BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK PROJECT

Tera Environmental Resource Analyst Ltd. - Hat Creek Project - Detailed Environmental Studies - Wildlife Report - Inventory - June 1978.

ENVIRONMENTAL IMPACT STATEMENT REFERENCE NUMBER: 18 a

B.C. HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES
LAND RESOURCES SUBGROUP

WILDLIFE REPORT

PREPARED BY:

THE TERA ENVIRONMENTAL RESOURCE
ANALYST LIMITED

JUNE 1978

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2.0 INTRODUCTION

The wildlife study was undertaken by The TERA Environmental Resource Analyst Limited as part of the Land Resources Subgroup Detailed Environmental Studies of the Hat Creek project. This report documents wildlife occurrence in the vicinity of the proposed Hat Creek coal mine and thermal generating plant and fulfills the requirements for the wildlife impact assessment of the Hat Creek Detailed Environmental Studies.

2.1 TERMS OF REFERENCE

The terms of reference for the inventory phase of the wildlife study are specified in a document issued August 1977 by British Columbia Hydro and Power Authority entitled "Proposed Hat Creek Development, Detailed Environmental Studies, Terms of Reference". These are as follows:

1. *Game Species*

In relation to major habitat types determine the seasonal distribution and numbers of big game animals, including the sheep herd in the area southeast of the Upper Hat Creek Valley.

2. *Waterfowl*

Determine the distribution and numbers of species of waterfowl in relation to nesting, feeding and staging. Provide an inventory of all suitable and potential waterfowl habitat including seasonal physical dimension, invertebrate organisms, bottom composition, edge vegetation and water quality.

3. *Other Avian Fauna*

Determine the major habitat types occupied by upland game birds, passerines, and raptors. Include information on migratory status, and

seasonal distribution and on numbers where readily available; an elaborate census is not required.

4. *Small Mammals*

Census small mammal and fur bearer populations for each major habitat type.

5. *Relate numbers and densities of above species to the regional and provincial resource of the same species.*

6. *Identify rare or endangered species.*

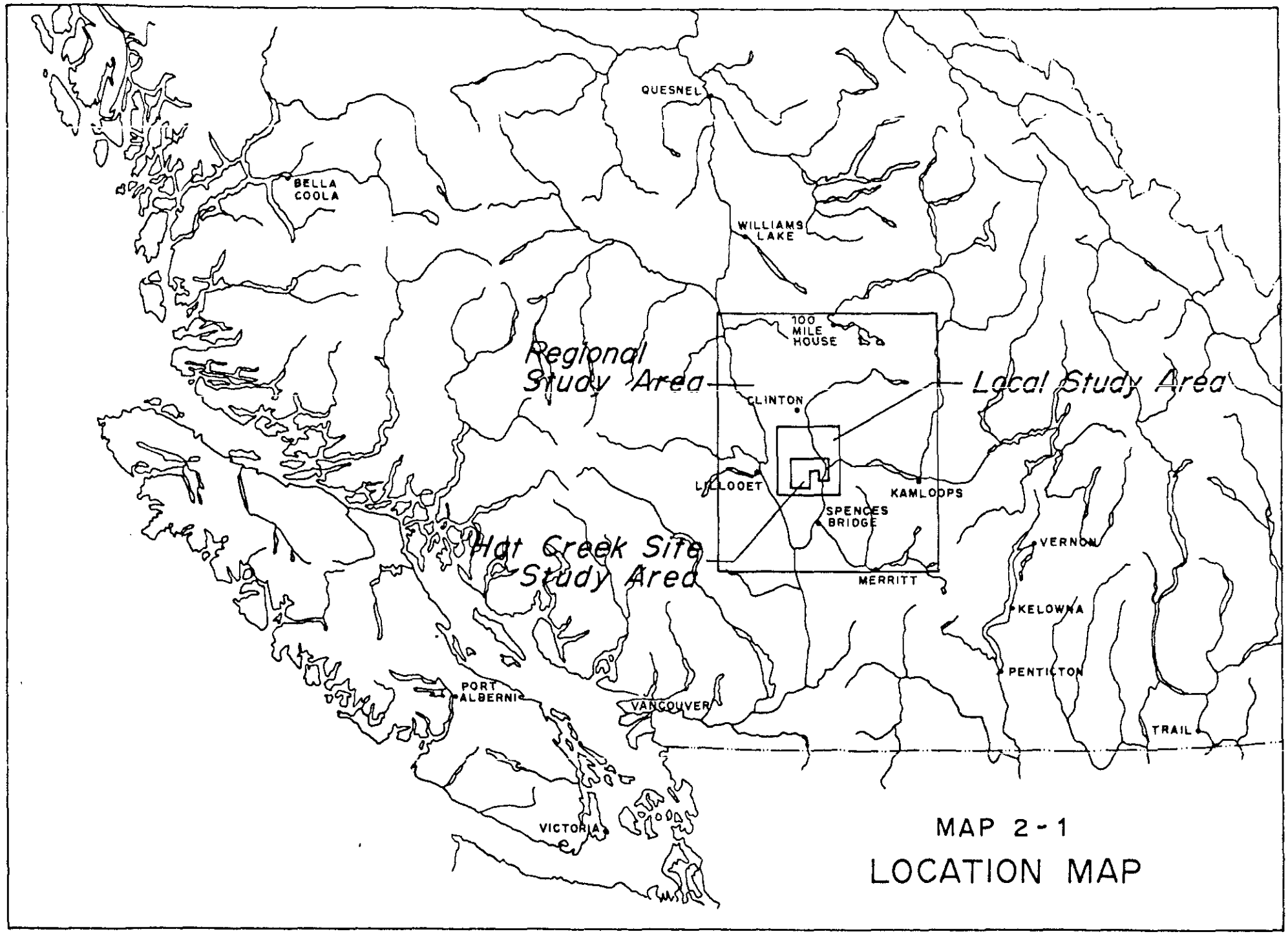
7. *Determine present and potential harvest and catch success of registered trap lines.*

2.2 SCOPE AND PURPOSE

The purpose of this study is to ascertain the present wildlife occurrence, abundance and diversity in the vicinity of the proposed Hat Creek coal mine and thermal generating plant. Where possible, the potential wildlife value of the region and the direct usage of wildlife by society are also assessed. In order to account for both broad general overviews and for detailed site-specific data, three study areas of differing scope have been used: regional, local and Hat Creek site.

The regional study area was defined by the terms of reference as being bounded on the north by 100 Mile House, on the west by the west end of Seton Lake, on the south by a point 13 km (eight miles) south of Lytton, and on the east by Kamloops Municipality. Mapping of regional study area information is usually presented at a scale of 1:250,000.

The local study area was defined by the availability of resource materials and is a rectangular region whose boundaries are located 18.9 km (11.7 mi.) north, 17.5 km (10.9 mi.) west, 22.4 km (13.9 mi.) south and 20.8 km (12.9 mi.)



MAP 2-1

LOCATION MAP

east of the proposed thermal plant location (Site B). Mapping of local study area information is presented at a scale of 1:50,000.

Any analysis more detailed or more specific than that of the local study area is termed as pertaining to the Hat Creek site. This includes the vicinity of the mine, thermal plant, and associated facilities. Mapping of this more detailed information is done at a scale of 1:24,000.

This report also includes information which has been gathered by government agencies and which cannot be reorganized into the above study areas. Such information is reported in its original format, and a map or suitable description is included. The relevance of this information to the various defined study areas varies, and is discussed in later sections of this report.

The Hat Creek watershed is a convenient and natural unit used to report some of the wildlife inventory and usage data and is divided into two zones: the Upper Hat Creek watershed (or valley) which consists of the area drained by Hat Creek upstream from a point adjacent to the intersection of the Hat Creek road and Highway 12, and the Lower Hat Creek watershed (or valley) which consists of the area drained by lower Hat Creek downstream from this point to the Bonaparte River. The Study Area Boundary Map (Map 2-1) shows the relationship of the various study areas to each other and to the plant and mine site.

2.3 ACKNOWLEDGEMENTS

We would like to thank the following people for their invaluable assistance and co-operation in assembling the pertinent information for this report.

For informative discussion of special aspects of the study and for releasing relevant information:

M. Clark — Ducks Unlimited, Kamloops

D. Demarchi	Resource Analysis Branch, Victoria
B. Gates	Environment and Land Use Committee Secretariat, Victoria
P. Holman	B.C. Fish and Wildlife Branch, Kamloops
S. MacDonald	B.C. Fish and Wildlife Branch, Kamloops
C. McIvor	B.C. Fish and Wildlife Branch, Lillooet
G.W. Smith	Resource Analysis Branch, Victoria
T. Sterling	Ducks Unlimited, Kamloops
L.W. Ward	B.C. Fish and Wildlife Branch, Merritt
C. Williams	B.C. Fish and Wildlife Branch, Clinton.

For the release of information:

S. Bertoli	B.C. Fish and Wildlife Branch, Kamloops
P. Haley	B.C. Fish and Wildlife Branch, Victoria
E. Hendricks	B.C. Fish and Wildlife Branch, Merritt
G. Kaiser	Canadian Wildlife Service, Delta
W. Monroe	B.C. Fish and Wildlife Branch, Victoria
B. Saunders	B.C. Fish and Wildlife Branch, Victoria

For discussions on special aspects of the study:

R.W. Campbell	B.C. Provincial Museum, Victoria
J. Hunka	Kamloops Naturalists Club, Kamloops
P.W. Martin	Past Regional Biologist, B.C. Fish and Wildlife Branch, Kamloops
J. Miller	B.C. Fish and Wildlife Branch, Lillooet
J. Pojar	Ecological Reserves Committee, Victoria
R.W. Ritcey	B.C. Fish and Wildlife Branch, Kamloops
H. Leuenberger	B.C. Fish and Wildlife Branch, Clinton
M. Sheppard	B.C. Provincial Museum, Victoria
E. Taylor	Canadian Wildlife Service, Delta.

To residents of Upper Hat Creek Valley for sharing their impressions of local wildlife:

Mr. and Mrs. Hillman
Dr. Hunter
E. Lehman
I. Lehman
P. Milner
G. Parke
D. Ridler

and to Dr. G.G.E. Scudder of the University of British Columbia for advice and help with the wetland sampling programme.

3.0 RESOURCE INVENTORY METHODOLOGY

3.1 STUDY PERSONNEL

David B. Hawes, Ph.D., was the project manager for wildlife, conducted field research, and analyzed results for all aspects of wildlife except big game.

Myrnal Hawes, Ph.D., conducted field research and analyzed results for all aspects of the study except big game.

Ron Erickson, M.Sc., was in charge of the big game aspect of this report.

3.2 MAJOR WILDLIFE HABITAT

Much of the wildlife data has been recorded and is reported according to the habitat in which the wildlife was observed. These wildlife habitats are classified primarily by the existing vegetation. Vegetation has been described and mapped in vegetation associations in terms of discrete associations of uniform vegetative composition which are theoretically associated with definite sets of environmental factors.

These described vegetation associations reflect the expected condition of the vegetation in a climax or near climax plant community. The vegetation associations and the existing vegetation are described in the Hat Creek Physical Habitat and Range Vegetation Report. Existing vegetation may differ from the nominate vegetation association, especially for disturbed sites and for seral stages following fire or logging. These differences appear mainly in terms of relative species abundances and not so much in terms of species occurrence.

The wildlife habitats are defined according to vegetation associations with the following two differences:

1) Two or more similar vegetation associations were often lumped into one wildlife unit.

2) Adjustments were made for habitats in which existing vegetation differed from the nominate or climax vegetation.

Definition of wildlife habitats primarily in terms of vegetative characteristics is both realistic and practical. Two advantages which result from this approach are:

1) Wildlife habitat units can easily be recognized in the field on the basis of floral and vegetative characteristics.

2) Sampling of wildlife occurrence and usage can be done on stratified basis, thus simplifying the collection, presentation, and interpretation of wildlife data and minimizing sampling bias.

3.3 REPTILES AND AMPHIBIANS

At the outset of the study, on verbal request from the coordinator and client, reptiles and amphibians were included in the wildlife section. The herpetofauna of the regional study area was investigated using three methods. First, literature describing the distribution of reptiles or amphibians was searched to determine a hypothetical list for the regional study area[01, 02, 03, 04]. Second, specimen records at the B.C. Provincial Museum were searched. Third, direct field observations were made in July 1976, September 1976, April 1977, and May 1977. At these times, and concomitant with other field activities, incidental observations of reptile and amphibian presence and approximate numbers were made in all habitats, especially wetlands, that were visited.

3.4 WATERFOWL

(a) Resource Inventory

Existing information regarding distribution and numbers of waterfowl in the Upper Hat Creek Valley comes mainly from investigations initiated by the B.C. Fish and Wildlife Branch and carried out by Ducks Unlimited and by the B.C. Fish and Wildlife Branch in Kamloops. Data are summarized in three reports[05, 06, 07]. Original Ducks Unlimited data from investigations in 1975 and 1976 were also obtained and are utilized in estimating waterfowl populations. Additional breeding waterfowl data were gathered as part of an overall breeding bird survey, July 3rd to 6th, 1976.

Waterfowl use the Hat Creek wetlands during spring and autumn migrations. During migration, a much greater number of waterfowl use the wetlands than during the breeding season, but each migrating duck would depend upon the local wetlands to a lesser extent than would a breeding duck. A total census of migrating waterfowl in Hat Creek was beyond the scope of this study. Instead, an index of waterfowl usage was gained by counting the total number of waterfowl present at one time during spring and autumn migrations. Waterfowl counts were taken from a helicopter on September 16, 1976 and on April 28, 1977. Spring migration at Hat Creek would be expected to occur approximately between March 1st and early May with peak numbers in the first and second weeks of April. A one-day spring migration waterfowl count was taken from a helicopter on April 28, 1978, slightly after the probable peak numbers in spring. Autumn migration is slightly more protracted, extending from the latter part of August until freeze-up in early to mid-November with peak numbers occurring from mid-September to mid-October. A one-day autumn migration waterfowl count was taken from a helicopter on September 16, 1977, well within the time of major waterfowl migration. Additional information regarding species presence and relative abundance was gained from incidental ground surveys in September 1976, and April and May 1977. Comparison of the Hat Creek site study area with other waterfowl habitat within the regional study area was done via impressions gained during a helicopter flight on April 23, 1977 and during a fixed wing flight on May 17, 1977.

(b) Wetland Inventory

In addition to counting waterfowl, an inventory and classification of waterfowl habitat was undertaken in the Hat Creek site study area. Air photo interpretation, verified by ground observations and Ducks Unlimited data were used to map, classify and count wetlands. Once this was done, the relative completeness of the breeding waterfowl survey was assessed, and the capability of habitat to support waterfowl was assessed with a much finer resolution than would have been otherwise possible.

The regional perspective was obtained from published land capability data (Canada Land Inventory information) and from discussions with Canadian Wildlife Service employee, Ernie Taylor, who was one of the biologists who prepared the Canada Land Inventory waterfowl capability maps for the Hat Creek region.

An attempt was made to classify wetlands according to the system proposed by Stewart and Kantrud[08], who define eight classes of wetlands based on habitat physiognomy, six sub-classes based on salinity, and four based on cover types. The total number of actual wetland classifications is considerably less than the 192 which are possible because some classes are associated with only one or two sub-classes or cover types.

Use of this classification system was not strictly possible from air photo interpretation. The following compromise system was derived:

1. (a) Wetlands that contained no open water were classified as temporary and include both ephemeral and temporary potholes (classes 1 and 2 of Stewart and Kantrud).

(b) Areas of undulating topography which contained many small ephemeral or temporary wetlands which could not be individually mapped were lumped and mapped as a separate category.

2. Wetlands that contained open central areas and which were dry, nearly dry, or algae-choked were classified as semi-permanent and correspond to

seasonal potholes and semi-permanent potholes (classes 3 and 4 of Stewart and Kantrud).

3. Tillage potholes (class 5) were either not present in the study area, or were not detected.

4. Permanent ponds and lakes (class 6) were easily identified and classified. Three sub-classes of permanent water bodies were detected:

(a) those with a fringe of emergent vegetation
(b) those lacking an emergent fringe
(c) those with an evident alkaline fringe.

5. Wetlands that were characterized by alkaline fringes and which were not permanent water bodies were classified as saline (class 7 of Stewart and Kantrud).

6. Wetlands having central areas dominated by alkaline bog vegetation were classified as bogs. This class corresponds to class 8 of Stewart and Kantrud.

7. Additionally, riparian zones were delineated and mapped.

Each wetland was mapped, counted, described, and categorized. Areas of wetlands and circumference of edge were estimated using an elliptical approximation method[09].

On May 18, 1977, 17 wetlands were sampled for physical parameters. These wetlands were chosen so as to represent the range of wetland types within the Upper Hat Creek Valley. Each wetland was visually inspected and specific impressions regarding appearance of vegetation, depth, water profile, and soils were recorded. The pH was measured using wide-range pH paper, and a water sample was taken. Invertebrate fauna were collected using a hand-held sieve, and types of invertebrates and their approximate abundances were recorded,

although no quantitative measurements were made.

On May 19, 1977, the specific conductivity of each of the water samples was measured using a Radiometer Conductivity Meter, Type CDM2. At this time pH was remeasured using a narrow-range pH paper.

3.5 UPLAND GAME BIRDS

Three primary sources of information were utilized concerning upland game birds. First, 1975 and 1976 kill statistics from the hunter check station in Cache Creek[10, 11] and returns from the 1973 and 1974 hunter surveys[12, 13] were reviewed. Second, impressions of B.C. Fish and Wildlife Branch conservation officers, C. McIvor and C. Williams, and longtime Hat Creek resident Ike Lehman were recorded. Third, a direct survey was undertaken.

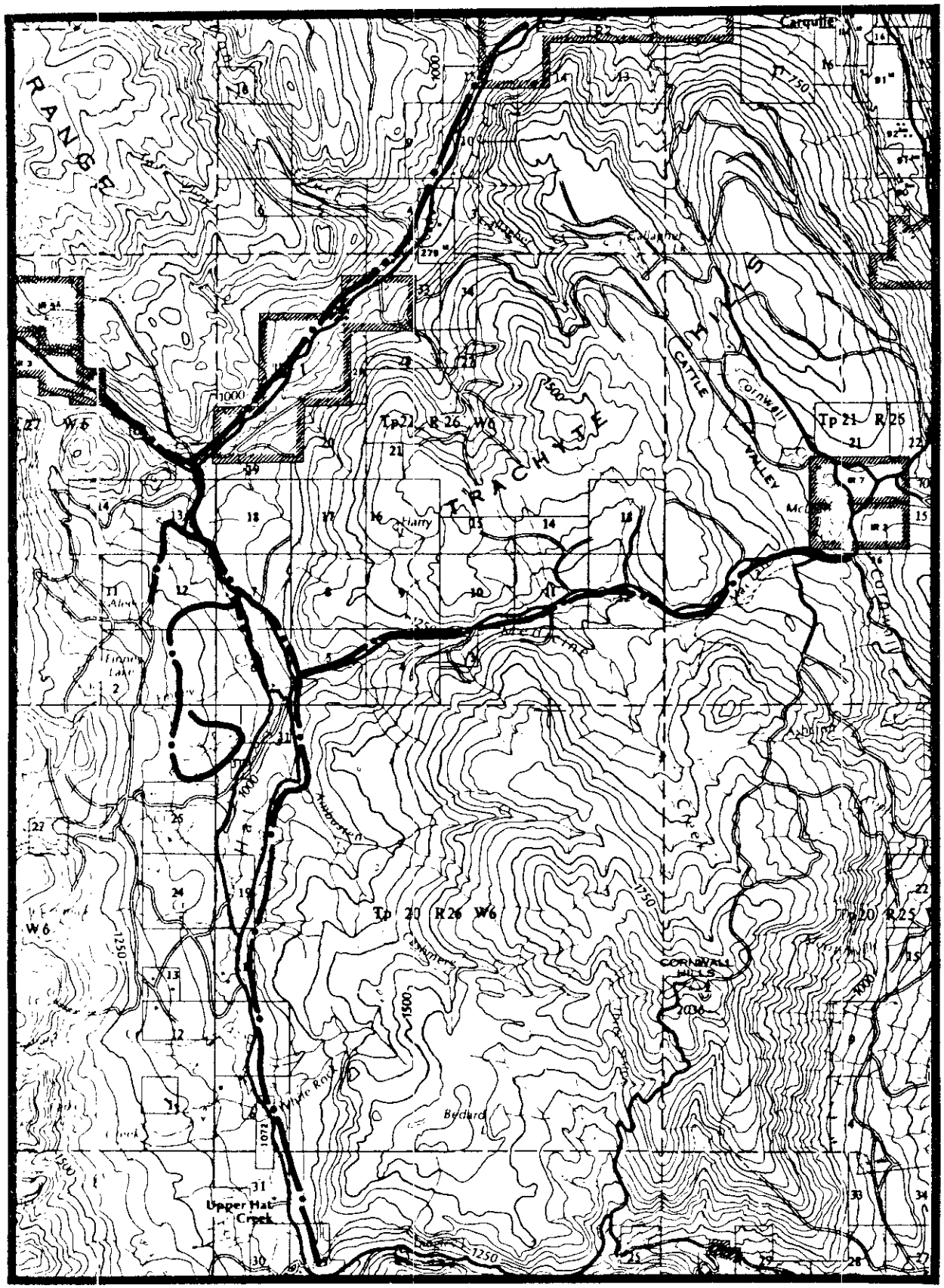
The survey was conducted on April 26 and 27, 1977 in the Upper Hat Creek and Medicine Creek valleys. At a total of 40 stations (10 each in four habitats: riparian, ponderosa pine - Douglas-fir/bunchgrass, open range, and Douglas-fir/pinegrass) the numbers and species of game birds seen or heard during a six-minute period were counted. Stations were separated by at least 0.8 km (0.5 miles).

3.6 BIRDS

Birds were studied by a number of methods. Distribution and seasonal status information was gathered from the literature[14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]. Sight records of birds in all of British Columbia are kept on file at the B.C. Provincial Museum in Victoria. This file was searched for records of species of special interest, such as rare or endangered species and raptors. Discussions were held with biologists familiar with Hat Creek (R.W. Campbell, M. Sheppard, and J. Pojar) and with local residents. Most information was derived from direct observations of avifauna; quantitative data were gathered from a breeding bird survey and an owl survey.

The breeding bird survey concept is most valid when used as an index of year-to-year changes in numbers of birds[23]. However, the breeding bird survey also provides a quantitative measurement of perceived avian presence and can be used for comparison of avifauna among locations. Official surveys are carried out in a specified manner. Beginning one-half hour before dawn, individual birds seen or heard within a three minute period are counted and identified to species. This procedure is repeated at one-half mile (0.8 km) intervals along the 25-mile (40 km) route[23]. The official procedure was modified for the Hat Creek study by counting and identifying birds at one-quarter mile (0.4 km) intervals and by recording observations by habitat. In this way, the avifauna could be compared among habitats. Three-minute counts of birds were taken at 20 stations in each of five habitats: open range (low and mid-elevation grassland), riparian, aspen, ponderosa pine - Douglas-fir/bunchgrass, and Douglas-fir/pinegrass. The rationale behind selecting these five is presented in the wildlife sampling effort section (4.1(c)). A map indicating the routes followed is included (Map 3-1).

The purpose of the owl survey was to establish whether or not owls were a major component of the local study area avifauna. None of the previous techniques employed would have revealed the presence of owls. Since owls, like hawks, are carnivores at the end of the food chain, they may be especially vulnerable to environmental changes. Rather than ignoring this component of the avifauna, we felt that it was best to gain some idea of the prevalence of owls in the local study area. In order to accomplish this, we surveyed owls in four habitats: open range, riparian, ponderosa pine - Douglas-fir/bunchgrass and Douglas-fir/pinegrass on April 27 and 28, 1977. Aspen habitat was not sampled because results of the breeding bird survey and of the small mammal census indicated that the wildlife in aspen habitat did not differ substantially from that of surrounding habitats. In each habitat, five 15-minute stops were made after dark. Ideally we should have played recordings of owl calls and listened for the responses of territorial owls. However, recordings could not be obtained in time, and Professor of Ornithology, Dr. N. Verbeek of Simon Fraser University advised us that owls would respond to nearly any



MAP 3-1

BREEDING BIRD SURVEY ROUTES

kind of noise after dark in April. We, therefore, merely listened for owls and imitated owl calls. Indeed, when owls were present, we found that they responded immediately and vigorously to our imitations.

3.7 SMALL MAMMALS

The census programme for small mammals was undertaken and completed in the period from September 2nd to September 28th, 1976. The basic approach involved the establishment of trapping areas of known size, wherein small mammals were captured, marked, released, and re-captured. On the basis of the re-capture data, estimates of population size for each species captured can be established using one of several possible methods[27].

Fifteen live-trapping plots (see Map 3-2) were established; three in each of the following five habitats:

(1) open range
(2) ponderosa pine - Douglas-fir/bunchgrass
(3) riparian
(4) aspen
(5) Douglas-fir/pinegrass.

A typical live-trapping plot consisted of Longworth traps[28] set 10 m (32.8 ft.) apart in seven rows of seven traps. In habitats that were long and narrow, a 7 x 7 grid would have extended out of the sampled habitat and into surrounding habitat. To remedy this undesirable situation, we used a grid of four rows of 12 traps on four of the 15 plots (three riparian plots and one aspen plot). Both configurations sample essentially the same area.

The traps were baited with oats and supplied with cotton batting for nesting material and were set for a total of five full days in each plot. Traps were checked each morning and the species, sex, reproductive condition and weight were recorded for each captured animal. Small mammals, e.g. mice and shrews, were individually marked by clipping one or two toes from the hind feet.

Larger mammals, e.g. chipmunks and weasels, were marked by clipping a bit of fur in a recognizable pattern. Mammals too large to enter the live-traps but observed on the plots, i.e. red squirrels and snowshoe hares, were also recorded and the number seen in each plot counted.

Counts of the total number of animals marked or observed in each live-trapping plot (minimum number known alive) were compared with a method of estimating population size (Lincoln Index). In no case was the estimated population size found to be more than one greater than the actual minimum number known alive. The minimum number known alive has been found to be the most reliable census technique for small mammals[29], so this estimate was used as an estimate of population size.

The estimation of actual population density from these data is not strictly possible unless other parameters, i.e. home range and trappability are known for each species. Home range affects the area effectively sampled by the grid system, while trappability determines the proportion of the population which is susceptible to being trapped. For example, two species could have the same actual population yet the estimated trappable populations could be quite different if one species had a large home range and high trappability and the other had a small home range and a low trappability. Density estimates given in Section 4.6 assume that home range and trappability are in inverse proportion to each other. Species with both high trappability and a large home range will have densities overestimated; those with low trappability plus a small home range will have densities underestimated.

In September 1976, four lines of 25 Museum Special snap traps were set for one night, two on Chipuin peak and two on Mt. Blustery. At each site, one line was set in subalpine krummholz and one was set in mature Engelmann spruce dominated forest near treeline. Traps were spaced approximately 10 m (32.8 ft.) apart and were baited with peanut butter.

3.8 FURBEARERS

Furbearer populations were not directly censused. Rather, harvest data from registered traplines and discussions with B.C. Fish and Wildlife biologists were utilized to estimate relative abundances of furbearing species. Returns from individual traplines for the 1971 - 72 to 1975 - 76 seasons were tallied for all registered traplines in the regional study area and within the jurisdictions of the Clinton, Kamloops and Lillooet based conservation offices (Map 3-3). The conservation officer in Merritt provided a five-year total for that portion of the study area within his jurisdiction. Trapping data were requested from the conservation officer at 100 Mile House, but were not received. Trapping done by status Indians is not recorded by the B.C. Fish and Wildlife Branch and is not included in this analysis.

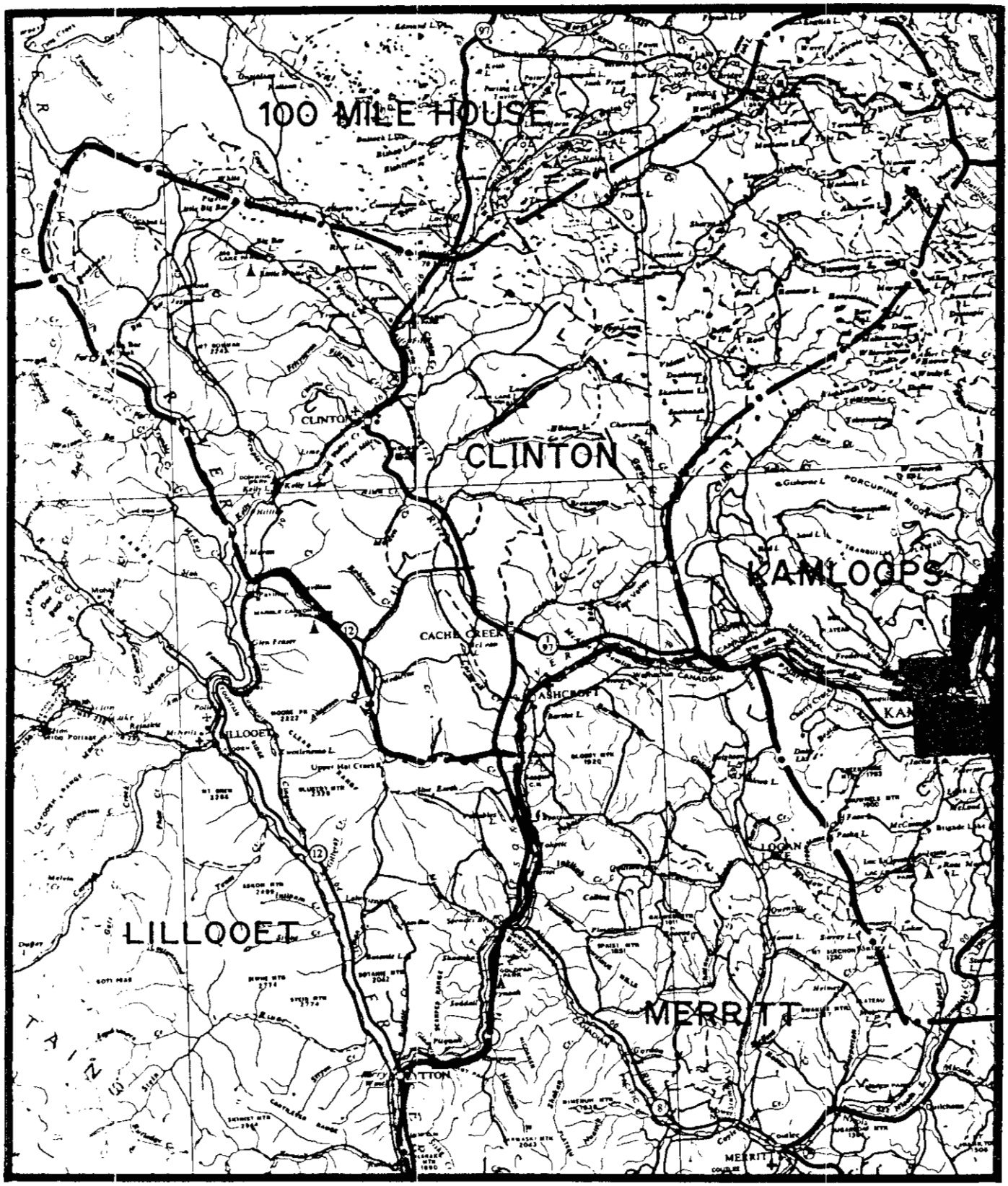
Discussions concerning actual furbearer harvests, habitat preference of furbearers and the capacity of the environment to sustain trapping activity were held with B.C. Fish and Wildlife Branch personnel at Lillooet and Clinton. Total furbearer harvest information for the province of B.C. was obtained from B. Saunders of the B.C. Fish and Wildlife Branch in Victoria.

Impressions gained from field investigations and from discussions with local residents were also used to interpret the furbearer data.

3.9 BIG GAME

The methodology originally proposed to satisfy the terms of reference consisted of the preparation of an impact assessment report based on available information, summer and winter range aerial surveys, and information exchange within the Land Resources Subgroup. As the study progressed, several uncontrollable factors arose which necessitated re-evaluation of data collection and processing.

