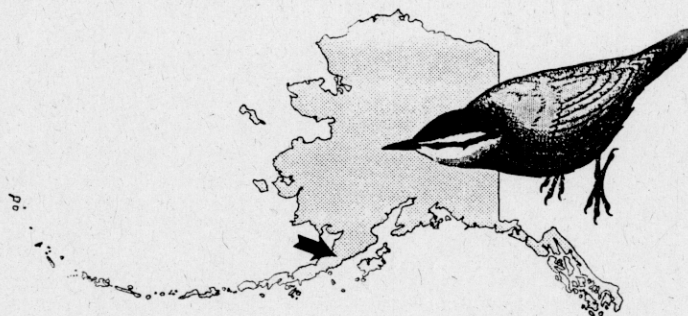


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**A BASELINE ECOSYSTEM STUDY:**

**AVIAN BREEDING AND MIGRATION  
AT THE ISLAND ARM PORTION OF BECHAROF LAKE,  
BECHAROF NATIONAL WILDLIFE REFUGE, ALASKA  
JUNE-SEPTEMBER 1995**



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**Key Words:** Alaska Peninsula, Becharof Lake, bird banding, chickadees, Island Arm, migration, mist-nets, neotropical migratory birds, passerines, point counts, redpolls, sparrows, swallows, thrushes, warblers

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## ABSTRACT

A baseline avian inventory was initiated during June-September 1995 in the Island Arm portion of Becharof Lake with an emphasis on landbirds. Two seabird, 2 shorebird and 25 landbird species were captured, with 1752 individuals banded, primarily using mist nets. Warblers were the primary landbirds captured, with yellow warblers (*Dendroica petechia*, 469 banded) being the most common overall, followed closely by Wilson's warblers (*Dendroica pusilla*, 455 banded), and orange-crowned warblers (*Vermivora celata*, 197 banded). The capture of a western wood-pewee (*Contopus sordidulus*) on 23 August yielded the first record of this species for southwestern Alaska. To supplement banding efforts, 3 off-road point count transects were established as well as 8 island point count sites. Additional avian sightings yielded records of 82 species using the area.

## INTRODUCTION

Very little work has been done on migratory landbirds on the Alaska Peninsula. In the early 1970's, Bailey (1974) conducted constant effort mist netting and winter songbird banding at Cold Bay, which provides the only historical data. Small-scale mist netting operations were conducted at the King Salmon office compound during the summers of 1984-1986 [U.S. Fish & Wildlife Service (FWS) files, King Salmon, Alas.] at Ugashik Narrows during 1988 (Savage et al. 1988). In 1994, constant effort mist netting during breeding and fall migration was initiated at Mother Goose lake with plans to make this a long term monitoring station. No songbird work has been conducted to date in the Becharof Lake Ecosystem. Similarly, no work on avian predators or migration phenology has been conducted around Becharof Lake.

The establishment of landbird studies is an effort to identify and understand factors affecting their populations. Long-term monitoring efforts have shown that many of our migrant landbirds have experienced a steady decline over the last 25 years (Robbins et al. 1989, Sauer and Droege 1989, Hagan et al. 1989). In Alaska, accessibility has prevented monitoring of landbird populations over most of the state. The Mother Goose Lake Field Station (1994 - current) has been established as a long term monitoring site to examine avian survivorship and productivity using Monitoring Avian Productivity and Survivorship (MAPS) protocols (DeSante and Burton 1994). Similar work needs to be conducted in the Becharof Lake Ecosystem but with more emphasis on gathering baseline species abundance, distribution and habitat use data, rather than focusing on long term survivorship and productivity at a single site. Plans to move the monitoring site annually within the ecosystem, would provide a broader picture of this large and diverse area, at the sacrifice of long term survivorship information. Yet by following parallel methods as those used at Mother Goose Lake and other Alaska Peninsula avian study sites (Cold Bay, Yantarni Sound), this ecosystem data can be compared to that from these other longer term projects.

Research objectives of avian monitoring at Island Arm were to:

- 1) determine relative abundance and breeding status of landbird species using the Becharof Lake Ecosystem, targeting neotropical migrants;
- 2) document local habitat use by landbird species both during breeding and fall migration;
- 3) collect baseline information on migration phenology of landbirds using the Island Arm area; and
- 4) collect baseline data on presence and relative abundance of other migratory bird species using the Island Arm portion of Becharof Lake from June through September;

## STUDY AREA

Becharof Lake is located within the Becharof National Wildlife Refuge on the Alaska Peninsula in southwestern Alaska (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). Becharof Lake was named in 1868 by W.H. Dall for the navigator "Bocharov" of the Imperial Russian Navy, who was stationed at Kodiak in 1788 (Orth 1967).

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 the primary source of the ash... Mt. Peulik (1466 m, 4835 ft), with its last major eruption documented in 1814. However, 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 would fall under 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 is dominated by non-vasculars (lichens, mosses), grasses and ericaceous plants.

Cabin Island.-- The Cabin Island mist netting site was located on the eastern side of the island (Appendix I), along a west-facing slope and lake-level plateau. The elevation varied from 5 to 30 m (15-90 ft), with Net 1 being the highest net site. This netting array was a mosaic of willow and alder thickets, tundra (dwarf shrub meadow) and wet meadow. The tundra is characterized by crowberry (*Empetrum nigrum*), Labrador tea (*Ledum palustre*) and lowbush cranberry (*Vaccinium vitis-idaea*). Understory in and around the shrub thickets consisted of grasses (Gramineae), fireweed (*Epilobium angustifolium*), Jacob's Ladder (*Polemonium* spp.), chocolate lilies (*Fritillaria camschatchensis*) and wild geranium (*Geranium erianthum*). Shrub heights ranged 1.5-3 m (5-9 ft) tall. The site was bordered by ericaceous tundra along the ridge and top of the island and lakeshore along the western edge.

Mainland Site.-- The mainland site (Appendix I) was located approximately 0.8 km (0.5 mi) NW of the Lake site. Thick, brushy tracks of taller (<5 m) willows and alders formed a shrub canopy layer along the lakeshore. The understory was characterized by devil's club (*Echinopanax horridum*), lady ferns (*Athyrium felix-femina*), various grasses, and horsetails (*Equisetum arvense*). Tall forb meadows intersperse the shrubs, as dominated by cow parsnip (*Heracleum lanatum*), wild celery (*Angelica lucida*) and fireweed (*Epilobium angustifolium*). Dwarf shrub and wet meadows also were part of the mosaic of this site. Rocky/sandy lakeshore bordered the array to the east and west.

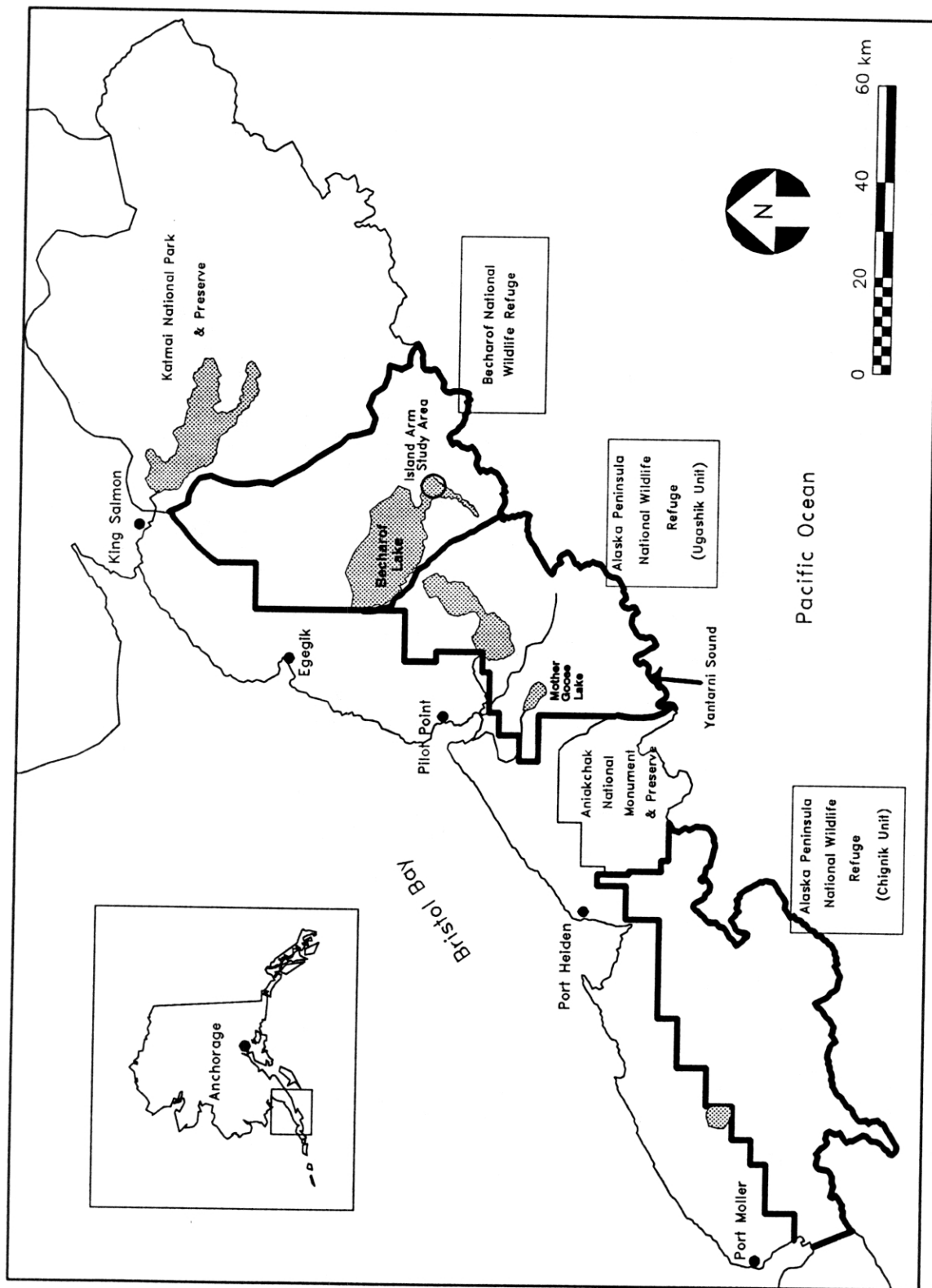


Fig. 1. Location of the Island Arm Study Area of Becharof Lake in the Alaska Peninsula/Becharof Refuge Complex.

