# A RESEARCH PLAN FOR SPATSIZI PLATEAU WILDERNESS PARK AND GLADYS LAKE ECOLOGICAL RESERVE

A PROPOSAL TO PROVIDE INFORMATION TO ASSIST AND GUIDE PARK AND RESERVE MANAGEMENT

also part 4
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# SYNOPSIS

The purpose of this innovative proposal is to present a research program that will guide and assist management of the Spatsizi Plateau Wilderness Park and the Gladys Lake Ecological Reserve. It represents the joint efforts of university and provincial government biologists. The proposal is problem-oriented as it addresses issues faced by those managing the Park.

The goals of the research are: (1) to obtain an understanding of the functioning of this northern ecosystem to ensure its maintenance as a wilderness landscape in which natural communities are preserved intact and the progressions of the natural systems may proceed without alteration; and (2) to provide information that contributes to the management of human usage so that it does not result in the degeneration of the ecosystem.

Eight high priority research projects are considered necessary in order to provide information on problems related to recreational use (consumptive and non-consumptive), industrial use, and the various aspects of the park and ecological reserve boundaries.

These eight projects on the large animal complex, are expected to last at least five years. They will require changes in the hunting regulations. At all times, some hunting will be permitted in the Park, but not on all species all the time. The hunting will be controlled, such that it will become an integral part of the experimental manipulations.

It is expected that in the initial five year research program, the average cost of a project will be $16,721 per year, making a total for all projects over all years of around $750,000. Support is expected from the Provincial Government, Federal Government, National Research Council and the Spatsizi Association.

The proposed research, not only will assist in the management of the Park and Ecological Reserve, but will undoubtedly aid management of wildlife species for much of the northern part of the province.

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# I. INTRODUCTION

The purpose of this proposal is to present a research program that will guide and assist management of the Spatsizi Plateau Wilderness Park and the Gladys Lake Ecological Reserve. It represents the joint efforts of university and provincial government biologists. The proposal is problem-oriented as it addresses issues faced by those managing the Park. However, the proposed studies will undoubtedly aid management of wildlife species for much of the northern part of the province, too.

The Spatsizi Plateau Wilderness Park was created in November 1975. Its establishment represented the realization of conservationists' goal for over 20 years. The purpose of the Park was to retain high quality wildlife habitat and preserve impressive alpine scenery. Simultaneously, the Gladys Lake Ecological Reserve was created. Lying wholly within the Park, it was designated primarily to afford protection to the area and to permit long term study of Stone sheep and mountain goat in an undisturbed environment.

These two special use areas are about 330 km NNW of Smithers or approximately 1,000 km NNW of Vancouver. The Park covers 6,750 $km^2$ and the Reserve is 33 $km^2$: their total area is 6,783 $km^2$. The Park is the second largest in the province while the Reserve is the largest, almost three times the size of the next biggest one.

Since their creation, both the Park and the Ecoreserve have been the subject of often heated discussion and concern. The apparent issues were related to Park management philosophy and to Park and Reserve boundaries. A problem analysis contained in this proposal reveals however, that many problems face these newborn areas. The difficulties are centered around recreational uses, industrial uses and boundaries.

Like most natural resource management problems, the Spatsizi one has several aspects, and therefore it demands several steps for satisfactory solution. These steps involve the public, the administrators, the managers and the researchers. In this brief, the role that research can play is described.

The research program is outlined generally at first with respect to major objectives, target species, scheduling of projects and their estimated cost and duration. Project proposals are appended for those who wish further details. It is important to realize that the proposed research must be integrated with other aspects of Park and Reserve management in order to yield maximum benefits to management.

## II. BACKGROUND STUDIES

Earliest recorded data on wildlife are to be found in reports of land surveyors such as G.M. Dawson, S. Black and P.M. Monckton, but these are only as a brief observation in passing. The prospector and the big game hunter were the next visitors to use the upper Stikine from Telegraph Creek. Few records are found for this era of exploitation. A.E. Vincellette recorded a 42 day hunt into Spatsizi in 1916 from Telegraph Creek (Vincellette 1976), and M.C. Turton in his book "Cassiar" (1934) describes hunting trips into the Spatsizi Park area in the early 1900's. R. Hyland had a trading post on the lower Spatsizi River, catering to the Indian villages at Metsantan and Caribou Hide. T. Walker established himself as a resident guide in the area in 1948 (see Walker (1976) for an account of his involvement with Spatsizi). In the 1950's, visits to the area by museum staff resulted in the first scientific results to be documented, and the first push for continuing research under the quality control of U.B.C. (Szczawinski 1959). Public pressure surfaced briefly in the intervening years (e.g. Walker 1960), but it was not until 1975 that it again appeared in full bloom and resulted in the creation of the Park and the Reserve.

Wildlife species have received greatest scientific interest to date. Studies began in 1961 with detailed research on Stone sheep behaviour at Gladys Lake (Geist 1966, 1971). The first aerial survey by provincial government biologists followed shortly after in 1962 by F. Hartman. However, it is only recently that the area has been surveyed with any degree of completeness. Records of these flights are on file at Fish and Wildlife Branch offices in Smithers and Victoria, with a summary report currently in preparation (Hazelwood, Macgregor, pers. comm.). These surveys concerned the large mammal species (Stone sheep, mountain goat, caribou, moose, grizzly bear, wolf and mule deer). Carswell

(1975) presented results of a 1974 comprehensive wildlife inventory that included both birds and mammals. It and a detailed companion report on vegetation by Pojar (1976) were confined primarily to the ecological reserve and the immediate area to it.

Other aspects of the Park ecosystem have also been studied. Botanical research began with Szczawinski's (1959) reconnaissance survey of the Coldfish Lake area. Welsh and Rigby (1971) described physiography and botany of the area, also at a reconnaissance level. The thorough study by Pojar (1976) provides the fullest and best treatment of vegetation and plant-animal relationships for the Ecoreserve and adjacent areas in the Park. Geological and physiographical information is provided by Eisbucker (1974), Holland (1964), and Welsh and Rigby (1971). Recreational potential of the Stikine River has been evaluated in 1976 by Parks Canada (Anon, 1976): the headwaters of this River are included in the Park.

