393

ENVIRONMENTAL STUDIES ANNUAL REPORT 1980

SUBTASK 7. 11 WILDLIFE ECOLOGY

BIRDS AND NON-GAME MAMMALS

APRIL 1981

Terrestrial Environmental Specialists, Inc.

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

ENVIRONMENTAL STUDIES ANNUAL REPORT 1980

SUBTASK 7. 11 WILDLIFE ECOLOGY

BIRDS AND NON-GAME MAMMALS

APRIL 1981

by

UNIVERSITY OF ALASKA MUSEUM
Fairbanks, Alaska 99701
and
TERRESTRIAL ENVIRONMENTAL SPECIALISTS, Inc.
Phoenix, New York 13135

for

ACRES AMERICAN, INCORPORATED
Liberty Bank Building, Main at Court
Buffalo, New York 14202

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

ENVIRONMENTAL STUDIES ANNUAL REPORT

SUBTASK 7.11
BIRDS AND NON-GAME MAMMALS

by
Brina Kessel, Principal Investigator
Stephen O. MacDonald
Daniel D. Gibson
and
Brian A. Cooper

University of Alaska Museum
Fairbanks, Alaska 99701

SUMMARY

The first year's field studies of the birds and small (non-game) mammals of the upper Susitna River Basin were conducted from 6 July to 4 October 1980. The overall study area extended from near Sherman on the west to the mouth of the MacLaren River on the east and for approximately 15 km (10 miles) on either side of the Susitna River channel. Within this region during 1980, we 1) established ten 10-ha (25-acre) intensive sites for subsequent animal-habitat studies, 2) established 13 small mammal traplines and, between 26 August and 2 September, sampled the small mammals in the respective habitats of these traplines, 3) flew a raptor survey on 6 July, 4) flew fall waterbird surveys between 7 September and 4 October, and 5) conducted general bird and small mammal surveys throughout the period at a number of more-or-less random localities. Data for the region are still very limited, so interpretations made in the report are preliminary in nature and conclusions tentative.

Intensive study plots were established in vegetation types that represented each of the major woody avian habitats present in the region in sufficient size and uniformity to accommodate a square 10-ha plot: Low Birch Shrub Thicket, Medium Birch Shrub Thicket, Low-Medium Willow Shrub Thicket, Tall Alder Thicket, Cottonwood Forest, Paper Birch Forest, White Spruce-Paper Birch Forest, White Spruce Forest, White Spruce Scattered Woodland, and Black Spruce Dwarf Forest. Small mammal traplines were established in all but the Low Birch Shrub Thicket and in Sedge-Low Shrub Meadow, Tall Forb Meadow, and Black Spruce-White Spruce Forest.

Thirteen small mammal species were found during 1980, and the presence of three others was suspected. During the fall survey, red-backed voles and masked shrews were the most abundant species trapped; and these, plus the dusky shrew, appeared to be habitat generalists, occupying a wide range of vegetation types. Meadow voles and pygmy shrews were least abundant and the most restricted in their habitat use, the former occurring only in meadows and the latter in forests. Tall Forb Meadow,

Sedge-Low Shrub Meadow, and Cottonwood Forest had the most small mammals and most diverse communities, while Paper Birch Forest and White Spruce Forest had the fewest individuals and lowest diversity.

One hundred fifteen species of birds were recorded during the 1980 field season, the most abundant being scaup sp. and Common Redpoll. Blue-winged Teal, American Kestrel, White-tailed Ptarmigan, Short-eared Owl, Northern Phalarope, Greater Yellowlegs, Lesser Yellowlegs, Surfbird, Sanderling, and Pectoral Sandpiper were classified as "rare" on the basis of 1980 sightings. All, however, are represented by healthy breeding populations elsewhere, and future field work is expected to prove some of them more abundant in the study area than currently classified.

Ten active raptor/raven nests were counted during the raptor survey; of these, two Bald Eagle nests and at least four Golden Eagle nests would be flooded by Devil Canyon-Watana Dam construction, as would about three currently inactive raptor/raven nest sites.

Little time was spent in wetland areas during the summer season, but cursory observations indicated a low population of waterbirds on the lakes of the region. Trumpeter Swans, however, nested on a number of the lakes between the Oshetna and Tyone rivers. At least 21 species of loons, grebes, and waterfowl were identified during the fall aerial surveys. Species composition was similar to that in interior Alaska, with scaup sp. being the most abundant species (38% of observations) and American Wigeon the second most abundant (15%). The relative importance of the waterbodies of the upper Susitna River Basin for migrants appeared low, with a lake (WB 131) near the mouth of the MacLaren River and the Stephan Lake area being relatively most important.

Assessment of impacts of the Susitna Hydroelectric Project can only be general at this stage of our studies and this stage of planning for construction and operation. The major impacts will be from habitat destruction due to flooding and from a range of habitat alterations due

to various construction and operational factors. Flooding will destroy a large percentage of the riparian cliff habitat and forest habitats upriver of Devil Canyon dam. Raptors and ravens using the cliffs could be expected to find alternative nesting sites in the surrounding mountains, and the forest inhabitants are relatively common breeders in forests in adjacent regions. Lesser amounts of lowland meadows and of fluviatile shorelines and alluvia, each important to a few species, will also be lost. None of the waterbodies that appear to be important to waterfowl will be flooded, nor will the important prey species of the upland tundra areas be thus affected. Impacts of other types of habitat alteration will depend on the type of alteration, e.g., which habitats are destroyed or altered or which replacement habitats develop. Generally, however, animals that are habitat generalists will be less affected than habitat specialists. Mitigation of potential impacts on waterfowl and raptors and their habitats through avoidance is recommended, i.e., keep construction and related activities at a distance from potential raptor cliffs and from the Stephan-Murder Lake area.

TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF TABLES

Table

LIST OF FIGURES

1 - INTRODUCTION

The bird and non-game or small mammal studies of the upper Susitna River Basin are being undertaken to aid in determining the potential effect that the proposed Susitna Project might have on the fauna of the region. More specifically, we will determine what species of birds and small mammals occur in the upper Susitna River Basin and determine, on a seasonal basis, the manner and extent of their use of the region, including the habitats in which they are found. These data can then be used to 1) evaluate habitat potential in the area, 2) provide a basis for predicting faunal changes based on habitat changes caused by environmental alterations, including changes in water level, and 3) evaluate possible mitigative measures, should they prove necessary.

The bird and small mammal studies are composed of three interrelated work packages: 1) Bird community-habitat study, 2) Small mammal studies, and 3) Avifaunal survey.

1.1 - Literature Review

Prior to the initiation of this study, almost nothing was known about the birds and small (non-game) mammals of the upper Susitna River Basin. The only published bird information from the region was a report of birds seen by Hinckley (1900) while he was with a U.S. Geological Survey party in the Susitna Valley in 1898. In the surrounding regions, Abercrombie (1899) in summer and Bailey (1926) in winter both visited the upper Copper River Basin and provided sketchy accounts of birds seen. More recently, Williamson and Peyton (1959) reported inland breeding of Double-crested Cormorants (Phalacrocorax auritus) at Lake Louise, and Schaller (unpubl. Univ. Alaska MS, 1954) reported on summer birds seen in the Talkeetna Mountains. More data are available from the vicinity of Mt. McKinley National Park, where O. J. Murie (1923, 1924), A. Murie (1946, 1956), Dixon (1927a, 1927b, 1933a, 1933b, 1933c, 1938), and Sheldon (1909, 1930) spent extended periods of time.

A. Murie (1963) prepared a generalized summary of occurrence of birds in Mt. McKinley National Park, and a recent checklist of the birds of the Park was compiled by Murphy and Kertell (unpubl. 1977). In the Alaska Range, directly north of the Susitna study area, a study of the nesting and hunting behavior of the Gyrfalcon* has just been completed (Bente 1981). All pertinent pre-1978 data from the above citations have been consolidated and summarized by Gabrielson and Lincoln (1959) and Kessel and Gibson (1978).

Between 10 and 15 June 1974, White (1974) carried out a raptor survey on the Susitna River upstream of the proposed Devil Canyon dam site; and, between 12 and 15 July 1975 and on 18 July 1975, White and Cade (1975) conducted a raptor survey on the proposed Susitna powerline corridors, but not in the current study area.

The small mammals of the upper Susitna River Basin had never been surveyed prior to this study and hence were essentially unknown except by inference. Published species lists for nearby areas of central Alaska come from only a small number of studies and surveys: Mt. McKinley National Park area (Sheldon 1930, Dixon 1938, Viereck 1959, A. Murie 1962), several collecting sites on the Denali and Richardson highways (Baker 1951, Strecker et al. 1952, Pruitt 1968), and the upper Cook Inlet area (Osgood 1901, Wilber 1946, Hock and Cottini 1966). General distributional information has been summarized by Hall and Kelson (1959) and Manville and Young (1965). Based on the literature, a potential list of small mammals for the upper Susitna River Basin is presented in Table 1.

Historically, little attention has been paid to species-habitat relationships in Alaska, although generalized, descriptive accounts of species

---

*See Avifaunal Survey (Section 3.5) for scientific names of birds.

TABLE 1

SPECIES OF SMALL MAMMALS OCCURRING OR POTENTIALLY OCCURRING IN THE UPPER SUSITNA RIVER REGION OF ALASKA

Order INSECTIVORA
- Family Soricidae
  - *Sorex cinereus*, masked shrew
  - *Sorex monticolus*, dusky shrew*
  - *Sorex palustris*, water shrew
  - *Sorex arcticus*, arctic shrew
  - *Sorex hoyi*, pygmy shrew**

Order CHIROPTERA
- Family Vespertilionidae
  - *Myotis lucifugus*, little brown bat

Order LAGOMORPHA
- Family Ochotonidae
  - *Ochotona collaris*, collared pika
- Family Leporidae
  - *Lepus americanus*, snowshoe hare

Order RODENTIA
- Family Sciuridae
  - *Marmota caligata*, hoary marmot
  - *Spermophilus parryii*, arctic ground squirrel
  - *Tamiasciurus hudsonicus*, red squirrel
  - *Glaucomys sabrinus*, northern flying squirrel
- Family Cricetidae
  - *Clethrionomys rutilus*, northern red-backed vole
  - *Microtus pennsylvanicus*, meadow vole
  - *Microtus oeconomus*, tundra vole
  - *Microtus miurus*, singing vole
  - *Lemmus sibiricus*, brown lemming
  - *Synaptomys borealis*, northern bog lemming
- Family Zapodidae
  - *Zapus hudsonius*, meadow jumping mouse
- Family Erethizontidae
  - *Erethizon dorsatum*, porcupine

* *S. monticolus* = *S. obscurus* (Hennings & Hoffmann 1977)

***S. hoyi* = *Microsorex hoyi* (Diersing 1980)

habitats can be found scattered throughout the literature. The lack of more specific and of quantitative information on Alaska's birds and small mammals, however, is being addressed by a growing number of researchers. Avian community-habitat studies in central Alaska include West and DeWolfe (1974), Spindler (1976), Quinlan (1978a, 1979), MacDonald (1979, 1980), Kessel et al. (1980), and Spindler and Kessel (1980); and small mammal community-habitat studies include Buckley and Libby (1957), Whitney (1973), West (1974, 1979), Spindler (1976), Bangs (1979), MacDonald (1979, 1980), and Quinlan (1978b).

1.2 - Objectives

Over the two-year period of this study, the general objectives of the three work packages are as follows:

(a) Bird community-habitat study

1. Determine, for as many of the major upland avian habitats of the region as feasible, the type and degree of use by birds, and compare these habitats relative to species composition, density, etc.

2. Obtain data relative to species habitat use that can be used in later analyses on habitat selection by specific species (1982).

(b) Small (non-game) mammal studies

1. Determine all species of small and medium-sized mammals occurring in the region.

2. Determine, for each of the major habitats of the region, species composition, relative abundance, and habitat use.

(c) Avifaunal survey

1. Determine all species of birds using the region.

2. Determine, on a seasonal basis (winter, summer, spring and fall migration), each species' relative abundance and general habitat use.

3. Determine spring and fall migration dates (earliest, latest, peak) and, insofar as time permits, the seasonal chronologies of each species.

4. Determine the extent and type of use of the area by the Peregrine Falcon, Bald Eagle, and Osprey.

5. Determine, generally, the use of the region by waterbirds, including shorebirds and waterfowl.

1.3 - Study Area

Geographically, the overall study area extends from near Sherman, adjacent to the Alaska Railroad, up the Susitna River to the mouth of the MacLaren River, and out to approximately 15 km (10 miles) on either side of the river (Fig. 1). Survey work includes habitats throughout this vast area, but the intensive sites have been located within a few kilometers of the current river channel. Except for the Cottonwood Forest plot at Sherman, the intensive sites are located between the Devil Canyon dam site and the slope east of Kosina Creek.

1.4 - Acknowledgments

A project of the scope of these bird and small mammal studies could not be conducted without the assistance of many competent field and laboratory personnel, and we are pleased to acknowledge and express appreciation

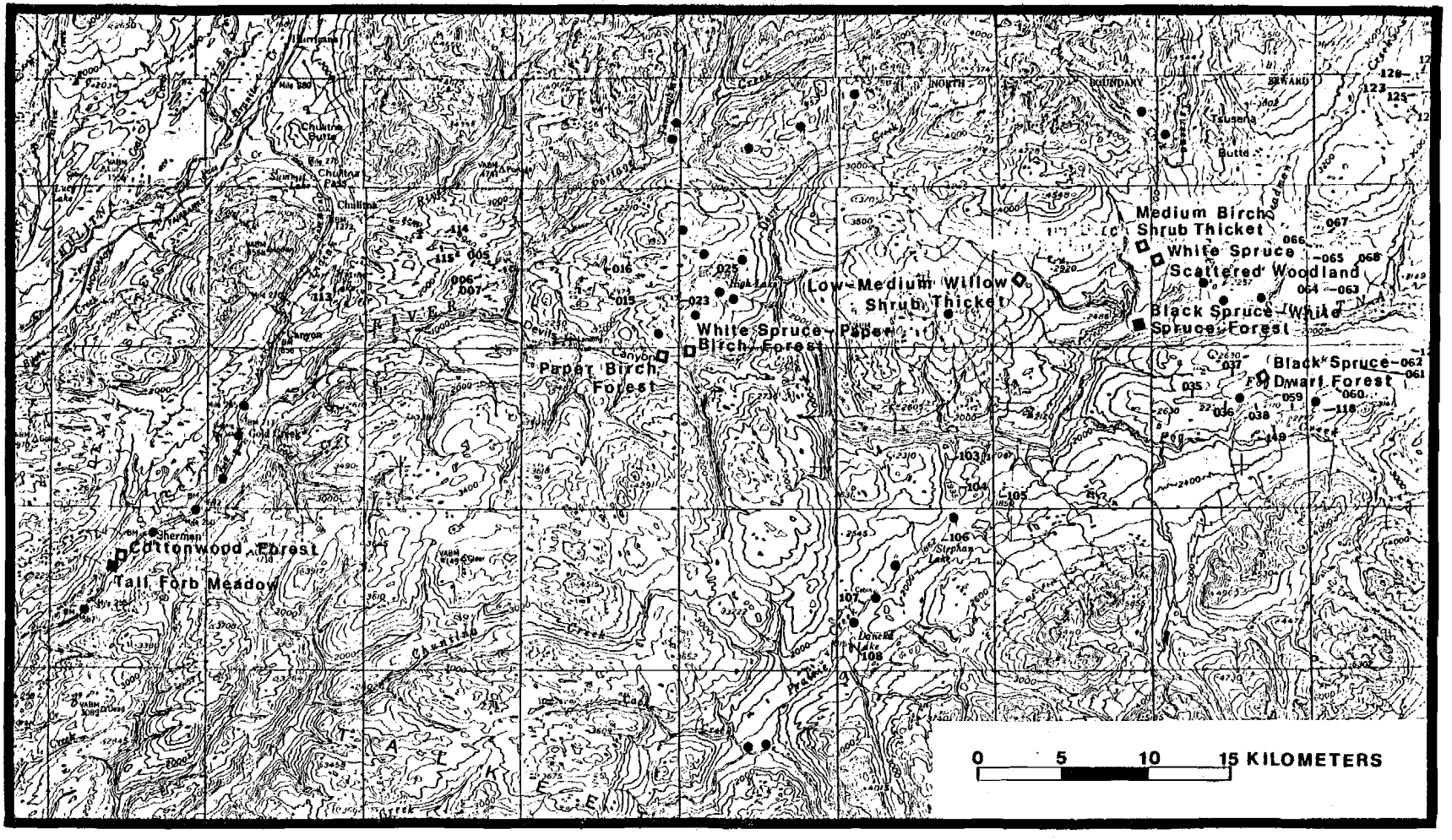

FIGURE 1

Map of the upper Susitna River Basin showing locations of the ten intensive study plots (▫), three additional small mammal trapping sites (■), locations of additional bird survey counts (•), and the waterbodies (numbers) included in the fall waterfowl surveys.

