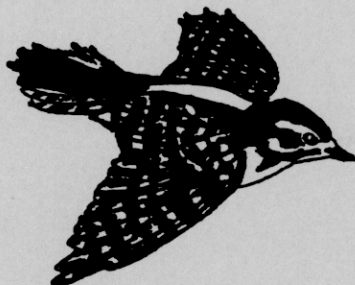


AVIAN STUDIES AT BECHAROF LAKE  
BECHAROF NATIONAL WILDLIFE REFUGE, ALASKA  
JUNE-SEPTEMBER, 1996



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## ABSTRACT

Landbird inventories were conducted at Becharof Lake during June-September 1996. During June and July, point counts were combined with constant-effort mist netting at Ruth River in the southern portion of Island Arm. During August and September, constant-effort mist netting was conducted at Bible Camp on the northern coast of the main body of the lake. Mist netting yielded 2285 total birds banded of 27 species between both camps. The combination of mist netting, point counts and incidental observations allowed documentation of 93 species utilizing the Becharof Lake area. The Bible Camp site is recommended for use as a long term fall migration banding station.

## INTRODUCTION

Beginning in 1994, federal agencies were directed by Vice President Gore to adopt an "ecosystem approach" to wildlife and environmental management. The goal of the ecosystem approach is "to restore and maintain the health, sustainability, and biological diversity of ecosystems while supporting sustainable economies and communities" (Interagency Ecosystem Management Task Force 1995). This directive has broad implications for the U.S. Fish and Wildlife Service (Service), but as a starting point separate funding has been allocated to identify research needs and conduct relevant studies.

The state of Alaska was divided into 10 geographical units, each intended to focus on a different water system-based ecosystem. The Bristol Bay/Kodiak unit team identified the Becharof Lake drainage as one of its focal areas, with plans to concentrate interagency efforts on baseline data collection.

Landbird studies serve as an essential indicator for ecosystem based management, because:

- 1) landbirds are typically short-lived, meaning that general population changes can be detected in only a few years;
- 2) multiple species and a relatively large number of individuals can be monitored with a single type of sampling;
- 3) avian species are specific to a wide variety of habitats; and
- 4) biologists have the ability to study both residents and migrants simultaneously.

Very little work has been done with landbirds on the Alaska Peninsula previous to 1994 (Dewhurst 1996). In 1994, the Alaska Peninsula/Becharof National Wildlife Refuge Complex (Complex) initiated constant effort mist netting at Mother Goose Lake, with plans to make this a long term monitoring station (Dewhurst et al. 1995). In 1995, as part of the Ecosystem initiative, a baseline avian inventory was also conducted in the Island Arm portion of Becharof Lake during both the breeding season and fall migration (Dewhurst et al. 1996).

In 1996, Ecosystem funding was again allocated for baseline avian studies in the Becharof Lake area. The Complex split its efforts between 2 camps, Ruth River and Bible Camp. The Ruth River field staff was moved in late July to Bible Camp for bear safety reasons as well as the assumption that Bible Camp would support more avian use during fall migration, due to its geographic location.

Research objectives of avian studies at Becharof Lake are to:



- 1) determine relative abundance and breeding status of landbird species using the Becharof Lake Ecosystem (Ruth River);
- 2) document local habitat use by landbird species during both breeding and fall migration (Ruth River and Bible Camp);
- 3) collect baseline information on migration phenology of landbirds using the Becharof Lake area (Bible Camp); and
- 4) collect baseline data on presence and relative abundance of other migratory bird species using Becharof Lake from June through September (Ruth River and Bible Camp).

A decision was made to move the study site annually within the ecosystem, in order to provide a broader inventory of this large and diverse area while at the sacrifice of productivity and survivorship information.

### STUDY AREA

Becharof Lake is located within the Becharof National Wildlife Refuge on the Alaska Peninsula (Fig. 1). Centered roughly at 58°N and 156°30' W, Becharof Lake is the second largest lake in Alaska encompassing approximately 117,000 ha (290,000 acres). This immense lake is fed by smaller Ruth Lake and Island Arm tributaries to the southeast, and drains into the Egegik River and ultimately Bristol Bay to the northwest. The Bruin Bay Fault runs diagonally (SW/NE) across the main body of the lake creating its maximum documented depth at 182 m (600 ft).

The southeastern arm of Becharof Lake is known as "Island Arm" for the numerous small, low-lying islands present. This portion of the lake was formed by glacial scouring, with the islands likely the results of moraines and till deposits. The surrounding western slopes of the Aleutian Mountain Range and associated lowlands are covered by volcanic ash with underlying layers of unconsolidated glacier till dating back to the Pleistocene (FWS 1985). To the west of Island Arm stands volcanic Mt. Peulik (1466 m, 4835 ft), which last erupted in 1814. In 1977, a sequence of phreatic (water related) eruptions formed two maars ("Ukinrek Maars") just to the northwest of the volcano (Kienle et al. 1980), which constitutes the most recent activity in the area.

Due to the immense size of the Becharof Lake Ecosystem, it is difficult to briefly summarize vegetation types. According to the Kessel (1979) system of classifying avian habitats, the lake and its edges are lacustrine waters and shorelines. Moving uphill away from the lake, tundra or dwarf shrub/grass meadows are interspersed with medium-tall shrub thickets of willows (*Salix* spp.) and alders (*Alnus crispa*). The local tundra vegetation is made up primarily of non-vascular flora (lichens and mosses) and crowberry (*Empetrum nigrum*), Labrador tea (*Ledum palustre*), and grasses (Gramineae). At Bible Camp, the brushy stands of alders become thicker as you head toward Bible Creek (approx 3/4 mile to the north).

#### Ruth River

Ruth River drains Ruth Lake and flows into Becharof Lake at the southernmost tip of Island Arm (Fig. 2). The Ruth River camp was located on a small peninsula to the west of the river's mouth. The mist netting site (Fig. 3) was located on the northern side of the peninsula, along a north-east facing slope and a small lake-level plateau. The elevation varied from 10 to 15 m.

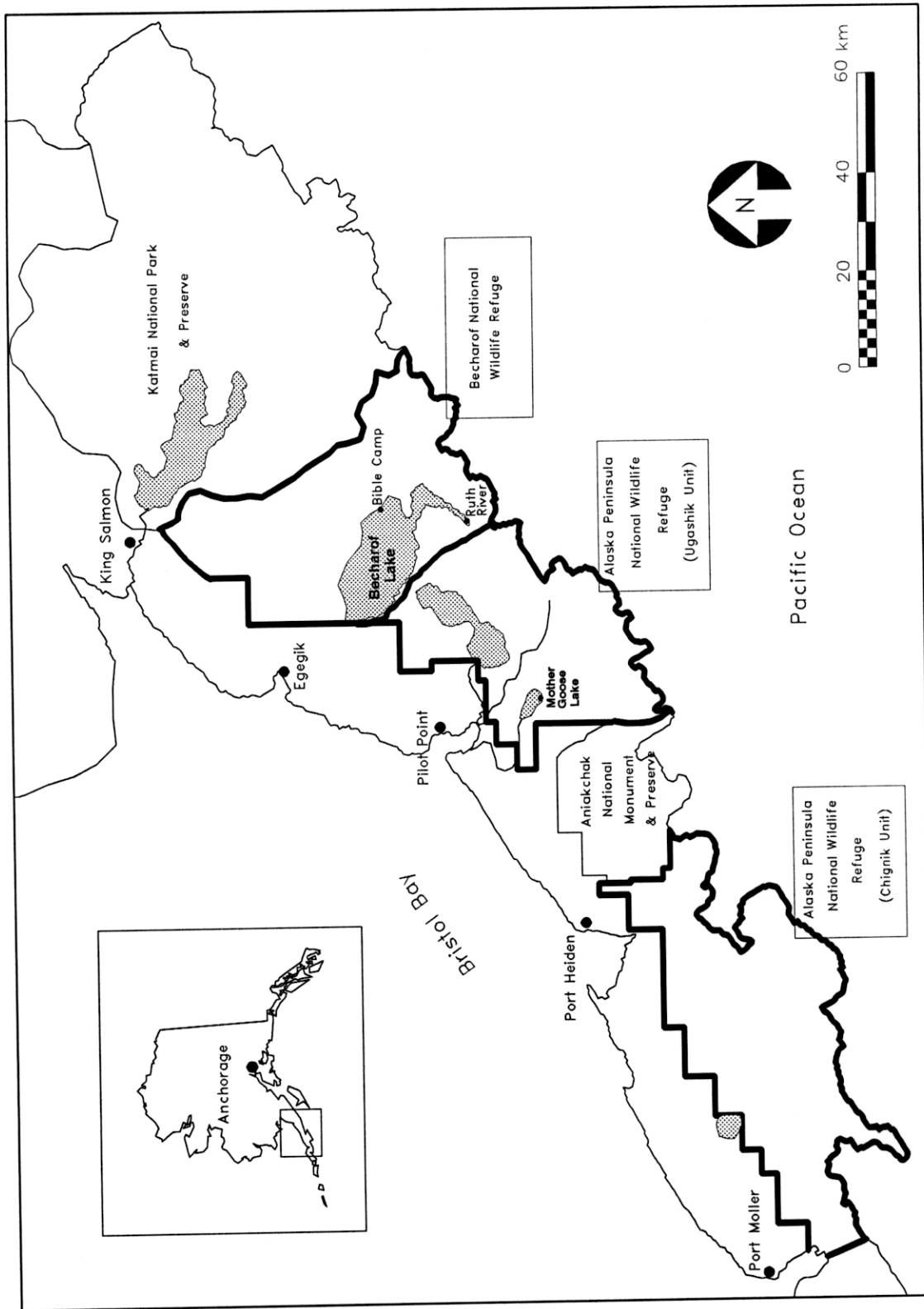


Figure 1. Ruth River and Bible Camp Study Areas on Becharof Lake in the Becharof National Wildlife Refuge.

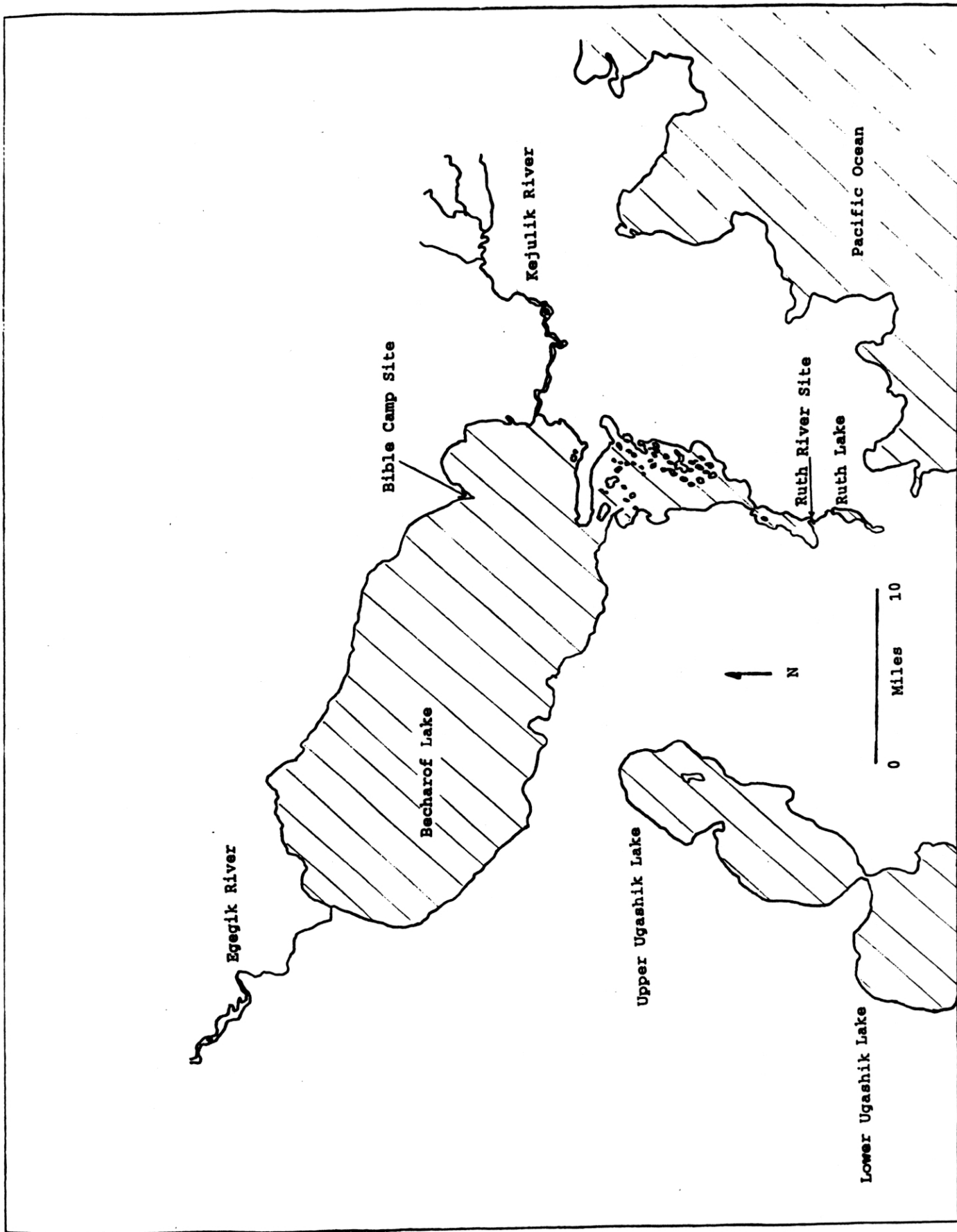


Figure 2. Location of 1996 Becharof Lake study sites, Becharof National Wildlife Refuge.