## III. RESEARCH AIMS

Research aims are derived from and consistent with those proposed for the Park in the Order-in-Council 3756 that established the Park. Thus the goals of research in the Park are:

1. To obtain an understanding of the functioning of this northern ecosystem to ensure its maintenance as a wilderness landscape in which natural communities are preserved intact and the progressions of the natural systems may proceed without alteration.

2. To provide information that contributed to the management of human usage so that it does not result in the degeneration of the ecosystem.

We note that the goals as stated in the Order-in-Council are in conflict.

## IV. PROBLEM ANALYSIS

In order to set up specific research objectives, the problems related to the management of the area must be identified first. They are outlined under three distinct headings as follows:

A. Recreation Use Problems
B. Industrial Use Problems
C. Boundary Problems

These are expanded below:

### A. Recreation Use Problems

These may be divided into consumptive uses and non-consumptive uses.

1. Consumptive Uses. The problem here is associated with removal of resources through activities such as (a) hunting; (b) fishing; (c) trapping; (d) cutting of firewood. The need is to determine the limits of removal consistent with park aims and objectives. At the present time the greatest concern is for the effects of hunting on the large mammal species, i.e. caribou, moose, wolf, Stone sheep, mountain goat, and bears (both black and grizzly). It is recognized that these species interact within the ecosystem and a coordinated study approach is likely to be the most productive way to handle this problem.

2. Non-consumptive Uses. The problems here are associated with placement of facilities and specific activities in critical areas. Six main areas of concern are recognized, namely (a) park facility siting; (b) river touring; (c) horse pack riding; (d) hiking; (e) mountaineering; (f) nature study and photography.

IV. B. Industrial Use Problems

Present information indicates that the park boundaries are not sufficient to provide adequate protection to some of the major species of park animals, e.g. caribou, wolves, grizzly bear, etc. Therefore, industrial uses both within and outside of the park are of concern.

The industrial uses in order of present impact are (1) transportation; (2) forestry; (3) mining; (4) hydroelectric projects; (5) telecommunications.

1. Transportation. This presents two major problems which can be posed in the following way.

   (a) What is the impact of the facility on the plant and animal communities?
   (b) What is the impact of transportation on the levels of human use? The need here is to manage access in order to limit detrimental effects.

   The two transport systems of immediate concern are the B.C. Railway and aircraft.

2. Forestry. It is necessary to determine the impact of forestry development (including access) on critical habitats used by park animals. Of special significance is the Stikine River valley north of the present boundary, because this is used by caribou and moose in winter.

3. Mining. The Order-in-Council establishing the park, states that if in the future it is deemed essential to provide for a mining access corridor, then this might go through the southeast part of the park. The problem here is concerned with the question of the essential nature of such a route and the determination of which of the alternative access routes would be least disruptive.

IV. B. 4. Hydroelectric Development. B.C. Hydro is examining the feasibility of constructing a dam 58 miles upstream of Telegraph Creek on the Stikine River. This places it not far outside of the northwest corner of the park. Fully flooded the water will reach an estimated elevation of 2,600 ft. a.m.s.l. Consequently, the Stikine valley will be flooded immediately north of the park and in the area used by the caribou, moose and wolf in winter. This flooding may affect the use of the areas by these animals, and act as a barrier preventing them crossing the River in their regular migration.

5. Telecommunications. Potential sites are present within the park boundary. Their development will concern immediate site access and its development.

C. Boundary Problems

1. Outer Boundary of Park. Existing park boundaries present two major problems. First, the caribou, moose and wolf in the park have critical needs for habitat that is presently outside or cut by the existing boundaries. The critical areas are:

(a) winter range along the Stikine River, north of the Park,
(b) caribou summer range at the south end of Fire Flats,
(c) caribou rutting and winter ranges in the Brothers Lake and Mt. Edozadelly area.

Second, important recreation areas lie partly outside the boundaries. Their comprehensive protection and management is therefore difficult to plan and implement. The areas in question are:

(d) the upper Duti River,
(e) the recreational corridor along the Stikine River,
(f) the land lying between the Park's western boundary and the BCR right-of-way or Klappan River.

IV. C. 1.

These two boundary problems can be resolved in several ways. One way is to extend the present boundaries to include the above-mentioned area. Alternatively, items (b), (c) and (d) could be incorporated into Tatlatui Park with the remainder going into Spatsizi.

2. Ecological Reserve Boundary. The boundaries of the Reserve probably do not properly protect the home ranges of the enclosed Stone sheep and mountain goat. Additionally, heights of land are more difficult to distinguish than water courses for hunters and other recreationists on the ground. Therefore the present boundaries should be extended to correct these problems. Drainage boundaries should be incorporated south of Mt. Will and on the west in the headwaters of Tsetia Creek and Eaglenest Creek. Also, an important caribou-sheep maternity area and mineral licks in Cullivan Creek area should be included in the Reserve by extending the present boundaries north westward.

## V. RESEARCH PRIORITIES

The problem analysis clearly indicates a number of high priority items, that is problems requiring immediate research or management action. These are indicated as an "A" priority in the tabulation below.

V. Uses

| Uses | Priority of Problem A | B | C |
|---|---|---|---|
| A. Recreation Use | | | |
| 1. Consumptive Use | | | |
| (a) Hunting | X | | |
| (b) Fishing | | X | |
| (c) Trapping | | | X |
| (d) Firewood Cutting | | | X |
| 2. Non-consumptive Use | | | |
| (a) Park Facility Siting | X | | |
| (b) River Touring | X | | |
| (c) Horse Pack Riding | | X | |
| (d) Hiking | | | X |
| (e) Mountaineering | | | X |
| (f) Nature Study and Photography | | | X |
| B. Industrial Use | | | |
| 1. Transportation | X | | |
| 2. Forestry | X | | |
| 3. Mining | | X | |
| 4. Hydroelectric | X | | |
| 5. Telecommunications | | | X |
| C. Boundary Problems | | | |
| 1. Outer Boundary of Park | X | | |
| 2. Ecological Reserve Boundary | X | | |

The high priority "A" problems are all related to the constellation of large mammals species. By studying this complex, information on virtually all of the immediate problems will be forthcoming.

