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Floral and Faunal Inventory of Selected Wildlife Habitats and other Observations in the Alaska Peninsula National Wildlife Refuge 1985-87, Part I: Quantitative Assessment

By

Randall J. Wilk[a] and Karen I. Wilk[b]

U. S. Fish and Wildlife Service
Alaska Peninsula/Becharof National Wildlife Refuges
P. O. Box 277
King Salmon, Alaska 99613-0277

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[a]Present address: Kanuti National Wildlife Refuge, 101 12th Ave., Box 11, Fairbanks, Alaska 99701
[b]Present address: P. O. Box 912, Fairbanks, Alaska 99707-0912

ABSTRACT

"On-ground" inventories of the flora and fauna of 3 study sites on the Alaska Peninsula National Wildlife Refuge were carried out between 20 May 1985 and 5 August 1987. Dwarf shrub, wet and grass meadows and medium and low shrub thickets characterized most of the avian habitat class coverage on 15 bird plots. A total of at least 317 taxa of plants in 59 families were recorded and collected during the study. Peak flowering of plants in the Dog Salmon (DS) study area occurred during the first week of July in 1987. Bi-modal peaks (early and late July) in flowering occurred at Lawrence/Grass valleys, 1 week later in 1985 than in 1986. At Braided Creek (BC), peak flowering was also 1 week earlier in 1986 (9 July) than in 1985. Peak arrival of migratory (mostly passerine) birds occurred after investigators arrived to the study areas except for LG and perhaps BC in 1986. We speculate that the peak of passerine arrival to all study areas occurred during the first 2 weeks of May in all years. Indexes and estimates of bird abundance on plots were determined for 10 habitats. Savannah sparrows (Passerculus sandwichensis), Lapland longspurs (Calcarius lapponicus) and least sandpipers (Calidris minutilla) were the most abundant nesters in dwarf shrub meadows. In wet and grass meadows, American tree sparrows (Spizella arborea) and savannahs were most abundant. In medium and low shrub thickets, a variety of species occurred, including orange-crowned (Vermivora celata), Wilson's (Wilsonia pusilla) and yellow warblers (Dendroica petechia), golden-crowned (Zonotrichia atricapilla), white-crowned (Z. leucophrys) and American tree sparrows, and willow ptarmigan (Lagopus lagopus). Lapland longspurs, tree and white-crowned sparrows were absent from these habitats where they were expected to be present at LG. Thirteen species of birds were recorded in the cottonwood (Populus balsamifera) deciduous forest

during surveys at DS. The most abundant species were Wilson's and orange-crowned warblers. Observed habitat use of 108 bird species in 19 avian habitat classes is presented.

The first year of small mammal trapping (1985) coincided with a "crash" in small mammal abundance. Sorex spp., Clethrionomys rutilus, Microtus oeconomus, and Zapus hudsonius were the most common species captured in their respective habitats. 1986 was another poor year for small mammals and only in 1987, was a recovery apparent from capture indexes over the previous 2 years. Wolverine (Gulo gulo), gray wolf (Canis lupus), red fox (Vulpes vulpes) and grizzly (brown) bear (Ursus arctos) were recorded at scent stations during the period. Moose (Alces alces), caribou (Rangifer tarandus) and grizzly bear were observed from systematic and incidental observations. A second part to this paper is under preparation and will provide annotated species accounts of all birds and mammals recorded.

INTRODUCTION

The information summarized in this report is concerned with the wildlife and plant life in 3 study sites on Alaska Peninsula National Wildlife Refuge, Alaska (Fig. 1). Studies were initiated in 1985 in response to the need for fundamental "on-ground" data to aid in management decisions which might arise in relation to the development of transportation corridors proposed in The Bristol Bay Regional Management Plan (U. S. Department of the Interior 1985). Impacts from this potential threat to habitat is in direct conflict with the refuge mandate to conserve wildlife and habitats in their natural diversity (Alaska National Interest Lands Conservation Act, Public Law 96-487, 94 Stat. 23771, 1980).

Specific study objectives were:

1. Classify and describe habitat categories on nesting bird study plots.
2. Document plant flowering phenology and collect herbarium specimens.
3. Document bird arrival, occurrence, status, and estimate densities on plots.
4. Determine the relative abundance of small mammals from capture indices.
5. Determine indices for occurrence of major mammalian predators.
6. Note occurrence of large mammals.

Field camps were established in 1985 and again in 1986 near Braided Creek in the Meshik River drainage, and in lower Lawrence and Grass valleys in southeast Herendeen Bay. In 1986, a third area was established in the upper Ugashik drainage on the Dog Salmon River, and was revisited in 1987. Time spent in each field camp was dictated by availability of experienced staff and

seasonal personnel, logistics, weather and water levels (Dog Salmon) for accessibility to camp by float plane (Table 1). The results provided first time data on the flora and fauna of primarily terrestrial habitats. It is hoped that this report will provide the kind of information which will enable cautious planning and prudent management of Alaska Peninsula Refuge and related habitats (off refuge) on the Alaska Peninsula.

The final writing of this report was completed after the authors departed Alaska Peninsula/Becharof Refuges in August 1988. Therefore, with an early deadline, a full-time commitment to the write-up - a literature review, thorough presentation of, and exhaustive analysis of all data, and presentation of comparative data from other studies was not possible. Rather the pertinent information is presented with a brief discussion where applicable. A second volume to this report is under preparation and will provide annotated species accounts of the birds and mammals studied or observed.

STUDY AREAS

The Alaska Peninsula adjoins the mainland of Alaska at about latitude 59° 20'N, longitude 155° 30'W and extends approximately 500 miles (800 kilometers) southwest as a barrier between the Pacific Ocean and Bristol Bay of the Bering Sea (Fig. 1). The climate is generally subpolar maritime, but 3 climatic zones occur, ranging from extreme ploar maritime at the base, to moderate Aleutian maritime at the terminus (Selkregg 1976). All weather regimes are characterized by cool, humid and windy weather. "Terrestrial" habitats of the peninsula are many and diverse ranging from wet tundra dotted by ponds and marshes in the coastal lowlands, to alpine tundra of the Aleutian Range. Most of the plots in the 3 study areas were located in similar habitats in wet and moist tundra (Appendixes 1-3).

Dog Salmon River

The Dog Salmon River study area was located about 95 air miles (150 kilometers) southwest of King Salmon, and 23 miles (37 kilometers) southeast of Pilot Point, in the Ugashik drainage (Fig. 2). The camp was based out of a guide cabin along the shore in the upper river. Plots were located in the broad, flat and wet basin. Floristically, wet sedge (Carex spp.), cottongrass (Eriophorum spp.), and Sphagnum spp. dominated the lowland tundra. Riparian habitat was dominated by alder (Alnus spp.) and willow (Salix spp.). Uplands near the cabin included a sparse stand of cottonwood (Populus balsamifera) and alder. Alpine tundra was also visited during during the study.

Braided Creek

The Braided Creek study area was located 160 air miles (260 kilometers) southwest of King Salmon and 22 miles (35 kilometers) southeast of Port Heiden in the Meshik River drainage. The camp was located on an abandoned mining camp airstrip on an upland ridge (elevation 30 meters), extending north and west from the Aleutian Range foothills (Fig. 3). The ridge divides the upper lowland basin between Braided Creek to the west and Landlocked Creek to the east; Big Butte separates the headwaters of these streams. Habitats in study plots included wet sedge meadows in the lowlands and willow in the uplands. Alpine tundra of the Aleutian foothills was also investigated.

Lawrence and Grass Valleys

This coastal site was located in extreme southeastern Herendeen Bay, 240 air miles (380 kilometers) southwest of King Salmon, and 20 miles (30 kilometers) southwest of Port Moller, on the lower end of Lawrence and adjacent Grass valleys (Fig. 4). Plots were located in lowland sedge meadows and upland alder-willow thickets and riparian zones.

METHODS

Weather

Data on weather at each camp was recorded twice daily at about 0800 and 2200. Maximum-minimum thermometers were used to measure current and daily extreme temperatures. Wind velocity and direction was measured with hand-held portable wind meters. Cloud cover was visually estimated and precipitation was measured in a rain gauge. Barometric pressure was measured using an altimeter and relative humidity was calculated using wet/dry bulb readings from a sling psychrometer.

Selection and Establishment of Study Plots

Study plots were selected based on their relative accessibility from each camp and their general representation of the study area. At each site, plots were measured and the perimeters were staked and flagged at 50 meter intervals.

At Dog Salmon, six 0.10 square kilometer rectangular (1,000 x 100 meters) plots were staked, 4 on the north side and 2 on the south side. Additionally, 11 listening stations were systematically established in the upland cottonwood (Populus balsamifera). At Braided Creek, four 0.20 square kilometer (1,000 x 200 meters) rectangular plots were established, 2 on each side of the landing strip. Additionally, 18 listening stations were systematically established along the runway. Finally, at Herendeen Bay, three 0.10 square kilometer (1,000 x 100 meters) plots were established in Lawrence Valley in 1985 with an additional two plots (0.10 square kilometer; 1,000 x 100 meters) added in Grass Valley in 1986. Locations of the study plots in each study area are shown in Appendixes 1-3. Maps of individual bird plots are on file in King Salmon.

Classification and Description of Vegetation "Sub-classes" and Avian Habitat Classes on Plots

Vegetation communities, heretofore, known as "vegetation sub-classes", within each study plot were delineated, mapped and described. A modified releve technique (Mueller-Dombois and Ellenberg 1974) was used to initially describe sub-classes within plot boundaries. Generally, each plot was mapped by broad plant assemblages (communities). A range of measurements on vertical structure of ground, middle and overstory plants were noted and estimates of percent cover of each plant within the sub-class were made (see Wilk et al. 1986:appendices). Sub-classes were then named based on plant dominance and position or type and land form.

Once these sub-classes were described, detailed data on species composition, vertical structure, percent cover and frequency were obtained using 1 square meter sampling quadrats placed randomly within each. This work was generally conducted after peak flowering (late July) in the second year for each study area. To determine a minimum sampling intensity (minimum area) for the random quadrats we used nested plots up to an area of 16 square meters for each community. An area-species curve was then fitted to a logarithmic or linear curve (whichever best fit the line) to estmate the minimal area needed to sample predetermined proportions of the total number of plants inventoried from each sub-class (see Wilk et al. 1986:21 appendices). The minimum area sampled was then extrapolated based on 90 or 95% of the total of plants found in the 16 square meter nested plot samples or in the catalog of total species identified in each sub-class. This approach resulted in fewer samples required for communities of species evenness and more sampling in communities of high species richness, especially if only a few plants of some species were present.

Cover values were recorded for each stratum of vertical structure in each sub-class. Generally, the ground story ranged from 0 - 10 centimeters tall; middle story, 10 - 30 centimeters; and overstory >30 centimeters for open habitats. However, even within lowland subclasses of sparse brushy vegetation, the height range within each story was quite variable. The following cover classes were used:

I	= 0 - 1%	(class mid-point = 0.5%)
II	= 1 - 5%	(2.5%)
III	= 5 - 25%	(15%)
IV	= 25 - 50%	(37.5%)
V	= 50 - 75%	(62.5%)
VI	= 75 - 100%	(87.5%)

When calculating mean percentage cover, the mid-point of each cover class was used.

Vegetation sub-classes were determined and were compared with Level IV classifications of Viereck et al. (1986) in Wibbenmeyer et al. (1982), and avian habitat classes for Alaska (Kessel 1979) (Table 2). Kessel's scheme was used in all subsequent analyses. Area of each avian habitat class was determined using a dot grid over a scaled map of each plot and proportions were calculated. No adjustments of area were made for slope elevational gradients as plots were primarily in lowland or on gradual slopes.

At Dog Salmon in the cottonwood deciduous "forest", vegetation within a 5 meter radius of each listening station was sampled by the releve technique. At Braided Creek, along the

airstrip, communities were delineated and mapped using similar methods.

