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# Wolf and Wolverine Density Estimation Techniques

Earl F. Becker

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# PROGRESS REPORT (RESEARCH)

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## SUMMARY

Unsuitable weather conditions allowed only one wolverine (*Gulo gulo*) and one wolf (*Canis lupus*) density estimate to be completed in Game Management Unit 13 during the report period. Six systematic samples consisting of 3 38.9-km-long transects were surveyed aerially for wolverine in the Talkeetna Mountain study area. Wolverine densities were estimated to be 4.69/1,000km$^2$ (80% confidence interval of 3.79-5.59/1,000 km$^2$). We detected no departures from the model assumptions used to obtain the wolverine density estimate. Seven systematic samples consisting of 5 57.6-km-long transects were surveyed for wolves in the Subunit 13B study area. No estimate was obtained because 3 of the model assumptions were violated. Weather conditions and an on going hunt were the causes of the failure. Recommendations to test the sensitivity of the technique and its applicability for subunit or unit estimates are discussed.

## CONTENTS



## BACKGROUND

Research to test the feasibility of a furbearer estimation technique using systematic line transects (Becker 1991) for estimating wolf (*Canis lupus*) and wolverine (*Gulo gulo*) densities began in 1990 (Becker and Gardner 1990). Background information and results from the first year of study has been presented in Becker and Gardner (1990) and Becker (1991).

During the first year of study we found that the assumptions of the technique were reasonable, and accurate estimates could be obtained for wolves. Because of poor survey conditions, we did not verify these assumptions for wolverines. For wolves, we found that the estimation precision could be influenced by snow conditions, orientation of the study area (relationship of the x-axis to the major wolf travel routes) or timing of the survey to the extent that using the estimate in management decisions would be risky. It was apparent that we needed to find methods that would take these factors into account and give a precise estimate if this technique was to be useful to wolf and wolverine managers and researchers.

During this sampling period we had 3 primary goals. The first was to determine sampling processes that could increase the precision of the estimate for both wolves and wolverines without violating the model assumptions. Secondly, to test the feasibility of using the technique to estimate wolf numbers in large areas (> 6,000 $km^2$) and lastly, to test the validity of the assumptions for estimating wolverines.

## OBJECTIVES

- To test different sampling intensities and increasing length of time between end of snowfall and initiation of the survey on the precision of the wolf and wolverine estimates.

- To test the feasibility of the technique for estimating wolf densities in large areas.

- To estimate wolverine population densities in 2 study areas in Game Management Unit 13 using aerial line transect surveys.

- To test the assumptions of the technique for surveying wolverines.

## METHODS

We tested a systematic sampling scheme employing line transects and probability sampling (Becker 1991) to estimate wolf densities in Subunit 13B and wolverine densities in the Talkeetna Mountain study area. The mathematical equations, model assumptions, and general sampling methodology are explained in Becker (1991). We surveyed the study areas with 3 pilot-biologist teams in Piper Super Cubs (PA-18) 48 to 96 hours after a 7.5 cm or greater snowfall. Wolf or wolverine tracks that intersected a transect were followed and the distance each wolf pack or wolverine moved perpendicular to the transect was used to generate the probability of observing that pack or individual animal. This inclusion probability was used to generate a population estimate for each systematic sample. The mean of the systematic sample population estimates was used as the population estimate.

Assumptions of the technique were tested for both the wolf and wolverine estimates following the same procedures outlined in Becker and Gardner (1990). We extended the period between snowfall and the survey for both wolves and wolverines to determine if increased time for the animals to make tracks increases the precision of the estimate without violating other assumptions. For wolves, we delayed the survey 15 hours and for wolverines, we delayed the survey about 30 hours compared to past surveys.

To test the feasibility of the technique for estimating wolf densities in large areas we planned to use subunits A, B, and C as study areas. We were unable complete this objective because of unsuitable weather conditions.

## RESULTS AND DISCUSSION

During winter 1990-91, most snowfalls greater than 7.5 cm were accompanied by high winds or low clouds. Because of these conditions we were able to complete only 2 censuses; 1 wolverine and 1 wolf. The wolverine study area, totalling 2700 $km^2$, was surveyed 47 hours after a 15 cm snowfall on 27 February 1991. The wolf study area, totalling 5335 $km^2$, was surveyed 69 hours after a 7.5 cm snowfall on 14 March 1991.