A major component of the overall big game study was a helicopter winter survey scheduled for early 1977. Data generated from this survey were to relate



MAP 3-3

FURBEARER JURISDICTION AREAS
WITHIN REGIONAL STUDY AREA

ungulate winter concentrations to vegetation associations in the study area. In mid-January 1977, the winter survey was postponed because of the below average snow pack. By late February, snow accumulations had not increased and the winter survey was cancelled. In an attempt to fill the data gap, available study area information was collected and analyzed as thoroughly as possible. In March 1977, report production dates were extended and this provided the opportunity to generate additional data by establishing ungulate pellet group transects in the local study area.

The information required for each objective in the terms of reference was provided in the following manner. Background information on resident big game species was provided by a literature search. Every effort was made to collect the specific information available on wildlife species within the regional study area. The libraries at the University of British Columbia, B.C. Fish and Wildlife Branch in Victoria, and Provincial Museum Archives in Victoria provided the majority of the information. B.C. Fish and Wildlife Branch regional biologists, technicians and conservation officers in Kamloops, Clinton, Lillooet and Merritt provided considerable information on local big game winter and summer ranges and known migration routes.

Canada and British Columbia Land Inventory maps were consulted for ungulate capabilities in all study areas. Land areas of the individual categories and percentages of each class within the local study area were calculated. The above was supplemented by information retrieved from the files of the Resource Analysis Branch in Victoria. This material was in the form of field notes and 1:250,000 scale topographic maps containing winter aerial survey information on Ashcroft (flown 1970), Pemberton (1970 and 1971), Taseko Lakes (1971) and Bonaparte River (1971) mapsheets.

A reconnaissance field trip to the local study area was carried out between July 27 and August 3, 1976. The Hat Creek Valley, Pavilion and Kelly Lake areas were examined. A summer range aerial survey was carried out on September 17th of the known California bighorn sheep ranges on Marble and Shulaps

- Ranges, Yalakom Mountain and Slok Hill.

A pellet group transect survey was conducted during the week of May 16 to 20, 1977. Prior to going into the field, the vegetation map units as identified and described for the local study area (Hat Creek Physical Habitat and Range Vegetation Report) were reviewed for their potential as big game range. Plant species composition, elevation and aspect were the criteria considered. Nine units were selected as potential big game range. Two pellet group transects were established in each of the following: lodgepole pine, Douglas-fir/pinegrass, ponderosa pine - Douglas-fir/bunchgrass, sagebrush, alpine, mid elevation grassland, and low elevation grassland. Sites were selected so that transects within similar map units were separated by several kilometres (see Map 3-2 for transect locations). Only one transect was established in each of the riparian and bog units because of their limited extent.

Transect locations were chosen so that a 152 m (500 ft.) line could be measured within the selected map unit. Reinforcing rods, 1 cm in diameter by 1 m long, were driven into the ground at a point 3 m (10 ft.) in front of the first plot in each transect. A 30.5 m (100 ft.) tape was streched out to identify the transect centre line. To facilitate transect relocation, a 15 cm spike was driven into the ground at each 30 m (100 ft.) interval. Transect boundaries were delineated by measuring a 5 ft. interval on either side of a tape stretched along the transect centre line. The transect area, 152 m long and 3.0 m wide (456 m^2 (5000 sq. ft.)) was then searched for pellet groups and other signs of wildlife or domestic livestock activity. Pellet groups or portions thereof, observed within this 3 m (10 ft.) strip, were tallied and their locations were recorded on a schematic form of the transect (Figure 3-1). General wildlife observations were also recorded.

Recording pellet group locations in the above manner allows transect data to be analyzed on the basis of:

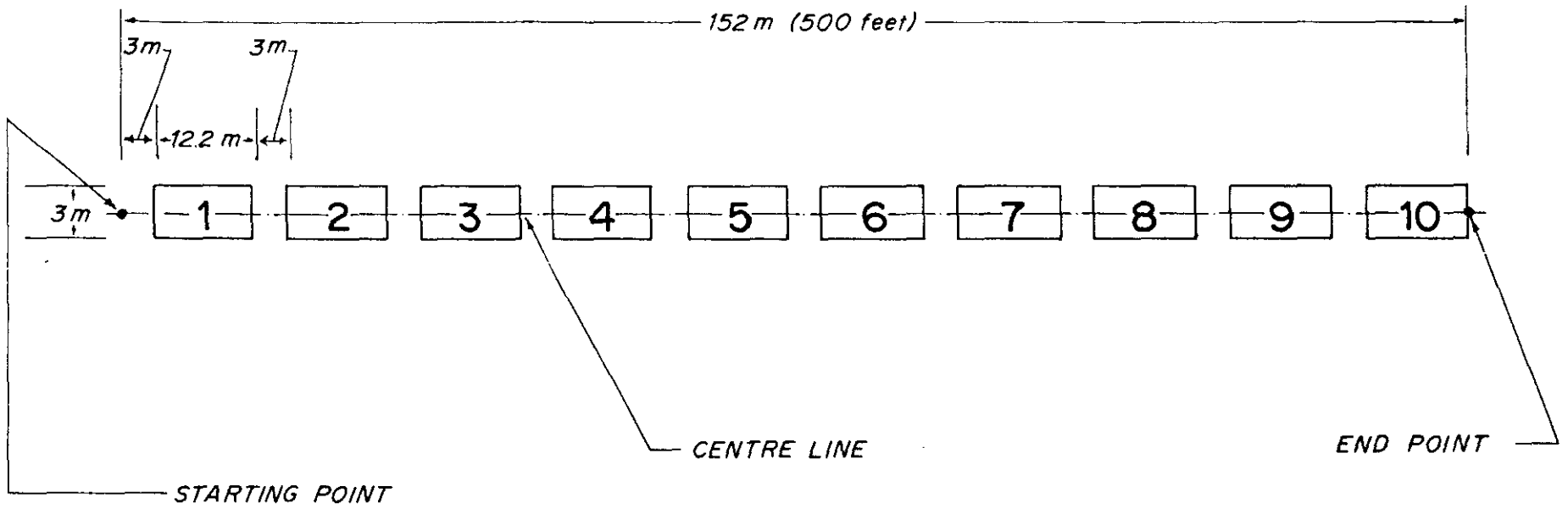


FIGURE 3-1

GENERAL PELLET GROUP TRANSECT LAY-OUT

(1) a single belt transect, or;
(2) ten plots within a single transect.

If the belt transect concept is used, each transect measures 3 m (10 ft.) by 152 m (500 ft.). If the 10-plot concept is used, each plot would measure 3 m (10 ft.) by 12.2 m (40 ft.) and would be separated from its neighbour by a 3 m (10 ft.) space. Both concepts were used to analyze collected data.

Deer defecate chiefly where they feed and seldom where they bed; whereas cattle chips are most concentrated at bedding grounds and shading places[30]. As a result of these practices the author concludes that the pellet group count is a reliable index to the intensity of deer use, but is much less reliable for cattle.

The number of ungulate pellet groups or chips per hectare (acre) of the ten vegetation units sampled were calculated using the following formula:

$$\frac{\text{Number of pellet groups or chips recorded per transect}}{\text{Transect area in hectares}}$$

Defecation rates (number of pellet groups deposited per day) of moose and deer were assumed to be 13 per day[31]. The mean defecation rate of cattle was assumed to be 11 chips per day[32].

The life span of pellet groups and cow chips is dependent on the amount and intensity of rainfall[33, 34] and the presence of certain fungi and insects[31].

In Utah, which has a climate generally similar to Hat Creek, Neff[31] reported that 96.5 percent, 93.1 percent, 93.1 percent, 65.5 percent and 24.1 percent of a sample of deer pellet groups were recognizable after one through five years field exposure, respectively. The life span of big game ungulate pellet groups in the Hat Creek area was assumed to be four years. This four year figure could result in over estimates of ungulate dats because

of the possibility that some pellet groups are more than five years old.

The longevity of cow chips was studied by Weeda[33] in New Zealand. The author reported that the largest number of chips disappeared in one or two months in autumn and four to six months in late spring and summer; although extremes ranged from half a month to 17 months. Hat Creek climate conditions are considerably more arid than the conditions under which the above experiments were conducted, therefore, the life span of cow chips in the Hat Creek area was assumed to be at least one year. The one year figure will likely result in overestimates in numbers of cow days of grazing because of the likelihood that some chips have lasted longer than one year.

Based on the above assumptions, the mean annual number of ungulate days of foraging provided by each 100 hectares (acres) of the ten vegetation units sampled were calculated using the following formula:

$$\frac{\text{Number of pellet groups or chips per hectare (acre)}}{\text{Defecation rate x Lifespan of pellet groups or chips}} \times 100$$

Animal observations and track abundance from British Columbia Land Inventory field maps and notes[35, 36, 37, 38, 39, 40], B.C. Hydro and Power Authority 1976 and 1978 aerial surveys[41, 78] and the B.C. Fish and Wildlife Branch 1975 ground survey[42] in the study area formed the basis of the available data on ungulate winter distribution. This information, in conjunction with the literature review, information solicited from local sources, B.C. Fish and Wildlife Branch Cache Creek hunter kill data[43], and the results of the pellet group survey provided the basis for the big game input into the biophysical classification system.

3.10 CONSUMPTIVE AND NON-CONSUMPTIVE USE

The term "game animals", as used in this report, refers to those species for which a hunter requires a license to hunt in British Columbia. This category is further broken into big game, game birds, and furbearing animals (see Appendix A). Animal species not included in the above categories are classified as non-game species.

Generally, wildlife resource use is considered under the headings of consumptive and non-consumptive. Consumptive use involves the removal of the animal from the environment and usually involves game animals. In the study area, these activities take the form of resident hunting, non-resident hunting, and trapping. Non-consumptive use involves obtaining some form of enjoyment through association with the animal without destroying it or removing it from its environment and involves both game and non-game species.

(a) Consumptive Use

The B.C. Fish and Wildlife Branch annually estimates hunting in the province from: a) the Hunter Sample data collected from questionnaire returns from a sample of resident hunters; b) returns filed by registered guide-outfitters; and c) the Cache Creek Check data collected from hunters passing through the check station at Cache Creek.

Prior to 1976, the B.C. Fish and Wildlife Branch managed wildlife within 28 Game Management Areas in the province. In 1975 and 1976, these areas were amalgamated into seven Regions which, in turn, were divided into Management Units. Data collected on the new system will provide much more specific information on the British Columbia wildlife resource and its use than was available in the past. Unfortunately for this study, only a small portion of the data collected on the Management Unit basis has been summarized to date by the B.C. Fish and Wildlife Branch.

(i) Consumptive Use, Waterfowl

Consumptive use of waterfowl has been estimated using three sources of

information: B.C. Fish and Wildlife Branch Hunter Survey questionnaire results 1973[12] and 1974[13], Cache Creek Check Station returns in 1975[10], and Canadian Wildlife Service species composition surveys in 1975[44] and 1976[45]. These sources of information differ in terms of the area covered and the way in which the data were collected.

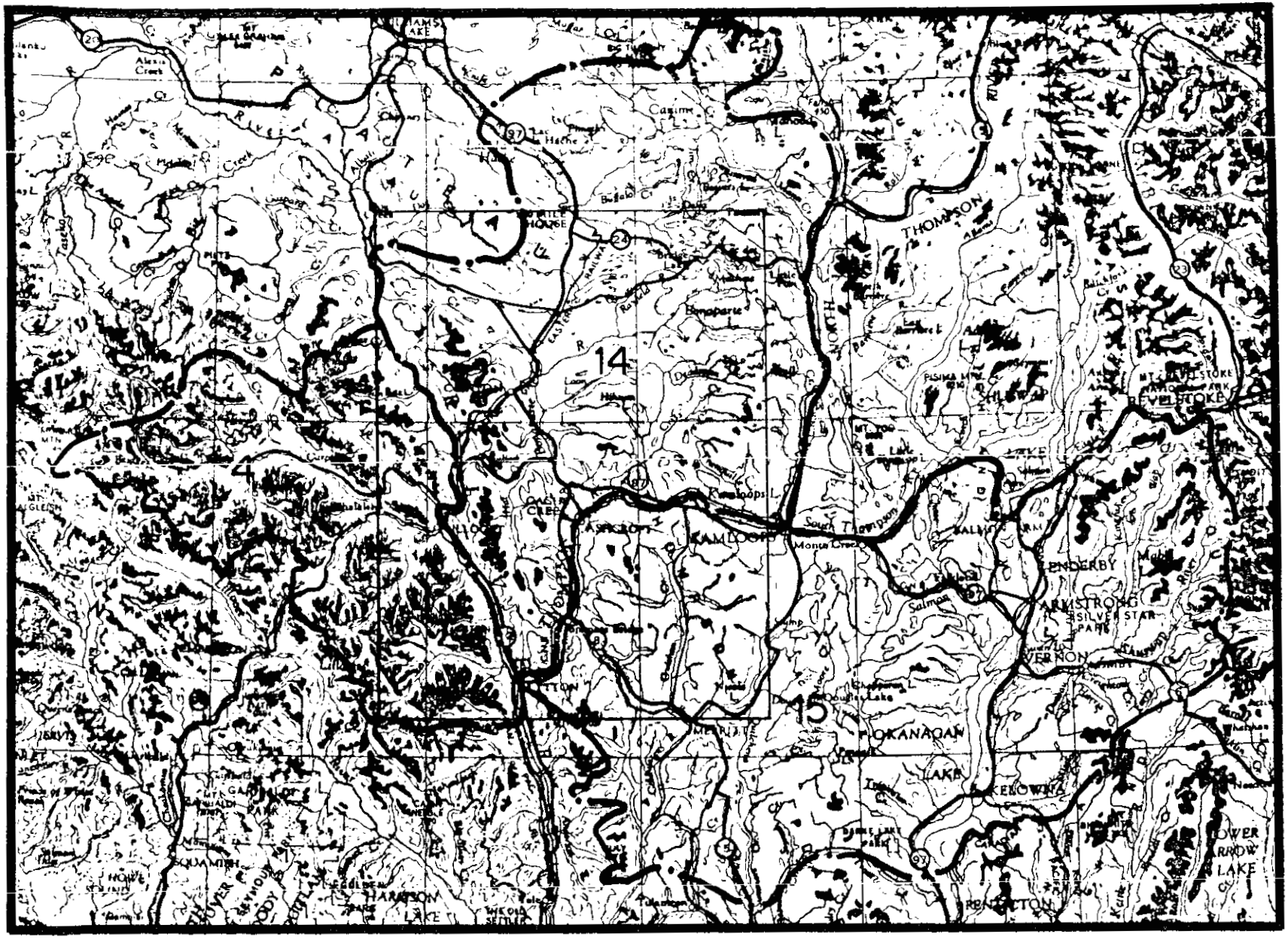
The B.C. Fish and Wildlife Branch Hunter Survey results are reported according to Game Management Areas. Unfortunately, the Game Management boundaries do not match the regional study area boundary (Map 3-4). Either much of the regional study area must be left out of the analysis, or much extraneous area must be included. For the purpose of game bird hunting, the former error was judged to be preferable to the latter because most waterfowl hunted within Game Management Areas 4 and 15 would come from outside the regional study area. Therefore, only information from Game Management Area 14 has been included in the analysis.

While the Hunter Survey data are available only by Game Management Areas, the Cache Creek Check Station results for 1975-76 have been compiled according to Management Units. These data are collected when hunters driving by the check station just north of Cache Creek on Highway 97 stop and report their success. The Cache Creek Check Station data, therefore, are strongly biased, and quite incomplete.

The Canadian Wildlife Service conducts a sampling of waterfowl hunters in some respects similar to the B.C. Fish and Wildlife Hunter Survey. For the purposes of the Hat Creek project, the major difference is that results are reported by degree-blocks (of longitude and latitude). As with the B.C. Fish and Wildlife Branch Hunter Survey, kill and hunter effort are estimated based on returns from a randomly selected subset of hunters.

(ii) Consumptive Use, Upland Game Birds

Consumptive use of upland game birds was estimated in the same way as for



MAP 3-4

REGIONAL STUDY AREA AND
GAME MANAGEMENT AREAS 4, 14 AND 15

waterfowl, except the Canadian Wildlife Service information (which is gathered for waterfowl only) is not available.

(iii) *Consumptive Use, Furbearers*

The consumptive use of furbearers in the regional study area was determine by examining trapping returns on file with the B.C. Fish and Wildlife Branch. In order to renew a trapping license, all trappers (except status Indians) must file a record of the previous year's harvest. These records were searched for all registered traplines within the regional study area and within the jurisdictions of the Kamloops, Merritt, Lillooet and Clinton conservation offices (Map 2-1) for the 1971-72 to 1975-76 trapping seasons inclusive, and all harvest information use was recorded. The results, therefore, represent a complete tally of all fur reported taken within that time period and area except that taken by status Indians.

(iv) Consumptive Use, Big Game

General resident hunting was analyzed within the boundaries of Game Management Areas 4, 14 and 15 (Map 3-4). Data on these three entire areas are included because the information contained therein could not be segregated into a better fit of the regional study area boundary. In light of the range of the big game species involved, it was also decided that an analysis of Game Management Area 14 data alone would not provide a complete picture of resident hunter use of big game within the regional study area.

B.C. resident hunter use of the big game resource in Game Management Areas 4, 14 and 15 was assessed by reviewing the B.C. Fish and Wildlife Branch survey information for the period 1970 to 1974, inclusive. Information averaged over the five-year period was assessed under the categories listed below:

(1) estimated number of hunter days provided by each big game species

(2) residency of hunters hunting in the study area

(3) total estimated number of hunters hunting in the study area as compared to the rest of B.C.

(4) estimated number of big game species harvested and the percent each Game Management Area contributed to the study area as compared to the total British Columbia harvest, and

(5) estimated value of the wildlife resources in the three Game Management Areas (values were calculated using the most recent detailed economic figures available).

Specific resident hunting was analyzed within the boundaries of Management Unit 3-17. The Kamloops office of the B.C. Fish and Wildlife Branch had plotted Cache Creek Check Station statistics on 1:250,000 scale maps for the years 1969 through 1974. Management Unit 3-17 and Upper and Lower Hat Creek boundaries were superimposed on those maps and the information was used in the Hat Creek big game distribution assessment.

Non-resident hunting was assessed on the basis of hunter returns filed by guide-outfitters operating in Game Management Areas 4, 14 and 15 from 1970 to 1974. These returns are filed with the regional offices of the B.C. Fish and Wildlife Branch in Kamloops and in Williams Lake and are summarized annually in the B.C. Fish and Wildlife Branch Hunter Sample Reports.

(b) Non-Consumptive Use

Non-consumptive wildlife use was estimated in a relative, comparative sense only. Non-consumptive wildlife use is scattered and disjunct; a direct study of such use was beyond the scope of this study and was not attempted. Information regarding non-consumptive wildlife use concomitant with other recreational pursuits was to have been gathered as part of the survey of recreational activity (Hat Creek Recreation Report).

Our approach has been to collect information regarding one well-recorded activity, bird watching, and make generalizations on the basis of the comparative use of the Upper Hat Creek Valley with other British Columbia locations.

The prime sources of information were the nest record cards and the sight record cards on file in the B.C. Provincial Museum. Although not all birdwatchers use these record cards, a substantial proportion of the serious birdwatchers do in fact contribute their observations to the Provincial Museum's records. If the Hat Creek Valley were regularly used by birdwatchers, one would expect the locality to repeatedly appear among the extremely voluminous records. If the valley is not used, one would expect to find references to nearby localities, but not to the Hat Creek Valley itself.

3.11 RARE AND ENDANGERED SPECIES

The terrestrial vertebrates listed and discussed as rare or endangered species in the study area are based on compilations of the Canadian Wildlife Service, National Museum of Canada, Canadian Wildlife Federation, and the International Union for Conservation of Nature and Natural Resources[47, 48, 49, 50, 51, 52, 53, 54, 55]. These compilations are compared with inventory information to generate the list of rare or endangered species specific to this study.

4.0 RESOURCE INVENTORY

4.1 GENERAL DESCRIPTION OF MAJOR WILDLIFE HABITATS

(a) Biogeoclimatic Zones and Regional Study Area Evaluation

Regional wildlife habitat is considered in terms of the Canada Land Inventory System for ungulate and waterfowl capabilities[56]. The sheep map prepared by the Resource Analysis Branch[57] is used to define the bighorn sheep habitat. For wildlife other than waterfowl and ungulates, regional habitat is considered in terms of the biogeoclimatic zones of Krajina[58]. A brief description of the zones within the regional study area and their relevance to wildlife follows.

The Ponderosa Pine-Bunchgrass Zone (PPBZ) is the warmest, driest zone and is found at lower elevations in the Fraser, Thompson, and Bonaparte valleys. It is roughly equivalent to what is sometimes termed the "interior dry belt". Much of the existing vegetation is open range. This zone contains one of the most distinctive vertebrate faunas in British Columbia[22, 68]. Mammals, birds, and reptiles all are part of an abundant, diverse and unusual fauna in this biogeoclimatic zone.

The Interior Douglas-Fir Zone (IDFZ) is somewhat cooler and moister than the Ponderosa Pine-Bunchgrass Zone. The climax vegetation in this zone would be a semi-open forest dominated by Douglas-fir *(Pseudotsuga menziesii)*. However, existing vegetation includes seral stages and edaphic habitats such as open range or open forest in which ponderosa pine *(Pinus ponderosa)* is a major constituent. Most of the planned Hat Creek mine and thermal plant activities would occur in this zone and most of the wildlife sampling in this report is pertinent to the Interior Douglas-fir Zone. This zone constitutes an important range for game animals (e,g. deer and ruffed grouse) and has a reasonably diverse and abundant avifauna.

The Engelmann Spruce-Subalpine Fir Zone (ESSFZ) is found altitudinally above the Interior Douglas-Fir Zone. The vegetation in this zone consists almost entirely of closed canopy coniferous forest, dominated either by Engelmann spruce *(Picea engelmanii)* or by lodgepole pine *(Pinus contorta)*, depending on successional stage and on burning history. The fauna is characterized by boreal birds (siskins, kinglets, Clark's nutcracker, crossbills, spruce grouse, etc.) and by snowshoe hares, fisher and lynx.

The highest elevations are in the Alpine Tundra Zone (ATZ). Vegetation is low herbaceous and dwarf-woody meadow or is nearly non-existent. The alpine zone is an important summer range for bighorn sheep and mountain goat.

The northwest portion of the study area contains a wide band of Caribco Aspen - Lodgepole Pine - Douglas-Fir Zone (CALPDFZ) parkland vegetation. Forests and grasslands occur in a patchy pattern, providing habitat diversity for wildlife. This is a prime moose, waterfowl, and furbearer zone.

A very small part of the southwest corner of the regional study area is in the Coastal Western Hemlock Zone (CWHZ). This zone is found in some canyons where precipitation is sufficiently high to allow dense western hemlock *(Tsuga heterophylla)* dominated forests to become established.

(b) Wildlife Habitats, Local Study Area

As described in the methodology portion (Section 3.2), wildlife habitats were defined on the basis of vegetation associations (described in the Hat Creek Detailed Environmental Studies Physical Habitat and Range Vegetation Report) and modified by existing overstory vegetation. In total, 14 wildlife habitats have been differentiated and mapped (Wildlife Habitat Map 3-2) within the local study area. The relationship between wildlife habitats and vegetation associations and biogeoclimatic zones is represented in Table 4-1. Descriptions of the wildlife habitats follow.

TABLE 4-1

RELATIONSHIPS BETWEEN WILDLIFE HABITATS,
VEGETATION ASSOCIATIONS AND BIOGEOCLIMATIC ZONES
WITHIN THE LOCAL STUDY AREA

Wildlife Habitat	Vegetation Association(s)	Biogeoclimatic Zone(s)
Subalpine krummholz	Engelmann spruce - willow - red heather parkland	ESSFZ
Engelmann spruce - lodgepole pine forest	Engelmann spruce - grouseberry - white rhododendron	ESSFZ
	Engelmann spruce - grouseberry	ESSFZ
	Engelmann spruce - subalpine fir - grouseberry	ESSFZ
	Engelmann spruce - grouseberry - pinegrass	ESSFZ
	Engelmann spruce - horsetail	ESSFZ
Douglas-fir/pinegrass	Some seral stages within Engelmann spruce - grouseberry	ESSFZ
	Some seral stages within Engelmann spruce - subalpine fir - grouseberry	ESSFZ
	Some seral stages within Engelmann spruce - grouseberry - pinegrass	IDFZ
	Douglas-fir - spirea - bearberry	IDFZ
	Douglas-fir - pinegrass	IDFZ
	Douglas-fir - bunchgrass - pinegrass	IDFZ
	Douglas-fir - bunchgrass (a few mature, closed canopy stands)	IDFZ
Ponderosa pine - Douglas-fir/ bunchgrass	Some seral stages within Douglas-fir - bunchgrass - pinegrass	IDFZ
	Most seral stages within *Douglas-fir - bunchgrass*	IDFZ
	Ponderosa pine - bunchgrass	PPBZ

TABLE 4-1 (Continued)

Wildlife Habitat	Vegetation Association(s)	Biogeoclimatic Zone(s)
Aspen	Some forest types within Douglas-fir - pinegrass	IDFZ
	Some forest types within Douglas-fir - pinegrass - bunchgrass	IDFZ
Riparian	Riparian	PPBZ - IDFZ
Open Range - Alpine	Mountain avens - sedge high elevation grassland	ATZ ESSFZ
Open Range - Mid elevation grassland	Kentucky bluegrass	ESSFZ
Open Range - Low elevation grassland	Bunchgrass - Kentucky bluegrass	IDFZ - ESSFZ
Open Range - Sagebrush	Sagebrush - bluebunch wheatgrass	IDFZ
Open Range - Big Sage	Big sagebrush - bunchgrass	PPBZ
Brush	Not satisfactorily restocked	PPBZ - IDFZ - ESSFZ
Bog	Willow - sedge bog	PPBZ - IDFZ - ESSFZ
Cultivated fields	Described in the Hat Creek Detailed Environmental Studies Agriculture Report	IDFZ - PPBZ

Note: Biogeoclimatic zones CWHZ and CALPDFZ occur within the regional study area but do not occur within the local study area.

Subalpine krummholz habitat corresponds to the Engelmann spruce - willow - red heather parkland association. Most of the area is covered with chest-high willow *(Salix spp.)* and dwarf conifers. It comprises 0.7 percent of the local study area and is found at high elevation just below the Alpine Tundra Zone.

The Engelmann spruce - lodgepole pine habitat includes vast tracts of higher elevation forest (24.1 percent of the local study area) currently dominated either by Engelmann spruce or by lodgepole pine. It corresponds to the climax vegetation and to some seral stages (e.g. those dominated by lodgepole pine) of the Engelmann spruce - subalpine fir associations: Engelmann spruce - subalpine fir - grouseberry, Engelmann spruce - grouseberry - pinegrass, Engelmann spruce - grouseberry - white rhododendron, and Engelmann spruce - horsetail associations.

The Douglas-fir/pinegrass habitat covers more of the local study area, 38.7 percent, than any other habitat. Douglas-fir *(Pseudotsuga menziesii var. glauca)* is the climax species for Douglas-fir - pinegrass, Douglas-fir - bunchgrass, Douglas-fir - spirea - bearberry, and Douglas-fir - bunchgrass - pinegrass associations. Douglas-fir dominated habitats also occur as seral stages in some of the lower elevation Engelmann spruce - subalpine fir vegetation associations, especially the Engelmann spruce - subalpine fir - grouseberry and Engelmann spruce - grouseberry - pinegrass associations.

Ponderosa pine - Douglas-fir/bunchgrass habitat in the study area consists mostly of seral stages of Douglas-fir - bunchgrass, Douglas-fir - bunchgrass - pinegrass, and to a lesser extent, Douglas-fir - pinegrass associations in which ponderosa pine *(Pinus ponderosa)* is the predominant canopy species and bunchgrass *(Agropyron spicatum)* is well represented in the understory. The ponderosa pine - bunchgrass association is also included in this category. In total, an estimated 8.3 percent of the local study area is currently this type of habitat. The ponderosa pine - Douglas-fir/bunchgrass habitat differs from the Douglas-fir/pinegrass habitat, from a wildlife perspective, by being more open, by having an understory vegetation which produces more seeds,

and by containing a significant proportion of ponderosa pine in the canopy.

Aspen habitat is dominated by quaking aspen *(Populus tremuloides)* or by a mixture of quaking aspen and conifers. This forest type which comprises 1.7 percent of the local study area is found mainly within the Douglas-fir - pinegrass vegetation association and often occurs as a transitional zone between coniferous forest and open range. Because this deciduous and mixed coniferous-deciduous type is qualitatively different from coniferous forests, it was initially sampled for wildlife. The small mammal and breeding bird fauna, however, proved to be essentially similar to that of the surrounding habitat types, so sampling in aspen habitat was discontinued for the owl and upland game bird surveys.

Riparian habitat covered only about 0.5 percent of the local study area, but was intensively sampled for wildlife because we felt that its relative importance to local wildlife would be proportionally much greater than its percentage coverage. Riparian habitat corresponds to the riparian vegetation association and is found only near streams or oxbow remnants of streams. This habitat is characterized by the presence of black cottonwood *(Populus trichocarpa)*, willows *(Salix spp.)* and other shrubs.

Open range habitats cover a very wide range of climatic and edaphic conditions. In the study area, open, treeless habitat dominated by grasses or grasslike vegetation can be found from low elevations near the Thompson and Fraser rivers to the tops of the highest peaks on steep, dry slopes to waterlogged saline depressions. Taken as a whole, including alpine tundra, open range covers 21.0 percent of the local study area.

The highest elevation grassland-type community is alpine habitat which includes the mountain avens - sedge and the highland grassland associations. This community covers approximately 2.0 percent of the local study area. Because of difficulty in obtaining access, wildlife sampling in this habitat was minimal.

Just below the alpine tundra and generally above 1200 m (4000 ft.) a band of mid-elevation grassland (Kentucky bluegrass association) occurs which covers 3.4 percent of the local study area. This type of grassland is characterized by a more or less continuous carpet of short grass and is heavily grazed by cattle.

On better drained soils, the low elevation grassland (bunchgrass - Kentucky bluegrass association) occurs covering 2.9 percent of the local study area. This habitat is characterized by scattered bunchgrass *(Agropyron spicatum)* and noticeable areas of bare soil.

Two other major open range habitats are recognizable, sagebrush habitat (sagebrush - bluebunch wheatgrass association) which covers only 0.4 percent of the local study area, mostly in the northern half of the Upper Hat Creek Valley, and the big sage habitat (big sagebrush - bunchgrass association) which is widely distributed in the Thompson and Bonaparte valleys (12.4 percent of the local study area). Wildlife sampling of open range habitats was done mainly in the low elevation grassland with some effort being applied to the mid and high elevation grasslands.

Brush habitat occurs under certain environmental conditions as an early seral stage following logging or burning of forest communities. Brush habitat is dominated by a 20-40 percent cover shrub species, mainly common snowberry *(Symphoricarpos albus)*, willow *(Salix spp.)*, roses *(Rosa spp.)*, western shadbush *(Amelanchier alnifolia)*, and juniper *(Juniperus communis)* plus scattered regeneration of lodgepole pine, Douglas-fir, and Engelmann spruce with a dense understory of pine grass *(Calamagrostis rubescens)*. This habitat, which was not sampled for wildlife, covers approximately 1.8 percent of the local study area.

Bog habitat is a minor one, covering 0.4 percent of the local study area. It corresponds to the willow - sedge bog association and occurs over a wide range of elevations wherever topography and drainage conditions favour its formation.

Cultivated fields cover 2.1 percent of the local study area. The value of these fields to wildlife depends, to a great extent, on the type of agriculture practised. The minimal disturbance type of agriculture practised in the Upper Hat Creek Valley can be conducive to wildlife usage. However, cultivated fields were not quantitatively sampled for wildlife because of the difficulty of standardizing results with respect to agricultural practices.

The remaining 0.8 percent of the local study area is categorized as miscellaneous habitats. Exposed rock, lakes, rivers, urban developments, and saline depressions are examples of habitats classified as miscellaneous. Saline depressions and waterbodies are biologically important and are described in detail in the waterfowl section. Otherwise, miscellaneous habitats were not sampled for wildlife. The various habitats with their absolute and relative areas are tabulated in Table 4-2.