Plant Flowering Phenology and Collection of Herbarium Specimens

Botanical data were recorded in the form of community species lists (described above), noting various stages in phenology. Flowering plants were collected, identified, labeled and immediately pressed.

Bird Arrival, Occurrence, Status, and Density Estimates

Arrival dates of birds were recorded at sites established in early May. Daily notes were maintained and summarized each evening.

Bird study plots were censused once every seven to ten days during the prenesting, nesting and fledging periods of most species, although not all of these periods were covered for each study area each year. Between 2 and 4 investigators walked the plots and recorded all observations of birds. In some areas, a rope was dragged by investigators to potentially enhance detection of ground nesting species in open habitats. Censuses were initiated between 0700 and 0800 in most instances, but when weather was bad or visibility was poor, starting times were later. On days when winds exceeded about 20 miles per hour (32 kilometers per hour), plots were not walked, but started the next day. Weather conditions were seldom ideal for optimum birding.

All sightings were consolidated each week onto a map. Confirmed nesting pairs were based on locating nests; probable territories were based on clustered observations of singing males of the same species where nesting was not confirmed. We used other behavioral cues (e.g., adult with food) as indicators to

probable nesting pairs. Density indexes of species were determined by simple extrapolations of number per area on plots for avian habitats of $\geq$ 0.01 km^2 in size.

The status of each species was determined over the summer based on cumulative observations. On many occasions, day hikes and extended trips from camp supplemented our observations on plots or established new observations from different habitats and geographic locations.

In the cottonwoods at Dog Salmon, the variable circular plot method was used to determine composition and numbers of birds (Reynolds 1980), based on visual and aural observations of birds from listening stations systematically placed within the interior of the 0.7 square kilometer stand. Usually 2 observers remained at each of 11 stations for 10 minutes, recording all vocalizations by species, and estimating distances to each from the listening station. Estimation of distances was aided by marking measured distances out from listening stations with flagging every 10 m. These counts were conducted once per week in the morning, usually between 0800 and 1100. Most bird density "inflection points" (see Reynolds et al. 1980) determined in 1986 were applied to 1987 data on the same plots when applicable in order to standardize data and to facilitate comparisons between years.

Composition and Abundance of Small Mammals

Live trapping grids for small mammals were subjectively established in lowland meadow and upland shrub habitats in each study area (Table 3). One small folding live trap was baited (with a mixture of oats and peanut butter in a small ball of cheese cloth, and indigenous vegetation) and placed at each trapping station within each grid. Each trap station interval was 10 meters apart. When trapping occurred, traps were checked

at least twice daily around 0800 and 2000. Captures were identified and marked with sequentially numbered ear tags or toe-clipping for subsequent identification.

Capture indices reported were calculated by the following formula:

$$\text{Captures per 100 trap hours} = \frac{\text{Number of captures}}{\text{Number of traps open} \times \text{Number of hours of traps open}} \times 100$$

This formula was an attempt to standardize capture data due to the inconsistency of scheduling by which mammal trapping was conducted from camp to camp and because of the relatively low capture rates in all study areas.

Scent Stations

Seventeen scent stations were established along a 3,000 meter transect on top of both ridges on the Braided Creek study area (Fig. 3) to determine the presence of "predators". Each 2 meter diameter station was baited in the center with predator survey discs (U. S. Fish and Wildlife Service, Pocatello Supply Depot, Idaho). A 380 meter buffer zone was maintained between camp and the scent stations to minimize encounters with grizzly (brown) bears (Ursus arctos). In 1985, stations were run each week for 3 to 5 consecutive nights. Later, and in 1986, this period was cut back to 1 night. Each track inside the 2 meter diameter circle was identified to species (Murie 1974).

Occurrence of Large Mammals

Random and systematic observations of large mammals were recorded on a daily basis. On 2 or 3 evenings each week, 1 to 3 observers would scan the lowlands with binoculars or spotting scopes from vantage points covering broad areas adjacent to the field study camps. These observation periods lasted 0.3-0.5 hr.

RESULTS AND DISCUSSION

Weather

1985 was cooler than 1986 in Braided Creek (BC), but in Lawrence/Grass valleys (LG) temperatures were about the same for the late spring/early summer periods in both years (Tables 5-6). At Dog Salmon (DS), conditions were significantly milder in 1987 than 1986 (Table 4). 1985 was an unusually late year on the peninsula, but near the peninsula's southern terminus (Herendeen Bay), the influence of Bristol Bay moderated these conditions. This was not the case in the northern peninsula where continental climatic conditions often prevail (Selkregg 1976).

Mean daily precipitation varied widely among areas and between years. Rainfall at BC in June 1986 averaged three times higher than in June of 1985 producing flooding throughout the study area. Similarly, July precipitation at DS was three times higher in 1986 than in 1987. However, masked in these data were flooding conditions during late June-early July 1987. LG also averaged three times more rainfall in July 1985 than in July 1986.

Avian Habitat Classes, Vegetation and Study Plots

Dwarf shrub meadows occupied the largest proportion of habitat on avian study plots (Table 7). Ninety-three percent of the DS plots and almost half of the BC plots were in dwarf shrub meadow. The major habitat class at LG was the tall forb meadow. Wet meadow and grass meadow, and medium and low shrub thickets covered almost 1/4 of all plots.

Vegetation sub-classes (refer to Table 2) representing these habitats were sampled at all study sites and those that occupied the largest proportions of area within plots of all study areas

are listed in Table 8. In this analysis, dwarf shrub meadows were characterized by Sphagnum spp., Carex, Betula nana and Empetrum nigrum. Equisetum, Carex, Sphagnum, Salix and Potentilla palustris dominated wet and grass meadows. Salix, Empetrum, Equisetum, Epilobium angustifolium and a variety of forbs were typical of medium and low shrub thickets.

The cottonwood deciduous forest was characterized by Populus balsamifera, Epilobium angustifolium, Heracleum lanatum, Angelica lucida, Salix, Achillea borealis and a moss layer (Table 9).

Herbarium Collection

In all, 317 taxa of plants in 59 families (nomenclature from Hulten 1968) were recorded (Table 10). Table 10 is also a partial list of plants collected in all study sites. Specimens were deposited in the refuge herbarium in King Salmon. In many instances, several specimens from each site were collected.

Plant Flowering Phenology

The relationships between temperature and plant flowering phenology (and bird arrival phenology) are depicted in Figures 5-7. The apparent peak flowering period in 1987 (DS) occurred during the first week of July, but the peak flowering in 1986 was obscured by data collected away from the general study area (in habitats not visited in the same period in 1987). Relationships for BC and LG are somewhat clearer than DS, but only in 1986 can direct comparisons of flowering phenology among all study areas be made.

In 1986, two peak flowering periods occurred at LG (late June and late July). The bi-modal peaks were also apparent in 1985, both occurring one week later than in 1986. At BC, only

one peak flowering period was apparent, but also occurred one week later in 1985 (early-mid-July) than 1986.

Bird Arrival Phenology

The peak of bird arrival probably occurred prior to the arrival of investigators to study sites, except for LG and perhaps BC in 1986 (Figs. 5-7). The arrivals reflected in Figures 5-7 are primarily for passerines. Arrival data from BC showed the highest numbers of new birds were tallied on the day of arrival to the field camp, and 2 weeks later. Since no data were available for earlier periods, the information is inconclusive. LG arrival data suggested a peak number of birds occurring in mid-May, 1 week after the arrival of investigators. We can only speculate that the peak of passerine arrival probably occurred between the first 2 weeks of May in all study areas. Observations we have made for the spring period 1984-88 suggested that peak arrival of passerines to the King Salmon area at the base of the peninsula in fact occurred between early and middle May (Wilk and Wilk unpubl. data). It would seem that passerines nesting in the 3 study areas farther down the peninsula probably would arrive a day or so later than in King Salmon (In May 1986, the first yellow warbler [Dendroica petechia] [bird phylogeny and nomenclature from Gibson 1986] recorded at BC occurred exactly 2 days after the first was seen in King Salmon and 1 day after the species was recorded at Dog Salmon!.).

Bird Occurrence, Status and Densities on Plots

Indexes and estimates of bird abundance on plots were determined for 10 habitats in the 3 study areas (Tables 11-14). In dwarf shrub meadows, savannah sparrows (Passerculus sandwichensis), Lapland longspurs (Calcarius lapponicus) and least sandpipers (Calidris minutilla) were the most abundant nesting species. Lapland longspurs however, were absent in this habitat in LG. In wet meadow and grass meadow habitat, American tree (Spizella arborea) and savannah sparrows were most abundant. Tree sparrows were lacking in this habitat in LG. A variety of species were recorded in medium and low shrub thickets, including orange-crowned (Vermivora celata), Wilson's (Wilsonia pusilla) and yellow warblers, golden-crowned (Zonotrichia atricapilla), white-crowned (Z. leucophrys) and American tree sparrows, and willow ptarmigan (Lagopus lagopus). Interestingly, white-crowned sparrows were absent in this habitat again at LG. Dwarf shrub meadow, wet meadow and grass meadow, and medium and low shrub thicket accounted for 3/4 of the habitat coverage on bird plots.

The absence of Lapland longspurs, tree sparrows and white-crowned sparrows in expected habitats in LG may be attributed to the geographic isolation of the area. Differences in structure between similar habitats in different areas may also be important. Tree and white-crowned sparrows are relatively rare in this area of their range, but the Lapland longspur is abundant elsewhere in appropriate habitats (Narver 1970, Bailey 1974, Gill et al. 1981, R. Wilk pers. obs.). The wide between-year variation in densities of some birds at DG (Table 11) LG (Table 14) may have been attributed in part, to the addition of new plots to the LG site in 1986 and/or incomplete coverage of nesting areas on plots by investigators. A thorough discussion of all species recorded during the study will be included in the annotated species accounts in Part II.

Thirteen bird species were recorded during surveys in the cottonwood deciduous forest at DS (Table 12). Densities of the common species did not vary significantly between years. Wilson's warblers were the most abundant species and showed little variation in numbers between years. Peak abundance of all species varied between the second and third weeks of June, except for gray-cheeked thrushes (Catharus minimus) that occurred in the first week of July. The status and habitat use of all species recorded on plots and adjacent areas is listed in Table 15.

Relative Abundance of Small Mammals

The first year of small mammal trapping (1985) coincided with a "crash", following a year of very high small mammal abundance (1984) in general on the Alaska Peninsula (pers. obs.). Thus, except for the genus Sorex, few small mammals were taken (Tables 16-18). As might be expected, few raptors such as northern harriers (Circus cyaneus) and short-eared owls (Asio flammeus) were observed in the BC and LG study areas in 1985. 1986, again, was a poor year for small mammal captures at all 3 camps. Only a slight improvement at BC and LG occurred over the previous year. In 1987, the small mammal population was apparently recovering. At DS, capture indices of Microtus oeconomus (nomenclature from MacDonald 1978) were significantly higher in 1987 than in the previous year in all habitats sampled. Significant increases in capture rates of Clethrionomys rutilus and Zapus hudsonius also occurred. Decreases in the capture rates of Sorex and Zapus in LG between 1985 and 1986 were attributed to black-billed magpies (Pica pica) which meddled in traps and sprang them prematurely.

Mammalian Predators

"Predator" species recorded at scent stations along the BC transect included wolverine (Gulo gulo), gray wolf (Canis lupus), red fox (Vulpes vulpes) and grizzly bear. Indices were not calculated because sites for setting up scent stations were scarce and a system could not be established to objectively quantify their occurrence. The annotated species accounts will address these species.

Large Mammals

Observations on moose (Alces alces), caribou (Rangifer tarandus) and grizzly bear were made incidental to other work and during systematic surveys. In general, all 3 species were most common in June. By early June - about the calving period, moose and caribou were rarely seen. Small numbers reappeared by late June/early July. By July, bears were converging on salmon streams and some caribou had moved to other areas, perhaps to seek relief from biting insects. More detailed records will be presented in the species accounts.