## METHODS

### Weather

Weather data was collected daily at approximately 0800 hrs. Measurements of ceiling height, wind speed and direction, barometric pressure, current precipitation, visibility, minimum and maximum temperature over past 24 hours, and total rainfall over last 24 hours were recorded. Also, a determination was made regarding the possibility of banding at that time. Feasibility criteria followed guidelines established by Ralph et al. (1992). Banding feasibility was recorded even if banding was not scheduled for that day.

### Breeding Season Banding

Constant-effort mist netting and banding was conducted generally using the MAPS banding protocol established by DeSante and Burton (1994). One notable deviation from MAPS was in frequency of banding, which was conducted as often as 2X/week. The Cabin Island site was operated from 9 June to 2 August, with 13 banding days. The Mainland site was operated from 11 June to 22 July, with 9 banding days. Efforts were made to record captures to the nearest 30 min rather than 10 min intervals recommended by DeSante and Burton (1994). During busy times, captures were only recorded to the nearest hour. Also, 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]. All 10 nets remained in place throughout the season at the Cabin Island site, but 2 nets at the Mainland site were relocated on 21 June due to distance and brown bear (*Ursus arctos*) safety considerations. Rainy and windy conditions sometimes precluded the opening of all nets, but at least 8 were open during operation.

All captured birds were brought back to the banding site (weatherport or 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). Bird weight was typically measured on an electronic scale to the nearest 0.1 gm; however, on 8 banding days (approximately 11% of total captures) birds were weighed using a less precise Pesola scale to the nearest 0.5-1.0 gm. Young, juvenile ("local") birds were returned to the area of capture for release, while all other birds were released from the processing tents. Banding data were recorded on forms developed by the Alaska Bird Observatory and later transferred to a dBase III+ file. An inventory/schedule of the bird bands used was also sent to the Bird Banding Laboratory, Laurel, Md., on standardized National Biological Service forms.

Consistent with other banding stations in the state (Boreal Partners in Flight), special measurements were taken on Catharus thrushes (Dewhurst et al. 1995). Additional measurements were also collected on Wilson's warblers (*Wilsonia pusilla*) to obtain information on plumage-based aging and sexing criteria. Crown length and crown code (Waddington 1992) were recorded as often as possible. Also, age classifications [After Second Year (ASY) and Second Year (SY)] were made based on rectrices shape, wear (Pyle et al. 1991) and extremes in crown code (mostly ASY males). These age classifications were only made on an experimental basis. All ASY and SY birds were reported to the banding lab as After Hatching Year (AHY) birds.

### Point Counts

Point counts were conducted at breeding season mist netting sites during the equivalent of the first 3 corresponding MAPS banding periods (5-7) for the Cabin Island site and the first 2 periods at the Mainland site (DeSante and



Burton 1994). All point count methods, habitat type classifications and mapping followed MAPS guidelines established by DeSante and Burton (1994). Nine points were established for each of the 10-net arrays. Ten minute observation periods were used at each sampling point and data was recorded on standardized forms (DeSante and Burton 1994). Point counts were not generally conducted simultaneously with mist netting, due to staff limitations. Habitat data was collected for each point at both sites on the standard MAPS forms, consistent with data collected at peninsula MAPS sites in 1994 and 1995. Incidental vegetative sampling was conducted to document vascular plant species in the area, with species pressed, mounted and ultimately stored in the FWS herbarium in King Salmon.

Three off-road point counts were conducted along the east side of Island Arm (Appendix I). Each route consisted of 12 points arranged in 1-2 parallel transects. A 5-min census was conducted at each point. The distance between each point varied from approximately 300 to 450 m depending on the habitat -- open areas required longer distances to avoid recounting birds. Habitat and vegetation descriptions were made at each stop by one person while the other performed the count. Unlike the station counts, both observers alternately shared counting duties. All avian and habitat data was recorded on standardized forms developed by NBS, Anchorage, Alas. On lake islands too small to conduct transect counts (Appendix I), individual point counts of 10 min each were conducted.

#### Fall Migration Banding

Fall migration mist netting and banding was conducted at the Cabin Island site from 6 August to 19 September and operated daily as weather permitted. All netting and banding methodologies were consistent with 1994 efforts (Dewhurst et al. 1995) and those concurrently running at similar sites at Mother Goose Lake (Eskelin and Dewhurst 1996) and Yantarni Sound (Moore 1996). The same 10 net sites used during the breeding season were again employed with 2 new nets added within the array (Appendix I).

#### Avian Sightings

Miscellaneous landbird and waterbird sightings were compiled on forms created by the Refuge Complex (Dewhurst et al. 1995). All observations included date, species, quantity, habitat classification (Kessel 1979), observer, behavior, breeding status, and notes on age and sex of individuals. All information was then stored in a computerized database (dBase III+) used by FWS and the National Park Service.

#### Waterbird/Shorebird Off-Site Baseline Studies

In order to assess productivity and relative abundance of non-landbird species during the breeding season, a supplemental census and banding effort was conducted on the islands and shorelines of Island Arm. Particular emphasis was placed on gulls, terns and shorebirds. During the breeding season, frequent boat excursions were used to locate and chart waterbird colonies. Counts were made of the eggs and/or young from each colony. If opportunity allowed, chicks were caught by hand, banded, measured, and examined. During the migration period, which began in July, the focus was expanded to determine staging areas for shorebirds and ducks. Again if opportunity allowed, migrant shorebirds were caught by walking them into mist nets set along the shore. All captured birds were banded, measured, and examined. Having lower priority than the landbird project, these banding efforts were consequently sporadic in nature and in no way interfered with the operation of the standardized banding program.

## Data Analysis

For analysis purposes, bird 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.

Age composition of individual birds captured was divided into "hatching year" (HY) or young-of-the-year and "after hatching year" (AHY) which included both sub-adults and adults.

## **RESULTS**

### Weather

The total rainfall measured at Cabin Island on Becharof Lake from 9 June to 19 September was 302.5 mm (12.1 in) with measurable precipitation on 67 out of 103 days (65%). The monthly breakdown of precipitation included: June - 11 days, 24.7 mm; July 24 days, 82.3 mm; August - 17 days, 109.6 mm; and September (1-19) - 15 days, 85.9 mm.

As common on the Alaska Peninsula and further west, wind proved a constant challenge to banding operations. Mist netting was generally suspended when winds reached 15 to 20 mph, but on 19 days there was banding with winds at this speed. Closure of the nets also depended on the direction of the wind. At both mist netting sites, some nets were susceptible to wind of a particular direction, while others remained relatively calm. Since calm periods were very rare at Becharof Lake, virtually all banding was accomplished in some wind.

### Mist Netting and Banding

Constant-effort mist netting and banding was conducted on 49 days cumulative at both sites over the season. A total of 2434.5 net-hours yielded 2302 captures (included new and recaptured birds), with 1740 birds of 25 species banded (Table 1). The most common species were yellow warblers (*Dendroica petechia*, 619 captures), Wilson's warblers (*Dendroica pusilla*, 583 captures), Savannah sparrows (*Passerculus sandwichensis*, 272 captures), and orange-crowned warblers (*Vermivora celata*, 310 captures). Of the remaining species, half were represented by 5 or fewer captured birds, and only 9 species had more than 10 individuals banded. A breakdown by season follows.

Breeding Season.-- Banding was conducted on 22 days, with 1027.5 net-hours total. Fourteen species of 5 different families were captured. Total birds banded numbered 563, with 850 captures. Mean capture rates ranged from 84.2 birds/100 net hrs at Cabin Island to 91.5 birds/100 net hrs at the Mainland (Fig. 2). The highest rate (207 birds/100 net hrs, Mainland site) on 11 June was likely due to some late spring migration movement. As expected, capture rates picked up in late July with the emergence of HY birds; however, the mainland site was not operated after 22 July due to bear problems, preventing full documentation of this increase.

Productivity, as gauged by the number of HY birds captured, was low for both breeding season sites as compared to Mother Goose Lake. At the Cabin Island site, 48% captured were HY birds, while this percentage was only 32% for the

Table 1. Birds banded during mist netting operations at Island Arm, Becharof Lake, June-Sept 1995.

SPECIES	ISLAND SITE			MAINLAND SITE			MIGRATION			MISC	TOTALS			GRAND TOTAL
	AHY	HY	UNK	AHY	HY	UNK	AHY	HY	UNK		AHY	HY	UNK	
Semipalmated Plover										2				2
Black Turnstone										1				1
Mew Gull										3				3
Arctic Tern										5				5
Tree Swallow	1										1			1
Black-capped Chickadee	2	1		1	2	1		1			3	4	1	8
Red-breasted Nuthatch								2				2		2
Brown Creeper								2				2		2
Golden-crowned Kinglet								1				1		1
Ruby-crowned Kinglet								1				1		1
Gray-cheeked Thrush	2			4			3				6	3		9
Swainson's Thrush	1										1			1
Hermit Thrush *	11	7		12	7		2	39			25	53		78
American Robin	1			1			2	2			4	2		6
American Pipit								2				2		2
Northern Shrike								5				5		5
Orange-crowned Warbler *	32	32		30	16		8	79			70	127		197
Yellow Warbler *	63	53		24	3		44	282			131	338		469
Blackpoll Warbler								1				1		1
Wilson's Warbler *	23	33		36	12		14	337			73	382		455
American Tree Sparrow *	9	5		10	10		15	102			34	117		151
Savannah Sparrow *	15	26		10	9		12	167	2		37	202	2	241
Fox Sparrow *	4	2		2	4			7			6	13		19
Golden-crowned Sparrow *	8	6		3	2		4	24			15	32		47
White-crowned Sparrow							1	2			1	2		3
Slate-colored Junco								1				1		1
Lapland Longspur								7		1		7		8
Common Redpoll	12	3	1	9	2		2	4			23	9	1	33
TOTALS	184	168	1	142	67	1	104	1071	2	12	430	1306	4	1752