VI. RESEARCH PLAN

The immediate research on the large animal complex, has the following list of objectives in order or priority.

1. To document present distribution, movements, and habitat utilization.

2. To describe the existing populations in terms of size, fertility, recruitment and mortality, with particular reference to predation.

VI. 3. To determine harvest limits by experimental manipulation of the large mammal complex.

4. To monitor inter-relationships between large herbivores and the plant communities (the range study).

5. To undertake biophysical monitoring for integration with the above, weather being a vital component.

The following tabulation presents an estimate of the timing and sequencing of this research. Number entries refer to the numbering in the list above.

| | Year | | | | |
|---|---|---|---|---|---|
| Animal | 1977 | 1978 | 1979 | 1980 | 1981 |
| Caribou | 1,2 | 2,($3^a$) | $3^a$ | $3^a$ | $3^a$ |
| Moose | 1,2 | 2,($3^b$) | $3^b$ | $3^b$ | $3^b$ |
| Wolf | 1,$3^a$ | 1,$3^a$ | 1,$3^a$ | 1,$3^a$ | 1,$3^b$ |
| Stone sheep | 1 | 1,2,$3^c$ | 2,$3^c$ | $3^c$ | $3^c$ |
| Mountain goat | 1 | 1,2,$3^c$ | 2,$3^c$ | $3^c$ | $3^c$ |
| Bear | | | 1 | 1,2 | 1,2 |
| Range | 4 | 4 | 4 | 4 | 4 |
| Weather | 5 | 5 | 5 | 5 | 5 |

Key to experimentation:

$3^a$ = no hunting permitted
$3^b$ = hunting permitted
$3^c$ = no hunting in some populations, hunting permitted in others

VI. The individual high priority, short term projects may be listed as:

1. Distribution, movements, habitat utilization and population dynamics of caribou and moose (Appendix A).

2. Population ecology of the wolf, and its impact on the ungulate populations (Appendix B).

3. Detailed movements, habitat and feeding preferences of caribou (Appendix C).

4. Variation in fertility of moose and caribou in relation to changes in density and environment (Appendix D).

5. Distribution, movements and population dynamics of Stone sheep (Appendix E).

6. Distribution, movements and population dynamics of Mountain goat (Appendix F).

7. Biophysical monitoring, including use of LANDSAT imagery (Appendix G).

8. Range conditions and impact of herbivores (Appendix H).

For each of these eight projects (Appendix A-H), the following have been considered in the detailed project proposals:

1. Objective
2. Rationale
3. Methods
4. Duration
5. Estimated Costs
6. Benefits

## VII. RESEARCH SITE AND LOGISTICS

The main practical problems with studies in the Spatsizi Area are (1) the only access is by air, and (2) there are no laboratory facilities. Little can be done about access, but permanent accommodation and laboratory facilities must be organized as a pre-requisite to any of the detailed studies.

The best place to site a research centre is Hyland Post. This is at a lower elevation than other areas and therefore is less subject to low cloud preventing air access. It has a land runway, and float planes can use a stretch of the Spatsizi River about 7 miles upstream. However, Hyland Post may not be available since it is already leased. Acquiring the lease or property is being investigated. This has been accepted as the immediate aim of the Spatsizi Association.

An alternative site is at McEwen Airstrip which is outside of the park to the west, and has road and rail access. The Parks Branch might also be able to provide some assistance in connection with a possible site for a Park Ranger centre. The Cold Fish Lake establishment is a potential site, but it has many disadvantages, particularly bad weather owing to its high elevation.

A research centre is essential for many of the research projects: it must provide accommodation and laboratory facilities. Once established it will require some maintenance and year round supervision. A back country ranger position in the Parks Branch might be appropriate for this purpose.

## VIII. BUDGET

The following tabulation presents the yearly budgets for the eight high priority research projects: more details are contained in Appendix A-H.

VIII.

| | Year | | | | | |
|---|---|---|---|---|---|---|
| | 1977 | 1978 | 1979 | 1980 | 1981 | Project Total |
| Project 1 A. | $10,000 | | | | | A. $ 10,000 |
| B. | 27,400 | $ 25,600 | $ 25,600 | $ 25,600 | $ 25,600 | B. 129,800 |
| Project 2 | - | 45,300 | 35,800 | 35,800 | 35,800 | 152,700 |
| Project 3 | - | 32,600 | 26,600 | 26,600 | 26,600 | 112,400 |
| Project 4 | - | 13,250 | 13,250 | 11,500 | 11,500 | 49,500 |
| Project 5 | 19,180 | 19,480 | 7,480 | 2,000 | 2,000 | 50,140 |
| Project 6 | 18,180 | 19,980 | 7,980 | 2,000 | 2,000 | 50,140 |
| Project 7 | 13,000 | 4,500 | 4,500 | 4,500 | 4,500 | 31,000 |
| Project 8 | - | 35,800 | 15,800 | 15,800 | 15,800 | 83,200 |
| Projects Yearly Total | 87,760 | 196,510 | 137,010 | 123,800 | 123,800 | 668,880 |
| Research station maintenance and supervision | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 | 75,000 |

Grand Total $743,880[1,2]

Footnotes:

[1] All totals include salaries of Postdoctoral Fellows, graduate students and/or field assistants.

[2] Totals do not include inflation factors.

The average project budget is $16,721 per year. This is very reasonable considering the difficulties of research in northern environments. Totalled for the five years, the average project is $83,605. The total budget for the complete research plan is $743,880. Salaries and transport by air constitute the major items of expense.

## IX. FUNDING

It is anticipated that research funding will be obtained from four principal sources:

1. Provincial Government
2. Federal Government
3. National Research Council grants to University Faculty, and scholarships to students.
4. Spatsizi Association.

At the present time, neither Provincial nor Federal sources have been explored in detail. National Research Council grants to University Faculty are known in general terms and partial funding is already available for Projects 1 and 4: Parks Branch funding for part A. of Project 1 is also expected. The Spatsizi Association has undertaken to raise funds in order to procure the lease of a research site, hopefully at Hyland Post.