RECOMMENDATIONS

1. An effort should be made to map the habitats of all areas along the proposed transportation corridors so that the number of fauna expected to be extirpated by habitat degradation can be grossly quantified.

2. Any future studies of a similar nature should include the gathering of bird migration data so that the timing of the occurrence (arrival and departure) of migratory birds can be better understood.

3. Information on shorebird and other water bird use of nearshore, inshore and tidal habitats on each end of the transportation corridors is needed, especially if economic development is imminent.

4. Aerial surveys of large mammals in all habitats to be affected by development of transportation corridors should be implemented for all areas along the corridors (if development is imminent).

5. More supervisory latitude must be given to the principal biologists in future studies so that they are able to implement and properly execute the best practical strategies in the field for accomplishing the mission. There was much responsibility in planning the studies, but authority to oversee the project and carry out these responsibilities was lacking. The results in this report were confounded by inconsistencies in data collection between and among camps, between and among years. As a result, it is unclear whether the annual variation in parameters of some populations was the result of natural (biological) variation or biases in the data imposed by observers in the field.

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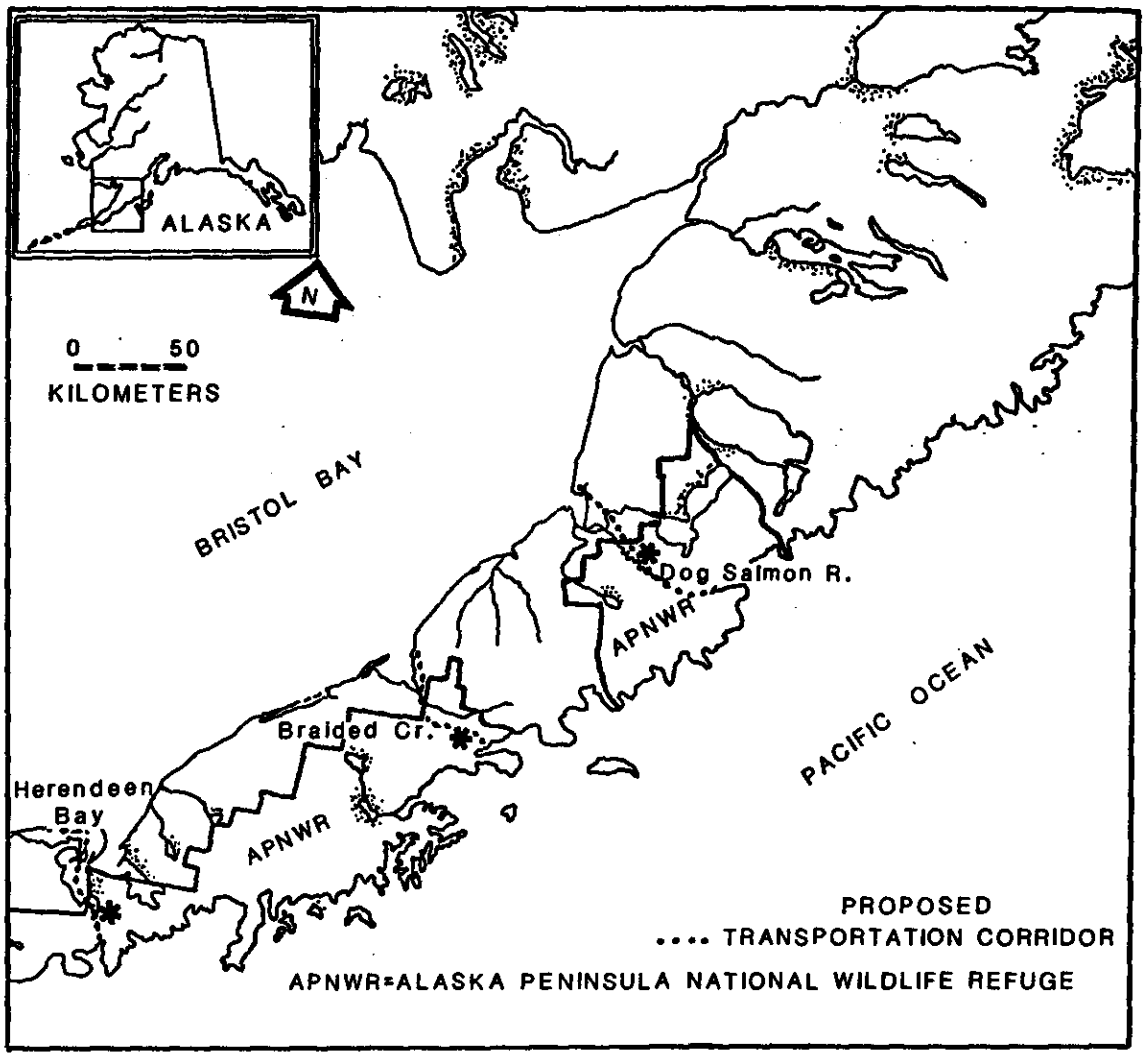

Figure 1. Locations of study areas and proposed transportation corridors on Alaska Peninsula National Wildlife Refuge.

Figure 2. Aerial view of the Dog salmon Study Area, Alaska Peninsula National Wildlife Refuge. See Appendix 1 to locate plots in relation habitats. The open arrow points to location of the field camp.

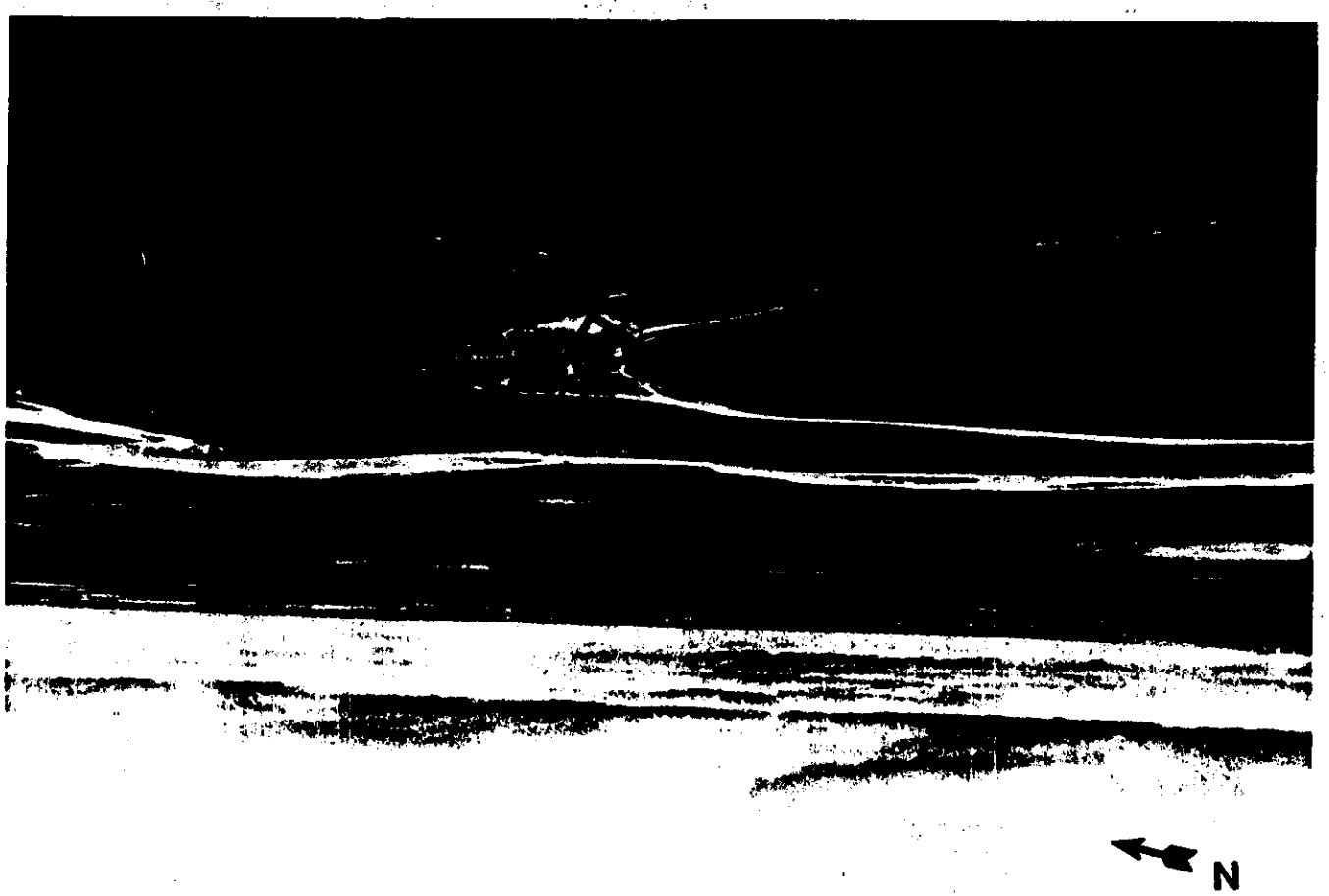
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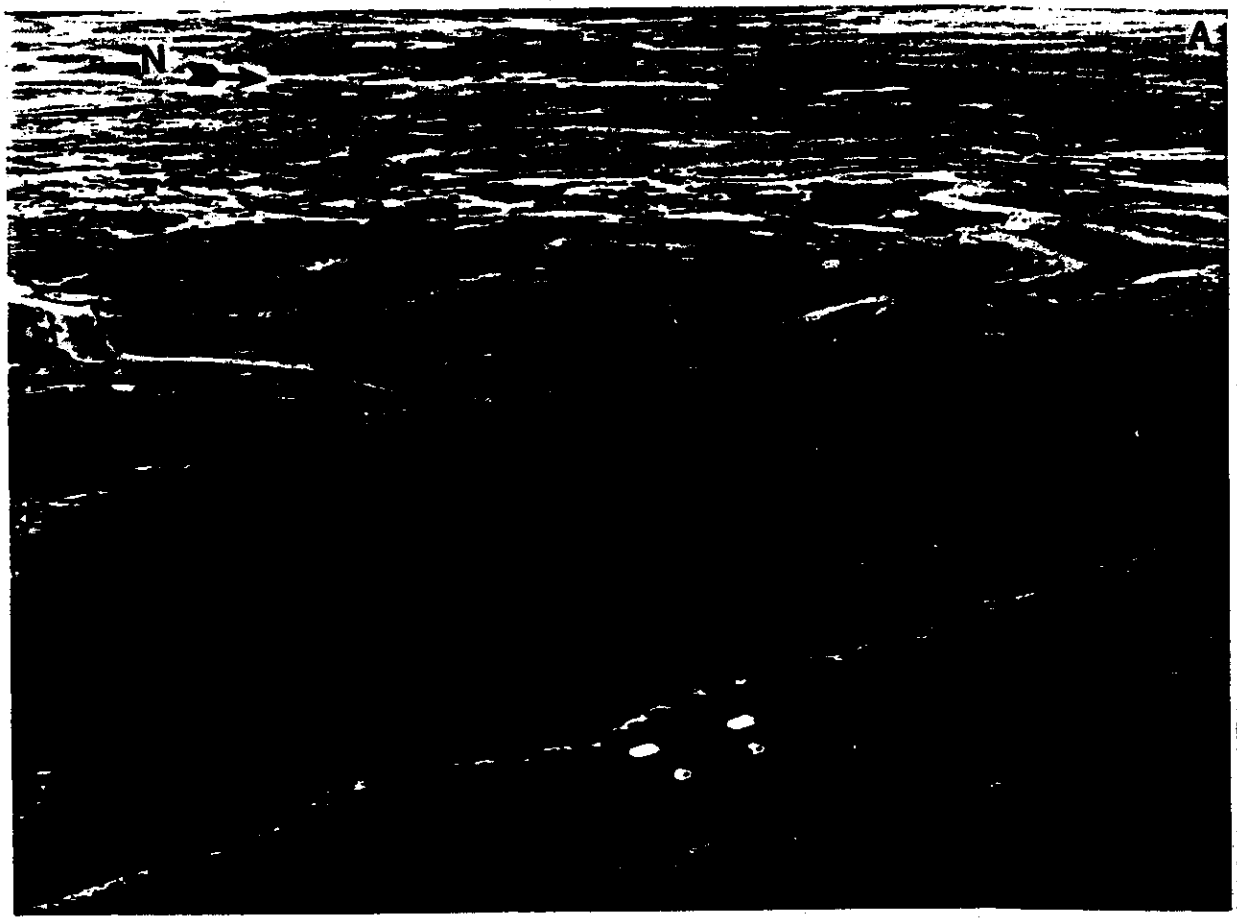
Figure 3. Aerial view of the Braided Creek Study Area, Alaska Peninsula National Wildlife Refuge. See Appendix 2 to locate plots in relation habitats. The open arrow points to location of the field camp (white weather ports; easily distinguishable in photo A).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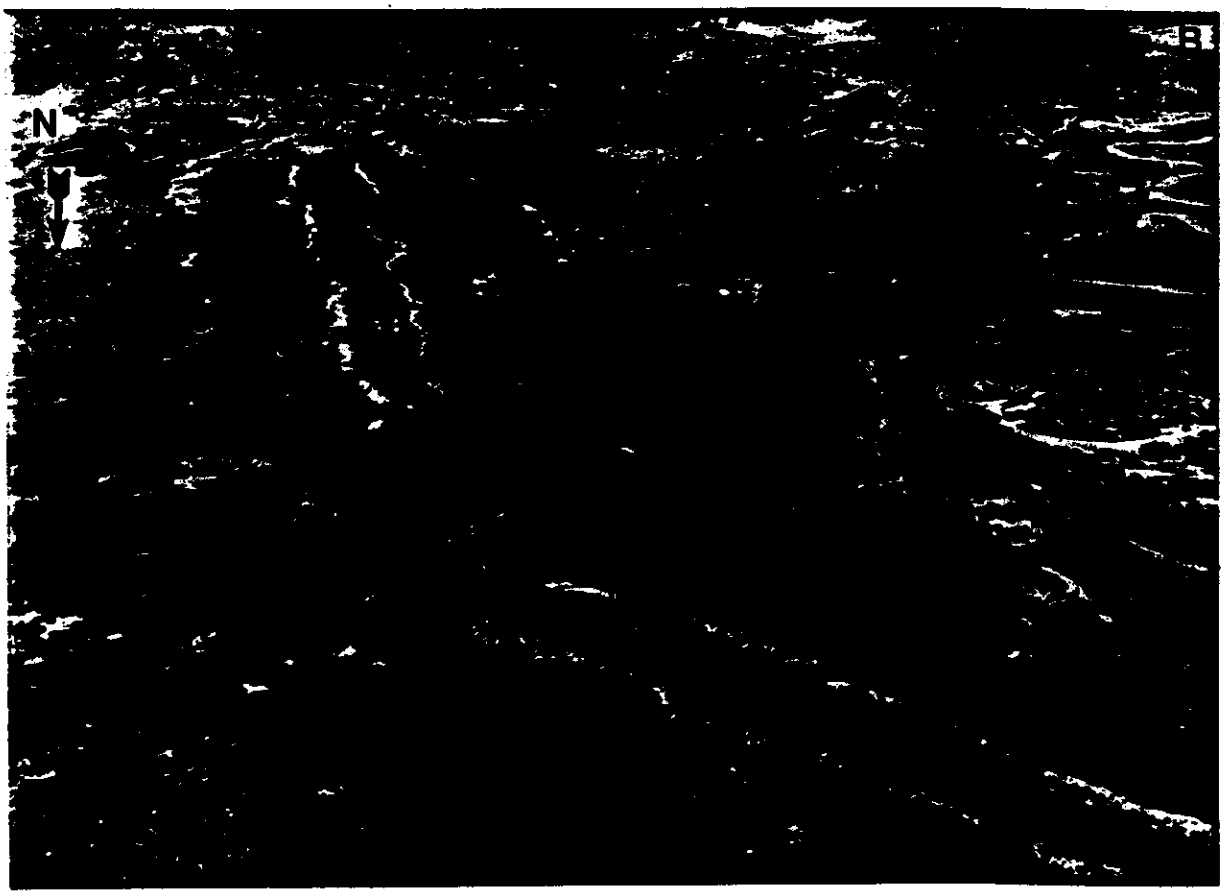
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Figure 4. Hillside view of the Lawrence Valley Study Area, Alaska Peninsula National Wildlife Refuge. See Appendix 3 to locate plots in relation habitats. The open arrow points to location of the field camp. Beyond the bluff in background is Grass Valley.