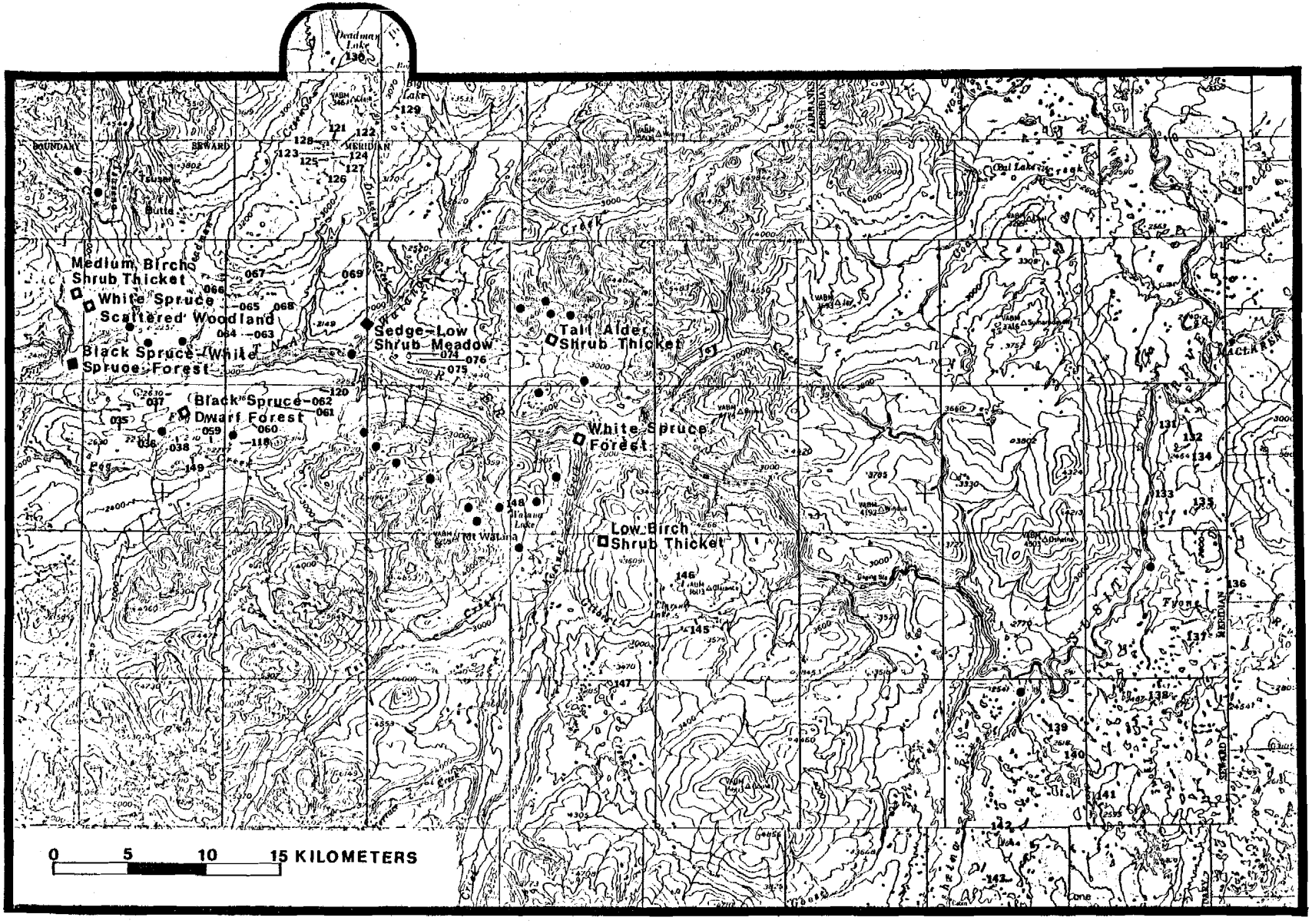

FIGURE 1 (Continued)

for all such help we have received. Alan M. Springer, Fairbanks, Alaska, shared his raptor-hunting expertise with us by participating in the raptor survey. Betty A. Anderson and Jan Overturf spent many tedious hours helping us survey plots and measure habitat variables. Brian E. Lawhead helped monitor fall bird migration and flew all of the fall waterfowl surveys. Donald A. Williamson helped with the fall small mammal trapping survey, and Catherine H. Curby put our massive habitat data onto computer files and executed a preliminary reduction of these data.

We also thank Philip S. Gipson and Steven W. Buskirk of the Furbearer Studies for their contribution of data applicable to our studies. And we laud the fine logistics provided by all the field support personnel at Watana and High Lake, especially Onnalie Logsdon of Terrestrial Environmental Specialists and the helicopter pilots from ERA Helicopters and Akland Air.

2 - METHODS

2.1 - Selection and Configuration of Intensive Study Sites

Ten square 10 ha (25 acres) intensive study plots were established in the study area during the 1980 summer season. This plot size is above the minimum recommended by the International Bird Census Committee (1970) and is one that can be adequately censused in 4 h, the approximate period of maximum bird activity each morning. Plot sites were selected in relatively uniform patches of vegetation that represented each of the major woody avian habitats (after Kessel 1979) present in the region, except that none were established in habitats of the Tundra Formation (Viereck and Dyrness 1980), where birds were very sparse.

Each of the 10-ha plots was divided by a 7x7 grid to aid in animal censusing procedures and in analysis of habitat variables. The entire 10-ha plot will be used for the bird community-habitat study, whereas grid lines number three and five were selected for the establishment of traplines for small mammal sampling. Traplines were established also at three additional locations to increase the number of vegetation types sampled.

2.2 - Measurement of Habitat Variables

The variables chosen to describe the habitats of the intensive study plots (Table 2) were those judged most likely to affect, either directly or indirectly, the animal community structure, species composition, and habitat occupancy levels of these habitats. Some of these variables have already been tested in central Alaska by Spindler (1976), Wolff (1977), West (1979), MacDonald (1980), and Spindler and Kessel (1980).

The gridded subplots and small mammal trap stations were used as sample units in vegetation analyses. Systematically located points were sampled, using the point-centered quarter method of Cottam and Curtis (1956), but

TABLE 2

MEASURED HABITAT VARIABLES USED TO DESCRIBE BIRD AND SMALL MAMMAL INTENSIVE STUDY PLOTS, UPPER SUSITNA RIVER BASIN, ALASKA, JULY-AUGUST 1980.

Habitat Variable	Method
Distance between trees	Average distance to nearest tree (≥ 5 m height), in quarters (Cottam and Curtis 1956)
Distance between shrubs/shrub clumps*	Average distance to center of nearest shrub/shrub clump (1.2-4.9 m high), in quarters (Cottam and Curtis 1956)
Canopy area of shrub/shrub clump	Average area of shrub/shrub clump canopy, in quarters (Cottam and Curtis 1956). Calculated as area of ellipse from length and width measurements)
Height of trees and shrubs	Average height of nearest tree and nearest shrub, in quarters (Cottam and Curtis 1956)
Diameter of tree trunk	Average diameter (dbh) of trunk of nearest tree, in quarters (Cottam and Curtis 1956)
Canopy thickness of tree layer and shrub layer	Average canopy thickness of nearest tree and nearest shrub, in quarters (Cottam and Curtis 1956). Derived from distance between lowest live branch and top of tree or shrub.
Foliage height density profile	Average number of 64 5.0 x 5.0 cm coverboard squares contacted, 3 m from centerpoint in quarters (Cottam and Curtis 1956), at heights 0-0.4 m, 0.6-1.0 m, 1.6-2.0 m, 3.5-3.9 m
Canopy coverage	Percent of 20 sightings (10 at 1 m intervals along each of two perpendicular lines centered on centerpoint) showing vegetation contact at cross-hairs of a vertical ocular tube. Tree and shrub as well as total canopy coverage obtained.
Ground cover	Percent each of sedge, grass, forb, microshrub (<0.25 m), litter, moss, lichen, water, and bare soil in a 1.0 x 1.0 m plot with corner on centerpoint.
Species frequency in ground cover	Occurrence of specific plant species in the 1.0 x 1.0 m plot at small mammal trap stations.
Dwarf shrub cover	Percent of shrub cover <0.4 m high in 3.0 x 3.0 m plot with corner on centerpoint.
Low shrub cover	Percent of shrub cover 0.4-1.1 m high in the 3.0 x 3.0 m plot.
Tree and shrub importance values	Sum of relative frequency, relative density, and relative dominance of species, nearest tree and nearest shrub species, in quarters (Curtis and McIntosh 1951)
Litter depth	Average depth of five random samples in the 1.0 x 1.0 m plot, using calibrated probe
Microrelief	Maximum vertical range of topography in the 3.0 x 3.0 m plot
Distance to water	Distance to nearest perennial water, if any, on subplot from centerpoint

TABLE 2 (Continued)

Habitat Variable	Method
Size and type of waterbody	Area and edge of waterbody within a subplot, calculated as area and circumference of an ellipse, respectively, from length and width measurements. Type differentiated as lacustrine or fluviatile
Depth of waterbody	Maximum depth of water
Distance to habitat edge	Distance to nearest edge, if any, on subplot from centerpoint. Defined as edge of forest opening at least 30 m x 30 m, or edge of shrub thicket opening at least 15 m x 15 m.
Length of habitat edge	Length of edge within a subplot
Slope	Degree of slope of 10-ha plot as measured with Abney level
Aspect	Direction of slope exposure of 10-ha plot measured with a compass
Age of stand**	Number of growth rings obtained from cut stems or with tree auger
Depth to frozen gound**	Depth to frozen ground in pits excavated in August.

* Clumps of intertwining shrubs were treated as a single shrub for the purposes of habitat analyses

** Measurements still to be obtained

including more detailed sampling of ground cover, understory, and shrub vegetation. Sampling was vertically stratified into six layers (after Kessel 1979): ground cover (< 0.25 m), dwarf shrub (< 0.4 m), low shrub (0.4-1.1 m), medium shrub (1.2-2.4 m), tall shrub (2.5-4.9 m), and tree (≥ 5.0 m).

Non-vegetative variables measured included litter depth, microrelief, distance to nearest standing water, if any, in subplot, and characteristics of that water (fluviatile or lacustrine, depth, surface area), distance to habitat edge and the length of that edge, if any, in a subplot, and the slope and aspect of the 10-ha study plot (Table 2). Data on depth to frozen ground and the age of the various stands are yet to be obtained.

2.3 - Small Mammal Trapline Sampling

A modification of the North American Census of Small Mammals (Calhoun 1948) was used to sample shrews, voles, and mice. Trapline transects consisted of 20 trap stations, spaced every 15.2 m. Two "Museum Special" snap-traps and one cone pitfall trap were set within a 1 m radius of each trap station centerpoint for three consecutive nights. Snap-traps were baited with a mixture of peanut butter, rolled oats, and ground walnuts. Pitfalls, which were heavy galvanized sheetmetal cones measuring 155 mm in diameter and 260 mm in depth, were set into the ground so that the cone opening was flush or slightly lower than ground level; they were not baited. Two of these trapline transects were set up in each of the 10-ha intensive study plots, with the exception of the Low Birch Shrub Thicket. In addition, two transects were established in a Tall Forb Meadow near Sherman, one in a Sedge-Low Shrub Meadow along Watana Creek, and two in a Black Spruce-White Spruce Forest at the mouth of Tsusena Creek.

The following data were recorded for each animal trapped during the August sampling period: Date, trap location (plot, station number),

trap type (snap-trap or pitfall), species, sex, weight (using 50 g and 100 g Pesola scales), and reproductive condition (males--testes abdominal or scrotal; females--pregnant, number and size of embryos, lactating, whether vaginal opening perforate or imperforate). Representative samples of study skins and skeletal material were preserved and deposited in the University of Alaska Museum.

2.4 - Raptor Survey

An aerial survey for raptor nests in the cliff habitat along the upper Susitna River and its tributaries was conducted on 6 July 1980. Observers were A. M. Springer, B. A. Cooper, O. Logsdon, and R. Harkness (pilot).

The survey was made in a Bell 206B "Jet Ranger" helicopter, which moved slowly past cliff faces as close as the pilot deemed safe, usually at a distance of about 30 m. All nests, active and inactive, were recorded on 1:63,360 USGS quadrangle maps, and nest site characteristics were briefly described. The number and age of young in active nests were recorded.

Whether or not we found all nests along the river cannot be ascertained, but several factors lead us to believe that our survey was as accurate as most aerial surveys of this type: 1) Springer is an experienced raptor biologist and has flown numerous raptor surveys, 2) we carried a copy of White's (1974) map with us during the flight and checked all of his locations, 3) we had three observers, in addition to the pilot, which is more than usual for such flights, and 4) when necessary, repeat passes were made to confirm observations.

2.5 - Fall Waterfowl Survey

Aerial survey flights to determine fall utilization of the upper Susitna wetlands by waterfowl, including loons and grebes, were conducted from 7 September through 4 October 1980.

Considerable effort was expended during the 1980 surveys in exploratory checks of waterbodies throughout the upper Susitna River Basin, so a number of sites were visited only once or twice during the fall. After the 7 September flight, however, a number of waterbodies were systematically rechecked throughout the rest of the season. Generally, these waterbodies included most of the large lakes near the proposed impoundments, plus a number of smaller lakes and ponds, either near the large lakes or those flown over enroute from one large lake to another.

Brian E. Lawhead was the observer on all survey flights. Except on 3 October, surveys were conducted from a Bell 206B "Jet Ranger" helicopter; an Aerospatiale AS350 "A-Star" was used on 3 October. Of the two models, the Jet Ranger was more suited to the operation, since it was quieter and caused less disturbance among the birds, and the cockpit bubble caused less visual distortion for the observer.

In searching for birds, usually a single pass at 60 to 90 m (200-300 ft AGL (above ground level) was made over small waterbodies; with larger lakes, the helicopter followed the shoreline around the lake. When birds were located, the helicopter circled widely and slowly around the birds while Lawhead counted and identified them with the help of 7X,35 binoculars. Large lakes containing scattered birds were surveyed in sections. Hovering was avoided, to minimize disturbance, except in several instances when identification was difficult.

As with most aerial surveying, accuracy of results was subject to many foibles, including weather-caused factors (sun glare, choppy water), bird behavior (diving, flushing, hiding in vegetation), differences in helicopter performance and pilots' flying styles, etc. Generally, however, we feel that results are a reasonably accurate indication of the species and numbers present on the respective waterbodies at the time of the surveys.

In an attempt to identify the waterbodies most significant to fall migrants, we derived an "Importance Value" for each of the 20 waterbodies that were consistently surveyed during September 1980. The importance value of each waterbody was the sum of relative mean abundance (number of birds) from the several censuses, the relative mean density (birds/km^2), and the relative mean species richness (number of species) (after Curtis and McIntosh 1951):

$$\text{IMPORTANCE VALUE of a waterbody} = \frac{\text{mean number of birds per census on waterbody}}{\text{sum of mean number of birds per census on all waterbodies}} + \frac{\text{mean density of birds per census on waterbody}}{\text{sum of mean densities of birds per census on all waterbodies}} + \frac{\text{mean number of species per census on waterbody}}{\text{sum of number of species per census on all waterbodies}}$$

2.6 - Avifaunal Survey

Several methods were used to accumulate general data on the avifauna of the region during 1980:

(a) A daily checklist enumerating all independent individuals (as opposed to dependent broods) of all species observed was maintained while we were in stationary camps, i.e., while we were surveying intensive study plots and measuring habitat variables.

(b) Whenever time permitted, we walked cross-country at various sites throughout the upper basin, recording all individuals of all species seen and, whenever feasible, the habitats utilized. Routes traversed were marked on 1:63,360 USGS maps, and hours in the field were recorded, broken down by habitat when possible. In all, over 200 party-hours were spent in this form of survey.

(c) All observations related to breeding chronologies were recorded, e.g., nests and their contents, and age and activity of dependent broods.

(d) Data on occurrence and seasonal chronologies from the raptor and fall waterfowl aerial surveys were used for this work package, but, for comparability, relative abundance information was derived solely from ground counts.

(e) Observations were solicited, either verbally or through posted data sheets, from others working in the region. Many of the reports received through this mechanism, however, proved of inadequate quality.