(c) Wildlife Sampling Effort

Wildlife sampling effort is tabulated by wildlife habitat and by sampling effort in Table 4-3. Five habitats were originally selected for intensive wildlife sampling: open range, riparian, aspen, ponderosa pine - Douglas-fir/bunchgrass, and Douglas-fir/pinegrass. These habitats were, out of necessity, selected early in the study - before the vegetation in the local study area was adequately researched. We believed that these five habitats would include the greater portion of the study area including areas of special value to wildlife such as riparian, deciduous and mixed deciduous - coniferous forests. However, one major habitat, Engelmann spruce - lodgepole pine, was not included in the quantitative small mammal and bird surveys, but was qualitatively compared with the other sampled habitats.

4.2 REPTILES AND AMPHIBIANS

(a) Regional Distribution and Abundance

The herpetofauna of the regional study area consists of eight species of

TABLE 4-2

ESTIMATED EXTENT OF OCCURRENCE OF WILDLIFE HABITAT

WITHIN THE LOCAL STUDY AREA

Habitat	Area (km^2)	Area (sq.mi.)	Percent of Total
Subalpine krummholz	11.0	4.2	0.7
Engelmann Spruce - Lodgepole Pine	390.2	150.7	24.1
Douglas-fir/Pinegrass	625.6	241.5	38.6
Ponderosa Pine - Douglas-fir/ Bunchgrass	134.2	51.8	8.3
Aspen	27.2	10.5	1.7
Riparian	10.4	4.0	0.6
High Elevation Grassland	32.4	12.5	2.0
Mid Elevation Grassland	54.6	21.1	1.3
Low Elevation Grassland/ Saline Depression	47.5	18.4	2.9
Sagebrush	6.7	2.6	0.4
Big Sage	199.9	77.2	12.3
Brush	28.7	11.1	1.8
Bog	6.5	2.5	0.4
Cultivated Fields	30.3	11.7	1.9
Waterbodies	7.5	2.9	0.5
Exposed Rock	7.0	2.7	0.4
Urban	1.3	0.5	0.1
Total Local Study Area	1621.1	625.9	100.0

TABLE 4-3

SUMMARY OF SAMPLING WITHIN WILDLIFE HABITATS

Habitat	Ungulate Pellet Transect	Small Mammal Live Trapping	Small Mammal Snap Trapping	Breeding Bird Survey	Upland Game Bird Survey	Owl Survey	Incidental Wildlife Observation
Subalpine krummholz			x				x
Engelmarn Spruce - Lodgepole Pine	x		x				x
Douglas-fir/Pinegrass	x	x		x	x	x	x
Ponderosa Pine - Douglas-fir/ Bunchgrass	x	x		x	x	x	x
Aspen		x		x	x	x	x
Ripariar		x		x			x
Open Ranges	x	x		x	x	x	x
Alpine and High Elevation Grassland	x						x
Mid Elevation Grassland	x	x		x	x	x	x
Low Elevation Grassland	x	x		x	x	x	x
Sagebrush Grassland	x						x
Big Sage Grassland							x
Brush							
Bog	x						x
Cultivated Fields							x
Miscellaneous							x

reptiles and eight species of amphibians (Table 4-4). These 16 species have either been recorded or would, on the basis of distribution, be expected to occur within the regional study area.

Amphibians tend to be limited by aridity and water quality; most species would be expected to be most commonly encountered in the cooler, moister, forested portions of the regional study area. The tailed frog (*Ascaphus truei*) survives in cold, very fast-running waters that lack predator fish[59], and would only be expected to occur in the southwest portion of the regional study area. The Pacific tree frog (*Hyla regilla*) is a coastal species and possibly may be found in the extreme southwest corner of the regional study area (in the Coastal Western Hemlock Biogeoclimatic Zone).

The western spadefoot toad (*Scaphiopus hammondi*) differs from other regional study area amphibians in that it requires hot temperatures and thrives in temporary wetlands in semi-arid to arid climates[59]. This amphibian species would be found only in wetlands in the warmest portions of the Thompson and Fraser River valleys. The remaining five amphibian species listed in Table 4-4 would be distributed primarily through the Interior Douglas-fir and Engelmann Spruce - Subalpine Fir Biogeoclimatic Zones within the regional study area.

Reptiles are relatively common and abundant in the "interior dry belt" (Ponderosa Pine - Bunchgrass Biogeoclimatic Zone) with 10 of the 12 B.C. reptile species occurring in this zone[01]. Reptiles are temperature sensitive and prefer hot weather; cool summers are much more limiting to reptiles than are cold winters[59]. Garter snakes (*Thamnophis spp.*), and possibly the rubber boa (*Charina bottae*) and blue racer (*Coluber constrictor*) occur in riparian habitats at the elevation of the mine site. The other five reptile species listed in Table 4-4 would be found only at lower elevations in the Thompson, Fraser and Bonaparte valleys.

(b) Local Distribution and Abundance

Three amphibian species, western toad (*Bufo boreas*), long-toed salamander

TABLE 4-4

REPTILES AND AMPHIBIANS
OF THE HAT CREEK REGIONAL STUDY AREA

Species	Nearest Known Locality	Comments
Amphibians		
Rough-skinned newt *(Taricha granulosa)*	South of Merritt	Northern limit of distribution may reach study area
Long-toed salamander *(Ambystoma macrodactylum)*	Upper Hat Creek	Widespread
Tailed frog *(Ascaphus truei)*	North of Lytton	In cool, trout-free, torrent streams
Western spadefoot toad *(Scaphiopus hammondi)*	Kamloops	Breeds in very warm, temporary ponds
Western toad *(Bufo boreas)*	Upper Hat Creek	Widespread, abundant
Western tree frog *(Hyla regilla)*	Unknown	Northern limit of distribution may reach study area
Western spotted frog *(Rana pretiosa)*	Upper Hat Creek	In cooler waters
Wood frog *(Rana sylvatica)*	Clinton	In cooler waters
Reptiles		
Western painted turtle *(Chysemys picta)*	Thompson Valley	Requires warm waters
Northern alligator lizard *(Gerrhonotus coeruleus)*	Unknown	Northern limit of distribution may reach study area
Rubber boa *(Charina bottae)*	Pavilion Lake	Subterranean, rarely seen
Blue racer *(Coluber constrictor)*	Seton Lake and Kamloops	Requires moderately hot summers
Gopher snake *(Pituophis melanoleucus)*	Ashcroft	Requires hot summers

TABLE 4-4 (Continued)

Species	Nearest Known Locality	Comments
Wandering garter snake *(Thamnophis elegans)*	Upper Hat Creek	Garter snakes are common near water
Common garter snake *(Thamnophis sirtalis)*	Upper Hat Creek	Garter snakes are common near water
Western rattlesnake *(Crotalis viridus)*	Ashcroft	Requires very hot summers

(*Ambystoma macrodactylum*) and spotted frog (*Rana pretiosa*), are all widely distributed among the wetlands of Uppper Hat Creek Valley. Local amphibians appear to be neither especially abundant nor scarce in the regional study area. Eight species out of the 19 amphibian species native to B.C. occur within the regional study area[02]. Of these, only the ubiquitous western toad (*Bufo boreas*) was regularly encountered in the Upper Hat Creek Valley. The wood frog (*Rana sylvatica*), a northern species, has been recorded as far south as Clinton and may very well occur at higher elevations in the local study area. The rough-skinned newt (*Taricha granulosa*) is found south of the local study area, the nearest known locality being Merritt.

All of these five amphibian species require waterbodies in order to bree. Additionally, suitable habitat for the adults must be located in or near the breeding ponds. This habitat must provide food and shelter from dessicating conditions. At present, the ponds in the Upper Hat Creek Valley located at the edge of the forest zone and extending up to at least 1200 m (4000 ft.) elevation appear to be suitable for amphibians and to be used by them.

Because of the relative coolness of the Hat Creek Valley, reptile distribution tends to be restricted to the valley bottom. Only garter snakes (*Thamnophis spp.*) were actually encountered during field investigations. All snakes seen were in riparian habitat and most were at the northern end of the valley. Long-time residents of Upper Hat Creek report that snakes are very rare and that lizards and turtles are non-existent. The rubber boa (*Charina bottae*) and the blue racer (*Coluber constrictor*) possibly occur in the Upper Hat Creek Valley (in the riparian zone), but to date have not been recorded.

4.3 WATERFOWL

(a) Waterfowl Resource

(i) Regional Waterfowl

Within the regional study area we classified land into one of three capability categories: high, medium or low. Capability ratings are derived from the Canada Land Inventory system[56]. A high rating corresponds to Canada Land Inventory class 1, 2, 3 or 3M (special migration areas). A medium rating corresponds to Canada Land Inventory class 4 or 5, and a low rating corresponds to Canada Land Inventory class 6 or 7.

The distribution of these three waterfowl capability categories within the regional study area (Map 4-1) shows that the Hat Creek Valley is one of the few areas of high waterfowl capability within 75 km (50 mi.) of the proposed mine site. The nearest extensive areas of high breeding waterfowl capability are found to the southeast of Nicola Lake, northeast and southeast of Kamloops, and scattered in the vicinity of 70 Mile House. The South Thompson River, east of Kamloops, is an important waterfowl migration and wintering stop.

Areas of medium waterfowl capability are scattered throughout the Thompson Plateau. The mountainous regions, the area west of the Fraser River and the Clear and Marble ranges have a uniformly low waterfowl capability. The Fraser Plateau north of the Thompson Plateau and Marble Range is relatively flat and has extensive areas of medium waterfowl capability.

Regional waterfowl habitat has been categorized according to capability. However, actual waterfowl production is modified by land use and a substantial drop in waterfowl productivity may be the result of environmental modifications induced by ongoing grazing, mining or agricultural practices. Hence, moderately high capability ratings such as are assigned to the Hat Creek Valley may be misleading in context of present and future land use impacts upon waterfowl. The Hat Creek Valley wetlands appear to be substantially less productive than would be expected based on the capability rating (see Section 4.3(a)(ii)B).

(ii) Local Waterfowl

A. Wetland Inventory

An inventory of the wetlands of the Upper Hat Creek Valley is presented in the Wetland Inventory map (Map 4-2). These data are summarized in Table 4-5. Physical parameters were measured or estimated in 17 ponds which were selected as being typical representative Upper Hat Creek ponds (Table 4-6).

The wetland inventory is reasonably complete for larger ponds and lakes, but the resolution of the air photos is such that many of the smaller temporary and ephemeral ponds will have been missed. Comparison of air photo interpretation data with complete ground surveys done by Ducks Unlimited personnel confirms this bias as well as indicating that ponds were not always put into the proper seasonal category. Ground verification also indicated some difficulty differentiating between salt encrusted hardpan and swales of foxtail barley (*Hordeum jubatum*), as both appear white on the colour air photographs.

Heavy cattle grazing in the Hat Creek Valley has disturbed the shallow portions of wetlands, removing marsh vegetation and making classification of wetlands difficult. Very little edge or emergent vegetation was present in Hat Creek wetlands, however, the precise reasons for this cannot be ascertained without long-term experimentation. Grazing by cattle is a suspected causal agent; this is a contention which has been advanced by most biologists familiar with the local study area.

Bottom composition of Upper Hat Creek wetlands varied very little. The bottoms of all permanent and semi-permanent ponds consisted of a 15 to 45 cm (6 - 8 inch) layer of organic sediment. In wetlands where the bottom periodically dries, such as ephemeral, temporary and seasonal wetlands and the higher portions of semi-permanent and permanent wetlands which have seasonal variations in water level, a saline calcareous chernozemic soil develops. Intermediate between the organic sediment and the chernozem, a partly mineralized organic regosol is found. Because the underlying till is nearly impervious to water, most surface water in Hat Creek Valley wetlands is lost by surface runoff or by evaporation. When evaporation accounts for a large proportion of soil water

TABLE 4-5

SUMMARY OF WETLAND INVENTORY
HAT CREEK SITE SPECIFIC STUDY AREA

Wetland Type	Number	Area (ha)	Edge (km)
Temporary* and Ephemeral*	50	12.40	9.58
Semi-permanent	138	14.90	20.91
Permanent with Emergent Vegetation	45	21.38	15.38
Permanent without Emergent Vegetation	85	132.31	43.38
Saline	73	5.06	8.96
Bog	31	20.15	13.47
Totals	425	206.21	111.68

* Numbers underestimated

TABLE 4-6

PHYSICAL PARAMETERS OF SELECTED SAMPLE PONDS

Pond Number	Field pH	Lab pH	Conductivity µS/cm at 25°C	Type[41]	Invertebrates	Vegetation
1	7	7	445	Semi-permanent	lots: *A,B,G*	50% cover of *U,T* 100% of *W,Z*
2	7	7.5	1108	Ephemeral	few: *G*	Narrow border of *T,U*
3	?	7	641	Ephemeral	lots: *G*	100% cover of *T* Narrow border of *U*
4	7	6.5	430	Permanent	moderate: *B,G,H*	Border plus emergent patches of *U*, some *W,Y,Z*
5	7	7	497	Permanent	lots: *A,E,H*	Border of *U,W* small patch of *X,Y,Z*
6	7	7	573	Semi-permanent	nothing	Narrow border of *U,V* 80% *W*; some *Y,Z*
7	7	7	1040	Temporary	moderate: *B,C,G*	50% cover of *T*
8	8	8.8	2638	Seasonal	lots: *C,D*	Narrow border of *V*
9	7+	7	1100	Permanent	lots: *A,E*	Border of *T,U*
10	10+	10+	13867	Semi-permanent	few: *G*	Small amount of *Z*
11	8	8.8	4258	Semi-permanent	moderate: *C,D,F*	Wide border of *T,U,Z*
12	8	8	1794	Semi-permanent	moderate: *C,D,G,F*	Wide border of *T,U,Z*
13	7-8	8.2	1628	Temporary	lots: *B,C, D,F,G*	100% of *T,Z*
14	7	6.5	384	Permanent	few: *B,F*	Border of *T,U* some *X,Z*
15	10	9	5652	Temporary	lots: *C,G*	Narrow border of *T*
16	9	8.5	4100	Seasonal	lots: *C,D*	Narrow border of *V*
17	10+	10+	6285	Permanent	moderate: *E*	Small amount of *Z*

TABLE 4-6 (Continued)

Invertebrates - classify abundance into three general classes; underscore indicates dominant class of invertebrate in sample, if any

A freshwater clams
B gastropods
C copepods - *Daphnia* sp., *Diaptomus* sp.
D Fairy shrimp
E Amphipods
F large insect larvae - *Odonada, Corixidae, Belostomadidae*
G Dipteran larvae - *Chironomidae, Culicidae*
H Amphibian larvae

Vegetation

T Baltic rush *(Juncus balticus)*
U Hood's sedge *(Carex rostrata)*
V Foxtail barley *(Hordeum jubatum)*
W Duckweed *(Lemna minor* and *L. trisulca)*
X Cattail *(Typha latifolia)*
Y Submergents: *Hippurus montanus, Myriophyllum spicatum, Ranunculus gmelinii, R, alismaefolis*
Z Algae

loss, a net upward movement of salts occurs, resulting in the saline and calcareous soil which characterizes the soils in the immediate vicinity of most Hat Creek Valley wetlands.

Limitations to waterfowl can be grouped into three broad categories: food availability, nesting requirements, and mortality factors. Information gathered in Hat Creek by The TERA Environmental Resource Analyst Limited, Canadian Wildlife Service, Ducks Unlimited, and B.C. Fish and Wildlife Branch biologists indicates that the most severe limitation to waterfowl nesting is the general lack of marsh vegetation in the Hat Creek wetlands. Numerous studies of waterfowl food habits (see Keith[60] for summary) show that, in general, breeding adult waterfowl of the species found in the local study area consume mainly plant material, especially seeds of aquatic vegetation[61]. The noticeably thin marsh edges in the Hat Creek wetlands are limited in productivity and extent. Larger marshes produce more food, and more food attracts more ducks[60].

Since the pond sieve samples indicated that the invertebrate fauna is well developed in most ponds, an adequate food supply for ducklings appears to exist in Hat Creek wetlands.

The waterfowl production of marshes in the Hat Creek Valley appears to be limited by several factors, not all of which are necessarily applicable to any one wetland or group of wetlands. These are: grazing, topography, water quality, and soil fertility.

Grazing, as has been previously mentioned, can severely limit the waterfowl productivity of marsh ecosystems. In a well developed marsh, a programme of controlled seasonal grazing has been shown to improve vegetation and to increase waterfowl utilization[62, 63]. A heavily overgrazed area, such as Hat Creek, would probably require a period of several years in which no grazing whatsoever is permitted. Such an interruption in grazing pressure would be necessary to allow marsh vegetation to redevelop.

Another reason for limited marsh development is unfavourable topography. Wetlands formed in potholes with steep sides have, at best, only a narrow zone suitable for marsh development. Topography also influences hydrology and effects water quality, variation in water level, and permanence. Ponds that dry out too early become an unmitigated disaster for the breeding efforts of waterfowl that depend upon them, unless other more permanent ponds are sufficiently close such that the ducklings can be safely walked to them.

Conductivity readings (Table 4-6) and total dissolved solids (T.D.S.) estimates taken by the B.C. Fish and Wildlife Branch[06] indicate that salinity of some Hat Creek Valley wetlands may be high enough to significantly reduce productivity. Precise interpretation of the effects of conductivity or T.D.S. on wetland productivity is difficult unless information is available on the anion and cation balance of the wetlands in question*. In most cases, water chemistry problems can be solved by flushing wetlands with a sufficient quantity of fresh water (a solution which is feasible only if sufficient fresh water is available).

Soil fertility is one of the more significant, but also more elusive, parameters affecting marsh productivity. Only a few generalizations can be made.

Practical experience has shown that wetland soils rapidly lose their productivity and lose their attractiveness to waterfowl unless they are periodically dried[64**]. Highly organic soils are not as productive as the more mineralized chernozemic soils; a dry/wet regime increases soil fertility in the more permanent wetlands. At the other extreme, a yearly wet/dry regime in a closed drainage basin results in the drawing of salts to the surface and an overly saline soil. Wetlands with saline soils need to be inundated and flushed to restore productivity.

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* G.G.E. Scudder, personal communication - Professor, Dept. of Zoology, University of British Columbia, Vancouver, B.C.

**Murray Clark, personal communication, Ducks Unlimited, Kamloops, B.C.

The seasonality of a wetland has a bearing upon its value to waterfowl. In the prairies east of the Rockies, wetlands which dry very rapidly and those which are permanent are not used by waterfowl, while longer-lived temporary wetlands are preferred by dabblers, and semi-permanent ponds are preferred by diving ducks[65]. In the Upper Hat Creek Valley, the same pattern appears, with the exception that permanent ponds do have limited value as breeding areas to nesting waterfowl.

The productivity of Hat Creek wetlands appears to be considerably less than it might be. Control of water flows can help solve problems of water quality, topography, and soil fertility. Fencing cattle from wetland areas plus possibly planting waterfowl food crops would help increase the standing vegetation and the productivity of Hat Creek wetlands.

In order to breed, waterfowl need nesting areas and brood areas. Standing vegetation is an integral part of these requirements. Some wetlands provide both; however, at Hat Creek the two are usually found in separate wetlands. Nests are located in relatively dense cover at varying distances from water[60]. Dense cover is singularly lacking in many parts of the Hat Creek Valley and most of what is available is found in very shallow wetlands and swales which dry up very early in the season. When the ducklings hatch, they must travel overland to an adequate brood pond. Hence, brood ponds and suitable nesting areas should be adjacent to one another.

This factor (good interspersion of ponds) is crucial to nesting success in the Hat Creek Valley. A concentration of ponds in a small area is much more productive of waterfowl than are the same number of ponds scattered over a very large area because of social facilitation of breeding activity among waterfowl*. In general, the Hat Creek Valley has good interspersion of wetlands, expecially the region encompassing the lower two-thirds of the Upper Hat Creek Valley and to the west of the creek itself.

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* T. Sterling, personal communication, Ducks Unlimited, Kamloops, B.C.

Mortality factors can theoretically limit waterfowl. No data are available on parasitism within the study area, so nothing can be said about it other than that it could cause mortality of adults or young. Predation is most severe on nests and on ducklings. Brood success of Hat Creek waterfowl[05] appears to be reasonably good, so local predation on waterfowl is probably not excessive. Predation pressure depends not only on the numbers and types of predators, but also on the adequacy of vegetative cover for nesting and on the amount of overland movements of ducklings that must occur. Entanglement of ducklings in pond weeds and filamentous algae can be a significant source of mortality[66].

B. Population Surveys

The most rigorous investigation of breeding waterfowl in the Upper Hat Creek Valley was that conducted by Ducks Unlimited and the B.C. Fish and Wildlife Branch in 1974, 1975, and 1976[05, 06, 07]. The data from their study have been used to estimate breeding waterfowl populations at Hat Creek (Table 4-7). The breeding surveys were done only in the lower portions of the valley, up to the elevation of Finney Lake (1200 m or 4000 ft.). hence the results are not strictly applicable to higher elevation wetlands. The breeding survey results, therefore, apply only to the "main valley", that portion of the Upper Hat Creek watershed below 1200 m.

Breeding pair counts by Ducks Unlimited and B.C. Fish and Wildlife personnel were taken in 10 sections in 1975 and in six sections in 1976 (of which two sections were counted in 1975). Summing the count for each section (the better count for the two sections with two years' data) results in a total of 156 breeding pairs for all 14 sections. By comparing wetlands censused for waterfowl with all of the wetlands, some idea can be gained of what proportion of the total waterfowl population has be included in the census.

The 14 sampled sections (Table 4-7) contain 64.6 percent of the total number of brood ponds censused. No reason exists for presuming that counts are overestimates or underestimates[67], but conservatively assuming that 90 percent

TABLE 4-7

SUMMARY OF COMPREHENSIVE DUCK COUNTS
HAT CREEK
1974 TO 1976

Sections Sampled for Waterfowl (Map 4-2)	1974			1975				1976	
	Breeding Pair Counts	Broods	Number of Wetlands Used	Breeding Pair Counts	Number of Wetlands Used	Broods	Number of Wetlands Used	Breeding Paid Counts	Number of Wetlands Used
S11, T21, R27	N/C	1	1	21	4	5	1	N/C	N/C
S12, T21, R27	N/C	1	1	0	-	1	1	N/C	N/C
S1, T21, R27	N/C	6	2	13	11	6	2	10	4
S2, T21, R27	N/C	N/C	N/C	0	-	3	2	N/C	N/C
S3, T21, R27	N/C	N/C	N/C	1	1	3	2	N/C	N/C
S6, T21, R26	N/C	N/C	N/C	2	1	0	-	N/C	N/C
S30, T20, T26	N/C	N/C	N/C	19	1	8	1	N/C	N/C
S31, T20, R26	N/C	N/C	N/C	15	7	7	5	21	6
S36, T20, R27	N/C	N/C	N/C	27	7	2	2	N/C	N/C
S25, T20, R27	N/C	N/C	N/C	8	5	5	3	N/C	N/C
S12, T20, R27	N/C	N/C	N/C	N/C	N/C	N/C	N/C	4	3
S1, T20, R27	N/C	N/C	N/C	N/C	N/C	N/C	N/C	6	3
S1/2 of S31, T19, R26	N/C	N/C	N/C	N/C	N/C	N/C	N/C	15	4
N1/2 of S30, T19, R26	N/C	N/C	N/C	N/C	N/C	N/C	N/C	14	3
S19, T19, R20	N/C	N/C	N/C	N/C	N/C	N/C	N/C	5	3

Data from M. Clark, Ducks Unlimited and P. Holman, B.C. Fish and Wildlife Branch.

N/C - no counts

of breeding pairs were detected by the ground workers, that results in an estimate of 259 pairs of breeding waterfowl in the main Hat Creek Valley. If one assumes that all waterfowl within the census areas were counted and that the area of the brood ponds is the critical parameter, a low estimate of 200 breeding pairs for the valley is obtained. If one assumes that 90 percent of the waterfowl were detected, and the edge available for nesting is the limiting factor to waterfowl, a high estimate of 315 breeding pairs is obtained. These figures compare with an estimate of 200 ± 50 breeding pairs in the main valley by B.C. Fish and Wildlife Branch, Kamloops[05].

Productivity Estimate

Productivity can be estimated if four factors are known: breeding population, nesting success, brood size and fledgling rate. Since estimates of the first three factors can be derived, the number of ducklings produced can be estimated, but as fledgling success rates are unknown, the number of ducks which reach maturity cannot be estimated.

The breeding population has been estimated at approximately 260 pairs. In 1975, B.C. Fish and Wildlife Branch and Ducks Unlimited did breeding pair counts and brood counts on 10 sections. On these 10 sections, 106 breeding pairs and 40 broods were counted. Thus, it appears as if 37.7 percent of the breeding pairs were eventually successful. In 1975 and 1976, ducklings in 43 broods were counted. The mean brood size was 6.1. From these data, it appears as if approximately 600 ducklings are produced yearly in the Upper Hat Creek Valley.

The actual waterfowl production from the Upper Hat Creek Valley is significantly less than the potential waterfowl production one would expect from a C.L.I. class 3 wetland in British Columbia. Ideal waterfowl productivity in a class 3 area would probably be best exemplified by wetlands studied by the Canadian Wildlife Service in the Cariboo Parklands of B.C.* In these wetlands, waterfowl can be found at densities of 30.6 breeding pairs per km^2 (12.4 per 100 acres),

* Gary Kaiser, personnal communication. Canadian Wildlife Service, Delta, B.C.

10.1 broods per km^2 (4.1 per 100 acres), and 77.3 young per km^2 (31.3 per 100 acres)[79]. In the Hat Creek Valley, the class 3 waterfowl zone is in a band approximately 16 km (10 mi.) long and 2.5 km (1.5 mi.) wide, encompassing approximately 40 km^2 (15 sq. mi.). Using this area estimate and the productivity figures derived above, breeding waterfowl densities for Upper Hat Creek are 6.5 breeding pairs, 2.5 broods, and 15 young per km^2 (2.7 breeding pairs, 1.0 broods, and 6.3 young per 100 acres) within the class 3 waterfowl area. Thus, Hat Creek wetlands appear to support breeding waterfowl at densities of between one-quarter and one-fifth of its suspected capability.

Migration

A rough idea of the degree of waterfowl utilization of Hat Creek wetlands during spring and fall migrations was obtained during helicopter surveys done on September 16, 1976 and April 28, 1977. Results of the surveys are presented in Tables 4-8 and 4-9. In total, 507 waterfowl were counted in the autumn survey and 371 waterfowl were counted in the spring survey. Both surveys probably sampled a minimum of 75 percent of the wetlands, indicating that approximately 700 and 500 ducks, respectively, were present at the time of sampling.

Species Composition

A list of species waterfowl recorded from the Upper Hat Creek Valley and the relative abundance (as a percentage of the total) of each species are listed in Table 4-10. These data were derived from all available first-hand observations: those made by Ducks Unlimited and B.C. Fish and Wildlife Branch, as well as those made by The TERA Environmental Resource Analyst Limited. The list should be considered as being incomplete, especially for migrating waterfowl because records were taken during only one day, rather than over the entire season.

Nevertheless, the samples are probably representative of the species composition of waterfowl utilizing the Upper Hat Creek Valley. Mallard, teal species and goldeneye species (mainly Barrow's goldeneye) were the three most commonly encountered waterfowl, comprising a combined total of 81 percent of the spring

TABLE 4-8

HAT CREEK WATERFOWL SURVEY
SPRING MIGRATION
APRIL 1977

Map Unit (Map 4-2)	Mallard	Pintail	American Wigeon	Gadwall	Green-winged Teal	Blue-winged Teal	Cinnamon Teal	Unidentified Teal	Goldeneye spp.	Scaup spp.	Ring-necked Duck	Bufflehead	American Coot	Common Loon	Unidentified Diver	Unidentified Duck	Total Ducks	Total Wetlands
1																	0	1
2 and 8	9				4			8	8			2				2	33	23
3	4																4	45
4																	0	28
5									4	6						5	15	2
6																	0	0
7	12		2		2				6						1		20	1
8	SURVEYED WITH MAP UNIT 2 ABOVE																	
9									4						2		4	23
10	NOT SAMPLED																	
11	NOT SAMPLED																	
12																	0	1
13																	0	1
14			4					2	2	4							12	1
15	12		4		2	4	6		5	4	2	1				4	44	45
16	6				6		6					1					19	15
17	7		2					1	2		3			2			15	4
18	4		2					3		4							13	4
19			1			5			10					2			16	1
20									4							2	6	1
21	8				4		5		3								20	46
22	2						1		4								7	32
23	6						2		3								11	30
24	5	2	2					2									11	1
25	4							2									9	1
26	3	2				2			2					2			9	2
27	9	4				14							2	2			27	2
28	16		4	2	4		4	9	18					4			57	1
29	3							4	5							1	13	3
30	3																3	3
Total	113	8	22	2	22	25	24	31	80	18	5	4	2	12	3	14	368	297

TABLE 4-9

HAT CREEK WATERFOWL SURVEY
FALL MIGRATION
SEPTEMBER 1976

Map Unit (Map 4-2)	Mallard	Pintail	American Wigeon	Gadwall	Green-winged Teal	Blue-winged Teal	Cinnamon Teal	Unidentified Teal	Goldeneye spp.	Scaup spp.	Ring-necked Duck	Bufflehead	American Coot	Common Loon	Unidentified Diver	Unidentified Duck	Total Ducks
1																	0
2																	0
3	12																12
4		1															1
5								32									32
6	17							5									22
7	35	10						20									65
8	7	2						14				4	4				31
9								3									3
10		1															1
11																	0
12															3		3
13	5	4													6		15
14															1		1
15	4		8					12		10		30					64
16																	0
17																	0
18								8				4					12
19	25								7			2					34
20															5		5
21																	0
22		6															6
23	13							3									16
24	2							2								10	14
25																	0
26																	0
27	20	8						50	15								93
28	35	17						3				2				18	75
29	5	4						10									19
Total	180	53	8					162	22	10		42	4		15	28	523

Total number of ponds surveyed = 95

TABLE 4-10

RELATIVE SPECIES COMPOSITION OF WATERFOWL
UPPER HAT CREEK

	Spring Migration April 28, 1977 Percent	1975 & 1976 Breeding Populations Percent	Fall Migration September, 1976 Percent
Common loon	<1	2	
Pied-billed grebe		<1	
Horned grebe		<1	
Western grebe			1
Trumpeter swan			*
Canada goose			*
Mallard	31	21	36
Pintail	2	7	11
Northern shoveler			*
American wigeon	7	4	2
Gadwall	<1		
Green-winged teal	28	8	33
Common teal		5	
Blue-winged teal		8	
Redhead		2	
Ring-necked duck	2	2	*
Scaup sp.	5	7	2
Barrow's goldeneye	22	25	5
Common goldeneye			
Bufflehead	2	3	8
White-winged scoter			*
Red-breasted merganser		<1	
American coot	<1	4	3

* Seen in area but not counted during official survey.

count, 67 percent of the breeding pairs, and 77 percent of the autumn count. In autumn, pintail were slightly more numerous than were goldeneye.

(b) Consumptive Use

Consumptive use of waterfowl has been estimated using information gathered from several available sources. The area covered by each source differs, but by consolidating all information, a reasonable estimate of consumptive use patterns can be derived.

The most general analysis is that reported in the Hunter Sample conducted by the B.C. Fish and Wildlife Branch[12, 13]. The 1974 data (the most recent currently published) for Game Management Area 14 are summarized in Table 4-11. Game Management Area 14 includes the major portion of the regional study area, but extends outside the boundaries to the north and east. A portion of the regional study area west of the Fraser River is included in Game Management Area 4, while a portion to the south and east of the Thompson River is included in Game Management Area 15 (Map 3-4). These latter two Game Management Areas are not included in the present analysis because most of their area lies outside the regional study area boundary and, consequently, generalizations based on Game Management Areas 4 or 15 may not be relevant to the regional study area. Subsequent analysis using the smaller Management Units may provide a more accurate assessment of hunting within the study area boundaries. Game Management Area 14 is approximately two percent of the total area of the province. More than seven percent of the provincial hunters hunted in it and approximately five percent of the waterfowl were harvested in Management Area 14.