The Talkeetna Mountain study area was surveyed for wolverine using 6 systematic samples consisting of three 38.9 km transects oriented in an east-west direction (Figure 1). After completing the transects each survey team searched between transects to determine if all wolverine tracks crossing the transects had been observed. These additional searches did not produce any missed tracks.

Eleven wolverine tracks (Table 1) were followed to the animal or to its hiding place under snow or rocks resulting in an estimate of 12.66 wolverines (SE = 1.64 ), with an 80% confidence interval of 10.23 to 15.09 wolverines. One other wolverine was followed but had not crossed a transect. The average group distance travelled perpendicular to the transects was 9.74 km (SE = 1.85). Two groups of 2 wolverines had travelled together and both were associated with moose carcasses. One group observed on a moose carcass had travelled around 10 km together since the end of snowfall. The other group had used a common carcass but had separated by survey time. The 2 animals had travelled about 17 km and 33 km since the end of snowfall.

The time between end of snowfall and the survey was 25 to 32 hours longer than the last successful wolverine survey (conducted 12 to 18 hours after snowfall). The gain in precision, based on differences in the 80% confidence interval half width expressed as a percentage of the point estimate, was 14.1% (33.3 to 19.2%). Since sampling intensity, as measured by transect density was similar (1 transect/150 to 155 $km^2$) for both surveys, and the median of the observed inclusion probabilities were similar (0.479 in the earlier survey and 0.435 in 1991), the increase in precision was mainly a result of the reduction in standard error because of a larger sample size. Based on the length of movements and the amount of coursing and backtracking done by these wolverines in 47 hours, we believe that the maximum time a wolverine survey should be conducted after an adequate but shallow snowfall (7.5 to 20 cm) is 48 hours. The sampling intensity of 6 systematic samples and 3 transects for a 2,700 $km^2$ area with a 48 hour delay between end of snowfall and the survey gave a reasonable population estimate that could be used in management decisions.

The wolf survey was conducted on 14 March, 69 hours after a 7.5 cm snowfall in the 5,335 $km^2$ subunit 13B study area. Three Super Cubs were used to fly 7 systematic samples consisting of five 57.6-km-long transects oriented in a north-south direction (Figure 2). Our localized searches between transects did not find any wolf tracks that intersected the transects and had not been observed.

We did not obtain an estimate from this survey because 3 of the technique's assumptions outlined by Becker (1991) were violated. The 3 assumptions violated were: 1) pre- and post-snowstorm tracks can be distinguished, 2) all animal tracks are continuous, and 3) all animals can be tracked to both their current location and location at the end of the snowstorm. Weather and light conditions and an ongoing wolf hunt caused the failure. In parts of the study area, the light was too flat and the delay between end of snowfall and the survey was too long for the snow conditions. The 7.5 cm snowfall came after 3 weeks of no snow and the ungulate and canid track density in the area was high. This minimum amount of snow was not enough to cover old tracks adequately and we had a very difficult time following the packs, especially through the trees when they were following one of their own trails or a moose trail. Before the survey in the northern part of the study area, a strong wind blew erasing the tracks for long distances causing us to lose the tracks of 2 packs. In concert with the difficult tracking conditions, there were obvious impacts from the ongoing wolf hunting season. The wolves were very difficult to see as they were very secretive, travelling long distances in dense timber and also, several packs were scattered because they were recently hunted. In total, we found tracks of 6 packs but only observed wolves in 3 of the packs observed.

To obtain a useful wolf density estimate, careful attention must be given to weather conditions and the amount of human disturbance. Factors to be considered for determining survey timing are: 1) the amount of snowfall and its consistency over the entire study area; 2) whether snowfall was light (at least 7.5 cm) and track deposition prior to snowfall; 3) normal weather patterns for the area, i.e. the chance for strong winds or significant cloud cover; 4) the habitat of the area; 5) ungulate densities and 6) the intensity of the wolf hunting in the study area.

Considering the effects on the estimation precision, this technique should not be depended on in areas of volatile weather patterns, dense tall vegetation, or high densities of caribou.

After completing 5 wolf surveys in GMU 13, we believe that for areas between 5,000 and 6,000 $km^2$ that 7 systematic samples with 5 transects is an adequate sampling intensity. Approximate cost including flying the area between the transects is $1,900 to $2,600 per survey ($135.00/hr Super Cub cost).