N

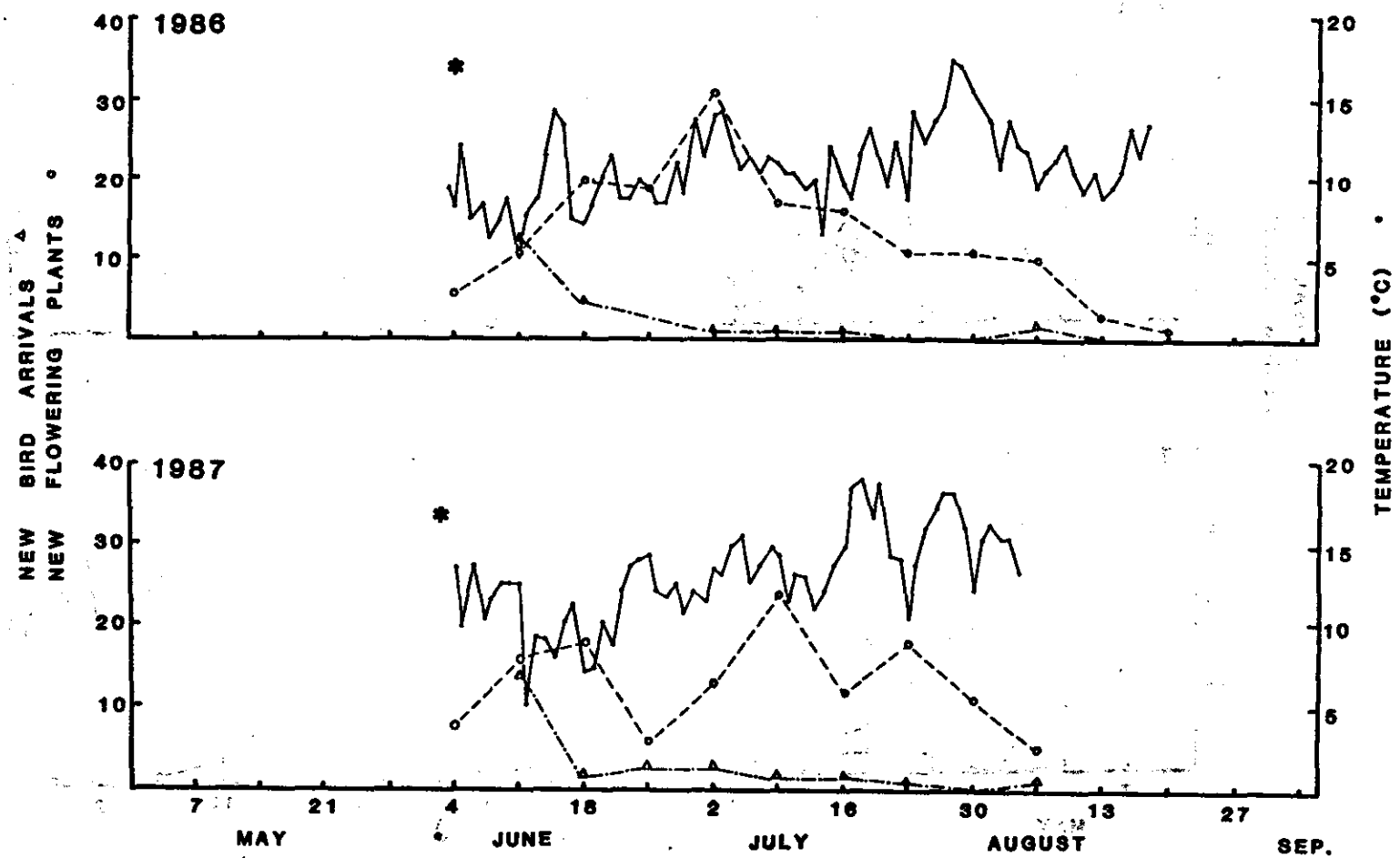


Figure 5. Mean daily temperature, weekly new arrivals of birds and weekly new flowers observed in the Dog Salmon Study Area, Alaska Peninsula National Wildlife Refuge, 1986-87 (plants do not include grasses and sedges). The 2 July peak in 1986 is attributed to additional observations recorded on a trip into alpine habitats of Dog Mountain. The asterisk denotes number of birds recorded upon arrival to the study site.

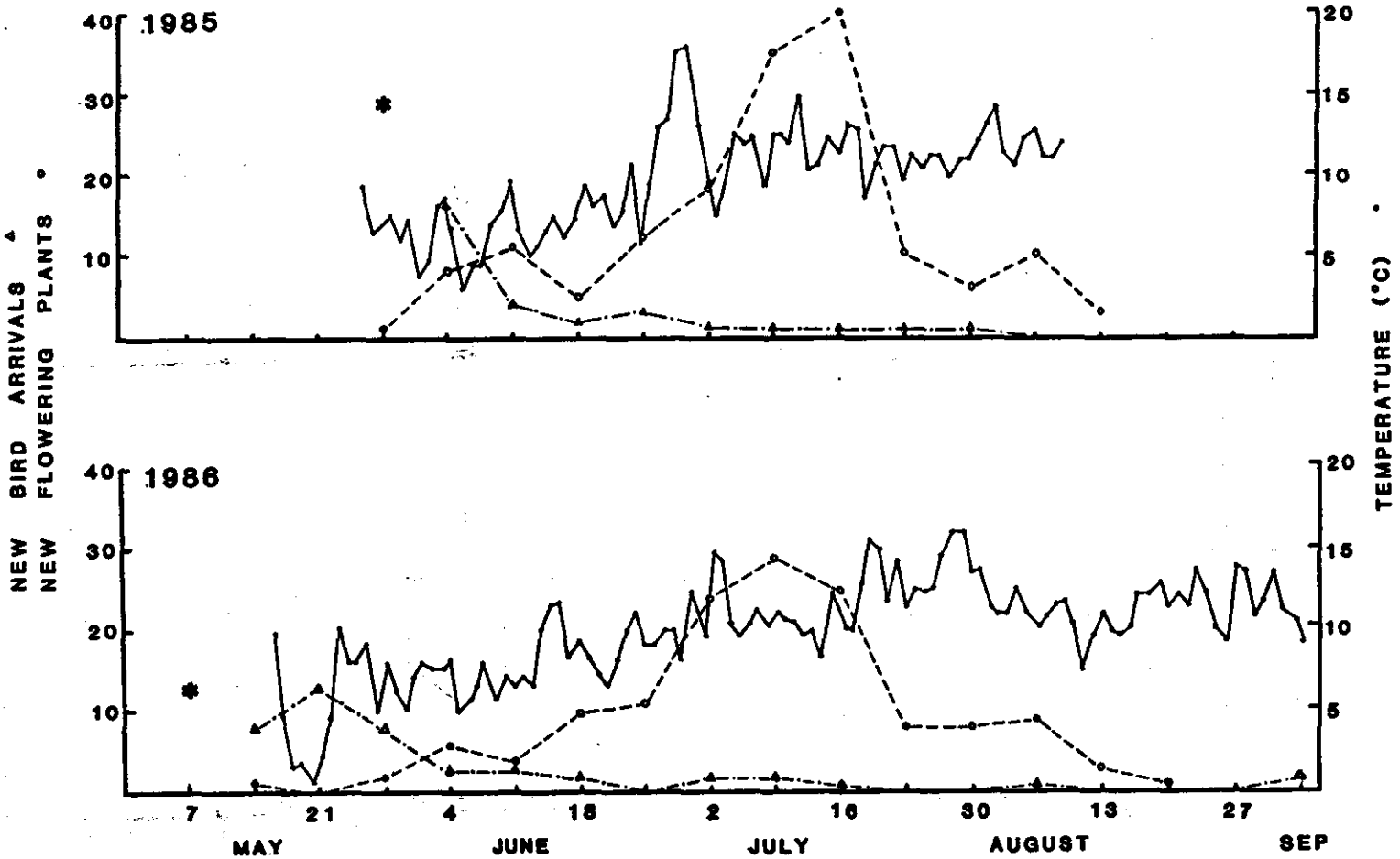


Figure 6. Mean daily temperature, weekly new arrivals of birds and weekly new flowers observed in the Braided Creek Study Area, Alaska Peninsula National Wildlife Refuge, 1985-86. The asterisk denotes number of birds recorded upon arrival to the study site.