In 1976, Game Management Areas were changed to the much smaller Management Units. Hunter Sample returns based on B.C. Fish and Wildlife Branch Hunter Questionnaires are not yet readily available for these smaller units. However, Cache Creek Hunter Check returns for 1976 are available for the smaller Management Units. The Cache Creek check station located on the north side of

TABLE 4-11

ESTIMATED CONSUMPTIVE USE OF WATERFOWL IN
GAME MANAGEMENT AREA 14 AND BRITISH COLUMBIA

	Ducks	Geese
Estimated Number of Hunters		
Game Management Area 14	2,439 ± 450	908 ± 285
British Columbia	32,245 ± 7,821	13,130 ± 5,138
Estimated Harvest		
Game Management Area 14	13,228 ± 1,109	454 ± 232
British Columbia	261,479 ± 7,411	12,434 ± 1,429
Percentage of Provincial Hunters from Game Management Area 14	7.6	6.9
Percentage of Provincial Harvest taken from Game Management Area 14	5.6	3.7

town on Highway 97, samples only those hunters who stop at the check station during hours of operation. Because most potential hunters would reside to the south of the check station in Kamloops, Cache Creek, Ashcroft or the Lower Mainland, the Cache Creek check station is probably most valid when used to compare Management Unit 3-17 (especially the north half including Hat Creek), Management Unit 3-30 (especially the western portion), and Management Unit 3-31 (especially the eastern portion)(Management Units portrayed on Map 4-1).

Table 4-12 presents 1976 waterfowl harvests from Management Units surrounding Hat Creek. Comparisons reveal that Management Unit 3-17 (including Hat Creek) is relatively unimportant to regional hunters in comparison to Management Units 3-30 and 3-31. The area around Clinton appears to be nearly an order of magnitude more productive to hunters than is the Hat Creek area. However, the relative importance of Hat Creek to local hunters or to those who leave the valley via the Oregon Jack Creek Road cannot be estimated from the Cache Creek check station data.

One other source of waterfowl hunting information is available, the Canadian Wildlife Service species composition survey[44, 45]. This information is available in degree-blocks. The degree-block which includes Hat Creek is between 50^{0} and 51^{0} N. latitude and 121^{0} and 122^{0} W. latitude. The Canadian Wildlife Service has estimated waterfowl harvest for each degree-block, for the Interior of British Columbia (east of the crest of the Coast Range), and for the entire province of British Columbia (Table 4-13). In the degree-block which includes Hat Creek, an estimated 1103 waterfowl hunter days were expended to harvest an estimated 1609 ducks and 37 geese[45]. The data for 1976 were searched by Canadian Wildlife Service biologist Gary Kaiser for returns identifiable as being from the local study area. In total 55 percent of the 1976 duck returns for the appropriate degree-block apparently originated from the Hat Creek Valley. None of the goose returns were from the Hat Creek Valley. Thus, the estimated duck harvest from the local study area in 1976 is 882 ducks or 0.4 percent of the B.C. total (Table 4-13).

TABLE 4-12

1976 CACHE CREEK CHECK STATION
WATERFOWL RETURNS FROM MANAGEMENT UNITS SURROUNDING HAT CREEK

Management Unit	Ducks	Percent of Total	Geese	Percent of Total
3 - 17	26	6.3	2	10.5
3 - 30	131	32.0	4	21.1
3 - 31	253	61.7	13	68.4
Totals	410	100.0	19	100.0

TABLE 4-13

ESTIMATED 1976 WATERFOWL HARVEST IN THE HAT CREEK VALLEY
IN COMPARISON TO ESTIMATED PROVINCIAL AND OTHER HARVESTS

	Ducks	Percent of Total	Geese	Percent of Total
British Columbia*	231,000	100.0	11,500	100.0
Interior*	82,096	35.5	5,741	49.9
Degree-block 50-51N 121-122W*	1,609	0.7	37	0.3
Hat Creek**	882	0.4	-	-

* Canadian Wildlife Service estimates

** Hat Creek estimates derived by multiplying degree-block estimate by the proportion of duck wings returned from Hat Creek as compared with the total from the degree-block.

4.4 UPLAND GAME BIRDS

(a) Regional Distribution and Abundance

From a regional perspective, ruffed, spruce, and blue grouse appear to be the most common and the most hunted species of upland game birds. Chukar and sharptailed grouse are locally present in the Thompson Valley and are hunted, but suitable habitat for these species is limited in comparison to habitat for other grouse species. Ringnecked pheasant, although historically abundant, appear to be becoming increasingly scarce[13].

Observations of conservation officers, C. Williams and C. McIvor, are in agreement with the information presented in this report. They indicated that chukar and sharptailed grouse are found in the big sage grassland habitat; that ruffed grouse is the most abundant species and is found in riparian habitat, bog habitat and Douglas-fir/pinegrass habitat; that spruce grouse are found above the ruffed grouse in the Engelmann spruce - lodgepole pine habitat; and that blue grouse are found principally at forest edge, at timber line and at the Douglas-fir ponderosa pine - open range ecotone.

(b) Local Distribution and Abundance

Ruffed grouse and blue grouse are the two species of upland game birds that were commonly seen in the Upper Hat Creek valley. The upland game survey produced the following quantifiable results: out of 10 stations in open range, no game birds were seen or heard; seven ruffed grouse were recorded from 10 stations in riparian habitat; two ruffed and three blue grouse were recorded from 10 stations in ponderosa pine - Douglas-fir/bunchgrass habitat; and seven ruffed grouse were recorded from 10 stations in Douglas-fir/pinegrass habitat.

Mourning doves and common snipe were observed in the valley and chukar

were seen in the Thompson Valley, south of Ashcroft. Long time Hat Creek resident Ike Lehman reports that ring-necked pheasant and sharptailed grouse were previously found in Upper Hat Creek, but have since disappeared. Spruce grouse were not observed, but probably occur in the Engelmann spruce - lodgepole pine habitat in the local study area and are recorded from the hunter samples[11]. In September 1976 a relatively large number of blue grouse was observed at timberline.

(c) Consumptive Use

The sources of information used, the method of analysis, and the limitations are the same for upland game birds as for consumptive use of waterfowl, except that the Canadian Wildlife Service does not gather information for upland game birds.

The results for the B.C. Fish and Wildlife Branch Hunter Sample for 1974 are presented in Table 4-14. These data show that a significant portion of the upland game bird hunters and harvest is centred in Game Management Area 14. The region is particularly significant for chukar hunting, with over half the B.C. hunters using the area, and nearly a third of the provincial harvest being taken from the area. Sharptailed grouse, spruce grouse, ruffed grouse, and blue grouse are all important game species in the Hat Creek region.

The more specific results from the 1976 Cache Creek check station data comparing Management Units 3-17, 3-30 and 3-31 (Table 4-15) reveal that harvest from Management Unit 3-17 (including Hat Creek) is very small (only three percent) in comparison to harvest from the other two management units. More than four-fifths of the recorded harvest comes from Management Unit 3-30, east of Highway 97. As with waterfowl, but to an even greater degree, regional upland game bird hunters appear to prefer adjacent areas in preference to Hat Creek itself.

TABLE 4-14

B.C. FISH AND WILDLIFE BRANCH HUNTER SAMPLE, MANAGEMENT AREA 14

UPLAND GAME BIRDS, 1974

Species	Estimated Area 14 Hunters	±	Provincial Hunters	±	Percent*	Estimated Area 14 Harvest	±	Provincial Harvest	±	Percent*
Blue Grouse	4888	645	44114	9789	11.0	7190	953	64455	3041	11.2
Ruffed Grouse	7330	781	71348	12390	10.3	27644	1832	226268	5088	12.2
Spruce Grouse	5322	674	44139	9515	12.1	16529	1573	122541	4289	13.5
Sharptailed Grouse	1476	350	8511	2472	17.3	951	529	6902	1194	13.3
Chukar	619	232	2355	1142	26.3	1523	638	4818	1057	31.6
Ring-necked Pheasant	53	51	6530	2279	0.8	nil		679		0.0

* Percent of total 1974 B.C. hunters hunting in Game Management Area 14

TABLE 4-15

CACHE CREEK CHECK STATION
UPLAND GAME RETURNS FROM MANAGEMENT UNITS SURROUNDING HAT CREEK, 1976

Upland Game Species	Management Unit 3-17	Management Unit 3-30	Management Unit 3-31
Spruce grouse	11	468	93
Blue grouse	8	127	39
Ruffed grouse	27	691	89
Sharptailed grouse	0	3	1
Chukar	1	0	0
Snipe	0	0	4
Total of Upland Birds	47	1,285	230
Percent of Total	3.0	82.3	14.7

4.5 BIRDS

(a) Population Survey

Results of the bird observations are presented in tabular form. Results from the breeding bird survey are given in Table 4-16. Table 4-17 compares the five habitats' avifauna with respect to species diversity, local uniqueness and abundance. Of the five habitats sampled, the highest number of individuals were seen in the ponderosa pine - Douglas-fir/bunchgrass habitat. The fewest were seen in the open ranges. Species diversity was highest in the riparian and aspen habitats and was approximately the same in the other three habitats. The riparian habitat contained the highest number of unique or restricted distribution species; the aspen habitat contained the fewest. In this context, unique species are defined as those species recorded exclusively in one wildlife habitat.

The results of the owl survey conducted in April, 1977 are presented in Table 4-18. Only two species were heard: great horned owl and screech owl, neither of which was abundant. Both species were found only at forest-water ecotones; in riparian habitat and in Douglas-fir/pinegrass habitat near McLean Lake. Provincial government biologists from Clinton (C. Williams and H. Leuenberger) reported that great grey owls were occasionally heard near Clinton at higher elevations during the winter. Overall, owls do not appear to be a major component of the local study area avifauna.

To summarize from these data and from general impressions:

(1) Open range contains relatively few species and few individuals but the fauna is distinct from that of the other habitats;

(2) Ponderosa pine - Douglas-fir/bunchgrass habitat contains many individuals but lacks diversity. Most birds seen in this habitat were also relatively common in other habitats;

TABLE 4-16

BREEDING BIRD SURVEY, SIGHTINGS BY HABITAT
HAT CREEK, JULY 1976

Species	Habitat					Total Sightings	No. of Habitats in which Species was Observed
	OR	P-D/B	RIP	ASP	D/P		
Unidentified	1	2				3	
Mallard				2		2	1
Pintail	5		5			10	2
American kestrel	2	1	1			4	3
Killdeer	7			2	1	10	3
Spotted sandpiper					1	1	1
Greater yellowlegs				2	1	3	2
Mourning dove	1			1		2	2
Common nighthawk			2			2	1
Rufous hummingbird			2	1	2	5	3
Belted kingfisher			1			1	1
Common flicker	6	20	8	15	2	51	5
Pileated woodpecker					3	3	1
Yellow-bellied sap-sucker		3	7	26	4	40	4
Eastern kingbird			6			6	1
Alder flycatcher			4	2	2	8	3
Hammond's or dusky flycatcher				3		3	1
Western flycatcher		2	9	4	1	16	4
Western wood peewee		1	8	4	2	15	4
Olive-sided fly-catcher				2	12	14	2
Horned lark	9					9	1
Tree swallow	4		7	1		12	3
Rough-winged swallow			4			4	1
Cliff swallow	5			4		9	2
Gray jay					2	2	1
Stellar's jay		1			1	2	2
Black-billed magpie		2				2	1
Common raven	2			1	3	6	3
Common crow	7	26	5	1	1	40	5
Black-capped chicka-dee		1	7	5	17	30	4
Mountain chickadee		14	2	13	15	44	4
White-breasted nut-hatch		1	1			2	2

TABLE 4-16 (Continued)

Species	Habitat OR	P-D/B	RIP	ASP	D/P	Total Sightings	No. of Habitats in which Species was Observed
Red-breasted nuthatch	1	3		1	4	9	4
Winter wren					1	1	1
American robin	2	54	45	26	23	150	5
Hermit thrush					3	3	1
Swainson's thrush		1	1	8	32	42	4
Veery		2	26	4		32	3
Mountain bluebird	6	2		4		12	3
Townsend's solitaire					2	2	1
Golden-crowned kinglet					2	2	1
Ruby-crowned kinglet				6	2	8	2
Cedar waxwing			8			8	1
Common starling	1	50	5	5		61	4
Red-eyed vireo			1	1		2	2
Warbling vireo			2	2		4	2
Orange-crowned warbler		1	4		1	6	3
Yellow warbler			15	4	1	20	3
Yellow-rumped warbler		3	2	3	4	12	4
Townsend's warbler		6	2	4	13	25	4
MacGillivray's warbler			9	1		10	2
Common yellowthroat			1			1	1
Wilson's warbler			1			1	1
American redstart			1			1	1
Western meadowlark	20	2		3		25	3
Red-winged blackbird	4		1	3		8	3
Northern oriole			4			4	1
Brewer's blackbird	15		3	2		20	3
Brown-headed cowbird	1	1	1	1		4	4
Western tanager			1	2		3	2
Evening grosbeak		2				2	1
Purple finch		1		3	1	5	3
Pine siskin	1	34	4	23	24	86	5
Red crossbill		35				35	1
Vesper sparrow	36	23		9		68	3
Dark-eyed junco		2	4	21	40	67	4
Chipping Sparrow	1	24	1	5	4	35	5
White-crowned sparrow	1					1	1
Song sparrow			6	1	4	11	3
Total Species	21	30	41	42	34	68	5

OR = open range; P-D/B = Ponderosa pine - Douglas-fir/Bunchgrass;
RIP = riparian; ASP = aspen; D/P = Douglas-fir/pinegrass

TABLE 4-17

SONGBIRD SURVEY SUMMARY
HAT CREEK, JULY 1976

	OR	P-D/B	RIP	ASP	D/P
Number of unique species	1	4	9	2	7
Number of species with 75 percent or more of sightings within this habitat (*minimum of four* sightings)	3	1	7	1	2
Number of species with 50 percent or more of sightings within this habitat (minimum of four sightings)	10	4	15	4	6
Average (mean) number of species per check	3.6	5.7	7.1	6.4	7.2
Index of diversity (Shannon)	2.5	2.6	3.0	3.0	2.5
Average (mean) number of observations per check	6.8	16.1	11.4	11.6	11.6

OR = open range
P-D/B = ponderosa pine - Douglas-fir/bunchgrass
RIP = riparian habitat
ASP = aspen
D/P = Douglas-fir/pinegrass

TABLE 4-18

OWL SURVEY
HAT CREEK, APRIL 1977

Species	Habitat OR	P-D/B	RIP	ASP	D/P	Total Detections	No. of Habitats
Screech Owl			2	N/S	1	3	2
Great Horned Owl	1			N/S	2	3	2

OR = open range
P-D/B = ponderosa pine - Douglas-fir/bunchgrass
RIP = riparian habitat
ASP = aspen
D/P = Douglas-fir/pinegrass
N/S = not sampled

(3) The riparian habitat is the most rewarding for birdwatching, containing a high diversity of breeding birds, many of which are uncommon in British Columbia;

(4) The Douglas-fir/pinegrass habitat also has a high species diversity but the avifauna is similar to that of large areas in western British Columbia;

(5) The avifauna of the aspen stands was similar to that of surrounding habitats in terms of diversity and species occurrence but often differed in terms of the relative proportions of the species found;

(6) Engelmann spruce - lodgepole pine forests appear most similar to Douglas-fir/pinegrass habitat but were not visited during the breeding season so no secure conclusions can be reached. However, species density and diversity did appear to be somewhat less than in any other habitat;

(7) Similarly, alpine habitat was visited only once in the fall. At that time, alpine habitat appeared to be used relatively heavily by migrating hawks and songbirds;

(8) Saline depressions and other wetlands have a rich and interesting avifauna. Longbilled curlews breed in these saline depressions, as do other shorebirds and many waterfowl.

(b) General Status, Distribution and Abundance

Table 4-19 summarizes information concerning presence, seasonal status, relative abundance and habitat preferences of Hat Creek avifauna. Species are listed only if they were actually observed or recorded within the local study area. Seasonal status was taken from Munro and Cowan[22] and from the Checklist of Kamloops birds[21]; habitat from Munro and Cowan[22] and abundance

TABLE 4-19

SUMMARY OF FIELD OBSERVATIONS, SEASONAL STATUS, DISTRIBUTION AND ABUNDANCE OF AVIAN SPECIES IN THE HAT CREEK STUDY AREA

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Common Loon *(Gavia immer)*	X	X		S	2	Lakes, ponds
Red-necked grebe *(Podiceps grisegena)*		X		S	3	Lakes, ponds
Horned grebe *(Podiceps auritus)*	X			S	3	Lakes, ponds
Western grebe *(Aechmophorus occidentalis)*			X	S	3	Lakes, ponds
Pied-billed grebe *(Podilymbus podiceps)*		X		S	3	Lakes, ponds
White pelican *(Pelicanus erythrorhynchos)*	X			T	4	-
Great blue heron *(Ardea herodias)*	X	X		S	3	Riparian
Whistling Swan *(Olor columbianus)*	X			T,W	3	Wetlands
Trumpeter Swan *(Olor buccinator)*	X			T,W	3	Wetlands
Canada goose *(Branta canadensis)*	X			T,S	2	Wetlands, saline depressions
Mallard *(Anas platyrhynchos)*	X	X	X	S	1	Wetlands
Gadwall *(Anas strepera)*	X			S	3	Wetlands
Pintail *(Anas acuta)*	X	X	X	S	1	Wetlands
Green-winged teal *(Anas carolinensis)*	X	X	X	S	1	Wetlands
Blue-winged teal *(Anas discors)*	X	X	X	S	1	Wetlands

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Cinnamon teal *(Anas cyanoptera)*	X	X	X	S	1	Wetlands
American wigeon *(Anas americana)*	X	X	X	S	1	Wetlands
Northern shoveler *(Anas clypeata)*	X		X	S	2	Wetlands
Ring-necked duck *(Aythya collaris)*	X	X	X	S	2	Wetlands
Greater scaup *(Aythya marila)*	X		X	T	1	Wetlands
Lesser scaup *(Aythya affinis)*	X	X	X	S	1	Wetlands
Common goldeneye *(Bucephala clangula)*	X		X	T	2	Wetlands
Barrow's goldeneye *(Bucephala islandica)*	X	X	X	S	1	Wetlands
Bufflehead *(Bucephala albeola)*	X	X	X	S	1	Wetlands
White-winged scoter *(Melanitta deglandi)*			X	T,S	2	Wetlands
Ruddy duck *(Oxyura jamaicensis)*	X			S	2	Wetlands
Common merganser *(Mergus merganser)*		X		S	3	Lakes, ponds
Goshawk *(Accipiter gentilis)*				R	3	Varied
Sharp-shinned hawk *(Accipiter striatus)*	X		X	T,S	3	Varied
Cooper's hawk *(Accipiter cooperii)*			X	T,S	3	Varied
Red-tailed hawk *(Buteo jamaicensis)*	X		X	S	2	Varied
Swainson's hawk *(Buteo swainsoni)*		X		S	3	Open range

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Golden eagle *(Aquila chrysaetos)*			X	S	3	Alpine
Marsh hawk *(Circus cyaneus)*	X		X	S	2	Open range
Osprey *(Pandion haliaetus)*			X	S	3	Lakes
Peregrine falcon *(Falco peregrinus)*	X			T,R	3	Open country
Merlin *(Falco columbarius)*			X	S	3	Varied
Prairie falcon *(Falco mexicanus)*				R	3	Open range
American kestrel *(Falco sparverius)*	X	X	X	S	1	Open range
Blue grouse *(Dendragapus obscurus)*	X	X	X	R	1	Forest edge
Ruffed grouse *(Bomasa umbellus)*	X	X		R	1	Douglas-fir forest, Riparian
Spruce grouse *(Canachites canadensis)*			X	R	1	Spruce/pine forests
Sharp-tailed grouse *(Pedioecetes phasianellus)*			X	R	2	Big sage
Chukar *(Alectoris chukar)*	X		X	R	2	Big sage
Sandhill crane *(Grus canadensis)*	X			T	3	Wetlands
American coot *(Fulica americana)*	X		X	S	2	Wetlands
Killdeer *(Charadrius vociferus)*	X	X		S	1	Saline depressions
Common snipe *(Capella gallinago)*	X			S	2	Wetlands
Long-billed curlew *(Numenius americanus)*	X			S	2	Wetlands

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Spotted sandpiper *(Actitis macularia)*		X		S	1	Wetlands
Greater yellowlegs *(Tringa melanoleuca)*			X	S	2	Wetlands
Wilson's phalarope *(Steganopus tricolor)*	X			S	3	Wetlands
Northern phalarope *(Lobipes lobatus)*	X			T	3	Wetlands
Mew gull *(Larus canus)*	X			T	3	Wetlands
Band-tailed pigeon *(Columba fasciata)*		X		T	4	Forests
Rock dove *(Columba livia)*		X		R	2	Urban
Mourning dove *(Zenaida macroura)*	X	X		S	2	Open range, spruce woodlands
Screech owl *(Otus asio)*	X			R	2	Forests
Great horned owl *(Bubo virginianus)*	X			R	2	Forests
Great Grey owl *(Strix nebulosa)*				W	3	Forests
Poorwill *(Phalaenoptilus nuttallii)*		X		S	3	Big sage
Common nighthawk *(Chordeiles minor)*		X		S	2	Varied
Black swift *(Cypseloides niger)*		X		S	2	Varied
Vaux's swift *(Chaetura vauxi)*		X		S	2	Varied
Rufous hummingbird *(Selasphorus rufus)*	X	X		S	2	Varied, riparian
Belted kingfisher *(Megaceryle alcyon)*	X	X		S	2	Riparian

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Common flicker *(Colaptes auratus)*	X	X	X	S	1	Varied
Pileated woodpecker *(Dryocopus pileatus)*		X		R	3	Forests
Yellow-bellied sapsucker *(Sphyrapicus varius)*	X	X		S	1	Deciduous trees
Hairy woodpecker *(Dendrocopos villosus)*			X	R	3	Forests
Downy woodpecker *(Dendrocopos pubescens)*				R	3	Forests
Black-backed three-toed woodpecker *(Picoides arcticus)*			X	R	3	Forests
Williamson sapsucker *(Sphyrapicus thyroideus)*		X		S	4	Forests
Eastern kingbird *(Tyrannus tyrannus)*	X	X		S	1	Riparian ecotones
Western kingbird *(Tyrannus verticalis)*	X	X		S	1	Open range
Say's phoebe *(Sayornis saya)*	X			S	3	Varied
Willow flycatcher *(Epidonax traillii)*	X	X		S	2	Varied
Hammond's/Dusky flycatcher *(Empidonax sp.)*		X		S	2	Varied
Western flycatcher *(Empidonax difficilis)*		X		S	1	Varied
Western wood peewee *(Contopus sordidulus)*		X		S	1	Forests, riparian
Olive-sided flycatcher *(Nuttallornis borealis)*		X		S	1	Forests
Horned lark *(Eremophila alpestris)*		X	X	S	1	Open range

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Violet-green swallow *(Tachycineta thalassina)*	X	X		S	2	Varied
Tree swallow *(Iridoprocne bicolor)*	X	X		S	2	Varied
Rough-winged swallow *(Stelgidopteryx ruficollis)*	X	X		S	2	Varied
Barn swallow *(Hirundo rustica)*	X	X		S	3	Varied
Cliff swallow *(Petrochelidon pyrrhonota)*		X		S	3	Varied
Gray jay *(Perisoreus canadensis)*		X		R	2	Subalpine, Spruce-pine forests
Stellar's jay *(Cyanocitta stelleri)*		X		R	2	Forests
Black-billed magpie *(Pica pica)*	X	X	X	R	2	Open range
Common raven *(Corvus corax)*	X	X	X	R	1	Varied
Common crow *(Corvus brachyrhynchos)*	X	X	X	S	1	Varied
Clark's nutcracker *(Nucifraga columbiana)*	X		X	R	1	Forests
Black-capped chickadee *(Parus atricapillus)*	X	X	X	R	1	Varied
Mountain chickadee *(Parus gambeli)*	X	X	X	R	1	Varied
White-breasted nuthatch *(Sitta carolinensis)*		X	X	R	3	Forests
Red-breasted nuthatch *(Sitta canadensis)*	X	X	X	R	1	Forests
Winter wren *(Troglodytes troglodytes)*		X		S	3	Forests
American robin *(Turdus migratorius)*	X	X	X	S	1	Varied

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Hermit thrush *(Catharus guttata)*		X		S	3	Forests
Swainson's thrush *(Catharus ustulata)*		X		S	1	Douglas-fir forests
Veery *(Catharus fuscescens)*		X		S	1	Riparian
Mountain bluebird *(Sialia currucoides)*	X	X	X	S	1	Ponderosa pine forests, varied
Townsend's solitaire *(Myadestes townsendi)*		X		S	2	Varied
Golden-crowned kinglet *(Regulus satrapa)*	X	X	X	S	3	Forests
Ruby-crowned kinglet *(Regulus calendula)*	X	X	X	S	2	Forests, prefers deciduous
Water pipit *(Anthus spinoletta)*	X	X		S	2	Open range, wetlands
Cedar waxwing *(Bombycilla cedrorum)*		X		S	3	Varied, wetlands
Common starling *(Sturnus vulgaris)*	X	X	X	S	3L	Urban, cultivated fields
Red-eyed vireo *(Vireo olivaceus)*		X		S	3	Riparian
Warbling vireo *(Vireo gilvus)*		X		S	2	Riparian, varied
Orange-crowned warbler *(Vermivora celata)*	X	X		S	2	Riparian, aspen
Yellow warbler *(Dendroica petechia)*		X		S	1	Riparian
Yellow-rumped warbler *(Dendroica coronata)*	X	X	X	S	1	Varied
Townsend's warbler *(Dendroica townsendi)*		X		S	1	Forests
MacGillivray's warbler *(Oporornis tolmiei)*		X	X	S	2	Brush, riparian

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Common yellowthroat *(Geothlypis trichas)*		X		S	3	Riparian
Wilson's warbler *(Wilsonia pusilla)*		X		S	3	Riparian
American redstart *(Setophaga ruticilla)*		X		S	3	Riparian
House sparrow *(Passer domesticus)*	X	X	X	R	1L	Urban
Western meadowlark *(Sturnella neglecta)*	X	X	X	S,R	1	Open range
Red-winged blackbird *(Agelaius phoeniceus)*	X	X		S	1	Cultivated fields, wetlands
Northern oriole *(Icterus galbula)*		X		S	3	Riparian
Brewer's blackbird *(Euphagus cyanocephalus)*	X	X		S	1	Cultivated fields
Brown-headed cowbird *(Molothrus ater)*		X		S	2	Varied
Western tanager *(Piranga ludoviciana)*		X		S	3	Varied
Luzuli bunting *(Passerina ampena)*		X		S	3	Riparian
Evening grosbeak *(Hesperiphona vespertina)*		X	X	R	2	Varied, forests
Purple finch *(Carpodacus purpureus)*	X	X	X	S	2	Forests
Pine siskin *(Spinus pinus)*	X	X	X	R,S	1	Coniferous forests
American goldfinch *(Spinus tristis)*	X			S	3	Varied
Red crosbill *(Loxia curvirostra)*		X	X	R	2	Coniferous forests
Vesper sparrow *(Pooecetes gramineus)*	X	X		S	1	Open range

TABLE 4-19 (Continued)

Species	Occurrence*			Status**	Abundance***	Habitat
	Spring	Summer	Fall			
Dark-eyed junco *(Junco hyemalis)*	X	X	X	S	1	Varied, forests
Chipping sparrow *(Spizella passerina)*	X	X		S	1	Varied
White-crowned sparrow *(Zonotrichia leucophrys)*	X	X	X	S	2	Subalpine
Song sparrow *(Melospiza melodia)*	X	X	X	S	2	Riparian

* Based on actual sightings or site records

** Status:

R resident, all seasons
T transient, spring and/or fall
S summer only, winters elsewhere
W winter only, breeds elsewhere

*** Abundance:

1 common, nearly always observed in appropriate season and habitat
2 regular, repeated sightings or records
3 uncommon, seen or recorded only a few times during field observations
4 rare
L local, only occurs at a few scattered locations

from field observations in the Upper Hat Creek Valley. No regional avifauna perspective has been attempted.

In general, the Upper Hat Creek Valley is an excellent area in which to watch birds. The habitat is open and the birds are much more evident than in the forests of coastal British Columbia. In addition, the avifauna is quite diverse in Upper Hat Creek. Species which are characteristic of dry, warm zones and species which are characteristic of cool, moist zones can be found within a few kilometers of each other.

4.6 SMALL MAMMALS

(a) Regional

Mammals, large and small, which on the basis of distribution[68, 69] should be found within the regional study area are listed in Table 4-20. Also included in this table are comments regarding trophic status and the distribution or relative abundance of the species within the study area. These comments are derived from trapping information, from a knowledge of the general biology of the species in question, and from previous distribution records[68].

(b) Local

Distribution and abundance of small mammals in the local study area were determined from live-trapping results (Table 4-21). Comparisons among habitats are valid but caution should be used when comparing densities among species. The deer mouse (*Peromyscus maniculatus*) was found to be the most commonly encountered small mammal in all sampled habitats. Red squirrels (*Tamiasciurus hudsonicus*) were seen in all forested zones and chipmunks (*Eutamias amoenus*), although recorded from only three habitats during the official censuses, were evident ir all habitats.

Microtine rodents (*Microtus spp.*) were not abundant, however, several valley

TABLE 4-20

HYPOTHETICAL LIST OF MAMMALS
HAT CREEK REGION

Species	Trophic Status	Comments
* Maskec shrew *(Sorex cinereus)*	insectivore	
* Dusky shrew *(Sorex obscurus)*	insectivore	
Northern water shrew *(Sorex palustris)*	insectivore	Riparian habitat only
Western big-eared bat *(Plecctus townsendii)*	insectivore	
California myotis *(Myotis californicus)*	insectivore	
Long-eared myotis *(Myotis evotis)*	insectivore	
Little brown myotis *(Myotis lucifugus)*	insectivore	
Small-footed myotis *(Myotis subulatus)*	insectivore	Dry-belt species
Fringed myotis *(Myotis thysanodes)*	insectivore	Dry-belt species
Long-legged myotis *(Myotis volans)*	insectivore	
Yuma myotis *(Myotis yumanensis)*	insectivore	
Pallid bat *(Antrozous pallidus)*	insectivore	Dry-belt species
Big brown bat *(Eptesicus fuscus)*	insectivore	
Hoary bat *(Lasiurus cinereus)*	insectivore	
Silvery-haired bat *(Lasionycteris noctivagans)*	insectivore	
Pika *(Ochotona princeps)*	herbivore	West of Fraser River

TABLE 4-20 (Continued)

Species	Trophic Status	Comments
* Snowshoe hare *(Lepus americanus)*	herbivore	
Aplodontia (mountain beaver) *(Aplodontia rufa)*	herbivore	Recorded near Merritt
* Yellow-bellied marmot *(Marmota flaviventris)*	herbivore	
Hoary marmot *(Marmota caligata)*	herbivore	Alpine - subalpine west of Fraser River
* Yellow pine chipmunk *(Eutamias amoenus)*	granivore	
* Red squirrel *(Tamiasciurus hudsonicus)*	granivore	
Northern flying squirrel *(Glaucomys sabrinus)*	omnivore	
Northern pocket gopher *(Thomomys talpoides)*	herbivore	
Great basin pocket mouse *(Perognathus parvus)*	granivore	Dry-belt species
* Beaver *(Castor canadensis)*	herbivore	
* Deer mouse *(Peromyscus maniculatus)*	omnivore	
* Bushy-tailed woodrat *(Neotoma cinerea)*	herbivore	
Northern bog lemming *(Synaptomys borealis)*	herbivore	Alpine - subalpine
Mountain phenacomys *(Phenacomys intermedius)*	herbivore	Alpine - subalpine
Boreal redback vole *(Clethrionomys gapperi)*	herbivore	
* Long-tailed vole *(Microtis longicaudus)*	herbivore	
* Mountain vole *(Microtus montanus)*	herbivore	Dry-belt species
Meadow vole *(Microtus pennsylvanicus)*	herbivore	

TABLE 4-20 (Continued)

Species	Trophic Status	Comments
Muskrat *(Ondatra zibethica)*	herbivore	
Norway rat *(Rattus norvegicus)*	omnivore	Human commensal
Roof rat *(Rattus rattus)*	omnivore	Human commensal
House mouse *(Mus musculus)*	omnivore	Human commensal
Meadow jumping mouse *(Zapus hudsonius)*	granivore	
Western jumping mouse *(Zapus princeps)*	granivore	
Porcupine *(Erithizon dorsatus)*	herbivore	
* Coyote *(Canus latrans)*	carnivore	Abundant
* Gray wolf *(Canus lupus)*	carnivore	Rarely seen in study area
Red fox *(Vulpes fulva)*	carnivore	Uncommon
* Black bear *(Ursus americanus)*	omnivore	
Grizzly bear *(Ursus arctos)*	omnivore	West of Fraser
Pine marten *(Martes americana)*	carnivore	Not as common locally as fisher
Fisher *(Martes pennanti)*	carnivore	
* Short-tailed weasel *(Mustela erminea)*	carnivore	
Long-tailed weasel *(Mustela frenata)*	carnivore	
* Least weasel *(Mustela nivalis)*	carnivore	Rare
* Mink *(Mustela vison)*	carnivore	

TABLE 4-20 (Continued)

Species	Trophic Status	Comments
River otter *(Lutra canadensis)*	carnivore (fish)	
Wolverine *(Gulo luscus)*	carnivore	Rare, alpine - subalpine
Badger *(Taxidea taxus)*	carnivore	Rare, dry-belt species
Striped skunk *(Mephitus mephitus)*	omnivore	
Cougar (mountain lion) *(Felis concolor)*	carnivore	
Lynx *(Lynx canadensis)*	carnivore	
Bobcat *(Lynx rufus)*	carnivore	
* Mule ceer *(Odocoileus hemionus)*	herbivore	
* Moose *(Alces alces)*	herbivore	
Caribou *(Rangifer tarandus)*	herbivore	Historical records only west of Fraser River, all mountainous terrain
Mountain goat *(Oreamnos americanus)*	herbivore	
* Bighorn sheep *(Ovis canadensis)*	herbivore	
Elk *(Cervus canadensis)*	herbivore	Historical records, small herd released near Lytton

* Species seen by TERA personnel during field observations

TABLE 4-21

SMALL MAMMAL SPECIES DENSITY ESTIMATES*
AND HABITAT DISTRIBUTION

Species	OR	P-D/B	RIP	ASP	D/P
Masked shrew *(Sorex cinereus)*			1.5		
Dusky shrew *(Sorex obscurus)*			1.5		
Yellow pine chipmunk *(Eutamias amoenus)*		2	1.5		1.5
Red Squirrel *(Tamiasciurus hudsonicus)*		1.5	1.5	1	1
Deer mouse *(Peromyscus maniculatus)*	24	12	16	3.5	2
Long-tailed vole *(Microtus longicaudus)*			2.5		
Mountain vole *(Microtus montanus)*	1		0.5		
Snowshoe hare *(Lepus americanus)*				0.5	
Short-tailed weasel *(Mustela erminea)*			0.5		
Least weasel *(Mustela nivalis)*	0.5				
Number of species	3	3	8	3	3
Species Diversity Index	0.22	0.60	1.17	0.59	0.79

* expressed in numbers/hectare

residents independently remarked that 1976 had been an exceptionally low year for "mice". The mice they refer to are probably microtine rodents. As these mice are known to undergo periodic population fluctuations, they may well constitute a significant fraction of the small mammal resource in other years. We observed many old, unused microtine runways in the open range and riparian habitats where the grass was dense and tall. Microtine rodents could have serious impact on revegetation programmes.