## X. RESEARCH ADVISORY PANEL

While it is expected that ultimately the research will come under the jurisdiction of the Provincial Park Branch, it is suggested that a Research Advisory Panel be established immediately by the Minister. This should be composed of those that have been involved in the preparation of this research proposal and who will be involved in the actual research suggested. Members should be drawn from both University and Government.

We suggest that the following seven biologists would constitute an ideal Research Advisory Panel:

D.S. Eastman, Fish and Wildlife Branch
G. Hazelwood, Parks Branch
D. Hatler, Fish and Wildlife Branch
J. Pojar, Ecological Reserve Unit, Land Management Branch
R.M.F.S. Sadlier, Department of Biological Sciences, Simon Fraser University
G.G.E. Scudder, Department of Zoology, University of British Columbia
A.R.E. Sinclair, Department of Zoology and Institute of Animal Resource Ecology, University of British Columbia

PROJECT 1: DISTRIBUTION, MOVEMENTS, HABITAT UTILIZATION AND POPULATION DYNAMICS OF CARIBOU AND MOOSE.

1. Objectives

This study is to be divided into two stages.

A. An initial description of the caribou population lasting one year.

B. Long-term monitoring of both the caribou and moose populations.

A. This study is to be concerned with obtaining an initial data base on the demography of the caribou population. Aspects to be covered are:

1. Age-structure and its change within the year
2. Sex structure
3. Proportion of non-antlered females
4. Timing of the birth and rut seasons
5. Assessment of hunting kill

B. This study is to be concerned with the yearly monitoring of the caribou and moose populations. Aspects covered will be:

1. Age structure, fertility and mortality rates
2. Sex structure changes
3. Timing of birth and rut seasons
4. Causes of mortality e.g. undernutrition, disease, predation and hunting. Relative importance of these and whether their impact changes.

5. Gross distribution and movement patterns in different seasons and from year to year.

6. Habitat preferences

## 2. Rationale

The purpose of dividing the study into an initial short phase and a second long term phase is to allow a detailed initial description by A.T. Bergerud and A.R.E. Sinclair. Initial observations by both government and University personnel show an October 1976 recruitment in the Caribou of only 7% and a male:female adult sex ratio of 1:4. These figures indicate an unbalanced and potentially unstable population resulting from the combination of predation and hunting. The initial phase should document this situation as closely as possible. Experience gained during this first period will lay the foundation for the less intensive yearly monitoring in the second phase. This foundation is necessary so that comparisons can be made with it in the following years when the hunting has been removed, to see what kind of population response is taking place. Two questions are being asked;

i) what proportion of the population of caribou can be hunted in the Spatsizi when wolf predation is also taking place and while ensuring an adequate degree of resilience against climatic fluctuation?

ii) what is the carrying capacity of the vegetation for caribou and how stable is the caribou-vegetation interaction?

These questions can only be answered by altering the hunting of caribou and observing the population response. The hunting can be increased or decreased. The former would be inappropriate from a conservation standpoint, so the latter approach is adopted here. At the same time hunting of wolves should not proceed, but hunting of moose should be continued at the same intensity as in previous years. This will allow an evaluation of the wolf response to changes in caribou population, without confounding effects from changes in moose population. This response will provide information on the combined effects of hunting and predation. The information is, of course, relevant to all hunted populations, not just the Spatsizi caribou. Finally, as the caribou population increases, we should obtain information on the way in which nutrition and disease affects the population, and the way in which the population affects the vegetation.

## 3. Methods

A. Description of the demographic characteristics of the caribou population will have to be carried out initially from ground counts of animals classified into different age and sex classes. If possible this should include pregnant versus non-pregnant females in May before the calving begins. Following birth, a series of classified samples should be obtained to track the rate of calf mortality. At this time of year the animals are extremely scattered and travel will have to be by

helicopter. Failing this, aerial observations from light aircraft will have to suffice.

It is important to obtain a reliable estimate of the proportion of non-antlered females in the population, through ground counts during the rut. At this period the timing and other features of the rut should be described. Again helicopter transport would be preferable.

Finally we should obtain an accurate estimate of hunting mortality through careful monitoring of both resident and non-resident hunters.

B. Methods of aerial demographic monitoring should be developed by checking with the results of the ground counts, during the first year of study. Aerial photographic techniques have now reached a stage where it should be possible to obtain estimates of calf, female and male proportions in the population of caribou. These techniques will then be used in future years for monitoring. For moose, counts by eye will probably suffice.

Systematic aerial survey using transects will provide information on distribution, gross movements of the population and habitat preferences. These surveys should be conducted at different seasons in order to assess whether wintering, calving and rutting areas remain the same or not from year to year.

Causes of mortality must be assessed by co-ordination with other projects. Thus information on carcasses will come from the studies on wolves, from the telemetry studies on caribou,

and studies on fertility. Autopsy of carcasses for estimation of body condition should be carried out where possible.

To observe the effect of hunting on caribou, this activity should cease for this species after the first stage which lasts one year. By that time the basic distribution of the population and its annual movements through systematic aerial survey will have been recorded for two years and therefore would be sufficiently well documented to initiate the experiment.

In subsequent years the critical information will be concerned with the rate of change in population parameters such as fertility, mortality and hence population size. Equally important is the information on the degree to which wolf predation on the moose may also be changing, close monitoring of the same aspects of this species is also needed.

As is already taking place the aerial surveys can occur without a base in the Spatsizi, but for the ground work in Stage A and B, some sort of local base is necessary.

4. Duration

Stage A should be carried out jointly by A.T. Bergerud and A.R.E. Sinclair. A.T. Bergerud will cover all the above mentioned topics in a contract with the Provincial Parks, lasting 6 months in 1977. Copies of the basic demographic data (including sample sizes) will be supplied to both the Provincial Parks and A.R.E. Sinclair, by the end of 1977. These data should include a) the proportion of permanently non-antlered females, b) the proportion

portion of pregnant females in May 1977, c) the proportion new-born calves surviving in the first few months, d) the adult sex ratio, e) any other relevant information, such as position of densities to help start the wolf project, causes of mortality, etc. A.R.E. Sinclair or R. Boonstra will accompany A.T. Bergerud to learn identification techniques. At the same time they will continue to improve the aerial photographic sampling by comparing with the ground information supplied by A.T. Bergerud.