## RECOMMENDATIONS

We recommend that the wolf study be continued for 1 more year. For the density estimation technique to be useful to managers and researchers, the variance of the estimates must be reduced and its application should be expanded to subunit and possibly unitwide estimates.

More work is needed to determine the effects of survey timing on the estimation precision. Based on computer simulations we feel that 4 to 5 days are optimal for wolves in areas of low caribou numbers and normally have little wind but we haven't had the necessary weather conditions to test this hypothesis. We need to gain more insight on how estimation technique will react when the waiting time or the number of transects need to be changed because of weather patterns, wolf movements, habitat or season to determine if the technique will give meaningful results.

We recommend that this technique be used in fall before the opening and again at the end of same-day-hunting (SDA) in Subunit 13B to test its sensitivity to change. This hunt offers a good opportunity to see how accurately this technique can detect a known decline.

We recommend the wolverine project be completed at this point and a final report be prepared next year along with the final wolf report. If adequate numbers of radio-collared wolverines become available, an additional wolverine survey coupled with locating and backtracking the radio collared wolverine, would provide an excellent test of the assumption that all of the wolverine which cross the transect are observed.

## ACKNOWLEDGMENTS

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Prepared by:

Earl Becker
Biometrician II

Submitted by:

Karl Schneider
Regional Research Supervisor

Approved by:

David G. Kelleyhouse, Director
Division of Wildlife Conservation

Steven Peterson, Senior Staff Biologist

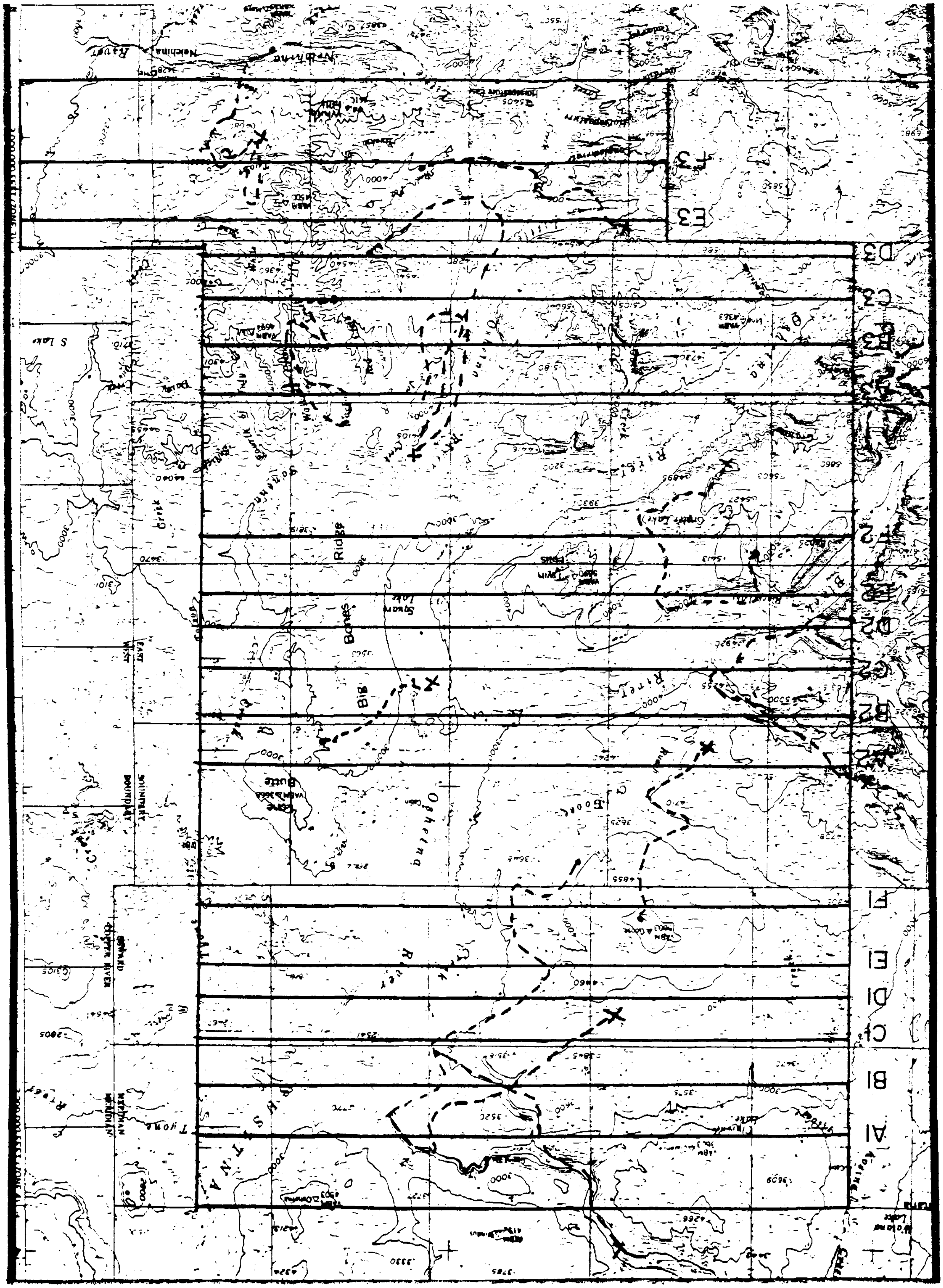

Figure 1. Talkeetna Mountains region wolverine study area for 2 February 1991. Survey study area boundaries, location of 5 systematic samples [A-F] with 3 transects per sample [1-3], wolverine movements [--], and location [x] shown.