The riparian habitat contains the greatest diversity of small mammals. Of special note is the capture of a least weasel (*Mustela nivalis*) in one of the open range plots (located near Harry Lake). Cowan and Guiget[68] report only five specimen records of this species in British Columbia and this capture is well tc the southwest of its previously recorded range[69].

Yellow-bellied marmots (*Marmota flaviventris*) were commonly observed in the study area. Marmots seemed to prefer rock piles in the midst of open ranges and were only observed in the southern two-thirds of the Upper Hat Creek Valley. Tracks in the mud along Hat Creek indicate that feral cats (*Felis domesticus*) are an important component of the local fauna.

Because the small mammal data were collected in a suitable quantitative form, species' diversity can be compared among habitats using Brillouine's diversity index[70]. The results (Table 4-21) show that of the five habitats sampled, mammalian species diversity is greatest in riparian habitat and least in open range. Riparian habitat also had the greatest number of species (eight) and was roughly comparable with open range in terms of the total number of individuals captured. Very few small mammals were captured in either apen or Douglas-fir/pinegrass forests.

4.7 FURBEARERS

(a) Regional Distribution and Abundance

Table 4-22 summarizes in tabular form the habitat distribution and relative abundance of furbearers in the regional study area. The information in this table stems from discussions with B.C. Fish and Wildlife Branch conservation officers C. Williams and C. McIvor, from analysis of regional fur returns, and from a knowledge of the general biology of these animals.

(b) Registered Trapline Returns

Registered trapline returns for the regional study are reported in Table 4-23. Average values per pelt were obtained from the 1973-74 and 1975-76 seasons from the B.C. Fish and Wildlife Branch and are reported in Table 4-24. The two years were chosen to represent the median year and the current year. The data show that the regional study area, which comprises approximately three percent of the province, produces approximately one percent of the pelts and fur value.

Lynx, beaver and coyote are the most important species taken in terms of the value of the fur. Fisher, muskrat, mink and bobcat are the next most significant species.

If the 38 trappers are, at best, producing furs worth an estimated $25,576.00 in 1976 (Table 2-24), an average of only $673.00 per trapper, then trapping must be a marginal enterprise for most of these people. Clarence Williams, the conservation officer for Clinton, states that the fur being taken out of the region is only a small fraction of what could be taken out. He claims that many trappers hardly trap at all and that a large percentage of the fur is taken by a small percentage of the trappers.

The area potentially affected by physical disturbance associated with the mine and thermal plant has no registered traplines in it. The Upper Hat Creek region, however, appears to have an abundance of furbearers. Beaver were found all along Hat Creek and along most of its tributaries and many of the more valuable waterfowl wetlands are the result of beaver activity. Dams were found associated with recent beaver sign but few lodges were seen, meaning that the

TABLE 4-22

SUMMARY OF FURBEARER HABITAT UTILIZATION
AND RELATIVE ABUNDANCE
HAT CREEK REGIONAL STUDY AREA

Species	Distribution	Relative Abundance
Beaver *(Castor canadensis)*	Widespread in most river systems in study area	High
Bobcat *(Lynx rufus)*	Rock formation; sparse forests on steep slopes	Low to moderate
Coyote *(Canis latrans)*	Ubiquitous	Very high
Fisher *(Martes pennanti)*	High plateau (1200 to 1550 m); lodge-pole pine forests	Relatively high
Fox *(Vulpes fulva)*	Scattered in lower elevations	Low
Lynx *(Lynx canadensis)*	Higher elevation forests on low to moderate slopes	Moderate density, widespread species
Marten *(Martes americana)*	Douglas-fir forests	Low relative to fisher
Mink *(Mustela vison)*	Along rivers; same areas as beaver	Moderate
Muskrat *(Ondatra zibethica)*	Sloughs, creeks and ponds; very few or none in Hat Creek Valley	Temporarily low, but relatively heavily trapped
Otter *(Lutra canadensis)*	Scattered through-out, along streams	Low
Raccoon *(Procyon lotor)*	Riverine riparian at lower elevations	Rare
Skunk *(Mephites mephites)*	Riverine riparian at lower elevations	Rare
Squirrel *(Tamiasciurus hudsonicus)*	Everywhere within forested region	High
Weasel *(Mustela spp.)*	Where mice are	High
Wolf *(Canis lupus)*	Northeast portion of study area	Low
Wolverine *(Gulo luscus)*	High country, alpine and subalpine	Rare

TABLE 4-23

FIVE-YEAR AVERAGE ANNUAL FUR RETURNS
HAT CREEK REGIONAL STUDY AREA
1972 - 1976

	Kamloops*	Clinton	Lillooet	Merritt	Totals	Percent of 1974 B.C. Total
Beaver	61.5	150.8		49.8	262.1	1.18
Bobcat	2.3	3.2	0.4	3.8	9.7	2.70
Coyote	20.3	43.4	0.4	14.2	78.3	2.64
Fisher	1.3	21.0			22.3	1.27
Fox	3.3	7.2			10.5	1.19
Lynx	8.8	23.4		8.2	40.4	0.46
Marten		2.2			2.2	0.02
Mink	6.3	68.4		3.8	78.5	2.29
Muskrat	34.8	214.8		57.2	306.8	1.58
Otter	2.0	6.2		2.6	10.8	0.90
Squirrel	102.5	126.2	8.0	52.0	288.7	1.00
Weasel	8.5	28.6		4.0	41.1	0.95
Wolf		1.0			1.0	0.64
Black bear	0.5				0.5	0.10
Badger	0.3				0.3	-
TOTALS	252.4	696.4	8.8	195.6		1.08
Registered traplines	11	16	6	4	37	
Private property traplines	0	0	0	1	1	
Indian traplines**	?	1	15	5	21+	

* four-year average

** Returns from Indian lines are not reported

TABLE 4-24

VALUE OF FUR RETURNS
FROM THE HAT CREEK REGIONAL STUDY AREA

Species	Average Value/Pelt 1974	Average Value/Pelt 1976	Est. Annual Value of Fur* 1974	Est. Annual Value of Fur* 1976
Beaver	$ 16.83	$ 19.45	$ 4411.00	$ 5098.00
Bobcat	66.95	137.13	619.00	1268.00
Coyote	31.39	41.84	2456.00	3274.00
Fisher	49.14	75.51	1093.00	1680.00
Fox	46.40	66.57	485.00	696.00
Lynx	40.32	93.92	3787.00	10455.00
Marten	16.31	19.18	36.00	42.00
Mink	12.96	16.20	1017.00	1271.00
Muskrat	2.72	4.43	833.00	1357.00
Otter	42.03	65.27	454.00	705.00
Squirrel	.87	.72	251.00	208.00
Weasel	.40	.96	16.00	39.00
Wolf	82.56	90.55	83.00	91.00
Black bear	52.49	43.41	26.00	22.00
TOTALS			$16210.00	$25576.00

* Using figures from "Totals" column from Table 4-23 and average values per pelt.

beaver probably burrow in the banks of the streams rather than build lodges. In some areas dams were also lacking. These habits make a census of the beaver population by the convential method of counting lodges meaningless.

Red squirrels were seen in all forested areas. A mink was seen along Hat Creek and two weasels were captured in live-traps set for mice. No muskrats were seen in Hat Creek wetlands but sign of many was seen north of Clinton. Many coyotes were sighted in the Hat Creek Valley. Two black bears were seen, one near Hat Creek and the other in Venables Valley, and a wolf was seen on Cornwall Peak.

4.8 BIG GAME

(a) Regional Study Area

Information contained in British Columbia Land Inventory Division unpublished data[35, 36, 37, 38, 39, 40], provided the initial information on ungulate capability in the regional study area (Map 4-3). This information was prepared by the Resource Analysis Branch of the B.C. Ministry of the Environment and provided the basis of the preliminary (Pemberton 92J, Ashcroft 92I, and Bonaparte 92P) and final (Taseko Lakes 92O) 1:250,000 Canada Land Inventory, Land Capability for Wildlife, Ungulates, mapsheets[56].

Canada Land Inventory mapping categorizes the capability of land to produce ungulates (hoofed mammals such as deer, moose, etc.) and waterfowl. The classification system is based on a scale from class 1 (lands which have no significant limitations to the production of specified wildlife) to class 7 (lands which have limitations so severe that there is no specified wildlife production). A "W" associated with the class number indicates that the area is an ungulate winter range on which animals from surrounding areas depend. In British Columbia, capability classes 1 to 3 are considered very important wildlife habitat, especially if designated as a winter range.

(i) Habitat Requirements and Land Capabilities

Mule deer (*Odocoileus hemionus hemionus*) select southern exposures supporting new plant growth as spring range as they move from low elevation winter ranges to alpine and subalpine summer and fall ranges. These kinds of habitats are found throughout the regional study area. The Bonaparte Plateau and the Green and Sheridan Lakes area to the north of Hat Creek provide class 2W, 3 and 3W deer range. In the more mountainous terrain to the northwest, west, south and southeast, valley bottom lands (Fraser, Bridge, Thompson and North Thompson valleys) also provide class 2W, 3 and 3W range for mule deer (Map 4-3).

Moose (*Alces alces andersoni*) occupy a variety of habitats from valley bottom to high mountain valleys. Highest moose densities are achieved in forests opened by fire and other forms of timber removal, permitting willow, birch or aspen regeneration. The central and northern portions of the regional study area provide isolated areas of class 2W moose range scattered among vast areas of class 3 and 3W moose range (Map 4-3).

Mountain goat (*Oreamnos americanus*) select alpine and subalpine areas for summer range and precipitous rock faces for winter range. The largest concentrations of this species are located in the southwest corner of the regional study area where class 3W goat range is found (Map 4-3).

California (*Ovis canadensis californiana*) and Rocky Mountain (*Ovis canadensis canadensis*) bighorn sheep reside in the regional study area. These sheep use mid and low elevation grasslands and exposed ridges for winter range, precipitous terrain for lambing grounds, and high elevation alpine and subalpine areas for summer range. Juxtaposition of these ranges is very important and is often the factor determining range use by bighorn sheep. California bighorn sheep are found in the Bridge River and Big Bar Creek areas, while Rocky Mountain bighorn inhabit the Thompson River Valley between Lytton and Spences Bridge (Map 4-3).

Rocky Mountain elk (*Cervus canadensis nelsoni*) winter on low elevation

south-facing slopes supporting fire-induced seral plant cover and naturally occurring grass/shrub vegetation associations. Summer months are spent in mountain ranges as high as grazing is available[68]. Canada Land Inventory mapping does not indicate that elk are found in the regional study area (Map 4-3). However, a small population of elk are know to reside in the Lytton area, and sporadic sightings have been recorded from the Hat Creek Valley.

Mountain caribou (*Rangifer tarandus*) winter in high elevation mature forests, foraging on arboreal lichens. In the summer, alpine and subalpine areas are frequented and a wide variety of succulent plants are used. Valley bottoms are used during spring and fall when snow conditions hinder travel and feeding. Canada Land Inventory mapping does not indicate that caribou are found in the regional study area (Map 4-3).

Black bears (*Ursus americanus*) are found throughout the regional study area. During summer and fall, black bears are widely dispersed and forage on plant and animal foods. Berries and other wild fruits comprise a large element of the fall diet. Avalanche tracks, providing vegetation and carrion, are preferred spring range. Improper garbage disposal from human settlement is a major attraction to black bears.

Grizzly bears (*Ursus arctos horribilis*) are scattered throughout the regional study area. In summer they occur largely in alpine habitat where they seek plant and animal foods, largely grasses, legumes and marmots. In the early spring period, avalanche tracks are a preferred habitat, supplying dislodged plant material and carrion. High elevation meadow habitat is preferred by grizzly bears in the late summer, and sedges appear to be the main source of food. Late summer and fall months offer a variety of fruits on seral and subalpine areas. Grizzly bears, like black bears, are readily attracted to garbage, a tendency that can result in dangerous confrontations with humans. The greatest concentrations of grizzly bears appear to be in the more isolated mountain terrain in the western and, particularly, southwestern portion of

the study area.*

Cougars (*Felis concolor*) are scattered throughout the study area. This carnivore may be found in a wide variety of habitats, but it favours rocky and mountainous terrain[68]. Bighorn sheep, mountain goats, elk and moose are taken by cougars for food[67, 68, 73, 75]. However, as deer are the major food of this species, greatest cougar densities can be found wherever deer concentrate, for example, major deer winter ranges.

Wolves (*Canis lupus*) frequent a variety of habitats including open plains, forests, mountains and brushlands, where deer, moose, caribou and mountain sheep are preyed upon. Moose provide a large portion of the wolf's winter diet and, therefore, the greatest wolf concentrations during winter can be expected in major moose winter ranges.

(ii) Regional Big Game Numbers

Estimates of the total B.C. big game populations and estimates of the provincial big game harvests by Game Management Areas[43] are available in the literature. This information was used to calculate the percentage of each big game species annually harvested in B.C. These percentage figures were then applied to Game Management Areas 4, 14 and 15 total estimated harvests by species to derive a total big game population figure (Table 4-25).

In reference to the content of Table 4-25, it is critical that the numbers contained therein be kept in proper perspective. The provincial estimates were made ten years ago and, at that time, considered "very rough". The estimated numbers of animals harvested in British Columbia is calculated from returns of hunter survey questionnaires. In calculating animal numbers in the study area, the assumption was made that the percentage of animals harvested per species from the provincial total was the same as the percentage

* C. McIvor, personal communication - Conservation Officer, B.C. Fish and Wildlife Branch, Lillooet, B.C.

TABLE 4-25

ESTIMATED NUMBERS OF BIG GAME SPECIES RESIDENT AND ANNUALLY HARVESTED IN BRITISH COLUMBIA AND GAME MANAGEMENT AREAS 4 14 AND 15

SPECIES	BRITISH COLUMBIA			GAME MANAGEMENT AREAS 4, 14, AND 15	
	ESTIMATED POPULATION*	ESTIMATED NUMBER HARVESTED ANNUALLY**	PERCENT OF ESTIMATED POPULATION HARVESTED ANNUALLY	ESTIMATED NUMBER HARVESTED ANNUALLY**	CALCULATED POPULATION
Deer	400,000	46,616	11.7	6459	55,000
Moose	300,000	15,044	5.0	1053	21,000
Goat	100,000	900	.9	104	11,000***
Bighorn Sheep	6,500	210	3.2	7	200+
Grizzly bear	5,000 to 10,000	219	4.4 to 2.2	6	200+
Black bear	Abundant	2,810	?	234****	Very Abundant
Cougar	5,000	265	5.3	15	300+
Wolf	2,500 to 5,000	995	4.0 to 2.0	74	200+
Elk	25,000 to 30,000	971	4.9 to 2.4	0	100+

* Data Source: Pearse Bowden[46]

** Data Source: B.C. Fish and Wildlife Branch Hunter Sample (1970 - 74)[43]

*** Value may be highly inflated because of disjunct distribution of mountain goat in British Columbia.

**** Data for 1973 and 1974 only

of animals harvested from Game Management Areas 4, 14 and 15.

Suffice it so say that Table 4-25 provides numbers of big game species in the general study area based on the best data available. However. it is clearly evident that these numbers are based on gross speculation and questionable assumptions. The qualifications placed on the above data parallel those pointed out by Pearse Bowden[46] in their assessment of the figures presented as estimated numbers of big game in British Columbia.

> *"It must be emphasized that these estimates of numbers, while they are the best available, are nevertheless very rough, and for some species represent only an educated guess. It should be pointed out also that the abundance of any game species varies widely over its range, and changes in density occur as the result of seasonal and cyclical influences. Moreover all game populations are dynamic. Populations are constantly changing as the result of biological and environmental factors, especially man-made changes in their habitats."*

Mule deer numbers in the regional study area apparently increased in the mid 1950's and peaked in the early 1960's*. A considerable decline (20 percent) in female mule deer productivity was recorded in Game Management Area 14 from 1964 to 1974. During the period from 1965 to 1969, an average of 72 fawns per 100 adult does was reported at the Cache Creek hunter check station compared with an average of only 58 from the same region between 1970 and 1974. The reduced productivity was partially attributed to the severe winters of 1970-71 and 1971-72. At the present time, deer numbers are considered to be below average**.

Moose were first reported south of Bonaparte Lake in 1909 and at Green Lake in

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* C. Williams, personal communication - Conservation Officer - B.C. Fish and Wildlife Branch, Kamloops, B.C.

** P. Martin, personal communication - Former Regional Biologist - B.C. Fish and Wildlife Branch, Kamloops, B.C.

1912. These animals increased rapidly in numbers and peak numbers were reached in 1948*. Moose are second to deer in the amount of recreation they provide B.C. resident hunters[46]. Since 1950, the number of moose hunters in the province has more than doubled while the annual number of animals harvested has increased about 450 percent[43]. At the present time, moose numbers are considered to be below the numbers reached in the late 1940's*.

Pearse Bowden[46] speculated that there are approximately 100,000 mountain goats in British Columbia and that 80 percent of the mountain goats in North America reside in British Columbia. This adds considerable weight to the importance of the provincial goat population on an international basis. The authors noted that, although mountain goat hunting does occur throughout most of the province, it was particularly concentrated in some areas. The more northerly parts of the Lower Mainland area was one such location identified by the authors and the Cayoosh - Texas Creek areas would fall within these boundaries. This area was surveyed in late August 1966 and recorded 354 goats in the Cayoosh Range and 176 goats in the Texas Creek - Mt. Brew area[71].

California bighorn sheep are native to the regional study area[72]. It has been estimated that over 400 of these animals utilize the Marble, Camelsfoot (Yalakom Mountain, Nine Mile Ridge and Red Mountain) and Shulap Ranges, and Mission Range[71]. Fifty to 150 Rocky Mountain bighorn sheep inhabit the Scarped Range just north of the confluence of the Fraser and Thompson rivers at Lytton[73]. This herd has developed from 39 sheep transplanted from Squilax by the B.C. Fish and Wildlife Branch in 1932**.

Elk were widely distributed through the southern interior of British Columbia until the mid 1800's when their numbers suddenly declined[46]. In 1941, "many"

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* P. Martin, personal communication - Former Regional Biologist - B.C. Fish and Wildlife Branch, Kamloops, B.C.

** B. Gates, personal communication - Former Regional Biologist, B.C. Fish and Wildlife Branch, Burnaby, B.C.

elk were reported in the Lillooet and Clinton detachments in the Annual Report of the Provincial Game Commission and preserved antlers are still occasionally found in the Churn Creek area*. Elk are occasionally seen in the regional study area at present and, although they are not found in any significant numbers, the number of sightings has increased within the last few years[74]. In the autumn of 1972, the B.C. Fish and Wildlife Branch transplanted 49 elk from Jasper National Park to the Lytton area**. The present distribution of these elk include the Botanie Valley and Lytton - Kanaka areas***.

In the early 1900's, mountain caribou were hunted in the Taseko Lake country but are not known to occur there now. Since 1960, however, several caribou sightings have been reported from the Chilcotin area in the vicinity of Big Creek[74]. At the present time, the largest caribou herds are found outside of the regional study area (to the northeast) in the Wells Gray Park area.

Information on population sizes of the remaining big game species found in the regional study area (black bear, grizzly bear, cougar and wolf) is minimal. The best available indicator is that the regional study area makes up about four percent of the area of the province and accounts for 8.3 percent, 5.7 percent and 7.5 percent of the provincial harvest of black bear, cougar and wolf. These percentage figures reflect a combination of the abundance of game and hunter effort. For example, black bear, cougar and wolf may be very actively hunted by regional study area residents because these species are thought to interfere with livestock production. Nevertheless, based on the harvest figures, it is probably safe to assume that black bear are very abundant in the regional study area and that good populations of cougar and wolf are also present. Based on the large amount of black bear habitat and the number of prey species

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* C. Williams, personal communication - Conservation Officer, B.C. Fish and Wildlife Branch, Clinton, B.C.

** B. Gates, personal communication - Former Regional Biologist, B.C. Fish and Wildlife Branch, Burnaby, B.C.

*** E. Hendricks, personal communication - Conservation Officer, B.C. Fish and Wildlife Branch, Merritt, B.C.

available for cougar and wolf, the regional study area populations of all three species are assumed to be very stable.

Grizzly bear harvest in the regional study area accounts for approximately 2.7 percent of the provincial harvest (Table 4-25). The fact that the regional study area provides below average grizzly bear harvests for the land area involved is partially attributed to the presence of large areas of poor quality grizzly bear habitat as well as increasing human pressures resulting from increased access and more intensive land use. In light of the above, grizzly bear numbers in the regional study area are considered low and are likely declining.

(b) Local Study Area

A review of the available information on the Hat Creek area and the results of the data collected during this study area presented in this section.

(i) Habitat Capabilities

The Canada Land Inventory ungulate capability map covering the Hat Creek watershed (Ashcroft mapsheet 92I/NW) provides the best overall picture of local ungulate capabilities. The watershed consists of 13.1 percent class 3 deer (d) and moose (m) range (lands in this class have slight ungulate production limitations) and 86.9 percent class 4 (lands in this class have moderate ungulate production limitations) deer and moose range (Table 4-26). Classes designated "W" in the table are winter ranges which provide habitat for animals from adjacent areas. Wildlife habitat limitations of poor soil moisture (M), excessive snow depth (Q), restrictive soil depth (R), and adverse exposure or aspect (U) are found in the watershed. According to the Canada Land Inventory map of the study area, the lands most important to local deer and moose (class 3) are located in the upper drainage of Anderson Creek, between the 1050 and 1350 m (3445 and 4430 ft.) elevation (approximately), on the west side of Hat Creek between Martly and Colley creeks and crossing Hat Creek to Blue Earth Lake, the valley bottom section of Hat Creek

TABLE 4-26

AREA (IN HECTARES) OF
CANADA LAND INVENTORY UNGULATE CAPABILITY CLASSES
HAT CREEK WATERSHED

CLI Class*	Area in Upper Hat Creek	Area in Lower Hat Creek	Watershed Total	Percent of Total Watershed
$3_dW^{M}_{R}$		3,560	3,560	5.4
3^{M}_{d}	145	850	995	1.5
3^{Q}_{d}	650		650	1.0
4^{Q7}_{dm} $3W^{Q3}_{md}$	10,100		10,100	15.2
$4R^{Q7}_{d}$ $3W^{Q3}_{d}$		1,300	1,300	2.0
4^{Q}_{dm}	16,130	4,400	20,530	31.0
$4Q^{R}_{d}$	7,900	4,350	12,250	18.4
$4Q^{R}_{dm}$	2,720	9,200	11,920	18.0
$4M^{U}_{d}$	4,990		4,990	7.5
TOTALS	42,635	23,660	66,295	100.0

* See text for explanation of symbols

where the creek parallels Highway 12 and the north and south ridges of the mouth of the Hat Creek Valley in the Carquile area.

A. Aerial and Ground Surveys

During the winter of 1975-76, the Fish and Wildlife Branch surveyed the Upper Hat Creek road "about once a week" for ungulate crossing sites[42]. Livestock and dog tracks were observed during the sampling period, however, no wild ungulate tracks were recorded.

B.C. Research and B.C. Fish and Wildlife Branch personnel completed a wildlife winter survey of the Upper Hat Creek watershed the winter of 1975-76[42]. B.C. Fish and Wildlife Branch observations indicated no wild ungulate tracks in the valley bottom south of the confluence of Hat and Medicine creeks. North of the confluence of these two creeks to Highway 12, however, scattered deer tracks were recorded. Scattered deer tracks were also recorded at elevations of approximately 1000 to 1300 m (3500 to 4500 ft.) on the north banks (southern exposures) of the mouths of Medicine Creek and Langley Lake valleys as well as in the Finney Lake area. Scattered moose tracks were recorded in the upper White Rock Creek area and along the west side of the Hat Creek Valley at approximately the 1200 m (4000 ft.) elevation in the Phil, McCormick, Anderson and Martley Creek drainages, and Finney Lake.

In the original proposal this study was to include an ungulate winter range helicopter survey of the local study area. The survey was re-scheduled several times and finally cancelled in late March 1977 due to below average snow accumulations. Snow accumulation was greater during the 1977-78 winter than it was the previous year and a decision was made to proceed with the survey. On January 30, 1978 B.C. Hydro and Power Authority and B.C. Fish and Wildlife Branch biologists completed an aerial census of wild ungulates in the Hat Creek Valley[78]. Wild ungulates or observed tracks and descriptions and elevations of habitats being utilized were recorded.

A total of 23 deer were seen during the 3 and one-half hour survey. Nineteen

of these deer along with abundant deer tracks were observed on the south-facing slopes just north of Highway 12 between Marble Canyon and Carquile. Eight of these deer were found in ponderosa pine - Douglas-fir/bunchgrass habitat (Section 4.1) at elevations ranging from 850 m to 1190 m (2790 to 3900 ft.), seven were found in Engelmann spruce - lodgepole pine habitat at 1830 m (6000 ft.) elevation and four were located in Douglas-fir - pinegrass habitat at 1250 m (4100 ft.). The remaining four of the 23 deer, along with abundant deer tracks, were recorded on the west side of the Hat Creek Valley between Finney Creek and Highway 12 at an elevation of 1040 m (3410 ft.).

One moose was recorded in the Langley Lake area and sparse moose tracks were recorded on the north-facing slope of the Trachyte Hills.

In summary the authors concluded that, "a reasonable maximum estimate of the mule deer population in the Hat Creek Valley would thus appear to be about 50". Regarding moose numbers the report concluded, "... it appears unlikely that the total number of moose in Hat Creek watershed at the time of the census exceeded about five animals".

B. Pellet Group Transects

Virtually no difference in the number of ungulate days of foraging was detected when the pellet group transect data were analyzed as ten plots per transect, as opposed to a single belt transect. The belt transect approach was chosen to simplify reporting and the results are presented in Tables 4-27 and 4-28.

Evidence of cattle activity was found in all transects in all map units except riparian (Tables 4-27 and 4-28). Low and mid elevation grasslands exhibited by far the greatest concentrations of cattle chips. Although no chip pellet groups were found in the transect located in the riparian habitat, livestock tracks and chips adjacent to the transect indicated that this unit is used by livestock.

TABLE 4-27

PELLET GROUP TRANSECT RESULTS

Map Unit and Transect Location	Pellet Groups or Chips per Transect			Ungulate Days per Year per 100 Ha			Ungulate Days per Year per 100 Acres		
	Deer	Moose	Cattle	Deer	Moose	Cattle	Deer	Moose	Cattle
SAGEBRUSH									
(East of Hat Creek)	42	0	31	1771	0	7590	717	0	3070
(West of Hat Creek)	36	0	6	1518	0	1470	614	0	595
(Average)	39	0	18.5	1645	0	4530	666	0	1835
ENGELMANN SPRUCE - LODGEPOLE PINE									
(Pavilion Mountain)	7	1	3	295	42	735	119	17	295
(Cornwall Mountain)	3	2	17	127	84	4160	51	34	1685
(Average)	5	1.5	10	211	63	2448	85	25	990
PONDEROSA PINE - DOUGLAS-FIR/ BUNCHGRASS									
(Hat Creek Valley)	1	0	24	42	0	5875	17	0	2380
(Medicine Creek Valley)	5	0	7	211	0	1715	85	0	685
(Average)	3	0	15.5	127	0	3795	51	0	1539
ALPINE									
(Pavilion Mountain)	0	0	0	0	0	0	0	0	
(Corwall Mountain)	3	0	5	127	0	1225	51	0	495
(Average)	1.5	0	2.5	63	0	613	25	0	248
MID ELEVATION GRASSLAND									
(Medicine Creek Valley)	0	0	122	0	0	29860	0	0	12090
(Harry Lake)	0	0	30	0	0	7350	0	0	2950
(Average)	0	0	76	0	0	18605	0	0	72

TABLE 4-27 (Continued)

Map Unit and Transect Location	Pellet Groups or Chips per Transect			Ungulate Days per Year per 100 Ha			Ungulate Days per Year per 100 Acres		
	Deer	Moose	Cattle	Deer	Moose	Cattle	Deer	Moose	Cattle
LOW ELEVATION GRASSLAND									
(East of Hat Creek)	0	0	122	0	0	2450	0	0	990
(West of Hat Creek)	0	0	183	0	0	44790	0	0	18135
(Average)	0	0	96.5	0	0	23620	0	0	9563
DOUGLAS-FIR/PINEGRASS									
(East of Hat Creek)	0	0	3	0	0	735	0	0	300
(West of Hat Creek)	0	0	14	0	0	3425	0	0	1390
(Average)	0	0	8.5	0	0	2080	0	0	845
BOG									
(Oregon Jack Creek)	1	1	5	42	42	1225	17	17	495
RIPARIAN									
(Hat Creek)	0	0	0	0	0	0	0	0	0

TABLE 4-28

RELATIVE NUMBERS OF PELLET GROUPS OR CHIPS IN SAMPLED WILDLIFE HABITATS

Map Unit	Pellet Group Ratios
Cattle	
Low Elevation Grassland	38.6
Mid Elevation Grassland	30.4
Sagebrush	7.4
Ponderosa Pine - Douglas-fir/Bunchgrass	6.2
Engelmann Spruce - Lodgepole Pine	4.0
Douglas-fir/Pinegrass	3.4
Bog	2.0
Alpine and High Elevation Grassland	1.0
Riparian	SEE TEXT
Deer	
Sagebrush	26.0
Engelmann Spruce - Lodgepole Pile	3.3
Ponderosa Pine - Douglas-fir/Bunchgrass	2.0
Alpine	1.0
Riparian	SEE TEXT
Moose	
Engelmann Spruce - Lodgepole Pine	1.0
Bog	SEE TEXT

Evidence of deer activity was concentrated in the sagebrush habitat in the north end of the Upper Hat Creek Valley (Tables 4-27 and 4-28 and Map 3-2). Calculations reveal that this unit provides approximately 29 deer days per hectare per year (Table 4-27). The degree of deer use, the vegetation composition, and the elevation (1000 m or 3280 ft.) of this habitat suggest that it is ar important winter range for deer in the surrounding area.