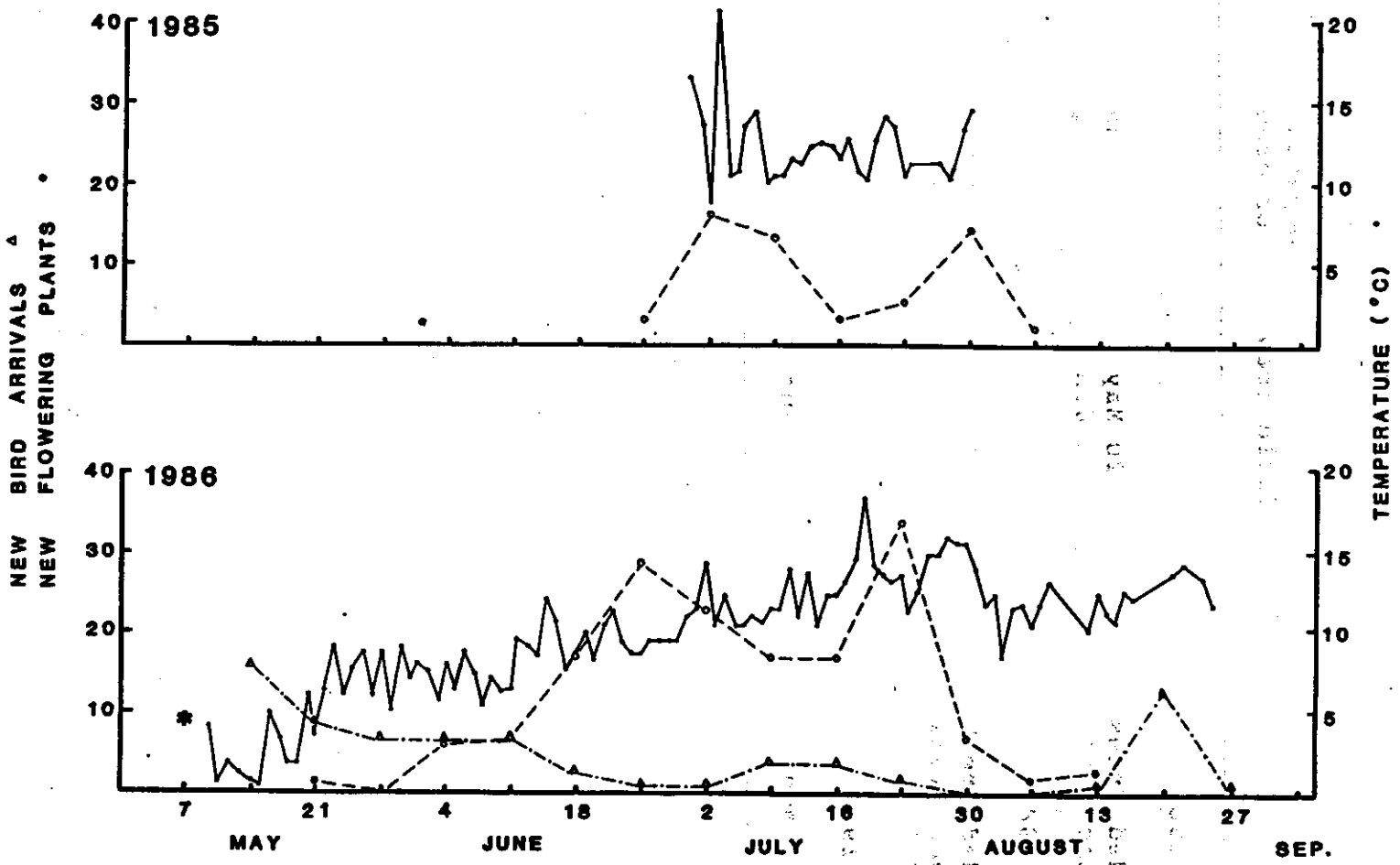


Figure 7. Mean daily temperature, weekly new arrivals of birds and weekly new flowers observed in the Lawrence/Grass Valley Study Area, Alaska Peninsula National Wildlife Refuge, 1985-86. The 20 August peak in 1986 is attributed to additional observations recorded on a trip to Mud Bay. The asterisk denotes number of birds recorded upon arrival to the study site.

Table 1. Dates of field work for studies conducted at 3 sites on the Alaska Peninsula National Wildlife Refuge, Alaska, 1985-87.

	Arrival of field crew	Departure of crew	Total days
1985			
Braided Creek	20 May	11 Aug	84
Lawrence Valley	23 Jun	2 Aug	41
1986			
Braided Creek	10 May	4 Sep	118
Lawrence Valley	7 May	25 Aug	111
Dog Salmon	2 Jun	19 Aug	77
1987			
Dog Salmon	3 Jun	5 Aug	64

Table 2. Avian habitat classes for Alaska (Kessel 1979) and corresponding vegetation (sub-) classifications from Viereck et al. (1986) and this study.

Kessel	Viereck et al. Level IV	This study[a]
Fluviatile waters and shorelines		Creek and sand/gravel bar[2, 3]
Dwarf shrub meadow	Open dwarf birch-ericaceous shrub Sphagnum	Dwarf shrub-graminoid-Sphagnum, dwarf shrub-Sphagnum hummock, horsetail-herb-Sphagnum bog[1]; Sphagnum-sedge grass tussock, riparian herb[2]; sedge tussock, Sphagnum tussock[3]
Dwarf shrub meadow and dwarf shrub mat[b]	Ericaceous shrub tundra	Crowberry hummock[2,3]
Wet meadow and grass meadow[b]	Fresh herb marsh; fresh sedge marsh	Wet sedge marsh[1]; Buckbean-horsetail-herb or sedge marsh[1,3]; wet sedge and ponds[2,3]; bluejoint marsh[3]
Grass meadow	Bluejoint tall grass; mesic herb	Riparian herb-open willow[1]; Grass mat[2,3]
Tall forb meadow	Mesic herb	Mesic herb meadow[3]
Low shrub thicket	Sweetgale-sphagnum bog	Sedge-willow-sweetgale[2]
Medium shrub thicket and low shrub thicket[b]	Closed willow-tall shrub; open willow-tall shrub	Riparian willow[1]; Upland willow[2,3]; Lowland willow[2,3]
Medium shrub thicket and tall shrub thicket[b]	Closed alder tall shrub; open alder-willow tall shrub	Riparian alder-willow[1,3]; Riparian alder[2]; Upland alder thicket[3]
Artificial habitats		Gravel airstrip[2]

[a]Numbers in parentheses are [1]Dog Salmon, [2]Braided Creek and [3]Lawrence/Grass Valley study areas.
[b]If two classes are listed, the first is the dominant class.

Table 3. Configuration, habitat, area and trapping periods on live-trapping grids for small mammals at 3 study areas in the Alaska Peninsula Refuge, 1985-87.

Location	Habitat	Configuration of grid	Total trap stations	Area (m^2)	Trapping periods	Hrs traps open
Dog Salmon						
1986	Wet mead., grass mead., med., low shrub thicket	10 x 10	100	8,100	21-24 Jun	63
					29 Jun-1 Aug	85
	Dwarf shrub mead.	10 x 10	100	8,100	21-24 Jun	63
					29 Jun-1 Aug	85
1987	Wet mead., grass mead., med., low shrub thicket	10 x 7	70	5,400	24-27 Jun	68
					21-24 Jul	60
	Dwarf shrub mead.	10 x 7	70	5,400	24-27 Jun	68
					21-24 Jul	60
	Cottonwood decid. forest	1 x 10	10	90	24-27 Jun	68
					21-24 Jul	60
Braided Ck.						
1985	Med., low shrub thicket	7 x 7	49	3,600	30 Jun-4 Jul	120
					21-24 Jul	68
					7-10 Aug	72
	Med., low shrub thicket	7 x 7	49	3,600	30 Jun-4 Jul	120
					21-24 Jul	68
					7-10 Aug	72
	Dwarf shrub mead.	10 x 10	100	8,100	24-29 Jun	120
					24-27 Jul	72
					4-7 Aug	68
1986	Med., low shrub thicket	6 x 7	42	3,000	28-31 May	80
					24-27 Jun	80
					29 Jul-1 Aug	56
					24-25, 27-29 Aug	60
	Med., low shrub thicket	6 x 7	42	3,000	27-31 May	80
					24-27 Jun	80
					29 Jul-1 Aug	56
					24-25, 27-29 Aug	60
	Dwarf shrub mead.	7 x 10 (+5)	75	5,800	27-31 May	80
					24-27 Jun	80
					31 Jul-2 Aug	56
					24-25, 27-29 Aug	60

Table 3. Continued.

Lawrence Val.						
1985	Dwarf shrub mead., dwarf shrub mat, Tall forb meadow	5 x 8	40	2,800	3-7 Jul 15-18 Jul 23-27 Jul	96 72 98
	Dwarf shrub mead., dwarf shrub mat, Med., tall shrub thicket	5 x 8	40	2,800	9-13 Jul 20-23 Jul 27-31 Jul	96 96 89
1986	Dwarf shrub mead., dwarf shrub mat, Tall forb meadow	9 x 10	90	7,200	22-26 May 26 Jun-1 Jul 23-28 Jul	96 109 120
	Dwarf shrub mead., dwarf shrub mat, Med., tall shrub thicket	3x6, 5x8, 2x3 3x6, 2x2	81	5,100	22-26 May 26 Jun-1 Jul 23-28 Jul	96 109 120

Table 4. Daily weather from Dog Salmon study area, Alaska Peninsula National Wildlife Refuge, 2 June - 19 August 1986, and 3 June - 5 August 1987[a].

		June		July		August	
		1986	1987	1986	1987	1986	1987
Air temp. (° C)							
min.		1.1	2.8	2.2	6.7	1.1	9.4
mean min.		5.7	6.0	7.5	9.6	6.7	10.9
max.		22.8	23.3	26.1	30.0	21.1	23.3
mean max.		12.8	16.3	16.7	19.9	16.1	19.9
Cloud cover (mean %)		88	87	83	82	83	83
(SD)		19	25	23	31	23	23
Precip. (mean mm)		2.5	2.5	2.9	1.0	2.1	1.5
(SD)		5.0	3.9	6.1	1.5	2.0	1.2
Wind speed (mean km)		12	14	9	9	6	15
(SD)		11	14	8	10	6	9
direction (%)	N	2					
	NE		16		5		38
	E	60	26	34	23	27	25
	SE		11	6	8	5	25
	S						
	SW	2	4		2	5	
	W	5	9	5	16	11	
	NW	7	16	21	15		
	Calm	23	19	34	32	51	13
Barom. (mean mbar)		1013	1006	1022	1021	1018	1019
(SD)		6	9	7	6	7	10
Rel. humid. (mean %)		86	85	94	88	95	88
(SD)		7	11	4	10	4	8

[a]Daily measurements averaged from a morning and evening reading.