Stage B carried out by A.R.E. Sinclair, should also commence in 1977, following on from similar studies in 1976. It will also incorporate techniques developed in stage A, when that has finished. The monitoring of the no-hunting experiment should last initially for 5 years, so together with the prior period of stage A, the duration would be at least 6 years, 1977-1982.

5. Costs

Stage A. A.T. Bergerud. (Parks Branch contract)

| | |
|---|---|
| Equipment and supplies | $ 1,500 |
| Aerial survey: fixed wing and helicopter | 4,500 |
| Horse hire and guides | 4,000 |
| TOTAL | $10,000 |

Stage B a) Capital

Capital expenses excluding the setting up of laboratory facilities (which will not be considered here) should be minimal since the photographic equipment has already been obtained.

Field Equipment (tent, special clothing, etc.) $1,800

b) Recurrent

Systematic aerial survey in a Cessna 185 at $120/hr. Each survey takes 15 hours plus 4 hours ferry time, fuel caching and accomodation. Total = $2,9000/survey.

| | |
|---|---|
| ∴ Total 1 year | =$17,400 |
| Miscellaneous (autopsy, nutrition work, etc.) | = $1,000 |
| Summer Assistant. 4 months @ $800/month | = $3,200 |
| Hire of horses | = $4,000 |
| Total for Stage B | =$25,600/yr. |

6. Benefits

i) In the long term this experimental study will allow an assessment of the impact of hunting on an ungulate population when predation is also occurring.

ii) It will also provide information on how a population responds as it approaches "carrying capacity" of the vegetation.

iii) At the same time it allows one to assess how the vegetation responds, and how the predators respond. Because experiments have never been done on this scale, little is known at present about these aspects, particularly in northern climates.

iv) It will provide information on whether the Caribou live in one or several distinct herds, information necessary for allocation of hunting quotas and other management needs.

v) The information on distribution during winter, calving and rutting and movements in between will allow assessment of boundary needs for protection.

PROJECT 2: POPULATION ECOLOGY OF THE WOLF AND ITS IMPACT ON THE UNGULATE POPULATIONS.

1. Objectives - There are two major objectives in this study:

A. To study the population ecology of the wolf.

Aspects to be covered within selected study areas are:

1. Distribution, density, territory or home range size and movements.
2. Den sites and rendezvous sites.
3. Population size, birth rate and mortality.
4. Feeding habits. How important is each ungulate species in the wolf's diet?

B. To study the impact of the wolves on the ungulate populations as the latter change with the manipulation of hunting.

Specific aspects should include:

1. The monitoring of the rate of predation on the calves of the various ungulate species.
2. An attempt to describe a "functional response curve" - that is the curve of proportion killed against prey density.

2. Rationale.

The wolf study is probably central to the joint programming, for it is the affect of the wolf on its prey populations that is of interest in the context of the affects of hunting. Therefore the affects of wolf predation need to be measured on both hunted and non-hunted populations of caribou, moose,

sheep and goat.

The initial information on the wolf must cover its basic ecology, including distribution, density, range and movements. Focal points where wolves can be easily studied, such as dens and rendezvous sites, need to be documented. In order to determine how important each of the prey species is for the wolf, its diet should be documented. For example it is unknown how important the goat is in the wolf's diet. This information is needed to determine future research time-tables for the goat.

With the initiation of the no-hunting experiment on caribou, close monitoring of the population dynamics of the wolf is needed. Does this population increase and if so how fast, when the Caribou increase? Thus pack sizes, birth rate and mortality should be assessed.

Monitoring should also continue on the predation rate of the various prey species to see whether wolves switch their attention from one species to another as a result of the hunting manipulation. Eventually it may be possible to describe the relationship between the proportion of prey killed and prey density. This information would be valuable for making management predictions of harvest by hunters.

3. Methods

Clearly all wolf packs in the park cannot be studied in great detail. A study area should be set up to include a significant area of the caribou range, and if possible re-main reasonably close to the base, at Hyland Post. Possible

sites could include the wolves in the Stikine valley east of Hyland Post, to include Blueberry and Tobias mountain. Alternatively an area west of Hyland Post including the Spatsizi Plateau might provide information useful to the Ecological Reserve.

The most valuable method of finding the wolves is through the use of radio telemetry. Radios should be put on animals at the first opportunity. Recent studies in North-Eastern Minnesota were successful in using these methods to obtain the same type of information required here. Capture was through leg-hold traps, but they should be carefully and humanely placed. The help of an experienced trapper for the initial stage may save a lot of wasted effort. Once the collars are attached, data collection becomes reasonably straightforward.

Aerial tracking will provide the information on distribution, movements and location of den and rendezvous sites. Depending on the availability of aircraft (Supercub PA-18) four intensive periods of tracking could be considered, with flights every three or four days. In between these, ground observations, if feasible, could be carried out. It is essential that these flights be closely co-ordinated with the Caribou tracking flights to make the most efficient use of flying time and funding. The researchers on these two projects should be compatible so that a co-ordinated programme is carried out.

Observations at den sites when breeding is taking place

should provide information on birth rates and early cub survival. In winter direct analysis of kill remains, while in summer collection of scats from den sites should indicate the extent to which different prey species make up the diet.

4. Duration

The study will require a scientist residing in the area for a large part of the time. Consequently it should start as soon as living accomodation and laboratory facilities become available. Duration should last as long as the Caribou-Moose monitoring. I suggest that it should be divided into two periods of 3 years. This provides an opportunity of a research worker to appraise progress in the first 3 years, and so determine the course of the work in the next period. It would also allow a changeover of personnel if necessary. Dr. R. Boonstra of U.B.C. may be a suitable researcher for the first period.

