Designing an Experiment for Large Mammal Recovery in the Aishihik Area, Yukon Territory

Minutes of Technical Meeting

October 4, 1992

Westmark Klondike
Whitehorse, Yukon

Yukon
Renewable Resources

MR-92-2

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Government of the Yukon
Department of Renewable Resources
Fish and Wildlife Branch
Wildlife Management Section
Regional Management Section
Box 2703
Whitehorse, Yukon Y1A 2C6

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Renewable Resources
Box 2703, Whitehorse, Yukon Y1A 2C6

Our File: fw2/BH#1H/cover
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October 20, 1992

Dear Reader:

These notes summarize ideas of a team of wildlife scientists and management biologists to recover a Woodland caribou herd and moose population in the Aishihik area of the southern Yukon. A workshop was considered the best approach to designing a scientifically valid recovery experiment.

In preparation for considering an experimental design, some theoretical ideas about scientific experimentation, and current ideas about predator-prey population dynamics and prey switching were presented on October 3 (Appendix I). On October 4, we attempted to incorporate these principles into an experiment designed to increase ungulate prey in the Aishihik area, learn what kind of system is operating there, and determine how intensive management of wolves and hunting could affect the long-term dynamics of the large mammal ecosystems in the Yukon.

These notes are intended as a public record of the discussions on October 4. This information is not intended for scientific publication. A formal study design will be prepared by December 1992 following scientific and public review, as required by the Yukon Wolf Conservation and Management Plan.

I wish to thank A.R.E. Sinclair of the University of British Columbia, S. Boutin of the University of Alberta, and F. Messier of the University of Saskatchewan for their helpful scientific advice and continued interest in addressing wildlife management problems with scientific theory.

Sincerely,

Don Toews
A/Director
Yukon Fish and Wildlife Branch

Designing a Large Mammal Experiment for Aishihik Ungulate Recovery
October 4, 1992
Klondike Westmark, Whitehorse, Yukon

Summary of Discussions

B. Hayes called meeting to order at 9:25. He was given the task to coordinate a study design for Aishihik ungulate recovery. To develop a scientifically sound design, the Fish and Wildlife Branch recognized the best way to address the problems was through a workshop involving those persons directly affected by a recovery program, and a team of management and research biologists Through this approach, an adaptive management program can be designed through sound scientific methods for determining the cause of ungulate population declines, and the factors limiting or regulating ungulates at Aishihik.

Each participant was introduced:

R. Hayes **BH**, coordinator of meeting, Yukon wolf management biologist, YFWB.
Tony Sinclair **TS**, Univ. of B. C., Department of Zoology- large and small mammals.
Stan Boutin **SB**, Univ. of Alberta, small mammal ecology - interest in predation and population dynamics of large mammals.
Jean Carey **JC**, sheep management biologist, YFWB.
Richard Ward **RW**, moose management biologist, YFWB.
Rob Florkiewicz **RF**, moose research biologist, habitat specialist, YFWB.
Ray Quock **RQ**, Council for Yukon Indians wildlife biologist.
Rick Farnell **RF**, woodland caribou biologist- conducted initial caribou studies at Aishihik.
Linnea Hume **LH**, a member of Champagne-Aishihik band, Yukon College student.
Ray Brennerman **RB**, Kluane National Park warden, coordinates biological research.
Charlie Pacus **CP**, National Parks biologist, Winnipeg.
Francois Messier **FM**, Univ. of Saskatchewan, wolf-moose researcher and theoretical ecologist.
Dan Drummond **DD**, conservation officer, YFWB.
Doug Larsen **DL**, moose management biologist, YFWB.
Alan Baer **AB**, wolf management technician, YFWB.

Three members of the Yukon Fish and Wildlife Management Board attended as observers: J. Rear, S. Stange, D. Dickson.

BH introduced the study area with a 1:250,00 map, showing areas where Aishihik and Burwash caribou herds range, wolf (1992), sheep (1992) and moose (1990) survey areas (see *Study Areas Map*). Brief summaries of large mammal surveys and research in the area were presented.

1. Woodland Caribou- RF.

Aishihik herd was estimated at 1,500 animals in 1981, following rut count by DL. Survey was a total count. Herd recounted in 1991 by stratified random sampling technique - 785 caribou were found. In hindsight, area DL counted was smaller than area presently used by herd, so it is possible that more caribou were present in 1981. A summary of the status of the caribou herd in the past 2 years was presented (*Summary#1*) Sex ratio is skewed heavily to females. This is happening in a number of herds in SW Yukon and northern B.C. Chronic low calf recruitment manifests itself in skewed sex ratios, due to higher male mortality. The Aishihik herd decline appears to be recent, in past 3-4 years.

TS: asked for summary of cow:calf ratio data from past surveys (best estimates:1990-92,*S* #2).

DL: asked RF to discuss other Yukon caribou surveys.

RF: We suspect 23 different woodland caribou herds in the Yukon. Caribou inventory program began in 1980. Program includes rut counts for trend information and stratified, random quadrat surveys also, adapted for woodland caribou. The Finlayson herd is the only herd that has been managed to increase numbers through harvest restrictions and wolf control (1983-89).

TS: Are skewed sex ratios explainable by hunting?

RF: Not entirely, there is higher natural mortality on adult male caribou caused by wolf predation, especially after the rut. (ed. note- see Mech et al. recent study results in Denali National Park, Alaska). Aishihik reported harvest cannot explain decline alone, unless there had been chronic, negative recruitment in the herd for some time.

FM: Is this a common condition of woodland caribou here?

RF: Yes, ratios are skewed throughout Yukon. (There was some technical questions regarding sex ratios). RF answered that chronic low recruitment can be manifest in low bull/cow ratios, and suggested that both conditions can be found in a declining herd.

No further caribou questions were asked.

2. Moose DL

DL described moose information from Aishihik area, and neighbouring Zone 7 studies. There is less information on moose than caribou. There was a stratified random sample survey done in a part of the GMZ 5 area in the early 1980s, and another conducted in 1990 (*S#3*). Population has declined by 23%. This is the third lowest density moose area in the Yukon (*S#4*). By comparing calf recruitment to estimated natural mortality of adults (10%), predicted a population change of 0.9 (decline- *S#5*) to 1.02 (increase). Herd could be rapidly declining or slowly increasing. Problem of knowing which is the real trend is related to the sampling error in the survey technique. Recruitment rate in 1990 was 12% based on yearling counts. Should be about 14% for stable herd. There was very high calf recruitment in the same survey (54 calves/100 females). It is possible that most calves are removed before they become yearlings, from wolf predation (reference BH study on the Coast Mountain wolves, where 50-60% of calves that survived to early winter were eventually killed by wolves by late winter). This could explain the low recruitment of yearlings but high calf numbers earlier. DL showed a number of correlational analyses of calf recruitment (predicting increasing herd), yearling recruitment (stable to declining), and showed that total harvest was likely inexcess of 2% of the herd, which could have contributed to decline of the moose population (*S#6*). Harvest of moose in zone 5 is at maximum and likely it is an overharvested population, but harvest is not evenly distributed in all subzones there. End of Aishihik moose data presentation.

DL followed with a short summary of results of moose research in zone 7. Showed *S#7* and *S#8*, indicating that wolf predation, while smaller than brown-bear related mortality was still important. DL argued that wolves are very important in system, and experiment that was proposed in GMZ 7 was terminated before results of intensive wolf control could be shown.

FM: Asked Doug why he thought that bear predation on calf cohort was the most important factor limiting the population? FM argued that wolf predation across all cohorts in the population, all year long was more important in limiting population. Cited BH data showing 10% removal of adults by wolves in the winter, in the Coast Mountains (Zone 7). Not a lot of debate ensued, with both agreeing of the importance of both wolf and bear-related predation on moose.

Jim Rear of FWMB asked to be allowed to ask questions. BH declined, saying that the time did not allow for observers to ask questions.

There were no further moose questions.

3. Dall sheep JC

JC summarized Dall sheep data (*S #9*). Sheep population on east side of Kluane Lake has been monitored since 1973. Counts usually are carried out after lambing to get a total number of sheep, with no estimate of variability. Population count was highest in mid 1980s at 800. 1992 count was 600, but we are reluctant to panic, and reluctant to suggest predation has caused decline. In 1992 there was a very late spring, and a near total loss of lambs produced. Probably weather induced problem. Harvest has been stable This area was monitored as an experimental control area for wolf reductions in Zone 7 during the mid 80s (see Barichello et al. 1990). Both populations behaved similarly, indicating that reduced wolf numbers in zone 7 did not apparently increase population size there. In 1992, Zone 7 block was also surveyed as potential experimental control for Aishihik sheep. Lambs there did slightly better but still low production. No further questions regarding sheep.

FM- Which of the 3 species represent hard management issues. Are all 3 species of concern in the Aishihik area, or is proposed action directed at one species?

BH- moose and caribou are ungulates of concern. Caribou are the most important due to large decline observed, but public interest is as high, or higher, for moose in some parts of Zone 5.

RF. People grasp the herd concept for caribou, rather than low density descriptions of ubiquitious moose. Caribou operate more as a single unit. Moose, however, is the main ungulate for food. Caribou are important to people of the area, especially Burwash band, but also are being used as a political tool.

?FM: Are there other ungulates in the area?

BH: yes, mule deer, elk, and bison. Elk and bison are introduced, mule deer are naturally expanding their range in the area. All 3 are thought to be unimportant to wolves and other predators. There has been no documented predation by wolves on wood bison in the area, since the herd was introduced in the mid 1980s. (Wolf predation on elk has been observed on 2 occasions during October in the Takhini population, west of Whitehorse-K. Schmidt, YFWB). Wood bison did not become part of diet of wolves in Wood Buffalo National Park until 20 years after the bison became common in the area.

4. Wolves BH

BH summarized wolf data from Aishihik. Figure (*S #10*) shows 12 areas where wolves were censused by snow-tracking or radio-telemetry in the Yukon. Represents about 1/3 of the Yukon since 1983. Wolves are relatively easy to census compared to other large mammals. We are very confident of

the accuracy of the minimum total count method, because of the consistent staff, and predictable density results, based on food supply predictions (Todd Fuller's index-1990 paper). Highest wolf densities (18 wolves/ 1000 sq km) was where prey density was highest (Teslin burn-400 moose/1000 sq km) and lowest wolf density was in Carmacks area (3-4/ 1000) where moose were the lowest density recorded (40/1000 sq km). Summary report for Aishihik wolf survey was discussed (*S #11*). Aishihik wolf survey found about 150 wolves in a 14,900 sq km area, density was unexpectedly high (11 wolves/1000 sq km). Based on biomass/wolf index (*S#12*), wolf density is expected to be about 4 wolves/1000. The biomass index calculated for Aishihik (70) is the lowest of 27 studies of wolves/prey in North America, and well below the range of 150-300 found in most other places. This indicates that wolves are at a density that is higher than the food supply would predict, and wolves are likely lagging in response to earlier prey declines. Isle Royale studies showed that wolves could take 10 years lag before they declined in response to major changes in moose numbers. Wolves could be supported by snowshoe hares in the past few years in Aishihik. Hares have declined greatly this year.

There are 3 radio-instrumented wolf groups in the Aishihik area, all along the Kluane Park/Zone 5 boundary where Parks Canada and Yukon Fish and Wildlife Branch have designed a joint management plan to conserve park wolves if wolf control in Zone 5 happens. Charlie Pacus and R. Brennerman will give more information on this later.

There were no further questions on wolves or ungulates. Break at 10:40

Back to order at 11:07

TS, SB, and FM asked collectively if they were there to review a study design for Aishihik, given wolf control would go ahead regardless, or were they there to consider if there is biological justification for such a management action? This was important to them to understand.

BH answered that the Yukon wolf conservation and management plan requires that *before* a wolf control program is considered there are a number of conditions that *must* be met. Primarily, there must be a scientifically designed, and peer reviewed study design that justifies the action from scientific methodology. Wolf control is not a fait a complet, but the participation of all people present today is to consider the question of whether there is a justification to expect population increase in ungulates in Aishihik with a hunting closure and wolf control. Advice from scientific advisors will be in designing a scientific, experimental study design. Techniques determining cause and effect are developed with the most sensitive measurements to detect biological changes, and various alternate hypothesis are proposed that could also explain why ungulate populations are declining there. Questions of knowing whether wolves are important can only be

answered by large scale purturbations of the wolf-prey system there, followed by technically sound measurements of ungulate population change.

BH showed a brief summary of what was presented (*S#13*). There was further discussion and additions to the summary, especially from local knowledge of what the possible causes of declines in moose and caribou could have been related to (see below RQ). .

RF and FM summarized caribou data. Initial reproduction seems to be okay based on pregnancy rates last year. High adult mortality (as seen this spring on radio-collared cows) cannot be ignored in population trend. Low calf survival of caribou and high adult mortality are synergistic in causing escalated decline. Population size is very low and predation may have inversely density-dependent effect.