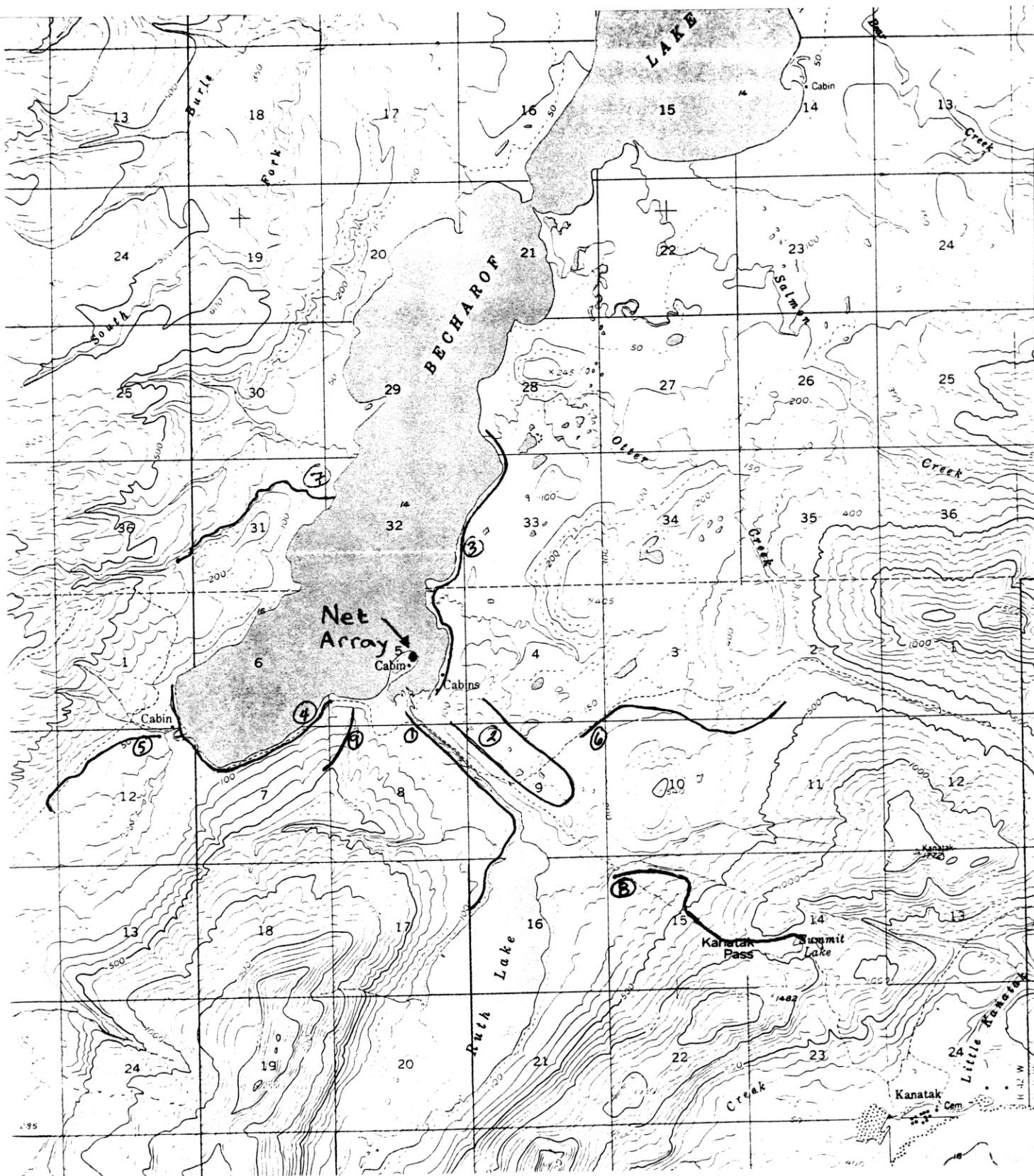


Figure 3. Locations of the Ruth River mist net array and off-road point count routes at Island Arm, Becharof Lake, 1996.

The net array (Fig. 4) was set in a mosaic of willow and alder thickets and grass meadow. Understory in and around the shrub thickets is dominated by grasses (family Graminae), fireweed (*Epilobium augustifolium*), Jacob's ladder (*Polemonium spp.*), chocolate lilies (*Frittilaria camschatchensis*), and wild geranium (*Geranium erianthum*). The site is bordered by ericaceous tundra along the top of the peninsula (to the south), and lakeshore to the west, north and east.

#### Bible Camp

Bible Camp is located in the Becharof National Wilderness Area along the northern coast of the main body of Becharof Lake. The field site consists of 8 plywood buildings built by the Aleut villagers of Egegik around 1965 as a summer bible camp. The camp was active until 1992, serving children and their families from Dillingham to Port Heiden, Alaska. The site is located on a sharp peninsula jutting southerly into the lake. The Bible Camp mist-net array (Fig. 5) was located in the southern-most alder thickets of that peninsula. The peninsula slopes roughly to the north at the location of the net array. The thickets are located >500 m from the lakeshore, and are mostly homogenous alder (3 nets were partially bordered by a mosaic of alder and willow). The understory is composed of grasses and mosses. The site is bordered by bare gravel to the southeast, more alder thickets to the north, and ericaceous tundra in all other directions.

### **METHODS**

#### Weather

Weather data was collected daily, usually around sunrise. At this time a determination was made whether mist netting was feasible. Feasibility criteria followed guidelines established by Ralph et al. (1992). Measurements of ceiling height, wind speed and direction, current precipitation, visibility, minimum and maximum temperature over the past 24 hours, and total rainfall over the last 24 hours were recorded.

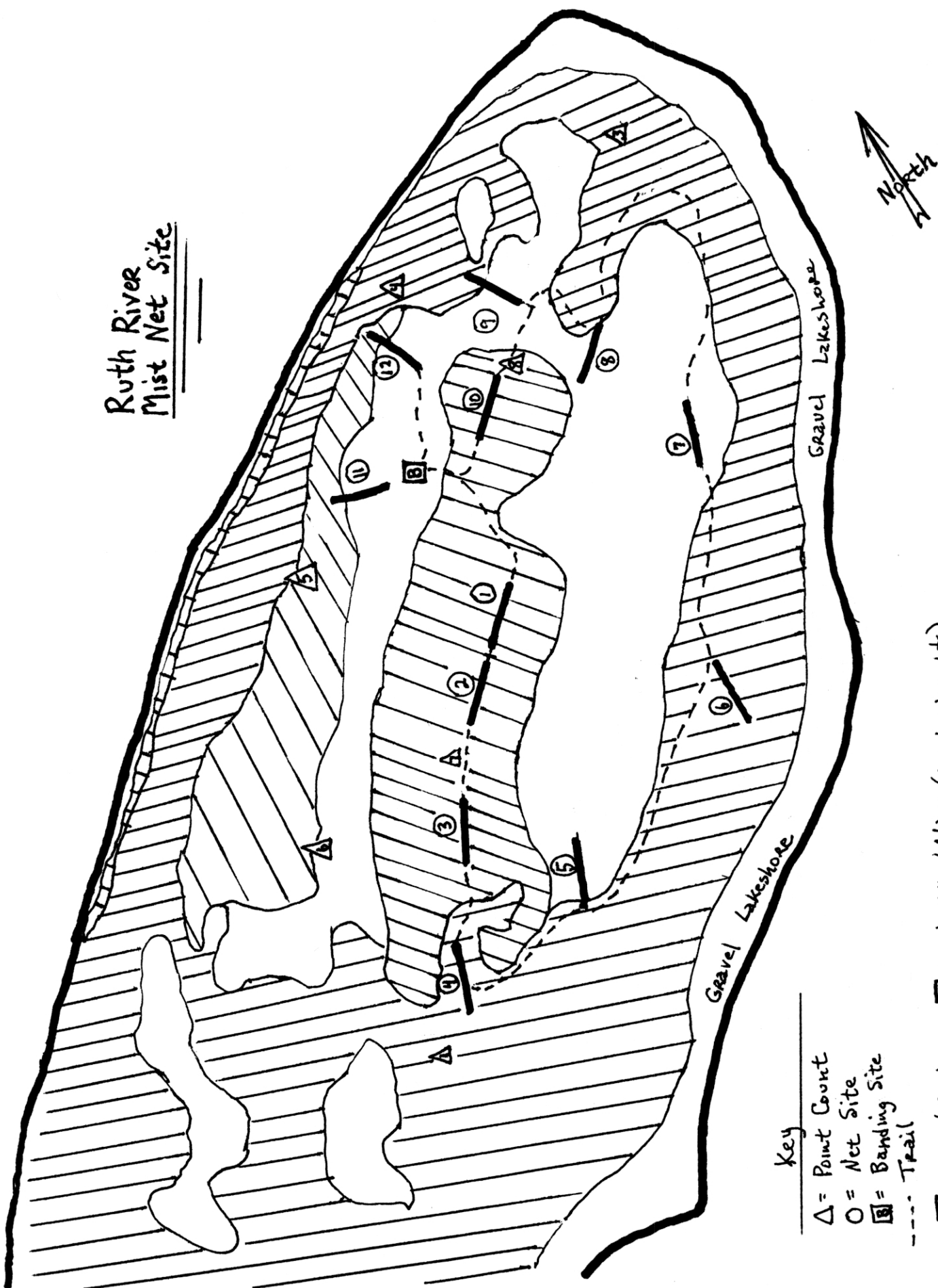
#### Breeding Season Banding

Constant effort mist netting at Ruth River was conducted on as many days as possible, with exceptions made to allow for point counts. Mist netting and banding were conducted generally using the Monitoring Avian Productivity and Survivorship (MAPS) protocol established by DeSante and Burton (1994). One notable exception was in frequency of banding, with 2-3x/week targeted at Ruth River. Nets were operated on 15 days between 4 June and 26 July, with the full array consisting of 12 nets. Starting time was moved to 45 min after sunrise due to bear safety concerns (Dewhurst et al. 1995). All nets used were Association of Field Ornithologists (AFO) HTX mist nets [12 m (39.4 ft), 30 mm (1.2 in) mesh]. Rainy and windy conditions sometimes precluded the opening of all nets, but at least half (6) were open during operation.

All captured birds were brought back to the banding tent. Captured birds were identified using standard field guides, aged using plumage attributes and/or skulling (Pyle et al. 1987), sexed via plumage and presence/absence of a developed cloacal protuberance or brood patch. Captured birds were also weighed, measured, examined for amount of body fat molt stage documented and banded with a standard FWS/NBS metal leg band (DeSante and Burton 1994, Ralph et al. 1992). Very young birds were returned to the area of capture for release, while all others were released from the processing tents. Banding data were recorded on forms developed by Boreal Partners in Flight (BFIP) and



# Ruth River Mist Net Site



- Key
- $\Delta$  = Point Count
  - $\circ$  = Net Site
  - $\square$  = Banding Site
  - Trail
  - $\square$  (horizontal lines) Grass/Tundra
  - $\square$  (vertical lines) Mixed Willow/Alder (Shootea heights)
  - $\square$  (diagonal lines) Tall Alders
  - $\square$  (cross-hatch) Willows

Figure 4. Sketch of Ruth River mist net site, Becharof National Wildlife Refuge, 1996.