\* Confirmed Local Breeder

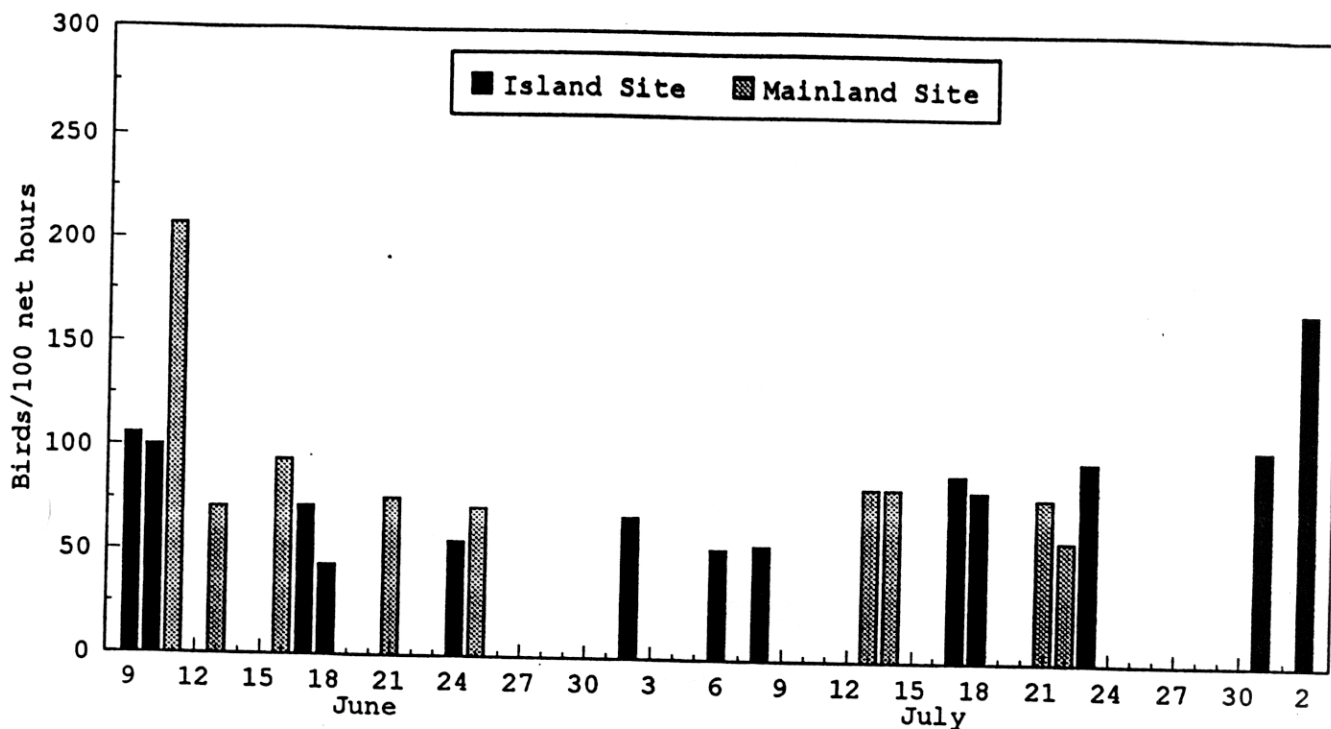


Figure 2. Capture rates of landbirds caught in mist nets during the breeding season at Island Arm, Becharof Lake, June-July 1995.

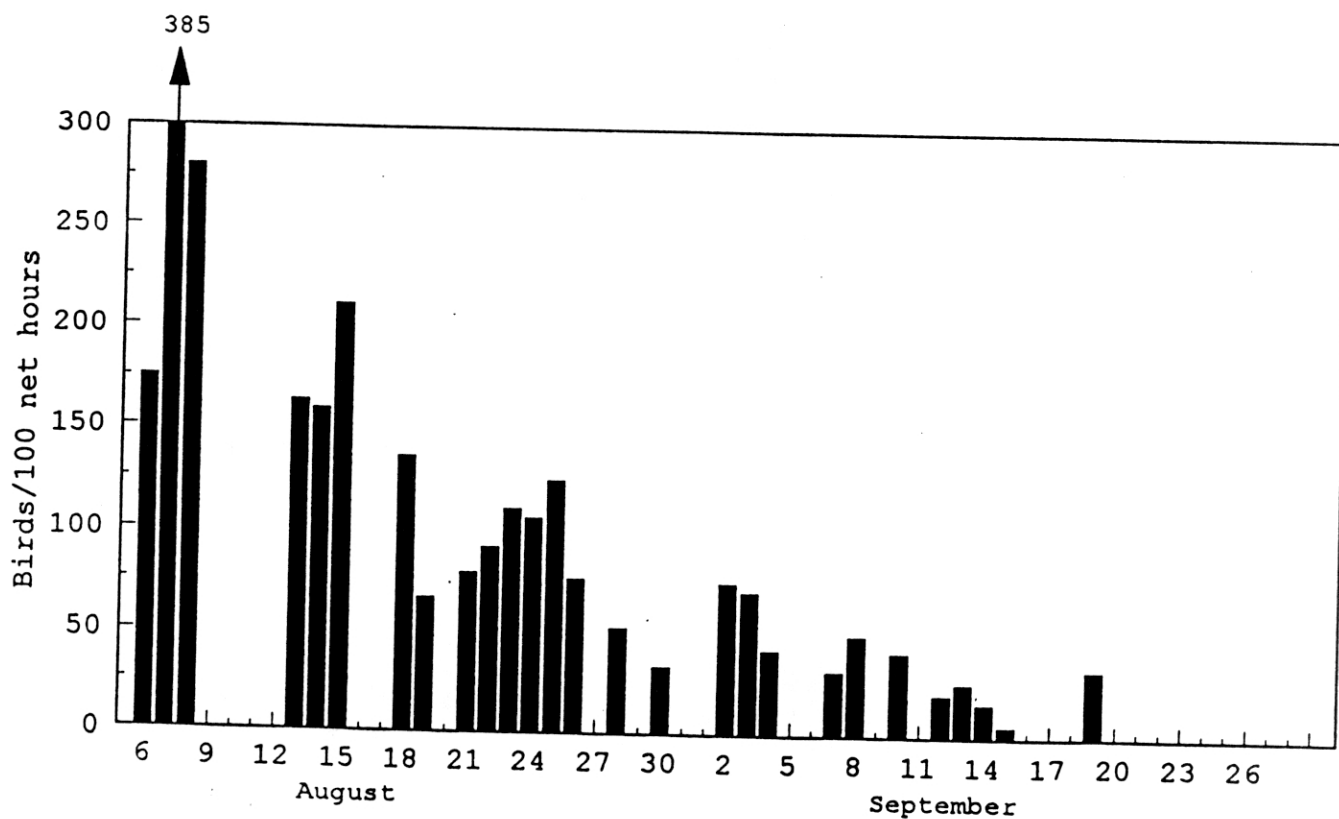


Figure 3. Capture rates of landbirds caught in mist nets during fall migration banding at the Cabin Island site of Island Arm, Becharof Lake, August-September 1995.



Mainland site (Table 1). Sites at Mother Goose Lake generally have produced 60-80% HY birds (Dewhurst et al. 1995, Eskelin and Dewhurst 1996). Eight species (48 individuals) (6 neotropical migrant species, Table 2) were aged as "local" at both sites, confirming breeding in the immediate vicinity of the capture sites (Table 1), with another 6 species documented as probable breeders (Table 3).

Fall Migration.-- Banding was conducted on 27 days, with 1407 total net-hours. Twenty-three species from 9 different families were captured. Total birds banded were 1177, while total captures were 1452, with a mean capture rate of 103.2 birds/100 net hrs (Fig. 3). Capture rates peaked on 7 August (385.4 birds/100 net hrs) and then steadily declined throughout the rest of migration. Neotropical migrant species peaked in early to mid-August, but were still being captured in small numbers in mid-September (Table 2).

Most of the migrants captured were species which had previously been caught during the breeding season with proportions were similar to that of the breeding season. The most common species captured was Wilson's warbler (351 or 30% of the birds banded). This was due largely to a massive movement of HY individuals on 7 & 8 August in which 176 (42% of the species' migration total) were captured. Yellow warblers, the most common breeder caught in the area, followed closely with 326 banded (28%). Together with orange-crowned and blackpolls (*Dendroica striata*), warblers comprised 65% of the birds banded during fall migration. Savannah and American tree sparrows (*Spizella pallida*) (181 and 117 banded, respectively) were the next most captured birds during migration. All 7 species of sparrows together provided 28% of the captures and 29% of the birds banded. Only two other species, hermit thrushes (*Catharus guttatus*, 63 captured) and golden-crowned sparrows (*Zonotrichia atricapilla*, 40 captured) were caught in numbers >10.

A few birds associated with the boreal forests to the northwest were caught. Although adding substantially to the species list, the numbers involved were quite low and consisted solely of hatching year birds. The species included: 2 - red-breasted nuthatches (*Sitta canadensis*) on 18 & 25 August; 1 - blackpoll warbler on 25 August; 1 - slate-colored junco (*Junco hyemalis*) on 3 September; 1 - ruby-crowned and golden-crowned kinglet (*Regulus calendula* and *satrapa*) 7-8 September; and 2 - brown creepers (*Certhia americana*) on 14 & 19 September.

Recaptures.-- Recaptures during the breeding season comprised 29% at Cabin Island and 31% at the Mainland, with all species recaptured except for those represented by single captures (Table 4). The recapture rate dropped to 17% during fall migration, but was still noticeably higher than recorded at other fall migration sites on the Peninsula; Yantarni Sound (9.8%, Moore 1996) and Mother Goose Lake (5.8% in 1994, Dewhurst et al. 1995).