DL. With moose there seems to be good calf survival in one year, but low yearling recruitment. There is no data on physical condition and pregnancy rates of moose? DL offered that data from neighbouring zone 7 during the mid 1980s is good to use as standard of good healthy, productive females in the area. No reason to believe recruitment is lower due to physical condition problems in Aishihik moose.

JC. sheep productivity is extremely variable from year to year, and unpredictable stochastic events (weather) seems to be more important than other factors in limiting sheep in the area. Sheep productivity was low in 1992, but ok the 3 previous years. RB. Wrangell/St. Elias sheep also are showing low recruitment, likely result of poor spring conditions for lambling.

RQ answered request from BH to explain what the human element in the problem and solution is for Aishihik. Indian knowledge says moose moved into area in the past 100 years. Before this time they were very rare. Indian people used to control hunting in their areas. When white man came, the indian population eventually decreased by 90% (not well known fact). Harvest by Indians has declined greatly in recent past. As recently as the 60s Indian people hunted brown bears every spring. It became illegal to sell hides, so Indians stopped killing bears. In Aishihik area, the Indians reduced bears and likely elevated calf survival of moose as a result. Now, the Aishihik people are not subsistence based, but wage economy based.

BH: Is it fair to say that combined hunting of Indians and whites has been a part of the Aishihik problem?

RQ: This has been an incredible problem recently. Before 1983, moose cows were available to hunted by whites and Indians. Unregulated hunting was very important reason why populations have declined- and a major cause of the crash in ungulates in the southwestern Yukon.

RF: Caribou went extinct in western part of zone 7 since the 1930's. We originally thought these old cast antlers in the area were from the 40 mile herd, but we now believe they were a remnant of the Carcross herd.

BH: What is the status of Indian hunting in the area now?

RQ: Indians have voluntarily reduced hunting of moose and have completely stopped hunting caribou. Moose hunting is along south Aishihik.

FM: Is there a change in the sex of ungulates taken by Indians?

RQ: definetely more males taken now. Cow hunting is being stopped. If people in Champagne-Aishihik band abuse cow hunting, they will be kicked out of the band. Considered a serious problem to solve.

There were no more discussions or comments about human dimensions in the area.

BH. What is the main question that we want to solve in the Aishihik area? Can we get down to addressing the actual problems to solve, and the ways to do it through scientific design:?

DL. Main concern is two fold. Management interest is to increase moose and caribou for people in the area. Question is - will wolf control increase populations? Research question is do wolves regulate moose and caribou numbers?

TS. The questions of science are bit more deep than that, but still management oriented. I think that everything shown says if you kill wolves, prey will go up. Although we have not begun to address the problems of brown bears. But if you were able to kill brown bears the prey should go up. But what will happen when you quit culling predators? The larger, more important question is, will the system simply revert back to the way it was through natural processes. Until we solve this question, we will only be treating the symptoms of the problems? Maybe that is what we want to do, but given political and social sensitivity of wolf control, we must begin to address the broader questions of long-term impacts of such programs on population dynamics of prey. I presume that knowing such things is implicit in the science. We can learn from deductive approach, but it requires long-term commitment to monitoring all species involved.

DL: This is what we want to learn, for the approach to wolf control has far reaching impacts. For example, I believe we could be forced into pulse management programs, because these systems may naturally revert to low density equilibrium (see Gasaway et al. 1992). If we understand then we will

know what kind of management practice to invoke, and where harvest regulations fit in the equations we develop.

AB: I think there is some longstanding questions here. We do not have enough data on hunting history in the Yukon, and how it could have impacted these populations. There is good agreement among Yukon elders that game was much more plentiful long ago. There has been 60 years of unregulated white hunting to start some of these problems.. For example, we opened a cow season on moose in 1975, because there was a belief that low calf survival in the fall was due to low bull/cow ratios causing poor reproduction. It seems that we were very wrong, for predation likely was removing calves, and keeping your reproductive females from hunters was much more important to keeping some stability.

RQ. There is a lack of respect for wildlife that has evolved in recent years. Many elder Indians believe that we have assumed there is unlimited harvest, and this lack of spiritual recognition in wildlife has resulted in an imbalance in the system. Some elders believe that by killing wolves, you will create further imbalance in the long run.

TS: Why do Yukoners want to do something about the small number of caribou in the herd? Why not let it go?

RF. There are two options: intensively manage or let it follow natural decline. Both are defendable. Public in Yukon prefers intensive management on this herd. Many peoples lives are linked to the land. In Alaska, they subsidize harvest with wolf control. Not in the Yukon. Wolf control is to recover and maintain declined herds, then set harvest to stop the decline from occuring again.

BH. In Aishihik, we need to address public policy (wolf conservation and management plan) and design something scientific, with a set of hypotheses and alternate hypotheses.

FM. We need to understand what are the possible wolf-prey relations in the area. I have included 4 possible scenarios to consider (*S#14*). The % recruitment is the potential recruitment given that bears and other factors do not change. Wolf predation is the total response of wolves, including numerical and functional responses. It is not just wolf/prey ratio. This is important to recognize.

Scenario 1. In this scenario, the actual predation effect by wolves may be well above the line where recruitment and mortality balance to a stable system. At 200 moose/1000 sq km the wolf predation effect in a natural system could be the highest stable point, where wolf predation becomes increasingly greater

than recruitment potential through density dependent processes, causing the population to return to low density. At Aishihik, the actual predation could be much higher because of a lag effect which sees a large wolf population that has not adjusted to the low prey base in the area. It is critical that in any attempt to correct possible lag effect, you do not create more ungulates than the Aishihik system can possibly hold. If brown bears are important factor in maintaining low recruitment, you could apply one year of wolf control and then monitor caribou to see if the recovery of the herd occurs.

Scenario 2. In this scenario, the actual predation effect is still above the recruitment rate, but on the curve above a stable point .

SB. This is good test of time lage hypothesis. If time lag is not in effect, then wolf removal should not result in return of densities. One year of wolf control would show this, one way or the other. Risk of long term manipulations is that you are creating more biomass than the system can possibly support. Be very careful here.

TS. What if there is no stable point at all? We must not neglect that this is a possibility(see below).

Scenario 3. Here the predation effect at declining caribou density is inversely density dependent and the only outcome is extinction of caribou, the secondary or alternate prey to moose. The predation effects at all densities is greater than the potential recruitment (remember the recruitment % assumes other mortality factors, including bears, does not change-only wolf predation varies- there was some considerable confusion among observers about this).

TS. Using the diagrams that Francois showed in the slide talk yesterday, We could have 3 scenarios (*S#15*). We could have some sort of recruitment rate with two types of predator total response curves, both declining but one is higher than the other. One of the stable states is 0 prey density. This is only possible if there is alternate prey to support the predators. For bears, are they supported by human habitation in the area, to produce artificially high density? Alternate prey for wolves could be allowing them to stay high. System could be already at that point. But it does not have to be. If this is the case, then we can shoot predators, but as soon as you stop, they will come back and exert anti-regulatory effect again. If we let prey density come up, and this situation exists, then scenario 3 is the one with no upper stable point .

These scenarios lump all predator species together, we need to tease apart which predators are doing what. If this can be done experimentally. This would suggest having several different treatments where you remove several predators. Let us return to the 3 possible scenarios with a 1 year wolf cull. What are predictions. Scenario 1 is true if prey increase and stabilize at higher density. Scenario 2 is true if there is no natural increase in prey after 1 year,

and prey stabilizes at lower density. Scenario 3 is true if prey continue to decline rapidly and there is no stable point.

FM: There is a limitation of the one year wolf cull test. Most large mammal populations do not change in one year. There are important factors including age, sex distribution of population during year of wolf cull. Monitoring is critical to this type of test. Must know that your predator population returns to normal density.

TS. No. 2 scenario would predict that we have stable herd if total predation response is on equilibrium point. But data does not indicate this is the case for caribou. The measured mortality rate of caribou is 3 times higher than recruitment rate, so we cannot be looking at an equilibrium situation for caribou. Herd is likely declining. Actual predation effect must be above equilibrium point.

BH: We should be careful to remember that we have a temporal control for Aishihik wolf removal in the Finlayson area where wolves were removed for 7 consecutive years. The questions of whether the system will return naturally to low density can be much better answered in Finlayson for we have 4 years of wolf recovery in the area, and continued monitoring of wolves, moose and caribou there. We should incorporate this into the knowledge of the wolf-prey systems and the Aishihik study design expectations.

FM: we then have the case where a manipulation has been done and scenario 1 is the right case? If I can take your word at face value.

TS: We still have not addressed why we are in the situation. Until we know this, then we will only get short term answers. Why is this system intrinsically unstable. Moose and caribou seem to have coexisted in greater numbers for some time. The line has shifted now, we are to the right of the stability point in any of the 3 possible scenarios. Why have things changed?

RW. Will a single year of wolf control tell us whether we have a single or multi-state system? If a single state then 1 year is ok. If 2 state systems, then more than 1 year will likely be required to allow population to be released from low density range where wolves maintain low density. This is critical point to recognize.

BH. It is very important to know where this upper boundary point is at low density (ie. scenario 1 at 200 moose). In Yukon we are living with an upper boundary somewhere around 400-500 moose/1000 sq km, if natural density maximum is upper boundary. In Aishihik, we could be producing 5 times as many moose before we push the system above the low density equilibrium point. By manipulating wolves to achieve this density, we then must reduce

the % take of harvest as we reach the upper maximum, for the sustainable yield will actually decline as density increases to the equilibrium point.. Public must understand that as we get to higher density, then % of prey they take must decline (but no. may actually increase compared to lower density).

SB. My sense is that you would not bring system above Yukon norm. multi-state system is red herring. We have the test at Finlayson.

BH. It is not so clear that a 2 state system does not occur, or that we know where the upper low density (single state) could be. At Tanana (Gasaway's 1983 study area) moose are now at 800/1000 and still growing. Wolves are well above pre control density (from 11 to 16 wolves/1000). perhaps there is a wider range of 'low' density than we can figure from Francois's models.

TS. Must disagree slightly. There is possibility of 2 states (Scenario 4 *S#14*). Where predation and recruitment meet there is stability. There are many sorts of interesting instability points. There are many alternate ideas here, if we change the recruitment rate to decline as prey density increases. What we need to do is ensure that alternate hypotheses are articulated at the same time. If we recognize the old predator pit theory, the point where predation exceeds recruitment at high and low density (Scenario 4 *S#14*) will cause prey to decline in both cases. As population declines, predation rate becomes higher still (density independent) it could cause extinction with multi-prey available. Recruitment rate is declining in caribou herd. If instantaneous rates of decline are accelerating, indicates we have this state. This only argues against time lag. Control for one year in which case you would quickly return to extinction. But why are we looking at such a declining state? Is it a natural change in the system? There is no indication of nutritional stress, range limitations. Recruitment decline because of density independent mortality rate-.

RQ. Traditional bear management has been highly conservative. Culling large boars has been the management strategy. There are new studies that show that by removing adult boars, we could be increasing immigration rates of immature males.

AB. We could be looking at a systems that is out of balance because the 40 mile caribou herd has disappeared. They could have supported the predator populations that exist in the area now, but with the herd disappearing there may be a strong lag effect where wolves are supported by marginal moose populations. Wolves then have anti-regulatory effect on woodland caribou. Could explain the small size of many woodland herds in the area.

TS: I will summarize so far. The important questions we need to ask of the study design are:

1. What predator-prey system exists (of 4 scenarios)?
2. Has this system apparently changed in the past 10 years? (after JC argued that we do not necessarily know if it has changed).
3. If it has changed, what were the causes?

There was discussion here about how much we can learn from the past, since there was no real survey work done until the mid 70s, and no quantitative study of moose and caribou until the 1980s.

TS and SB. We must start making approaches to investigating which of the scenarios is operating, realizing that the sky is not the limit. We should try to find the cheapest way to determine what is driving this sytem. At the same time, we are being instructed to elevate prey, but there is little we can do with bears, and we seem to know even less about what effects reducing boars could have on bear population size.

RQ. Yes, there is a legal responsibilty to elevate prey for basic needs levels of Indian, according to the land claim.

AB. Is there a way to design program to do single year cull in one area to the east and longer term control in the core caribou area, to determine the application of each treatment in addressing population grown and theoretical examination of the 4 scenarios presented?

RW: Need to consider that if bear predation is regulating system, then short term solutions to moose density can be achieved with wolf control. We need to recognize this as potential problem in study design. How do we tease this piece of information out. This is quite critical to long-term application of predator reduction.

TS: That is a step beyond what is being discussed here. Must keep logical sequence, for we do not know which is correct at this point, we are only looking for what are possible suggestions.

FM addressed what may occur based on short and long term wolf removal. SB noted that Scenario 3 and 4 cannot apply for all prey species.