5. Costs

A) Capital

| | |
|---|---|
| Telemetry | $3000 |
| Two snowmobiles | $4000 |
| Field Equipment (2 people) | $1500 |
| Other Equipment (weighing machines, autopsy, traps etc.) | $1000 |
| | $9500 |

B) Recurrent

| | |
|---|---|
| Salary Research Worker (Postdoctoral Fellow) | $12000 |
| Full time field assistant at $800/month | $ 9600 |
| Flying Expenses (half cost of combined Wolf-Caribou tracking Study) | $ 5000 |
| Maintenance of Snowmobiles and other equipment | $ 2000 |
| Air transport to and from area | $ 1600 |
| Supplementary living expenses in the field @ $50/week for 32 weeks | $ 1600 |
| Hire of horses - 4 horses at $10/day | $ 4000 |
| Total excluding Scientists Salary | $23,800/yr. |
| Total including Scientists Salary | $35,800/yr. |

6. Benefits

This should provide information on:

i. the status of the wolf population

ii. the degree of protection the present park boundaries provide for this species.

iii. the effects of predation on each prey species

iv. the way in which the wolves switch prey species with changes in their abundance as a result of the cessation of hunting. It should be possible from this to predict how hunting rates on prey affect the wolf population and also the prey population. These predictions are necessary for the management of hunting.

# APPENDIX C

## PROJECT 3: DETAILED MOVEMENTS, AND HABITAT AND FEEDING PREFERENCES OF CARIBOU.

### 1. Objective

This study is to be concerned with the detailed movements of individual caribou. Movements are to be described in relation to changes in habitat, food availability, predation and climate.

### 2. Rationale

This study concentrates on the fine scale details of the caribou responses to changes in its environment. It is complimentary to the monitoring programme which observes the overall responses of the population. Because this detailed approach requires researchers to be constantly in the field to keep track of the animals it is regarded as a separate study. However the study will rely on information from the climatic monitoring programme, as well as information from the studies on wolves, particularly those concerned with wolf movements, and also those on vegetation use. Consequently the study is regarded as an integrated part of a co-ordinated long-term plan.

### 3. Methods

The most important technique for use in this study is radio-telemetry. Visual markers such as collars will be inappropriate in a population that spreads out over such

a wide area. The chances of seeing a collared animal are minimal except during the rut. For example in May 1976, fifteen flying hours resulted in only about 50 animals being observed, so the chances of one of these being marked are small indeed. The use of radio transmitters and aerial tracking will allow an average range of about 10 miles (greater on hill tops, less in the valleys) and tracking then becomes feasible. A light aircraft such as a Supercub must be available at least every few days when tracking is in operation. Tracking could be carried out in periods of a few weeks at a time, with the periods spread through the seasons.

Observations should include the number and type of associated individuals, habitat, behaviour and weather amongst others. The technique of aerial tracking is suitable for a number of different species, including wolves, so that all transmitters could be located on one flight by a pilot alone, or the pilot and one biologist. Therefore this study and the one on wolves should be very closely co-ordinated.

At intervals ground tracking of the marked animals should be attempted to observe feeding preferences. This would require ground transport, probably horses or snow-mobiles depending on season. However it is recognized that ground transport presents a serious problem and the efficacy of the above methods is still in doubt.

4. Duration.

The study should start as soon as permanent living facilities are available in the region of the Spatsizi, and when an aircraft becomes available. This study is not feasible without aerial observation. Duration should be for two complete years, initially.

5. Costs

a) Capital

| | |
|---|---|
| Telemetry | $3000 |
| Snowmobile | 2000 |
| Drying ovens, weighing machines, other equipment | $1000 |
| Total | $6000 |

b) Recurrent (per year)

Flying costs are the major item. Assuming four 6-week periods in the field per year, and a flight every four days as a minimum frequency, with 2 hours each flight, then a minimum of 80 hours will be spent each year. Taking in ferry time and additional flights it will be closer to 100 hours. At $100 per hour,

| | |
|---|---|
| Flying expenses (½ cost of combined wolf-caribou tracking study) | $5000 |
| Salary (graduate student) | 9600 |
| Telemetry equipment | 1000 |
| Miscellaneous (maintenance of snowmobile etc.) | 1000 |

| | |
|---|---|
| Air Transport to and from area 5 times/yr. | $ 1,600 |
| Supplementary living expenses in the field @ $50/week for 24 weeks | $ 1,200 |
| Summer Assistant 4 months at $800/month | $ 3,200 |
| Hire of horses | $ 4,000 |
| Total | $26,600 |

6. Benefits

This study will provide information on;

(i) whether there is a consistent pattern to the annual movements of caribou.

(ii) Secondly it should show whether there is more than one wintering area, and rutting area.

(iii) Thirdly it will provide information on the individuals responses to climate, habitat and food.

These data are necessary for any decisions concerning protection of the caribou, such as for future boundaries of reserves, protection of critical habitats, and hunting regulations.

# APPENDIX D

PROJECT 4: VARIATION IN FERTILITY OF MOOSE AND CARIBOU IN RELATION TO CHANGES IN DENSITY AND ENVIRONMENT.

## 1. OBJECTIVE

To determine annual differences in female fertility rates of moose and caribou to relation to (a) changes in population density and (b) variations in winter conditions from year to year, with special emphasis on the immediate post-partum age-classes.

## 2. RATIONALE

Variations in cow-calf ratios indicate to wildlife managers variations in population productivity. However, under severe climatic influences on conditions of heavy range use due to high population density, it is difficult to determine whether the changes in such ratios are due to environmental factors operating before, during, or after parturition. By study of pregnancy rates in conjunction with the monitoring of other population parameters one can assess at what stage the environmental stress occurs.

## 3. METHODS

Pregnancy rates of females will be determined between January and March by evaluating hormone levels in blood taken from tranquilized animals. It will be necessary to confirm the state of pregnancy during the first two years of study by sacrificing a proportion of the animals from which blood is collected in order to inspect the ovaries. Alternatively, this confirmation may be achieved by visits to captive animals in Alberta.

In addition the blood will be analyzed for comparative indicators of metabolic condition (free fatty acids, serum proteins, albumin/globulin ratios etc.) to study variations in nutritional state.

4. DURATION

This study should last the same length of time as the caribou-moose monitoring study. An initial stage of 5 years is proposed starting in 1978. The principle worker will be Dr. Richard Sadlier of Simon Fraser University.

5. COSTS

(a) Capital will be minimal since most equipment is already present in the laboratories.