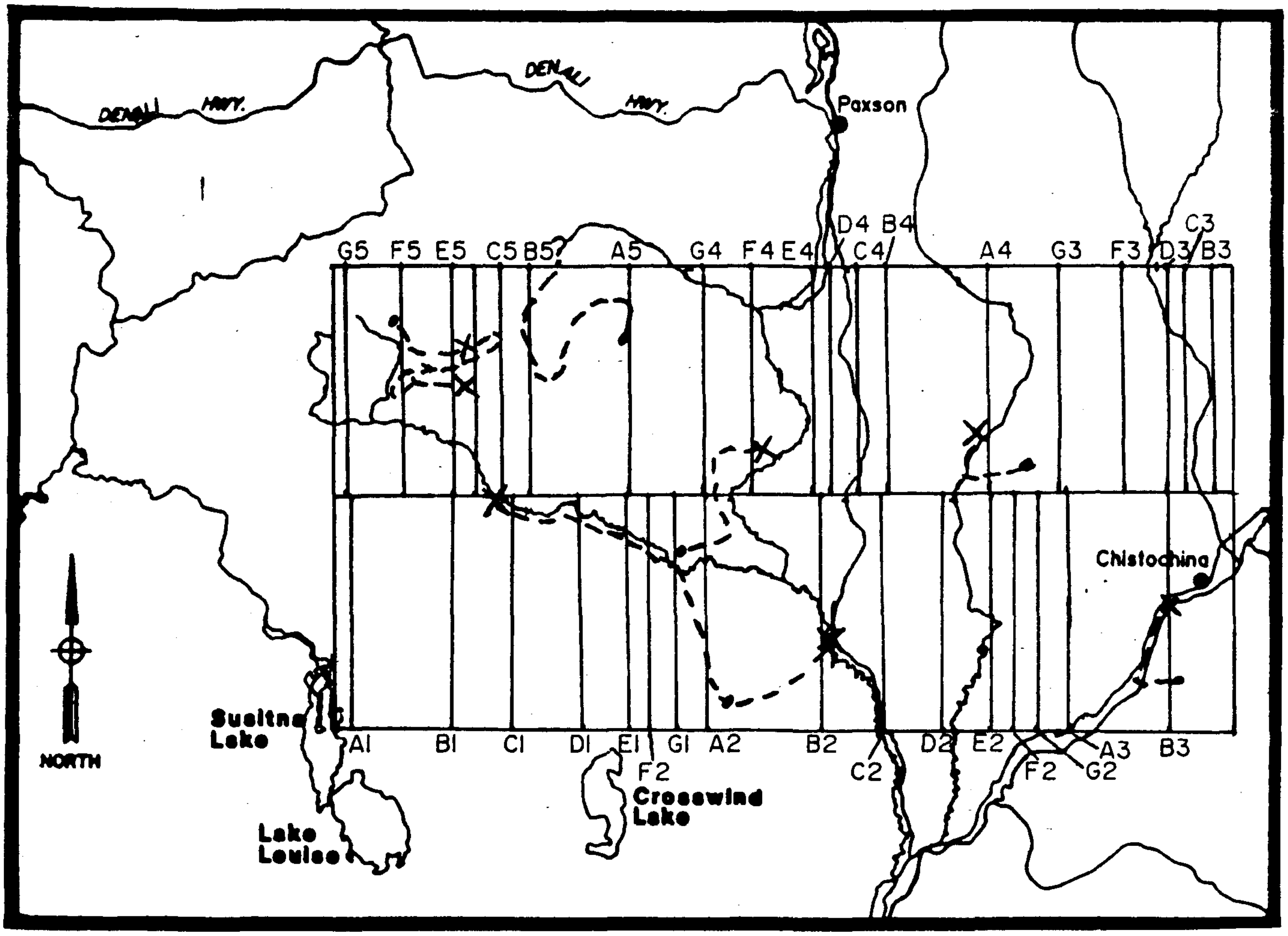


Figure 2. Alphabet Hills wolf study area for the 14 March 1991 survey. Study are boundaries and location of 7 systematic samples [A-G] with 5 transects per sample [1-5], wolf pack travel [--], and location [x] shown.

Table 1. Wolverine survey data for a 2700 km$^2$ area in the Talkeetna Mt. region of GMU 13, collected on 7 February 1991.

| Sample/ Transect Id | Group Id. | # of Wolverine | $X_{ua}$ | $p_{ub}$ | $T_{yijc}$ | $T_{yi.d}$ |
|---|---|---|---|---|---|---|
| A1 | 1 | 2 | 20.75 | 0.926 | 2.16 | |
| A2 | 2 | 1 | 9.75 | 0.435 | 2.30 | |
| A2 (cont.) | 3 | 1 | 10.38 | 0.463 | 2.16 | |
| A3 | 6 | 1 | 15.25 | 0.680 | 1.47 | |
| A3 (cont.) | 7 | 2 | 7.69 | 0.343 | 5.83 | |
| | | | | | | 13.92 |
| B1 | 1 | 2 | 20.75 | 0.926 | 2.16 | |
| B2 | 3 | 1 | 10.38 | 0.463 | 2.16 | |
| B2 (cont.) | 4 | 1 | 2.25 | 0.167 | 5.99 | |
| B3 | 6 | 1 | 15.25 | 0.680 | 1.47 | |
| B3 (cont.) | 7 | 2 | 7.69 | 0.343 | 5.83 | |
| | | | | | | 17.61 |
| C1 | 1 | 2 | 20.75 | 0.926 | 2.16 | |
| C2 | 3 | 1 | 10.38 | 0.463 | 2.16 | |
| C3 | 6 | 1 | 15.25 | 0.680 | 1.47 | |
| C3 (cont.) | 7 | 2 | 7.69 | 0.343 | 5.83 | |
| | | | | | | 11.62 |
| D1 | 1 | 2 | 20.75 | 0.926 | 2.16 | |
| D2 | 3 | 1 | 10.38 | 0.463 | 2.16 | |
| D3 | 6 | 1 | 15.25 | 0.680 | 1.47 | |
| | | | | | | 5.79 |
| E1 | 1 | 2 | 20.75 | 0.926 | 2.16 | |
| E2 | 5 | 1 | 9.75 | 0.435 | 2.30 | |
| E3 | 6 | 1 | 15.25 | 0.680 | 1.47 | |
| E3 (cont.) | 8 | 1 | 4.13 | 0.184 | 5.43 | |
| | | | | | | 11.36 |
| F1 | 1 | 2 | 20.75 | 0.926 | 2.16 | |
| F1 (cont.) | 2 | 1 | 9.75 | 0.435 | 2.30 | |
| F2 | 5 | 1 | 9.75 | 0.435 | 2.30 | |
| F3 | 8 | 1 | 4.13 | 0.184 | 5.43 | |
| F3 (cont.) | 9 | 1 | 7.75 | 0.346 | 2.89 | |
| | | | | | | 15.08 |

(a) $X_u$ denotes the distance traveled perpendicular to the X-axis (km) by the u $^{th}$ group of wolverines; (b) $p_u$ denotes the inclusion probability for the u $^{th}$ group of wolverines; (c) $T_{yij}$ denotes the contribution to the i $^{th}$ population estimate; (d) $T_{yi.}$ denotes the population estimate based on the i $^{th}$ systematic sample.

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