Escapes.-- Escapes were defined as birds that during any point of the handling or banding process escaped from the hands of one of the banding personnel. There were 70 escapes or 3.0% of total captures during the season, comprised of 8 of the 25 species captured. Escapes were most problematic during the days with the most numerous captures. Thirty birds (43% of the escapes) were inadvertently freed on 7 & 8 August, the 2 busiest days of the entire season, even though these days provided only 17% of the total captures. The percentages of escapes correlated well with the percentages of each species caught. Yellow Warblers provided 27% of captures and 27% of the escapes, followed closely by Wilson's Warblers (25% captures, 24% escapes).

Mortality.-- As with any banding operation, avoiding injuries and mortalities was of the utmost concern. At Island Arm, the mortality rate was only 0.78% out of 2302 captures. Most of the mortality (67%) occurred on just 2 banding days, 14 July and 7 August, with the leading source involving exposure or stress while the birds were in the mist net. Surprisingly, though northern shrikes were common in the area and even caught in the mist nets on a few instances, only 1 captured bird was killed as a result of shrike

Table 2. Individual species migration capture rates of common landbirds at Island Arm, Becharof Lake, August-Sept 1995. Capture rates expressed as birds/100 net hrs and grouped in 5 day blocks.

Species	August										September					Cum.
	3 - 6	7 - 11	12 - 16	17 - 21	22 - 26	27 - 31	1 - 5	6 - 10	11 - 15	16 - 22						
Type A Neotropical Migrants																
Willson's Warbler	17	166	88	27	95	7	19	5	0	0	0	0	0	0	30	
Yellow Warbler	25	80	105	41	84	21	16	11	2	0	0	0	0	0	27	
Orange-crowned Warbler	22	59	22	7	18	9	2	1	2	0	0	0	0	0	10	
Type B Neotropical Migrants																
Hermit Thrush	4	3	3	1	14		8	19	11	0	0	0	0	0	4	
Savannah Sparrow	30	47	38	20	26	1	21	13	6	0	0	0	0	0	14	
Fox Sparrow	0	2	2	1	1	0	2	0	1	0	0	0	0	0	1	
Nearctic Migrants																
American Tree Sparrow	11	6	8	18	52	6	9	23	14	17	12	12	12	12	12	
Golden-crowned Sparrow	1	9	3	4	7	2	3	5	6	0	3	3	3	3	3	
Common Repoll	2	1	0	1	1	0	0	0	2	0	1	1	1	1	1	
Net hours	60	115	152	114	294	99	129	198	234	16	1411	1411	1411	1411	1411	

Migration strategy classification:

Type A: Neotropical migrant with majority of winter range south of U.S./Mexico Border

Type B: Neotropical migrant with majority of winter range north of U.S./Mexico Border

Nearctic migrant: Migrant with entire or almost entire winter range in the U.S. and Canada

Table 3. Capture frequency and range of dates for probable breeding and migrant landbirds mist netted at Island Arm, Becharof Lake, June-Sept 1995

SPECIES	NUMBER CAPTURED	RANGE OF CAPTURE DATES	NUMBER OF DAYS CAPTURED	PEAK CAPTURE & DATE
<b>Probable Breeders</b>				
Yellow Warbler	619	9 June - 13 Sept	46	53 on 15 August
Wilson's Warbler	583	9 June - 10 Sept	41	85 on 8 August
Orange-crowned Warbler	310	9 June - 13 Sept	43	32 on 7 August
Savannah Sparrow	272	9 June - 14 Sept	44	31 on 6 August
American Tree Sparrow	189	9 June - 19 Sept	44	18 on 25 August
Hermit Thrush	129	9 June - 14 Sept	42	10 on 10 Sept
Golden-crowned Sparrow	77	9 June - 15 Sept	35	7 on 7 August
Common Redpoll	35	9 June - 14 Sept	17	5 on 6 June
Fox Sparrow	24	9 June - 14 Sept	18	2 on 6 days
Gray-cheeked Thrush	14	10 June - 18 August	9	4 on 16 June
Black-capped Chickadee	13	21 June - 28 August	8	3 on 14 July
Lapland Longspur	7	7-18 August	4	4 on 7 August
American Robin	6	16 June - 14 Sept	6	1 on each date
Tree Swallow	1	10 June	1	1 on 10 June
<b>Probable Migrants</b>				
Northern Shrike	5	15 August - 10 Sept	4	2 on 18 August
White-crowned Sparrow	4	26 August - 19 Sept	3	2 on 26 August
Redbreasted Nuthatch	2	18-21 August	2	1 on 18 & 21 August
Brown Creeper	2	12-19 Sept	2	1 on 12 & 19 Sept
Golden-crowned Kinglet	2	8 Sept	1	2 on 8 Sept
Ruby-crowned Kinglet	2	7-8 Sept	2	1 on 7 & 8 Sept
American Pipit	2	7-19 August	2	1 on 7 & 19 August
Western Wood-Pewee	1	23 August	1	1 on 23 August
Swainson's Thrush	1	10 June	1	1 on 10 June
Blackpoll Warbler	1	25 August	1	1 on 25 August
Slate-colored Junco	1	3 Sept	1	1 on 3 Sept
<b>ALL</b>	<b>2302</b>	<b>9 June - 19 Sept</b>	<b>49</b>	<b>212 on 7 August</b>

Table 4. Number of birds captured and recaptured by species at each banding site at Island Arm, Bercharof Lake, June - September, 1995.

Species	Mainland		Cabin Island		Migration		Total
	Captured	Recaps	Captured	Recaps	Captured	Recaps	
Western Wood-Pewee					1		1
Tree Swallow			1				1
Black-capped Chickadee	6	1	5	2	2	1	13
Red-breasted Nuthatch					2		2
Brown Creeper					2		2
Golden-crowned Kinglet					2	1	2
Ruby-crowned Kinglet					2	1	2
Gray-cheeked Thrush	8	4	3	1	3		14
Swainson's Thrush			1				1
Hermit Thrush	28	9	39	20	63	21	130
American Robin	1		1		4		6
American Pipit					2		2
Northern Shrike					5		5
Orange-crowned Warbler	63	16	105	37	142	45	310
Yellow Warbler	59	30	175	52	385	46	619
Blackpoll Warbler					1		1
Wilson's Warbler	73	20	85	26	424	56	582
American Tree Sparrow	27	7	20	5	142	22	189
Savannah Sparrow	22	2	48	7	202	10	272
Fox Sparrow	6		9	3	9	2	24
Golden-crowned Sparrow	9	2	28	12	40	11	77
White-crowned Sparrow					4	1	4
Slate-colored Junco					1		1
Lapland Longspur					7		7
Common Redpoll	11		17	1	7		35



predation. Over 80% of the mortalities involved three species of warblers. With a 1.4% mortality rate, Wilson's Warblers represented 44% of the mortalities, paralleling results recorded at Mother Goose Lake (Dewhurst et al. 1995, Eskelin and Dewhurst 1996).

Noteworthy Non-banded Captures.-- The single most unusual capture of fall migration was a western wood-pewee (*Contopus sordidulus*) caught 23 August at the Cabin Island site. No previous occurrences of this species have ever been documented on the Alaska Peninsula or southwestern Alaska, making it the first regional record for that species. This hatching year individual was without feather molt and in apparently good health. Identification was confirmed by Dan Gibson of the University of Alaska-Fairbanks Museum.

Mist Net Efficiency.-- Individual mist net efficiency varied from 68 to 118 birds/100 net hrs during the breeding season (Table 5), and was comparable between the two netting sites. During fall migration at the Cabin Island site, Net 4 dominated with 224 birds captured/100 net hours, with other lakeshore nets (5, 7 and 8) also having higher catch rates. Net 4 was located on a wooded point along the island's lakeshore (Appendix I), demonstrating a similar concentration phenomena to lakeshore point nets (12 & 13) at Mother Goose Lake (Dewhurst et al. 1995, Eskelin and Dewhurst 1996). Vegetation collected and observed from the mist net arrays and surrounding area are listed in Appendix III.

#### Point Counts

MAPS-type Point Counts.-- Twenty-eight avian species were documented during point counts conducted within the mist net arrays, using MAPS methodology (Table 6). Bank swallows (*Riparia riparia*), common ravens (*Corvus corax*) and black-billed magpies (*Pica pica*) were the only landbird species documented during point counts that were not captured in the mist nets. Conversely, Swainson's and gray-cheeked thrushes (*Catharus ustulatus* and *minimus*), black-capped chickadees (*Parus atricapillus*), and Gambel's white-crowned sparrows (*Zonotrichia leucophrys gambelii*) were captured during banding, but not recorded during the point counts. No notable differences were recorded between the species composition recorded at the two mist netting sites (Table 6) nor between landbird species composition in the point counts versus banding data (Table 1).

Off-Road Point Counts.-- Three off-road point counts were conducted in the southeastern Island Arm area, documenting 25 avian species (Table 7). Lapland longspurs (*Calcarius lapponicus*) were the one significant addition to those landbird species recorded around the mist net arrays, likely due to a higher occurrence of tundra on the off-road transects. Otherwise, species composition closely paralleled that of the mist net sites.

Single point counts were also conducted on the lake islands too small for transects. The eight point counts yielded 18 avian species listed in order of abundance in Table 8. Willow ptarmigan (*Lagopus lagopus*) was the one new landbird species encountered on these island surveys.

#### Waterbird/Shorebird Off-Site Baseline Studies

Twelve birds of 5 species were caught during non-standardized banding efforts, bringing the cumulative total of birds banded at Island Arm this year to 1754 and captures to 2315. Banding effort and success were low for a few reasons. The general lack of birds presented one obstacle. The only colonies of mew gulls (*Larus canus*) and arctic terns (*Sterna paradisaea*) found in the Island Arm area were located at the mouth of Featherly Creek, which was on the opposite side of the lake. Strong winds and high seas frequently prevented crossing in our boat (a 16' Boston Whaler). The few visits that were made frequently yielded chicks that were too young or too old to band. Altogether, 2 semipalmated plovers (*Charadrius semipalmatus*), 3 mew gulls, and 2 arctic terns, all juveniles, were caught and banded at this site. Numerous tern

Table 5. Summary of individual mist net efficiencies during banding operations at Island Arm, Becharof Lake, June-Sept 1995. Capture rates expressed as birds/100 net hrs.