3 - RESULTS AND DISCUSSION OF BASELINE STUDY

3.1 - Habitat Descriptions of Intensive Study Plots

Ten intensive study plots were established in the shrubland and forest vegetation types of the upper Susitna River Basin in 1980 (Fig. 1). Plot sites within these vegetation types were chosen to represent each of the major woody avian habitats (Kessel 1979) present in the region in sufficient size and uniformity to accomodate a square 10-ha (25-acre) study plot. Below are listed the avian habitats (a-f) represented by our plots and their most distinguishing habitat characteristics, followed in brackets by the approximate vegetative equivalents of Viereck and Dyrness (1980). Classified thereunder are the ten intensive study sites.

(a) LOW (0.4-1.1 m high) AND/OR MEDIUM (1.2-2.4 m high) SHRUB THICKETS [Lowland and/or Tall Shrubland, separated at 1.5 m]

Low Birch Shrub Thicket
Medium Birch Shrub Thicket
Low-Medium Willow Shrub Thicket

(b) TALL (2.5-4.9 m high) SHRUB THICKET [Tall Shrubland, >1.5 m]

Tall Alder Thicket

(c) DECIDUOUS (90% of canopy) FOREST [Deciduous Forest, 75% of canopy]

Cottonwood Forest
Paper Birch Forest

(d) MIXED (10-90% of canopy) DECIDUOUS-CONIFEROUS FOREST [Mixed Conifer and Deciduous Forest, 25-75% of canopy]

White Spruce-Paper Birch Forest

(e) CONIFEROUS (90% of canopy) FOREST [Conifer Forest, 75% of canopy]

White Spruce Forest

(f) SCATTERED WOODLAND ($\geq$ 5 m high) AND DWARF FOREST ($<$ 5 m high) (Stunted growth of 0.2-20% canopy) [Conifer and Deciduous woodlands, 10-24% tree canopy]

White Spruce Scattered Woodland
Black Spruce Dwarf Forest

There are only two significant conflicts in the upper Susitna River Basin studies in using the vegetative classification of Viereck and Dyrness (1980) to describe avian habitats. One is the fact that their Tall Shrubland supports two more or less distinct bird communities (medium and tall shrub birds of Kessel [1979]). The other is that their definition of conifer and deciduous forests is not restricted enough for birds, since only about 10% of either vegetation type will attract the respective bird species into these forests. These conflicts will probably be less of a problem with the small mammal studies, since ground cover plays a more dominant role than some of the taller vegetation types in the habitat preferences of small mammals.

A brief description of each of the 10-ha study plots and of three additional mammal trapping sites that were sampled in 1980 are provided below. Table 3 presents a summary of the various habitat variables measured on each of the 10-ha plots in 1980, and Table 4 gives the frequencies of shrub and herb species in these plots. A few data are still lacking and will be obtained during 1981. When animal population data are available, these measured habitat variables will be analysed relative to bird and mammal community characteristics and, eventually, habitat preferences.

TABLE 3

SUMMARY OF VALUES OF HABITAT VARIABLES FROM EACH 10-HA INTENSIVE STUDY PLOT, UPPER SUSITNA RIVER BASIN, JULY-AUGUST 1980. SEE TABLE 2 FOR DESCRIPTION OF METHODS.

Habitat Variable	Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
GROUND COVER (%)										
Grass	11.2	4.1	16.0	21.1	19.3	12.5	28.7	2.5	4.8	3.4
Sedge	5.4	7.3	37.7	0.1	0.7	0.0	0.0	0.0	1.0	8.9
Forb	1.2	0.7	35.2	15.4	45.8	30.0	40.2	1.9	2.7	11.7
Microshrub (<0.25 m)	58.7	57.7	34.6	16.0	0.8	32.2	26.3	47.2	79.5	54.0
Litter	1.8	4.7	39.6	81.8	97.5	88.3	73.3	5.3	5.5	3.1
Moss	59.8	85.7	59.4	9.6	4.1	13.8	17.0	82.5	74.3	79.2
Lichen	48.4	9.8	0.0	0.2	0.0	0.6	0.5	25.7	3.1	9.6
Water	0.0	0.8	4.4	0.0	0.0	0.0	0.0	0.0	0.3	1.9
Bare soil	3.4	1.1	0.0	6.4	9.4	6.2	7.7	0.1	0.2	1.1
MICRORELIEF (m)	--	0.37	0.25	0.13	0.22	0.32	0.28	0.24	0.32	0.33
LITTER DEPTH (m)	--	0.9	7.8	8.6	10.6	10.5	9.5	0.4	0.9	7.0
DWARF SHRUB COVER (< 0.4 m)(%)	26.9	61.8	44.4	27.7	1.7	38.4	7.5	60.6	81.5	64.3
LOW SHRUB COVER 0.4-1.1 m)(%)	42.5	22.3	47.7	19.9	28.1	3.9	33.4	19.8	34.0	34.5
MEDIUM-TALL SHRUBS/SHRUB CLUMPS (1.2-4.9 m)										
Distance between shrubs (m)	--	1.5	4.6	3.6	1.4	5.1	2.7	5.9	2.0	2.5
Shrub height (m)	--	1.4	1.3	3.8	2.6	3.7	3.2	2.8	1.5	2.9
Height to canopy bottom (m)	--	0.1	0.3	0.2	0.6	0.2	0.1	0.2	0.2	0.2
Canopy thickness (m)	--	1.3	1.1	3.6	2.0	3.5	3.1	2.6	1.4	2.7
Canopy area (m^2 horizontal plane)	--	1.3	0.9	12.3	2.6	8.3	7.5	0.9	1.8	1.4
Shrub heterogeneity (100 SD/$\bar{x}$)	--	37.1	101.3	47.8	29.4	45.4	50.0	56.1	50.1	60.2

TABLE 3 (Continued)

Habitat Variable	Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
TREES (≥5.0 m)										
Distance between trees (m)	--	--	--	--	6.2	5.6	8.0	4.6	20.6	--
Tree height (m)	--	--	--	--	17.6	13.5	13.5	10.4	9.0	--
Height to canopy bottom (m)	--	--	--	--	7.4	4.2	1.3	0.6	0.1	--
Canopy thickness	--	--	--	--	10.1	9.3	12.2	9.8	8.9	--
Tree diameter (m dbh)	--	--	--	--	0.34	0.21	0.23	0.16	0.22	--
Tree heterogeneity (100 SD/$\bar{x}$)	--	--	--	--	54.0	57.7	30.3	34.0	44.4	--
CANOPY COVERAGE (%)										
Trees	--	--	--	--	11.3	11.0	5.1	3.9	0.6	0.3
Medium-tall shrubs	0.0	3.6	1.0	14.9	14.0	6.6	12.9	0.7	2.9	3.0
Total (trees & shrubs)	0.0	3.6	1.1	14.9	17.5	14.8	15.9	4.3	3.5	3.3
FOLIAGE DENSITY PROFILE (Number of Coverboard Squares Contacted)										
Woody stems:										
0.0-0.4 m	41.7	62.3	57.8	46.1	53.0	35.7	43.1	53.2	59.8	54.1
0.6-1.0 m	4.5	58.0	40.0	34.0	47.7	27.0	38.7	20.9	51.5	29.6
1.6-2.0 m	0.0	2.7	0.0	44.1	37.0	27.0	42.9	15.0	8.7	15.3
3.5-3.9 m	0.0	0.1	0.0	40.5	42.3	29.4	36.1	15.5	2.5	7.7
Graminoid stems:										
0.0-0.4 m	25.0	12.1	40.1	33.1	41.0	42.5	50.3	6.2	12.1	16.7
0.6-1.0 m	0.7	1.7	7.2	7.2	13.5	14.5	18.6	0.3	1.0	0.7
1.6-2.0 m	0.0	0.0	0.0	0.0	0.1	0.9	0.3	0.0	0.0	0.2
Forb stems:										
0.0-0.4 m	1.0	0.4	20.2	22.7	42.4	24.7	33.4	3.4	5.3	10.5
0.6-1.0 m	0.2	0.0	0.0	1.0	16.8	5.2	3.0	0.0	0.0	0.1
1.6-2.0 m	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0

TABLE 3 (Continued)

Habitat Variable	Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
TREE IMPORTANCE VALUES										
White spruce, Picea glauca	0	0	0	0	15	61	163	202	293	0
Black spruce, Picea mariana	0	0	0	0	0	0	0	90	7	0
Cottonwood, Populus balsamifera	0	0	0	0	220	0	0	2	0	0
Quaking aspen, Populus tremuloides	0	0	0	0	0	9	0	0	0	0
Willow, Salix spp.	0	0	0	0	1	0	0	4	0	0
Paper Birch, Betula papyrifera	0	0	0	0	2	223	135	2	0	0
Alder, Alnus spp.	0	0	0	0	62	7	2	0	0	0
MEDIUM-TALL SHRUB IMPORTANCE VALUES										
White spruce, Picea glauca	0	0	0	0	0	37	18	118	0	8
Black spruce, Picea mariana	0	0	0	0	0	0	0	141	4	284
Willow, Salix spp.	0	0	124	5	13	5	0	2	3	8
Shrub birch, Betula glandulosa/ hybrids	0	300	164	5	0	0	0	13	289	0
Paper birch, Betula papyrifera	0	0	0	0	0	30	37	13	0	0
Alder, Alnus spp.	0	0	12	289	195	211	240	13	4	0
Raspberry, Rubus idaeus	0	0	0	0	2	0	0	0	0	0
Alaska spiraea, Spiraea beauverdiana	0	0	0	0	0	0	5	0	0	0
Greene mountain ash, Sorbus scopulina	0	0	0	0	0	16	0	0	0	0
Prickly rose, Rosa acicularis	0	0	0	0	0	0	0	2	0	0
Devil's club, Echinopanax horridum	0	0	0	0	20	0	0	0	0	0
High bush cranberry, Viburnum edule	0	0	0	0	71	0	0	0	0	0

TABLE 3 (Continued)

Habitat Variable	Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
TOTAL LENGTH OF EDGE (m)	150	90	233	180	0	0	0	90	79	0
SLOPE (degrees)	0-6	0-4	--	25	0	22	--	1-4	5-13	1-3
ASPECT (degrees)	knoll	282	--	148	--	157	--	312	112	268
ELEVATION (m)	1100	900	880	1200	180	600	600	520	820	730

TABLE 4

FREQUENCIES (%) OF SHRUB AND HERB SPECIES IN INTENSIVE STUDY PLOTS, UPPER SUSITNA RIVER BASIN, ALASKA, JULY-AUGUST 1980. BASED ON OCCURRENCE IN 40 1.0 m x 1.0 m SAMPLE PLOTS LOCATED AT THE MAMMAL TRAPSITES ON LINES THREE AND FIVE OF THE 10-HA STUDY PLOTS

Plant Species	Low Birch Shrub Thicket*	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
SHRUB										
Alnus crispa				13		3				
Andromeda polifolia		3								
Arctostaphylos rubra			13					10	5	
Betula glandulosa/hybrids		100	97	17				63	85	95
Cornus spp.		70	95	33		93	73	53	100	15
Echinopanax horridum					33					
Empetrum nigrum		100	67	3		7		37	100	97
Ledum palustre		97	20	16		6		85	97	93
Linnaea borealis			7	37		90	85	40	43	
Oxycoccos microcarpus		3	3							45
Potentilla fruticosa			10					3	3	
Ribes glandulosum						7	55			
Ribes triste					57		27			
Ribes spp.				25						
Rosa acicularis			10	27	33	3	10	27	17	
Rubus idaeus				5	30	5	40			
Salix bebbiana								3		
S. myrtillifolia								3		
S. novae-angliae								3		
S. planifolia (?)			97	3						20
S. reticulata			40	3				3		
Salix spp.		15		5			3	5	33	
Spiraea beauverdiana		85	27	33		55	27		60	17
Vaccinium ovalifolium							3			
Vaccinium uliginosum		40	63	27		17		50	97	100
Vaccinium vitis-idaea		100	57	35		43	13	100	97	100
Viburnum edule			10	3	55		7			
FORB										
Achillea spp.		40	3						5	
Aconitum delphinifolium			30	13			5			

TABLE 4 (Continued)

Plant Species	Low Birch Shrub Thicket*	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
Actaea rubra					17					
Anemone spp.			35							
Arnica spp.			3							
Artemisia spp.		20	20							
Circaea alpina					3					
Delphinium glaucum					5					
Epilobium spp.			23	93	47	13	50	7	17	
Erigeron spp.			10							
Galium boreale			23		3			3		
Galium trifidum					90					
Gentiana spp.			23							
Geocaulon lividum								20		
Geranium erianthum			3							
Hedysarum alpinum								10		
Heracleum lanatum					10					
Hieracium gracile			35							
Listera cordata			10							
Lupinus spp.		7								
Mertensia paniculata			55	35	20		10	15		
Pedicularis spp.		3	33						5	5
Petasites spp.			27	10				3		43
Platanthera spp.			3							
Polemonium acutiflorum			57	23			3		7	
Potentilla palustris										3
Potentilla spp.			20							
Pyrola spp.		5	27		83	10	7	3	15	3
Ranunculus spp.										3
Rubus arcticus			17	30			5	5	10	
Rubus chamaemorus		47	83		5	17	7		35	75
Rubus pedatus						83	70			
Rumex arcticus		10								7
Sanguisorba stipulata		3	73			10	45		10	
Saussurea angustifolia								7		
Sedum rosea			7							
Senecio spp.			13						3	
Solidago spp.			5	10					3	

TABLE 4 (Continued)

Plant Species	Low Birch Shrub Thicket*	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
Stellaria spp			10	7	10					5
Streptopus amplexifolius			3		60	5				
Thalictrum sparsiflorum					3					
Thalictrum sp.			40							
Trientalis europaea		3	10	17	27	90	80		3	
Valeriana capitata			15							
GRASS										
Calamagrostis spp.				83	87	80	95	15	23	7
Deschampsia spp.					7			57		
Grass, unidentified		77	93						57	10
SEDGE										
Carex spp.		65		5		5	5	5	15	85
Eriophorum spp.			3							
Sedge, unidentified			100						12	
HORSETAIL										
Equisetum spp.		7	95	17	70	20	73	27	43	40
FERN										
Dryopteris spp.					47	17	40			
Gymnocarpium sp.					55	33	60			
Matteuccia struthiopteris					7					
Thelypteris spp.							7			
CLUB MOSS										
Lycopodium spp.		17	20	3		50	33	7	20	3
MOSS		100	100	77	83	97	95	100	100	100
LICHEN		100	15	63	3	35	35	97	100	83

*Data not yet obtained.

Generally, we have used common names for the most important tree and shrub species (Table 3) and major plant groups (e.g., sedges, lichens), but only scientific names for the less common species and ground cover plants. Nomenclature follows Hultén (1968), except for willows, which follows Argus (1973).

3.1.1 - Low Birch Shrub Thicket

The plot consisted of a relatively uniform stand of shrub birch (Betula glandulosa/nana) with some small open patches interspersed. Average shrub height was about 0.7 m. The fairly uniform ground cover was dominated by microshrubs (Empetrum nigrum, Vaccinium vitis-idaea, V. uliginosum), moss, and lichens. The plot was located atop a dry, broad knoll west of Kosina Creek, at 62°42'47" N, 147°53'50" W, and at 1100 m (3600 ft) elevation.

3.1.2 - Medium Birch Shrub Thicket

A dense, homogeneous stand of 1.4 m-high shrub birch characterized this plot. Ground cover consisted of thick moss and a dense mat of microshrubs, especially Empetrum nigrum, Vaccinium vitis-idaea, Ledum palustre, and lesser amounts of Spiraea beauverdiana. The plot was along a broad, relatively dry ridge that sloped slightly to the west. It was located west of Tsusena Creek, at 62°52'17" N, 148°37'05" W, and at 900 m (3000 ft) elevation.

3.1.3 - Low-Medium Willow Shrub Thicket

Although a rather heterogeneous plot, the vegetation was dominated by willow (probably Salix planifolia pulchra). Dense low shrubs, predominately willow, occurred throughout the plot, with interspersed wet sedge meadow openings present on the upper third of the plot. Medium-height shrubs of shrub birch and willow grew on the lower two-thirds of the plot. Ground cover consisted of about equal

percentages of microshrubs (especially Cornus sp., Empetrum nigrum, Vaccinium uliginosum, and V. vitis-idaea, with lesser amounts of Salix reticulata), sedges, many species of forbs (including relatively high frequencies of Equisetum sp., Rubus chamaemorus, Sanguisorba stipulata, Polemonium acutifolium, and Mertensia paniculata), and litter. The substrate was moist to wet, and the above-mentioned ground cover vegetation was underlain by moss. The plot was on the NE-facing slope of a draw west of Tsusena Creek, at 62°51'10" N, 148°45'50" W, and at 880 m (2900 ft) elevation.