FM: For moose in scenario 1, if predation rate is increasing, recruitment is stable, then one year of intensive control of wolves (80%) should result in reduced predation and natural recovery of moose. For moose in scenario 2, moose should increase initially but will then drop to lower levels unless other important recruitment factors (ie bears) are concurrently reduced. For scenarios 3 one or mutliple year culls will not ever release caribou to grow because recruitment is too low.

There was some debate about the benefits of one year control program in getting the type of recruitment change.

BH summarized that there are certain constraints that the Aishihik plan is under from the wolf conservation and management plan. Conditions to consider before wolf control can go.
1. Wolves must be expected to be an important limiting factor on target ungulate. We must expect they are in the Aishihik area, otherwise we cannot justify controlling wolf numbers.

2. Target ungulate population must be a low density, compared to what the range could support.

3. Hunting closure for 2 consecutive seasons before wolf control is considered. Aishihik qualifies, after Nov. 1.

To consider continuing wolf control after 2 years, recruitment rates of target ungulate must double (and, logically, must indicate growth rate in herd size). After 5 years, herd size has to be shown to have grown substantially to continue any further actions. There is a public expectation that if you are going to intensively kill wolves then there has to be direct, immediate and substantial benefits for the target ungulate population in the area. Small scale changes in recruitment and population size will not wash.

TS: Here we need to make conditions species specific. Those conditions could apply caribou, maybe for moose, but not for sheep. Should be incorporated in hypotheses, which we have not yet discussed. Still not clear that 1 year and longer term removals are mutually exclusive. With 1 year, if it increases then stabilizes. If it goes down and stabilizes, it does not match the prediction, so we stop removal. This is ok because it is stabilized. If it continues to decline even though we have done removal , we are not fine. It will drive toward extinction, because of other factors limiting recruitment and mortality.

The crucial things to determine is if mortality on caribou is density dependent or density-independent. To determine this, we need a control study population. Is there such a thing?

DL. No, not a perfect case, for ecological conditions will change among areas.

RF: For caribou we can look at 5 different herds through rut counts.

TS: Are other herds declining like this?

RF: Yes, the Chisana herd has had very low calf recruitment, and population decline.

TS: To measure whether you are dealing with the important limiting factor, and which pred-prey model you are in, you need to follow and know causes of predation rates. How can you do this in your treatment and control areas?

FM: Look at cow:calf ratios. This is a better method than radio-collars for there is larger sample size. With 2 herds, (high and low) you assess pregnancy rate, measure cow/calf ratios in June, July and other times of year. This will allow you to assess offtake by bears.

TS: But this does not tell you the causes, need to collar calves and follow their mortality, determining what is killing them.

RF: The herd is very small, and I have a problem with the ethics of handling so many of the potential calves in the population to study direct causes of mortality.

BH. We can radio-collar samples of caribou and moose females and follow them intensively throughout the summer and winter, to determine when the bulk of mortality occurs. There is plenty of data from Denali and the Porcupine herd to know the periods when caribou calves are vulnerable to bear predation. There is good data on moose from the Zone 7, Tok and Nelchina studies to give same information about bear mortality. Combine both the cow/calf ratio and fate of calves of radio-instrumented females to determine differences in survival rates in control and treatment areas. Female sample will also allow some measurement of adult mortality changes.

DL. I have accepted that the moose system is the way it is because of bears.
TS: You do not know that, it is only your hypothesis, for it has not been tested.
DL: I agree. What I am saying is that bears play a role in determining moose density in these systems in the southwestern Yukon. I am convinced we are in a low density moose system.

TS: You are ignoring a lot of things. The point is that it is quite possible that bears can cause the whole lot to become extinct, they are perfectly capable. The management things can be done without further knowledge, but we do not know where the system will go in the end. We need the science to predict and experiment with these larger questions.

BH: Can we infer causes from rates?- I believe we can if we monitor samples of collared ungulates and do composition counts at critical times. Observing mortality of calves is highly costly and perhaps not necessary if we can use rates of mortality from intensively studied calves where their deaths were known.

TS: Collars are the best thing for they let you know more about individual mortality.

FM: But what kind of sample size do we need? At least 50. And do you do this during the first year of wolf control? Perhaps you will predispose your calves to mortality. The proportion taken by predators then could artifically change because of the handling.

SB. Why not operate in smaller scale zones, and manipulate the prey base, rather than deal with large scale removals, where prey density is very variable. Better to choose 4 or 5 packs, determine prey density and then monitor predation rate of wolves.

FM: You could do it that way. For example first survey moose, and easure predation predation rates of radiocollared wolves. Then do your killing, and monitor change in prey density for following month. The problem is getting information on the annual prey base, where movements of prey is common, and could confuse analysis.

SB. How do we get at differences in bear and wolf predation, that is the key. Look at changes in proportions of prey in different areas, with both moose and caribou.

DL: Best indicator of bear predation is cow/calf ratio in June/July. If bears important mortality source, then ratio will be low early.

There was some discussion about whether bears ,wolves or abiotic factors could be causing high neonatal mortality in caribou.

Lunch break at 1:30, resumed meeting at 1:42.

BH: We left discussion on what kind of mortality is operating. How do we get at measuring changes from manipulating wolves. There is a difference in opinion in the potential impacts of bears on moose and caribou in Zone 5.

DD, Haines Junction conservation officer. I have spent considerable time on the ground in the area, and feel there is small number of bears there. Bear harvest is low, despite high quota, and hunters do not see many bears. Habitat is considerably less attractive to bears than the more moist St. Elias mountain ranges to the west, in Kluane.

RB. There is some difficulty here, because we have had good calf survival in Kluane moose, despite high bear density.

TS: We need some structure now. Details of what variable to measure.

FM: We need to measure at least the following:
1. wolf numbers (each year)
2. cow/calf ratio(at different times of the year)
3. survey absolute numbers (every 3-5 years)
4. monitoring should continue past the control period- this is critical.

SB: What about control study areas? We cannot choose areas too close to treatment areas.

DL: We have a time control, only without other areas monitored. I am not convinced that spatial controls are useful, given the possibility of wide annual fluctuations. If we chose spatial controls, then we need some relative index of bears, as we seem to coming back to the beast regularly in the design considerations. What about hunting, Francois? Do we need to find a control area where there is no hunting, similar to Aishihik?

FM. No, as long as hunting is on males only, and less than 4-5% of annual population, do not worry about it complicating design.

DL: Proposed that rather than looking at one area as a control, take in annual moose population census program, which moves around from year to year.

TS, FM, SB. Cannot use such an approach because there are too many vagaries and potential for natural processes to be different in each area. It will only confuse the comparison because you may be dealing with apples and oranges. Agreement was met that using ongoing inventory program was not legitimate for moose 'control' monitoring.

BH. For caribou, RF will annually monitor 5 surrounding herds as a control.

FM: That is not necessary, but it is good. Problem is making technique fit for moose. One reason to have same area compared each year is that year to year differences should affect both areas similarly, as long as conditions are the same in both areas. With no continuity of space then there is good chance that variations will be unpredictable and weaken the design considerably.

Unknown speaker; take area where density of moose is comparable today. And where wolf density is also similar. No areas were proposed at this time.

Regarding both moose and caribou, it was felt that you could have different densities of both species, and the thing to monitor between control and manipulated areas is the rate of change.

FM. Why are you going to monitor all caribou herds, each year? Seems excessive.

RF: Logic is to assume there will be variable population dynamics in some of these areas, because Aishihik is a unique ecosystem (mountain dwelling caribou that do not use the forest). At same time, I can use the Glenlyon population study to look at more detailed survival data for comparison. This herd would be studied annually, could follow the same design as Aishihik (monitoring calf survival rates of radio-collared cows and calf/cow ratios in summer, fall and winter).

BH. There will likely be a calf mortality study on the Chisana herd next year, which would give us much better information on comparative dynamics in a control herd. Keep this in mind for future.

TS Began to list the data that should be measured before and after control starts, in Aishihik and control areas for both moose and caribou. SB suggested that we are one step ahead. We should ask if all the potential reasons for an imbalance have been discussed.

1. Moose decline
2. Predators supported by alternate prey
3. Hunting pushed prey below the boundary level (B).
4. Physical condition of calves are lower and they are predisposed to predation or other mortality.

SB. Is there any good way to assess condition of calves born.

RF. Mortality study using radio-collars, but there are too few calves to fool around with. If wolf control goes, then are we now dealing with a system that is manipulated and artificial. Not a lot of point in doing calf study in this case, need pre-control data to compare to 'control' area. Right now there are not enough calves to work with.

SB What about differential mortality among sexes of calves as indicator of condition. RF says it can be done to 6 months old. SB To test hypothesis, radio-collar females, watch them through calving. If it does not live past 48 hours, and there is no sign of predation then the animal can be assumed to have been non-viable. If it lives longer then it is considered viable.

RF One way to measure nutritional stress is to see if peak of calving is later. In barren-ground herds under stress, calving is considerably later- a density dependent, competition for forage factor there.

TS: Seems that there is no unique and easy measurement to take, but a number of clues could be looked at to test the non-viability hypothesis. Growth rate, sex ratio, survivorship of selected sample of calves of collared females. How does this address hypothesis? Tight monitoring of first 48

hours indicates degree of perinatal mortality. Compare low calf viability with predator mortality. Am I getting this right? (Some confused nods).
You appreciate that for everything we write here, you must also do in the control area?

Measurements to be taken in control and manipulated areas.

1. census of wolves, bears, moose and caribou
2. calf/cow ratios for moose and caribou, (June, July, Oct, April
3. Adult mortality from radio collars on both moose and caribou.
4. Frequency of dates of birth
5. Mortality schedule of newborn calves-linked to adult radiocollared cows.
6. Sex ratio of calves to 6 months old.

In severe nutritional distress, male calves should be more susceptible to mortality. If information can be collected cheaply, it would be very important to compare Aishihik herd status and the Chisana, where a calf mortality study will be carried out next year.

A discussion about the reasons for the imbalance continued (see above). RQ suggested overhunting was cause of decline. FM showed that overhunting is never a good hypothesis, for if you stop hunting you will return to natural state. If you do stop hunting and the decline continues, then it would have declined anyway. The discussion is not about where the equilibrium boundary is , but what pushed population below boundary. .

To assess no. 2 we need to know what the predators are eating in the area. Both bears and wolves.

TS: Difficult to image how wolves can live on so few prey. Sooner or later the wolves will have to decline as well. Why is this not happening quickly at Aishihik? Suspicion is that something else is holding them up. Either prey are so vulnerable predators are having easy time, or alternate food other than ungulates is there. Perhaps humans are supporting system. This is happening in othere systems, we know it for foxes, coytotes, racoons, etc.

BH, I would argue that it is not happening over most of the study area, for there is very little human habitation, wolves are well distributed and act like classic, wild populations, spacing out evenly to prey on ungulates. No clumping around communities. For bears, it is not so clear, but also unlikely. It is possible that the high snowshoe hare population has supported wolves, especially pup survival in past years. Decline should follow with more stressed wolf population, more conflicts with humans for domestic food.

SB: What about possibility that wolves have gone through moose, caribou and now are onto sheep. Are they possibly taking more sheep than we think?

(R. Sumanik's study in Kluane Game Sanctuary in mid 1980s showed sheep to be the most important prey of many wolf packs there).

JC: Sheep population has not changed dramatically, but it could be true, only it is at early progressional stage.

RF: We can assess how important caribou are in the winter diet of wolves from cesium samples collected from necropsied wolves.

FM: What about influx of wolves from outside the core area to use prey. Could this be occurring, and be related to the problems of high mortality. Is there a dispersal sink from Kluane operating here?

RB: Don't know much about movement of wolves along Kluane boundary, but we are already into radiocollaring wolves along the boundary to assess the residency of certain wolf packs. This is a cooperative agreement with YFWB to mitigate the impacts of wolf control on Kluane Park wolves.

BH: Kluane does not hold a lot of wolves, for the only good habitat is along the front ranges. Further back, only snow and ice. Likely few packs are in the park, issue of dispersal not real important but could be looked at with radiocollared wolves.

Understanding the diet of bears in Aishihik and control areas is essential, how much is neonatal calves in each area? We also need to know relative density. This can be achieved by doing female composite home range studies of radiocollared bears, or Lincoln-Peterson index by marking and recapturing bears. These are very expensive techniques to get indication of numbers.

TS What about developing a relative index of density of bears by observing ungulate calving and comparing observation of bears associated with collared ungulates and calves. You could also mark bears in both areas and look at their behaviour during calving. This would require considerable $$.

SB: What about looking at scats as index of abundance, and diet in spring and summer?

RF: Bear scat transects could be set up in both areas to assess numbers and diet. Champagne Aishihik band could be contracted to do this work.

Conversation was about how to get adult mortality rate information in Aishihik and control areas.

TS: There is some adult mortality data for caribou, but not for moose. You must capture a number of cows and radio-instrument, then monitor survival rates. Animals must be collared in both areas.