Cabin Island Site - Breeding													
Net #	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Total Birds	41	76	62	60	51	48	73	49	33	44			537
Net hrs	60	68	68	68	68	67	62	63	60	59			642.7
Capture rate	68	112	91	88	75	72	118	78	55	75			84
Mainland Site - Breeding													
Total Birds	49	32	13	18	18	35	42	33	26	47			313
Net hrs	44	44	12	38	23	44	45	45	45	45			385
Capture rate	111	73	108	47	78	80	93	73	58	104			81
Fall Migration													
Total Birds	69	131	119	294	153	109	127	139	128	56	51	76	1452
Net hrs	98	131	131	131	131	131	114	131	92	92	114	114	1407
Capture rate	70	100	91	224	117	83	111	106	139	61	45	67	103

Table 6. Frequency of species occurrence during breeding point counts (mist net arrays) at Island Arm, Becharof Lake, June-July 1995. Frequency equals number of points at which a species was recorded divided by total number of points per route.

Species	Cabin Island			Mainland	
	June 19	June 29	July 8	June 20	July 7
Common Loon		0.11			
Bald Eagle	0.11		0.11		0.11
Willon Ptarmigan		0.11			
Lesser Golden-Plover		0.11			
Greater Yellowlegs					0.22
Least Sandpiper				0.33	
Common Snipe				0.22	0.11
Long-tailed Jaeger		0.11			
Mew Gull	0.33		0.11		
Glaucous-winged Gull		0.22		0.22	
Arctic Tern		0.1	0.11		0.11
Tree Swallow		0.44	0.33		
Bank Swallow					0.11
Black-billed Magpie					0.22
Common Raven			0.11		
Black-capped Chickadee		0.11			
Gray-cheeked Thrush				0.67	
Hermit Thrush	0.56	0.89	1	0.56	1
American Robin	0.11	0.89	1	1	0.44
Northern Shrike		0.11	0.11	0.11	0.11
Orange-crowned Warbler	0.89	0.67	0.11	1	0.33
Yellow Warbler	0.89	1	1	1	1
Wilson's Warbler	0.78	0.89	0.78	1	0.44
American Tree Sparrow	0.89	0.78	0.78	0.89	0.78
Savannah Sparrow	0.89	0.89	0.78	1	1
Fox Sparrow	0.11	0.33		0.56	
Golden-crowned Sparrow	1	1	0.67	1	0.89
Common Redpoll	0.78	0.78	0.78	0.78	0.78

Table 7. Frequency of species occurrence during off-road point counts at Island Arm, Becharof Lake, 1995. Frequency equals number of points at which a species was recorded divided by total number of points per route (12).

	Rt.1	Rt.2	Rt.3
Species	26 June	3 July	10 July
Semipalmated Plover			0.08
Lesser Golden-Plover			0.08
Greater Yellowlegs	0.08		
Least Sandpiper	0.17		0.08
Long-tailed Jaeger	0.08		
Mew Gull	0.08		
Bald Eagle			0.08
Rock Ptarmigan			0.08
Bank Swallow			0.17
Common Raven			0.08
Black-capped Chickadee	0.08	0.08	
Gray-cheeked Thrush	0.67	0.25	
Hermit Thrush	0.83	0.92	0.92
American Robin	0.33		0.17
Northern Shrike			0.08
American Pipit			0.08
Orange-crowned Warbler	0.67	0.25	0.67
Yellow Warbler	0.58	0.92	0.67
Wilson's Warbler	0.75	0.92	0.58
American Tree Sparrow	0.33		0.25
Savannah Sparrow	1	0.83	0.83
Fox Sparrow	0.25	0.58	0.33
Golden-crowned Sparrow	1	0.92	1
Lapland Longspur	0.17	0.08	0.33
Common Redpoll	0.67	0.75	0.58
Total number of taxa	17	11	20



Table 8. Avian species presence/absence during island point counts at Island Arm, Becharof Lake, June-July 1995.

	Island #									
	1	2	3	4	5	6	7	8		
Species	Date	6/15	6/15	6/30	6/30	7/5	7/5	7/5	7/5	Total
Savannah Sparrow		x	x	x	x	x	x	x	x	8
Yellow Warbler		x	x	x		x	x	x	x	7
Golden-crowned Sparrow		x	x		x		x	x	x	6
Fox Sparrow		x	x	x			x	x	x	6
Common Redpoll		x	x			x	x	x	x	6
Glaucous-winged Gull			x	x	x	x				4
Hermit Thrush			x			x	x	x		4
Wilson's Warbler		x	x				x	x		4
Gray-cheeked Thrush						x	x	x		3
American Tree Sparrow		x	x							3
Orange-crowned Warbler			x					x		2
Double-crested Cormorant						x				1
White-winged Scoter				x						1
Long-tailed Jaeger								x		1
Mew Gull		x								1
Arctic Tern		x								1
Willow Ptarmigan							x			1
Bank Swallow			x							1
Total number of taxa		9	11	5	3	7	10	10	5	

chicks were found on the east side of Island Arm, but only 2 were caught and banded. Several active glaucous-winged gull (*Larus glaucescens*) nests were located at various parts of Island Arm, but none were banded due to the lack of appropriate size bands.

The Island Arm portion of Becharof Lake appeared to be a relatively poor staging area for migrating shorebirds. The most commonly seen species were lesser golden-plover (*Pluvialis dominica*), whimbrel (*Numenius phaeopus*) and greater yellowlegs (*Tringa melanoleuca*) (Appendix II). Most of the shoreline was stony, rocky, or vegetated all of which are not conducive to the foraging habits of most shorebirds. Sandbars were located at the mouths of a few of the creeks that empty into the Island Arm area, but were generally small. No mudflats were found. The best staging site within the Island Arm area was at the mouth of Featherly Creek, which likewise had the largest section of beach within Island Arm. Eight species of shorebirds were seen here on 4 visits in July and August, but never in appreciable concentrations (Appendix II). Because of rainy and windy weather, shorebird banding could only be conducted once at this site, and that for just a couple hours on 10 August. However, the effort quickly yielded a black turnstone (*Arenaria melanocephala*). With a more intensive effort and benevolent weather, more shorebirds could likely have been banded here.

#### Avian Sightings

Eighty-two avian species were observed in the Island Arm portion of Becharof Lake during late May through September 1995 (Appendix II). Noteworthy were: a cliff swallow (*Hirundo pyrrhonota*) in June, a lone Steller's eider (*Polysticta stelleri*) in July, and marbled and ancient murrelets (*Brachyramphus marmoratus* and *Synthliboramphus antiquus*) in August. Greater scaup (*Aythya marila*), white-winged and black scoters (*Melanitta fusca* and *nigra*) and red-breasted mergansers (*Mergus serrator*) were the most common waterfowl observed using this portion of the lake throughout the summer. Glaucous-winged gulls greatly out-numbered mew and Bonaparte's gulls (*Larus philadelphia*) in the area, likely due to local breeding colonies present.

### **DISCUSSION**

#### Landbird Abundance

Species Composition.--The composition of landbird species at the mist netting sites and localized lake island area was well documented through the combined use of point counts, avian sightings and mist netting. Moving the study site annually would provide a broader picture of this large and complex lake ecosystem. Balancing the time spent between off-road point counts and mist netting this season proved to be a point of debate, given limited days of good working weather. Trying to work two mist netting sites and do point counts was a challenge for the 3-person field crew. Given the wider survey scope of the point counts, perhaps they should be given priority in future work as to best meet the needs of baseline sampling in the ecosystem.

Breeding Densities.--Mist netting and banding at Island Arm this year provided a baseline for comparisons of breeding adult landbird capture rates. The low capture of HY birds, relative to Mother Goose Lake (Eskelin and Dewhurst 1996), may indicate a lower local productivity of the island willow/alder habitat. However, another explanation may be juvenile dispersal of local HY birds upon fledging to better feeding areas or habitats. Follow-up work in this area would likely yield a more complete understanding of the situation by comparing annual variation to that of habitat and location differences.

## Habitat Use

Use of the Cabin Island site for both breeding season and fall migration studies, provided an opportunity to compare habitat use of 10 individual net sites by breeding versus migrating birds (Table 4). At Mother Goose Lake, another site with the same nets used for both the breeding season and fall migration, the use of the lakeshore nets increased during fall migration (Eskelin and Dewhurst 1996). At the Cabin Island, Net 4 (Appendix I) showed the greatest increase in capture rates from the breeding season to migration. Net 4 was on a point of land, closest to the mainland. Net 9 had the second highest change in capture rates, possibly due to the island effect of being located in an isolated shrub patch surrounded by tundra. These results support those from Mother Goose Lake inferring that migration habitat use by landbirds may be more determined by geography than by vegetation type. Yet the extreme high catch rates documented at Mother Goose Lake never materialized at Island Arm or Yantarni Sound (Moore 1996) indicating that a combination of vegetative and geographical habitat factors more likely influences landbird roosting and stop-over feeding during migration on the peninsula. Fall migration monitoring at other sites around Becharof Lake would further test the geographic versus vegetation type effects on landbird migration through the ecosystem, and may provide insight into the migration pathways of area landbirds passing through the Becharof Ecosystem.

Vegetation sampling at point count centers within the net arrays was the only quantitative analysis of plant species composition and density in the netting areas, both at Mother Goose Lake and Island Arm. This type of sampling was general in nature and did not sample the mist net sites themselves. Future habitat work that better quantifies habitat parameters (canopy density, stem density, ground cover height and types...) needs to be completed at the mist net sites if bird species composition and density are to be related to local habitat differences.

## Fall Migration Landbird Phenology

Timing of individual landbird species migration through the Island Arm area (Table 3) supported findings from other Alaska Peninsula migration monitoring sites concerning conflicts between breeding season and fall migration work (Dewhurst et al. 1995, Eskelin and Dewhurst 1996, Moore 1996). By starting fall migration monitoring in early August, the earliest fall migrants are usually missed [tree (*Tachycineta thalassina*) and bank swallows, alder flycatchers (*Empidonax alnorum*)], as well as the start of shorebird migration through the area. In 1995, two breeding season mist netting sites were being monitored, preventing the switch to intensive fall migration banding until August. Ideally, fall migration intensive mist netting should be initiated by mid-July and continued through late September, but maintaining multiple sites or changing sites for bear safety reasons, may continue to delay this in the Becharof studies.