3.1.4 - Tall Alder Shrub Thicket

The plot was dominated by dense, tall Sitka alder (Alnus crispa sinuata), averaging 3.6 m in height. The upper half to two-thirds of the plot was dense alder, whereas the lower portion had some openings and intrusions of small groups of white spruce trees. Ground cover was predominantly leaf and grass litter, with moderate amounts of dwarf and microshrubs (Linnaea borealis, Vaccinium vitis-idaea, Spiraea beauverdiana, Cornus sp., V. uliginosum, Rosa acicularis, and Ribes spp.), grass, and forbs. The plot was on a steep, SE-facing slope east of Watana Creek, at 62°50'40" N, 147°59'00" W, at approximately 1200 m (4000 ft) elevation.

3.1.5 - Cottonwood Forest

A dense stand of tall, mature cottonwoods (Populus balsamifera), averaging 17.6 m tall and 34 cm dbh, dominated this plot. The forest was homogeneous, except for an old, overgrown river channel that intruded into the northern edge, resulting in a narrow strip of only dense alder and no trees. There was a two-level understory--an alder (Alnus spp.) layer with a canopy top at about 6 m, and a medium shrub layer of high bush cranberry (Viburnum edule) and devil's club (Echinopanax horridum). A 28% low shrub cover consisted primarily of Ribes triste, Rosa acicularis, and Rubus idaeus; and

the ground cover was composed of more than 97% litter and many forbs, most commonly Galium trifidum, Pyrola spp., Streptopus amplexifolius, and Epilobium angustifolium. Equisetum spp. and the ferns Dryopteris dilatata, Gymnocarpium dryopteris, and Matteuccia struthiopteris were frequent, and there were many fallen logs. The plot was located on the Susitna River floodplain near Sherman, at 62°42'10" N, 149°49'45" W, and at 180 m (600 ft) elevation.

3.1.6 - Paper Birch Forest

The plot was composed predominantly of mature paper birch (Betula papyrifera) that averaged 13.5 m tall and 21 cm dbh, although patches of white spruce intruded into the SW corner. There were patches of heavy undergrowth of tall alder, and this was the only plot in which Greene mountain ash (Sorbus scopulina) occurred. The forest floor had a high cover (88%) of litter, and a moderate cover (30 and 38%, respectively) of forbs and of dwarf and microshrubs, including Cornus sp., Linnaea borealis, Spiraea beauverdiana, and Vaccinium vitis-idaea. The plot was on a steep SSE-facing, rocky, terraced slope, with rock cliffs 3 to 6 m high. It was located on the north wall of the Susitna River canyon 8 km downstream from Devil Creek, at 62°48'46" N, 149°11'30" W, and at 600 m (2000 ft) elevation.

3.1.7 - White Spruce-Paper Birch Forest

An open, uniform stand of mature paper birch (Betula papyrifera) and white spruce (Picea glauca), averaging 13.5 m high and 23 cm dbh, dominated this mixed deciduous-coniferous forest. Similar to the deciduous forest plots, this one had a dense undergrowth of tall alder. There was a moderate cover (33%) of low shrubs (especially Ribes spp., Rubus idaea, and Spiraea beauverdiana) and microshrubs (Cornus sp., Linnaea borealis, and Vaccinium vitis-idaea). Ground cover was dominated by litter, with lesser amounts of forbs, especially,

as in the paper birch forest, Trientalis europaea and Rubus pedatus. The ground cover had the highest percentage of grass of any 10-ha plot, 28.7%. The plot was located a little NE of the Paper Birch Forest plot, and was also on a steep slope on the north side of the canyon of the Susitna River (62°49'10" N, 149°08'25" W, 600 m [2000 ft] elevation).

3.1.8 - White Spruce Forest

Mature white spruce trees (Picea glauca) dominated this plot, but a few black spruce (Picea mariana) were scattered throughout and increased in frequency toward the SW corner. The white spruce averaged 10.1 m tall and 19 cm dbh, whereas the black spruce averaged 8.1 m tall and 12 cm dbh. There were many dead spruce snags of both species standing on the plot, with an average distance between snags of 11.3 m. Thirteen snags with complete tops identifiable as white spruce averaged 13.3 m tall, and six identifiable as black spruce averaged 10.8 m tall. Many small spruce indicated continued regeneration by both species. The deciduous shrub understory consisted primarily of shrub birch, paper birch, and alder. Ground cover was predominantly moss, with considerable interlacing of lichens and of dwarf and microshrubs, especially Vaccinium vitis-idaea, Ledum palustre, Cornus sp., and V. uliginosum. Litter was essentially absent. The plot was located on an old outwash plain at the mouth of Kosina Creek, at 62°47'00" N, 147°57'16" W, and at 520 m (1700 ft) elevation.

3.1.9 - White Spruce Scattered Woodland

The dominant trees on the plot were mature, but relatively short, white spruce (Picea glauca), averaging 9.0 m tall and 22 cm dbh. They were widely scattered throughout the plot, becoming somewhat denser toward the SE corner; average distance between trees was 20.6 m. Between the spruce was a relatively dense medium and low

shrub cover of shrub birch, averaging about 1.5 m high. Beneath this layer was a dense cover (80%) of dwarf and microshrubs, especially Cornus sp., Empetrum nigrum, Ledum palustre, Vaccinium uliginosum, and V. vitis-idaea, and a relatively high ground cover of moss. The plot was located on an ESE-facing slope just north of the mouth of Tsusena Creek, at 62°51'47" N, 148°35'50" W, and at 820 m (2700 ft) elevation.

3.1.10 - Black Spruce Dwarf Forest

An open stand of stunted black spruce (Picea mariana) comprised this plot. The spruce averaged only 2.9 m high and 4 cm dbh (and hence are treated as "shrubs" in Table 3). They were somewhat clumped in distribution and became more dense toward the W edge of the plot. There was a moderate cover (35%) of low shrubs, composed mostly of shrub birch and black spruce, and a denser cover (64%) of dwarf shrubs, primarily Vaccinium uliginosum, V. vitis-idaea, Empetrum nigrum, Ledum palustre, and shrub birch. The predominant ground cover was moss (79%). There was an extensive area of water seepage through the plot and some hummocky ground. There was a slight slope (1-3°), giving the plot a W exposure. The plot was located in the Fog Lakes area, at 62°47'48" N, 148°28'15" W, at 730 m (2400 ft) elevation.

3.1.11 - Sedge-Low Shrub Meadow

The habitat variables for this mammal trapping site have not yet been measured nor plant species identified. The patch of habitat was oval-shaped and about 300 m x 90 m in size. It was bisected by a small, braided stream, resulting in wet sedge meadow habitat along the lower third of the trapline; a more mesic sedge-low shrub was along the upper trapline. The sedge appeared to be a Carex, whereas the shrub, which averaged about 0.6 m high, appeared to be the diamondleaf willow (Salix planifolia pulchra). The site

was bordered on the W side by steep spruce forest and on the E by creek bottom spruce and cottonwood. It was located 2.7 km up Watana Creek at 490 m (1600 ft) elevation.

3.1.12 - Tall Forb Meadow

The habitat variables for this mammal trapping site have not yet been measured. The site was a small patch of habitat dominated by 2 m-tall cow parsnip (Heracleum lanatum) and tall, dense grass (probably Calamagrostis canadensis). The trapline site was adjacent to the SW edge of the Cottonwood Forest plot near Sherman. It was bordered on the NW by a tall shrub border along a river slough, on the SE by the Alaska Railroad, and on the SW by a paper birch-cottonwood forest and tall shrub thicket.

3.1.13 - Black Spruce-White Spruce Forest

The habitat variables for this mammal trapping site have not yet been measured. Mature black spruce and white spruce dominated the riverbottom site, which was bordered on the south and east by narrow alluvial shorelines. Adjacent stands of white spruce graded quickly into increasingly stunted black spruce away from the better drained riverbanks. The west edge of the site included scattered patches of wet sedge meadow. The trap site was located near the confluence of Tsusena Creek with the Susitna River, at 62°49'25" N, 148°36'40" W, at 460 m (1500 ft) elevation. The traplines were in a portion of a furbearer study grid.

3.2 - Small Mammal Studies

Of the twenty potentially occurring small mammal species of the upper Susitna River region (Table 1), thirteen were found in the study area during the 1980 field season: four species of shrews--masked, dusky, arctic, and pygmy; two lagomorphs--collared pika and snowshoe hare; and

seven rodents--hoary marmot, arctic ground squirrel, red squirrel, northern red-backed vole, meadow vole, tundra vole, and porcupine. The presence of three additional species is also suspected: water shrew (tracks between ice openings on Watana Creek, March 1980, by S. W. Buskirk), little brown bat (small bat over High Lake in evening, August 1980, by J. Wilson, and small bat at mouth of Tsusena Creek, mid-August 1980 by S. W. Buskirk), and singing vole (droppings and clippings, dry rocky slopes at 1200 m [4000 ft] elevation, between Tsusena and Devil creeks, July 1980, by MacDonald).

In the fall 1980 trapping survey, 26 August-2 September, 1011 small mammals of seven species were captured. The most abundant species by far were red-backed voles and masked shrews, which accounted for 77% of the total trapline captures (Table 5). Arctic shrews comprised 12% of total captures, dusky shrews, 10%, and pygmy shrews, less than 1%. Within the genus Microtus, tundra voles comprised 3% of total captures and meadow voles, 1%. Table 5 summarizes capture information for all sites sampled.

Because extensive surveys have yet to be conducted for the other small mammal species inhabitating the study area, the following discussion on their local distribution and abundance remains general.

Arctic ground squirrels were abundant and widespread throughout higher elevations of the study area. Although most were concentrated on drier sites above treeline, a small number were found at lower elevations: one near the mouth of Tsusena Creek and several along the railroad siding near Sherman. One animal was encountered 0.8 km below treeline in mixed spruce-birch forest near Portage Creek by B. E. Lawhead.

TABLE 5

RELATIVE ABUNDANCE OF SMALL MAMMALS (CATCH PER 100 TRAP NIGHTS) FOR EACH SITE TRAPPED IN THE UPPER SUSITNA RIVER BASIN, ALASKA, BETWEEN 26 AUGUST AND 2 SEPTEMBER 1980

Species	Total Captures	Sedge-Low Shrub Meadow	Tall Forb Meadow	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cottonwood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest	Black Spruce-White Spruce Forest
Masked shrew, *Sorex cinereus*	371	15.00	12.78	1.67	9.72	17.22	16.11	7.78	14.72	1.11	5.28	5.55	3.61
Dusky shrew, *S. monticolus*	99	1.11	3.05	5.55	4.44	1.67	3.33	1.94	1.94	1.39	0.28	0.83	2.50
Arctic shrew, *S. arcticus*	118	0.00	15.00	6.94	1.94	0.55	5.00	0.28	0.83	0.00	2.22	0.00	0.00
Pygmy shrew, *S. hoyi*	6	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.83	0.00	0.28	0.28
Northern red-backed vole, *Clethrionomys rutilus*	378	16.67	9.17	1.67	0.55	9.17	13.33	1.11	10.55	8.33	10.83	19.44	12.50
Meadow vole, *Microtus pennsylvanicus*	13	6.67	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tundra vole, *M. oeconomus*	26	1.67	1.39	0.28	0.00	0.55	0.00	0.00	0.00	0.00	0.28	3.33	0.55
Number of trap nights	4140	180	360	360	360	360	360	360	360	360	360	360	360
Total number of species		5	5	5	4	6	5	4	4	4	5	5	5
Total animals per 100 TN		41.11	41.39	16.11	16.67	29.44	38.05	11.11	28.05	11.67	18.89	29.44	19.44
Species diversity $1/\Sigma(P_i)^2$		3.07	3.54	3.07	2.35	2.26	3.06	1.88	2.37	1.86	2.37	2.06	2.15

Small colonies of hoary marmots were reported from widely scattered locations at higher elevations within the study area. None were observed in any of the proposed impoundment areas. Location of sightings of hoary marmots were as follows:

(a) Watana Mountain, east side, 1050 m (3500 ft) elevation, at least six animals.

(b) Mountain slope east of Stephan Lake (62°41' N, 148°41' W), 1200 m (4000 ft) elevation, several animals.

(c) Headwaters of Devil Creek (62°55' N, 148°55' W), 1050 m (3500 ft) elevation, one animal.

(d) Portage Creek, several sites, including blockfield east of confluence with Susitna River.

Red squirrels inhabited coniferous forests throughout the area, but nowhere were they numerous. The largest number of red squirrels were in the mature spruce stands that occur along the larger creeks, such as Watana and Tsusena.

Scattered colonies of collared pikas occurred in suitable habitat at higher elevations in the study area (up to 12 animals at one location). None have been found within proposed impoundment areas.

Snowshoe hares were uncommon in the Susitna River Basin in 1980. Summer observations included a single hare near the mouth of Tsusena Creek and one in black spruce forest near Fog Lakes. Winter observations, as reported by personnel flying transects for the furbearers studies in mid-November 1980, also indicated a general scarcity of hares in the area. Local "pockets" of concentrated hare tracks were found near Jay and Goose creeks, and at one site farther up the Susitna toward Tyone

River (Buskirk, pers. comm.). No hare tracks were seen on any of the transects downriver from about Fog Creek, and hares were confined to areas below 900 m (3000 ft) elevation, primarily in forest and woodland habitats.

Another uncommon resident of the study area was the porcupine. During summer and fall 1980, single animals were seen near the mouths of Kosina and Watana creeks, near the junction of Thoroughfare Creek and Portage Creek, and in an outbuilding at High Lake. Porcupine sign was reported from the lower Oshetna River by S. Regan. Extensive coverage of the basin area in November 1980 by the furbearer study resulted in reports of porcupine tracks at only two locations: several sets just north of Devil Canyon and a single set just west of Portage Creek.

Information on habitat-small mammal relationships is currently limited to the results of a single sampling period, although 1980 trapping sites did include most of the major vegetation types in and near the proposed impoundments. A general indication of habitat occupancy patterns is revealed by the fall capture data (Table 5). Red-backed voles, masked shrews, dusky shrews--all common to abundant species--occupied a broad range of habitats. Arctic shrews and tundra voles occurred in fewer habitats, and meadow voles and pygmy shrews--the least abundant species--were most restricted. Tall Forb Meadow, Sedge-Low Shrub Meadow and Cottonwood Forest had the most small mammals and most diverse communities, while Paper Birch Forest and White Spruce Forest had the fewest individuals and lowest diversity.