FM: I strongly recommend that each biologist involved make a table scheduling the sample sizes of radio-collared animals that must be monitored to detect any change in rates of mortality, natality, etc. This is critical to the design and should be clearly laid out from the beginning in order to defend the design.

For calf mortality schedule, there is some limited data from this spring on rates of mortality. Most were gone by July, this was different than other years, but other years had small calf survival to winter. There is no information on moose calves, except in 1990 when there was a large number of moose calves, but small number of yearlings in survey.

RF: Regarding estimates of caribou abundance, I am not as comfortable with total count.

FM: Why are we so unhappy about counting all the animals in a herd? It is a much better method than sampling, but it does require a total count. Should not be so critical of such a technique.

TS: You can estimate how many animals you could have missed by knowing how many radio-collared individuals you missed in your census. Apply a sightability correction from this. This allows you to estimate the extent of bias in the count.

RF: We can do this. There was some discussion about how caribou are counted in the Yukon using strata estimation.

SUMMARY

FM: As overall project you must continually reevaluate how target species are reacting to manipulation of wolves. I predict caribou will react strongly to wolf control. Moose not so strongly. With some level of bear reduction there is a much better chance of recovery for both species. You should keep bear option open. In 3 years you can decide if you should also manipulate bears. If you liberalize hunting it should be easy to know if you increased harvest in the area.

JC: Liberalized harvest has not worked in other years, in other areas. We cannot expect that it will work here.

BH: Rob Florkiewicz, is there anything to add regarding potential carrying capacity of moose and caribou here? Should we be doing something now to monitor long term changes in food supply for both moose and caribou?

RF: In long term management scheme it could be important. It can be measured through condition parameters of handled females, pregnancy rates, twinning rates of moose. Body condition parameters are very useful to detect nutritional stress. There is plenty of work going on elsewhere to draw from to help us with this question at Aishihik.

BH: There is little time to continue. I think we have the skeleton ideas here now to design a good scientific large mammal experiment. This is critical to learning more about the impacts of predation on low density ungulates in the Yukon. We will need to write the design, clearly stating the theory, hypothesis and alternate hypotheses to be tested, and the measurements we will take to monitor change between Aishihik and control areas. The design needs to be reviewed by Tony, Stan and Francois to ensure we were correct in setting the design. The Yukon public also will need to review the plan before winter progresses. I will stay in touch with participants . There will be a summary of meeting minutes available in a few weeks, with any current papers supplied (Francois and Stan's, for example).

FM: In the design, ensure that you separate the must things to do with the maybe things to do. Do not compromise the must for the maybe. Ensure the politicians understand the limitations of what you can do without the adequate resources.

There was no further comments or questions. Participants were thanked for attending on short notice.

Meeting was adjourned at 3:50 pm.

Maps and Summaries of Data Presented During Workshop

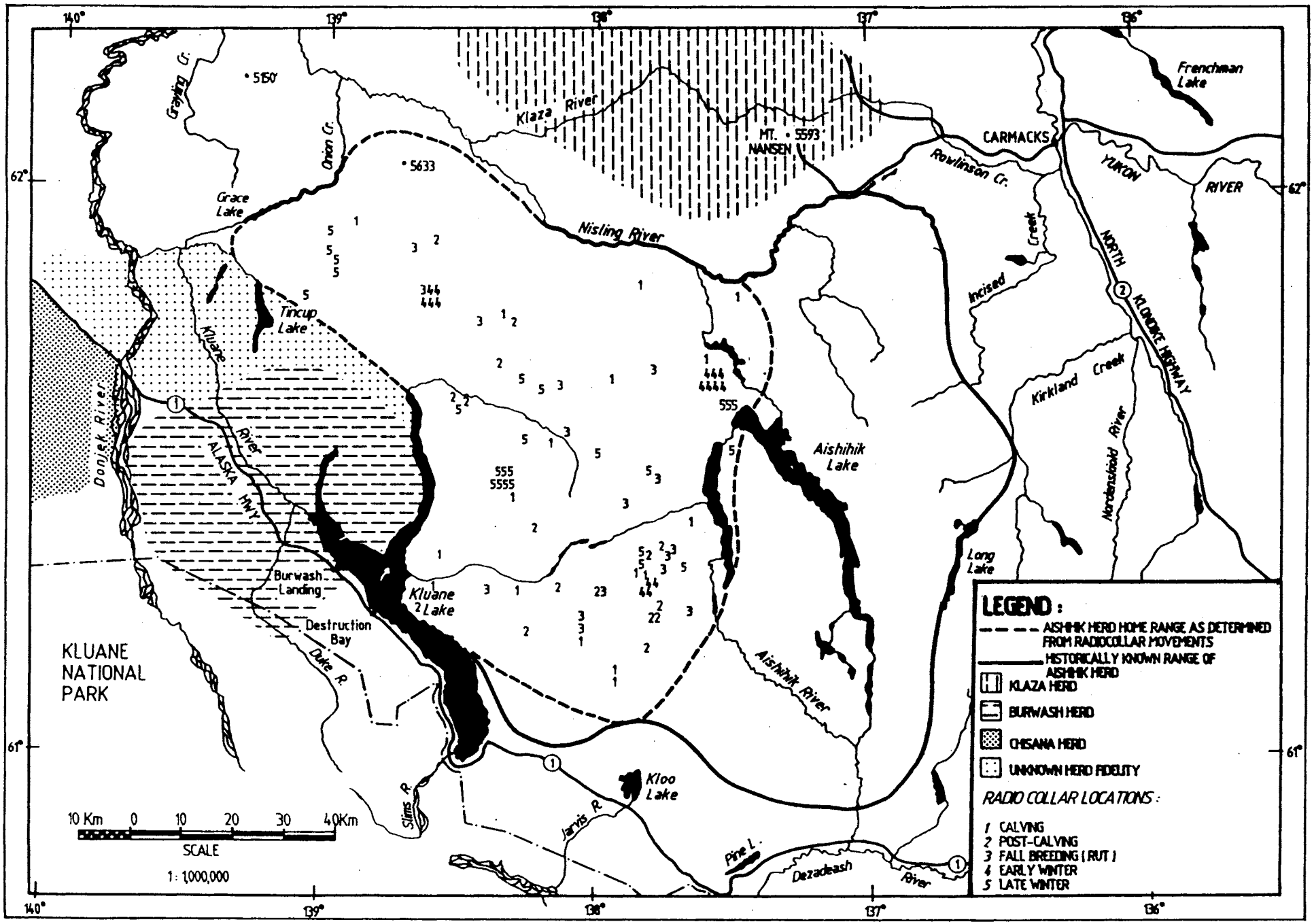
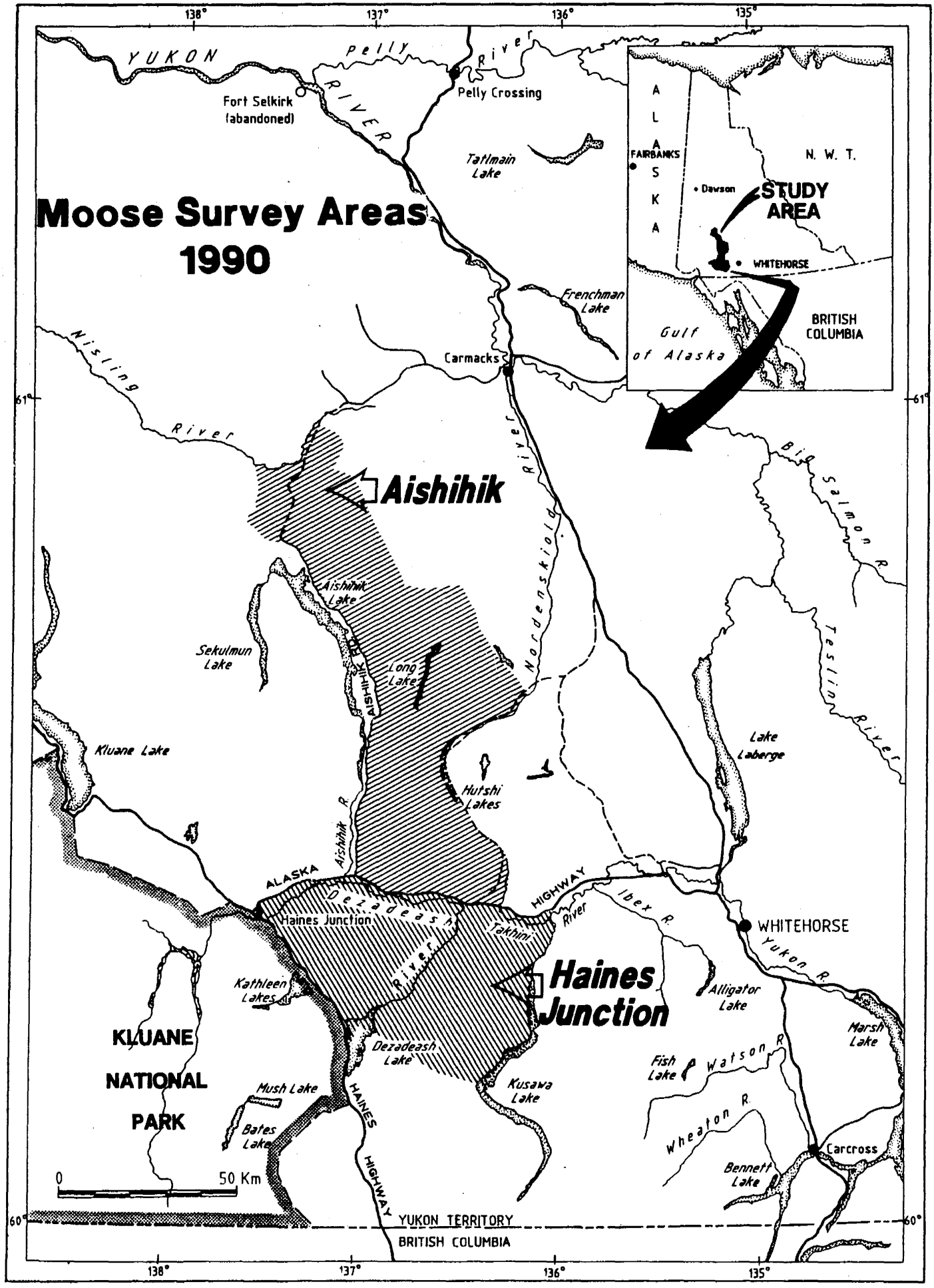


Figure : Home Range of the Aishihik Caribou Herd in relation to neighbouring caribou herds, based on radio-collar relocations.


Moose Survey Areas
1990
138°
137°
136°
135°
61°
60°
YUKON
Pelly River
Fort Selkirk
(abandoned)
Pelly Crossing
Tatlmain Lake
Frenchman Lake
Carmacks
Nisling River
Aishihik
Aishihik Lake
Sekulmun Lake
Long Lake
Kluane Lake
Hutshi Lakes
Aishihik R
Nordenskiold River
Big Salmon R
Teslin River
Lake Laberge
ALASKA HIGHWAY
Dezadeash River
Haines Junction
Takhini River
Ibex R
WHITEHORSE
Yukon R
Haines Junction
Kathleen Lakes
KLUANE NATIONAL PARK
Dezadeash Lake
Kusawa Lake
Alligator Lake
Marsh Lake
Fish Lake
Watson R
Wheaton R
Carcross
Bennett Lake
Mush Lake
Bates Lake
HAINES HIGHWAY
0
50 Km
YUKON TERRITORY
BRITISH COLUMBIA
ALASKA
FAIRBANKS
N. W. T.
Dawson
STUDY AREA
WHITEHORSE
BRITISH COLUMBIA
Gulf of Alaska