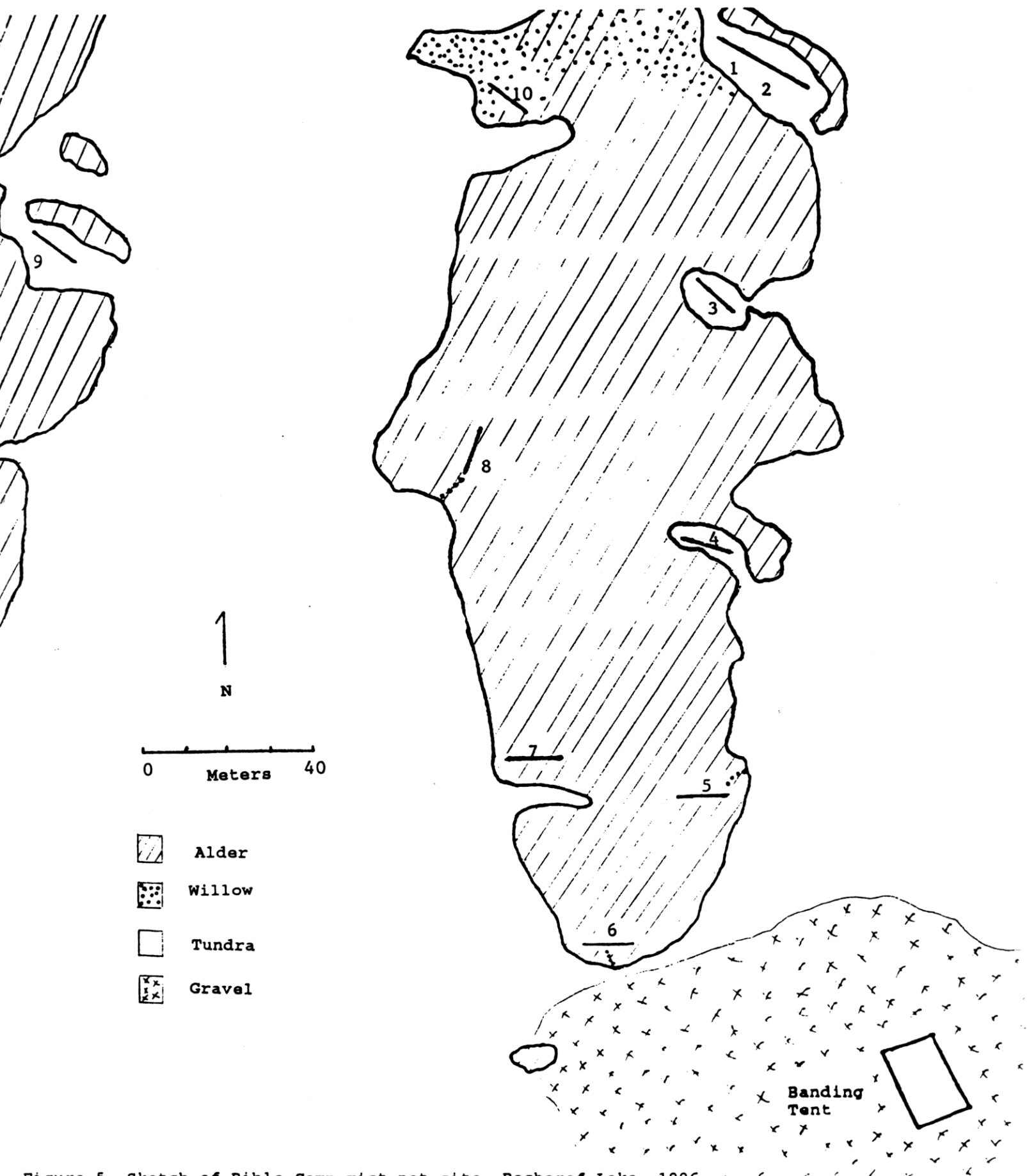


Figure 5. Sketch of Bible Camp mist net site, Becharof Lake, 1996.

later transferred to a Lotus Approach database. An inventory/schedule of the bird bands used was also sent to the Bird Banding Laboratory, Laurel, Md., on standardized National Biological Service [currently reassigned to U.S. Geological Survey (USGS)] forms.

Consistent with previous years' banding methods, special measurements were taken on *Catharus* thrushes, alder flycatchers (*Empidonax alnorum*), Wilson's warblers (*Wilsonia pusilla*) and pine grosbeaks (*Pinicola enucleator*) (Dewhurst et al. 1996). In 1996, BPIF developed regional bird banding forms, incorporating several new measurements of interest for the area. Additions included: color of eye rings, auriculars and rectrices; flight feather contrast in the coverts; and base color and wash or streaking in the body or undertail coverts. These new measurements are species specific with a detailed guide produced by BPIF (Colleen Handel, USGS, Anchorage, Alas.). BPIF also provided a guide with diagrams to help banders provide more detailed descriptions of primary and rectrices feather shape for regional species. Age classifications [After Second Year (ASY) and Second Year (SY)] were sometimes made based on plumage characteristics (Pyle et al. 1991). These age classifications were only made for local information and all birds were reported to the Banding Laboratory as either HY (hatching year) or AHY (after hatching year).

#### Point Counts

MAPS-type point counts were conducted at the Ruth River mist net array on 14 and 28 June, and 7 July (during the equivalent of MAPS banding periods 5-7). Census methods, habitat type classifications and mapping followed MAPS guidelines established by DeSante and Burton (1994). Due to staff limitations, point counts could not be conducted simultaneously with mist netting. Eight points were used in the array; each point was observed for a 10 minute period and data was recorded on standardized MAPS forms (DeSante and Burton 1994).

Eight off-road point counts were also conducted in the southern Island Arm area (Fig. 5). Each route consisted of 8-12 points, 250 to 400 m apart depending on the habitat (open areas required longer distances to avoid recounting birds). A 5 min census was conducted at each point. Vegetation descriptions were made at each stop by one person while another performed the count. All avian and habitat data was recorded on standardized forms developed by USGS, Anchorage, Alas.

#### Vegetation Surveys

Vegetation data was collected at each mist net consistent with sampling initiated this year at Mother Goose Lake. Four 1-m squares were described for each net, the centers being located 4 m towards the center of the net and 4 m perpendicular to the net lane. Estimates were made of canopy density, number of woody stems in the area, highest, lowest and average height of woody vegetation, estimated percentage of vascular and non-vascular ground cover, height of vascular cover, and all vascular species present in order of dominance. Habitat classifications were assigned to each net according to Kessel (1979). At Bible Camp, canopy density estimates were unintentionally omitted from the data collected.

Incidental vegetative observations also documented vascular plant species in the general camp areas. Specimens from both camps were pressed, mounted and ultimately stored in the Fish and Wildlife Service (FWS) herbarium in King Salmon. Blooming phenology was recorded weekly at Ruth River, based on observations during daily activities.

### Fall Migration Efforts

Constant effort mist netting was conducted at Bible Camp from 6 August to 16 September. Ten nets were operated daily as weather permitted, although high bird numbers could force the closing of some nets, due to staffing constraints. Methodology was consistent with fall migration protocols described by Dewhurst et al. (1995).

Birds recaptured within one hour of processing were eliminated from the data because of the likelihood that their flight path had been altered. This determination is consistent with methodology used at other migration stations operated by the Complex, but differs from breeding season protocol (where all captures are recorded).

For analytical purposes, landbird species described in this report were categorized by migration strategies following models established by national and western regional committees of Partners in Flight (Gauthreaux 1992, Carter and Barker 1993, Handel et al. 1995). The following migration strategy categories were used:

- A = Neotropical migrant with majority of winter range south of U.S./ Mexico border
- B = Neotropical migrant with majority of winter range north of U.S./ Mexico border
- N = Nearctic migrant with entire or almost entire winter range in the U.S. and Canada
- P = Palearctic or Paleotropical migrant with entire winter range in Asia
- R = Resident species, non-migratory or very weakly migratory.

### Avian Sightings

Daily records were kept of all birds sighted during the study period at both locations. Habitat type (Kessel 1979), behavior (Andres 1994) and observed breeding status were also recorded on customized forms (FWS files, King Salmon, Alas.) and transferred into a computerized database. Breeding status was classified as either confirmed (nest or young directly observed), probable (behavior indicating local breeding observed), possible (suitable habitat present in the area) or nonbreeder (no suitable habitat present in area). Observed breeding status includes only characteristics noted outside of mist netting. The Ruth River and Bible Camp sightings were lumped together since those observations already included species seen in all habitats visited and were not necessarily representative of the net array area.

## **RESULTS**

### Weather

Ruth River.-- A total of 200.1 mm of precipitation was measured at Ruth River during the study period. Light snow was recorded on 10 June. Measurable precipitation was recorded on 37 out of 65 days (57%). The 1995 Island Arm site had a comparable number of days with precipitation (65%), although about half the accumulation (107 mm) was recorded during June and July at that site.

As common on the Alaska Peninsula, wind and rain were a constant challenge to banding operations. Mist netting was generally suspended when winds reached 15 to 20 mph, but direction of the wind proved more relevant than speed. Most

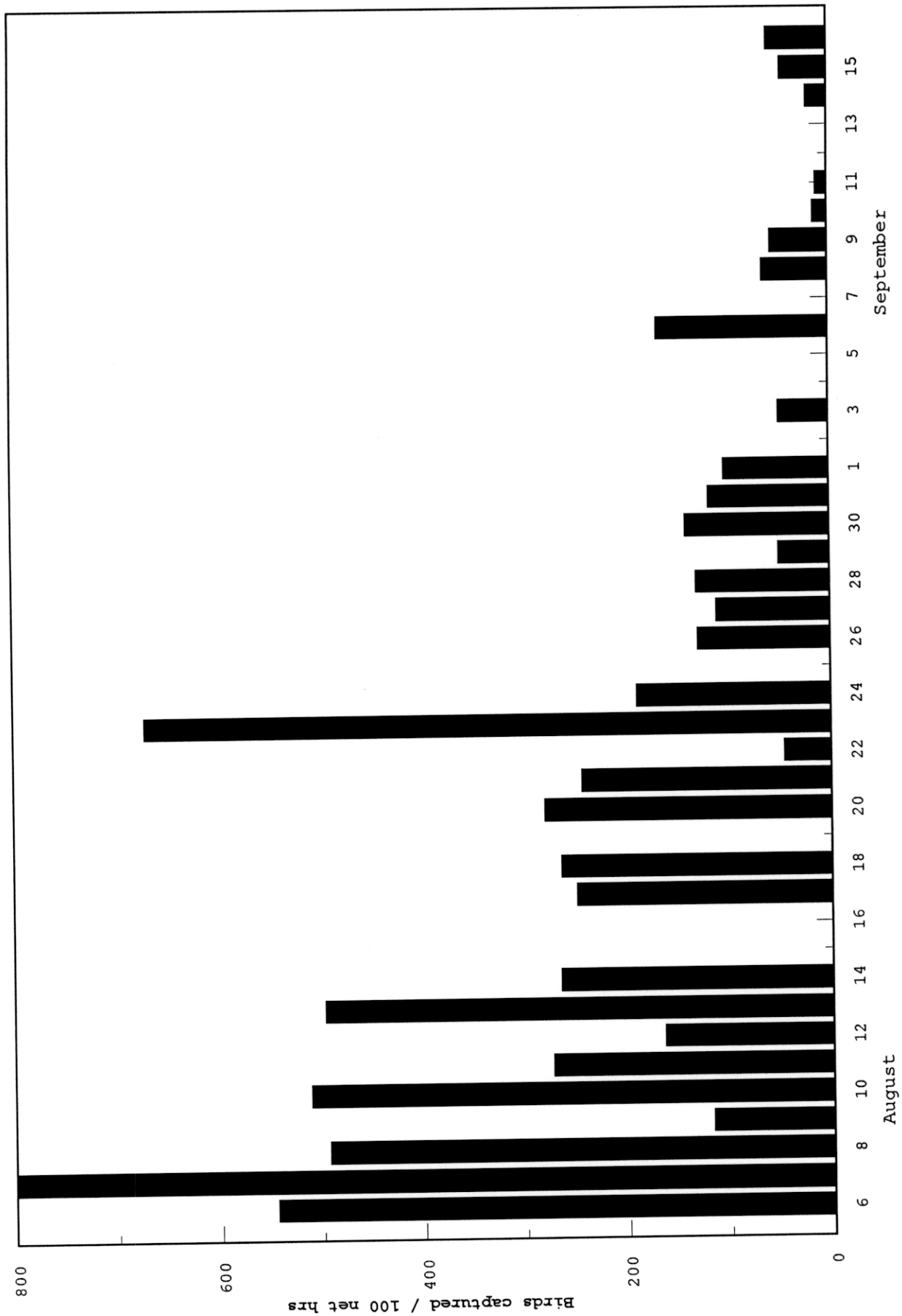


Figure 6. Capture rates of landbirds caught at Bible Camp, Becharof Lake, during August and September 1996.



of the nets were more susceptible to winds out of the north than any other direction. Since calm periods were very rare at Becharof Lake, virtually all banding and point counts were accomplished in some wind. Banding was determined to be feasible on 36 days (55%).

Bible Camp.-- A total of 173.7 mm of precipitation was measured at Bible Camp during the study period. Measurable precipitation was recorded on 34 of 48 days (71%). Total precipitation accumulation was comparable to the Island Arm site during August and September 1995, which reported 195.5 mm. The nets at Bible Camp were well protected by brush, and banding was accomplished on a higher percentage of days than at Ruth River. Banding was determined to be feasible on 33 days (69%). The percentage of days bandable was closely comparable to all other fall migration stations previously operated by the Complex, which has ranged from 62 to 73% (Moore 1996).