(b) Recurrent

| | |
|---|---|
| Salary Field Assistant 4 months @ $800/month | $ 3,200 |
| Laboratory Assistant 1 month @ $800/month | 800 |
| Access Air fares (2 people) | 1,000 |
| Capture 10 moose, 10 Caribou by helicopter using 15 hours @ $350/hour (first 2 years then 10 hours) | 5,250 |
| Travel to sources of captive animals | 2,000 |
| Miscellaneous equipment (consumable supplies) | 1,000 |
| Total | $13,250 |

6. BENEFITS

(a) The study will indicate how population fertility changes in response to hunting pressure.

(b) It will provide a method to monitor fertility in live animals, both moose and caribou.

(c) The determination of pregnancy rates assists in an understanding of population processes by indicating more exactly the timing of environmental stresses.

# APPENDIX E

## PROJECT 5: DISTRIBUTION, MOVEMENTS AND POPULATION DYNAMICS OF STONE SHEEP

### 1. OBJECTIVES

(a) To determine changes in the population dynamics of previously hunted Stone sheep when protected from hunting.
(b) To describe changes in the seasonal use of habitats of previously hunted Stone sheep when protected from hunting.
(c) To evaluate the adequacy of the present boundaries of the Gladys Lake Ecological Reserve for protecting Stone sheep.

### 2. RATIONALE

The Gladys Lake Ecological Reserve is the only area in the province where base-line information on population dynamics, range use and behaviour of Stone sheep is adequate (Geist 1966, 1971). These sheep have been hunted for at least 25 years, but heaviest pressure has likely occurred during the past decade. (Luckhurst (1973) studied Stone sheep ecology in northeastern B.C.) Several observers report that the current herd is less than it was in 1962. Thus there is a possibility that loss of mature rams has led to loss of range tradition in the sense proposed by Geist. Also, it is possible that disturbance by hunting on wintering ranges has caused rams to desert some of these traditional habitats (Geist 1971: 77-78). Hunting ended when the Ecological Reserve was established in November 1975. Thus an excellent and unique opportunity exists to test the loss of tradition hypothesis, as well as document recovery of populations once subjected to hunting but now protected. As this type of work requires marked animals, the movements of sheep in relation to the present Ecological Reserve boundary can be assessed, too.

The response of the protected herd requires a "control" (i.e. a hunted herd) in order to separate non-hunting effects from effects due to other factors. While the comparative herd need not be studied in as great detail as the Ecological Reserve group, it will at least require monitoring.

The following hypotheses are proposed for testing in this project. They are directed mainly at rams and their winter habitats.

(a) Winter habitats known to have been used previously (e.g. as recorded by Geist in 1961 and 1962), will remain unused by class III rams and older.
(b) Any use of these areas will be by class II or younger males.
(c) Habitats used by Ewe-lamb groups will show no change from that recorded previously by Geist.

## 3. RATIONALE

(a) Ranges to be studied as described in range project e.g. mapping, description, productivity and utilization. This information will establish suitability of unoccupied ranges by their comparison with currently used ranges.
(b) Population responses through aerial and ground classified counts at appropriate times in the annual cycle. Minimal amount would be a survey during rut for herd structure, pre-winter ratio, survival to yearling stage, rut habitat.
(c) Testing tradition hypothesis and herd identification requires marked animals (paint, collars or radio transmitters, depending upon funding).
(d) Biophysical monitoring requires at least one climate station for winter weather (also snow survey transects). Vegetation monitoring as part of range project.

## 4. DURATION

Initial intensive work will take two-three years; followed by routine extensive, field surveys for the following 5-10 years. Intensity of extensive surveys depends upon funding, but should exclude at least one winter (rut) survey.

5. COSTS

(a) Capital
Telemetry $ 3,000

(b) Recurrent

| | 1977 | 1978 | 1979 |
|---|---|---|---|
| 1 Graduate Student @ $1000/month | $ 4,000(4) | $ 8,000(8) | $ 4,000(4) |
| 1 Field Assistant @ $ 800/month | 3,200(4) | 3,200(4) | |
| Support: $200/man month | 1,600 | 2,400 | 800 |
| Aerial Surveys: | | | |
| Fixed wing (2x2hx$120) | 480 | 480 | 480 |
| Helicopter (3x2hx$350) | 3,900 | 3,900 | 700 |
| Marking costs | 2,000 | 500 | 500 |
| Other equipment and material | 1,000 | 1,000 | 1,000 |
| Estimated annual cost | $16,180 | $19,480 | $ 7,480 |

Estimated annual cost for continuing extensive monitoring $2,000 per year

Notes: Estimates depend greatly upon integration with other research. For this study, costs could be reduced with respect to aircraft rental, field assistants and support. The estimates for helicopter costs assume use when available in the area.

6. BENEFITS

(a) Evaluation of existing Ecological Reserve boundaries with suggestions for their revision, if needed.
(b) Assessment of the resiliency of Stone sheep to hunting, i.e. can hunted herds return to unhunted levels and if so, in what time period.
(c) Assessment of whether Stone sheep can successfully re-colonize previously utilized habitat.

# APPENDIX F

## PROJECT 6: DISTRIBUTION, MOVEMENTS AND POPULATION DYNAMICS OF MOUNTAIN GOAT

### 1. OBJECTIVES

To build on the base line information acquired by Walker and Geist particularly with regard to population dynamics, behaviour and movements of goat in a formerly hunted population.

### 2. RATIONALE

There is no other area in the northern half of the province with base line data on numbers, behaviour and movements of the species. These data were gathered by Geist in the early 1960's while the area was under low hunting pressure. Since then, the hunting pressure increased, but stopped in 1976, providing a chance to study a recovering population. Natural mortality would be closely studied.

A study of Stone sheep in the same area at the same time would be complimentary to a goat study.

### 3. METHODS

A research cabin near Gladys Lake to be available as a base. Study would concentrate on observational techniques augmented by marking select animals either with color or a transmitter. Unused mineral licks and caves would be sought as evidence of either a shifting population or one that was once higher. This evidence of historical use of the reserve by goat would be supplemented by range studies to indicate the presence of either unused or overused goat range. Data would be gathered on the proximate and ultimate factors causing mortalities in these unhunted populations.