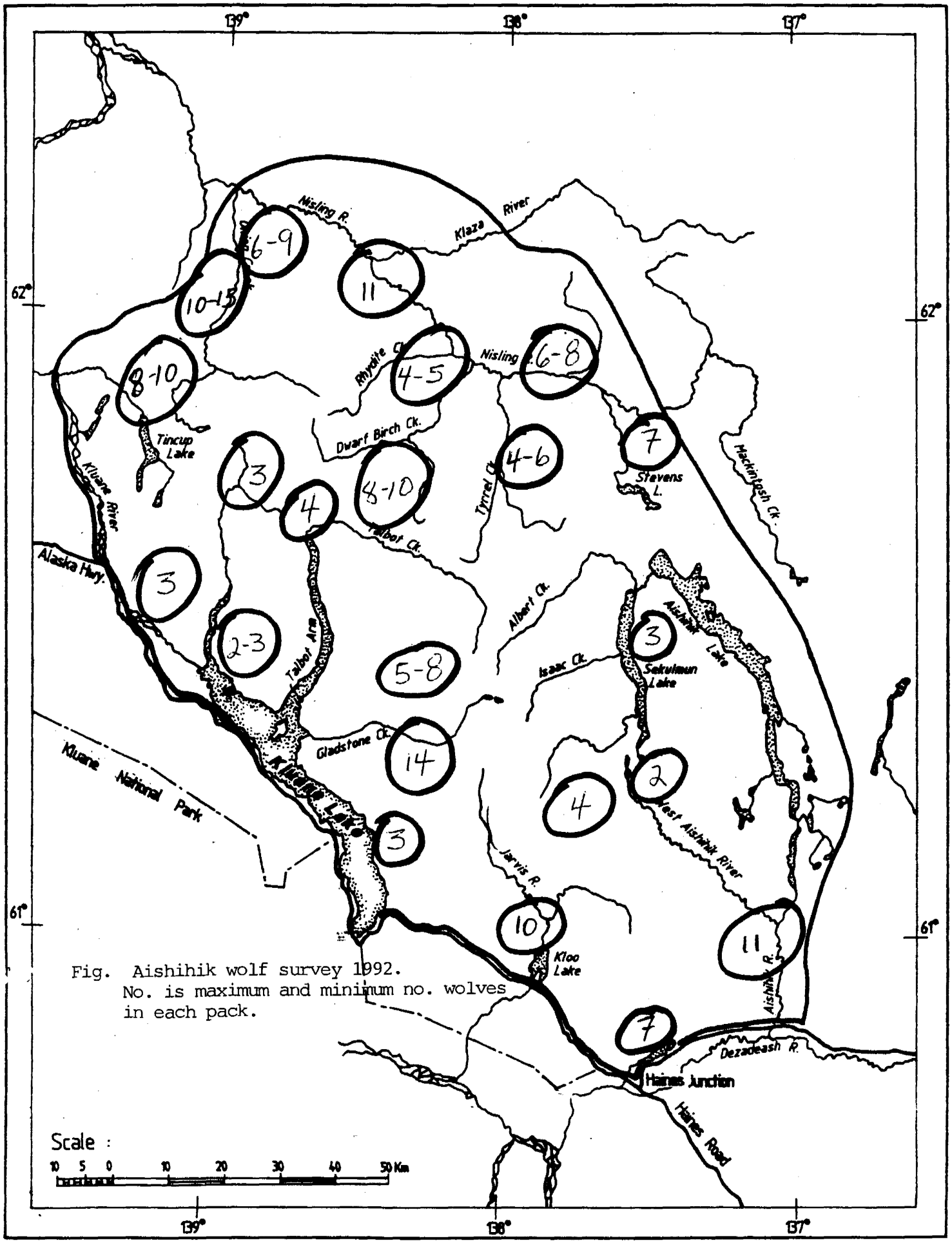


Fig. Aishihik wolf survey 1992.
No. is maximum and minimum no. wolves in each pack.

DATA SHEET FOR A AISHIHIK HERD

1. Aishihik caribou herd decline

   A. Herd decreased by roughly one-half.

   1) 1,225 caribou counted for estimated herd size of 1,500 in 1981.
   2) herd size of 785 in 1991 (total count).
   3) indications are a recent (3-4 year) phenomena based on local observations.

2. Management actions

   A. Harvest reduction.

   1) harvest was evenly split between outfitters and resident hunters and averaged 46 caribou between 1979-1989.
   2) native harvest thought to be light in recent years.
   3) harvest cannot fully explain herd decline
   4) male caribou harvest only since 1987 and licenced hunting closed in 1991.

3. Cause of decline

   A. Poor calf survival

   1) survival in April 1991 was only 20 calves/100 cows for that year's calf crop.
   2) survival was only 15 calves/100 cows within six weeks of calving in July 1991.
   3) calf survival decreased to 9 calves/100 cows by fall 1991.
   4) for 1992, calf survival was 11 calves/100 cows immediately following the calving period in June (however, only a small percentage of the herd was counted as post-calving aggregations and not yet formed).
   5) low calf survival indicates continued rapid decline (30-40 calves/100 cows in the fall rut counts indicative of stable to slowly increasing herd size).
   6) because calves are not hunted, the decline is due to natural factors (i.e. probably predation).

   B. Poor survival of adults

   1) 20 radio-collars were fitted to caribou in February and March 1991.
   2) of these, 3 caribou died of unknown causes within 1 week of collaring and 1 additional caribou died of natural causes over the subsequent year.

3) an additional 10 radio-collars were fitted to caribou in December 1991.
4) between March and June 1992, 7 of 26 collared caribou died from natural causes.
5) the natural mortality rate for adult caribou could be very high and possibly ranged from 6% in 1991 to 27% in the spring of 1992.

C. **Caribou body condition studies in December 1991 indicate favorable animal health for that period for that particular year.**

1) pregnancy rate (48 of 50 caribou tested) was 96% in December 1991.
2) all caribou proved negative for disease (brucellosis only).
3) body size and fat content was normal.
4) therefore, climate and habitat (i.e. poor nutrition) is likely not causing decline.

D. **Aishihik wolf population**

1) wolf density in Aishihik area is 10.5 wolves/1,000 km^2 (or about 210 wolves in the 20,000 km^2 Aishihik herd range).
2) higher than Finlayson area prior to wolf control (9.3/1,000 km^2).
3) range of wolf densities found in Yukon 3-18/1,000 km^2.
   a. lowest wolf density is related to lowest moose density (4 moose/1,000 km^2 for Casino Trail area) in Yukon.
   b. highest wolf density related to highest moose density (550 moose/1,000 km^2 for Teslin Burn) in Yukon.
   c. relative rating of Aishihik wolf density is 3rd highest in Yukon despite a very low moose density (moose declined from 107/1,000 km^2 in 1981 to 79/1,000 km^2 in 1991).
4) wolf harvest low.
   a. annual wolf harvest by hunters 10/year.
   b. annual wolf harvest by trappers 5/year.

4. Conclusion

A. **Ongoing decline in Aishihik caribou likely caused by high predation rates as alternate prey for wolves following decline in moose numbers.**

AISHIHIK HERD CALVING SURVEYS JUNE 1 & 15, 1992

On 1 June a survey was flown during the calving period, and 15 June another survey was flown after calving was finished. These are 2 of 3 surveys planned for gaining insight to timing and distribution of herd calving, birth rate, calf and adult survival in the ACH. The following points should summarize the results;

---

1 June Survey

1. The 1 June survey required 8.5 hrs. helicopter time to relocate and count a sample of 71 caribou (18 groups) associated with radio-collared female. Known extent of herd range has expanded to include a large area northwest, almost to the Donjek R., as a result of calving distribution. Most calving took place in the Ruby Range, however. Only 1 of 17 radio-collared females was not relocated by the helicopter survey. 83% of all caribou were observed in alpine habitats.

2. Caribou appeared to be in the middle of calving as only 27 calves/100 females were counted, while 40% of females still had hard antlers, and 77% of those without had extended utters. It appears that the peak calving date for the ACH is sometime in early June. Not in late May as earlier speculated. Of 11 radio-collared females 5 had calves at heel, 6 had hard antlers (indicating they were likely pregnant), and only 1 did not appear to have an extended utter. The calf/female ratio for the radio-collared sample (n=10) was 50/100.

---

3. A total of 7 radio-collared caribou (6 female & 1 male) died between 14 March and 1 June when 26 transmitters were active. This implies a 27% mortality rate for adults over a <3 month period. Our sample of radio-collared females for reproductive history analysis has been severely reduced.

15 June Survey

4. The 15 June survey required 7 hrs. helicopter flight time to relocate and count a sample of 227 caribou (22 groups) associated with 11 active radio-collared female locations (fixed-wing). Herd distribution was similar to that found on 1 June. All caribou were found in alpine habitats.

5. No further mortalities of radio-collared caribou were found.

6. All caribou had new antler growth. Since all females had shed hard antlers, we assume calving was finished. The calf/female ratio for the sample count was 11/100 (19/171 observed) and for the radio-collared female subsample 18/100 (2/11 observed). Indicating very high initial mortality of calves following birth.

Our indicators of adult and calf survival imply that the ACH is in rapid decline because of high natural mortality. We have no reason

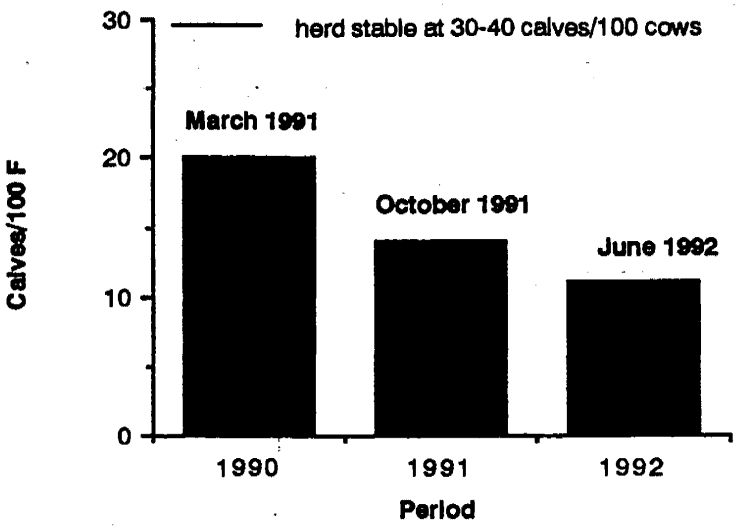
to suspect that caribou were predisposed to high mortality based on previous investigations into pregnancy rates and adult body condition. The rate of decline for the ACH appears to be accelerating from the survival measurements made over the previous 2 years. This suggests that unfavorable ecological forces are having a greater influence on population growth as herd density diminishes.

Given the magnitude of early calf mortality it appears the survey planned for 15 July will add little to our present assessment of ACH status. The survey planned for this October will add far more. We therefore recommend that the 15 July survey be cancelled.

Prepared by:

R. Farnell
B. Gilroy

Estimates of calf numbers in Alshihik Herd, 1990-92



WHAT DOES THIS SHOW?

1. The number of calves that are born and survive to winter are too low for the population to be stable. Herd must be declining still.

2. The 1992 calf count after birth was very low, and the rut count should be even lower.

Source: 1990 March survey 528 cows seen.
1991 October survey 486 cows seen.
1992 June survey 171 cows seen.

AISHIHIK MOOSE POPULATION INFORMATION

POPULATION ESTIMATES(90%C.I.) :

1981: 377(+-21%)
1990: 291(+-18%)

PAST STATUS:

RATE OF CHANGE BETWEEN 1981-1990: 23% DECLINE (-2.8/YR)

CURRENT STATUS:

DENSITY: 82moose/1000km2 (very low)

RATE OF CHANGE: 0.90 to 1.02 (rapid decline to slow increase, 1=stable)

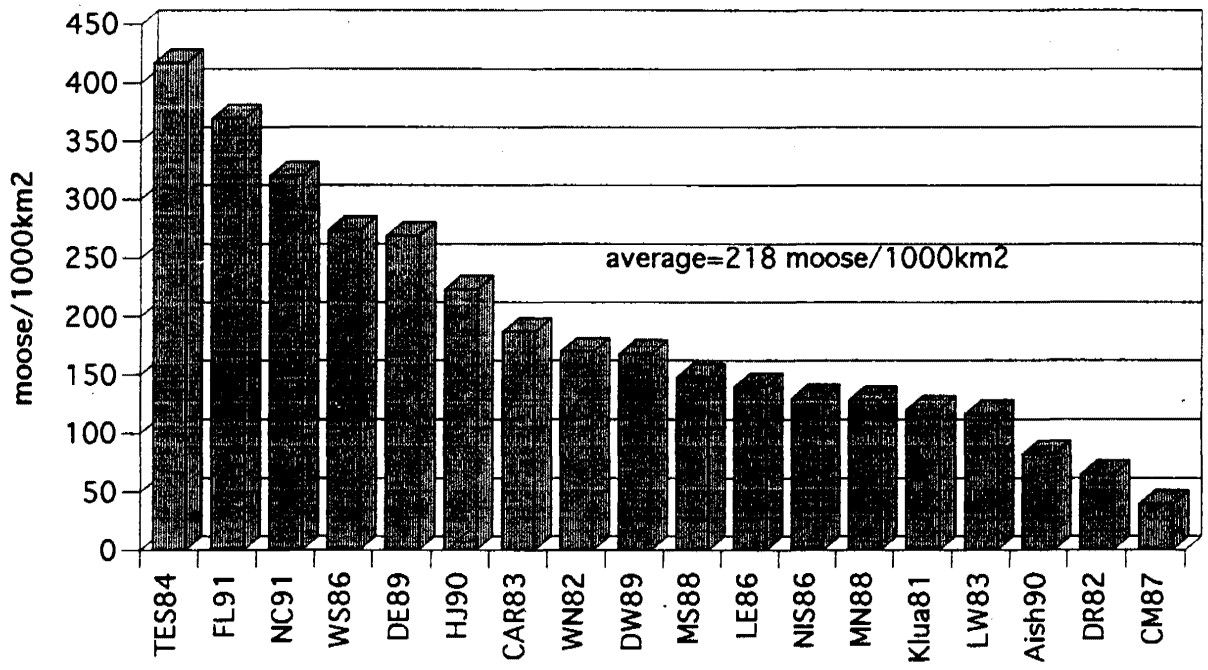
RECRUITMENT: 0.12 (slow decline, .14=stable)