#### Mist-netting and Banding

Breeding Season.-- Constant effort mist netting was conducted at Ruth River on 15 days between 4 June and 26 July. A total of 594 birds were captured in 746 net hours (79.6 birds/100 net hrs), including recaptured, escaped and injured birds. Of those captures, 361 (17 species) were newly banded (Table 1). Individual net efficiencies varied from 41.3 to 118.7 birds/100 net hrs (Table 2). The most common species were Savannah sparrow (*Passerculus sandwichensis*) (95 banded), Wilson's warbler (*Wilsonia pusilla*) (77 banded) and yellow warbler (*Dendroica petechia*) (47 banded). Nine species were represented by <5 individuals.

Capture rates at Ruth River were comparable to both 1995 breeding sites in Island Arm (Dewhurst et al. 1996), but low relative to those observed at Mother Goose Lake (Dewhurst et al. 1995, Eskelin and Dewhurst 1996). The lower breeding densities observed may be more representative of populations on the Alaska Peninsula, as the isolated black cottonwood (*Populus balsiforma*) stand around Mother Goose Lake likely concentrates breeders.

Productivity, as measured by percentage of newly banded birds that were HY, was also low (34%) as compared to other sites on the Peninsula. Sites at Mother Goose Lake generally have produced 60-80% HY birds (Dewhurst et al. 1995, Eskelin and Dewhurst 1996) and 48% of the birds captured at the 1995 Becharof Lake/Cabin Island site were HY.

Fall Migration.-- Mist netting was conducted at Bible Camp on 32 days between 6 August and 16 September. Capture efforts yielded 1924 birds of 24 species banded (Table 1), and 2470 total captures. Due to high bird volumes and staff limitations, on many days during August some nets were either shut early or not opened at all. Nets were open for 1351 total net hours, providing an overall capture rate of 182.8 birds/100 net hrs. Capture rates were highest on 7 August, (807.3 birds/100 net hrs) and steadily declined throughout the season (Fig. 6). Individual net efficiencies ranged from 97.7 to 285.1 birds/100 net hrs (Table 2). The most common species captured were yellow warblers (471 banded), American tree sparrows (*Spizella arborea*) (445 banded) and Savannah sparrows (311 banded), while 11 species were represented by <5 individuals.

Differences in individual species phenology (Table 3) were not as evident as at other Alaska Peninsula banding stations. In general, Type A migrants have displayed highest capture rates earlier in the season than Type B or N migrants (Moore 1996, Dewhurst et al. 1996). At Bible Camp, almost all species with substantial numbers had highest capture rates during the period 6-10 August. Typically, Types A and B migrants departed earlier than nearctic migrants or residents, which were still being captured during late September.

Table 1. Age composition of birds banded during mist netting operations at Ruth River (June-July) and Bible Camp (August-September), Becharof Lake, 1996.

| SPECIES                        | RUTH RIVER |     |     | BIBLE CAMP |      |     | GRAND TOTAL |
|--------------------------------|------------|-----|-----|------------|------|-----|-------------|
|                                | AHY*       | HY  | UNK | AHY        | HY   | UNK |             |
| Least Sandpiper                |            |     | 1   |            |      |     | 1           |
| Downy Woodpecker               |            |     |     | 2          | 5    | 3   | 10          |
| Olive-sided Flycatcher         |            |     |     |            | 1    |     | 1           |
| Alder Flycatcher               |            |     |     |            | 1    |     | 1           |
| Tree Swallow                   | 2          |     |     |            |      |     | 2           |
| Black-capped Chickadee         |            | 1   |     | 1          | 21   |     | 22          |
| Ruby-crowned Kinglet           |            |     |     |            | 1    |     | 1           |
| Gray-cheeked Thrush            | 2          |     |     |            | 2    |     | 4           |
| Swainson's Thrush              | 1          |     |     |            |      |     | 1           |
| Hermit Thrush                  | 4          | 3   |     |            | 18   |     | 25          |
| American Robin                 | 2          |     |     | 1          | 34   | 1   | 36          |
| Varied Thrush                  |            |     |     |            | 1    |     | 1           |
| American Pipit                 |            | 1   |     |            | 3    |     | 4           |
| Northern Shrike                |            | 1   |     |            | 4    |     | 5           |
| Orange-crowned Warbler         | 27         | 3   |     | 9          | 157  | 2   | 198         |
| Yellow Warbler                 | 40         | 7   |     | 36         | 434  | 1   | 518         |
| Blackpoll Warbler              |            |     |     |            | 2    |     | 2           |
| Northern Waterthrush           |            |     |     |            | 1    |     | 1           |
| Wilson's Warbler               | 69         | 8   |     | 19         | 270  | 2   | 368         |
| American Tree Sparrow          | 1          | 3   |     | 11         | 426  | 8   | 449         |
| Savannah Sparrow               | 26         | 69  |     | 8          | 298  | 5   | 406         |
| Fox Sparrow                    | 6          | 9   |     | 2          | 30   |     | 47          |
| Golden-crowned Sparrow         | 22         | 13  |     | 5          | 31   |     | 71          |
| Gambel's White-crowned Sparrow |            |     |     | 3          | 28   |     | 31          |
| Slate-colored Junco            |            |     |     |            | 2    |     | 2           |
| Rusty Blackbird                |            |     |     | 1          |      |     | 1           |
| Common Redpoll                 | 37         | 3   |     | 7          | 25   | 2   | 74          |
| TOTAL                          | 239        | 121 | 1   | 105        | 1795 | 24  | 2285        |

\*AHY = After Hatch Year (adults)

HY = Hatching Year (young of the year)

UNK = Unknown Age

Table 2. Summary of mist net efficiencies during banding operations at Ruth River (June-July) and Bible Camp (Aug.-Sept.), Becharof Lake, 1996. Capture rates are expressed as birds/100 net hrs.

| Ruth River   |       |       |       |       |       |       |       |       |       |       |      |       |        |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|--------|
| Net #        | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11   | 12    | Total  |
| Total Birds  | 56.0  | 34.0  | 50.0  | 66.0  | 73.0  | 19.0  | 38.0  | 61.0  | 45.0  | 38.0  | 59.0 | 53.0  | 592.0  |
| Net hrs      | 69.0  | 69.0  | 69.0  | 67.5  | 61.5  | 46.0  | 48.5  | 69.0  | 64.3  | 69.0  | 61.5 | 52.0  | 746.3  |
| Capture rate | 81.2  | 49.3  | 72.5  | 97.8  | 118.7 | 41.3  | 78.4  | 88.4  | 70.0  | 55.1  | 95.9 | 101.9 | 79.3   |
| Bible Camp   |       |       |       |       |       |       |       |       |       |       |      |       |        |
| Net #        | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |      |       | Total  |
| Total Birds  | 158.0 | 174.0 | 134.0 | 172.0 | 412.0 | 548.0 | 370.0 | 216.0 | 160.0 | 125.0 |      |       | 2469.0 |
| Net hrs      | 129.3 | 129.5 | 131.8 | 138.3 | 144.5 | 146.3 | 141.3 | 135.5 | 127.0 | 128.0 |      |       | 1351.3 |
| Capture rate | 122.2 | 134.4 | 101.7 | 124.4 | 285.1 | 374.7 | 261.9 | 159.4 | 126.0 | 97.7  |      |       | 182.7  |

Table 3. Seasonal variation in capture rates\* (birds/100 net hours) of ten migrant landbird species during fall migration banding at Bible Camp, Becharof Lake, 1996.

| SPECIES**                   | August<br>6-10 | August<br>11-15 | August<br>16-20 | August<br>21-25 | August<br>26-31 | September<br>1-5 | September<br>6-10 | September<br>11-15 | September<br>16-20 | Cumulative |
|-----------------------------|----------------|-----------------|-----------------|-----------------|-----------------|------------------|-------------------|--------------------|--------------------|------------|
| Neotropical Migrants Type A |                |                 |                 |                 |                 |                  |                   |                    |                    |            |
| OCWA                        | 78.7           | 44.2            | 22.1            | 34.7            | 4.1             | 0.9              | 0.0               | 0.0                | 0.0                | 18.7       |
| YWAR                        | 118.5          | 69.8            | 76.7            | 86.1            | 27.7            | 3.5              | 6.2               | 1.6                | 0.0                | 44.0       |
| WIWA                        | 26.9           | 96.9            | 41.3            | 37.6            | 13.3            | 1.8              | 0.5               | 0.0                | 3.3                | 24.6       |
| Neotropical Migrants Type B |                |                 |                 |                 |                 |                  |                   |                    |                    |            |
| HETH                        | 6.5            | 0.8             | 2.9             | 3.5             | 3.0             | 3.5              | 4.1               | 1.6                | 3.3                | 3.2        |
| SAVS                        | 119.4          | 27.9            | 12.8            | 57.2            | 9.6             | 10.5             | 2.1               | 1.6                | 10.0               | 25.0       |
| FOSP                        | 7.4            | 7.8             | 11.0            | 3.5             | 3.7             | 0.9              | 1.0               | 0.0                | 0.0                | 4.2        |
| GCSP                        | 7.4            | 7.8             | 7.6             | 2.9             | 2.6             | 3.5              | 2.1               | 0.0                | 0.0                | 3.8        |
| GWCS                        | 12.0           | 6.2             | 8.1             | 1.7             | 0.0             | 0.0              | 1.0               | 0.0                | 0.0                | 3.0        |
| Nearctic Migrants           |                |                 |                 |                 |                 |                  |                   |                    |                    |            |
| ATSP                        | 144.4          | 51.2            | 70.9            | 35.8            | 36.9            | 46.5             | 26.8              | 5.6                | 11.7               | 46.4       |
| CORE                        | 4.6            | 1.6             | 1.2             | 2.3             | 0.4             | 0.9              | 3.1               | 12.0               | 8.3                | 3.0        |
| Net Hours                   | 108            | 129             | 172             | 173             | 271             | 114              | 194               | 125                | 60                 | 1346       |

\*Capture rates include all recaptures, releases, escapes and mortalities.

\*\*OCWA - Orange-crowned Warbler      FOSP - Fox Sparrow  
 YWAR - Yellow Warbler      GWCS - Gambel's White-crowned Sparrow  
 WIWA - Wilson's Warbler      ATSP - American Tree Sparrow  
 HETH - Hermit Thrush      CORE - Common Redpoll  
 SAVS - Savannah Sparrow

Recaptures.-- Seven species of birds were recaptured at Ruth River, accounting for 38% (227) of total captures (Table 4). Golden-crowned sparrows (*Zonotrichia atricapilla*) had the highest recapture rate (53.9%), with only 35 out of 76 captures being new birds. The overall recapture rate dropped to 19.5% (482) at Bible Camp, but the difference in methodology with same-hour recaps should be noted. Hermit thrushes (*Catharus guttatus*) had the highest recapture rate at Bible Camp (57.1%), with only 18 out of 42 captures being new birds. While gray-cheeked thrushes (*Catharus minimus*) did exhibit a recapture rate of 66.7%, that number was discarded due to a sample size of only 2 birds.

One foreign bird was recovered at Bible Camp. American tree sparrow #2020-20932 was captured in Net 8 on 1 September. The bird was originally banded as an AHY (sex unknown) on 1 March 1995, near Fort Collins, Colorado.

Unbanded Birds.-- Any bird which was unintentionally released after being touched by a staff member and prior to banding was classified as an escape. Six birds escaped at Ruth River (1.0% of captures) and 37 escaped at Bible Camp (1.5% of captures). No mortality was observed at Ruth River, while at Bible Camp 16 birds (0.65%) died due to predators in the area or handling injuries. Of those, at least 4 were killed by northern shrikes (*Lanius excubitor*) and 5-7 more were killed by fox or bear which were hanging around the net array. Eight more birds at Bible Camp were intentionally released unbanded due to injuries. Predators in the net array were a constant problem at that site. Additionally, several nets were destroyed during banding operations by bears (*Ursus arctos horribilis*), red foxes (*Vulpes vulpes*) or caribou (*Rangifer tarandus*).

#### Point Counts

MAPS-type Point Counts.-- Sixteen avian species were documented during 3 point counts conducted within the Ruth River mist net array (Table 5), using MAPS methodology (DeSante and Burton 1994). No landbird species were detected which were not also captured in mist nets. Conversely, 7 landbird species were captured in mist nets but not recorded during point counts [tree swallow (*Tachycineta bicolor*), black-capped chickadee (*Parus atricapillus*), gray-cheeked thrush, Swainson's thrush (*Catharus ustulatus*), American pipit (*Anthus rubescens*), northern shrike and American tree sparrow]. Of the 9 landbird species detected, all but 2 were recorded on every repetition. Most surprisingly, no hermit thrushes were recorded on the 28 June count, while 11 individuals were recorded just 9 days later.