For preliminary analyses, trapline habitats have been grouped into just three categories--forest, shrub (including woodland), and meadow habitats--and the capture data for each of the habitats in each of the major categories has been averaged. The proportion of average abundance of a species in each category has been plotted as a single point in an equilateral triangle (Fig. 2), where each side of the triangle represents a habitat category. When imaginary lines are drawn perpendicularly to each side

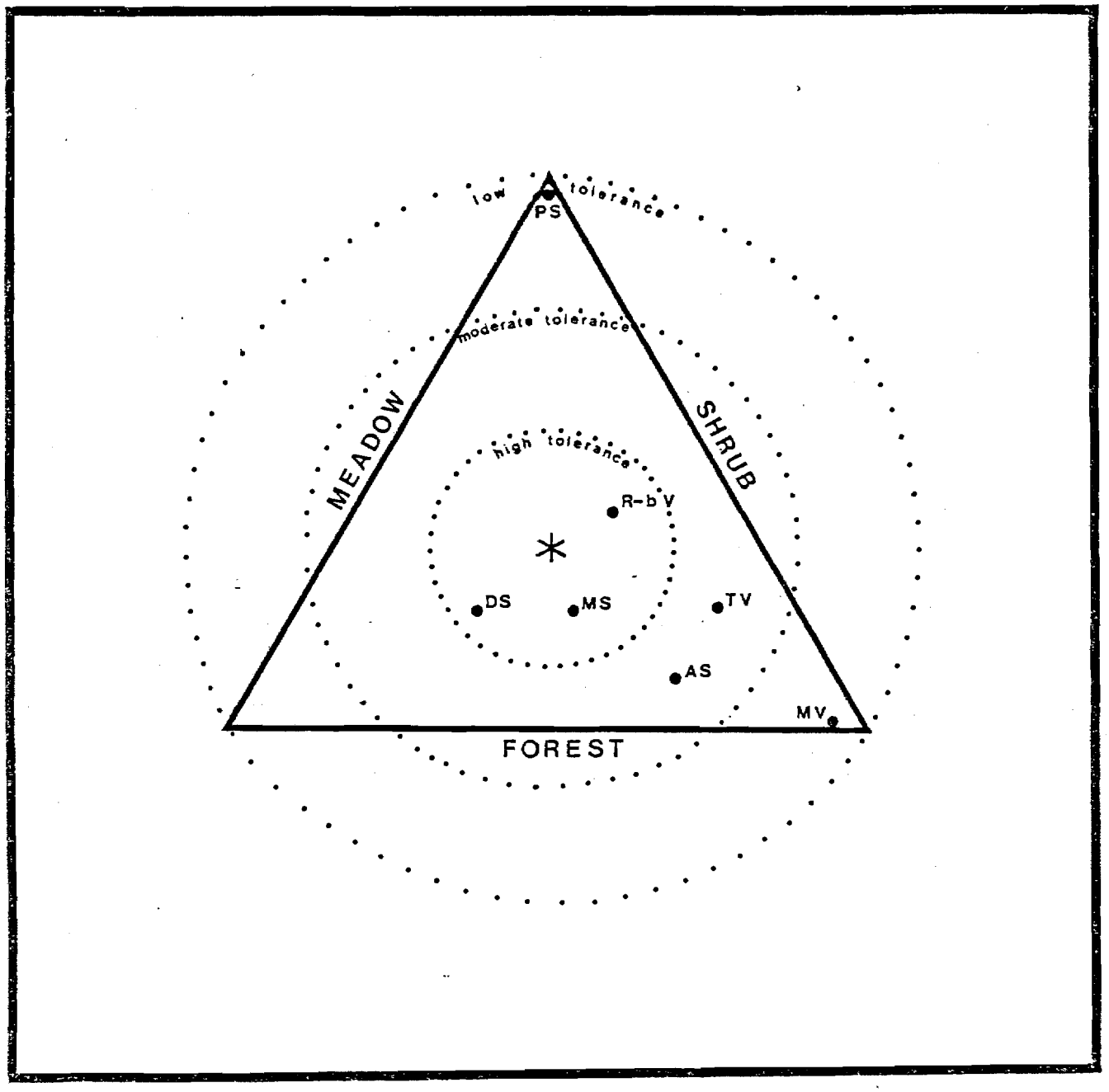

FIGURE 2

Ordination of small mammal species relative to three habitat categories--meadow, shrub, and forest--upper Susitna River Basin, fall 1980. The perpendicular distance between a species dot and a habitat line is proportional to the abundance of the species in that habitat category. Conversely, the concentric rings show the relative habitat tolerance (habitat specialist vs habitat generalist) of the various species. Key: MS=masked shrew, DS=dusky shrew, AS=arctic shrew, PS=pygmy shrew, R-bV=red-backed vole, MV=meadow vole, TV=tundra vole.

of the triangle, their respective lengths reflect the proportions of a species' abundance in forest, shrub, and meadow. Each small mammal species shows a different ordination relative to the three habitat categories (Fig. 2), and each species' position gives a general indication of habitat preference. Meadow voles, and, to a lesser extent, tundra voles and arctic shrews, preferred meadow habitats. Pygmy shrews were found exclusively in forest. Red-backed voles, masked shrews, and dusky shrews, with this gross level of analysis, showed no strong preference for any one habitat category.

The degree of a species' tolerance to different habitats (its habitat breadth, or, stated differently, its position on a continuum from habitat specialist to habitat generalist) is illustrated in Figure 2 by the relative distance of a species' point to the center of the triangle. Here, again, red-backed voles, masked shrews, and dusky shrews were shown to be habitat tolerant species. Arctic shrews and tundra voles were moderately tolerant, and meadow voles and pygmy shrews were the least tolerant.

While the habitat-small mammal analyses from the limited 1980 data tend to corroborate results of other small mammal studies in central Alaska (Guthrie 1968, West 1979, MacDonald 1980), interpretations from the Susitna data must be considered only preliminary. Repetitive sampling in more vegetative types is still necessary. Small mammal community structures, especially as they relate to species dominance and habitat usage, are highly correlated with population levels and species interactions. Because of extreme density fluctuations of most northern small mammal species (Krebs and Myers 1974), strict ecological boundaries are difficult to delineate. A small mammal population sampled during a "high" year may occupy a greater breadth of habitats than during a "low." The degree of species interactions also varies with density. Of the factors governing a species' local distribution, the physical features of the landscape (i.e., habitat variables) are probably the most important, followed by food, species interactions, and population density (Guthrie 1968).

3.3 - Raptor Survey

An aerial survey in search of raptor nests in and near the proposed impoundment area was conducted from a Bell 206B "Jet Ranger" helicopter on 6 July 1980, from 08:45 to 15:50 h. The search area included all cliff habitat along the Susitna River and its tributaries, from Portage Creek to the mouth of the Tyone River, but did not include the large number of upland cliffs and tops of the surrounding mountains. Weather during the flight was overcast, with light winds and scattered showers; temperatures averaged 15°C.

A total of 19 nests was enumerated on the survey, nine of which were inactive. The active nests included two Bald Eagles, six Golden Eagles (one containing a single dead chick), one Common Raven, and one unidentified raptor (site visited three times, but adults not observed). Table 6 summarizes information on each of the active nests. Based on the 1980 plans for Devil Canyon and Watana dams, it appears that nine of the 19 nest sites would be flooded, including the two active Bald Eagle nests in river-bottom trees and four of the active Golden Eagle nests on the cliff walls of the Susitna River. The elevations of the other two Golden Eagle nests are not yet known accurately enough to judge whether or not they would be flooded.

Within the same geographic area in 1974, White (1974) also found ten active nests: two Gyrfalcon, one Bald Eagle, and seven Common Raven. He reported 14 inactive nests, ascribing eight to ravens and three each to Golden and Bald eagles.

White (ibid.) saw two individual Peregrine Falcons during his 10-15 June 1974 survey, but he found no sign of nesting. One bird was a "single adult male ... roosting on a cliff about 4 miles upriver from the Devil Canyon Dam axis," and the other was "a sub-adult ... about 15 miles upriver from the Devil Canyon Dam axis." We saw no peregrines

TABLE 6

NEST DATA ON ACTIVE RAPTOR AND RAVEN SITES OBSERVED ON 6 JULY 1980 AERIAL SURVEY, UPPER SUSITNA RIVER AND TRIBUTARIES

Nest	Species	*	No. Young	Age of Young (Weeks)	Locality and Notes
A	Bald Eagle	+	1	?	8.0 km up the Susitna River from the mouth of Watana Creek. On wooded island in a spruce tree.
B	Bald Eagle	+	1	5	4.5 km up Oshetna River from its confluence with the Susitna River. Nest is a spruce tree along the river.
C	Golden Eagle	?	2	4+	3.5 km upriver from V-Canyon and 0.7 km up a narrow canyon on the north side of the Susitna River. Nest 9 m below cliff top.
D	Golden Eagle	+	1	3+	4.0 km up the Susitna River from the mouth of Jay Creek and in canyon on north side of the Susitna. Nest 9 m below top of cliff.
E	Golden Eagle	+	1	3+	2.7 km up Jay Creek from its junction with Susitna River. Nest half way up a cliff.
F	Golden Eagle	+	1 dead	<3	North bank of the Susitna River, 1.0 km downstream from the mouth of Kosina Creek.
G	Golden Eagle	+	1	3-4	North side of Susitna River 4.0 km downstream from the mouth of Watana Creek. Nest 60 m up a 120-m cliff.
H	Unknown	0	1	2	6.8 km down the Susitna River from mouth of Devil Creek and 4.0 km up a gorge on south side of the Susitna. Occupied by a Gyrfalcon in 1974 (White 1974).
I	Golden Eagle	?	1	4+	0.5 km up Devil Creek from its mouth. Nest on grassy ledge 60 m up a 90 m cliff.
J	Raven	0	?	?	1.0 km up Devil Creek from its mouth. Nest near top of cliff.
[K	Bald Eagle	0	?	?	8.0 km up Deadman Creek in a deciduous tree. Nest not part of survey; reported to us by others later in the summer.]

*KEY: + Would be flooded
0 Would not be flooded
? Unknown

during our survey flight, nor any during the entire field season, although two unconfirmed reports of flying birds were received from other observers (see Section 3.5).

White (1974) concluded:

> It is doubtful if a peregrine population, as such, breeds in the impoundment area of the Susitna River. Because of a lack of previous sightings or observations of breeding peregrines in the Yentna-Chulitna-Susitna-Matanuska rivers drainage basin, this entire region seemingly represents an hiatus in the breeding range of breeding peregrines....

White further concluded:

> ...the impact of the damsites along the Susitna River to peregrine falcon populations will be negligible. The impact of damsites on other raptor populations is also seemingly minor.... The only ecological equivalent to a raptor that will be significantly impacted is the raven but it exists in numerically healthy populations in regions adjacent to the river and the habitat created by the raven along the river is seemingly not used by other raptors.

Compared to 1974, we found more breeding Golden Eagles but fewer breeding ravens in the study area. It is difficult to determine from copies of White's (1974) maps the exact location of some of the nests he recorded, but it appears that one pair of the 1980 Golden Eagles was using a nest that White identified as an inactive raven nest, one may have been using what was an active raven nest in 1974, the one with the dead chick was using a nest identified as an inactive Golden Eagle nest in 1974, and three pairs were using sites in 1980 not recorded in 1974.

The smaller number of ravens in 1980 compared to 1974 was probably due in part to the fact that the 1980 survey date was late for finding unfledged raven young. The reason for the greater number of Golden Eagle nests is unknown. The 1980 density of active Golden Eagle nests (one pair per 14.8 km [9.2 miles]) was similar to that along the Dalton Highway through the Brooks Range in 1979 (one active nest per 15.7 km [9.7 miles]) (D.G. Roseneau, pers. comm.)--the Brooks Range having one

of the best populations of Golden Eagles in Alaska. A. Murie (1944), in Mt. McKinley National Park, found active nests as close as 1.6 and 2.4 km (1-1.5 miles) to each other in 1941 and 1939, respectively. Pairs of Golden Eagles regularly build and maintain a number of simultaneous nests, which they use as alternative sites in various years (Brown and Amadon 1968), some several kilometers apart (D. G. Roseneau, pers. comm.). It has been suggested (White et al. 1977) that local populations increase during years of high hare populations, but hares were relatively scarce on the upper Susitna in 1980. A. Murie (1944) found that ground squirrels were a major prey of Golden Eagles in Mt. McKinley National Park in 1939-1941, and this species was abundant in the Susitna area in 1980.

3.4 - Fall Waterfowl Survey

Eight waterbird surveys were flown in the upper Susitna River Basin between 7 September and 4 October 1980. This period was selected for survey on the basis of information for interior Alaska, where peak fall migration is known to occur during September (Kessel unpubl. notes, Kessel et al. 1980, Ritchie and Hawkings 1981).

Two of the surveys were limited in extent and covered some wetlands in the lower portion of the study area: On 22 September, the Bear-Otter lakes group west of Portage Creek was surveyed, as were the bars and sloughs of the Susitna River from the mouth of Portage Creek downstream to Talkeetna. On 4 October, the High-Swan-Dawn lakes group and the Bear-Otter lakes group were surveyed. None of the waterbodies searched during these two surveys supported many birds; the maximum number was 32 ducks, mostly divers, on Waterbody (WB) 005, a 0.34 km^2 pond in the Bear-Otter lakes group, on 22 September. This pond contained only a single grebe on 4 October.

The other six surveys covered the area from the Stephan Lake group upriver to the lakes between the Tyone and MacLaren river mouths. The 7 September survey was primarily exploratory, to gain an idea of the

species in the area and their relative abundance. Thereafter, a number of the waterbodies were rechecked on each flight, although additional wetlands were also explored. Wetlands rechecked regularly included the Stephan Lake group, the Fog Lakes group, waterbodies in the Deadman-Watana Creek drainages, and some waterbodies between the mouths of the Tyone and MacLaren rivers--but not those between the Tyone and Oshetna rivers, which were surveyed only irregularly. Survey time over the regularly-checked wetlands took approximately 3 h of flying time to complete.

As a result of the fall 1980 surveys, we obtained a broad overview of waterfowl utilization of much of the upper basin and have enough systematic data to 1) document the seasonal progress of migration, 2) compare the relative importance to fall migrants of 20 waterbodies within the basin, and 3) compare these waterbodies with selected waterbodies from the upper Tanana River area of eastern Alaska.

Based on the six upriver surveys, the commonest waterfowl during the migratory period were, in descending order of abundance, scaup sp., American Wigeon, goldeneye sp., Mallard, Bufflehead, scoter spp., and Pintail (Table 7). Generally, the species relative abundance and composition were similar to those of interior Alaska, including the presence of migrant swans and a few prairie ducks (Blue-winged Teal and Ring-necked Ducks) (Kessel, pers. obs.). There were two exceptions to the similarities, however: 1) Pintails were comparatively less numerous, especially in view of the fact that 1980 was a high year for Pintails in Alaska due to severe drought in the Canadian prairie provinces (King and Conant 1980); and 2) Black Scoters, which breed in the Alaska Range, were more numerous.

Peak Pintail numbers occurred on 16 September. Highest numbers of Mallards, goldeneyes, and Buffleheads occurred between 20 September and 3 October. Buffleheads and scoters peaked on 26 September. Overall, the peak number of birds occurred on 16 September, coincident with the peak of scaup and wigeon, the two most abundant waterfowl of the region.

TABLE 7

SUMMARY OF NUMBERS AND SPECIES COMPOSITION OF WATERBIRDS SEEN ON ALL WATERBODIES SURVEYED DURING EACH OF THE SIX FLIGHTS OVER THE AREA BETWEEN STEPHAN LAKE AND THE MOUTH OF THE MACLAREN RIVER, UPPER SUSITNA BASIN, FALL 1980

Species	DATE OF SURVEY						TOTAL
	7 Sept	11 Sept	16 Sept	20 Sept	26 Sept	3 Oct	
Loon sp.				4	1		5
Common Loon		3	2	3			8
Red-necked Grebe	2	3	4		5	3	17
Horned Grebe	1	4	17	9	2	2	35
Swan sp.		34	29	9	12	20	104
Canada Goose				1	20		21
American Wigeon		155	325	97	88	56	721
Green-winged Teal		30	83	9	1	2	125
Mallard	10	64	14	116	110	124	438
Pintail	60	60	53	21	3	4	201
Blue-winged Teal		1					1
Northern Shoveler		8	20				28
Ring-necked Duck			2	12			14
Scaup sp.	165	347	499	370	293	180	1854
Oldsquaw	7	4	13	13	16	4	57
Black Scoter		8	38	25	24	10	105
Scoter sp.*				6	56	72	134
Surf Scoter		5	4	2			11
White-winged Scoter	10			1	6	1	18
Bufflehead		33	40	95	127	101	396
Goldeneye sp.	15	36	68	124	95	133	471
Merganser sp.		8	30	36	68	19	161
TOTAL BIRDS	270	803	1241	953	927	731	4925
Total wetland area surveyed (km^2)	13.11	22.08	25.76	27.53	29.00	24.25	
Density (Birds/km^2 of wetlands)	20.6	36.4	48.2	34.6	32.0	30.1	

* Surf or White-winged scoter

Comparative "Importance Values" of the various waterbodies consistently surveyed between 11 or 16 September and 26 September were derived, using the sum of relative abundance, relative density, and relative species richness (see Section 2.5). Most of these waterbodies were surveyed four times during this period, but a few, which were not surveyed for the first time until 16 September, were surveyed only three times. The range of survey dates included in the Importance Value calculations was chosen for several reasons: 1) They represent the main fall waterfowl migratory period, 2) the 7 September survey did not cover a number of the waterbodies included after 11 September, and 3) the 3 October survey was flown in a helicopter less ideal for observation than the Jet Ranger used in the other surveys.

The Importance Value (I.V.) calculations indicated that 1.04 km^2 WB 131, between the mouths of the Tyone and MacLaren rivers, was the "hottest" of the waterbodies surveyed (Fig. 3). The Stephan Lake group, especially Stephan Lake itself and Murder Lake, were next most important. The I.V.'s on these waterbodies were relatively high because of a combination of high species richness with either high numbers (WB 106, Stephen Lake) or high densities (WB 107, Murder Lake) or because of a combination of all three characteristics, as in WB 131 (Table 8). The I.V.'s for Watana (WB 148) and Clarence (WB 145) lakes were elevated as a result of fairly consistent numbers of diving ducks on the lakes throughout the migratory period, including scaup and goldeneyes, plus mergansers on Watana Lake and Black Scoters on Clarence Lake. In addition, Clarence Lake had a relatively high species richness, with a mean of seven species, including grebes and dabbling ducks. The southernmost Fog Lake (WB 059) had an I.V. slightly higher than Watana Lake because of unusually high numbers of individuals and species on 16 September; otherwise the lake was not outstanding. Likewise, WB 105 was not outstanding, but about 30 scaup were on the waterbody during each of the four survey flights; also, 24 swans were on this lake on 10 October.