Table 5. Daily weather from Braided Creek study area, Alaska Peninsula National Wildlife Refuge, 26 May - 10 August 1985, and 10 May - 4 September 1986[a].

	May		June		July		August		Sep
	1985	1986	1985	1986	1985	1986	1985	1986	1986
Air temp. (°C)									
min.		-5.6	-1.7	0.0	3.3	5.6	7.2	1.1	3.3
mean min.		0.6	3.6	5.4	8.2	8.6	8.8	7.6	7.6
max.		19.4	26.1	18.7	22.2	24.4	20.6	18.9	15.6
mean max.		10.7	12.7	11.6	14.7	15.9	15.8	15.0	14.6
Cloud cover (mean %)	88	62	81	76	91	86	82	86	60
(SD)	13	37	24	28	16	20	17	20	41
Precip. (mean mm)	1.6	0.4	1.3	4.6	1.9	1.8	1.6	3.4	2.2
(SD)	1.7	1.4	2.0	8.2	3.4	3.7	2.3	6.9	3.0
Wind speed (mean km)	10	10	5	10	5	7	7	8	5
(SD)	4	6	5	7	6	4	7	7	1
direction (%) N		3	2	3				2	14
NE	18	6	5	2		2		3	
E	27	19	12	57	34	30	22	23	14
SE	18		3	2	2	3	6	10	14
S			5	3	3	2	6	10	
SW	9					5	6	5	
W		29	17	10	2	19	17	16	14
NW	9	13	20	8	8	10	6	6	14
Calm	18	29	37	15	51	31	39	26	29
Barom. (mean mbar)	994	1005	1016	1004	1018	1014	1011	1010	1020
(SD)	2	4	9	7	7	7	5	11	4
Rel. humid. (mean %)	92	79	89	82	96	85	95	86	84
(SD)	6	11	7	9	4	6	4	6	7

[a]Daily measurements averaged from a morning and evening reading.

Table 6. Daily weather from lower Lawrence Valley, southeastern Herendeen Bay, Alaska Peninsula National Wildlife Refuge, 27 June - 30 July 1985, and 7 May - 25 August 1986[a].

		May	June	July		August
		1986	1986	1985[b]	1986	1986
Air temp. (°C)						
min.		-5.0	2.2	6.7	5.6	4.4
mean min.		0.5	5.5	9.2	9.6	9.2
max.		16.7	17.8	23.3	23.3	21.1
mean max.		9.0	12.0	15.9	16.8	15.4
Cloud cover						
(mean %)		83	95	93	98	100
(SD)		30	14	12	6	1
Precip.						
(mean mm)		0.6	1.3	2.7	0.9	1.1
(SD)		1.6	1.2	1.2	2.4	2.4
Wind speed						
(mean km)		5	5	13	4	4
(SD)		4	4	7	3	4
direction (%)	N		2		2	3
	NE	7	12	13	3	3
	E	7	10	11	5	20
	SE	5	17	20	21	25
	S	2	8	2	11	
	SW			13		3
	W	30	30	19	24	23
	NW	32	3	14	15	8
	Calm	18	18	9	19	18
Barom.						
(mean mbar)		1011	1012	1013	1023	1021
(SD)		4	7	11	8	9
Rel. humid.						
(mean %)		83	93	95	95	94
(SD)		10	5	3	4	5

[a] Daily measurements averaged from an am and pm recording.
[b] Data include 27-30 June.

Table 7. Avian habitat classes (Kessel 1979) and areal coverage on plots in 3 study areas on the Alaska Peninsula National Wildlife Refuge, 1985-87.

	Dog Salmon	Braided Creek	Lawrence, Grass valleys	Total
Total area (km^2)	0.597	0.810	0.500 (0.200)[a]	19.072
Percentage of area on plots:				
Dwarf shrub meadow	92.7	44.7	15.5 (19.8)	52.1
Wet meadow and grass meadow	4.2	19.1	7.5 (7.6)	11.4
Med. and low shrub thicket	1.8	19.3	8.6 (5.6)	11.0
Tall forb meadow			34.8 (29.3)	9.1
Dwarf shrub meadow and dwarf shr. mat		13.6	10.8 (17.1)	8.6
Med. and tall shr. thicket	0.2	0.2	11.4 (18.0)	3.2
Grass meadow	1.0	0.5	7.9 (1.0)	2.6
Fluviatile waters and shorelines		1.0	3.4 (1.8)	1.3
Low shrub thicket		1.4		0.6
Artificial habitat		0.3		0.1

[a]Total for 1985 (prior to the addition of more plots in 1986) in parentheses.

Table 8. Composition, cover (x % ± sD) and frequency (%) of plants in vegetation sub-classes[a] sampled within avian habitat classes (Kessel 1979) in 3 study areas in Alaska Peninsula National Wildlife Refuge. Sub-classes sampled and presented as representative of all study areas[b] were from the Braided Creek (13-31 July 1986) and Laurence/Grass valleys (7 July - 1 August 1986).

	Avian habitat class (top), vegetation sub-class (middle) and study area of sample (BC = Braided; LG = Laurence/Grass)							
	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
	Sagt[c] BC	Mesp BC	Ss BC	Mhw LG	Ch BC	Sst LG	Gw LG	Sus BC
	(35)[d]	(12)	(32)	(25)	(13)	(15)	(15)	(13)
Overstory								
Equisetum arvense				0.2 ± 0.7 (12)[f]				
Dryopteris dilatata				15.0 ± 26.9 (32)				
Calamagrostis canadensis				9.9 ± 20.1 (44)				
Poa arctica				0.1 ± 0.1 (4)				
Elymus arenarius				1.2 ± 4.1 (16)				
Salix spp.	1.1 ± 6.3 (3)		39.5 ± 33.2 (75)					
Alnus crispa							58.7 ± 21.6 (100)	
Ranunculus Bongardi				0.6 ± 3.0 (8)				
Rubus spectabilis				1.4 ± 4.2 (20)				
Sanguisorba stipulata				0.1 ± 0.5 (4)				
Senu macrophyllum				0.6 ± 3.0 (4)				
Lupinus neetkatensis			3.0 ± 17.2 (3)					
Geranium erianthum				1.9 ± 5.0 (16)				
Epilobium angustifolium	0.7 ± 8.4 (13)			4.4 ± 6.0 (44)				
E. glandulosum				0.6 ± 3.0 (8)				
Coniosolinum chinense				0.6 ± 3.0 (4)				
Angelica genuflexa				1.9 ± 5.0 (16)				
Heracleum lanatum			3.0 ± 17.2 (3)	12.4 ± 26.9 (24)				
Solidago lepida				4.0 ± 14.3 (8)				
Middle story								
Equisetum variegatum	2.2 ± 3.9 (74)	0.4 ± 1.0 (17)						
E. fluviatile	2.2 ± 2.8 (74)	11.5 ± 6.4 (83)		0.1 ± 0.5 (12)				0.2 ± 0.7 (15)

Table 8. Continued.

	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
E. pratense				0.1 ± 0.5 (8)				
E. arvense	8.1 ± 13.4 (85)	10.3 ± 10.9 (92)	9.2 ± 10.0 (69)	3.6 ± 12.6 (44)	1.0 ± 1.1 (77)	0.4 ± 0.9 (33)	10.1 ± 17.9 (73)	
Thelypteris phegopteris						1.0 ± 3.9 (7)		
Dryopteris dilatata				0.1 ± 0.5 (4)		57.8 ± 26.6 (100)	12.7 ± 20.6 (33)	
Gymnocarpium dryopteris				0.1 ± 0.1 (8)				
Hierochloe odorata				0.1 ± 0.1 (8)	0.1 ± 0.1 (8)			
Phleum commutatum				0.1 ± 0.1 (4)				
Calamagrostis canadensis			1.4 ± 2.7 (63)	3.4 ± 12.7 (28)	0.1 ± 0.1 (8)	2.6 ± 5.1 (47)	43.0 ± 28.2 (100)	0.4 ± 0.9 (23)
Poa arctica	0.1 ± 0.1 (9)			0.1 ± 0.2 (16)			0.1 ± 0.1 (7)	
Poa spp.				0.1 ± 0.1 (4)				
Festuca altaica			2.0 ± 3.6 (66)	10.2 ± 22.2 (40)	5.2 ± 6.9 (54)			
Festuca rubra				0.1 ± 0.1 (4)				
Grass spp.	0.1 ± 0.1 (6)				2.5 ± 3.9 (85)			
Elymus arenarius			0.1 ± 0.1 (6)	3.4 ± 7.8 (12)	3.7 ± 6.5 (39)		0.5 ± 1.0 (27)	
Eriophorum angustifolium	0.1 ± 0.4 (6)	0.2 ± 0.2 (33)						4.0 ± 6.3 (77)
E. russeolum	0.2 ± 0.5 (29)							
Trichophorum caespitosum	0.1 ± 0.1 (3)							0.2 ± 0.7 (8)
Carex maclovania/ macrochaeta				3.2 ± 9.2 (32)				
C. Lyngbyei	4.5 ± 12.5 (29)	48.1 ± 29.1 (100)	1.8 ± 7.0 (19)	0.1 ± 0.5 (4)	0.1 ± 0.1 (8)		9.4 ± 21.9 (27)	
C. rariflora	18.1 ± 20.0 (77)	12.0 ± 16.7 (33)						4.6 ± 6.0 (69)
C. pluriflora				0.1 ± 0.1 (4)			0.5 ± 1.0 (27)	
Carex spp.	10.8 ± 13.3 (80)	1.3 ± 4.3 (8)	0.2 ± 0.6 (22)	3.4 ± 7.8 (12)				5.4 ± 6.7 (100)
Juncus spp.				0.1 ± 0.1 (4)				
Fritillaria camschatcensis				0.1 ± 0.2 (12)				
Streptopus amplexifolius						0.2 ± 0.7 (7)		
Erythronium dilatata				0.1 ± 0.1 (8)				
Salix arctica	0.1 ± 0.4 (3)							
Salix spp.	6.1 ± 10.4 (11)	15.6 ± 8.1 (92)	0.8 ± 2.7 (16)		6.4 ± 11.4 (31)			7.1 ± 4.3 (15)
Myrica gale	6.3 ± 11.4 (31)							2.9 ± 10.4 (8)
Betula nana	7.9 ± 13.2 (40)	3.1 ± 10.8 (8)						6.0 ± 4.0 (8)
Rubus fenestratus							0.2 ± 0.7 (7)	
Claytonia sibirica				2.7 ± 8.7		0.2 ± 0.7	0.1 ± 0.2	

Table 8. - Continued.