YEARLINGS/100 COWS: 19 (decline, 30=stable)

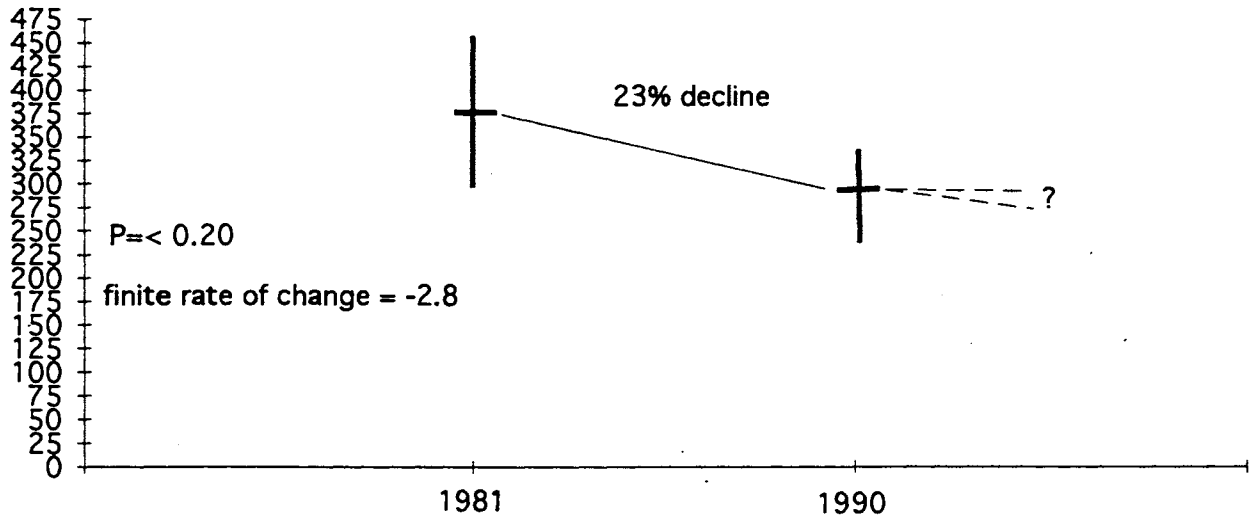
CALVES/100 COWS: 53 (increase, 35=stable)

CONCLUDE: **STABLE TO SLOWLY DECLINING WITHOUT HUNTING;**
NO SUSTAINABLE HARVEST

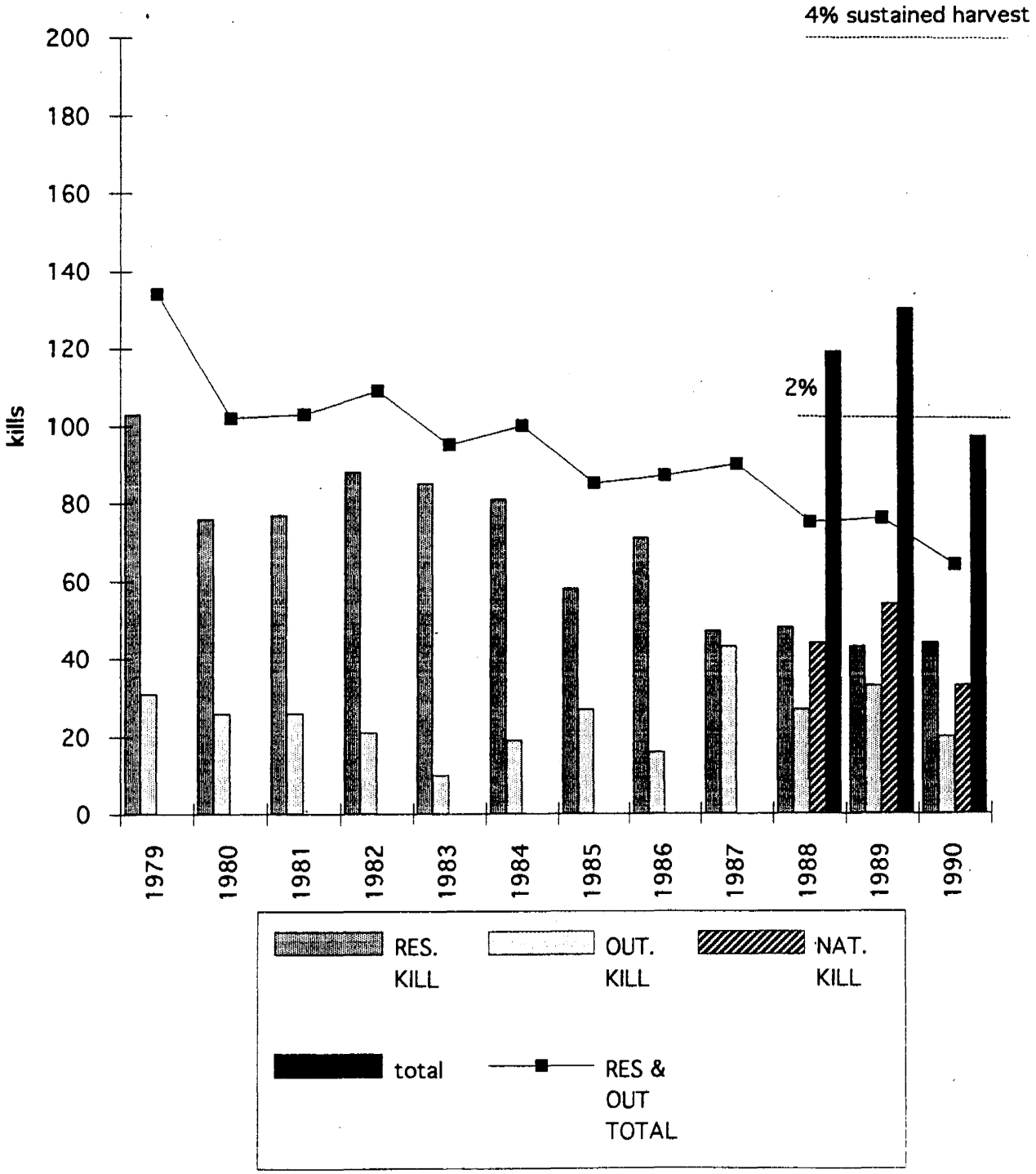
Moose density by survey area in the Yukon, 1981-1991.

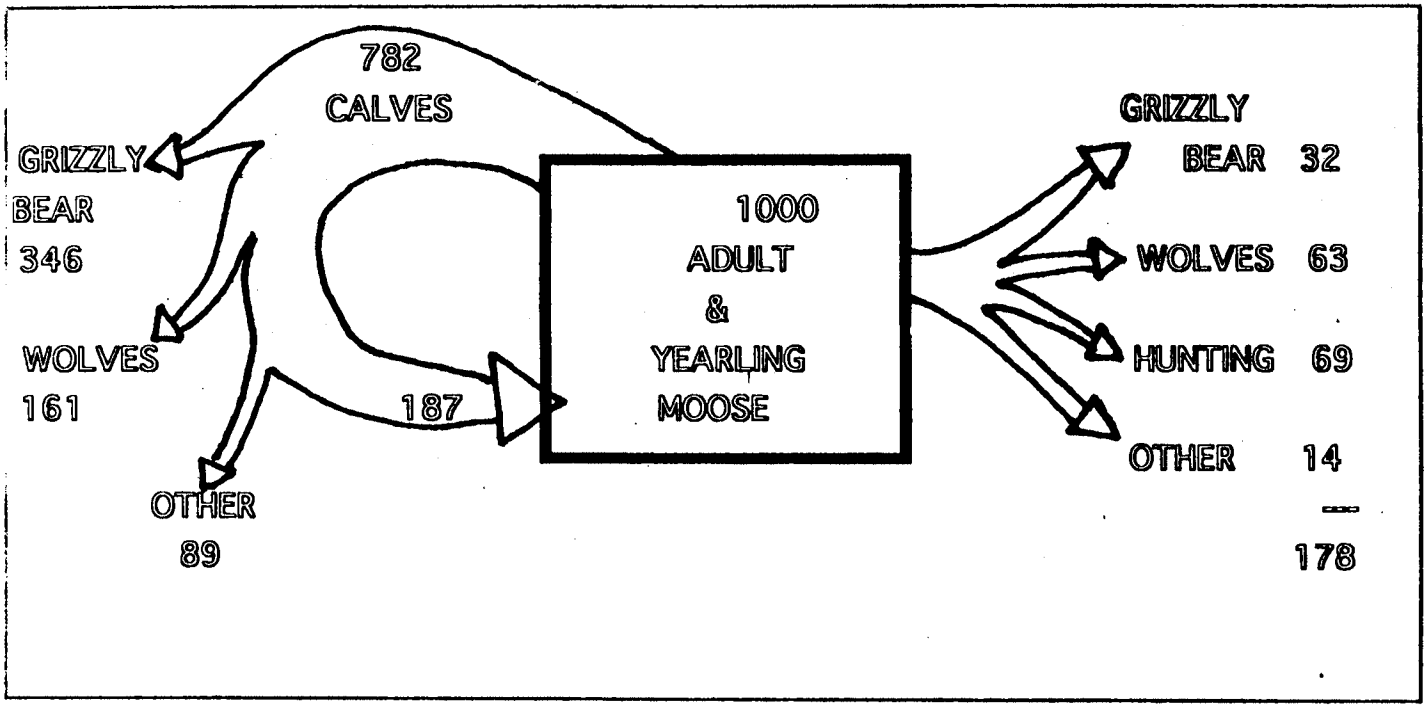


Moose population estimates (90% C.I.) in the Aishihik survey area in 1981 and 1990.



Moose harvest by user group in GMZ 5 between 1979 and 1990.

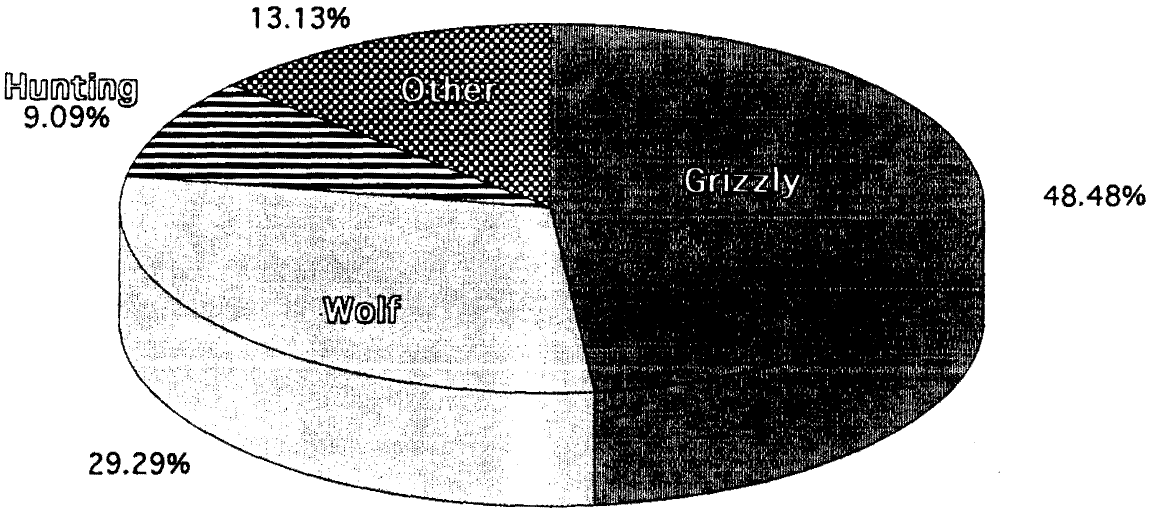




Percent of postcalving population killed by:

grizzly bears	21%
wolves	13%
other	6%
hunting	4%

Cause of adult and calf mortality over one year (based on combined data from the Zone 7 & 9 between 1983-1988).



STATUS OF DALL SHEEP IN THE AISHIHIK AREA

- surveys were conducted in the Ruby Range (GMS 5-31, 5-34, and 5-36) in June, 1992 (see attached flight note). One other subzone, 5-39 was surveyed in 1989; most other population information dates back to 1974.

- numbers seen this year were similar to 1989, but down from 1986. The problems with one-pass, "total" counts are highlighted in the last 2 surveys. The 1986 surveys were done under very windy conditions, and completed with only 2 observers, due to illness. The composition information is reliable, but some groups may have been missed. The late spring in 1992 may have affected the distribution of sheep; I am quite confident that we counted "all" the sheep in the subzones surveyed, but perhaps not all the sheep that are normally there were there at that time.