## Non-landbird Species

Non-landbird work conducted in 1995 involved mainly exploration and seabird breeding colony mapping. Efforts should be continued on this work to balance the emphasis placed on landbirds. Much of the work in 1995 was incidental in scope, illustrating a need for more systematic mapping of the inland seabird (gulls, terns, cormorants) colonies, using aerial reconnaissance to initially survey larger areas. Unfortunately, given the nomadic nature of many of the species involved, this effort would have to be conducted annually to document colony movement and perhaps detect longer term patterns of commonly used sites. This year's work together with previous surveys have established common use of the area by breeding colonies of arctic terns, glaucous-winged and mew gulls, and double-crested cormorants (*Phalacrocorax auritus*).

Due to the more isolated nature of shorebird nesting, any breeding season work would have to involve future nest searching in wetland areas. Fall migration could be also documented with visual observations and miscellaneous trapping (mist nets, walk-in traps).

#### RECOMMENDATIONS

1. This project provided an initial pinpoint picture of landbird use of the area and should be continued as long as funding permits. Moving the study site annually would provide a broader understanding of bird use of the ecosystem.
2. Care should be taken to minimize (but stay within MAPS guidelines) the size of the mist net array for purposes of bear safety.
3. The Zenith laptop computer needs to be replaced with a faster, more energy efficient notebook computer for future field use. Along with this, efforts should be made to seek alternate data base software (other than dBase III+), that is more user friendly.
4. A more intensive method of sampling vegetation characteristics at the mist net sites should be developed to quantify habitat types for comparative purposes.

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# LITERATURE CITED

- Bailey, E.P. 1974. Passerine diversity, relative abundance, and migration at Cold Bay, Alaska. *Bird-Banding* 45:145-151.
- Dewhurst, D. A., T. D. Eskelin, and J. A. Melton. 1995. Passerine breeding and fall migration monitoring at Mother Goose Lake, Alaska Peninsula National Wildlife Refuge, Alaska June-September 1994. U.S. Fish and Wild. Serv., King Salmon, Alas., (Unpubl). 46pp.
- DeSante, D. F. and K. M. Burton. 1994. 1994 MAPS Manual: Instructions for the establishment and operation of stations as part of the Monitoring Avian Productivity and Survivorship Program. The Institute for Bird Populations, Point Reyes Station, CA., (Unpubl). 55 pp.
- Eskelin, T. D. and D. A. Dewhurst. 1996. Landbird breeding and fall migration at Mother Goose Lake, Alaska Peninsula National Wildlife Refuge, Alaska, June-September 1995. U.S. Fish & Wildl. Serv., King Salmon, Alas., (Unpubl). 35pp.
- Hagan, John III, T. L. Lloyd-Evans, J. L. Atwood, and S. Wood. 1989. Longterm changes in migratory landbirds in the northeastern United States: Evidence from migration capture data. Pages 115-130 in J. M. Hagan and D. W. Johnston, eds. *Ecology and conservation of Neotropical migrant landbirds*.
- Hulten, E. 1968. *Flora of Alaska and neighboring territories - a manual of the vascular plants*. Stanford Univ. Press, Stanford, Calif. 1007pp.
- Kessel, B. 1979. Avian habitat classification for Alaska. *Murrelet* 60:86-94.
- Kienle, J., P.R. Kyle, S. Self, R. J. Motyka, and V. Lorenz. 1980. Ukinrek Maars, Alaska, I. April 1977 eruption sequence, petrology and tectonic setting. *J. Volcanol. Geotherm. Res.*, 7:11-37.
- Moore, H. 1996. Avian fall migration at Yantarni Sound, Alaska Peninsula National Wildlife Refuge, Alaska, August-September 1995. U.S. Fish & Wildl. Serv., King Salmon, Alas., (Unpubl)., 20pp.
- Orth, D. J. 1967. *Dictionary of Alaska place names*. Geol. Surv. Prof. Paper 567. U.S. Govt. Print. Office, Wash., D.C. 1084pp.
- Pyle, P., S. N. G. Howell, R. P. Yunick, and D. F. DeSante. 1987. *Identification Guide to North American passerines*. Slate Creek Press, Bolins, Calif., 278pp.
- Ralph, C. J., G. R. Guepel, T. E. Martin, and D. F. DeSante. 1992. *Field Methods for monitoring landbirds*. U.S. Forest Serv., Arcata, Calif., (Unpubl) 56pp.
- Robbins, C. S., J. R. Sauer, R. Greenberg, and S. Droege. 1989. Population declines in North American birds that migrate to the Neotropics. *Proceedings from the National Academy of Sciences* 86: 7658-7662.
- Sauer, J. R., and S. Droege. 1989. Geographic patterns in population trends of Neotropical migrants in North America. Pages 26-42 in J. M. Hagan and D. W. Johnston, eds. *Ecology and conservation of Neotropical migrant landbirds*.

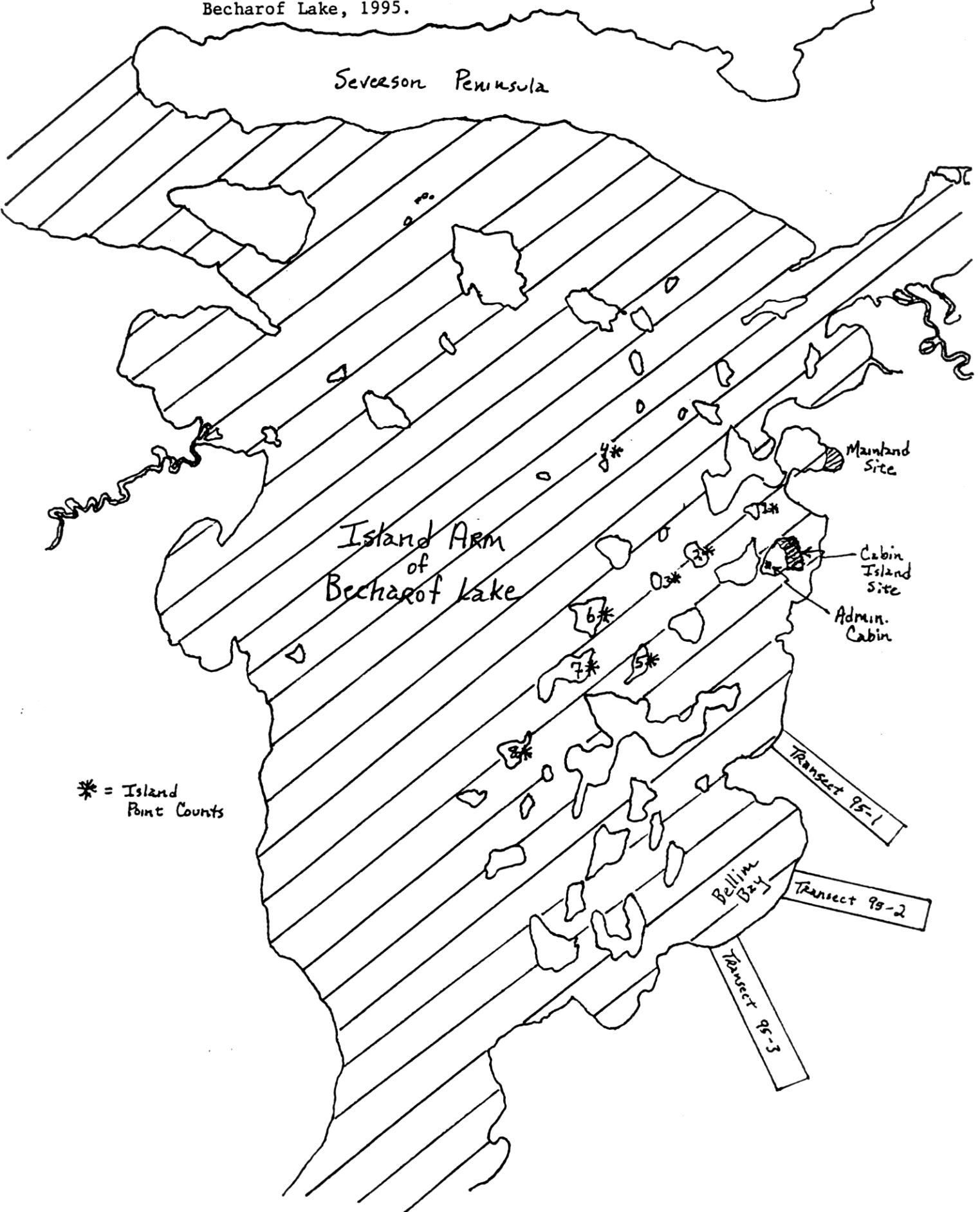
- Savage, S., J. F. Payne, J. Bolling, N. Corona, T. Hanks, P. Johnson, C. Pumphrey. 1988. Ugashik Narrows public use field camp, Alaska Peninsula National Wildlife Refuge, 15 June - 22 September 1988. U.S. Fish & Wildl. Serv., King Salmon, Alas., (Unpubl) 4pp.
- U.S. Fish & Wildl. Serv. 1985. Becharof National Wildlife Refuge final comprehensive conservation plan, environmental impact statement and wilderness review. U.S. Fish & Wildl. Serv., Anchorage, Alas., 255pp.
- Waddington, M. K. 1992. Aging and Sexing techniques for Wilson's warblers. Colorado Bird Observatory, Colorado Springs, CO., (Unpubl). 1pp.