	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
				(56)		(13)	(13)	
Stellaria crispa						0.1 ± 0.1 (7)		
S. sitchana				0.1 ± 0.1 (8)				
Stellaria spp.				0.1 ± 0.1 (8)				
Cerastium beeringianum				1.1 ± 4.8 (8)				
Mocringia lateriflora				0.2 ± 0.5 (16)	0.1 ± 0.1 (8)			
Aconitum delphinifolium			0.1 ± 0.1 (6)	0.2 ± 0.5 (32)	0.1 ± 0.1 (8)			
Ranunculus Bongardi				0.3 ± 0.8 (16)				
Cardamine pratensis	0.1 ± 0.1 (6)	0.1 ± 0.1 (8)						
C. umbellata				0.1 ± 0.5 (8)			0.2 ± 0.7 (13)	
Tellima grandiflora						1.0 ± 3.9 (7)		
Rubus chamaemorus	0.1 ± 0.1 (3)							
R. arcticus	1.2 ± 5.4 (11)		0.1 ± 0.1 (6)	0.1 ± 0.2 (12)	0.3 ± 0.7 (23)		0.1 ± 0.1 (7)	
R. spectabilis				0.3 ± 0.8 (16)		12.5 ± 16.3 (67)		
Potentilla palustris	1.3 ± 6.3 (11)						1.2 ± 3.9 (13)	
Geum macrophyllum				0.2 ± 0.1 (4)		0.1 ± 0.1 (7)		
Sanguisorba stipulata			2.8 ± 5.4 (44)	7.6 ± 9.2 (72)	0.3 ± 0.7 (39)	0.1 ± 0.2 (13)	1.3 ± 3.9 (20)	0.1 ± 0.1 (8)
Lupinus nootkatensis			3.4 ± 11.6 (22)		5.8 ± 14.1 (15)			
Geranium erianthum			6.5 ± 8.4 (88)	8.3 ± 12.7 (52)	4.9 ± 5.8 (92)			
Viola Langsdorfii				0.1 ± 0.1 (14)	0.1 ± 0.1 (8)		1.1 ± 3.9 (20)	
Epilobium angustifolium			10.3 ± 17.1 (97)	0.1 ± 0.2 (16)	4.9 ± 5.8 (100)		0.5 ± 1.0 (27)	
E. glandulosum				0.2 ± 0.5 (20)			0.1 ± 0.2 (13)	
E. beeringianum				0.1 ± 0.1 (4)				
Circaea alpina						0.3 ± 0.9 (13)		
Conioselinum chinense			0.1 ± 0.5 (6)	0.2 ± 0.7 (12)			0.4 ± 0.9 (20)	
Angelica lucida	0.1 ± 0.4 (3)			2.4 ± 5.6 (16)	0.1 ± 0.1 (8)	0.1 ± 0.1 (7)		
A. genuflexa		4.4 ± 11.3 (17)	0.5 ± 2.7 (6)	2.0 ± 5.7 (24)	0.1 ± 0.1 (8)		8.0 ± 13.4 (40)	
Angelica spp.					2.6 ± 5.1 (8)			
Heracleum lanatum			5.6 ± 16.5 (13)	4.5 ± 10.8 (24)		5.0 ± 7.3 (33)	7.0 ± 13.4 (27)	
Empetrum nigrum	2.3 ± 6.8 (3)		2.0 ± 11.0 (3)					
Trientalis europaea				0.1 ± 0.1 (4)		0.2 ± 0.7 (7)	0.1 ± 0.2 (27)	
Saxifr. perennis			0.1 ± 0.1 (3)	1.1 ± 4.6 (12)				

Table 8. Continued.

	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
Menyanthes trifoliata	1.1 ± 6.3 (6)	1.3 ± 4.3 (8)						
Polemonium acutiflorum	0.1 ± 0.4 (14)			0.6 ± 3.0 (8)			0.2 ± 0.7 (7)	
Castilleja unalaschcensis			0.2 ± 0.6 (5)	2.1 ± 4.9 (32)	0.1 ± 0.1 (8)		0.1 ± 0.1 (7)	
Rhinanthus minor				0.1 ± 0.1 (8)				
Pedicularis sudetica				0.1 ± 0.1 (4)				
Boschniakia rossica						0.1 ± 0.1 (7)		
Galium boreale			0.3 ± 0.7 (22)	0.4 ± 0.8 (24)	1.2 ± 1.2 (62)		0.2 ± 0.7 (20)	
G. triflorum				1.1 ± 4.8 (8)				
Sambucus racemosa						1.0 ± 3.9 (7)		
Valeriana capitata	0.1 ± 0.1 (3)	0.1 ± 0.1 (8)						
Solidago multiradiata				0.7 ± 3.0 (8)			0.2 ± 0.7 (7)	0.9 ± 2.1 (15)
S. lepida			2.8 ± 5.4 (47)	5.1 ± 9.4 (28)			0.2 ± 0.7 (20)	
Solidago spp.			0.1 ± 0.1 (3)					
Erigeron peregrinus				0.6 ± 3.0 (4)				
Achillea borealis			3.4 ± 5.2 (75)	1.8 ± 4.1 (52)	4.1 ± 6.3 (92)		3.0 ± 6.2 (20)	1.1 ± 3.3 (8)
Petasites frigidus				0.1 ± 0.5 (4)				
Arnica chamissonis			0.1 ± 0.5 (6)	0.1 ± 0.5 (12)				
Unknown forb				0.1 ± 0.1 (4)				
Ground story								
Sphagnum spp.	65.6 ± 31.8 (97)	25.2 ± 24.6 (83)	9.8 ± 12.5 (91)		5.6 ± 6.6 (100)			2.1 ± 4.0 (77)
Moss spp.				49.7 ± 29.8 (92)	0.1 ± 0.1 (8)	15.4 ± 18.0 (80)	27.0 ± 30.8 (80)	
Equisetum arvense			0.1 ± 0.1 (3)	0.1 ± 0.1 (8)				0.1 ± 0.1 (8)
Botrychium lunaria			0.1 ± 0.1 (4)					
Gymnocarpium dryopteris			0.2 ± 0.7 (8)					
Festuca altaica			0.1 ± 0.1 (4)					
Grass spp.			0.1 ± 0.1 (4)					
Trichophorum caespitosum								0.1 ± 0.1 (8)
Carex rariflora		1.3 ± 4.3 (8)						
Carex spp.			0.1 ± 0.1 (3)					
Fritillaria camschatcensis			0.1 ± 0.1 (3)					
Liliaceae spp.			0.1 ± 0.1 (4)					
Plantanthera ciliatata		0.2 ± 0.7 (8)						

Table 8. Continued.

	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
Plantanthera spp.	0.1 ± 0.1 (3)							
Salix reticulata	2.2 ± 5.3 (17)							0.1 ± 0.1 (8)
S. arctica	3.8 ± 14.8 (14)							
Salix spp.	2.8 ± 5.1 (57)							3.7 ± 5.1 (77)
Myrica gale								1.2 ± 4.2 (8)
Betula nana	12.2 ± 15.2 (54)	7.3 ± 11.5 (58)						6.2 ± 7.3 (62)
Polygonum viviparum	0.1 ± 0.4 (11)							0.1 ± 0.1 (8)
Claytonia sibirica			0.1 ± 0.1 (4)			0.1 ± 0.1 (7)	0.1 ± 0.1 (7)	
Stellaria calycantha		0.1 ± 0.2 (17)						
S. sitchana			0.6 ± 3.0 (12)			0.1 ± 0.2 (13)	0.3 ± 0.9 (27)	
Stellaria spp.			0.1 ± 0.1 (3)					
Mosheringia lateriflora	0.1 ± 0.1 (3)		0.2 ± 0.5 (34)	0.1 ± 0.1 (8)	0.1 ± 0.1 (8)			
Caltha palustris		0.1 ± 0.1 (8)						
Coptis trifolia						0.1 ± 0.1 (7)		
Aconitum delphinifolium			0.1 ± 0.2 (12)					
Thalictrum alpinum			0.8 ± 3.0 (20)					
Corydalis pauciflora				0.1 ± 0.1 (4)		0.1 ± 0.2 (13)		
Cardamine pratensis	0.1 ± 0.1 (3)	1.3 ± 4.3 (17)						
C. umbellata			0.1 ± 0.1 (3)	0.8 ± 3.0 (28)	0.1 ± 0.1 (8)	0.3 ± 0.7 (27)	0.4 ± 0.9 (33)	
Drosera rotundifolia	0.4 ± 0.7 (40)							
Parnassia palustris	0.1 ± 0.2 (20)	0.7 ± 1.1 (33)	0.1 ± 0.1 (3)					0.1 ± 0.2 (23)
Parnassia spp.	0.1 ± 0.1 (3)							
Rubus chamaemorus						0.1 ± 0.1 (7)	0.1 ± 0.2 (13)	
R. arcticus	0.6 ± 2.6 (14)	0.6 ± 1.1 (25)	3.0 ± 5.3 (75)	0.8 ± 3.0 (36)	0.5 ± 0.9 (39)	0.1 ± 0.2 (33)		0.2 ± 0.2 (31)
Potentilla palustris	1.9 ± 3.5 (57)	37.1 ± 27.6 (100)						0.4 ± 0.7 (39)
Sanguisorba stipulata			0.1 ± 0.1 (3)					0.1 ± 0.1 (8)
Lupinus nootkatensis			0.1 ± 0.1 (6)					0.1 ± 0.1 (8)
Geranium erianthum			0.1 ± 0.1 (3)		0.1 ± 0.1 (8)			
Viola Langsdorffii			0.3 ± 0.7 (25)	1.2 ± 3.1 (32)	0.1 ± 0.2 (23)			0.2 ± 0.7 (8)
Viola spp.			0.1 ± 0.1 (3)	0.1 ± 0.5 (4)				0.1 ± 0.1 (8)
Epilobium palustre	0.1 ± 0.1 (5)							
E. glandulosum	0.1 ± 0.1	0.9 ± 1.2						

Table 8. Continued.

	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
	(3)	(42)						
Epilobium spp.	0.2 ± 0.6 (17)	0.1 ± 0.1 (8)						
Circaea alpina				0.1 ± 0.2 (20)		0.3 ± 0.7 (33)	0.1 ± 0.1 (7)	
Angelica lucida				0.1 ± 0.2 (20)		0.1 ± 0.1 (7)	0.1 ± 0.2 (27)	
Angelica spp.			0.2 ± 0.6 (19)		0.1 ± 0.1 (8)			
Conioselinum chinense			0.1 ± 0.1 (3)					
Pyrola minor					0.1 ± 0.2 (25)			
Pyrola spp.			1.4 ± 2.7 (53)		0.2 ± 0.7 (8)			
Empetrum nigrum	15.6 ± 17.6 (74)		35.4 ± 36.5 (63)	1.5 ± 7.5 (4)	66.9 ± 22.0 (100)			5.7 ± 11.0 (62)
Ledum palustre	0.1 ± 0.1 (11)							
Andromeda polifolia	3.2 ± 5.0 (89)		0.1 ± 0.1 (3)					2.9 ± 5.4 (77)
Arctostaphylos uva-ursi	1.0 ± 5.1 (14)		5.0 ± 8.4 (56)		11.8 ± 13.4 (69)			
Vaccinium vitis-idaea	0.1 ± 0.4 (11)		2.4 ± 4.3 (63)		8.2 ± 7.6 (85)			0.1 ± 0.2 (15)
V. uliginosum								1.2 ± 4.2 (8)
Oxycoccus microcarpus	0.4 ± 0.4 (55)							0.1 ± 0.1 (8)
Trientalis europaea	0.2 ± 0.3 (37)	0.3 ± 0.7 (33)	0.5 ± 0.6 (78)	0.4 ± 0.7 (52)	0.4 ± 0.2 (69)	0.1 ± 0.2 (27)	0.1 ± 0.2 (13)	1.0 ± 1.8 (54)
Swertia perennis		0.2 ± 0.3 (33)	0.1 ± 0.5 (13)	0.3 ± 0.8 (16)	0.6 ± 1.1 (31)			0.6 ± 1.1 (23)
Menyanthes trifoliata	1.1 ± 6.3 (6)							
Polemonium	0.4 ± 0.8 (37)	2.0 ± 4.2 (67)		0.1 ± 0.1 (4)				0.3 ± 0.7 (31)
Mimulus guttatus							0.1 ± 0.1 (7)	
Castilleja unalaschcensis				0.2 ± 0.5 (28)				
Rhinanthus minor				0.1 ± 0.1 (4)				
Pedicularis labradorica	0.1 ± 0.1 (6)							
P. sudetica		0.3 ± 0.7 (25)						
Pedicularis spp.	0.1 ± 0.2 (14)							
Pinguicula villosa	0.1 ± 0.4 (9)							
Galium boreale			0.1 ± 0.2 (19)	0.1 ± 0.2 (16)	0.1 ± 0.1 (8)		0.1 ± 0.1 (7)	
Valeriana capitata		0.1 ± 0.1 (8)	0.1 ± 0.1 (3)					
Solidago multiradiata				0.6 ± 3.0 (4)			0.2 ± 0.7 (7)	0.6 ± 1.1 (31)
Achillea borealis			0.1 ± 0.5 (9)	0.1 ± 0.1 (4)			0.1 ± 0.1 (7)	0.1 ± 0.2 (23)
Unknown forb	0.1 ± 0.1 (6)		0.1 ± 0.2 (13)			0.1 ± 0.1 (7)		0.1 ± 0.1 (8)
Lichen spp.	1.7 ± 3.5		0.3 ± 0.7	0.1 ± 0.1	2.3 ± 4.0			

Table 8. Continued.

