interest, and have a desire to help.

10) To make the snowmobile protocol work, ABMP has to have a part-time winter tracking coordinator (5 to 6 months per year). They would be responsible for hiring seasonal employees, training trappers, and integrating the data collection of the two groups. This technician would be the critical liaison between ABMP and the public so must be chosen carefully.

11) Trappers and hunters are probably best suited to collecting the data in locations that are relatively easy to access. Safety and liability concerns would make it more appropriate to use seasonal staff in remote locations.

8 – Literature Cited

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