Off-Road Point Counts.-- Eight off-road point counts (Fig. 3) were conducted in the southern Island Arm area, documenting a total of 41 avian species (Table 6). Bald eagle (*Haliaeetus leucocephalus*), willow ptarmigan (*Lagopus lagopus*), alder flycatcher (*Empidonax alnorum*) and Lapland longspur (*Calcarius lapponicus*) were added to the species list of landbirds, likely due to varying habitats on the point count transects. Otherwise, species composition closely paralleled that of the mist net sites.

#### Vegetation Surveys

Data collected on vegetation/habitat at the net lanes is presented in Tables 7 and 8. Willows and alders were often not keyed out to species. Habitat at Ruth River was widely varied, with nearly equal amounts of low, medium and tall shrub thickets, grass meadow and edge habitats. Habitat at Bible Camp was more consistent: nets were placed close to the edge of a large patch of medium shrub thicket which was surrounded by ericaceous dwarf shrub meadow. Although vegetation composition was not quantified in 1995, habitat at the



Table 4. Recapture rates of species captured during mist netting operations at Ruth River (June-July) and Bible Camp (August-September), Becharof Lake, 1996.

| SPECIES                        | RUTH RIVER |       |        | BIBLE CAMP |       |        |
|--------------------------------|------------|-------|--------|------------|-------|--------|
|                                | total*     | recap | %recap | total      | recap | %recap |
| Least Sandpiper                | 1          | 0     | 0.0    |            |       |        |
| Downy Woodpecker               |            |       |        | 14         | 4     | 28.6   |
| Olive-sided Flycatcher         |            |       |        | 1          | 0     | 0.0    |
| Alder Flycatcher               |            |       |        | 1          | 0     | 0.0    |
| Tree Swallow                   | 2          | 0     | 0.0    |            |       |        |
| Black-capped Chickadee         | 1          | 0     | 0.0    | 25         | 3     | 12.0   |
| Ruby-crowned Kinglet           |            |       |        | 1          | 0     | 0.0    |
| Gray-cheeked Thrush            | 2          | 0     | 0.0    | 6          | 4     | 66.7   |
| Swainson's Thrush              | 1          | 0     | 0.0    |            |       |        |
| Hermit Thrush                  | 7          | 0     | 0.0    | 42         | 24    | 57.1   |
| American Robin                 | 4          | 2     | 50.0   | 42         | 6     | 14.3   |
| Varied Thrush                  |            |       |        | 1          | 0     | 0.0    |
| American Pipit                 | 1          | 0     | 0.0    | 3          | 0     | 0.0    |
| Northern Shrike                | 1          | 0     | 0.0    | 4          | 0     | 0.0    |
| Orange-crowned Warbler         | 47         | 17    | 36.2   | 244        | 76    | 31.1   |
| Yellow Warbler                 | 80         | 33    | 41.3   | 570        | 99    | 17.4   |
| Blackpoll Warbler              |            |       |        | 2          | 0     | 0.0    |
| Northern Waterthrush           |            |       |        | 1          | 0     | 0.0    |
| Wilson's Warbler               | 122        | 45    | 36.9   | 319        | 28    | 8.8    |
| American Tree Sparrow          | 4          | 0     | 0.0    | 617        | 171   | 27.7   |
| Savannah Sparrow               | 138        | 43    | 31.2   | 327        | 16    | 4.9    |
| Fox Sparrow                    | 21         | 6     | 28.6   | 54         | 22    | 40.7   |
| Golden-crowned Sparrow         | 76         | 41    | 53.9   | 50         | 14    | 28.0   |
| Gambel's White-crowned Sparrow |            |       |        | 39         | 8     | 20.5   |
| Slate-colored Junco            |            |       |        | 2          | 0     | 0.0    |
| Rusty Blackbird                |            |       |        | 1          | 0     | 0.0    |
| Common Redpoll                 | 80         | 40    | 50.0   | 41         | 7     | 17.1   |

\*Total number of birds banded, recaptured and recovered.

Table 5. Frequency of species occurrence during Ruth River net-array point counts, June-July 1996. Frequency equals the number of points at which a species was recorded divided by the number of points sampled.

| SPECIES                | DATE |    |       |    |       |    |
|------------------------|------|----|-------|----|-------|----|
|                        | 6/14 | n* | 06/28 | n  | 07/07 | n  |
| Black Scoter           |      |    | 0.13  | 2  | 0.13  | 2  |
| Red-breasted Merganser |      |    |       |    | 0.13  | 1  |
| Bald Eagle             |      |    |       |    | 0.13  | 1  |
| Semipalmated Plover    |      |    |       |    | 0.13  | 2  |
| Greater Yellowlegs     |      |    |       |    | 0.13  | 1  |
| Mew Gull               | 0.13 | 50 |       |    | 0.13  | 1  |
| Glaucous-winged Gull   |      |    |       |    | 0.63  | 7  |
| Hermit Thrush          | 0.13 | 1  |       |    | 0.88  | 11 |
| American Robin         |      |    | 0.25  | 2  | 0.13  | 1  |
| Orange-crowned Warbler | 0.63 | 5  | 0.88  | 13 | 0.75  | 9  |
| Yellow Warbler         | 0.38 | 3  | 0.75  | 7  | 0.50  | 4  |
| Wilson's Warbler       | 0.50 | 7  | 0.38  | 6  | 0.63  | 8  |
| Savannah Sparrow       | 0.88 | 12 | 1.00  | 28 | 0.88  | 11 |
| Fox Sparrow            | 0.38 | 4  | 0.13  | 1  | 0.13  | 1  |
| Golden-crowned Sparrow | 0.63 | 7  | 0.88  | 10 | 0.88  | 9  |
| Common Redpoll         | 0.50 | 11 | 0.88  | 6  | 0.88  | 12 |
| Number of points       | 8    |    | 8     |    | 8     |    |

\*n = number of individual birds encountered in the array during each replicate.

Table 6. Frequency of species occurrence during Ruth River off-road point counts, June-July 1996. Frequency equals the number of points at which a species is detected divided by the number of points sampled.

| SPECIES                | Route 1 |    | 2       |    | 3       |    | 4       |    | 5       |   | 6       |   | 7      |   | 8      |   |
|------------------------|---------|----|---------|----|---------|----|---------|----|---------|---|---------|---|--------|---|--------|---|
|                        | 14 June | n* | 15 June | n  | 15 June | n  | 16 June | n  | 16 June | n | 28 June | n | 3 July | n | 7 July | n |
| Common Loon            |         |    |         |    |         |    |         |    |         |   | 0.08    | 1 |        |   |        |   |
| Tundra Swan            |         |    | 0.08    | 2  |         |    |         |    |         |   | 0.08    | 1 |        |   |        |   |
| Mallard                | 0.08    | 1  |         |    |         |    | 0.18    | 2  |         |   |         |   |        |   |        |   |
| American Wigeon        |         |    |         |    |         |    | 0.09    | 1  |         |   |         |   |        |   |        |   |
| Greater Scaup          |         |    |         |    |         |    | 0.27    | 7  |         |   |         |   |        |   |        |   |
| Black Scoter           |         |    |         |    | 0.58    | 17 | 0.27    | 7  | 0.13    | 3 |         |   |        |   |        |   |
| White-winged Scoter    |         |    |         |    |         |    | 0.09    | 2  |         |   |         |   |        |   |        |   |
| Common Goldeneye       |         |    |         |    |         |    | 0.09    | 2  |         |   |         |   |        |   |        |   |
| Barrow's Goldeneye     |         |    |         |    |         |    | 0.09    | 2  |         |   |         |   |        |   |        |   |
| Red-breasted Merganser |         |    |         |    | 0.08    | 2  | 0.36    | 10 |         |   |         |   |        |   |        |   |
| Bald Eagle             |         |    |         |    |         |    | 0.09    | 1  | 0.25    | 2 |         |   |        |   |        |   |
| Willow Ptarmigan       | 0.17    | 2  | 0.17    | 15 | 0.08    | 1  |         |    | 0.13    | 1 |         |   |        |   |        |   |
| Sandhill Crane         |         |    |         |    | 0.08    | 2  |         |    |         |   |         |   |        |   |        |   |
| Black-bellied Plover   |         |    | 0.08    | 1  |         |    |         |    |         |   | 0.33    | 5 |        |   |        |   |
| Semipalmated Plover    | 0.08    | 1  |         |    |         |    | 0.18    | 4  |         |   | 0.50    | 9 |        |   | 0.17   | 7 |
| Greater Yellowlegs     | 0.25    | 4  | 0.67    | 18 | 0.67    | 10 | 0.09    | 1  | 0.25    | 2 | 0.17    | 2 |        |   |        |   |
| Least Sandpiper        |         |    | 0.42    | 5  |         |    |         |    |         |   | 0.08    | 1 |        |   | 0.17   | 2 |
| Rock Sandpiper         |         |    |         |    |         |    |         |    |         |   |         |   |        |   | 0.17   | 2 |
| Short-billed Dowitcher | 0.08    | 1  | 0.08    | 1  |         |    | 0.18    | 5  | 0.13    | 1 |         |   |        |   |        |   |
| Common Snipe           | 0.08    | 3  | 0.75    | 10 | 0.50    | 7  | 0.09    | 1  |         |   |         |   |        |   |        |   |
| Mew Gull               |         |    | 0.08    | 2  |         |    |         |    |         |   |         |   |        |   |        |   |
| Glaucous-winged Gull   | 0.17    | 2  |         |    | 0.08    | 2  | 0.09    | 1  |         |   |         |   |        |   | 0.17   | 5 |
| Unknown Gull           |         |    |         |    |         |    |         |    |         |   |         |   | 0.08   | 5 |        |   |
| Black-legged Kittiwake | 0.08    | 40 |         |    |         |    |         |    |         |   |         |   |        |   |        |   |

\*n = number of individual birds encountered on the route.

Table 6 (cont.). Frequency of species occurrence during Ruth River off-road point counts, June-July 1996. Frequency equals the number of points at which a species is detected divided by the number of points sampled.

| SPECIES                | Route 1 |    | 2       |    | 3       |    | 4       |    | 5       |    | 6       |    | 7      |    | 8      |    |
|------------------------|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|--------|----|--------|----|
|                        | 1(6/14) | n* | 15 June | n  | 15 June | n  | 16 June | n  | 16 June | n  | 28 June | n  | 3 July | n  | 7 July | n  |
| Alder Flycatcher       | 0.08    | 1  |         |    |         |    | 0.27    | 7  | 0.25    | 2  |         |    |        |    |        |    |
| Tree Swallow           |         |    |         |    |         |    |         |    |         |    |         |    | 0.08   | 1  |        |    |
| Unknown Swallow        |         |    |         |    |         |    |         |    |         |    |         |    | 0.42   | 8  |        |    |
| Black-capped Chickadee |         |    |         |    |         |    |         |    |         |    |         |    |        |    |        |    |
| Gray-cheeked Thrush    | 0.17    | 2  | 0.58    | 13 | 0.42    | 6  | 0.09    | 1  | 0.88    | 11 | 0.33    | 6  | 0.08   | 1  | 0.08   | 1  |
| Hermit Thrush          | 0.58    | 12 | 0.75    | 29 | 0.75    | 13 | 0.36    | 5  | 1.00    | 11 | 1.00    | 24 | 1.00   | 30 | 0.50   | 20 |
| American Robin         | 0.17    | 3  | 0.33    | 5  |         |    |         |    | 0.25    | 4  |         |    | 0.08   | 1  |        |    |
| American Pipit         |         |    |         |    |         |    |         |    |         |    |         |    |        |    | 0.50   | 14 |
| Northern Shrike        |         |    |         |    |         |    |         |    | 0.13    | 2  |         |    |        |    |        |    |
| Orange-crowned Warbler | 0.83    | 19 | 0.67    | 17 | 0.92    | 16 | 0.64    | 9  | 0.88    | 12 | 0.33    | 6  | 0.75   | 14 | 0.17   | 2  |
| Yellow Warbler         | 0.92    | 19 | 0.17    | 4  | 0.50    | 10 | 0.55    | 7  | 0.50    | 6  | 0.25    | 4  | 0.75   | 12 | 0.17   | 3  |
| Wilson's Warbler       | 0.92    | 19 | 1.00    | 45 | 0.92    | 22 | 0.91    | 16 | 1.00    | 11 | 1.00    | 22 | 1.00   | 29 | 0.33   | 9  |
| American Tree Sparrow  | 0.17    | 2  |         |    | 0.08    | 1  | 0.09    | 1  | 0.63    | 9  |         |    | 0.33   | 5  |        |    |
| Savannah Sparrow       | 0.83    | 30 | 0.75    | 21 | 1.00    | 23 | 0.64    | 12 | 1.00    | 12 | 0.75    | 19 | 0.92   | 16 | 0.42   | 8  |
| Fox Sparrow            | 0.08    | 1  | 0.25    | 5  | 0.33    | 4  | 0.73    | 12 | 0.13    |    | 0.33    | 4  | 0.50   | 9  | 0.17   | 3  |
| Golden-crowned Sparrow | 0.50    | 12 | 1.00    | 34 | 0.75    | 19 | 0.91    | 15 | 1.00    | 17 | 1.00    | 30 | 1.00   | 31 | 0.67   | 18 |
| Lapland Longspur       |         |    | 0.50    | 15 |         |    |         |    |         |    | 0.17    | 3  |        |    |        |    |
| Snow Bunting           |         |    |         |    |         |    |         |    |         |    |         |    |        |    | 0.25   | 2  |
| Common Redpoll         | 0.42    | 11 | 0.67    | 17 | 0.83    | 36 | 0.45    | 6  | 0.63    | 10 | 0.75    | 15 | 0.83   | 13 | 0.17   | 3  |
| Unknown Bird           |         |    |         |    |         |    |         |    |         |    |         |    | 0.17   | 2  |        |    |
| Number of points       | 12      |    | 12      |    | 12      |    | 11      |    | 8       |    | 12      |    | 12     |    | 12     |    |

\*n = number of individual birds encountered on the route.