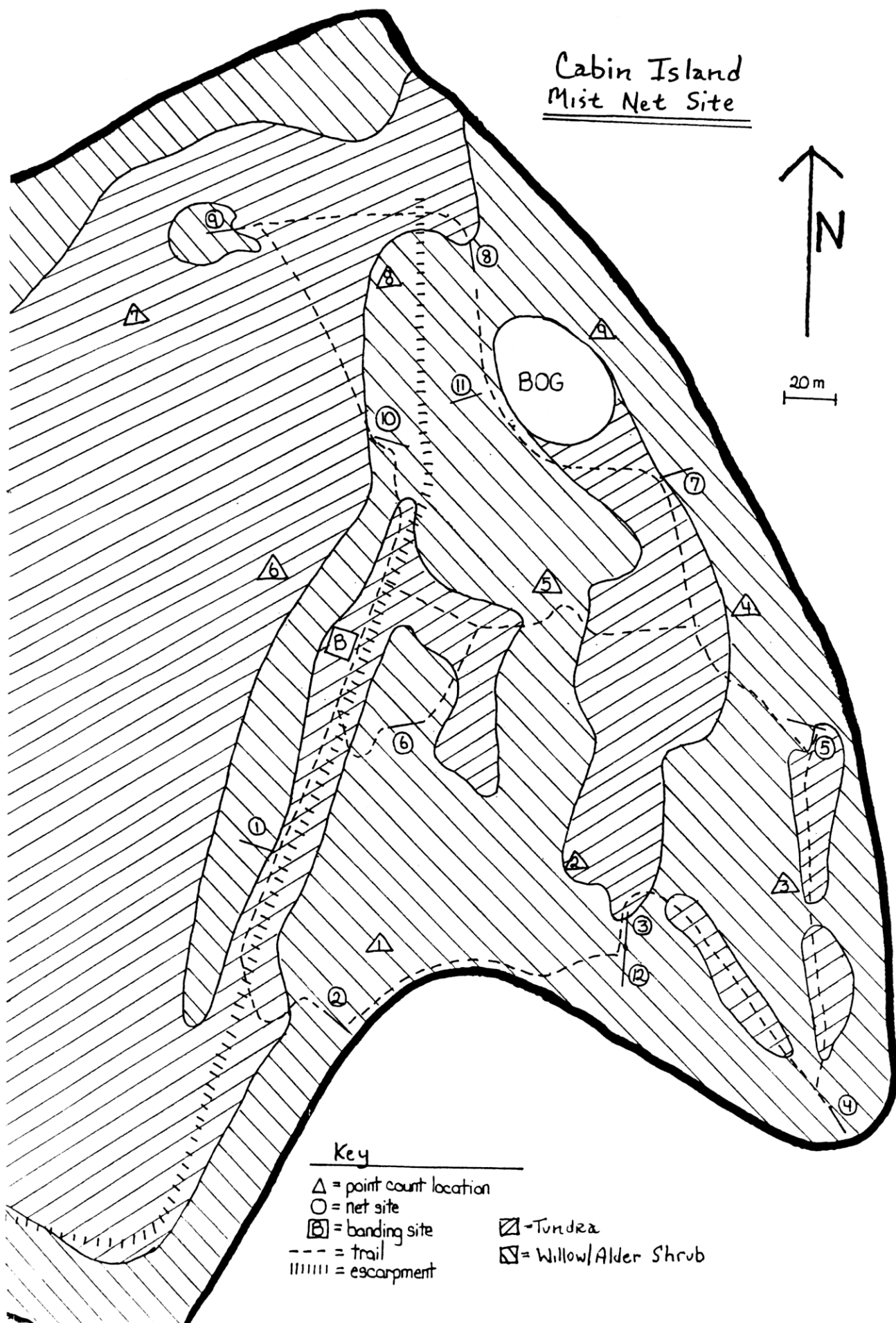
## APPENDICES

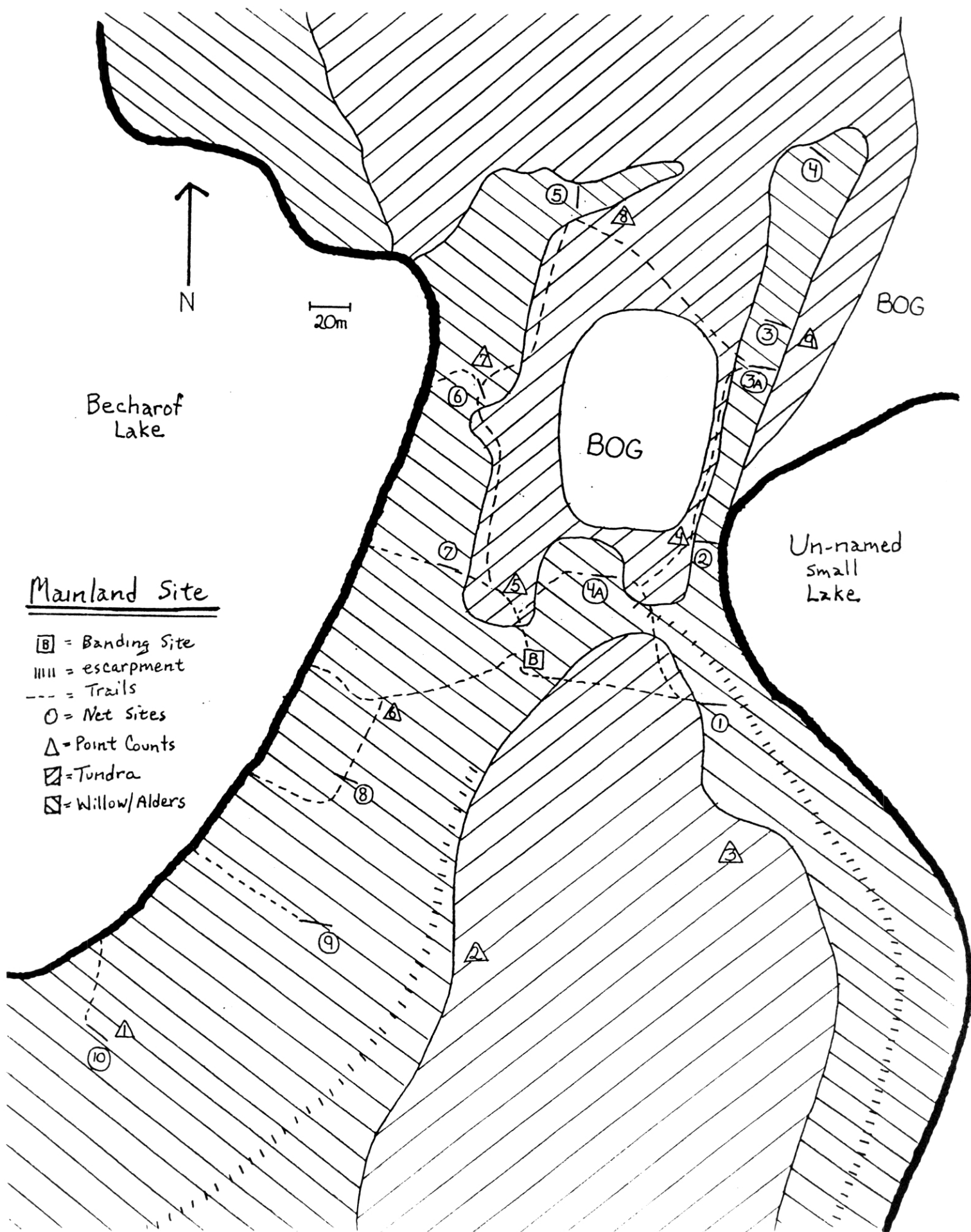


Appendix I. Rough sketches of the Cabin Island and Mainland mist net sites off-road point count transects and island point counts at Island Arm, Becharof Lake, 1995.



Cabin Island  
Mist Net Site









Appendix II. Summary of avian observations at Island Arm, Becharof Lake, May-Sept 1995.

Species	Date First Observed	Date Last Observed	No. Days Observed	Peak Count & Date
Red-throated Loon	3 June	22 Sept	61	20 on 7 July
Common Loon	3 June	13 Sept	86	15 on 7 July
Horned Grebe	4 June	21 Sept	23	30 on 3 Sept
Red-necked Grebe	2 June	9 Sept	21	4 on 24 & 28 August, 4 Sept
Double-crested Cormorant	3 June	22 Sept	76	90 on 7 July
Pelagic Cormorant	24 August	19 Sept	4	2 on 3 Sept
Tundra Swan	3 June	22 Sept	35	50 on 26 July
Greater White-fronted Goose	3 June	6 August	11	12 on 29 July
Green-winged Teal	31 May	11 Sept	6	4 on 28 August
Mallard	19 June	5 Sept	6	5 on 5 Sept
Northern Pintail	3 June	8 Sept	8	130 on 2 Sept
American Wigeon	2 June	11 Sept	27	20 on 15 July
Greater Scaup	3 June	22 Sept	80	3000 on 24 August
Steller's Eider	26 July	26 July	1	1 on 26 July
Harlequin Duck	1 July	7 Sept	3	9 on 7 Sept
Oldsquaw	3 June	3 July	3	2 on 1 & 3 July
Black Scoter	3 June	17 Sept	69	62 on 5 July
Surf Scoter	16 July	16 July	1	1 on 16 July
White-winged Scoter	3 June	11 Sept	62	250 on 15 July
Common Merganser	10 June	7 Sept	6	30 on 3 Sept
Red-breasted Merganser	2 June	21 Sept	79	300 on 3 Sept
Bald Eagle	2 June	17 Sept	62	14 on 16 July
Northern Harrier	31 May	15 Sept	22	1 each day
Rough-legged Hawk	31 May	3 Sept	6	1 each day
Merlin	25 August	16 Sept	4	1 each day
Peregrine Falcon	31 May	3 Sept	5	1 each day
Willow Ptarmigan	3 June	12 Sept	32	10 on 1 & 10 July
Rock Ptarmigan	10 July	10 July	1	12 on 10 July
Sandhill Crane	3 June	11 Sept	38	67 on 11 Sept
Black-bellied Plover	3 June	28 August	8	1 each day
Lesser Golden-Plover	3 June	22 Sept	14	34 on 3 Sept
Semipalmated Plover	7 July	11 Sept	9	5 on 8 August
Greater Yellowlegs	3 June	20 Sept	60	13 on 16 July
Wandering Tattler	21 July	7 Sept	3	1 each day
Whimbrel	7 July	5 Sept	14	7 each day
Ruddy Turnstone	10 August	10 August	1	3 each day
Black Turnstone	21 July	18 August	8	9 on 5 August
Western Sandpiper	8 July	1 Sept	6	8 on 8 July
Least Sandpiper	3 June	26 July	18	7 on 26 July
Short-billed Dowitcher	4 June	10 August	4	2 on 2 July
Common Snipe	3 June	30 August	12	3 on 12-14 July
Red-necked Phalarope	26 June	16 July	2	3 on 16 July
Parasitic Jaeger	7 July	22 August	13	3 on 13 July
Long-tailed Jaeger	3 June	26 July	13	3 on 29 June
Bonaparte's Gull	16 July	7 Sept	3	7 on 16 July
Mew Gull	3 June	7 Sept	62	50 on 8 July
Glaucous-winged Gull	3 June	22 Sept	91	200 on 15 July
Arctic Tern	3 June	2 Sept	46	50 on 8 & 21 July
Marbled Murrelet	15 August	25 August	2	1 each day
Ancient Murrelet	18 August	18 August	1	1 on 18 August
Belted Kingfisher	4 June	13 Sept	3	1 each day