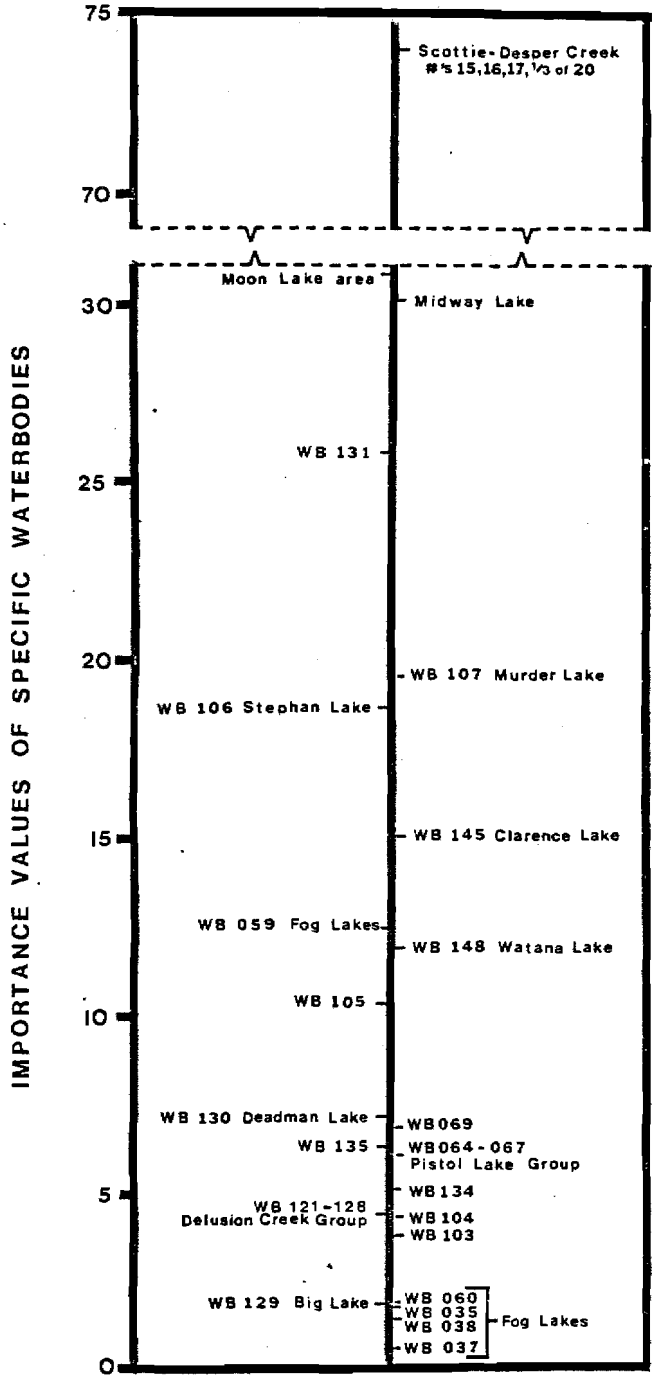

FIGURE 3

Relative importance of 20 waterbodies in the upper Susitna River Basin compared to three waterbodies in the upper Tanana River-Scottie Creek area of eastern Aláska for migrant loons, grebes, and waterfowl in fall 1980.

TABLE 8

ABUNDANCE, DENSITY, AND SPECIES COMPOSITION OF WATERBIRDS ON THE WATERBODIES OF THE UPPER SUSITNA RIVER BASIN FOUND TO BE MOST IMPORTANT TO WATERBIRDS DURING FALL MIGRATION 1980

Species	WB 131 (1.04 km^2)				WB 107, Murder Lake (0.15 km^2)				WB 106, Stephan Lake (3.55 km^2)			
	11 Sept	16 Sept	20 Sept	26 Sept	11 Sept	16 Sept	20 Sept	26 Sept	11 Sept	16 Sept	20 Sept	26 Sept
Common Loon												
Red-necked Grebe									1			
Horned Grebe	2		3							2	2	
Swan sp.	29	22	9									
Canada Goose												
American Wigeon	80	80	70	30+		30	4		20	45	5	12
Green-winged Teal							1		10	10	3	1
Mallard	25		70	60+	20	6	4	10		2	11	10
Pintail	15				10	10	5		8	6		
Blue-winged Teal									1			
Northern Shoveler									8	4		
Ring-necked Duck												
Scaup sp.	40	80	20	30+			20	15	40	102	72	42
Oldsquaw			1						4	4	4	
Black Scoter				1							7	8
Scoter sp.*			2									16
White-winged Scoter											1	
Bufflehead	30	30	60	50+				6			5	10
Goldeneye sp.			9						24	15	61	32
Merganser sp.	3				3	5	3	4			8	8
TOTAL BIRDS	224	212	244	171+	33	51	37	35	116	190	179	139
Mean abundance (Mean no. birds)	213				39				156			
Mean density (Birds/km^2)	204.6				260.0				43.9			

*Surf or White-winged scoter

TABLE 8 (Continued)

Species	WB 145, Clarence Lake (1.6 km^2)				WB 148, Watana Lake (1.25 km^2)				WB 059 (1.44 km^2)			
	11 Sept	16 Sept	20 Sept	26 Sept	11 Sept	16 Sept	20 Sept	26 Sept	11 Sept	16 Sept	20 Sept	26 Sept
Common Loon									1			
Red-necked Grebe	1			2								
Horned Grebe	2	3								12	1	
Swan sp.										5		
Canada Goose											1	
American Wigeon	15	15	1	32						60	7	
Green-winged Teal		12				2			20	16		
Mallard	9						10		10	6	3	
Pintail	2									10		
Blue-winged Teal												
Northern Shoveler												
Ring-necked Duck			12							2		
Scaup sp.	80+	65	45	15	40	60	50	55	15	40	27	2
Oldsquaw		1								4		
Black Scoter	8	31	12	8								
Scoter sp.*												
White-winged Scoter				1				5				
Bufflehead								5	3	5	12	
Goldeneye sp.	3	12	15	9	6	22	28	40	3	12	6	8
Merganser sp.		1	3			21	19	20				
TOTAL BIRDS	120+	140	88	67	46	105	107	125	52	172	57	10
Mean abundance (Total no. birds)		104				96				73		
Mean density (Birds/km^2)		64.8				76.6				50.5		

*Surf or White-winged scoter

None of the waterbodies in the upper Susitna River Basin had Importance Values as high as those calculated for some of the better wetland sites of eastern interior Alaska from data obtained during fall 1980 by Ritchie and Hawkings (1981) (Fig. 3). And, while comparable fall data are not available from other Alaska sites, summer data from the Scottie-Desper Creek drainage as a whole (not just the most productive series of waterbodies shown in Fig. 3) indicated that productivity, based on duck brood densities, was 30-40% lower than at Minto Lakes and the Yukon Flats (Kessel et al. 1980). Minto Lakes, Tetlin Lakes, and portions of the Yukon Flats are considered among the most productive wetlands in Alaska (J. G. King, U.S. Fish and Wildlife Service, pers. comm.). Comparatively, then, the waterbodies of the upper Susitna River Basin appear to support a relatively impoverished population of waterfowl during fall migration.

3.5 - Avifaunal Survey

Between 6 July and 4 October 1980, 115 species of birds were recorded in the upper Susitna River Basin. All data obtained on the status, distribution, relative abundance, and seasonal chronologies of these birds are briefly summarized below. Generalizations from our observations are still preliminary in nature, because studies did not begin until after the main breeding season, and they were carried out secondarily to the other work packages on a time-available basis.

The relative abundance ratings used in this section are based primarily on the total individuals enumerated during our party's ground-based observation periods; for reasons of comparability, counts made during aerial surveys and reports from other observers have been excluded from these ratings. The species were divided into groups of more-or-less related or similar-sized birds for determinations of relative abundance (Tables 9-12). With the less common species, we have also drawn on our knowledge of general abundance in adjacent regions. Since we spent little time during midsummer in wetland areas, abundance ratings for water-related birds may be low. An overview of the comparative

TABLE 9

RELATIVE ABUNDANCE OF LOONS, GREBES, AND WATERFOWL, BASED PRIMARILY ON TOTAL NUMBER OF GROUND OBSERVATIONS, UPPER SUSITNA RIVER BASIN, ALASKA, 6 JULY-4 OCTOBER 1980, SEE TABLE 7 FOR COUNTS FROM FALL AERIAL SURVEYS.

No.	Species	
1013	Scaup (Greater and Lesser)	ABUNDANT
568	American Wigeon	COMMON
203	Pintail	
159	Mallard	
134	Goldeneye (Barrow's and/or Common)	
124	Green-winged Teal	
100	Trumpeter Swan	
78	Bufflehead	FAIRLY COMMON
55	Oldsquaw	
55	Red-breasted Merganser	
51	Northern Shoveler	
47	Black Scoter	
31	Harlequin Duck	UNCOMMON
27	Horned Grebe	
22	Surf Scoter	
15	White-winged Scoter	
14	Red-necked Grebe	
13	Common Loon	
09	Canada Goose	
06	Red-throated Loon	
02	Ring-necked Duck (+12 aerial survey)	
01	Blue-winged Teal (= aerial survey)	RARE

TABLE 10

RELATIVE ABUNDANCE OF SHOREBIRDS AND GULLS, BASED PRIMARILY ON TOTAL NUMBER OF OBSERVATIONS, UPPER SUSITNA RIVER BASIN, ALASKA, 6 JULY-4 OCTOBER 1980.

No.	Species	
73	Mew Gull	COMMON
55	Common Snipe	
37	American Golden Plover	UNCOMMON
37	Spotted Sandpiper	
23	Arctic Tern	
09	Semipalmated Plover	
09	Least Sandpiper	
07	Bonaparte's Gull	
06	Upland Sandpiper	
05	Whimbrel	
04	Long-tailed Jaeger	
03	Baird's Sandpiper	
02	Wandering Tattler	
02	Northern Phalarope	RARE
12	Greater Yellowlegs *	
01	Lesser Yellowlegs	
01	Surfbird	
01	Sanderling	
01	Pectoral Sandpiper	

* All observations of a single pair, hence considered "rare."

TABLE 11

RELATIVE ABUNDANCE OF LARGE LANDBIRDS AND CRANES, BASED PRIMARILY ON TOTAL NUMBER OF OBSERVATIONS, UPPER SUSITNA RIVER BASIN, ALASKA, 6 JULY-4 OCTOBER 1980.

No.	Species	
130	Rock Ptarmigan	COMMON
114	Common Raven	
48	Spruce Grouse	FAIRLY COMMON
34	Bald Eagle	UNCOMMON
30	Sandhill Crane	
25	Golden Eagle	
19	Black-billed Magpie	
14	Marsh Hawk	
10	Merlin	
08	Red-tailed Hawk	
06	Goshawk	
04	Gyrfalcon	
04	Willow Ptarmigan	
03	Sharp-shinned Hawk	
01	American Kestrel	RARE
01	White-tailed Ptarmigan	
01	Short-eared Owl	

TABLE 12

RELATIVE ABUNDANCE OF SMALL LANDBIRDS, BASED PRIMARILY ON TOTAL NUMBER OF OBSERVATIONS, UPPER SUSITNA RIVER BASIN, ALASKA, 6 JULY-4 OCTOBER 1980.

No.	Species		No.	Species		No.	Species	
1670	Common Redpoll	ABUNDANT	77	Horned Lark	UNCOMMON	06	Pine Grosbeak	RARE
474	Tree Sparrow	COMMON	75	Bank Swallow		05	Smith's Longspur	
457	White-crowned Sparrow		70	Varied Thrush		04	Say's Phoebe	
405	Dark-eyed Junco		67	American Robin		04	Western Wood Pewee	
387	Water Pipit		58	Gray-cheeked Thrush		04	Brown Creeper	
309	Gray Jay		54	Arctic Warbler		04	Townsend's Solitaire	
287	Savannah Sparrow		45	Blackpoll Warbler		04	Gray-crowned Rosy Finch	
268	White-winged Crossbill		41	Black-capped Chickadee		04	Hairy Woodpecker	
263	Yellow-rumped Warbler		38	Hermit Thrush		03	Yellow Warbler	
179	Ruby-crowned Kinglet	FAIRLY COMMON	35	Fox Sparrow		02	Cliff Swallow	
156	Lapland Longspur		32	Swainson's Thrush		01	Black-backed Three-toed Woodpecker	
127	Wilson's Warbler		27	Tree Swallow		01	Eastern Kingbird	ACCIDENTAL
112	Bohemian Waxwing		27	Northern Shrike				
110	Boreal Chickadee		27	Rusty Blackbird				
106	Pine Siskin		25	Orange-crowned Warbler				
106	Snow Bunting		25	Northern Waterthrush				
			19	Belted Kingfisher				
			16	Violet-green Swallow				
			16	Golden-crowned Sparrow				
			15	Wheatear				
			13	Common Flicker				
			13	Lincoln's Sparrow				
			12	Olive-sided Flycatcher				
			11	Golden-crowned Kinglet				
			10	Alder Flycatcher				
			09	Dipper				
			08	Downy Woodpecker				
			08	Northern Three-toed Woodpecker				

abundance of loons, grebes, and waterfowl during fall migration only, however, can be obtained from Table 7. Repetitious counts of some individuals magnify some of the total numbers reported, especially for large birds with extensive hunting ranges (e.g., eagles) and especially at stationary sites (camp sites and lodges). We did not attempt to correct for this bias, except in the most blatant case (a single pair of Greater Yellowlegs resulting in a count of 12), because it did not seem to unreasonably affect the resultant generalized relative abundance ratings.

The breeding status of many birds in the study area has yet to be determined, because most young had fledged prior to our arrival. In the annotated list, a species is called a breeder only if we have a substantiated breeding record. Suspected breeding--based on such things as breeding or territorial behavior of adults, breeding status in closely adjacent areas, or persistent abundance of certain passerines in breeding habitats--is indicated as "probable" or "possible" breeding, depending on the strength of the evidence.

An annotated species list of the birds recorded during 1980 follows:

Common Loon. Gavia immer. Uncommon probable breeder on lacustrine waters. Species was observed as late as 23 September, an adult molting into basic plumage on High Lake.

Red-throated Loon. Gavia stellata. Uncommon probable breeder on lacustrine waters. Only six birds were recorded during the study period.

Red-necked Grebe. Podiceps grisegena. Uncommon breeder on lacustrine waters. An adult was flushed from its nest north of Watana Camp on 18 July. Species was observed through 3 October, when three were counted on Stephan Lake.

Horned Grebe. Podiceps auritus. Fairly common fall migrant, observed 27 August-3 October on lacustrine waters. Maximum count was 12 birds on Stephan Lake on 16 September.

Whistling Swan. Olor columbianus. A major movement of Whistling Swans passes through central Alaska each year during the first half of October (Kessel, unpubl. data), before most local Trumpeter Swans leave their breeding grounds. Hence, while unconfirmed by specific identifications, it is more than likely that the three swans seen on the 3 October census of Stephan Lake (where none had occurred earlier) and the 144 swans reported by George Nissen, helicopter pilot, on Stephan Lake and nearby WB 105 on 10 October were Whistling Swans.

Trumpeter Swan. Olor buccinator. Common breeder on lacustrine waters, especially in the wetlands east of the Susitna, between the Oshetna and Tyone rivers. Some apparent residents of this area were still present on the last aerial survey on 3 October. Maximum count was 42 swans present on WB 131 on 7 September.

Canada Goose. Branta canadensis. Uncommon fall migrant. A group of three birds on 16 August, a flock of six on 27 August, one bird on WB 059 on 20 September, and 20 birds at the Pistol Lake group on 26 September were the only records.

Mallard. Anas platyrhynchos. Common fall migrant, especially in late September and early October, and less numerous breeder on lacustrine waters. A female with two Ic young was seen at Watana Lake on 13 July.

Pintail. Anas acuta. Common fall migrant on lacustrine waters. Maximum numbers were 60 on WB 059 on 7 September and 15 and 25 birds, respectively, on WB 131 and WB 134 on 11 September.

Green-winged Teal. Anas crecca. Common fall migrant, especially 11-16 September, and less numerous breeder on lacustrine waters. A female with two IIa young was seen near High Lake on 12 July. Two birds were still present on Murder Lake on 3 October.