- a broad age distribution can be generated from survey information using the curl class of rams. For example, this year's lamb crop failure will be manifest as a lack of half curl rams in 1995. Similarly, cohort gaps and pulses in rams of a certain curl class can often be related back to their birth year.

- it is believed that most of the annual variability in lamb production can be related back to weather factors. Low lamb counts were noted throughout the southwest Yukon this year.

INFORMATION AVAILABLE

- surveys have been conducted in 1974, 1979, 1980, 1982, 1983, 1984, 1985, 1986, 1989 and 1992. Detailed classifications are available from 1984 on.

- there has been compulsory submission of all hunted animals since 1979. All inspected horns are aged, and can therefore be related back to the birth year. Cohorts born in 1980 and earlier should now be almost totally represented in the compulsory submissions (Kluane rams generally live to about 12 years). Approximately 16 rams are reported shot in these 3 subzones annually, with an average age of about 9 years.

INFLUENCE OF WOLF PREDATION ON SHEEP POPULATIONS

- little change in the size of the sheep population was noted following wolf reduction in the early 1980's

- trends in number of lambs and lamb:ewe ratios were similar in both the control and experimental areas.

- there was no relationship between lamb production and wolf density

- 1.9 sheep/100 km^2 were killed by wolves over a 180 day winter period

- predation rate was below that which was documented for Sheep Mt. (4.0 sheep/100 km^2)

- predation rates were pack specific

SHEEP SURVEY IN THE RUBY RANGE (GMS 5-31, 34, and 36)

Dates: 25-26 June, 1992

Weather: Clear and calm

Helicopter: TransNorth 206B

Pilot: D. Makkonen

Recorders/Observers: J. Carey, B. Hoover, D. Dixon

Surveys have been carried out in this region periodically since 1974, and is one of the few areas in the territory where long term trend information is available. In order that the information remains current, it has been recommended that surveys be carried out at three-year intervals and it was with that objective that surveys were conducted this year.

These surveys were postponed from earlier in the month because of a remarkably late spring. Snow patches were still dominant at the higher elevations which may have affected sightability. Green-up still had not occurred and flowers were notably lacking. Consequently, most sheep were found at lower elevations where forage was available.

Results of this year's surveys and those of 1986 and 1989 are given in the following table. Because of extremely variable lamb production, only adult sheep should be used in making year to year comparisons.

Subzone	Year	Nursery Sheep	Lambs	Rams 1/2	Rams 3/4	Rams 4/4	Tot. Adults	Total 100	Lambs/ n.s.
5-31	1992	164	6	23	18	28	238	232	3.7
	1989	210	94	14	36	47	402	308	44.8
	1986	173	5	42	94	25	340	335	2.9
5-34	1992	90	8	11	20	16	145	137	8.9
	1989	102	47	16	17	28	210	161	46.1
	1986	125	21	18	63	19	246	225	16.8
5-36	1992	120	21	25	24	24	214	193	17.5
	1989	58	21	24	20	19	142	121	36.2
	1986	94	23	23	47	22	209	186	24.5

Note: nursery sheep include ewes, yearlings and 2-year-old rams

Group size, combined with rough terrain, limited the number of yearlings that could be classified. There were 25:53, or 47 yearlings per 100 ewes classsified. This indicates very high lamb production last year, with excellent overwinter survival.

The total number of non-lamb sheep observed was very similar to the number seen in 1989 (562 compared to 590), with the difference almost entirely in the ram segment of the population. No one horn class was significantly over or under represented. Of the rams seen, 36.0% were classified as full curl; this proportion is comparable to other surveyed populations. The unusually heavy snowpack this past winter may have displaced the rams from traditionally used areas, but this is just conjecture. Known mineral lick sites along Gladstone Creek were checked, but no sheep were seen.

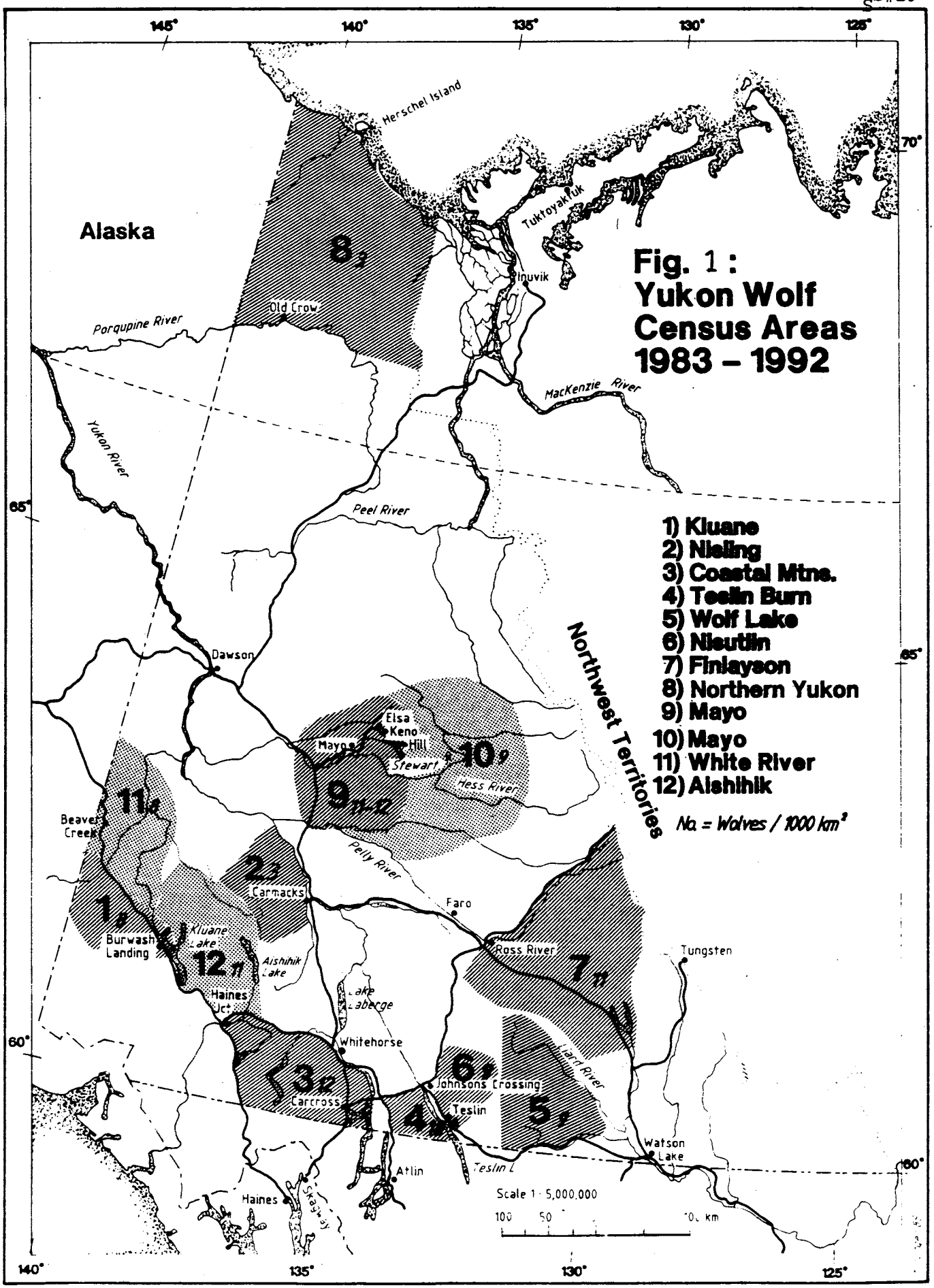


Fig. 1 : Yukon Wolf Census Areas 1983 – 1992

AISHIHIK WOLF SURVEY

January 10-17 & Mar 3-7 1992

Executive Summary Report

A wolf population survey was conducted in the Aishihik area during January and March 1992. This survey was done over two periods due to weather and time restrictions. Each of these periods addressed separate portions of the survey area which helped to reduce potential duplication of wolf packs.

The survey area, totalling 14,960 km^2, was delineated on the west and south by the Alaska Highway, from the Kluane River at mile 1118 to the Aishihik road turnoff at Canyon. The eastern boundary was slightly east of and parallel to the Aishihik road from the Alaska Highway to Aishihik Lake. The north eastern boundary was north of and parallel to the Nisling River, taking in most of Schist and Maloney creeks, as well as the lower reaches of the Klaza river. The north west boundary was the ridge of high ground west of Onion Creek, from its confluence with Onion Creek through Grace Lakes and over to the Kluane River.

The survey was flown with two fixed wing aircraft, using pilot/observer teams experienced in wolf tracking. Aircraft types used were a PA-18 Supercub and a Maule LR-7. A total of 75.6 hours were flown. Coverage rate was 3.3 km2/minute. Aircraft costs for the survey were $13,650.

A total of 22 packs were located in the survey area, 13 of these were seen and 9 were censused by tracks alone. All pack size estimates took track sign into account because visual sightings are minimum estimates, as some pack members may be missed. The wolf population estimate derived from this survey was 148-174 wolves. This estimate includes 135-158 pack wolves, to which an estimated 10% lone wolves were added. Density was 9.8-11.6 wolves/1000 km^2, which is moderate by Yukon standards, and typical of the southwestern Yukon mountain ranges. Other Yukon wolf density estimates (*) that it can be compared against are;

Coast Mountains	1983	12.3/1000
Finlayson Lake	1983	9.0/1000
Teslin	1984	18.1/1000
Wolf lake	1985	10.0/1000
Nisutlin	1987	10.0/1000
Wolf Lake/Cassiar mnts	1988	6.0/1000
Mayo west	1988	9.8/1000
Nisling	1988	3.3/1000
Mayo east	1989	9.4/1000
Beaver Creek	1989	6.1/1000

*** these values are mean values of the range**

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Mean pack size was 6.1-7.2 wolves/pack. Color composition of those wolves visually counted was 31 black or "dark" wolves and 38 grey or "light wolves";

Table 1. Wolf packs identified in the survey area between January 10 and February 7 1992.

Wolfpack name	# wolves	visual	colours		
			BG	GT	?
Haines Junction	7				
Aishihik River	11				
Kloo Lake	10	x	5	5	
Gladstone	14	x	7	6	1
Bear Lake	2	x	2		
Sekulman Lake	3	x	2	1	
Cultis Bay	3				
Stevens Lake	7	x		7	
Schist Creek	6-8	x	6		
Tyrrell Creek	4-6	x	2	2	
Serpenthead Lake	4	x	1	3	
Nisling/Klaza R.	11-13	x	5	6	
Onion Creek	6-9	x		6	
Onion Creek 2	10-15				
Tincup Lake	8-10				
Talbot/Dwarf Birch	8-10				
Dwarf Birch Creek	4-5				
Alaskite Creek	5-8	x		1	
Kiyera Lake	3	x	1	1	
Brooks Arm	2-3				
Mile 1118	3				
Dry Pass	4	x			

Moose observations

A total of 94 moose were classified (adult/calf) during the wolf survey: 87 were adults and 7 were calves. Calves represented 7.9% in the sample.

Aishihik Prey Biomass/Wolf Index

No. moose/1000 km^2
No. caribou/1000 km^2 divided by No. wolves/1000 km^2
No. sheep/1000 km^2

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92 moose x 6 (relative wt.) +
40 caribou x 2 + /10-11 wolves
88 sheep x 1

= 65 - 72 *

* This is the lowest ungulate biomass/wolf index among 27 wolf/prey studies in North /America. Other studies range from 112-659 with most in the 150-300 range.

What does this tell us?

This suggests that wolves are likely an important factor limiting ungulate prey in the area.

It also indicates that Aishihik wolf numbers have not yet declined to adjust to the small prey base there.