Table 7. Vegetation data collected during July 1996 from mist net sites at Ruth River, Becharof National Wildlife Refuge, Alaska. Values are expressed as means, while canopy density and woody vegetation height have the range printed above the mean.

| Net      | Canopy density    | No. Woody Stems | Woody Veg. Height     | Vascular Cover Ht. | 3 dominant vascular taxa                                      | Habitat type [Kessel 1979]                   |
|----------|-------------------|-----------------|-----------------------|--------------------|---|--|
| 1        | 40 to 80%<br>63%  | 9.8             | 1.0 to 4.0 m<br>2.0 m | 0.9 m              | Graminae, Epilobium augustifolium,<br>Equisetum arvense       | Medium Shrub Thicket                         |
| 2        | 50 to 75%<br>59%  | 4.8             | 2.0 to 5.0 m<br>4.0 m | 1.0 m              | Graminae, Sanguisorba stipulata,<br>Dryopteris dilata         | Tall Shrub Thicket                           |
| 3        | 45 to 85%<br>70%  | 7.5             | 1.5 to 3.0 m<br>2.5 m | 1.0 m              | Graminae, Sanguisorba stipulata<br>Epilobium augustifolium    | Tall Shrub Thicket                           |
| 4        | 0 to 30%<br>8%    | 1.0             | 1.0 to 2.0 m<br>0.8 m | 0.9 m              | Graminae, Achillea borealis,<br>Equisetum arvense             | Grass Meadow                                 |
| 5        | 0 to 95%<br>44%   | 3.3             | 0.3 to 2.3 m<br>1.0 m | 0.3 m              | Equisetum arvense, graminae<br>Achillea borealis              | Low Shrub Thicket                            |
| 6        | 0 to 15%<br>4%    | 1.3             | 0.1 to 0.5m<br>0.1 m  | 0.4 m              | Graminae, Cyperacea,<br>Achillea borealis                     | Grass Meadow                                 |
| 7        | 10 to 50%<br>30%  | 2.0             | 0.8 to 1.4 m<br>4.3 m | 0.6 m              | Graminae, Geranium erianthum,<br>Achillea borealis            | edge - Grass Meadow/<br>Tall Shrub Thicket   |
| 8        | 40 to 100%<br>68% | 2.3             | 1.2 to 1.5 m<br>1.6 m | 0.5 m              | Graminae, Epilobium augustifolium,<br>Aconitum delphinifolium | Medium Shrub Thicket                         |
| 9        | 40 to 70%<br>48%  | 2.3             | 1.0 to 3.0 m<br>1.7 m | 0.8 m              | Graminae, Equisetum arvense                                   | edge - Grass Meadow/<br>Medium Shrub Thicket |
| 10       | 10 to 80%<br>53%  | 2.5             | 0.8 to 2.0 m<br>1.5 m | 0.7 m              | Graminae, Equisetum arvense,<br>Dryopteris dilata             | Medium Shrub Thicket                         |
| 11       | 80 to 95%<br>90%  | 5.3             | 1.0 to 2.2 m<br>5.4 m | 0.7 m              | Graminae, Dryopteris dilata,<br>Achillea borealis             | Tall Shrub Thicket                           |
| 12       | 20 to 95%<br>59%  | 1.0             | 1.3 to 2.0 m<br>1.6 m | 0.8 m              | Graminae, Dryopteris dilata<br>Equisetum arvense              | Medium Shrub Thicket                         |
| All Nets | 0 to 100%<br>49%  | 3.6             | 0.1 to 5.0 m<br>2.2 m | 0.7 m              | Graminae, Equisetum arvense,<br>Epilobium augustifolium       |  |



Table 8. Vegetation data collected during September 1996 from mist net sites at Bible Camp, Becharof National Wildlife Refuge, Alaska. Values are expressed as means, while woody vegetation height has the range printed above the mean.

| Net      | Canopy density | No. Woody stems | Woody Veg. Height     | Vascular Cover Ht. | 3 dominant vascular taxa                            | Habitat type [Kessel 1979]                      |
|----------|----------------|-----------------|-----------------------|--------------------|---|---|
| 1        | -              | 0.8             | 0.5 to 2.4 m<br>1.4 m | 0.4 m              | Graminae, Empetrum nigrum,<br>Vaccinium uliginosum  | Dwarf Shrub Meadow                              |
| 2        | -              | 1.5             | 0.5 to 1.8 m<br>0.5 m | 0.6 m              | Graminae, Achillea borealis,<br>Empetrum nigrum     | Dwarf Shrub Meadow                              |
| 3        | -              | 1.0             | 0.7 to 1.5 m<br>1.1 m | 0.5 m              | Empetrum nigrum, Graminae                           | Dwarf Shrub Meadow                              |
| 4        | -              | 2.0             | 0.1 to 2.0 m<br>1.3 m | 0.6 m              | Graminae, Empetrum nigrum                           | Dwarf Shrub Meadow                              |
| 5        | -              | 2.0             | 1.7 to 3.0 m<br>2.3 m | 0.7 m              | Graminae, Empetrum nigrum                           | Medium Shrub Thicket                            |
| 6        | -              | 4.0             | 1.3 to 2.3 m<br>1.9 m | 0.4 m              | Graminae  | Medium Shrub Thicket                            |
| 7        | -              | 2.0             | 1.0 to 2.5 m<br>1.9 m | 0.6 m              | Graminae, Empetrum nigrum                           | Medium Shrub Thicket                            |
| 8        | -              | 0.3             | 2.4 m<br>2.4 m        | 0.6 m              | Graminae  | Medium Shrub Thicket                            |
| 9        | -              | 0.3             | 1.0 m<br>1.0 m        | 0.3 m              | Graminae, Empetrum nigrum,<br>Vaccinium vitis-idaea | Dwarf Shrub Meadow                              |
| 10       | -              | 1.5             | 0.8 to 2.3 m<br>2.0 m | 0.5 m              | Graminae  | edge-Dwarf Shrub Meadow<br>Medium Shrub Thicket |
| All Nets | -              | 1.5             | 0.1 to 3.0 m<br>1.6 m | 0.5 m              | Graminae, Empetrum nigrum                           |   |

Ruth River site was observed qualitatively to be closest to the Cabin Island site. The 1995 mainland site was also similar, with perhaps more willows instead of alders away from the lakeshore, and more grass meadow.

Appendix I is a list of 131 vascular plant species collected or observed at Becharof Lake during 1995 and 1996. During 1996, 34 new species were added to the inventory, including 5 new families (Aspidaceae, Haloragaceae, Lentibulariaceae, Orchidaceae and Portulacaceae). Also, 32 species observed or collected during 1995 were not found during 1996. Since plant collection was largely incidental during both years, species lists should only be classified as baseline. Families missing at Ruth River, while all relatively common at the other Island Arm sites, were Araliaceae, Iridaceae, Myricaceae and Valerianaceae. Another obvious difference between Ruth River and the other Island Arm sites was the species composition of grasses and sedges (family Cyperaceae).

#### Incidental Avian Sightings

Eighty-eight avian species were documented at or around Becharof Lake during 1996 (Appendix II). Observations were collected from a wide variety of habitats, from alpine tundra areas to dense shrubbery to the Pacific Coast. Based on these observations, 19 species were confirmed as breeding in the area, with 21 probable breeders, 17 possible breeders and 28 nonbreeders.

Miscellaneous observations also indicated that larger landbird species may be under-represented in mist net captures. Specifically, northern shrikes and American robins (*Turdus migratorius*) were consistently observed at Bible Camp in greater numbers proportionately than captured. On several occasions staff observed flocks of robins hitting a net and most of them immediately bouncing out. Our mist nets may select against larger birds, which rely on the bags rather than mesh to tangle them (Moore 1996). In order to minimize differences in capture rates, nets should be set with their trammels closer together than may seem necessary. Decreasing the capture area a little to do this should not significantly change catch rates, as long as the bottom trammel is still close to the ground. While not quantified, few captures have been observed at Alaska Peninsula stations in the top trammel of a net.

A few noteworthy sightings were recorded at Bible Camp. Emperor geese (*Chen canagica*) were observed on 9, 10 and 11 September, with a high count of 10. A gyrfalcon (*Falco rusticolus*) was commonly sighted in the area, with a pair observed on 6 and 7 August.

### **DISCUSSION**

#### Landbird Abundance and Breeding Status

Landbird abundance and breeding status was documented at Ruth River through the combined use of mist netting, point counts and incidental observations. As in 1995, balancing the time spent between off-road point counts and mist netting proved a challenge, especially given limited days of good working weather.

Point counts are likely only useful for presence/absence determinations, especially in the net array where points are close together. An experienced observer can obtain a broad qualitative sense of relative abundance, but several problems are associated with varying the annual variation of observers. For example, the 11 hermit thrushes recorded in the 7 July net-array point count probably represented a much smaller real number of individuals. Only 4 adult hermit thrushes were captured during the entire

breeding season, and on most days only 1 or 2 individuals were observed within the net array. Because of the proximity of the census points, it is possible that repeated individuals were not distinguished.

Mist netting and banding can provide estimates of relative abundance, as well as allowing identification of in-hand breeding characteristics and documentation of less common species with less occasion for identification error. However, these methods provide information about only a very small geographic area and are probably most useful for longer-term studies with the goal of providing productivity and survivorship estimates. Inherent variability in net placement precludes all but the broadest comparisons between sites. For example, the authors have observed that merely turning a net 45 degrees can markedly affect capture success. Due to the wider geographical scope of point counts and because of plans to move the breeding site annually, the authors recommend that point counts be given priority in future ecosystem work.

### Habitat Use

New vegetation survey methodology finally allowed us to quantify habitat around each net lane. One problem with the system noted at Bible Camp was that 3 of the 1-m squares at a given net in medium shrub thicket often had no woody stems originating in their areas. Since canopy density was not collected at that site, habitat type was not immediately evident from the data sheets. Number of woody stems should probably include those crossing through the area as well as those originating within.

Using Kessel's (1979) avian habitat classification system allows broad comparisons with other sites on the peninsula, especially during the breeding season. The most obvious difference between Becharof Lake breeding sites was this year's high capture rate of Savannah sparrows. Given the similar habitats between Ruth River and the 1995 Cabin Island sites, the high Savannah sparrow numbers at Ruth River were surprising. Otherwise, relative abundances were comparable between sites, with yellow warblers and Wilson's warblers making up the highest percentage of captures.

Moving the site mid-summer prevented the ability to compare habitat use between the breeding season and fall migration. During migration, geographic features may be more important than habitat for bird movements (Moore 1996, Dewhurst et al. 1996). However, the higher capture rates observed of tree sparrows and Savannah sparrows at Bible Camp were somewhat predictable because of the large open areas.

Differences in habitat use for some bird species may be more evident with closer attention to shrub composition. Efforts should be made to key out alders and willows to species at all mist net sites.

### Migration Phenology

Phenology during fall migration appeared relatively consistent with other banding sites on the Alaska Peninsula. However, beginning migration banding as late as 6 August possibly caused us to miss some aspects of fall migration. Because the highest capture rates of all migrant types were recorded on the first days of banding (one late spike occurred on 23 August), peak migration may have been missed. To document the beginning of fall migration, a banding operation on the Alaska Peninsula should be established by mid-July (Moore 1996). Also, early migrants such as tree swallows, bank swallows (*Riparia riparia*) and alder flycatchers may have been under-represented or missed, as described by Moore (1996). According to BPIF (Fadley et al. 1995), the essential window for neotropical migrants is 1 August-20 September, with an optimal seasonal period of 15 July-7 October. If breeding season efforts were

focused on point counts, the conflict with migration banding would be eliminated. Point counts are generally not conducted after mid-July, which would allow adequate time to set up a banding operation at a different site.