A good goat area near the reserve would be studied at the same time in order to better understand the effects of hunting on the movements and population dynamics of goat.

4. DURATION

To begin as soon as funds are available and to continue for at least three years.

5. COSTS

(a) Capital
Telemetry $ 3,000

(b) Recurrent

| | 1977 | 1978 | 1979 |
|---|---|---|---|
| 1 Graduate Student @ $1000/month | $ 4,000(4) | $ 8,000(8) | $ 4,000(4) |
| 1 Field Assistant @ $ 800/month | 3,200(4) | 3,200(4) | - |
| Support: $200/man month | 1,600 | 2,400 | 800 |
| Aerial Surveys: | | | |
| Fixed wing (2x2hx$120) | 480 | 480 | 480 |
| Helicopter (3x2hx$350) | 3,900 | 3,900 | 700 |
| Telemetry maintenance | 1,000 | 1,000 | 1,000 |
| Other equipment and materials | 1,000 | 1,000 | 1,000 |
| Total | $15,180 | $19,980 | $ 7,980 |

Estimated annual cost for continuing extensive monitoring $2,000 per year.

Note: Project makes use of helicopters while they are in the area.

6. BENEFITS

This study should indicate how to better manage hunted populations of goat, in particular, what is the natural increment in a hunted and non-hunted population and what should be the annual allowable harvest. Basic information gathered on goat ethology and ecology could have wide spread interest and application.

# APPENDIX G

## PROJECT 7: BIOPHYSICAL MONITORING INCLUDING USE OF LANDSAT IMAGERY

### 1. OBJECTIVES

(a) To provide basic information on climate over the park in general and in certain study areas for the use of other projects.
(b) Through the use of LANDSAT imagery to provide information on habitats and the changing pattern of climatic features such as snow cover.
(c) To produce a soils/landform map similar to those prepared by the E.L.U.C. Secretariat.

### 2. RATIONALE

Basic information on the weather is required by most of the projects. To avoid duplication and to ensure long term consistency it is proposed that a system of measuring stations be set up and read at regular intervals. This information would be available for all workers in the area.

### 3. METHODS

It is already apparent that there are gradients in rainfall and snow precipitation across the park. A system of storage rain gauges and snow depth posts should be established over the whole park to provide information on these gradients. In specific sites (such as study areas) more complete weather stations should be established to provide information on such variables as temperature, wind speed, and snow hardness. Reading of these stations will have to be done by air so that sitings of gauges should be near lakes. Snow posts may be read without the plane landing so these could be more widespread.

4. DURATION

Climatic information is so basic to all the studies that it should begin as soon as possible, preferably in 1977. It should continue for the length of the monitoring programme.

5. COSTS

| | | |
|---|---|---|
| (a) Capital | | |
| Meteorological equipment | | $5,000 |
| Installation by helicopter | | $3,500 |
| | Total | $8,500 |
| (b) Recurrent | | |
| Monthly survey and recording | | $4,500 |

6. BENEFITS

(a) Provision of weather information for the other studies.

(b) Development of vegetation and soils maps.

# APPENDIX H

## PROJECT 8: RANGE CONDITIONS AND THE IMPACT OF HERBIVORES

### 1. OBJECTIVES

This study should monitor the impact of the herbivores upon their food supplies.

### 2. RATIONALE

Relatively little is known about the dynamics of the interaction between a herbivore and its food supply. The limitation of hunting on caribou will allow an analysis of how the population responds as it increases and uses up its food supplies. At the same time it allows observations on how the food plant community changes in response to this increased feeding pressure, and in particular, whether an equilibrium between herbivore and food can be achieved in the presence of predation. Similar studies can be carried out on the sheep and goat populations by making comparisons between hunted and non-hunted populations.

### 3. METHODS

Description and mapping of the major plant communities using aerial photographs. Clusters of exclosure plots will be set up in the winter habitats of (a) caribou and moose and (b) Stone sheep and goat. Some plots will be permanent to observe long term changes in vegetation resulting from exclusing of grazing. Other plots will be relocated each year to observe annual production of food and offtake by the herbivores.

The important habitats for the herbivores where the exclosure plots will be sited, should be determined (in cooperation with the studies on the herbivores) by measurements of habitat use and food selection.

Construction of the exclosure plots will be the major difficulty in the study, for materials (posts, wire mesh, barbed wire) will have to be brought in by helicopter. After construction of the premanent plots a detailed botanical description of each should be carried out. Size of plot will vary from 20 x 50 m to 5 x 5 m depending upon the herbivore being excluded.

The nutritive value of the forage through the seasons and from year to year.

4. DURATION

Monitoring of the range should start when the hunting manipulation takes place. For caribou and moose this should be in 1978, and this probably applies to the sheep and goat studies as well. Since this study is relatively inexpensive after the plots have been established, monitoring should continue for as long as the herbivore population sutides. Initially this should be for 5 years.

5. COSTS

(a) Capital - One set of plots can be used for a combined caribou-moose study, another set for a sheep-goat study. Estimates have been based on three clusters of 3 plots, each plot being 20 x 50 m (more plots could be obtained by reducing their size).

| | |
|---|---|
| Material for caribou-moose habitat plots | $ 5,000 |
| sheep -goat habitat plots | 5,000 |
| Helicopter lift of materials @ $350/hour | 10,000 |
| Total | $20,000 |

(b) Recurrent

| | |
|---|---|
| Salary for Graduate Student 6 mo. @ $800/mo. | $ 4,800 |
| Field Assistant 6 mo. @ $800/mo. | 4,800 |
| Field expenses @ $50/week for 24 weeks | 1,200 |
| Hire of horses | 4,000 |
| Air transport to and from Spatsizi (2 persons) | 1,000 |
| Total | $15,800 |

## 6. BENEFITS

This study should provide information on the following questions:

(a) What is the carrying capacity of the habitat for each herbivore?
(b) Do the herbivores and the plant food reach a balance?
(c) What is the extent of change in the plant food (both in quantity and species composition) when the herbivores change in density?

Answers to these questions should allow an assessment of the nature of overgrazing, and allow decisions on management. Long-term successional trends and the role of fire in establishment and maintenance of range may become apparent.

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