Transects in Engelmann spruce - lodgepole pine, ponderosa pine - Douglas-fir/ bunchgrass, and alpine habitats indicated some use by deer (Table 4-27). No deer pellet groups were found within the transect in the riparian habitat, however, deer tracks, deer pellet groups, and moderate browsing on several shrub species indicated that this habitat is definitely used by deer. Land use in the Hat Creek Valley has undoubtedly reduced the area of this habitat to its present small area. This is unfortunate for local wildlife species as this type of habitat is very productive.

Sparse evidence of moose activity was located in the Engelmann spruce - lodgepole pine habitat only (Tables 4-27 and 4-28). During the vegetation field surveys, it was noted that moose pellet groups were abundant in the bog habitats, particularly on Pavilion Mountain. These data suggest that there is a scarcity of moose in the drier, lower elevations of Hat Creek and indicate that the areas used by local moose were not adequately sampled in the spring 1977 pellet group survey.

(ii) Big Game Use of the Hat Creek Watershed

Canada Land Inventory mapping classifies 3,560 ha (8800 acres) of land in the lower Hat Creek watershed as class 3 deer winter range and 3,300 ha (8155 acres) as class 3 deer and moose winter range in the Upper Hat Creek watershed. It is important to note that the Canada Land Inventory system is based on land capability and does not consider present land use. This is an important consideration in the Hat Creek Valley because, although large areas are designated as deer and moose winter range, a considerable percentage of these

lands are heavily committed to agricultural use. This commitment not only reduces the wildlife productivity of these lands but it increases wild ungulate dependency on the remaining class 3 ranges not as totally committed to agricultural use. At the present time, the sagebrush habitat appears to be very important to local wintering deer. The ponderosa pine - Douglas-fir/bunchgrass habitat also provided good deer winter habitat. No areas of exceptional moose winter range in the Hat Creek watershed were identified by this project.

Based on the material presented in Section 4.8(b) it is evident that deer and moose are the most abundant big game ungulates in the Hat Creek watershed. However, the numbers of both species undoubtedly fluctuates considerably throughout the year. Deer numbers in the Hat Creek watershed are likely highest in the late summer and fall. As winter approaches, it is speculated that some of the deer move down into the north end of the Hat Creek Valley while others move east and west to the Thompson and Fraser River valleys, respectively. Moose numbers in the Hat Creek watershed likely peak in the fall. The area to the north and east of Hat Creek supports large numbers of moose. It is speculated that some of the moose found in the Hat Creek watershed originated in this area and travelled to the Hat Creek Valley during the fall. This movement of animals could be related to either the breeding season or dispersal by hunters, or both.

Other big game species found in the Hat Creek watershed include black bear, cougar and wolf. Very little information on any of these species was uncovered by this study. It is assumed that densities of the above species in the Hat Creek watershed approximate those found in the regional study area (Section 4.8(a)(ii).

(c) Consumptive Use

(i) Local Perspective

Locations of big game kills by hunters reporting to the Cache Creek Hunter

Check Station were plotted on 1:250,000 scale maps by the B.C. Fish and Wildlife Branch staff in Kamloops. Analysis of these data, with respect to Management Unit boundaries, revealed that an annual average of 33 deer, 8 moose and 1.5 black bear were reported to be harvested in Management Unit 3-17 (Table 4-29). The Hat Creek watershed provided 28 percent of the deer, 34 percent of the moose and 13 percent of the black bear harvest of the total annual big game harvest in Management Unit 3-17 (Map 4-1). The north end of the Upper Hat Creek Valley (i.e., the watersheds of Medicine and Anderson creeks) accounted for 38 percent of the deer and 63 percent of the moose reported to be harvested in the entire Hat Creek watershed. Within the Upper Hat Creek Valley this northern portion accounted for 70 percent of the deer and 85 percent of the moose reported killed between 1969 and 1974. The Cornwall Creek area, which is the watershed east of Medicine Creek, provides annual deer harvests slightly less than those reported for the Medicine and Anderson drainages (Table 4-29).

Two independent sources of relevant big game harvest information are collected by the B.C. Fish and Wildlife Branch. The Cache Creek Hunter Check collects data on big game species being transported past the station. Species harvested in the area but not passing the station and species being transported when the station is closed are not included in the sample. The Branch also estimates the numbers of big game species harvested within each Management Unit (or Game Management Area). In Game Management Area 14 between 1971 and 1974, for every mule deer reported at Cache Creek to be harvested by resident hunters, 13.6, 8.8, 6.4, and 10.2 respectively, deer were estimated by the hunter questionnaires to have been harvested (average ratio was 1 to 9.75). For moose, the ratio was 1 to 3.5, and for black bear, the ratio was 1 to 5.9. These figures indicate that approximately 11 percent of the deer harvested in Game Management Area 14 are checked through Cache Creek. A higher percentage of the estimated moose (29 percent) and black bear (17 percent) harvest are checked through Cache Creek.

These data suggest that resident hunters who do not have to pass the Cache

TABLE 4-29

AVERAGE RESIDENT BIG GAME HUNTER KILLS FOR MANAGEMENT UNIT 3-17 AND FOR THE HAT CREEK WATERSHED FROM 1969 TO 1974 DATA COLLECTED AT CACHE CREEK HUNTER CHECK STATION AND MAPPED BY KAMLOOPS OFFICE OF B.C. FISH AND WILDLIFE BRANCH

SPECIES	SPECIAL AREAS		HAT CREEK WATERSHED		MANAGEMENT UNIT 3-17		
	Medicine & Anderson Creeks	Cornwall Creek	Upper	Lower	North of Hwy. 12	South of Hwy. 12	Total
Mule Deer	3.5	2.5	5	4.3	18	15	33
Moose	1.7	2.0	2	0.7	2	6	8
Black Bear	0	0.2	0.2	0	1	0.5	1.5

Creek station take a high percentage of the deer harvest (89 percent), while residents who do pass the station take approximately one-third of the moose harvest (29 percent). Application of the estimated resident hunter harvest ratios to the data in Table 4-29 produce harvest numbers for some big game species in Management Unit 3-17 and for the Hat Creek watershed (Table 4-30).

(ii) Regional and Provincial Perspective

The study area referred to in this section includes the B.C. Fish and Wildlife Branch Game Management Areas 4, 14 and 15 (Map 3-4). Game Management Area 4 is part of the Cariboo - Chilcotin Resident Area, while the latter two are included in the Kamloops Resident Area (Map 4-4). A considerable portion of Game Management Area 15 extends to the east of the regional study area boundary, however, it was taken into consideration because it includes a large area in the Lytton - Merritt - Kamloops area.

Area measurements of each Game Management Area, in relation to the study area and the province, are presented in Table 4-31. Game Management Area 14 is the largest of the three (42 percent of the study area) followed by Game Management Area 15 (32 percent) and Game Management Area 4 (26 percent). Game Management Areas 4, 14 and 15 account for 4.7 percent of the area of British Columbia (1.2 percent, 2.0 percent and 1.5 percent respectively).

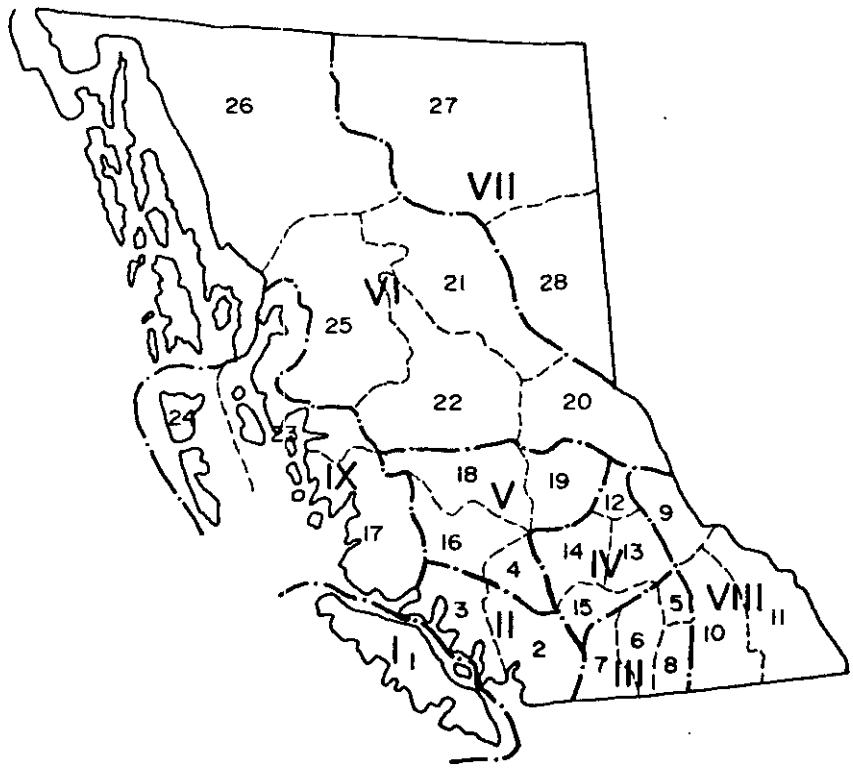
A. Resident Hunting

B.C. Fish and Wildlife Branch estimates of the numbers of hunters hunting in Game Management Areas 4, 14 and 15, as compared to the rest of the province are presented in Table 4-32. Over 15 percent of the estimated number of resident hunters in B.C. hunt these areas even though they account for approximately 4.7 percent of the land area of the province (Tables 4-31 and 4-32). Deer attract the greatest number of hunters, followed by moose, goat, and sheep (Table 4-32). There were no reports of caribou or elk being hunted in the study area for the period 1970 to 1974.

TABLE 4-30

NUMBERS OF DEER, MOOSE AND BLACK BEAR ESTIMATED TO BE HARVESTED IN MANAGEMENT UNIT 3-17 AND THE HAT CREEK WATERSHED. BASED ON CACHE CREEK CHECK STATION AND HUNTER RETURN QUESTIONNAIRE DATA

SPECIES	SPECIAL AREAS		HAT CREEK WATERSHED		MANAGEMENT UNIT 3-17		
	Medicine & Anderson Creeks	Cornwall Creek	Upper	Lower	North of Hwy. 12	South of Hwy. 12	Total
Mule Deer	34	24	49	42	176	146	322
Moose	6	7	7	2	7	21	28
Black Bear	0	1	1	0	6	3	9



	Residence Area	Game Management Areas
I	Vancouver Island	1
II	Lower Mainland	2, 3
III	Okanagan	5, 6, 7, 8
IV	Kamloops	12, 13, 14, 15
V	Cariboo - Chilcotin	4, 16, 18, 19
VI	Northern	20, 21, 22, 25, 26
VII	Peace River	27, 28
VIII	Kootenays	9, 10, 11
IX	Upper Coast	17, 23, 24

MAP 4-4

RESIDENCE AREAS AND GAME MANAGEMENT AREAS OF BRITISH COLUMBIA

TABLE 4-31

SIZE OF GAME MANAGEMENT AREAS
ADJACENT TO PROPOSED HAT CREEK DEVELOPMENT

	Game Management Area 4	Game Management Area 14	Game Management Area 15	Total
Square Kilometres	11,310	18,668*	13,754*	43,732
Percent of Total	26	42	32	100
Percent of British Columbia	1.2	2.0	1.5	4.7

* Figures provided by R. Ritcey of the Kamloops Office of the B.C. Fish and Wildlife Branch

TABLE 4-32

ESTIMATED ANNUAL NUMBER OF HUNTERS HUNTING
GAME MANAGEMENT AREAS 4, 14 AND 15
AS COMPARED TO TOTALS FOR B.C.
Figures based on 5 Year Average (1970 to 1974)
From B.C. Fish and Wildlife Branch Hunter Survey Questionnaires

	Game Management Areas 4, 14, and 15	Provincial Average	Percent of Provincial Average
Deer Hunters	20,068	113,485	17.7
Moose Hunters	4,736	46,335	10.2
Goat Hunters	326	2,825	11.5
Sheep Hunters	87	1,278	6.8
Total Hunters	25,217	163,923	15.4

The B.C. Fish and Wildlife Branch estimates that in Game Management Areas 4, 14 and 15 approximately 25,200 hunters (Table 4-32) harvest more than 7620 ungulates, or (Table 4-33) 11.7 percent of the estimated ungulate harvest in British Columbia.

The resident area and estimates of numbers of deer, moose, goat and sheep hunters hunting in Game Management Areas 4, 14 and 15 are summarized in Tables 4-34, 4-35, 4-36, and 4-37, respectively. The largest percentage of deer and moose hunters reside in the Kamloops area with the second largest number residing in the Lower Mainland area (Tables 4-34 and 4-35). The largest percentage of goat and sheep hunters reside in the Lower Mainland area with the second largest number residing in the Kamloops area (Tables 4-36 and 4-37). Hunters residing in the Kamloops and Lower Mainland areas accounted for over 80 percent of the ungulate hunters estimated to be hunting in Game Management Areas 4, 14 and 15 between 1970 and 1974. The following section of the report analyzes the contribution that each of the three Game Management Areas makes to the total study area.

Game Management Area 4

Game Management Area 4 encompasses some 11,310 km^2 (4367 sq. mi.) and covers 26 percent of the total of the three Game Management Areas and 1.2 percent of the area of British Columbia (Table 4-31). Of the three, this Game Management Area produces the highest number of mountain goat and grizzly bear harvested (Table 4-38). Over 70 percent of the goat hunters hunting this area reside in the Lower Mainland (Table 4-39).

The largest proportion of sheep hunters are reported to hunt this area (Table 4-40) despite the fact that the estimated numbers of sheep harvested is lower than in Game Management Areas 14 and 15 (Table 4-38).

Game Management Area 14

Game Management Area 14 encompasses some 18,668 km^2 (7208 sq. mi.) and accounts

TABLE 4-33

ESTIMATED ANNUAL NUMBER OF UNGULATES HARVESTED DURING 1970 - 1974 FROM GAME MANAGEMENT AREAS 4, 14, AND 15 IN COMPARISON WITH TOTALS FROM B.C.
Data from B.C. Fish and Wildlife Branch Hunter Survey Questionnaire

	Game Management Areas 4, 14, and 15	Provincial Average	Percent of Provincial Average
Deer	6,459	46,616	13.9
Moose	1,053	15,044	7.0
Goat	104	900	11.6
Sheep	7	210	3.3
Caribou	0	971	0.0
Elk	0	1,175	0.0
Totals	7,623	64,916	11.7

TABLE 4-34

ESTIMATED NUMBER OF DEER HUNTERS HUNTING
IN GAME MANAGEMENT AREAS 4, 14 AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent of Resident Area Hunters Hunting in Study Area
Kamloops	8,692**	68.7**
Lower Mainland	7,951	26.9
Cariboc-Chilcotin	1,157	18.7
Okanagan	1,398	11.2
Vancouver Island	509	2.3
Northern British Columbia	156	1.7
Kootenay	124	1.0
Upper Mainland Coast	63	1.5
Peace River	31	0.8
Total	20,068***	

* Figures taken from B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** An estimated 8,692 deer hunters residing in Kamloops Area hunt deer in Game Management Areas 4, 14, and 15 which represents 68.7 percent of the Kamloops Resident Area deer hunters

*** This figure represents 17.8 percent of B.C. resident deer hunters.

TABLE 4-35

ESTIMATED NUMBER OF MOOSE HUNTERS HUNTING
IN GAME MANAGEMENT AREAS 4, 14 AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent of Resident Area Hunters Hunting in Study Area
Kamloops	2,372	50.1
Lower Mainland	1,681	15.7
Okanagar	324	14.0
Cariboo-Chilcotin	139	4.5
Vancouver Island	103	3.1
Peace River	47	0.7
Kootenays	35	1.3
Northern British Columbia	29	0.2
Upper Mainland Coast	8	0.3
Total	4,736**	

* Figures taken from B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** This figure represents 10.2 percent of B.C. resident moose hunters.

TABLE 4-36

ESTIMATED NUMBER OF GOAT HUNTERS HUNTING
IN GAME MANAGEMENT AREAS 4, 14 AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent of Resident Area Hunters Hunting in Study Area
Lower Mainland	234	71.8
Kamloops	59	18.1
Cariboo-Chilcotin	19	5.8
Okanagan	8	2.5
Vancouver Island	5	1.5
Upper Mainland Coast	1	0.3
Total	326**	

* Figures taken from B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** This figure represents 12.3 percent of B.C. resident goat hunters.

TABLE 4-37

ESTIMATED NUMBER OF SHEEP HUNTERS HUNTING
IN GAME MANAGEMENT AREAS 4, 14 AND 15

Resident Area	Estimated Number of Hunters*	Percent of Resident Area Hunters Hunting in Study Area
Lower Mainland	42	48.3
Kamloops	29	33.4
Cariboo-Chilcotin	9	10.4
Okanagan	4	4.6
Vancouver Island	2	2.2
Kootenay	1	1.1
Totals	87**	

* Figures taken from B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** This figure represents 7.3 percent of B.C. resident sheep hunters.

TABLE 4-38

AVERAGE ESTIMATED NUMBER OF BIG GAME SPECIES HARVESTED, CONTRIBUTION TO THE PROVINCIAL HARVEST AND HUNTER-DAYS PROVIDED IN AREAS 4, 14 AND 15

Figures based on five-year average from B.C. Fish and Wildlife Branch Game Harvest Questionnaires (1970 - 1974) except where specified otherwise

	Game Management Area	Estimated Number Harvested Per Year	Percent of Study Area Harvest	Percent of Provincial Harvest	Avg. No. of Days to Harvest 1 Animal*	Est. No. of Hunter Days Provided
Deer	4	1,075	16.7	2.4	12.2	13,115
	14	3,607	55.8	7.6		44,005
	15	1,777	27.5	3.6		21,680
	Totals	6,459	100.0	13.6		78.800
Moose	4	28	2.8	.2		600
	14	793	75.5	5.2		16,970
	15	232	23.2	1.5	21.4	4,965
	Totals	1,053	100.0	6.9		22,534
Goat	4	95	92.4	10.3		1,634
	14	7	5.7	.6		120
	15	2	1.9	.3	17.2	34
	Totals	104	100.0	11.2		1,868
Sheep	4	0	0	0		0
	14	6	87.5	2.5	46.8	281
	15	1	12.5	.5		47
	Totals	7	100.0	3.0		328
Grizzly** Bear	4	3.3	52.4	2.2		75
	14	1	15.9	.4	34.0	14
	15	2	31.7	.8		27
	Totals	6.3	100.0	3.4		116
Wolf**	4	6.5	8.8	0.6		
	14	43.0	57.9	4.4	?	?
	15	24,8	33.3	2.5		
	Totals	74.3	100.0	7.5		
Cougar**	4	0	0.0	0		
	14	15	100.0	5.7	?	?
	15	0	0.0	0		
	Totals	15	100.0	5.7		
TOTAL VALUE						

* Figures provided by Pearse Bowden[46] for years 1970 - 1971

** Four year average 1971-1974

TABLE 4-39

RESIDENCY AND ESTIMATED NUMBER OF GOAT HUNTERS HUNTING IN GAME MANAGEMENT AREAS 4, 14, AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent Composition of Hunters by Residency
Game Management Area 4		
Lower Mainland	215	73.6
Kamloops	55	18.9
Cariboo-Chilcotin	17	5.8
Vancouver Island	5	1.7
Total	292	
Game Management Area 14		
Lower Mainland	13	72.2
Kamloops	3	16.7
Cariboo-Chilcotin	2	11.1
Total	18	
Game Management Area 15		
Lower Mainland	6	75.0
Kamloops	1	12.5
Okanagan	1	12.5
Total	8	

* Figures provided by B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive.

TABLE 4-40

RESIDENCY AND ESTIMATED NUMBER OF SHEEP HUNTERS HUNTING IN GAME MANAGEMENT AREAS 4, 14, AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent Composition of Hunters by Residency
Game Management Area 4		
Lower Mainland	25	59.2
Kamloops	9	21.3
Cariboo-Chilcotin	6	14.2
Vancouver Island	1	2.4
Kootenay	0.2	0.5
Total	42.2**	
Game Management Area 14		
Kamloops	19	47.5
Lower Mainland	15	37.5
Cariboo-Chilcotin	3	7.5
Vancouver Island	1	2.5
Total	40***	
Game Management Area 15		
Lower Mainland	2	50.0
Okanagar	1	25.0
Kamloops	1	25.0
Total	4****	

* Figures provided by B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** This figure represents 3.5 percent of the B.C. resident sheep hunters

*** This figure represents 3 percent of the B.C. resident sheep hunters

**** This figure represents 0.4 percent of the B.C. resident sheep hunters.

for 42 percent of the total of the three areas and 2.0 percent of the area of British Columbia (Table 4-31). The highest numbers of deer, moose, sheep, wolves and cougar harvested in the study area come from the area (Table 4-38). The largest number of sheep, deer and moose hunters reside in the Kamloops area (Table 4-40, 4-41 and 4-42) while the largest number of goat hunters reside in the Lower Mainland (Table 4-39).

Game Management Area 15

Game Management Area 15 encompasses some 13,754 km^2 (5311 sq. mi.) and accounts for 32 percent of the total area of the three Game Management Areas and 1.5 percent of the area of British Columbia (Table 4-31). Substantial numbers of deer, moose, grizzly bear and wolves are harvested in this area (Table 4-38). The largest percentage of goat and sheep hunters attracted to the area reside in the Lower Mainland (Tables 4-39 and 4-40) while the largest proportion of deer and moose hunters reside in the Kamloops Area (Tables 4-41 and 4-42).

B. Non-Resident Hunting

B.C. Fish and Wildlife Branch summaries of returns of guided residents and guided non-residents hunting in the province are presented in Table 4-43. Game Management Area 4 supports the second highest number of guides in the study area. Deer (14), goat (7), mountain sheep (2), black bear (2), moose (1), and grizzly bear (0.5) are species, in decreasing order of abundance, that are harvested in this area. Bracketed figures represent annual averages.

Game Management Area 14 supports the highest numbers of guides (Table 4-43). Moose (93) are by far the most abundant big game species harvested, followed by deer (17), black bear (5), and sheep (1). Game Management Area 15 supports the lowest number of guides in the study area. Moose (1) and deer (1) are the two species reported to be harvested. Bracketed figures represent annual averages.

On a provincial average basis, the three Game Management Areas support a

TABLE 4-41

RESIDENCY AND ESTIMATED NUMBER OF DEER HUNTERS HUNTING IN GAME MANAGEMENT AREAS 4, 14, AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent Composition of Hunters by Residency
Game Management Area 4		
Lower Mainland	1,626	59.9
Cariboc-Chilcotin	671	24.7
Kamloops	207	7.6
Vancouver Island	117	4.3
Okanagan	58	2.1
Northern British Columbia	27	1.0
Upper Mainland Coast	8	0.3
Kootenay	3	0.1
Total	2,717**	
Game Management Area 14		
Kamloops	4,989	44.9
Lower Mainland	4,918	44.3
Cariboo-Chilcotin	456	4.1
Vancouver Island	280	2.5
Okanagan	256	2.3
Northern British Columbia	97	0.9
Kootenay	39	0.4
Upper Mainland Coast	26	0.3
Peace River	28	0.3
Total	11,085***	

TABLE 4-41 (Continued)

Resident Area of Hunter	Estimated Number of Hunters*	Percent Composition of Hunters by Residency
Game Management Area 15		
Kamloops	3,496	55.7
Lower Mainland	1,407	22.5
Okanagan	1,084	17.3
Vancouver Island	112	1.8
Kootenay	82	1.3
Northern British Columbia	32	0.5
Cariboo-Chilcotin	30	0.5
Upper Mainland Coast	19	0.3
Peace River	3	0.1
Total	6,265****	

* Figures provided by B.C. Fish and Wildlife Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** This figure represents 2.4 percent of B.C. resident deer hunters

*** This figure represents 9.9 percent of B.C. resident deer hunters

**** This figure represents 5.5 percent of B.C. resident deer hunters.

TABLE 4-42

RESIDENCY AND ESTIMATED NUMBER OF MOOSE HUNTERS HUNTING IN GAME MANAGEMENT AREAS 4, 14, AND 15

Resident Area of Hunter	Estimated Number of Hunters*	Percent Composition of Hunters by Residency
Game Management Area 4		
Lower Mainland	75	62.4
Cariboo-Chilcotin	21	17.5
Kamloops	11	9.2
Vancouver Island	8	6.7
Okanagan	3	2.5
Kootenay	2	1.7
Total	120	
Game Management Area 14		
Kamloops	1,670	47.8
Lower Mainland	1,422	40.6
Okanagan	123	3.5
Cariboo-Chilcotin	110	3.1
Vancouver Island	79	2.3
Peace River	47	1.3
Northern British Columbia	23	0.7
Kootenay	19	0.5
Upper Mainland Coast	7	0.2
Total	2,500***	

TABLE 4-42 (Continued)

Resident Area of Hunter	Estimated Number of Hunters*	Percent Composition of Hunters by Residency
Game Management Area 15		
Kamloops	691	61.8
Okanagan	198	17.7
Lower Mainland	184	16.5
Vancouver Island	16	1.4
Kootenay	14	1.3
Cariboo-Chilcotin	8	0.7
Northern British Columbia	6	0.5
Upper Mainland Coast	1	0.1
Total	1,118****	

* Figures provided by B.C. Fish and Wildlife Branch Game Harvest Questionnaire Analyses 1970 to 1974 inclusive

** This figure represents 0.2 percent of B.C. resident moose hunters

*** This figure represents 7.6 percent of B.C. resident moose hunters

**** This figure represents 2.5 percent of B.C. resident moose hunters.

TABLE 4-43

SUMMARY OF GUIDED HUNTER ACTIVITY
IN GAME MANAGEMENT AREAS 4, 14, AND 15 DURING 1970 AND 1972 TO 1974 HUNTING SEASONS*

Year	G.M.A.	No. of Guides	No. of Assocs.	Resident Hunters	Non. Res. Hunters	Moose	Goat	Deer	Sheep	Grizzly Bear	Black Bear	Cougar
1970	4	9	8	6	32	3	12	22	1	1	3	1
	14	34	37	10	362	151		34			8	
	15	5	1	0	7	3		2				
	Total	48	46	16	401	157	12	58	1	1	11	1
	Prov. Total	585	861	172	6548	3175	607	335	438	230	290	21
1972	4	6	6		25		5	8	4	1	1	
	14	23	24	10	231	85		13	3		3	
	15	4		1								
	Total	33	30	11	256	85	5	21	7	1	4	0
	Prov. Total	545	847	98	6198	2844	451	187	380	173	347	45
1973	4	8	8		30		8	21			1	1
	14	22	10	5	219	86		15	1		7	
	15	4	1		2	2						
	Total	34	19	5	251	88	8	36	1		8	1
	Prov. Total	533	958	89	6110	2775	538	198	346	201	337	27
1974	4	5	1	1	19		2	5	3		1	
	14	17	7		97	48		4			1	1
	15	1			1							
	Total	23	8	1	117	48	2	9	3		2	1
	Prov. Total	468	808	89	4036	1787	372	82	283	136	233	26
Study Area Avg.		35	26	8	256	95	7	31	3	1	6	1
Prov. Avg.		538	869	111	5723	2645	492	200	362	185	302	30
Percent of Prov. Avg.		6	3	7	4.5	3.6	1.4	15.5	1	.5	2	3.3

* Figures provided by B.C. Fish and Wildlife Branch 1970 to 1974 Game Harvest Questionnaire Analyses (data not available for 1971).

slightly above average number of guides (6 percent) in relation to its land area (4.7 percent)(Tables 4-43 and 4-31, respectively). These guides attract an average number of non-resident hunters (4.5 percent) in relation to the study area size and harvest far above average numbers of deer (15.5 percent of provincial average) and below average numbers of moose (3.6 percent of provincial average), cougar, goats and sheep.

Regardless of the fact that low numbers of grizzly bear are harvested in the study area (0.5 percent of the B.C. provincial average), the presence of this species in conjunction with Rocky Mountain and California bighorn sheep and mountain goats makes the area attractive to non-resident hunters.

In 1966 the average non-resident hunter hunting in British Columbia spent $568 of which $345 was paid to his guide and $90 directly to the provincial government for hunting priviledges. The remaining $133 was spent on food, alcohol, lodging, taxidermy, meat storage, and special equipment[46].

Game Management Areas 4, 14 and 15 average 256 non-resident hunters over the years 1970 and 1972 to 1974 (Table 4-43). Based on 1976 prices, this would be worth approximately $154,875 to local guides, $40,250 to the provincial government and $50,500 to local merchants annually. Trophy fee increases of from 1.5 times (caribou) to eight times (black bear) since 1968 have the potential effect of, at least temporarily, reducing the number of non-resident hunters hunting in the province. As the new fees become accepted, they provide an increase in revenue to the provincial government.

4.9 NON-CONSUMPTIVE WILDLIFE USE

In comparison to other interior localities such as Ashcroft - Cache Creek, Kamloops, 100 Mile House, or the Okanagan Valley, very few sight records or nest records for the Hat Creek Valley were on file in the B.C. Provincial Museum's records. As the B.C. Provincial Museum nest and sight record schemes solicit records from all interested amateur birdwatchers in the province, the lack of Hat Creek records strongly implies that the valley is not used very

much for recreational birdwatching.

Apparently, the nearest active naturalists club is in Kamloops, although some naturalists may be active in Lillooet and Clinton. The Kamloops Naturalists Club publishes a checklist of birds[20] which includes a map portraying the area covered by the list. The observation that Hat Creek lies just outside the Kamloops bird area, whereas the northern limit of the area extends to Wells Gray Park, is of significance. Evidently, birdwatchers from Kamloops are willing to travel as far as Cache Creek to view birds but are not normally willing to travel the additional distance to Hat Creek.

We judged the Hat Creek Valley to be a superior area in which to observe birds. Birds are abundant, diverse and, in the open forests and rangelands, easily visible. Additionally, the Hat Creek avifauna includes species that are either not found elsewhere (e.g. Williamson's sapsucker) or are not as easily found. The potential for recreational nature watching is high, but this resource appears to be unutilized.

Our opinion is that limited access is, in part, responsible for the low level of non-consumptive wildlife use in the Hat Creek Valley. Except for the road to the Cornwall Peak fire lookout, most of the Hat Creek Valley is fenced, privately controlled land. The impression one gets when driving through the valley is that one would be intruding were one to stop, get out of the vehicle, and look around. Discussions with Upper Hat Creek residents also indicated that residents have always actively discouraged recreational activities of non-residents within the valley. People attempting to use the Upper Hat Creek Valley for nature enjoyment would be stopped and interrogated by passing locals, an experience that would discourage most recreationalists from returning.

4.10 RARE AND ENDANGERED SPECIES

The concepts of rare species and of endangered species differ in a fundamental way. The biological concept of rarity pertains to the distribution and

abundance of a species. Specifically, a rare species is one whose numbers are either widely separated into small sub-populations with reduced inter-breeding, or are restricted to a single population. Species which are common elsewhere, but rarely encountered within the local or regional study area are not considered to be rare or endangered within the context of this report. The concept of an endangered species is biologically meaningful only in context of existence through time. Hence, an endangered species is one whose reproductive potential is threatened.

With these definitions, a rare species is not necessarily endangered, nor is an endangered species necessarily rare. In accepted usage, a species considered as a "rare species" is not endangered, but may be vulnerable owing to its low numbers. "Endangered species" are in immediate danger of extinction (i.e. the particular gene pool which comprises the species or sub-species is immediately subject to being irrevocably lost), and these are categorized as vulnerable, threatened, or critically endangered, depending on the degree of vulnerability.

The terrestrial vertebrates listed (Table 4-44) and discussed in this section are rare or endangered species in the regional study area. The list is based on compilations of the Canadian Wildlife Service and National Museum of Canada[54], Canadian Wildlife Federation[48, 50, 51, 52], the International Union for Conservation of Nature and Natural Resources[76], and other published accounts[21, 22, 47, 48, 68]. The context or frame of reference (perspective) in which they are considered rare or endangered is stated in the following list.