Another factor influencing efforts during the first half of migration banding was capture rates which were so high that the complete net array could not be operated. While coverage was kept as consistent as possible by alternating nets used, likely some variability was still introduced. Staff should be increased during August to allow all nets to be operated.

The BPIF Working Group (Fadley et al. 1995) recommended that new migration stations should be run for at least 2 years, and ideally would have a long term commitment of >10 years. Because of high bird numbers and low expense required to operate the station, Bible Camp particularly lends itself to long term study.

#### Other Migratory Bird Species

Incidental observations allowed some documentation of other bird species utilizing Becharof Lake area. Unfortunately, problems with the outboard motor at Ruth River made seabird colony surveys impossible. Previous surveys have established common use of the area by breeding colonies of arctic terns (*Sterna paradisaea*), glaucous-winged gulls (*Larus glaucescens*), mew gulls (*Larus canus*) and double-crested cormorants (*Phalacrocorax auritus*) (Dewhurst et al. 1996). These colonies should be systematically mapped annually, using aerial reconnaissance to initially survey larger areas.

#### **RECOMMENDATIONS**

1. Bible Camp is recommended for use as a long term fall migration banding station. Fall migration banding would ideally begin before 1 August, with staff increased to at least 6 during August to allow all nets to be operated.
2. In view of plans to move the breeding season site annually, consideration should be given to de-emphasis of banding during the breeding season, and concentrating efforts on point counts. This would also allow the staff to be moved to Bible Camp by mid or late July.
3. Efforts should be made to systematically map the inland seabird colonies of Becharof Lake annually.
4. Efforts should be made to key out alders, willows and grasses to species at all mist net sites.
5. A long term plan should be developed in 1997 for annual locations of the Becharof Lake Ecosystem study area. Targeted sites should take into account both logistical and biological considerations (Appendix III).

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## **APPENDICES**



Appendix I. Vascular plants collected or observed at Becharof Lake, Alaska Peninsula, June-September 1995 and 1996. Identification and nomenclature is based on Hulten (1986). IA = Island Arm cabin, RR = Ruth River, BI = Bible Camp.

#### ARALIACEAE

Echinopanax horridum, Devil's Club, --IA

#### ASPIDIACEAE

Gymnocarpium dryopteris, Oak Fern, --RR

#### BETULACEAE (Birch Family)

Alnus crispa, Sitka Alder, --IA,RR,BI

Betula nana, Dwarf Birch, --RR

#### BORAGENACEAE

Eritrichium chamissonis, Arctic Forget-me-not, --IA,RR,BI

#### CAMPANULACEAE

Campanula lasiocarpa, Mountain Harebell, --IA,RR,BI

#### CAPRIFOLIACEAE

Sambucus racemosa, Elderberry, --IA,RR

#### CARYOPHYLLACEAE (Pink Family)

Cerastium arvense, Mouse-eared chickweed, --IA,RR

Cerastium baeringianum, Bering chickweed, --RR

Minuartia arctica, --IA

Minuartia macrocarpa, --RR

Moehringia lateriflora, --RR

Silene acaulis, Moss Campion/Cushion Pink, --IA,RR,BI

Stellaria laeta, --RR

#### COMPOSITAE (ASTERACEAE) (Composite Family)

Achillea borealis, Yarrow, --IA,RR,BI

Antennaria monocephala, Pussytoes, --IA,RR

Arnica frigida, Frigid Arnica, --RR

Arnica lessingii subsp. lessingii, --IA

Artemisia arctica subsp. arctica, --RR

Artemisia globularia, Globular Wormwood, --IA

Artemisia Tilesii, Wormwood, --RR

Aster sibiricus, --RR

Chrysanthemum arcticum, --BI

Erigeron peregrinus, Coastal Fleabane, --IA,RR

Petasites frigidus, Arctic Sweet Coltsfoot, --IA,RR,BI

Senecio pseudo-Arnica, Seabeach Senecio, --IA,RR,BI

Senecio resedifolius, --IA,RR

Solidago multiradiata, Northern Goldenrod, --IA

#### CORNACEAE (Dogwood Family)

Cornus canadensis, Bunchberry/Canadian Dwarf Cornel/Dwarf Dogwood, --IA

Cornus suecica, Swedish Cornel/Dwarf Dogwood, --IA,RR

#### CRASSULACEAE (Stonecrop Family)

Sedum rosea subsp. integrifolium, Roseroot, --IA,RR,BI

CRUCIFERAE (Mustard Family)

Arabis lyrata subsp. kamchatica, --IA

Arabis lyrata subsp. lyrata, --RR

Barbarea orthoceras, Wintercress, --IA,RR

CYPERACEAE (Sedge Family)

Carex Lyngbyaei, Lyngby Sedge, --RR

Eriophorum angustifolium subsp. subarcticum, Tall Cottongrass, --IA

Eriophorum Scheuchzeri, White Cottongrass --IA

DIAPENSIACEAE

Diapensia lapponica, Lapland Diapensia, --RR

EMPETRACEAE (Crowberry Family)

Empetrum nigrum, Crowberry, --IA,RR,BI

EQUISETACEAE (Horsetail Family)

Equisetum arvense, Coastal Horsetail, --IA,RR

ERICACEAE (Heath Family)

Andromeda polifolia, Bog Rosemary, --IA,RR

Arctostaphylos uva-ursi, Bearberry, --IA

Cassiope lycopodioides, Alaska Cassiope, --IA

Ledum palustre subsp. decumbens, Labrador Tea, --IA,RR,BI

Loiseleuria procumbens, Alpine Azalea, --IA

Oxycoccus microcarpus, Bog Cranberry, --IA

Rhododendron camtschaticum, Kamchatka Rhododendron, --IA,RR

Vaccinium uliginosum subsp. microphyllum, Bog Blueberry, --IA,RR

Vaccinium vitis-idaea, Lowbush Cranberry/Lingonberry, --IA

GENTIANACEAE

Gentiana algida, --RR,BI

Menyanthes trifoliata, Bog Bean, --IA

Swertia perennis, Star Gentian, --IA,RR

GERANIACEAE (Geranium Family)

Geranium erianthum, Cranesbill, --IA,RR

GRAMINEAE (Grass Family)

Alopecurus alpinus subsp. alpinus, Mountain Foxtail, --RR

Calamagrostis canadensis subsp. langsдорffi, Bluejoint, --IA

Elymus arenarius subsp. mollis, Lyme grass, --IA

Festuca altaia, --IA

Festuca rubra, Red Fescue, --IA

Poa arctica, Arctic Bluegrass, --IA

HALORAGACEAE

Hippurus sp. Maretail, --RR

IRIDACEAE (Iris Family)

Iris setosa subsp. setosa, Wild Flag, --IA

LEGUMINOSAE (Fabaceae) (Pea Family)

Lathyrus maritimus subsp. pubescens, Beach Pea, --IA,RR  
Lupinus nootkatensis, Nootka Lupine, --IA,RR,BI  
Oxytropis campestris, Field Oxytrope, --IA  
Oxytropis nigrescens, Blackish Oxytrope, --RR

LENTIBULARIACEAE (Bladderwort Family)

Pinguicula vulgaris, Butterwort, --RR

LILIACEAE (Lily Family)

Fritillaria camschatcensis, Chocolate Lily, --IA,RR  
Lloydia serotina, Alp Lily, --RR  
Streptopus amplexifolius, Wild Cucumber, --IA  
Tofieldia coccinea, --RR

MYRICACEAE (Wax Myrtle Family)

Myrica gale, Sweet Gale, --IA

ONAGRACEAE (Evening Primrose Family)

Epilobium augustifolium, Fireweed, --IA,RR,BI  
Epilobium behringianum, Bering Willow-herb, --RR  
Epilobium latifolium, Dwarf Fireweed/River Beauty, --IA,RR,BI

ORCHIDACEAE (Orchid Family)

Coeloglossum viride subsp. bracteatum, --RR

PAPAVERACEAE (Poppy Family)

Papavar alaskanum, Alaska Poppy, --IA,RR  
Papavar alboroseum, IA

PLUMBAGINACEAE (Leadwort Family)

Armeria maritima subsp. arctica, Thrift, --IA,RR,BI

POLEMONIACEAE (Polemonium Family)

Polemonium acutiflorum, Tall Jacob's Ladder, --IA,RR  
Polemonium pulcherrimum, Pretty Jacob's Ladder, --IA

POLYGONACEAE (Buckwheat Family)

Polygonum caurianum, --RR  
Polygonum pennsylvanicum, --RR  
Polygonum vivparum, Alpine Meadow Bistort, --IA  
Rumex arcticus, Arctic Dock, --IA,RR,BI

PORTULACACEAE (Purslane Family)

Claytonia chamissoi, Toad Hilly--RR  
Claytonia sarmentosa, Spring Beauty--RR

PRIMULACEAE (Primrose Family)

Androsace chamaejasme subsp. Lehmanniana, Rock Jasmine, --IA,RR  
Primula cuneifolia subsp. saxifragifolia, Pixie eyes, --RR  
Trientalis europaea subsp. arctica, Starflower, --IA,RR

PYROLACEAE (Wintergreen Family)

Pyrola asarifolia, Pink Pyrola/Wintergreen, --IA,RR

**RANUNCULACEAE (Crowfoot Family)**

Aconitum delphinifolium subsp. chamissonianum, Monkshood, --IA  
Aconitum delphinifolium subsp. delphinifolium, Monkshood, --RR  
Caltha palustris, Marsh Marigold, --IA  
Ranunculus reptans, --RR  
Thalictrum sparsiflorum, Few Flower Meadowrue, --IA

**ROSACEAE (Rose Family)**

Dryas octopetala subsp. octopetala, Mountain Avens, --IA,RR  
Geum macrophyllum, subsp. macrophyllum, Large-leaf Avens, --RR  
Geum Rossii, Yellow Avens, --IA,RR  
Luetkea pectinata, Alpine sperea, --RR  
Potentilla Egedii subsp. Egedii, --IA  
Potentilla palustris, Marsh Fivefingers, --IA,RR  
Rubus arcticus subsp. stellatus, Nagoonberry, --IA,RR,BI  
Rubus chamaemorus, Cloudberry, --IA,RR  
Sanguisorba stipulata, Burnet, --IA,RR  
Spiraea Beauverdiana, Alaska Spiraea, --IA,RR

**RUBIACEAE (Madder Family)**

Galium boreale, Northern Bedstraw, Alaskan Baby's Breath, --IA

**SALICACEAE (Willow Family)**

Salix arctica subsp. crassijulis, Arctic Willow, --RR  
Salix glauca subsp. acutifolia, Grayleaf Willow, --IA  
Salix phlebophylla, --RR

**SAXIFRAGACEAE (Saxifrage Family)**

Chrysoplenium Wrightii, Northern Water Carpet, --IA  
Heuchera glabra, Alpine Heuchera, --IA,RR  
Parnassia palustris subsp. neogaea, Northern Grass-of-Parnassus, --IA  
Saxifraga bronchialis subsp. Funstonii, Spotted Saxifrage, --IA,RR  
Saxifraga hirculus, Bog Saxifrage, --IA,RR  
Saxifraga nivalis, Snow Saxifrage, --RR  
Saxifraga oppositifolia subsp. oppositifolia,  
Purple Mountain Saxifrage, --RR  
Saxifraga punctata, subsp. Nelsoniana, Cordate-leaved Saxifrage, --RR  
Saxifraga serpyllifolia, Thyme-leaved Saxifrage, --IA,RR  
Saxifraga unalaschcensis, Unalaska Saxifrage, --RR

**SCROPHULARIACEAE (Figwort Family)**

Lagotis glauca subsp. glauca, Weasel Snout, --IA,RR  
Mimulus guttatus, Monkey Flower, --IA,RR  
Pedicularis capitata, Capitata Lousewort, --IA,RR  
Pedicularis Kanei, Kane Lousewort, --IA  
Pedicularis Labradorica, Labrador Lousewort, --IA  
Pedicularis langsдорffii, Langsdorf Lousewort, --RR  
Pedicularis parviflora, --IA  
Pedicularis verticillata, Bumble bee Flower, --IA,RR  
Rhinanthus minor subsp. borealis, Rattlebox, --IA,RR

**UMBELLIFERAE (APIACEAE) (Parsley Family)**

Angelica lucida, Wild Celery, --IA,RR,BI  
Cicuta mackenzieana, Mackenzie (Poison) Water Hemlock, --IA  
Heracleum lanatum, Cow parsnip, --IA,RR,BI

Ligusticum scoticum, Beach Lovage, --IA

VALERIANACEAE (Valerian Family)

Valeriana capitata, Capitate Valerian, --IA

VIOLACEAE (Violet Family)