Current Large Mammal Populations and Problems - Aishihik

Caribou

1. Population decline since 1981
2. Low calf survival and declining in past 3 years
3. Adult mortality high in 1992
4. Low bull/female ratio
5. Ninety-six percent pregnancy rates in January 1992, initial production apparently high
6. Female condition good
7. Late winter diet in 1991 was low in preferred lichens
8. Population size is very low - likely less than 700 animals

Moose

1. Apparent 23% decline since 1981
2. High calf survival to early winter in 1990 (53 calves/10 females)
3. Low density moose population (less than 100/1,000 km^2)
4. Unknown density in northern area, but may be higher than Aishihik

Sheep

1. Population apparently stable
2. Extremely low lamb survival rate in 1992
3. Survival is highly variable, and apparently linked to winter-spring conditions in Kluane
4. Density moderately high

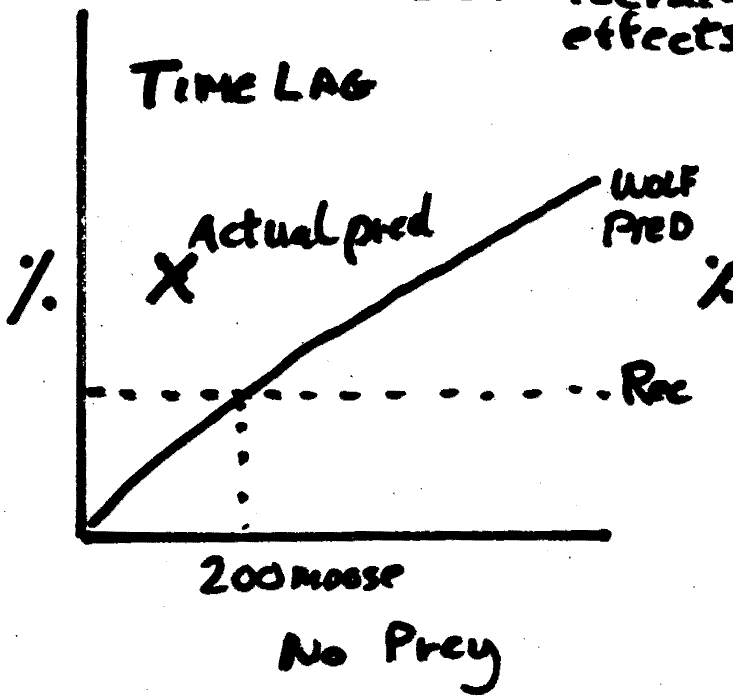
Wolf

1. 1992 survey - 11/1,000 km^2
2. Wolf density is higher than expected (4/1,000), in relation to low food supply
3. Ungulate biomass index is lowest of 27 studies in North America. Wolves are likely in large response to declines in moose and caribou in the area

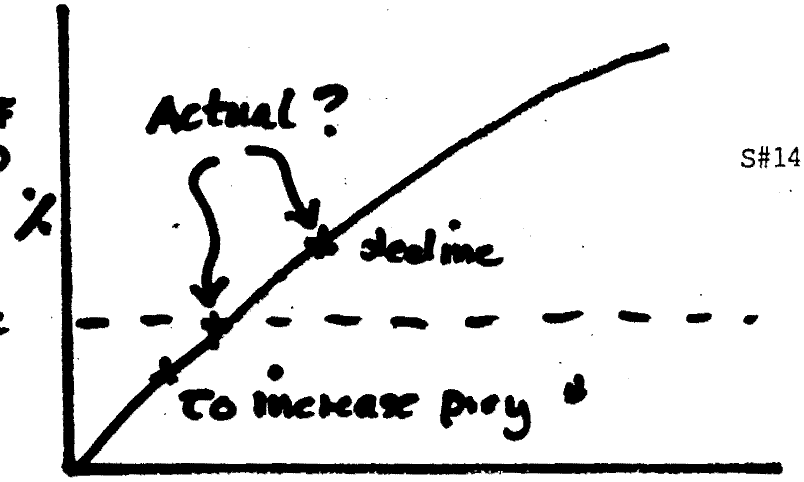
Human concerns

1. Moose are apparently relatively new to area (in last 100 years)
2. Many more caribou and moose in the area in earlier times
3. Indians have regulated their harvest on both species lately. No hunting of caribou by Indian and non-Indian hunters
4. Hunting has been an important part of problem
5. Reduced hunting of bears in spring, by Indians has made problem worse by not limiting bear-related predation on calves of moose
6. Caribou went extinct in the south of Zone 5 and 7 during the past 50 years

——— Total pred response - WOLF NUM + functional
- - - - recruitment (not including wolf predation effects



SCENARIO # 1



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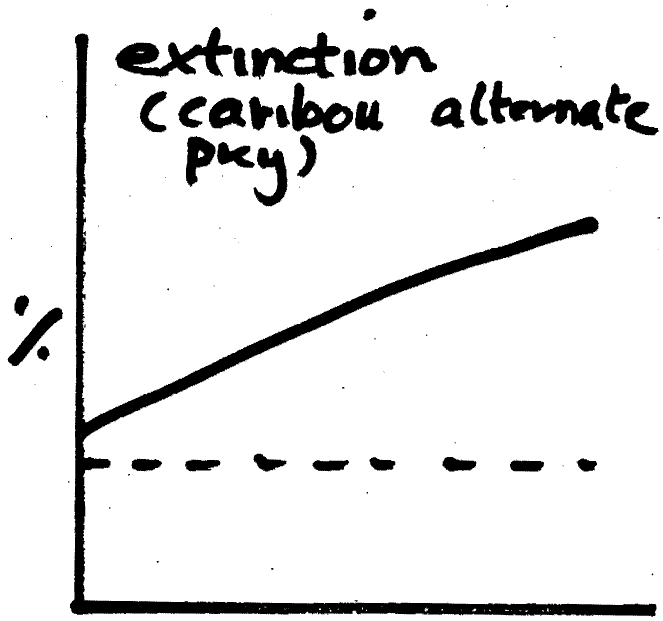

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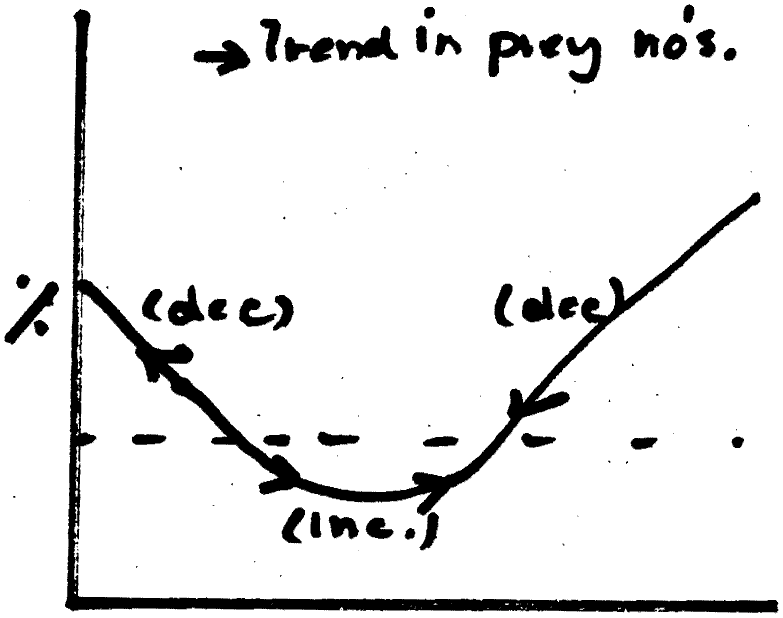
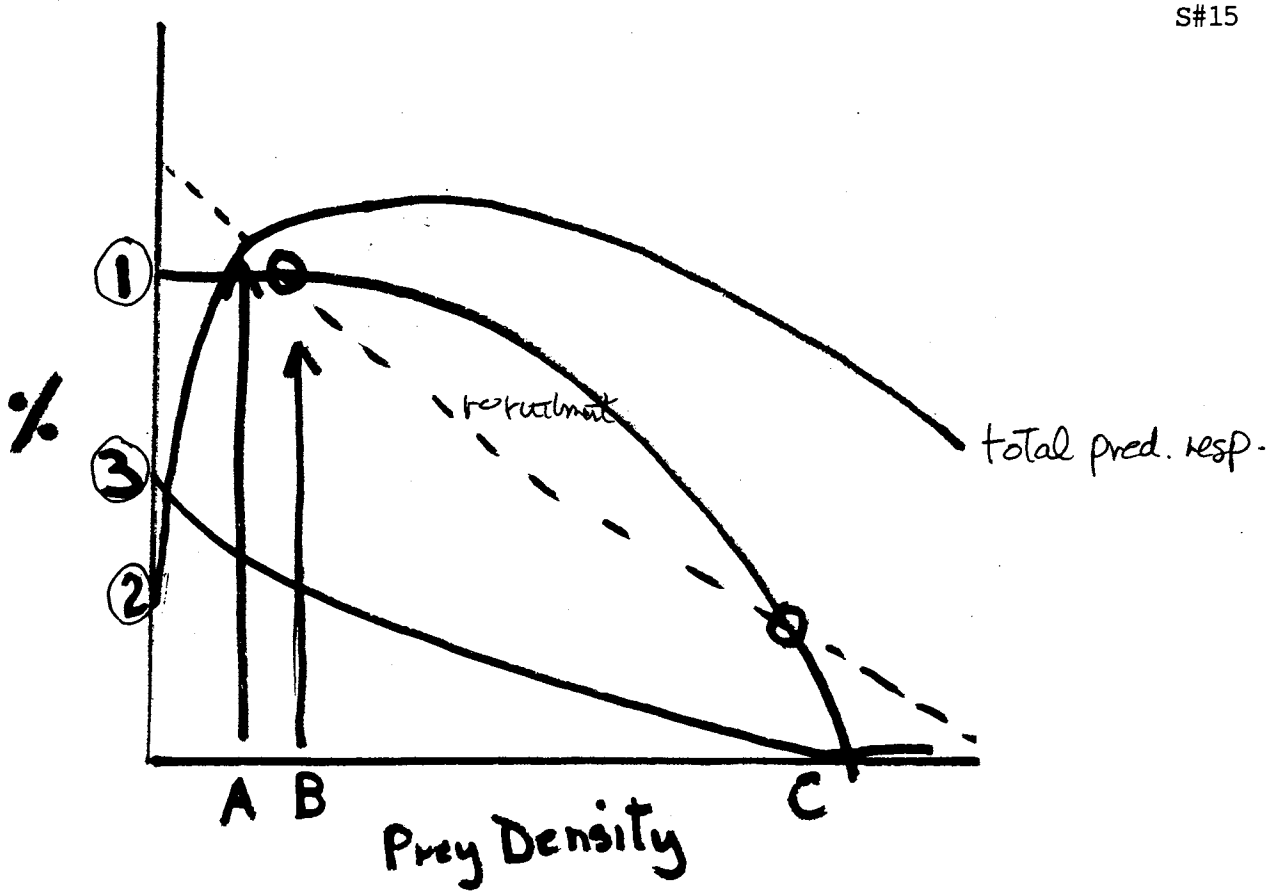


Scenario 4



How to distinguish the predator prey system

Exp: 1 year wolf removal

Prediction: i) if prey ↑ : stabilize . . . . → ①
ii) prey ↓ : stabilize ⟶ ②
iii) prey ↓↓ no stability 3 : 4

Expt: 5 yr. wolf removal

prediction: i as above
ii as above except 2 or 4.
iii as above ⟶ ③

APPENDIX I

Workshop on Predator/Prey Dynamics
and Aishihik Ungulate Recovery Study Design

October 3 and 4, 1992
Klondike Inn, Rendezvous Room
8:30 a.m. to 5:00 p.m.

AGENDA

This workshop is designed for all staff of the Fish and Wildlife Branch and other interested agencies and persons to learn about the current theories and studies of predator/prey dynamics. Presentations will be made by three wildlife population ecologists.

The first two lectures will address some theoretical aspects of predator/prey population dynamics, including numerical and functional responses and prey switching. The lectures will discuss various models, form simple predator/prey systems to more complex models with multiple predator and prey species interacting. Prey switching theory will be discussed with examples from small mammal research. Models will be applied to moose/caribou systems with wolves and bears interacting as predators.

The third lecture will attempt to bring together the theoretical models for testing the factors that are limiting large mammal populations. Aspects of deductive research techniques will be discussed, including predator removals, spatial and temporal 'controls', and follow-up research. Adaptive management principles will be discussed as a way of maximizing how much can be learned by experimenting with large mammal populations.

Each lecture will be from 45 minutes to one hour, with one hour of questions and answers.

Agenda:

8:30 a.m. - 10:30 a.m.

Speaker: Francois Messier
University of Saskatchewan

Topic: Theoretical Models of Predator/Prey Dynamics - from the simple to the complex.

10:30 a.m. - 11:00 a.m. - Break

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Workshop on Predator/prey Dynamics continued.....

11:00 a.m. - 1:00 p.m.

Speaker: Stan Boutin
University of Alberta

Topic: Prey Switching and the Implications to Large Mammals

1:00 p.m. - 2:00 p.m. - Lunch

3:00 p.m. - 5:00 p.m.

Speaker: Tony Sinclair
University of British Columbia

Topic: Designing Experiments for Studying Large Mammal Systems

October 4th, 1992

Topic: Experimental Study Design for Aishihik Ungulate Recovery

Due to time constraints, only those individuals directly involved with Aishihik will be invited to participate in this workshop. The following is a list of individuals: R. Farnell, B. Gilroy, D. Larsen, R. Ward, B. Hayes, A. Baer, J. Carey, Champagne-Aishihik, Kluane National Park and the three speakers. I have asked R. Florkiewicz to attend to advise on habitat concerns. Species biologist will give short presentations of the data presently collected in the area, followed by discussions of data deficiencies. These presentations will be followed by open discussions on the conditions to consider wolf control described in the Wolf Conservation and Management Plan, and how Aishihik conditions apply to the Plan. Following this we will focus on the scientific study design for Aishihik caribou recovery. Meeting schedule is 9:00 a.m. to 4:00 p.m.

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