(a) Tailed Frog (*Ascaphus truei*)

The tailed frog is unique among amphibians in that it breeds in torrent streams. It is a member of an archaic taxonomic group now represented only by itself and by a species in New Zealand. The tailed frog is not considered endangered, but is listed because it has been rarely collected in southwest British Columbia and because of its special biology and taxonomic status.

TABLE 4-44

RARE AND ENDANGERED SPECIES PROBABLY OCCURING WITHIN THE REGIONAL STUDY AREA

Species	Status	Perspective	Reference
Tailed Frog *(Ascaphus truei)*	Rare	Canada	*48*
Gopher Snake *(Pituophis melanoleuous catenifer)*	Rare	Canada	*48, 52. 54*
Cougar *(Felis concolor)*	Vulnerable	Canada	*54*
Grizzly bear *(Ursus arctos horribilis)*	Vulnerable	Canada	*54*
Wolf *(Canis lupus)*	Vulnerable	Canada	*76*
Californ ia bighorn sheep *(Ovis canadensis californiana)*	Vulnerable	Canada	*51, 54, 76*
Common Loon *(Gavia immer)*	Vulnerable	Canada	*54*
Prairie falcon *(Falco mexicanus)*	Endangered	Canada	*49, 54*
Peregrine falcon *(Falco peregrinus)*	Vulnerable Endangered	British Columbia Eastern Canada	*76* *47, 49, 50, 54*
Osprey *(Pandion haliaetus)*	Endangered	Canada	*54*
Bald eagle *(Haliaeetus leucocephalus)*	Vulnerable	Canada	*50, 54*
White pelican *(Pelicanus erythrorhynchos)*	Vulnerable Endangered	Canada British Columbia	*54*
Trumpeter swan *(Olor buccinator)*	Rare (but increasing)	World	*47, 76*

(b) Gopher Snake (*Pituophis melanoleucus catenifer*)

The gopher snake occurs only marginally in British Columbia in the warm, interior dry belt[01]. Its habitat in British Columbia is found wherever small mammals abound at lower elevations, below 610 m (2000 ft.). The species was probably never abundant in British Columbia and is a common reptile in the western United States.

(c) Cougar (*Felis concolor*)

Although the particular sub-species of cougar found in Hat Creek Valley (*Felis concolor oregonensis*) is not considered rare or endangered, the range and numbers of the species as a whole in Canada have diminished rapidly mainly because of overhunting[54]. The species is confined mainly to forested regions in British Columbia and Alberta. Historically, it had the greatest geographic range of any New World mammal[54]. The endangered sub-specied, *Felis concolor missoulensis*, probably occurs in the northern portion of the study area, but the details on exact sub-species borders or biological differences are not known[68]. Although beaver, rabbits, birds and mice comprise a portion of its diet, cougars depend primarily on deer for food.

(d) Grizzly Bear (*Ursus arctos horribilis*)

Like the cougar, the grizzly bear has its stronghold in the west, with most of the Canadian population found mainly in British Columbia and the Yukon. One of the endangered races, the Lillooet grizzly, occurs within the regional study area, mainly west of the Fraser River. Grizzly bears apparently were never abundant in the regional study area and because of heavy hunting pressure are now extremely rare or perhaps already extirpated. Although trophy hunting is a real threat to grizzly populations, the greatest threat at present is the encroachment of man on the large wilderness areas required to support grizzlies.

(e) Wolf (*Canis lupus*)

The wolf is not considered to be an endangered species in most of Canada, but

history has shown that wolves tend to be extremely vulnerable to the advance of civilization[76]. Wolves are endangered when humans decide that wolves can no longer be tolerated and act on that decision. That is, wolves are more vulnerable to the opinion men have of them than to any action of civilization per se.

(f) California Bighorn Sheep (*Ovis canadensis californiana*)

This sub-species of bighorn sheep is believed to have formerly occurred throughout most of the southern interior of British Columbia. It is now restricted to separate herds, like the Chilcotin-Riske Creek groups, the Vaseux Lake group, the Ashnola group, and other small groups, including several within the study area[57]. Decline in bighorn sheep numbers is in part attributable to meat and trophy hunting. Encroachment on their wilderness habitats has resulted in a drastic decrease in suitable habitat, which in turn makes for small populations which are more susceptible to the effects of parasites and epidemic diseases such as pneumonia. The most severe threats to bighorn populations are hunting, competition with domestic livestock for forage, and the transmission of diseases and parasites from domestic sheep to wild sheep[54]. Bighorn sheep are habitual in their utilization of summer and winter ranges, and conflict occurs when domestic livestock summer ranges overlap with bighorn winter ranges.

(g) Common Loon (*Gavia immer*)

As with other fish-eaters, pesticide and mercury poisoning is the greatest threat to common loons, although oil-spills and hunting are also causes for concern. Loons occur throughout Canada, but generally breed only in remote waters, usually only one pair to a lake. Pairs were sighted in McLean and Aleece lakes in the Hat Creek drainage, and appeared to have successfully bred there. Pesticide poisoning seems to be a bigger threat to loons in the eastern part of the species range, but the potential is high everywhere, especially because loons do not breed until they are four or five years old[54].

(h) Prairie Falcon (*Falco mexicanus*)

The Canadian range of the prairie falcon occurs along the southern border, from southeast British Columbia to southern Saskatchewan. In the regional study area, it occurs in arid plains and semi-desert habitat, albeit rarely. Waning falcon numbers is due primarily to the presence of pesticide residues (principally DDT, but also heptachlor, epoxide, and dieldrin), which result in soft-shelled eggs, embryo mortality, and a high incidence of nesting failures. The limited range of prairie falcons makes the species more susceptible to extinction than are species with wider distributions.

(i) Peregrine Falcon (*Falco peregrinus*)

The peregrine falcon has been the centre of a controversy regarding endangered and vanishing wildlife species in North America; it is on more lists of endangered species than any of the other species in Table 4-44[47, 49, 50, 54, 76]. The overall decline in numbers of peregrine falcons is generally believed to be the result of the accumulation of pesticides in the tissue of the birds, resulting in embryo mortality and in thin-shelled eggs which are subject to breakage and dehydration.

However, Beebe[77] contends that peregrine falcons are neither rare nor endangered in western Canada. Nevertheless, the species has been proven to be vulnerable, and DDT derivatives have been strongly implicated. Since peregrine falcons prey or migratory birds, they are not necessarily immune to the application of pesticides thousands of kilometres to the south. No peregrine falcon nests are recorded within the regional study area, but an individual was sighted in the Upper Hat Creek Valley during spring migration, and it is conceivable or even likely that peregrine falcons would or do nest within the regional study area.

(j) Osprey (*Pandion haliaetus*)

The osprey is a widely distributed (nearly cosmopolitan) bird of prey which is highly specialized to feed upon fish. Its exclusive fish diet makes the

osprey susceptible to pollution of the aquatic environment. In the past, drastic declines of osprey numbers have been recorded[54] and have been attributed to pesticide residue intoxication[47]. In British Columbia, ospreys are a common and, in places, even an abundant bird of prey and apparently have not declined as did eastern osprey populations[77]. The local study area provides almost none of B.C.'s habitat for ospreys (although one bird was seen during migration), but the regional study area provides many more waterbodies that contain a suitable fish population.

(k) Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is considered to be an endangered species over much of the North American continent. In some areas, bald eagle numbers have declined catastrophically as the result of persecution and of pesticide poisoning[54]. Because bald eagles are often scavengers, they are extremely susceptible to poisoning because they will eat flesh from animals that are debilitated by or have died from poisons. That fact notwithstanding, bald eagles are still common in British Columbia and probably occur in undiminished numbers[77]. In British Columbia, bald eagles are most abundant on the coast. Inland they are relatively uncommon but where they do occur they are associated with water (rivers and lakes) and tall trees[77]. The combination of water plus tall trees is infrequent in both the local and regional study areas, hence, bald eagles would be expected to be uncommon.

(l) White Pelican (*Pelicanus erythrorhynchos*)

Pelicans are large fish-eating birds which have proven to be extremely susceptible to pesticide poisoning[49]. The white pelican breeds primarily in the prairie provinces, but one colony is known to occur in B.C. at Stum Lake[54]. The white pelican is not believed to be in any immediate peril in Canada[54], but the fact that the B.C. population consists of only one breeding colony makes its continued existence extremely fragile. White pelicans would probably use the local and regional study areas only as they fly through during migration. Four individuals were observed during spring migration in the air

above Ashcroft.

(n) Trumpeter Swan (*Olor buccinator*)

Trumpeter swans were, in the 1930's, very rare; their numbers having been severely depleted by over-harvesting. Since that time, wildlife management and conservation measures were applied to the trumpeter swan and numbers have rapidly increased to the point where the species is often cited as an example of an animal that has been saved from extinction[49, 52]. Trumpeter swans migrate through the local study area and have been recorded from Hat Creek Valley wetlands. Presumably, even more occur in the regional study area, but no data are available regarding the distribution or abundance of trumpeter swans within the regional study area.

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APPENDIX A

GAME ANIMALS
AS RECOGNIZED BY THE BRITISH COLUMBIA FISH AND WILDLIFE BRANCH

APPENDIX A

GAME ANIMALS AS RECOGNIZED BY THE BRITISH COLUMBIA FISH AND WILDLIFE BRANCH

Big Game

Mountain sheep
Mountain goat
Caribou
Elk
Moose
Deer
Grizzly bear
Black bear
Cougar
Wolf

Or any mammal designated by regulation.

Game Bird

Grouse
Partridge
Quail
Pheasant
Ptarmigan
Migratory game bird

Or any bird designated by regulation.

Furbearer

Fox
Badger
Beaver
Marten
Fisher
Canada lynx
Bobcat
Mink
Muskrat
Land otter
Sea otter
Raccoon
Skunk
Red squirrel
Weasel
Wolverine
Wolf
Coyote

APPENDIX B

A REANALYSIS OF WILDLIFE CONSUMPTIVE USE PATTERNS BASED ON 1976 HUNTER SURVEY INFORMATION

TABLE OF CONTENTS

APPENDIX B

B1.0 INTRODUCTION

Prior to 1976, the B.C. Fish and Wildlife Branch managed provincial wildlife within 28 "Game Management Areas". In 1975 and 1976 these Game Management Areas were discarded and replaced by seven Regions. Each Region was further subdivided into Management Units (M.U.'s). These Management Units are smaller than were the old Game Management Areas and data collected by Management Units allows a greater degree of precision than was formerly possible.

When the production of the text of the wildlife inventory report was in progress, B.C. Fish and Wildlife Branch Hunter Survey Information was unavailable by Management Units. Subsequently, data from the 1976 Hunter Survey has become available. This appendix is intended to be a supplemental analysis of game harvests and hunter efforts and is intended to show more precisely the relevance of the proposed Hat Creek project to consumptive use patterns.

B2.0 METHODS

Two analysis areas are used in this appendix: the local analysis area and the regional analysis area. The local analysis area is defined by the boundary of B.C. Fish and Wildlife Branch Management Unit 3-17 and includes within it the local study area (see Section 2.2) and extends north and south to Clinton and Lytton, respectively (Figure B2-1). The regional analysis area has been chosen to approximate the regional study area (rectangle defined in Section 2.2 or 100 km (62 mi.) radius circle of the economic sector analysis), and includes 12 Management Units: 3-13, 3-14, 3-15, 3-16, 3-17, 3-18, 3-19, 3-29, 3-30, 3-31, 3-32, and 3-33 (Figure B2-1).

The residence of hunters is reported according to the seven Regions defined by the B.C. Fish and Wildlife Branch. These regions are numbered and named: Region 1, Vancouver Island; Region 2, Lower Mainland; Region 3, Thompson-Okanagan; Region 4, Kootenay; Region 5, Cariboo; Region 6, Skeena; and Region 7 Omineca-Peace. Region 3 is further broken down into six subregions, 3A, 3B, 3C, 3D, 3E, and 3F (Figure B2-2).

The Hunter Survey information used to produce this appendix is preliminary data based on one year's survey only, the first year in which these data have been collected by Management Units. Many apparent patterns could be spurious, and only replication of the survey in future years will eliminate this source of random sampling error. Thus, the conclusions reached from this Hunter Survey information should be tempered by rational judgment.

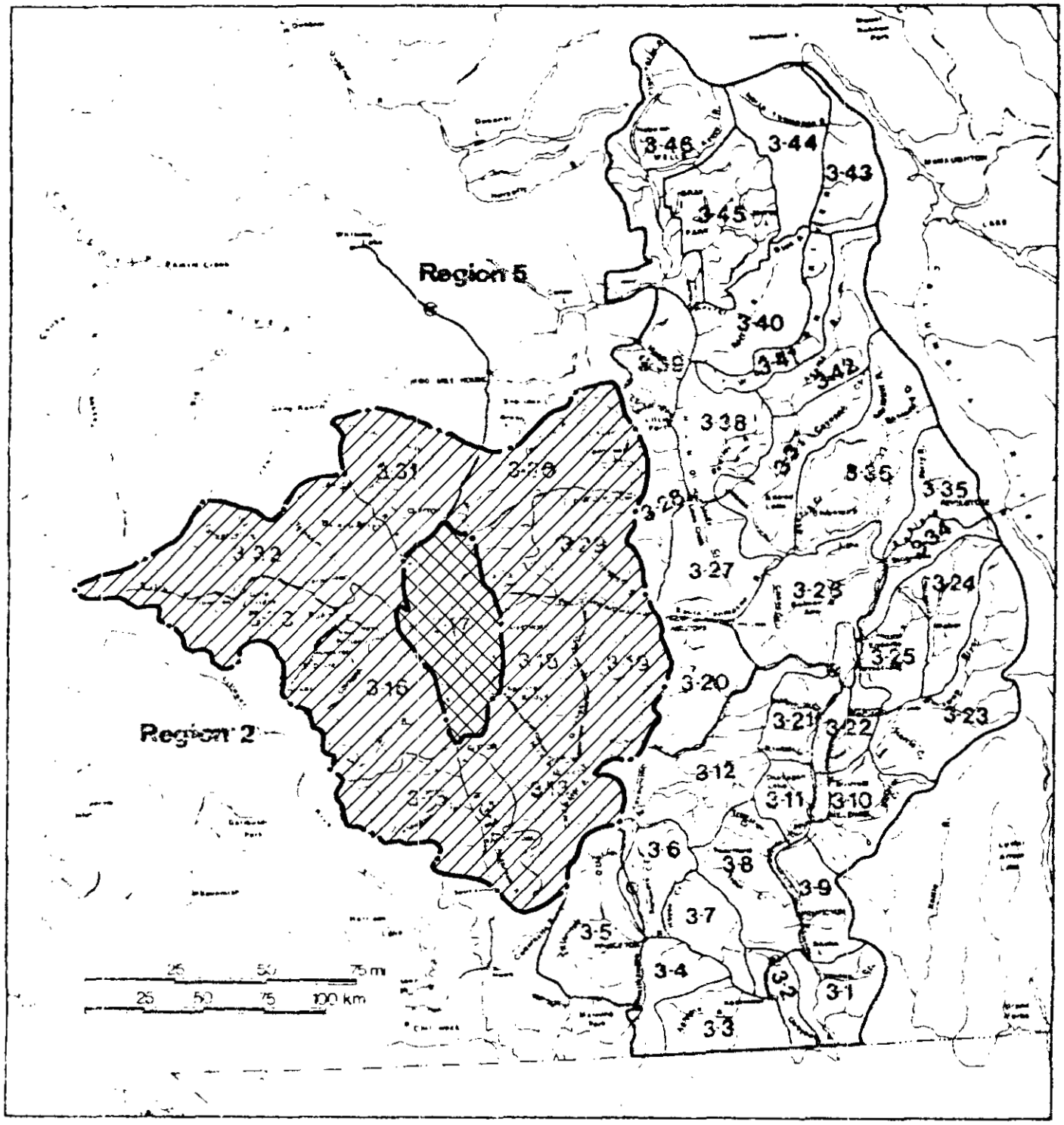


Figure B2-1

LOCAL AND REGIONAL ANALYSIS AREAS

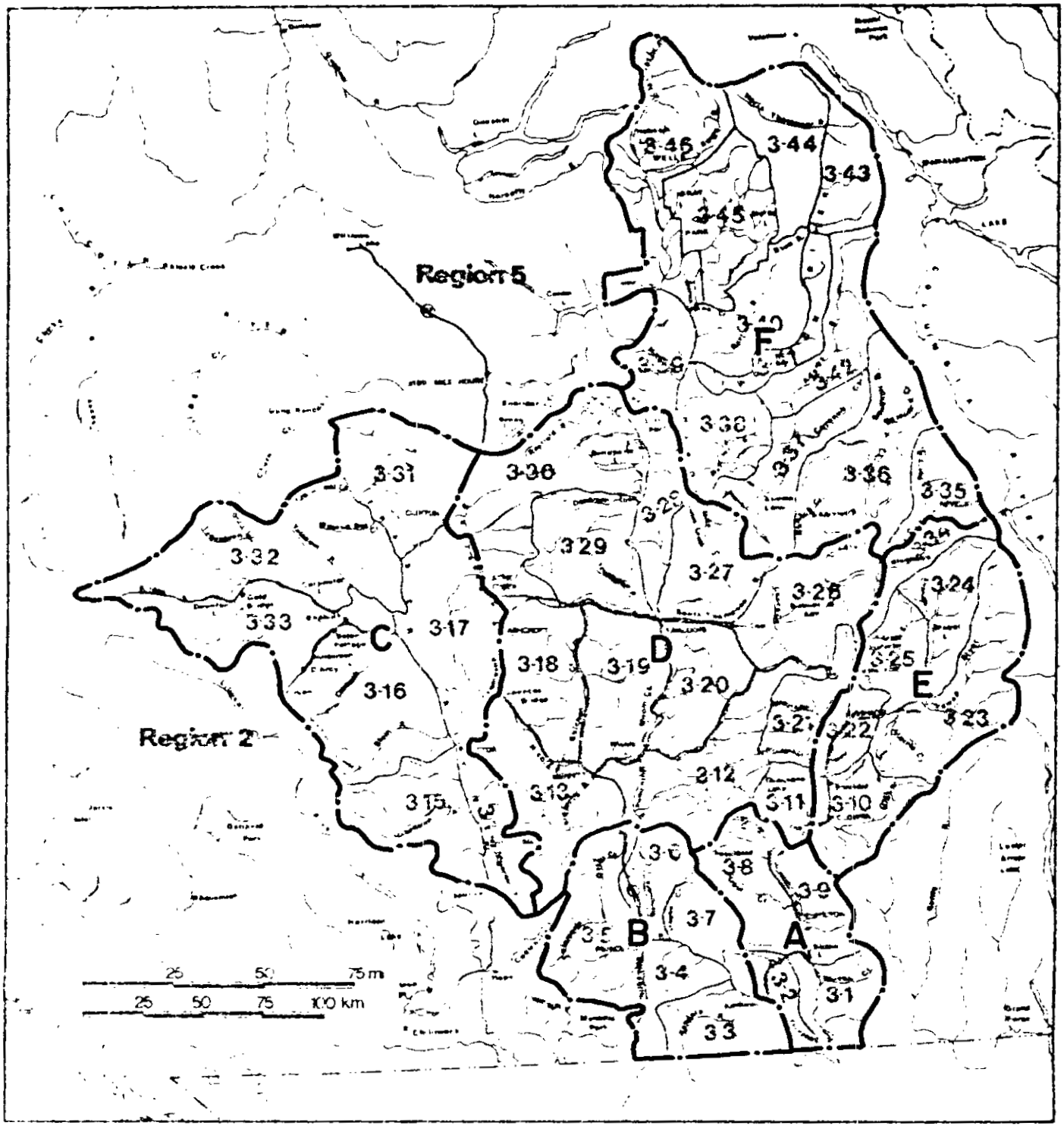


Figure B2-2

THOMPSON-OKANAGAN (REGION 3) HUNTER RESIDENCE SUBREGIONS

B3.0 RESULTS

B3.1 WATERFOWL

(a) Hunter Effort and Harvest

Information is currently only available for ducks with species breakdown not given. The estimated number of ducks harvested and the estimated number of duck hunters in each of the 12 Management Units in the regional analysis area are listed in Table B3-1.

The local analysis area, Management Unit 3-17, was estimated by the B.C. Fish and Wildlife Branch 1976 Hunter Survey to be of relatively minor importance in terms of both regional hunters and regional duck harvests. Only an estimated 4.4 percent of regional duck hunters chose to hunt in M.U. 3-17 and only 195 ducks or 2.1 percent of the regional duck harvest were estimated to have come from this Management Unit. These results are contrary to expectations and differ markedly from Canadian Wildlife Service estimates of 882 ducks from roughly the same area in 1976 (see Section 4.3(d)). Thus, two independent hunter surveys have produced estimates of 195 and 882 ducks from the same area in the same year.

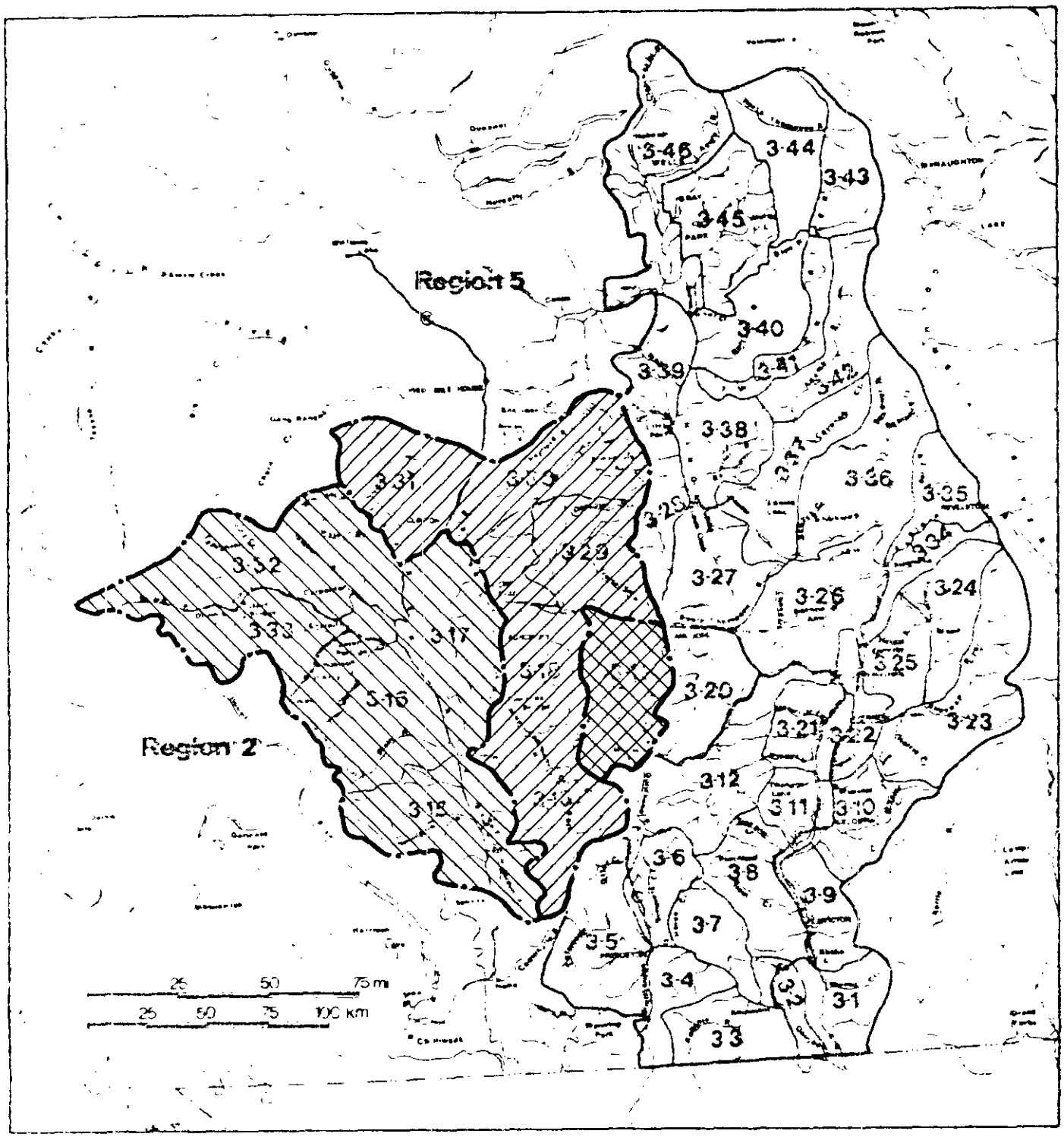
One would expect Hat Creek returns to show a small number of hunters and a relatively large harvest because access is limited, but chance of success should be good for those who can obtain access (mainly local residents). Surprisingly and perhaps erroneously, the Hunter Survey data indicate that the success rate of M.U. 3-17 hunters is relatively low compared to that of other Management Units. Two units, M.U. 3-14 and 3-15, have very high estimated success rates (12.2 and 36.5 respectively) compared to a mean success rate of 5.6 elsewhere in the regional analysis area. The results of the preliminary duck harvest information received appear to be somewhat unusual. For this reason, we have chosen our waterfowl analysis based on the estimated numbers of duck hunters.

By far the most popular Managemert Unit for duck hunters within the regional analysis area is M.U. 3-19, the area southeast of Kamloops. Nearly 30 percent of the 1976 regional duck hunting occurred in M.U. 3-19 and more than one-third of the estimated 1976 regional duck harvest also came from this unit. Five more Management Units, 3-13, 3-18, 3-29, 3-30, 3-31 each contain an additional 11 - 13 percent of the estimated regional hunter effort for a combined total of more than 60 percent. These five, plus M.U. 3-19, account for over 90 percent of the estimated regional duck hunter effort, leaving less than 10 percent spread among the other six Management Units (see Figure B3-1 for graphic representation).

The total estimated duck harvest in the regional analysis area in 1976 was 9229 ducks. This compares with a B.C. provincial total of approximately 231,000 ducks[1] or 244,000 ducks (B.C. Fish and Wildlife Branch, 1976 estimate). Thus, the regional analysis area appears to have accounted for approximately four percent of the B.C. provincial total in 1976.

(b) Hunter Residence

The data summarized in Table B3-2 clearly show that duck hunters in the local and regional analysis areas are mostly locals. In the local analysis area almost 96 percent of the duck hunters were from either subregion 3C, including Lillooet and Hat Creek (58 percent), or subregion 3D, including Cache Creek, Ashcroft, and Kamloops (38 percent). The remaining four percent were from Vancouver Island. Regional hunters were also predominantly locals as nearly 69 percent originated from within subregions 3C and 3D. The majority of the non-locals who hunted ducks within the regional analysis area were from the Lower Mainland (an estimated 19.5 percent of the total). Another five percent came from Cariboo-Chilcotin (Region 5), and very few came from elsewhere in the province.



High Hunter Use
> 15% of Regional Analysis Area Total Effort

Moderate Hunter Use
6% to 15% of Regional Analysis Area Total Effort

Low Hunter Use
< 6% of Regional Analysis Area Total Effort

Figure B3-1

RELATIVE DISTRIBUTION OF DUCK HUNTERS WITHIN THE REGIONAL ANALYSIS AREA IN 1976

TABLE B3-2

ESTIMATED DISTRIBUTION OF DUCK HUNTERS IN LOCAL AND REGIONAL ANALYSIS AREAS IN 1976 BY HUNTER RESIDENCE

	Vancouver Island	Lower Mainland	Kootenay	Chilcotin-Cariboo	Skeena	Omineca-Peace	Thompson-Okanagan Subregions A	B	C	D	E	F	Sub-total	Total
Local Hunters	3								40	26			66	69
Percent Composition	4.3								58.0	37.7			95.7	100.0
Regional Hunters	39	306	84	14	26		13		159	919	11		1102	1571
Percent Composition	2.5	19.5	5.3	0.9	1.7		0.8		10.1	58.5	0.7		70.1	100.0

B3.2 UPLAND GAMEBIRDS

(a) Hunter Effort and Harvest

Hunter Survey data regarding upland gamebirds is available by prey species. Eight species of upland gamebirds were reported to be hunted within the regional analysis area in 1976: blue grouse, ruffed grouse, spruce grouse, sharptailed grouse, chukar, ring-necked pheasant, mourning dove, and band-tailed pigeon. Harvests are presented by Management Unit in Table B3-3 and hunter effort in Table B3-4.

In general, upland gamebird hunter effort estimates parallel harvest estimates; the same distribution patterns appear in both sets of data. Harvest data may be safely added among Management Units, but hunter data may not because of "double counting" one hunter who hunts in more than one M.U.[2]. Therefore, and because no discrepancies in the data are evident, the analysis of upland gamebird hunting is based primarily on harvest data.

The local analysis area (M.U. 3-17) makes a significant contribution to upland gamebird hunting, providing an estimated 9.6 percent of both regional hunter opportunity and regional harvest. In 1976, four species were reported to be harvested: blue grouse, ruffed grouse, spruce grouse and chukar (listed in order of estimated harvest). In terms of relative harvest within the regional analysis area, blue grouse is also the most significant species, accounting for 17 5 percent of the regional harvest, followed by chukar (13.7 percent), ruffed grouse (7.3 percent), and spruce grouse (7.0 percent).