Blue-winged Teal. Anas discors. Rare fall migrant. One male on Stephan Lake on 11 September was the only record.

Northern Shoveler. Anas clypeata. Fairly common fall migrant. Maximum number was 15 birds on WB 134 on 16 September.

American Wigeon. Anas americana. Common fall migrant and less numerous breeder on lacustrine waters. It was the second most numerous duck in the region, after scaup, both in summer and fall. A brood of ten large young was observed at High Lake on 2 September.

Ring-necked Duck. Aythya collaris. Uncommon fall migrant. Two birds on WB 059 on 16 September and seven males and five females on Clarence Lake on 20 September were the only records.

Greater and Lesser Scaup. Aythya marila and A. affinis. Abundant fall migrants on lacustrine waters. Although each species was identified at various times during fall, it was ordinarily impossible to separate them in the field. Lesser Scaup bred in the region; three females with broods of 14, 7, and 8 young were seen on Stephan Lake on 21 August.

Goldeneye. Bucephala (sp.). Common fall migrant on the large waterbodies (Table 8). Both Barrow's (B. islandica) and Common (B. clangula) may have been involved.

Bufflehead. Bucephala albeola. Fairly common fall migrant on lacustrine waters. It was most numerous on WB 059 in the Fog Lakes group, Stephan and Murder lakes, and on the waterbodies between the mouths of the Tyone and MacLaren rivers, during the last half of September.

Oldsquaw. Clangula hyemalis. Fairly common fall migrant and less numerous breeder on lacustrine waters. A female with a brood of three Ib young was seen near High Lake on 12 July.

Harlequin Duck. Histrionicus histrionicus. Uncommon breeder on fluviatile waters. A downy was found dead on Kosina Creek on 17 July.

White-winged Scoter. Melanitta deglandi. Uncommon fall migrant on lacustrine waters.

Surf Scoter. Melanitta perspicillata. Uncommon summer visitant, possible breeder, and fall migrant on lacustrine waters.

Black Scoter. Melanitta nigra. Fairly common fall migrant during the second half of September and less numerous breeder on lacustrine waters. A female with a brood of six well-grown young was seen on Stephan Lake on 21 August.

Red-breasted Merganser. Mergus serrator. Fairly common fall migrant and less numerous breeder on lacustrine waters. A female with six young was seen on Portage Creek on 23 July, and a female with four young was seen at High Lake on 5 August.

Goshawk. Accipiter gentilis. Uncommon resident and probable breeder in mixed and coniferous forests.

Sharp-shinned Hawk. Accipiter striatus. Uncommon fall migrant; possible breeder in mixed and coniferous forests. A total of three birds was recorded.

Red-tailed Hawk. Buteo jamaicensis. Uncommon fall migrant.

Golden Eagle. Aquila chrysaetos. Uncommon breeder on cliffs, including six active nests along the upper Susitna River and its tributaries in 1980 (Table 6).

Bald Eagle. Haliaeetus leucocephalus. Uncommon breeder. Three active nests were found in the study area in 1980 (Table 6).

Marsh Hawk. Circus cyaneus. Uncommon fall migrant and possible breeder.

Gyrfalcon. Falco rusticolus. Uncommon breeder on cliffs. We recorded only four sightings, but White (1974) found two active nests in steep draws on the south side of the Susitna River just above the proposed Devil Canyon dam site, 10-15 June 1974.

Peregrine Falcon. Falco peregrinus. Two possible peregrine sightings were reported to us in 1980, neither adequately substantiated. A large, flying falcon near Tsusena Creek was seen briefly from a helicopter on about 18-20 April by Paul Arneson and Craig Gardiner. The other report was of a bird seen sitting in a tree near Gold Creek by a local resident in mid-August.

Merlin. Falco columbarius. Uncommon fall migrant and probable breeder. One caught a Spotted Sandpiper at Kosina Creek on 13 July.

American Kestrel. Falco sparverius. Rare fall migrant. One male at Stephan Lake on 23 August was the only record.

Spruce Grouse. Canachites canadensis. Fairly common resident and breeder in coniferous forest throughout the study area.

Willow Ptarmigan. Lagopus lagopus. Uncommon resident and probable breeder in low shrub thicket.

Rock Ptarmigan. Lagopus mutus. Common resident and probable breeder in dwarf shrub mat and block-fields.

White-tailed Ptarmigan. Lagopus leucurus. Uncommon resident and probable breeder in dwarf shrub mat and block-fields; probably local. Species occurs at higher elevations than its congeners.

Sandhill Crane. Grus canadensis. Two flocks of cranes were observed on 19 September, one of 30 birds flying NE up Devil Creek and one of 105 birds flying northeast up Tsusena Creek. They were the only records during the 1980 season.

Semipalmated Plover. Charadrius semipalmatus. Uncommon probable breeder and fall migrant.

American Golden Plover. Pluvialis dominica. Uncommon probable breeder in dwarf shrub mat and dwarf shrub meadow.

Whimbrel. Numenius phaeopus. Uncommon probable breeder in dwarf shrub meadow.

Upland Sandpiper. Bartramia longicauda. Uncommon probable breeder in dwarf shrub meadow. Two were seen near Watana Camp on 8 July, at least three birds were seen west of Kosina Creek on 13 July, and one was seen east of Kosina Creek on 19 July.

Greater Yellowlegs. Tringa melanoleuca. Rare breeder in wet meadow. A defensive pair was present near High Lake in mid-July.

Lesser Yellowlegs. Tringa flavipes. Rare summer visitant. One bird seen near High Lake on 13 July was the only record.

Spotted Sandpiper. Actitis macularia. Uncommon probable breeder on fluviatile water shorelines.

Wandering Tattler. Heteroscelus incanus. Uncommon fall migrant. One bird on 14 August and one on 9 September were the only records.

Northern Phalarope. Phalaropus lobatus. Rare probable breeder in wet meadow.

Common Snipe. Gallinago gallinago. Fairly common breeder in wet meadow.

Surfbird. Aphriza virgata. Rare possible breeder in dwarf shrub mat. One bird seen 13 July west of Kosina Creek was the only record.

Sanderling. Calidris alba. Rare fall migrant. One juvenile at the Tyone River mouth on 5 September was the only record.

Least Sandpiper. Calidris minutilla. Uncommon probable breeder in wet and dwarf shrub meadow.

Baird's Sandpiper. Calidris bairdii. Uncommon probable breeder in dwarf shrub mat.

Pectoral Sandpiper. Calidris melanotos. Rare fall migrant. One bird seen 16 September was the only record.

Long-tailed Jaeger. Stercorarius longicaudus. Uncommon probable breeder in dwarf shrub meadow and dwarf shrub mat.

Mew Gull. Larus canus. Fairly common summer visitant and breeder on lacustrine and fluviatile waters. Up to eight adults frequented the dump at High Lake camp, and eight others quickly found some cooked potatoes at streamside at Kosina Creek on 14 July. One downy was observed with parents on High Lake on 10 July, and two large feathered chicks were on a nearby lake on 12 July.

Bonaparte's Gull. Larus philadelphia. Uncommon summer visitant. Three birds at High Lake on 11 July and two on 10 and 12 July were the only records.

Arctic Tern. Sterna paradisaea. Uncommon probable breeder on lacustrine water shorelines.

Short-eared Owl. Asio flammeus. Rare summer visitant. One bird observed in the Watana Camp vicinity on 8 July was the only record.

Belted Kingfisher. Megaceryle alcyon. Uncommon probable breeder in cutbanks. One bird at Sherman on 11 September was latest record in fall.

Common Flicker. Colaptes auratus. Uncommon probable breeder. Last bird was seen on 11 September.

Hairy Woodpecker. Picoides villosus. Uncommon resident and probable breeder. Singles seen on 8 August and 12, 19, and 23 September were the only records, however.

Downy Woodpecker. Picoides pubescens. Uncommon resident and probable breeder. Single birds were seen at irregular intervals throughout the study period.

Black-backed Three-toed Woodpecker. Picoides arcticus. Probably rare resident in coniferous forest. One male seen along Watana Creek on 29 September was the only record.

Northern Three-toed Woodpecker. Picoides tridactylus. Uncommon resident in coniferous forest. Singles were recorded at irregular intervals throughout the study period.

Eastern Kingbird. Tyrannus tyrannus. Accidental. One bird observed near High Lake on 11 July was the only record. In Alaska this species is a regular visitant only in Southeastern; it is casual elsewhere in the state (Kessel and Gibson 1978).

Say's Phoebe. Sayornis saya. Rare probable breeder on upland cliffs. Three birds on 13 July at Mt. Watana and one in mountains east of Watana Creek on the 20th were our only records.

Alder Flycatcher. Empidonax alnorum. Uncommon probable breeder in medium and tall shrub thickets. One bird seen 10 August, four on 20th, and two on 21st were fall migrants.

Western Wood Pewee. Contopus sordidulus. Rare possible breeder in deciduous forest. Four birds at Watana Creek on 25 July provided the only record.

Olive-sided Flycatcher. Nuttallornis borealis. Uncommon probable breeder in open forest and scattered woodland. One bird at Stephan Lake on 23 August was latest in fall.

Horned Lark. Eremophila alpestris. Uncommon probable breeder in block-fields and dwarf shrub mat. Recorded in fall as late as 10 September, when four birds were seen at the summit between High Lake and Watana Camp.

Violet-green Swallow. Tachycineta thalassina. Uncommon summer visitant and possible breeder in riparian cliffs. Few were seen, latest two birds over Watana Creek on 25 July.

Tree Swallow. Iridoprocne bicolor. Uncommon possible breeder, foraging widely over lacustrine and fluviatile waters. Few were seen during summer 1980, none after 23 July.

Bank Swallow. Riparia riparia. Uncommon possible breeder and fall migrant. Five birds on 16 July at the mouth of Kosina Creek, a flock of 50 on 25 July over lower Watana Creek, and 19 birds on 21 August over Stephan Lake were the only records.

Cliff Swallow. Petrochelidon pyrrhonota. Uncommon possible breeder. Single birds were seen over the Susitna River at Kosina Creek on 11 and 12 July, the only records.

Gray Jay. Perisoreus canadensis. Common resident and breeder in coniferous and mixed forests throughout the study area.

Black-billed Magpie. Pica pica. Uncommon fall visitant. One bird near Watana Lake on 20 August was earliest record; the species may winter in the study area.

Common Raven. Corvus corax. Common resident and breeder, nesting on riparian and upland cliffs. Widespread, this species foraged in or near most habitats.

Black-capped Chickadee. Parus atricapillus. Uncommon resident and probable breeder in deciduous forests.

Boreal Chickadee. Parus hudsonicus. Fairly common resident and probable breeder in coniferous forests.

Brown Creeper. Certhia familiaris. Rare fall visitant in deciduous and mixed forests. One bird was seen at Portage Creek on 19 September, and three were seen at Gold Creek on 23 September.

Dipper. Cinclus mexicanus. Uncommon resident and breeder on suitable fluviatile waters. We recorded it only at Watana Creek.

American Robin. Turdus migratorius. Uncommon probable breeder in forests and medium and tall shrub thickets.

Varied Thrush. Ixoreus naevius. Uncommon probable breeder in coniferous forest and in tall alder shrub thickets.

Hermit Thrush. Catharus guttatus. Uncommon probable breeder in forests and tall alder shrub thickets. One bird seen 12 September was last record in fall.

Swainson's Thrush. Catharus ustulatus. Uncommon probable breeder in forests. One bird on 27 August was latest record.

Gray-cheeked Thrush. Catharus minimus. Uncommon probable breeder in scattered woodland and in medium and tall shrub thickets. Two birds on 4 September provided the latest record.

Wheatear. Oenanthe oenanthe. Uncommon breeder in block-fields. Defensive adults were seen in mid-July, and bob-tailed young were noted at the summit between High Lake and Watana Camp on 18 July. Last seen in the fall was one bird on 30 August.

Townsend's Solitaire. Myadestes townsendi. Rare breeder on cliffs. A pair at nest with young was observed in a rock outcrop in mountains east of Watana Creek on 22 July. Single birds seen 13 and 23 July were the only other records.

Arctic Warbler. Phylloscopus borealis. Uncommon probable breeder, occurring in medium and tall shrub thickets. We found it numerous only at High Lake, where twelve singing males were counted on 11 July and where food-carrying adults were seen 1 August. Four birds on 22 August were latest record.

Golden-crowned Kinglet. Regulus satrapa. Uncommon fall visitant, primarily in coniferous and mixed forests. One bird was seen at Cache Creek mouth on 9 September; at Portage Creek two were seen on 12 September, four on 19th, and two on 25th; and two were observed at Gold Creek on 4 October.

Ruby-crowned Kinglet. Regulus calendula. Fairly common breeder in coniferous forests; conspicuous fall migrant. A bird seen 25 September was latest fall observation.

Water Pipit. Anthus spinoletta. Common breeder about cliffs and block-fields and dwarf shrub mat. Food-carrying adults (four pairs) were seen at summit between High Lake and Watana Camp on 18 July. Seven birds there on 10 September were latest record in fall.

Bohemian Waxwing. Bombycilla garrulus. Fairly common fall migrant and less common probable breeder in scattered spruce woodland. Late-summer flocks included family groups of recently fledged young-of-the-year.

Northern Shrike. Lanius excubitor. Uncommon breeder in tall shrub thickets and scattered spruce woodland; as a migrant in fall, occurred in all open vegetated habitats. A family group of four birds, including at least two fledged young, was seen near High Lake on 9 July.

Orange-crowned Warbler. Vermivora celata. Uncommon probable breeder in medium and tall shrub thickets. One bird at High Lake on 7 September was latest record in fall.

Yellow Warbler. Dendroica petechia. Rare fall migrant. Three juveniles observed at Sherman on 30 August provided the only record.

Yellow-rumped Warbler. Dendroica coronata. Common breeder in forests. Adults were observed carrying food along the Susitna River below Watana Creek on 7 July. Two birds at Tsusena Creek on 24 September were the latest record.

Blackpoll Warbler. Dendroica striata. Uncommon breeder in medium and tall shrub thickets. Adults were observed carrying food below Watana Camp on 7 July. A juvenile at Gold Creek on 5 September was latest record.

Northern Waterthrush. Seiurus noveboracensis. Uncommon probable breeder in tall shrub thickets near water. One bird at Portage Creek on 6 September was latest record.

Wilson's Warbler. Wilsonia pusilla. Fairly common breeder in medium shrub thickets. A defensive, food-carrying pair was observed at High Lake on 7 July. Two birds on 17 September were last record in fall.

Rusty Blackbird. Euphagus carolinus. Uncommon fall migrant. Species was recorded from 16 August, eight birds at Stephan Lake, through 25 September, when one was seen at Portage Creek.

Pine Grosbeak. Pinicola enucleator. Rare fall visitant. Three birds at High Lake on 18 September and two at East Fork of Chulitna River on 4 October were the only records.

Gray-crowned Rosy Finch. Leucosticte tephrocotis. Rare or uncommon probable breeder in cliffs and block-fields. The only record was of four birds seen on Mt. Watana on 13 July.

Common Redpoll. Carduelis flammea. Abundant and widely distributed in the study area, the most numerous passerine bird recorded. Species probably breeds in low densities. A flock of 200+ at High Lake on 4 September was the largest group seen. It occurred throughout the period of study.

Pine Siskin. Carduelis pinus. Fairly common summer visitant and probable breeder, occurring in coniferous forests and tall alder shrub thickets. Itinerant and irruptive and near the northern end of its range, the species probably breeds in the study area at least occasionally.

White-winged Crossbill. Loxia leucoptera. Common on the study area in summer 1980, when the species possibly bred in coniferous forests. Like those of siskins and redpolls, numbers of this species may fluctuate markedly year-to-year.

Savannah Sparrow. Passerculus sandwichensis. Common breeder in open low shrub thickets throughout the study area. Dependent young and adults carrying food were observed in mid-July. Four birds on 7 September were latest record in fall.

Dark-eyed Junco. Junco hyemalis. Common breeder, occurring throughout forest and woodland habitats. It was seen through 29 September.

Tree Sparrow. Spizella arborea. Common breeder in low shrub thickets. Independent juveniles were observed as early as 13 July. The second-commonest passerine species, after redpoll, this species was seen throughout the study period, through 4 October, when six birds were observed.

White-crowned Sparrow. Zonotrichia leucophrys. Common breeder, widely distributed in shrub habitats. A nest with five young was found at High Lake on 11 July, and these young fledged on the 19th. A nest with three 4-day-old young was found in a tall forb-shrub patch at Kosina Creek on 12 July. The third-commonest passerine species, after redpoll and Tree Sparrow, this sparrow was last seen 9 September.