Viola Langsdorffii, Alaskan Violet, --IA,RR





Appendix II (cont.). Summary of avian observations at Becharof Lake, May-Sept 1996.

| Species                 | Date First Observed | Date Last Observed | No. Days Observed | Peak Count and Date         | Breeding Status |
|-------------------------|---------------------|--------------------|-------------------|-----------------------------|-----------------|
| Hairy Woodpecker        | 26 August           | 28 August          | 2                 | 1 each day                  | O               |
| Downy Woodpecker        | 9 Sept              | 16 Sept            | 5                 | 2 on 9 September            | O               |
| Alder Flycatcher        | 14 June             | 28 June            | 5                 | 2 on 16 June                | X               |
| Tree Swallow            | 29 May              | 5 August           | 65                | 10 on 26 June               | CY              |
| Bank Swallow            | 11 June             | 17 Sept            | 12                | 4 on 25 June                | X               |
| Black-billed Magpie     | 13 June             | 16 Sept            | 18                | 4 on 29 & 30 August         | X               |
| Common Raven            | 7 June              | 16 Sept            | 73                | 6 on 23 July                | X               |
| Black-capped Chickadee  | 3 July              | 16 Sept            | 23                | 6 on 3 July, 15 & 16 Sept   | CR              |
| American Dipper         | 22 June             | 21 July            | 7                 | 2 on 22 June, 7 & 21 July   | X               |
| Golden-crowned Kinglet  | 15 Sept             | 15 Sept            | 1                 | 1 on 15 September           | O               |
| Ruby-crowned Kinglet    | 14 Sept             | 14 Sept            | 1                 | 1 on 14 September           | O               |
| Gray-cheeked Thrush     | 10 June             | 21 July            | 22                | 17 on 16 June               | PT              |
| Swainson's Thrush       | 4 June              | 4 June             | 1                 | 1 on 4 June                 | O               |
| Hermit Thrush           | 7 June              | 16 Sept            | 43                | 40 on 17 July               | PT              |
| American Robin          | 5 June              | 15 Sept            | 70                | 20 on 17, 26 August, 8 Sept | PT              |
| Varied Thrush           | 16 Sept             | 16 Sept            | 1                 | 1 on 16 September           | O               |
| American Pipit          | 7 July              | 17 Sept            | 41                | 30 on 14 & 30 August        | PT              |
| Northern Shrike         | 2 June              | 17 Sept            | 57                | 10 on 13 August             | X               |
| Orange-crowned Warbler  | 5 June              | 7 Sept             | 47                | 50 on 14 June               | CY              |
| Yellow Warbler          | 3 June              | 7 Sept             | 56                | 26 on 16 June               | CR              |
| Wilson's Warbler        | 5 June              | 7 Sept             | 45                | 60 on 6 June                | CR              |
| American Tree Sparrow   | 14 June             | 14 Sept            | 35                | 20 on 7 September           | PT              |
| Savannah Sparrow        | 29 May              | 17 Sept            | 88                | 70 on 16 June               | CE              |
| Fox Sparrow             | 4 June              | 7 Sept             | 39                | 16 on 16 June               | PT              |
| Golden-crowned Sparrow  | 29 May              | 29 August          | 68                | 35 on 15 June               | PT              |
| White-crowned Sparrow   | 9 August            | 12 August          | 2                 | 5 on 9 August               | O               |
| Slate-colored Junco     | 13 August           | 10 Sept            | 2                 | 1 each day                  | O               |
| Lapland Longspur        | 30 May              | 13 Sept            | 16                | 12 on 15 June               | PT              |
| Snow Bunting            | 22 June             | 23 July            | 5                 | 15 on 17 July               | PT              |
| Gray-crowned Rosy Finch | 7 July              | 26 July            | 4                 | 4 on 17 July                | PT              |
| Common Redpoll          | 5 June              | 16 Sept            | 73                | 110 on 16 June              | PO              |

\*Key to Breeding Status:

O = Observed/non-breeding

X = Possible breeder

PO = Pair Observed

PC = Courtship

PT = Perm. Territory

CR = Recently Fledged Young

CO = Occupied Nest

CE = Nest w/Eggs

CY = Nest w/ Young

PA = Agitated Behavior

CN = Carrying Nesting Materials

Appendix II. Summary of avian observations at Becharof Lake, May-Sept 1996. Observations prior to 8/2/96 were at or around Ruth River; later observations were made at or around Bible Camp.

| Species                  | Date First Observed | Date Last Observed | No. Days Observed | Peak Count & Date             | Breeding Status* |
|--------------------------|---------------------|--------------------|-------------------|-------------------------------|------------------|
| Red-throated Loon        | 14 August           | 9 Sept             | 15                | 4 on 26 August                | O                |
| Common Loon              | 20 June             | 11 Sept            | 31                | 7 on 14 July                  | PC               |
| Horned Grebe             | 8 August            | 17 Sept            | 17                | 9 on 28 August                | PO               |
| Red-necked Grebe         | 20 June             | 20 June            | 1                 | 1 on 20 June                  | X                |
| Double-crested Cormorant | 31 May              | 17 Sept            | 64                | 1000 on 31 August             | CO               |
| Pelagic Cormorant        | 23 July             | 23 July            | 1                 | 5 on 23 July (Pacific coast)  | O                |
| Tundra Swan              | 29 May              | 15 Sept            | 37                | 6 on 2, 24 August             | CE               |
| White-fronted Goose      | 1 June              | 30 August          | 9                 | 30 on 14 August               | O                |
| Emperor Goose            | 9 Sept              | 11 Sept            | 3                 | 10 on 11 September            | O                |
| Canada Goose             | 15 Sept             | 15 Sept            | 1                 | 13 on 15 September            | O                |
| Green-winged Teal        | 29 May              | 23 July            | 18                | 15 on 26 June                 | CR               |
| Mallard                  | 3 June              | 18 August          | 27                | 6 on 6 & 8 June, 18 August    | CE               |
| Northern Pintail         | 2 June              | 9 Sept             | 33                | 15 on 8 June                  | CR               |
| Northern Shoveler        | 29 May              | 13 July            | 13                | 19 on 8 June                  | PO               |
| American Wigeon          | 2 June              | 9 Sept             | 26                | 18 on 7 June                  | PO               |
| Greater Scaup            | 1 June              | 9 Sept             | 50                | 50 on 20 June                 | CR               |
| Harlequin Duck           | 22 June             | 9 Sept             | 7                 | 30 on 23 July (Pacific coast) | CR               |
| Black Scoter             | 29 May              | 9 Sept             | 41                | 10 on 20 June                 | CY               |
| White-winged Scoter      | 11 June             | 30 August          | 5                 | 4 on 11 June                  | X                |
| Common Goldeneye         | 20 June             | 19 July            | 4                 | 9 on 1 July                   | PO               |
| Barrow's Goldeneye       | 12 June             | 20 June            | 5                 | 6 on 12 June                  | X                |
| Red-breasted Merganser   | 1 June              | 16 Sept            | 65                | 200 on 26 June                | CY               |
| Osprey                   | 30 May              | 30 May             | 1                 | 1 on 30 May                   | O                |
| Bald Eagle               | 29 May              | 7 Sept             | 53                | 3 on 3,20,21,29 June, 29 July | PO               |
| Northern Harrier         | 20 June             | 17 Sept            | 28                | 3 on 3 and 9 September        | X                |
| Rough-legged Hawk        | 2 June              | 16 Sept            | 10                | 2 on 7,28 August & 7 Sept     | X                |
| Merlin                   | 15 August           | 31 August          | 6                 | 2 on 24 August                | O                |
| Peregrine Falcon         | 8 June              | 7 Sept             | 4                 | 1 each day                    | O                |
| Gyr Falcon               | 3 August            | 17 Sept            | 12                | 2 on 6 & 7 August             | O                |
| Willow Ptarmigan         | 1 June              | 16 Sept            | 32                | 30 on 28 August               | CY               |
| Rock Ptarmigan           | 22 June             | 26 July            | 5                 | 12 on 26 July                 | CR               |
| Sandhill Crane           | 30 May              | 16 Sept            | 31                | 28 on 1 September             | X                |
| Black-bellied Plover     | 7 July              | 16 Sept            | 19                | 6 on 27 & 29 August           | X                |
| Lesser Golden-Plover     | 6 June              | 9 Sept             | 12                | 28 on 8 September             | PA               |
| Semipalmated Plover      | 29 May              | 8 Sept             | 66                | 20 on 26 July                 | CR               |
| Greater Yellowlegs       | 5 June              | 16 Sept            | 71                | 18 on 1 July                  | CR               |
| Wandering Tattler        | 1 July              | 20 August          | 4                 | 4 on 23 July (Pacific coast)  | O                |
| Spotted Sandpiper        | 26 June             | 16 Sept            | 4                 | 1 each day                    | O                |
| Whimbrel                 | 10 August           | 29 August          | 13                | 15 on 12 & 13 August          | O                |
| Black Turnstone          | 21 July             | 10 Sept            | 14                | 22 on 6 August                | X                |
| Western Sandpiper        | 12 July             | 28 August          | 6                 | 90 on 12 July                 | O                |
| Least Sandpiper          | 5 June              | 31 August          | 49                | 50 on 1 July                  | PA               |
| Rock Sandpiper           | 12 June             | 8 August           | 9                 | 4 on 3 July                   | PA               |
| Short-billed Dowitcher   | 7 June              | 23 July            | 7                 | 13 on 20 June                 | X                |
| Common Snipe             | 28 May              | 30 July            | 46                | 5 on 28 June                  | PC               |
| Red-necked Phalarope     | 12 June             | 25 June            | 6                 | 2 on 17 June                  | O                |
| Parasitic Jaeger         | 28 June             | 7 Sept             | 12                | 4 on 13 July                  | X                |
| Long-tailed Jaeger       | 16 July             | 16 July            | 1                 | 1 on 16 July                  | O                |
| Bonaparte's Gull         | 7 June              | 2 August           | 13                | 4 on 20 July                  | O                |
| Mew Gull                 | 5 June              | 16 Sept            | 59                | 40 on 19 & 23 July            | CO               |
| Glaucous-winged Gull     | 8 June              | 17 Sept            | 96                | 150 on 13 & 17 August         | CE               |
| Black-legged Kittiwake   | 14 June             | 14 August          | 3                 | 50 on 14 June                 | O                |
| Sabine's Gull            | 25 July             | 25 July            | 1                 | 1 on 25 July                  | O                |
| Arctic Tern              | 20 June             | 27 August          | 29                | 6 on 8 July                   | PA               |
| Pigeon Guillemot         | 23 July             | 23 July            | 1                 | 1 on 23 July (Pacific coast)  | O                |
| Short-eared Owl          | 1 June              | 12 Sept            | 22                | 4 on 14 & 17 August           | X                |
| Belted Kingfisher        | 31 July             | 31 July            | 1                 | 1 on 31 July                  | O                |

Appendix III. Logistical and biological considerations for possible avian study sites in the Becharof Lake Ecosystem.

| Site Name                | Type Aircraft Access | General Habitat Type           | Small Boat Access? | Bear Density Observed | Brush For Mist Nets? | Other Considerations                               |
|--------------------------|----------------------|--------------------------------|--------------------|-----------------------|----------------------|--|
| Mouth of Featherly Creek | Float or Wheel       | Medium Shrub/Tundra            | Yes                | High                  | Fair                 | High Winds Common<br>High Fish Guide Activity      |
| Gas Rocks                | Float or Wheel       | Medium Shrub/Tundra            | Yes                | High                  | Good                 | Geothermal Activity<br>Seabird Colonies Nearby     |
| Shoemaker Upper Airstrip | Wheel                | Cottonwoods<br>Medium Shrub    | No                 | Unknown               | Good                 | Private Land<br>Guided Hunter Use Aug-Oct          |
| Gertrude Creek           | Wheel or Float       | Medium Shrub/Tundra            | No                 | Medium                | Good                 | High Fish Guide Activity                           |
| Severson Peninsula       | Float                | Medium-Tall Shrub Thicket      | Yes                | Unknown               | Good                 | Subsistence Use Conflicts<br>Site exposed to winds |
| Becharof Lake Outlet     | Float or Wheel       | Sparse Shrubs<br>Grassy Tundra | Yes                | Medium                | Poor                 | Subsistence Use Conflicts                          |
| Cabin Creek              | Float                | Medium-Tall Shrub Thicket      | Yes                | Medium                | Good                 | High Fish Guide Activity<br>Higher rainfall site   |
| Base of Whale Mountain   | Float                | Tundra/<br>Medium Shrubs       | Yes                | Low                   | Poor                 | Site very exposed to wind                          |
| Kejulik Floatplane Lake  | Float                | Tundra/<br>Medium Shrubs       | No                 | Unknown               | Fair                 | Limited foot access for<br>Point Counts            |