Within the regional analysis area in 1976, 50 percent of the estimated upland gamebird harvest came from the northeast sector (M.U. 3-29 and 3-30). Another 30 percent came from Management Units 3-17, 3-18, and 3-19. The remaining 20 percent is spread among the other seven Management Units (see Figure B3-2 for graphic representation of relative upland gamebird harvests). This patterr is very similar to the distribution of big game hunter days (compare

TABLE B3-3

ESTIMATED UPLAND GAMEBIRD HARVEST IN THE REGIONAL ANALYSIS AREA IN 1976

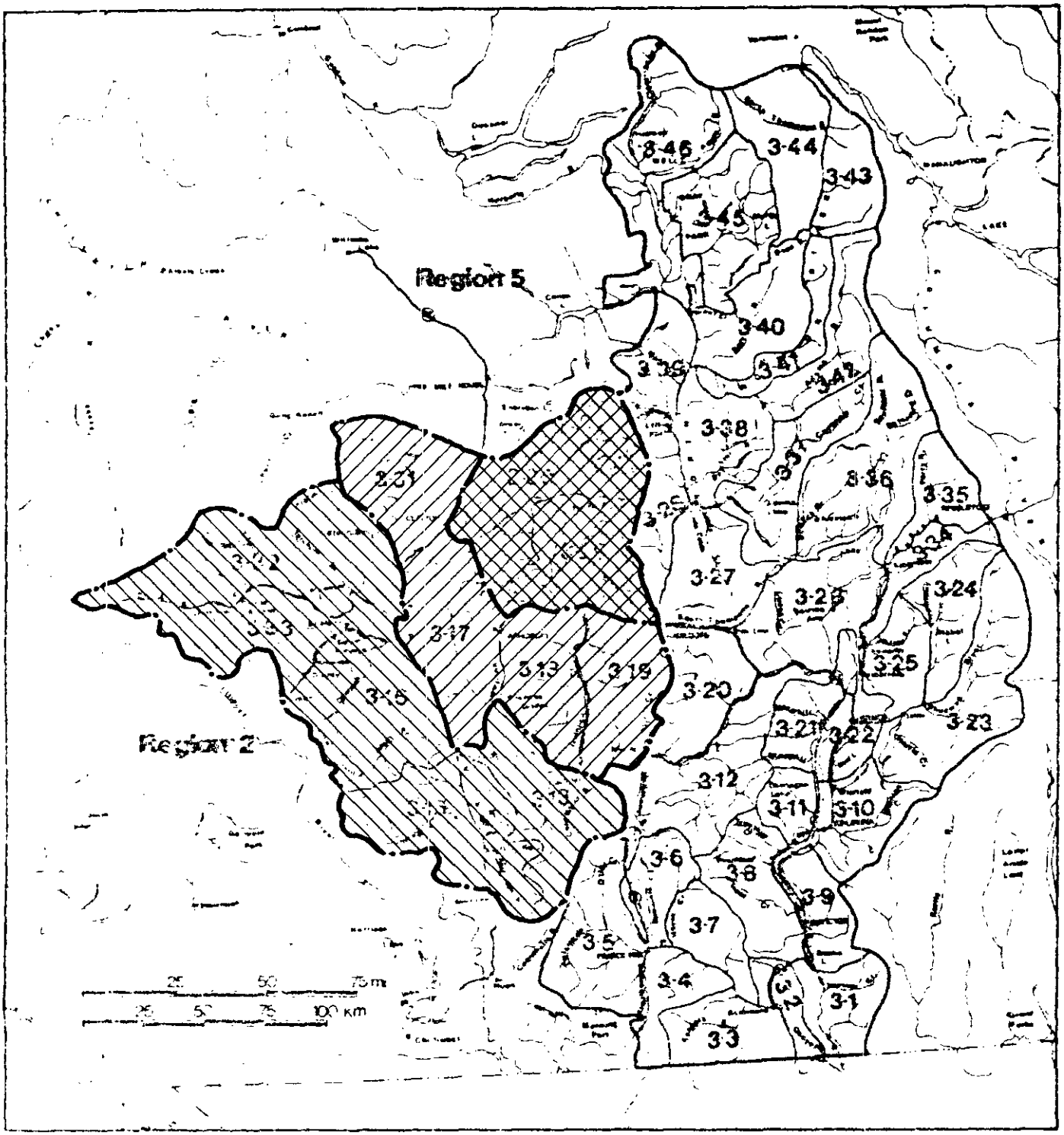
Management Unit	Blue Grouse	Ruffed Grouse	Spruce Grouse	Sharp-tailed Grouse	Chukar	Ring-necked Pheasant	Mourning Dove	Band-tailed Pigeon	Upland Gamebird Total	Percent Regional Harvest
3-17	1,504	1,151	676		168				3,499	9.6
3-13	329	915	237	39					1,520	4.2
3-14	129	92	243						464	1.3
3-15	293	142	23	34					492	1.4
3-16	93	262	126	34					515	1.4
3-18	584	1,154	916	23	344		11		3,032	8.3
3-19	799	1,896	1,131	132	157				4,115	11.3
3-29	1,678	3,063	2,556	130	484		150		8,061	22.2
3-30	1,831	5,050	2,697	137	70		454		10,239	28.2
3-31	523	1,147	703						2,373	6.5
3-32	651	614	344	11					1,620	4.5
3-33	169	209	50						428	1.2
Regional Analysis Area Total	8,583	15,695	9,702	540	1,223	0	615	0	36,358	100.0

TABLE B3-4

ESTIMATED NUMBERS OF UPLAND GAMEBIRD HUNTERS IN THE REGIONAL ANALYSIS AREA IN 1976

Management Unit	Blue Grouse	Ruffed Grouse	Spruce Grouse	Sharp-tailed Grouse	Chukar	Ring-necked Pheasant	Mourning Dove	Band-tailed Pigeon	Upland Gamebird Total*	Percent Regional Harvest
3-17	430	425	362	77	73	11	11		1,389	9.6
3-13	406	313	261	80	29				1,089	7.5
3-14	86	64	60						210	1.5
3-15	75	60	35	23					193	1.4
3-16	63	74	72	11					220	1.5
3-18	351	449	325	112	150	11	11		1,409	9.8
3-19	695	732	594	221	80	50			2,372	16.4
3-29	984	858	841	207	196	26	37		3,149	21.8
3-30	691	887	734	165	52	11	23	11	2,574	17.8
3-31	240	375	233	36					884	6.1
3-32	256	241	192	58					747	5.2
3-33	62	63	60	11					196	1.4
Regional Analysis Area Total*	4,339	4,101	3,769	1,001	580	109	82	11	14,432	100.0

* Because of "double counting" of hunters who hunt in more than one Management Unit or who hunt more than one species, totals are not correct. However, these totals do provide a basis for comparison among prey species or among Management Units.



High Hunter Use
> 15% of Regional Analysis Area Total Harvest

Moderate Hunter Use
6% to 15% of Regional Analysis Area Total Harvest

Low Hunter Use
< 6% of Regional Analysis Area Total Harvest

Figure B3-2

RELATIVE DISTRIBUTION OF UPLAND GAMEBIRD HARVEST WITHIN THE REGIONAL ANALYSIS AREA IN 1976

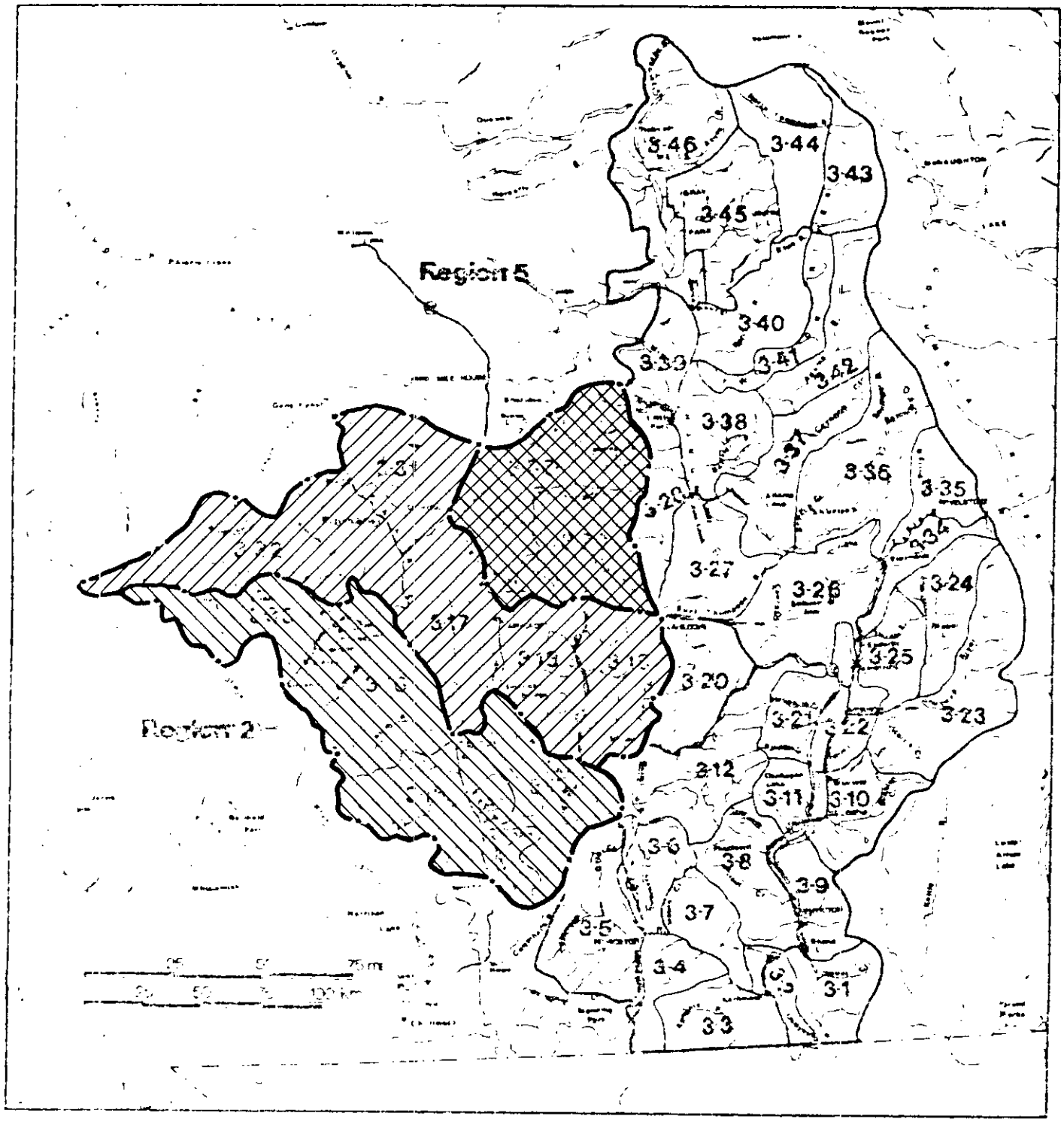
Figures B3-2 and B3-3) indicating that much upland gamebird hunting may be incidental to big game hunting.

In 1976, the B.C. Fish and Wildlife Branch estimated that 389,000 grouse (aggregate of blue, ruffed, spruce, and sharptailed grouse) were harvested in British Columbia. The estimated grouse harvest in the regional analysis area in 1976 was 34,520 or 9.0 percent of the B.C. provincial total. Grouse harvest in the local analysis area (M.U. 3-17) in 1976 was 3331 birds or 0.9 percent of the B.C. provincial total. Hence, a significant proportion of grouse hunting occurs in the local and regional study areas. A breakdown by species for the 1976 B.C. total upland gamebird harvests is not currently available.

(b) Hunter Residence

The pattern of upland gamebird hunter residence differs from that observed for duck hunter residence. Most upland gamebird hunters who hunted in Management Unit 3-17 (Table B3-5) apparently originated locally, but a small proportion did travel some distance to hunt. Almost 60 percent of the 1976 upland gamebird hunters came from the Thompson-Okanagan (Region 3) compared to 95 percent of the 1976 duck hunters), but a greater portion of these came from subregion 3D (Kamloops, Cache Creek, and Ashcroft) and, thus, must have driven a short distance in order to hunt in M.U. 3-17. Over 30 percent of the 1976 gamebird hunters in M.U. 3-17 originated from the Lower Mainland (Region 2), and would have had to drive a considerable distance. The observation that upland gamebird hunters travel further than waterfowl hunters is probably best explained by the previously stated supposition that much upland gamebird hunting is coincidental with big game hunting.

The estimated 1976 hunter residence within the regional analysis area is summarized in Table B3-6. The pattern of upland gamebird hunter origin is nearly identical to that seen in M.U. 3-17 (nearly 60 percent of the hunters are of local origin (Subregions 3C and 3D) and approximately 30 percent originate from the Lower Mainland (Region 2)). The residence of the remaining 10 percent is scattered throughout the province.



High Hunter Use
> 15% of Regional Analysis Area Total Effort

Moderate Hunter Use
6% to 15% of Regional Analysis Area Total Effort

Low Hunter Use
< 6% of Regional Analysis Area Total Effort

Figure B3-3

RELATIVE DISTRIBUTION OF BIG GAME HUNTER EFFORT WITHIN THE REGIONAL ANALYSIS AREA IN 1976

TABLE B3-5

ESTIMATED DISTRIBUTION OF UPLAND GAMEBIRD HUNTERS IN MANAGEMENT UNIT 3-17
BY HUNTER RESIDENCE

	Vancouver Island	Lower Mainland	Kootenay	Cariboo-Chicotin	Skeena	Omineca-Peace	Thompson-Okanagan						Sub-total	Total
							A	B	C	D	E	F		
Blue Grouse	14	113			26				80	197			277	430
Ruffed Grouse		148			26				80	171			251	425
Spruce Grouse	11	113			14				66	158			224	362
Sharp-tailed Grouse		11			14				13	39			52	77
Chukar	3	45			12					13			13	73
Pheasant		11												11
Mourning Dove		11												11
Band-tailed Pigeon														
Composite Upland Gamebird	28	452	-	-	92	-	-	-	239	578	-	-	817	1,389
Percent	2.0	32.5	-	-	6.6	-	-	-	17.2	41.6	-	-	58.8	100.0

TABLE B3-6

ESTIMATED DISTRIBUTION OF UPLAND GAMEBIRD HUNTERS
IN REGIONAL ANALYSIS AREA BY HUNTER RESIDENCE

	Vancouver Island	Lower Mainland	Kootenay	Cariboo-Chilcotin	Skeena	Omineca-Peace	Thompson-Okanagan						Sub-total	Total
							A	B	C	D	E	F		
Blue Grouse	92	1,247		70	82	81		26	372	2,313	56		2,767	4,339
Ruffed Grouse	96	1,522	14	99	96	41		13	400	2,170	90		2,673	4,541
Spruce Grouse	100	1,156	14	98	70	27	17		331	1,866	90		2,304	3,769
Sharp-tailed Grouse	17	362			70				39	513			552	1,001
Chukar	16	158		28	12					355	11		366	580
Pheasant		44								65			65	109
Mourning Dove		56								26			26	82
Band-tailed Pigeon		11												11
Composite Upland Gamebird	321	4,556	28	295	330	149	17	39	1,142	7,308	247	-	8,753	14,432
Percent	2.2	31.6	0.2	2.0	2.3	1.0	0.1	0.3	7.9	50.6	1.7	-	60.6	100.0

B3.3 BIG GAME

(a) Hunter Effort and Harvest

Estimates of harvests, hunter effort and hunter success of deer, moose, black bear, mountain sheep, mountain goat, grizzly bear and elk in the local and regional analysis areas are presented in Tables B3-7 through B3-13.

Mule deer are the big game species providing the greatest numbers of animals harvested annually in the local analysis area. In 1976 the local analysis area is approximately average or slightly above average within the regional analysis area in terms of the numbers of hunters, deer harvested, hunters per deer harvested, and hunter days per deer harvested (Table B3-7).

Within the regional analysis area, Management Units 3-29, 3-30, and 3-32 are the units most popular to deer hunters. Nearly 50 percent of the estimated number of 1976 deer hunters and over 50 percent of the estimated deer harvest were attributed to these three units. Other management units contributing above average deer harvests for the regional analysis area included M.U.'s 3-17, 3-19, and 3-31.

The total 1976 estimated deer harvest in the regional analysis area was 1460 deer, as compared with a B.C. provincial total of approximately 22,018 deer. Therefore, the regional analysis area appears to have accounted for approximately 6.6 percent of the total provincial deer harvest in 1976.

Moose are the second most numerous big game species harvested in the local analysis area. This area had below average numbers of estimated hunters, moose harvested, hunters per harvested moose, estimated number of hunter days and hunter days per moose harvested as compared to the regional analysis area (Table B3-8).

TABLE B3-7

ESTIMATED DEER HARVEST, HUNTER EFFORT AND HUNTER SUCCESS WITHIN THE LOCAL AND REGIONAL ANALYSIS AREAS DURING 1976

Management Unit	Hunters		Harvest		Hunters per Deer Harvested	Estimated Number of Hunter Days	Hunter Days per Deer Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17	949	9.0	124	9.0	8.0	4,872	39
3-13	570	5.0	50	3.0	11.0	2,075	42
3-14	290	3.0	34	2.0	9.0	943	28
3-15	185	1.0	23	2.0	8.0	848	37
3-16	504	4.0	84	6.0	6.0	1,520	18
3-18	750	7.0	37	2.0	20.0	3,294	89
3-19	1,085	10.0	128	9.0	9.0	5,664	44
3-29	1,748	16.0	150	10.0	12.0	9,937	66
3-30	2,291	20.0	331	22.0	7.0	12,625	38
3-31	914	8.0	125	9.0	7.0	4,430	35
3-32	1,423	10.0	304	21.0	5.0	6,420	21
3-33	433	4.0	70	5.0	6.0	1,223	17
R.A.A. Total	11,142	100.0	1,460	100.0	7.6	53,851	37
$\bar{X}$	929		122			4,488	

* R.A.A. = Regional Analysis Area

TABLE B3-8

ESTIMATED MOOSE HARVEST, HUNTER EFFORT AND HUNTER SUCCESS WITHIN THE LOCAL AND REGIONAL ANALYSIS AREAS DURING 1976

Management Unit	Hunters		Harvest		Hunters per Moose Harvested	Estimated Number of Hunter Days	Hunter Days per Moose Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17	86	4.0	20	6.0	4.0	511	26
3-13	:57	2.0	7	2.0	8.0	217	31
3-14	16	1.0	3	1.0	5.0	32	11
3-15	3	>0	0	0	>0	13	>13
3-16	17	1.0	4	1.0	4.0	145	36
3-18	239	11.0	47	13.0	5.0	1,348	29
3-19	273	12.0	36	10.0	8.0	1,186	33
3-29	337	15.0	26	7.0	13.0	1,732	67
3-30	843	38.0	146	40.0	6.0	5,190	36
3-31	261	12.0	54	15.0	5.0	1,280	24
3-32	75	3.0	15	4.0	5.0	325	22
3-33	23	1.0	3	1.0	8.0	72	24
R.A.A. Total	2.230	100.0	361	100.0	6.2	12,051	33
$\bar{X}$	186		30			1,004	

* R.A.A. = Regional Analysis Area

TABLE B3-9

ESTIMATED BLACK BEAR HARVEST, HUNTER EFFORT AND HUNTER SUCCESS WITHIN THE LOCAL AND REGIONAL ANALYSIS AREAS DURING 1976

Management Unit	Hunters		Harvest		Hunters per Bear Harvested	Estimated Number of Hunter Days	Hunter Days per Bear Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17	29	6.0	6	3.0	5.0	150	25
3-13	38	8.0	16	11.0	3.0	112	7
3-14	33	7.0	12	8.0	4.0	114	10
3-15	43	9.0	11	8.0	6.0	142	13
3-16	48	10.0	22	15.0	3.0	112	5
3-18	36	8.0	0	0	>36.0	125	> 125
3-19	41	9.0	16	11.0	4.0	117	7
3-29	55	12.0	7	5.0	11.0	134	19
3-30	24	5.0	11	8.0	3.0	327	30
3-31	78	16.0	9	7.0	12.0	102	11
3-32	37	8.0	25	17.0	3.0	286	11
3-33	9	2.0	9	7.0	2.0	160	18
R.A.A. Total	466	100.0	144	100.0	3.2	1,881	13
$\bar{X}$	39		12			157	

* R.A.A. = Regional Analysis Area

TABLE B3-10

ESTIMATED MOUNTAIN SHEEP HARVEST, HUNTER EFFORT AND HUNTER SUCCESS WITHIN THE LOCAL AND REGIONAL ANALYSIS AREAS DURING 1976

Management Unit	Hunters		Harvest		Hunters per Sheep Harvested	Estimated Number of Hunter Days	Hunter Days per Sheep Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17	18	21.0	3	21.0	6.0	62	21
3-13	2	2.0				17	
3-14							
3-15							
3-16	2	2.0				5	
3-18	3	3.0	2	16.0	1.5	16	8
3-19							
3-29							
3-30	1	1.0				4	
3-31	18	21.0	3	21.0	6.0	76	25
3-32	34	39.0	6	42.0	6.0	289	48
3-33	9	11.0				63	
R.A.A. Total	87	100.0	14	100.0	6.2	532	38
$\bar{X}$	7		1.2			44	

* R.A.A. = Regional Analysis Area

TABLE B3-11

ESTIMATED MOUNTAIN GOAT HARVEST, HUNTER EFFORT AND HUNTER SUCCESS WITHIN THE LOCAL AND REGIONAL ANALYSIS AREAS DURING 1976

Management Unit	Hunters		Harvest		Hunters per Goat Harvested	Estimated Number of Hunter Days	Hunter Days per Goat Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17							
3-13							
3-14	1	1.0				3	
3-15	6	3.0	3	8.0	2.0	17	6
3-16	112	59.0	29	74.0	4.0	385	13
3-18							
3-19	9	5.0					
3-29							
3-30							
3-31							
3-32	30	16.0	2	5.0	15.0	101	50
3-33	32	17.0	5	13.0	6.0	108	22
R.A.A. Total	190	100.0	39	100.0	4.9	614	16
$\bar{X}$	16		3.3			51	

* R.A.A. = Regional Analysis Area

TABLE B3-12

ESTIMATED GRIZZLY BEAR HARVEST, HUNTER EFFORT AND HUNTER SUCCESS WITHIN THE LOCAL AND REGIONAL ANALYSIS AREA DURING 1976

Management Unit	Hunters		Harvest		Hunters per Bear Harvested	Estimated Number of Hunter Days	Hunter Days per Bear Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17							
3-13							
3-14							
3-15							
3-16	16	70.0	4	100.0	4.0	82	21
3-18							
3-19	3	13.0			3.0	9	9
3-29							
3-30							
3-31							
3-32	3	13.0			3.0	11	11
3-33	1	4.0			1.0	3	3
R.A.A. Total	23	100.0	4	100.0	5.8	105	26
$\bar{X}$	1.9		0.3			8.7	

* R.A.A. = Regional Analysis Area

TABLE B3-13

ESTIMATED ELK HARVEST, HUNTER EFFORT AND HUNTER SUCCESS
WITHIN THE LOCAL AND REGIONAL ANALYSIS AREAS DURING 1976

Management Unit	Hunters		Harvest		Hunters per Elk Harvested	Estimated Number of Hunter Days	Hunter Days per Elk Harvested
	Estimated Numbers	Percent of R.A.A.*	Estimated Numbers	Percent of R.A.A.*			
3-17							
3-13							
3-14							
3-15							
3-16							
3-18	2	29.0				20	20
3-19	2	29.0				11	11
3-29							
3-30							
3-31							
3-32	3	42.0	2	100.0	1.5	24	12
3-33							
R.A.A. Total	7	100.0	2	100.0	3.5	55	27.5
$\bar{X}$	0.6		0.2			4.6	

* R.A.A. = Regional Analysis Area

Withir the regional analysis area, M.U. 3-30 was the most popular unit for moose hunting. During 1976 this unit attracted 38 percent of the moose hunters estimated to be hunting in the regional analysis area and accounted for 40 percent of the estimated moose harvest. Other Management Units accounting for above average moose harvests included 3-18, 3-19, and 3-31.

The total 1976 estimated moose harvest in the regional analysis area was 361, as compared with a B.C. provincial estimated total of 10,898. Therefore, the regional analysis area appears to have accounted for approximately 3.3 percent of the total 1976 provincial moose harvest.

Black bear were the third most numerous big game species harvested in the local analysis area during 1976. M.U. 3-17 had below average estimates in numbers of hunters as well as numbers of black bears harvested as compared to the regional analysis area (Table B3-9). The unit had approximately an average estimated number of black bear hunter days and hunters per bear harvested and an above average number of hunter days per black bear harvested.

Within the regional analysis area, M.U. 3-31 attracted the highest number of black bear hunters while the highest estimated harvest of black bears came from M.U. 3-32. It was estimated that Management Units 3-16, 3-18, and 3-19 also provided above average numbers of black bear harvested during 1976.

The total 1976 estimated black bear harvest in the regional analysis area was 144, as compared with the provincial estimated total black bear harvest of 3203. Therefore, the regional analysis area accounted for approximately 4.5 percent of the total 1976 provincial black bear harvest.

Mountain sheep were the fourth most numerous big game species harvested in the local analysis area during 1976. M.U. 3-17 accounted for 21 percent of the sheep hunters hunting in the regional analysis area as well as 21 percent of the sheep harvested (Table B3-10).

Withir the regional analysis area sheep hunters hunted in eight of the 12 Management Units and harvested sheep in four of these (Table B3-10). M.U. 3-32 attracted the greatest number of sheep harvested. The B.C. Fish and Wildlife Branch estimated that in 1976 Management Units 3-17, 3-31, and 3-32 attracted 81 percent of the hunters hunting in the regional analysis area and accounted for 84 percent of the sheep harvest.

The total 1976 estimated sheep harvest in the regional analysis area was 14, as compared with the provincial estimated mountain sheep harvest by resident hunters of 162. Therefore, the regional analysis area accounted for approximately 8.6 percent of the total provincial sheep harvest.

The B.C. Fish and Wildlife Branch estimated that there were no mountain goat, grizzly bear or elk harvested in the local analysis area in 1976 (Tables B3-10 to B3-13).

In the regional analysis area, M.U. 3-16 attracted the greatest number of goat hunters and accounted for the greatest number of goat harvested (Table B3-11). The regional analysis area provided 7.8 percent of the estimated provincial goat harvest (39 of 498) during 1976 and M.U. 3-16 contributed 74 percent of this total, or 5.8 percent of the provincial goat harvest.

Grizzly bear were hunted in four of the 12 Management Units in the regional analysis area (Table B3-12). M.U. 3-16 accounted for 100 percent of the regional analysis area grizzly bear harvest and 2.5 percent of the total estimated 1976 provincial harvest.

Rocky Mountain elk were hunted in three of the 12 Management Units in the regional analysis area (Table B3-12). M.U. 3-16 accounted for 100 percent of the regional analysis area grizzly bear harvest and 2.5 percent of the total estimated 1976 provincial harvest.

Rocky Mountain elk were hunted in three of the 12 Management Units in the regional analysis area during 1975 (Table B3-13). M.U. 3-32 accounted for

100 percent of the regional analysis area harvest and approximately 0.25 percent of the estimated resident hunter harvest.

Mountain caribou were not hunted in either the local or regional analysis areas during 1976.

Estimated hunter effort in 1976 has been summarized for big game species in Table B3-14. These data indicate that in both the local and regional analysis areas the most hunter days were expended in search of deer (87.1 percent in the local and 77.9 percent of the regional analysis area totals). Moose are the next most hunted big game, comprising 9.1 percent of the hunter days in the local analysis area and 17.4 percent of the hunter days in the regional analysis area. The remaining species account for less than five percent of the total big game hunter effort.

Within the regional analysis area two Management Units, 3-29 and 3-30, are more heavily used by big game hunters than are the others. Five Management Units, 3-17, 3-18, 3-19, 3-31, and 3-32 are of moderate popularity, while the remaining five are only lightly hunted in comparison to the others. The pattern of big game hunter usage is graphically illustrated in Figure B3-3.

(b) Hunter Residence

Analysis of the residency of big game hunters who hunted in the local and regional analysis areas in 1976 is summarized in Tables B3-14 and B3-15. Table B3-15 shows that 46 percent of the estimated big game hunters hunting in Management Unit 3-17 resided in the Lower Mainland (Region 2). The majority of the remaining hunters, an estimated 47 percent, resided in the Thompson-Okanagan Region; 30 percent residing in Subregion 3D, and 15 percent residing in Subregion 3C.

Residency of big game hunters hunting in the regional analysis area in 1976, on a percentage basis, approximates that of the local analysis area (Table B3-16). That is, over 45 percent of the estimated big game hunters resided

TABLE B3-14

SUMMARY OF ESTIMATED HUNTER DAYS BY BIG GAME SPECIES
AND BY MANAGEMENT UNIT WITHIN THE REGIONAL ANALYSIS AREA IN 1976

Management Unit	Deer	Moose	Black Bear	Mountain Sheep	Mountain Goat	Grizzly Bear	Elk	Management Unit Total	Percent of R.A.A.* Total
3-13	2,075	217	112	17				2,421	3.5
3-14	943	32	114		3			1,092	1.6
3-15	848	13	142		17			1,020	1.5
3-16	1,520	145	112	5	385	82		2,249	3.3
3-17	4,872	511	150	62				5,595	8.1
3-18	3,294	1,348	125	16			20	4,803	7.0
3-19	5,664	1,186	117			9	11	6,987	10.1
3-29	9,937	1,732	134					11,803	17.1
3-30	12,625	5,190	327	4				18,146	26.3
3-31	4,430	1,280	102	76				5,888	8.5
3-32	6,420	325	286	289	101	11	24	7,456	10.8
3-33	1,223	72	160	63	108	3		1,629	2.4
Total for R.A.A.*	53,851	12,051	1,881	532	614	105	55	69,089	100.0
Percent of R.A.A.*	77.9	17.4	2.7	0.8	0.9	0.2	0.1	100.0	

* Regional Analysis Area

TABLE B3-16

ESTIMATED DISTRIBUTION OF BIG GAME HUNTERS IN REGIONAL ANALYSIS AREA DURING 1976

Game Species	Hunter Residence												Sub-total	Total
	Vancouver Island	Lower Mainland	Kootenay	Caribou-Chilcotin	Skeena	Omineca-Peace	Thompson-Okanagan							
							A	B	C	D	E	F		
Deer	287	4,585	38	324	104	128	51	52	997	2,578	250		3,928	9,394
Moose	51	721	6	100	18	56	25	5	156	679	60	10	935	1,887
Black Bear		295							57	88	18	3	166	461
Mtn. Sheep	2	42		3					15	23	2		40	87
Mtn. Goat	4	112		8	2	3		2	11	35	12	1	61	190
Grizzly Bear	2	13	1		1	2				2	2		4	23
Elk			7											7
Caribou														
Total Big Game Species	346	5,768	52	435	125	189	76	59	1,236	3,405	344	14	5,134	12,049
Percent of Regional Analysis Area	3.0	47.0	.5	4.0	1.0	2.0	.5	.5	10.0	28.0	3.0	.5	42.0	100.0

TABLE B3-15

ESTIMATED DISTRIBUTION OF BIG GAME HUNTERS IN MANAGEMENT UNIT 3-17
(LOCAL ANALYSIS AREA) DURING 1976

Game Species	Hunter Residence												Sub-total	Total
	Vancouver Island	Lower Mainland	Kootenay	Cariboo-Chilcotin	Skeena	Omineca-Peace	Thompson-Okanagan							
							A	B	C	D	E	F		
Deer	34	443			26			13	146	276	11		446	949
Moose	3	13	6	4		12			14	34			48	86
Black Bear		35							6	7			13	48
Mtn. Sheep		9							1	7	1		9	18
Mtn. Goat														0
Grizzly Bear														0
Elk														0
Caribou														0
Total Big Game Species	37	500	6	4	26	12		13	167	324	12		516	1,101
Percent of Local Analysis Area	3.0	46.0	.5	.5	2.0	1.0		1.0	15.0	30.0	1.0		47.0	100.0

in the Lower Mainland region while over 40 percent resided in the Thompson-Okanagan Region.

(c) Economic Analysis

The value of B.C. Resident hunting was investigated by Pearse Bowden[3] who through questionnaires, attempted to determine the total expenditures of resident hunters (total spending) and the amount of money which hunters would be willing to pay per day to hunt big game species (average willingness-to-pay per day). The average spending per resident hunter during 1970-71 totalled $290.00. Expenditures included transportation costs ($142.00); guns, ammunition and equipment ($79.00); food and lodging ($39.00); miscellaneous expenses ($20.00); and licences and tags ($10.00). Corrected for consumer price index increases, the 1976 average spending per resident hunter is expected to be approximately $500.00.

The other significant value associated with wildlife resource use, "willingness-to-pay", is the value recreationists place on their activity over and above the costs which they must incur to participate. The willingness-to-pay value associated with each big game species in the local and regional analysis study areas during 1976 are presented in Table B3-16. The table clearly indicates the major contribution deer and moose make to local big game values.

Table B3-17 presents a total consumptive use value for big game species in the local and regional analysis areas. The local analysis area big game resource value comes to over $650,000, while the regional analysis area accounted for a value of over seven million dollars during 1976.

TABLE B3-16

POTENTIAL VALUE OF BIG GAME HUNTING
IN THE LOCAL AND REGIONAL ANALYSIS AREAS IN 1976

Species	Local Analysis Area			Regional Analysis Area		
	Hunter Days	Average Willingness to Pay per Day*	Potential Value	Hunter Days	Average Willingness to Pay per Day*	Potential Value
Deer	4,872	17.50	85,300	53,851	17.50	942,400
Moose	511	26.25	13,400	12,051	26.25	316,400
Black Bear	150	8.75	1,300	1,881	8.75	16,500
Sheep	62	36.00	2,200	532	36.00	19,200
Goat	0	18.00		614	18.00	11,100
Grizzly Bear	0	22.75		105	22.75	2,400
Elk	0			55	26.25	1,500
Caribou	0			0	28.00	
Totals	5,595		101,200	69,089		1,309,500

* Figures based on Pearse Bowden[3] for year 1970-1971 and corrected to 1976 values based on total consumer price index figures for Vancouver (B.C. Hydro and Power Authority).
These figures are defined as the average price which hunters would pay per day of hunting for each big game species[3].

TABLE B3-17

TOTAL CONSUMPTIVE USE VALUE FOR BIG GAME SPECIES
IN THE LOCAL AND REGIONAL ANALYSIS AREAS IN 1976

	Number of Hunters	Average Spending per Hunter	Total Spent	Total Willingness-to Pay Value	Total 1976 Value
Local Analysis Area	1,101	$290	$ 550,500	$ 101,200	$ 651,700
Regional Analysis Area	12,049	$290	$6,024,500	$1,309,500	$7,334,000

B4.0 REFERENCES

1 Cooch, F.G. and K.L. Mewell. 1977. Species of Waterfowl and Age and Sex Ratios of Ducks and Geese Harvested in Canada during the 1976 Season. Unpublished. Canadian Wildlife Service. Ottawa, Ontario.

2 Haley, P.F. 1974. Hunter Sample 1974. Wildlife Management Harvest Statistics No. 10. B.C. Fish and Wildlife Branch. Victoria, B.C.

3 Pearse Bowden Economic Consultants Limited. 1972. The Value of Resident Hunting in British Columbia. B.C. Fish and Wildlife Branch. Victoria, B.C.