Golden-crowned Sparrow. Zonotrichia atricapilla. Uncommon probable breeder in low shrub thickets and dwarf spruce forest. Species was last seen 6 September.

Fox Sparrow. Passerella iliaca. Uncommon probable breeder in medium and tall shrub thickets. Two on 1 September provided the latest record.

Lincoln's Sparrow. Melospiza lincolnii. Uncommon probable breeder in low and medium shrub thickets near water. Species was recorded irregularly in ones and twos. Two at Cache Creek on 9 September provided the latest record.

Lapland Longspur. Calcarius lapponicus. Uncommon breeder and fairly common migrant in dwarf shrub meadow and dwarf shrub mat, where juveniles were common as fall migrants. Four juveniles on 2 September provided the last fall record.

Smith's Longspur. Calcarius pictus. Rare probable breeder in dwarf shrub meadow. A pair north of Watana Camp on 8 July and two birds near Watana Lake on 13 July were the only records. The species breeds nearby along the Denali Highway (Kessel and Gibson 1978).

Snow Bunting. Plectrophenax nivalis. Fairly common probable breeder about cliffs and block-fields, feeding in dwarf shrub mat. This species was observed only at high elevations in the study area.

4 & 5 - IMPACT ASSESSMENT AND MITIGATION

The Susitna Hydroelectric Project will cause the inundation of a major portion of the riparian cliff habitat used for nesting by raptors and ravens. None of the species using this habitat in 1974 and 1980, however, require riparian cliffs, and it appears as if ample alternative sites are available in the nearby uplands and mountains. Similarly, it seems that alternative sites are available to replace the two Bald Eagle nesting trees that will be flooded.

Loss of cliff habitat by flooding may result in the unflooded cliff areas of the main river and its tributaries becoming more important to cliff-nesting species. Hence, special attention should be paid to avoiding disturbance of these remaining patches of habitat, i.e., transportation and powerline corridors and construction activities should be kept as far as possible from potential nesting cliffs, preferably 1.6 km (1 mile) away.

The project will also inundate most of the major forest habitats upriver of the Devil Canyon dam, since forests in this area occur primarily within the protected valleys and river canyons. Destruction of these habitats will reduce the numbers of birds and small mammals dependent upon them. We have not been in the region during the main breeding season and as yet have few concrete data from the upper Susitna River Basin, but based on 1980 observations and on habitat preferences in other areas of central and south-central Alaska, the following species observed in 1980 will be most affected by loss of forest habitats:

Pygmy shrew
Red squirrel
Porcupine
Goshawk
Spruce Grouse
Woodpeckers
Western Wood Pewee*
Gray Jay

Chickadees
Brown Creeper*
Hermit and Swainson's thrushes
Golden-crowned* and Ruby-crowned kinglets
Yellow-rumped Warbler
Pine Grosbeak*
Pine Siskin*
White-winged Crossbill*

(*rare or possibly itinerant species)

These species are mostly short-lived and are all common to uncommon breeders in forests at lower elevations in adjacent regions, although the Brown Creeper and Golden-crowned Kinglet are close to the northern limit of their ranges in this region.

Flooding will also eliminate lowland meadow habitats in the impoundment area, which the meadow vole uses almost exclusively. This vole, however, is also relatively common in lowland meadows in adjacent regions.

Some fluviatile shorelines and alluvia important to a few species of birds (Semipalmated Plover, Spotted Sandpiper, Wandering Tattler, Arctic Tern) will be flooded. Each of these species is uncommon, but not rare, in the region, and the relatively few individuals should be able to find alternative territorial sites along unflooded creeks or pond margins of adjacent areas.

Since flooding will not affect the upland tundra areas, local populations of collared pika, hoary marmot, arctic ground squirrels, and ptarmigan--all important prey species for mammalian carnivores and raptors--should be little affected by this environmental change.

None of the more important waterbodies of the region will be inundated or otherwise affected by the proposed impoundments. The large lakes to be formed could provide resting sites for migrant waterfowl, but the degree of utilization will depend upon the rate and kind of development of food resources in the new lakes. The drawdown zone, which is expected to be unvegetated, could be used by feeding birds, especially migrant sandpipers in spring, but will be of no use to small mammals.

Depending upon construction plans, the waterbird populations of the Stephan-Murder Lake area could be adversely affected. We still have little information about the birds of these wetlands, but these lakes appear to be among the more productive of the region. Roads and other construction activities should be kept away from the edge of these wetlands, preferably at least 0.8 km (0.5 mile), and siltation should be avoided. The possible impact of plane and helicopter activity on breeding birds and migrants, including swans, should be considered if aircraft activity increases during construction.

Habitat alterations that result from various aspects of construction (roads, material sites, transmission lines) or from changes in downstream river flow patterns will have a direct effect on animal populations utilizing impacted habitats. Animals dependent on the destroyed or altered habitats will disappear, whereas new habitats formed will increase populations of species that favor the newly created habitats. Generally, as illustrated above, habitat specialists will be more heavily impacted than habitat generalists. Until more is known about construction and operational plans, however, an analysis of the significance of these potentially habitat-altering impacts on the smaller birds and mammals is not feasible.

6 - REFERENCES

Abercrombie, W. R. 1899. Birds found in the Copper River Valley. p. 334-336. In: E. F. Glenn and W. R. Abercrombie, Report of explorations in the Territory of Alaska, 1898. War Department, Wash., D.C.

Argus, G. W. 1973. The genus Salix in Alaska and the Yukon. Nat. Mus. Canada Publ. Bot. No. 2. 270 p.

Bailey, A. M. 1926. Winter notes for the Copper River, Alaska. Condor 28:174-175.

Baker, R. H. 1951. Mammals taken along the Alaska Highway. Univ. Kansas Mus. Nat. Hist. Publ. 5:87-177.

Bangs, E. E. 1979. The effects of tree crushing on small mammal populations in south central Alaska. M.S. Thesis, Univ. Nevada, Reno. 80 p.

Bente, P. J. 181. Nesting behavior and hunting activity of the Gyrfalcon, Falco rusticolus, in the Alaska Range, Alaska. M.S. Thesis, Univ. Alaska, Fairbanks.

Brown, L., and D. Amadon. 1968. Eagles, hawks, and falcons of the world. Vol. 2. Country Life Books, Hamlyn Publ. Group Ltd., Middlesex, Gt. Britain. 945 p.

Buckley, J. L., and W. L. Libby. 1957. Research and reports on aerial interpretation of terrestrial bioenvironments and faunal populations. Arctic Aeromedical Lab., Fairbanks, Alaska, Tech. Rept. 57-32. 78 p.

Calhoun, J. B. 1948. North American census of small mammals. Rodent Ecology Project. Release No. 1. Johns Hopkins University, Baltimore, Maryland. 67 p.

Cottam, G., and J. T. Curtis. 1956. The use of distance measures in phytosociological sampling. Ecology 37:451-460.

Curtis, J. T., and R. P. McIntosh. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. Ecology 32:476-496.

Diersing, V. E. 1980. Systematics and evolution of the pygmy shrews (subgenus Microsorex) of North America. J. Mammal. 61:76-101.

Dixon, J. S. 1927a. Contribution to the life history of the Alaska Willow Ptarmigan. Condor 29:213-223.

Dixon, J. S. 1927b. The Surf-Bird's secret. Condor 29:3-16.

Dixon, J. S. 1933a. Nesting of the Wandering Tattler. Condor 35:173-179.

Dixon, J. S. 1933b. Red fox attacked by a Golden Eagle. J. Mammal. 14:257.

Dixon, J. S. 1933c. Three magpies rob a Golden Eagle. Condor 35:161.

Dixon, J. S. 1938. Birds and mammals of Mount McKinley National Park, Alaska. Nat. Parks Fauna Series No. 3. 236 p.

Gabrielson, I. N., and F. C. Lincoln. 1959. The birds of Alaska. Stackpole Co. and Wildl. Manage. Inst. 922 p.

Guthrie, R. D. 1968. Paleoecology of the late Pleistocene small mammal community from interior Alaska. Arctic 21:223-244.

Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Vol. I & II. Ronald Press, New York. 1162 p.

Hennings, D. and R. S. Hoffmann. 1977. A review of the taxonomy of the Sorex vagrans species complex from western North America. Univ. Kansas Mus. Nat. Hist. Occ. Pap. 68:1-35.

Hinckley, F. C. 1900. Notes on the animal and vegetable life of the region of the Sushitna and Kuskokwim rivers. p. 76-85. In: J. E. Spurr, A reconnaissance in southwestern Alaska in 1898. U.S. Geological Survey Ann. Rept. 20, part VII, 1898-1899:31-264.

Hock, R. J. and V. Cottini. 1966. Mammals of the Little Susitna Valley, Alaska. Amer. Midl. Nat. 76:325-339.

Hultén, E. 1968. Flora of Alaska and neighboring territories. Stanford Univ. Press, Stanford, Calif. 1008 p.

Kessel, B. 1979. Avian habitat classification for Alaska. Murrelet 60:86-94.

Kessel, B., and D. D. Gibson. 1978. Status and distribution of Alaska birds. Studies in Avian Biology No. 1. 100 p.

Kessel, B., S. M. Murphy, and L. J. Vining. 1980. Waterbirds and wetlands, Chisana-upper Tanana rivers, Alaska, 1979 (with emphasis on the Scottie-Desper Creek wetlands). Univ. Alaska Museum unpubl. report to Northwest Alaskan Pipeline Co. 126 p.

King, J. G., and B. Conant. 1980. Alaska-Yukon breeding pair survey--1980. U.S. Fish and Wildl. Serv. Pacific Waterfowl Flyway Report 79:in press.

Krebs, C. J., and J. H. Myers. 1974. Population cycles in small mammals. Adv. Ecol. Res. 8:267-399.

MacDonald, S. O. 1979. Survey of breeding birds and small mammals in the Delta Barley Project area, Alaska, 1978. Univ. Alaska Museum unpubl. report to Alaska Division of Lands, Fairbanks, Alaska. 63 p.

MacDonald, S. O. 1980. Habitats of small mammals and birds: evaluating the effects of agricultural development in the Delta Junction area, Alaska. Univ. Alaska Museum unpubl. report to Alaska Division of Lands, Fairbanks, Alaska. 72 p.

Manville, R. H. and S. P. Young. 1965. Distribution of Alaskan mammals. U.S. Dept. Interior Fish and Wildlife Service Circular 211. 74 p.

Murie, A. 1944. Golden Eagle. p. 222-229. In: The wolves of Mount McKinley. Nat. Parks Fauna Series No. 5. 238 p.

Murie, A. 1946. Observations on the birds of Mount McKinley National Park, Alaska. Condor 48:253-261.

Murie, A. 1956. Nesting records of the Arctic Willow Warbler in Mount McKinley National Park, Alaska. Condor 58:292-293.

Murie, A. 1962. Mammals of Mount McKinley National Park, Alaska. Mt. McKinley Nat. Hist. Assoc. 56 p.

Murie, A. 1963. Birds of Mount McKinley National Park, Alaska. Mt. McKinley Nat. Hist. Assoc. 86 p.

Murie, O. J. 1923. Nest and eggs of the Wandering Tattler found in Alaska. Murrelet 4:17.

Murie, O. J. 1924. Nesting records of the Wandering Tattler and Surf-bird in Alaska. Auk 41:231-237.

Murphy, D., and K. Kertell. 1977. Birds of Mount McKinley National Park, Alaska. Mimeographed checklist. 6 p.

Osgood, W. H. 1901. Natural history of the Cook Inlet region, Alaska. N. Amer. Fauna 21:51-87.

Pruitt, W. O., Jr. 1968. Synchronous biomass fluctuations of some northern mammals. Mammalia 32:172-191.

Quinlan, S. E. 1978a. Bird communities and white spruce succession on the Kenai Peninsula, Alaska. U.S. Forest Service unpubl. report, Seward, Alaska. 50 p.

Quinlan, S. E. 1978b. Species composition and relative densities of small mammal populations and white spruce succession on the Kenai Peninsula, Alaska. U.S. Forest Service unpubl. report, Seward, Alaska. 29 p.

Quinlan, S. E. 1979. Effects of controlled burning and succession of white spruce forests on breeding bird communities, Kenai Peninsula, Alaska. U.S. Forest Service unpubl. report, Seward, Alaska. 61 p.

Ritchie, R. and J. Hawkings. 1981. Summer and fall waterbird investigations along the proposed Northwest Alaskan Gas Pipeline, Alaska, 1980. Alaska Biological Research unpubl. report to Northwest Alaskan Pipeline Co.

Schaller, G. B. 1954. Some notes on the birds of the Talkeetna Mountains in Alaska. Univ. of Alaska unpubl. manuscript. 37 p.

Sheldon, C. 1909. List of birds observed on the upper Toklat River near Mt. McKinley, Alaska, 1907-1908. Auk 26:66-70.

Sheldon, C. 1930. The wilderness of Denali: explorations of a hunter-naturalist in northern Alaska. Charles Scribner's Sons, N.Y. 412 p.

Spindler, M. A. 1976. Ecological survey of the birds, mammals, and vegetation of Fairbanks Wildlife Management Area. M.S. Thesis, Univ. Alaska, Fairbanks. 258 p.

Spindler, M. A. and B. Kessel. 1980. Avian populations and habitat use in interior Alaska taiga. Syesis 13: in press.

Strecker, R. L., F. A. Ryser, W. J. Tietz, and P. R. Morrison. 1952. Notes on mammals from Alaska. J. Mammal. 33:476-480.

Viereck, E. N. 1959. Small mammal populations in Mt. McKinley National Park, Alaska. Univ. Colo. unpubl. manuscript, Boulder. 177 p.

Viereck, L. A., and C. T. Dyrness. 1980. A preliminary classification system for vegetation of Alaska. U.S Forest Service, Pacific Northwest Forest and Range Experiment Station, Gen. Tech. Report PNW-106. 38 p.

West, G. C., and B. B. DeWolfe. 1974. Populations and energetics of taiga birds near Fairbanks, Alaska. Auk 91:757-775.

West, S. D. 1974. Post-burn population response of the northern red-backed vole, Clethrionomys rutilus, in interior Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks. 66 p.

West, S. D. 1979. Habitat responses of microtine rodents to central Alaskan forest succession. Ph.D. Thesis, Univ. Calif., Berkeley. 115 p.

White, C. M. 1974. Survey of the Peregrine Falcon and other raptors in the proposed Susitna River reservoir impoundment areas. U.S. Fish and Wildlife Service unpubl. interim report. 3 p. plus map.

White, C. M., and T. J. Cade. 1975. Raptor studies along the proposed Susitna powerline corridors, oil pipeline and in the Yukon and Colville river regions of Alaska. U.S. Fish and Wildlife Serv., Bur. Land Mgmt., Nat. Park Service, Arctic Inst. N. Amer., and Amer. Mus. Nat. Hist. Unpubl. report. 28 p.

White, C. M., T. D. Ray, and L. W. Sowl. 1977. the 1970-1972-1974 raptor surveys along the Trans-Alaska Oil Pipeline. World Conf. Birds of Prey 1:222-229.

Whitney, P.H. 1973. Population biology and energetics of three species of small mammals in the taiga of interior Alaska. Ph.D. Thesis, Univ. Alaska, Fairbanks. 254 p.

Wilber, C. G. 1946. Mammals of the Knik River Valley, Alaska. J. Mammal. 27:213-216.

Williamson, F. S. L., and L. J. Peyton. 1959. Breeding record of the Double-crested Cormorant in southcentral Alaska. Condor 61:154-155.

Wolff, J. A. 1977. Habitat utilization of snowshoe hares (Lepus americanus) in interior Alaska. Ph.D. Thesis, Univ. Calif., Berkeley. 150 p.

7 - AUTHORITIES CONTACTED

Federal Agencies

U.S. Bureau of Land Management
Anchorage, Alaska

Paula Krebes and Page Spencer, Remote Sensing
- Letter from B. Kessel; 1 June 1980; requesting help on developing a preliminary list of plant species for the upper Susitna Basin.

U.S. Fish and Wildlife Service
Anchorage, Alaska

Donald McKay, Susitna Project Coordinator
- Letter from E. Reed; August 27, 1980; request for information on endangered and sensitive avian species.
- Letter to E. Reed; September 12, 1980; response to letter of August 27, 1980, including enclosure of available reports.

Other Organizations and Individuals

L.G.L. Alaska, Inc.
Fairbanks, Alaska

David G. Roseneau, Biologist
- Telephone calls from B. Kessel; 5 and 15 February 1981; requesting information on densities of Golden Eagles in Alaska.