Appendix II (cont.). Summary of avian observations at Island Arm, Becharof Lake, May-Sept 19

Species	Date First Observed	Date Last Observed	No. Days Observed	Peak Count & Date
Western Wood Pewee	23 August	23 August	1	1 on 23 August
Alder Flycatcher	13 June	14 July	3	1 each day
Tree Swallow	3 June	14 August	43	100 on 26 July
Bank Swallow	3 June	5 August	20	100 on 26 July
Cliff Swallow	6 June	6 June	1	1 on 6 June
Black-billed Magpie	9 June	13 Sept	21	4 on 1-2 Sept
Common Raven	1 June	21 Sept	65	8 on 19-20 August
Black-capped Chickadee	2 June	12 Sept	33	4 on 14 July
Red-breasted Nuthatch	18 August	21 August	2	1 each day
Brown Creeper	12 Sept	19 Sept	2	1 each day
Golden-crowned Kinglet	8 Sept	8 Sept	1	1 on 8 Sept
Ruby-crowned Kinglet	7 Sept	22 Sept	4	2 on 22 Sept
Gray-cheeked Thrush	5 June	18 August	19	20 on 26 June
Swainson's Thrush	10 June	10 June	1	1 on 10 June
Hermit Thrush	3 June	14 Sept	86	30 on 10 June
American Robin	3 June	13 Sept	66	10 on 14 July
American Pipit	2 July	19 Sept	21	6 on 25 August
Northern Shrike	2 June	14 Sept	26	4 on 26 July & 11 Sept
Orange-crowned Warbler	3 June	13 Sept	92	40 on 3 & 9 June
Yellow Warbler	3 June	13 Sept	96	53 on 15 August
Yellow-rumped Warbler	3 June	3 June	1	1 on 3 June
Blackpoll Warbler	25 August	25 August	1	1 on 25 August
Wilson's Warbler	3 June	10 Sept	92	85 on 8 August
American Tree Sparrow	3 June	20 Sept	108	18 on 25 August
Savannah Sparrow	3 June	14 Sept	102	50 on 26 June
Fox Sparrow	3 June	14 Sept	40	10 on 14 July
Golden-crowned Sparrow	3 June	20 Sept	107	50 on 26 June
White-crowned Sparrow	26 August	19 Sept	3	1 each day
Slate-colored Junco	3 Sept	3 Sept	1	1 on 3 Sept
Lapland Longspur	3 June	7 Sept	28	40 on 7 August
Common Redpoll	3 June	14 Sept	62	15 on 4-5 Sept

Appendix III. Vascular plants collected or observed at Island Arm, Becharof Lake, Alaska Peninsula, June-September. Identification and nomenclature based on Hulten (1986).

**ARALIACEAE**

Echinopanax horridum, Devil's Club

**BETULACEAE** (Birch Family)

Alnus crispa, Sitka Alder

**BORAGENACEAE**

Eritrichium chamissonis, Arctic Forget-me-not

**CAMPANULACEAE**

Campanula lasiocarpa, Mountain Harebell

**CAPRIFOLIACEAE**

Sambucus racemosa, Elderberry

**CARYOPHYLLACEAE** (Pink Family)

Cerastium arvense, Mouse-eared chickweed

Minuartia artica

Silene acaulis, Moss Campion/Cushion Pink

**COMPOSITAE (ASTERACEAE)** (Composite Family)

Achillea borealis, Yarrow

Antennaria monocephala, Pussytoes

Arnica lessingii subsp. lessingii

Artemisia globularia, Globular Wormwood

Erigeron peregrinus, Coastal Fleabane

Petasites frigidus, Arctic Sweet Coltsfoot

Senecio pseudo-Arnica, Seabeach Senecio

Senecio resedifolius

Solidago multiradiata, Northern Goldenrod

**CORNACEAE** (Dogwood Family)

Cornus canadensis, Bunchberry/Canadian Dwarf Cornel/Dwarf Dogwood

Cornus suecica, Swedish Cornel/Dwarf Dogwood

**CRASSULACEAE** (Stonecrop Family)

Sedum rosea subsp. integrifolium, Roseroot

**CRUCIFERAE** (Mustard Family)

Arabis lyrata subsp. kamchatica

Barbarea orthoceras, Wintercress

**CYPERACEAE** (Sedge Family)

Eriophorum angustifolium subsp. subarcticum, Tall Cottongrass

Eriophorum Scheuchzeri, White Cottongrass

**EMPETRACEAE** (Crowberry Family)

Empetrum nigrum, Crowberry

Appendix III (Cont.)

**EQUISETACEAE** (Horsetail Family)

Equisetum arvense, Coastal Horsetail

**ERICACEAE** (Heath Family)

Andromeda polifolia, Bog Rosemary

Arctostaphylos uva-ursi, Bearberry

Cassiope lycopodioides, Alaska Cassiope

Ledum palustre subsp. decumbens, Labrador Tea

Loiseleuria procumbens, Alpine Azalea

Oxycoccus microcarpus, Bog Cranberry

Rhododendron camtschaticum, Kamchatka Rhododendron

Vaccinium uliginosum subsp. microphyllum, Bog Blueberry

Vaccinium vitis-idaea, Lowbush Cranberry/Lingonberry

**GENTIANACEAE**

Menyanthes trifoliata, Bog Bean

Swertia perennis, Star Gentian

**GERANIACEAE** (Geranium Family)

Geranium erianthum, Cranesbill

**GRAMINEAE** (Grass Family)

Calamagrostis canadensis subsp. langsдорffi, Bluejoint

Elymus arenarius subsp. mollis, Lyme grass

Festuca altaia

Festuca rubra, Red Fescue

Poa arctica, Arctic Bluegrass

**IRIDACEAE** (Iris Family)

Iris setosa subsp. setosa, Wild Flag

**LEGUMINOSAE** (Fabaceae) (Pea Family)

Lathyrus maritimus subsp. pubescens, Beach Pea

Lupinus nootkatensis, Nootka Lupine

Oxytropis campestris, Field Oxytrope

**LILIACEAE** (Lily Family)

Fritillaria camschatcensis, Chocolate Lily

Streptopus amplexifolius, Wild Cucumber

**MYRICACEAE** (Wax Myrtle Family)

Myrica gale, Sweet Gale

**ONAGRACEAE** (Evening Primrose Family)

Epilobium augustifolium, Fireweed

Epilobium latifolium, Dwarf Fireweed/River Beauty

**PAPAVERACEAE** (Poppy Family)

Papavar alaskanum, Alaska Poppy

Papavar alboroseum

**PLUMBAGINACEAE** (Leadwort Family)

Armeria maritima subsp. arctica, Thrift

Appendix III (Cont.)

POLEMONIACEAE (Polemonium Family)

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

POLYGONACEAE (Buckwheat Family)

- Polygonum viviparum, Alpine Meadow Bistort
- Rumex arcticus, Arctic Dock

PRIMULACEAE (Primrose Family)

- Androsace chamaejasme subsp. Lehmanniana, Rock Jasmine
- Trientalis europaea subsp. arctica, Starflower

PYROLACEAE (Wintergreen Family)

- Pyrola asarifolia, Pink Pyrola/Wintergreen

RANUNCULACEAE (Crowfoot Family)

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

ROSACEAE (Rose Family)

- Dryas octopetala subsp. octopetala, Mountain Avens
- Geum Rossii, Yellow Avens
- Potentilla Egedii subsp. Egedii
- Potentilla palustris, Marsh Fivefingers
- Rubus arcticus subsp. stellatus, Nagoonberry
- Rubus chamaemorus, Cloudberry
- Sanguisorba stipulata, Burnet
- Spiraea Beauverdiana, Alaska Spiraea

RUBIACEAE (Madder Family)

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

SALICACEAE (Willow Family)

- Salix glauca subsp. acutifolia, Grayleaf Willow

SAXIFRAGACEAE (Saxifrage Family)

- Chrysoplenium Wrightii, Northern Water Carpet
- Heuchera glabra, Alpine Heuchera
- Parnassia palustris subsp. neogaea, Northern Grass-of-Parnassus
- Saxifraga bronchialis subsp. Funstonii, Spotted Saxifrage
- Saxifraga hirculus, Bog Saxifrage
- Saxifraga serpyllifolia, Thyme-leaved Saxifrage

SCROPHULARIACEAE (Figwort Family)

- Lagotis glauca subsp. glauca, Weasel Snout
- Mimulus guttatus, Monkey Flower
- Pedicularis capitata, Capitata Lousewort
- Pedicularis Kanei, Kane Lousewort
- Pedicularis Labradorica, Labrador Lousewort
- Pedicularis parviflora

Appendix III (Cont.)

Pedicularis verticillata, Bumble bee Flower  
Rhinanthus minor subsp borealis, Rattlebox

UMBELLIFERAE (APIACEAE) (Parsley Family)

Angelica lucida, Wild Celery  
Cicuta mackenzieana, Mackenzie (Poison) Water Hemlock  
Heracleum lanatum, Cow parsnip  
Ligusticum scoticum, Beach Lovage

VALERIANACEAE (Valerian Family)

Valeriana capitata, Capitata Valerian

VIOLACEAE (Violet Family)

Viola Langsdorffii, Alaskan Violet