	Dwarf shrub mead.	Wet mead., grass mead.	Med., low shrub thick.	Tall forb mead.	Dwarf shrub mead., shrub mat	Med., tall shrub thick.	Grass mead.	Low shrub thicket
	(57)		(20)	(4)	(85)			
Litter	13.0 ± 10.9	21.3 ± 31.8	21.3 ± 25.1	5.2 ± 14.6	3.4 ± 5.3	75.3 ± 12.8	18.3 ± 30.1	49.6 ± 28.1
	(91)	(100)	(90)	(16)	(77)	(100)	(40)	(100)
Standing water	5.8 ± 20.0	12.7 ± 16.9						
	(37)	(100)						

[a] Refer to Table 2.

[b] Data presented are from sub-classes within avian habitat classes which covered the highest proportion of area of all sub-classes in all study areas.

[c] Sagt = Sphagnum sedge grass tussock; Wsap = Wet sedge and ponds; Wu = Upland willow; Wmw = Mesic herb meadow; Ch = cranberry hummock; Wal = Upland alder thicket; Gw = Grass mat; Swm = Sedge-willow-muskegale.

[d] Number of random quadrats sampled in sub-class in parentheses.

[e] Generally, overstory = > 30 cm, middle story, 10-30 cm and ground story < 10 cm; however, ranges varied considerably within each sub-class.

[f] Frequency of occurrence (%).

Table 8. Stratum, species composition, height (range, cm), cover ($\bar{x}$ % ± sd) and frequency (%) of plants in 11 $10m^2$ (5m x 2m) relevés centered on variable circular plot listening stations in a cottonwood deciduous woodland in the Dog Salmon Study Area, Alaska Peninsula National Wildlife Refuge, Alaska, July 1986.

Stratum[a]	Species	Height	Cover	Frequency
T1	Populus balsamifera	120-750	51.9 ± 23.7	1.00
T2		130-165	5.7 ± 13.8	0.09
S1		85-190	5.7 ± 7.4	0.45
S2	Salix spp.	45-230	13.6 ± 21.8	0.55
H1	Heracleum lanatum	45-165	16.0 ± 15.2	0.82
	Angelica lucida	45-150	11.1 ± 6.6	0.82
	Grass spp.	57-110	11.8 ± 11.1	0.73
	Epilobium angustifolium	58-90	21.1 ± 15.7	0.73
	Aconitum delphinifolium	45-82	0.3 ± 0.3	0.55
	Geranium erianthum	34-75	3.0 ± 5.4	0.45
	Sanguisorba stipulata	30-62	1.6 ± 4.5	0.18
	Solidago spp.	42-58	1.6 ± 4.5	0.18
	Achillea borealis	54-57	3.4 ± 11.3	0.09
	Conioselinum chinense	62-93	1.4 ± 4.5	0.09
	Lupinus nootkatensis	50-80	0.2 ± 0.8	0.09
H2	Galium boreale	20-47	5.1 ± 6.4	0.82
	Carex spp.	18-47	4.2 ± 7.0	0.82
	Achillea borealis	7-50	12.7 ± 13.0	0.64
	Sanguisorba stipulata	20-50	3.4 ± 5.6	0.64
	Equisetum spp.	15-45	4.1 ± 7.1	0.64
	Geranium erianthum	32-60	2.5 ± 4.3	0.55
	Fern spp.	0-42	6.4 ± 11.9	0.36
	Solidago spp.	32-57	7.5 ± 12.1	0.36
	Aconitum delphinifolium	38-70	0.5 ± 1.0	0.27
	Grass spp.	35-91	0.3 ± 0.8	0.27
	Epilobium angustifolium	45-85	2.4 ± 6.0	0.27
	Lathyrus palustris	22-37	0.1 ± 0.2	0.18
	Angelica lucida	38	0.1 ± 0.2	0.13
	Luzula multiflora	44-50	0.1 ± 0.2	0.09
	Lupinus nootkatensis	52-70	0.2 ± 0.8	0.09
	Artemisia Tilesii	69-85	0.2 ± 0.8	0.09
	Rhinanthus minor	21-35	0.1 ± 0.2	0.09
H3	Rubus arcticus	6-25	5.3 ± 6.3	0.82
	Stellaria spp.	8-20	0.5 ± 0.7	0.55
	Trientalis europaea	4-14	0.3 ± 0.3	0.55
	Fern spp.	4-32	9.6 ± 15.0	0.45
	Pyrola asarifolia	4-20	1.3 ± 4.5	0.45
	Cornus suecica	8-22	0.6 ± 0.4	0.36
	Equisetum spp.	20-38	0.5 ± 1.3	0.18
	Achillea borealis	15-40	2.7 ± 2.4	0.18
	Galium boreale	37-45	0.2 ± 0.8	0.09
	Aconitum delphinifolium	25-45	0.1 ± 0.2	0.09
	Empetrum nigrum	5-12	0.2 ± 0.8	0.09
	Sanguisorba stipulata	35-45	0.2 ± 0.8	0.09
	Lupinus nootkatensis	17	0.1 ± 0.2	0.09
H4	Trientalis europaea	8-12	0.1 ± 0.2	0.18
	Stellaria spp.	5-20	0.3 ± 0.8	0.18

Table 9. Continued.

	Species	Height	Cover	Frequency
	Rubus arcticus	9-18	0.5 ± 1.3	0.18
	Fern spp.	3-15	0.2 ± 0.8	0.09
	Achillea borealis	8-23	1.4 ± 4.5	0.09
	Vaccinium vitis-idaea	3- 5	0.1 ± 0.2	0.09
M	Moss spp.	3- 5	38.0 ± 15.0	1.00
	Litter	4- 5	33.2 ± 22.6	0.91
	Foliose lichen	3- 5	0.4 ± 1.4	0.64
	Fungus spp.	5-10	0.1 ± 0.2	0.09

[a]T = canopy trees; S = shrubs; H = herbs; M = moss/litter. Numbers that follow stratum designations are height subdivisions, 1 being taller than 2, 2 being taller than 3 (Mueller-Dombois and Ellenberg 1974).

Table 10. Vascular plants found at Dog Salmon, Braided Creek, and Lawrence Valley study areas, Alaska Peninsula National Wildlife Refuge, 1985-87.

LYCOPODIACEAE
- Lycopodium selago L.
- L. annotinum L.
- L. clavatum L.
- L. alpinum L.
- L. sabinaefolium Willd.

ISOETACEAE
- Isoetes truncata (A.A. Eat.) Clute

EQUISETACEAE
- Equisetum hiemale L.
- E. variegatum Schleich.
- E. fluviatile L. ampl. Ehrh.
- E. pratense L.
- E. arvense L.

OPHIOGLOSSACEAE
- Botrychium lunaria (L.) Sw.
- B. lanceolatum (Gmel.) Angstr.

CRYPTOGRAMMACEAE
- Cryptogramma crispa (L.) R.Br.

THELYPTERIDACEAE
- Thelypteris limbosperma (All.) Fuchs.
- T. phegopteris (L.) Slosson

ATHYRIACEAE
- Athyrium felix-femina (L.) Roth
- Cystopteris fragilis (L.) Bernh.

ASPIDIACEAE
- Polystichum Braunii (Spenn.) Fee
- Dryopteris dilatata (Hoffm.) Gray
- Gymnocarpium dryopteris (L.) Newm.

POLYPODIACEAE
- Polypodium vulgare L.

SPARGANIACEAE
- Sparganium angustifolium Michx.
- S. hyperboreum Laest.

POTAMOGETONACEAE
- Zostera marina L.
- Potamogeton perfoliatus L.
- P. vaginatus Turez.

Table 10. Continued.

JUNCAGINACEAE
- Triglochin palustris L.

GRAMINEAE
- Hierochloe odorata (L.) Wahlenb.
- Phleum commutatum Gandoger
- Alopecurus pratensis L.
- A. alpinus Sm.
- Cinna latifolia (Trev.) Griseb.
- Agrostis exarata Trin.
- Calamagrostis canadensis (Michx.) Beauv.
- C. nutkaensis (Presl) Steud.
- Deschampsia caespitosa (L.) Beauv.
- D. beringensis Hult.
- Trisetum spicatum (L.) Richter
- Poa arctica R.Br.
- P.eminens Presl.
- P. palustris L.
- P. nemoralis L.
- Arctopila fulva (Trin.) Anderss.
- Festuca altaica Trin.
- F. rubra L. coll.
- Agropyron pauciflorum (Schwein.) Hitchc.
- Hordeum brachyantherum Nevski
- Elymus arenarius L.

CYPERACEAE
- Eriophorum angustifolium Honck.
- E. russeolum E.Fries
- Trichophorum caespitosum (L.) Hartm.
- Carex capitata Soland. in L.[a]
- C. dioica L.
- C. macloviana d'Urv.
- C. tenuiflora Wahlenb.[a]
- C. Kelloggii W.Boott
- C. aquatilis Wahlenb.
- C. sitchensis Prescott
- C. Lyngbyaei Hornem.
- C. Enanderi Hult.
- C. Mertensii Prescott[a]
- C. macrochaeta C.A.Mey.
- C. spectabilis Dew.[a]
- C. rariflora (Wahlenb.) J.E.Sm.
- C. pluriflora Hult.
- C. limosa L.
- C. rostrata Stokes
- C. saxatilis L.

Table 10. Continued.

JUNCACEAE
- Juncus arcticus Willd.
- J. castaneus Sm.
- Luzula parviflora (Ehrh.) Desv.
- Luzula tundricola Gorodk.
- L. multiflora (Retz.) Lej.

LILIACEAE
- Tofieldia coccinea Richards
- Veratrum viride Ait.
- Fritillaria camschatcensis (L.) Ker-Gawl.
- Lloydia serotina (L.) Rehb.
- Streptopus amplexifolius (L.) DC.

IRIDACEAE
- Iris setosa Pall.

ORCHIDACEAE
- Cypripedium guttatum Sw.
- Dactylorhiza aristata (Fisch.) Soo
- Coeloglossum viride (L.) Hartm.
- Platanthera convallariaefolia (Fisch.) Lindl.
- P. dilatata (Pursh) Lindl.
- Spiranthes Romanzoffiana Cham.
- Listera cordata (L.) R.Br.
- Corallorrhiza trifida Chatelain

SALICACEAE
- Populus balsamifera L.
- Salix reticulata L.
- S. rotundifolia Trautv.
- S. arctica Pall.
- S. fuscescens Anderss.
- S. cyclophylla Rydb.
- S. stolonifera Cov.
- S. glauca L.
- S. Barclayi Anderss.
- S. alaxensis (Anderss.) Cov.
- S. pulchra Cham.

MYRICACEAE
- Myrica gale L.

BETULACEAE
- Betula nana L.
- B. glandulosa Michx.
- Alnus crispa (Ait.) Pursh

Table 10. Continued.

POLYGONACEAE
- Koenigia islandica L.
- Rumex graminifolius Lamb.
- R. arcticus Trautv.
- Rumex fenestratus Greene
- Oxyria digyna (L.) Hill
- Polygonum viviparum L.

PORTULACACEAE
- Claytonia sibirica L.
- C. sarmentosa C.A.Mey
- C. Chamissoi Esch.
- Montia fontana L.

CARYOPHYLLACEAE
- Stellaria media (L.) Vill.
- S. crispa Cham.& Schlecht.
- S. humifusa Rottb.
- S. crassifolia Ehrh.
- S. calycantha (Ledeb.) Bong.
- S. sitchana Steud.
- S. monantha Hult.
- Cerastium Beeringianum Cham.& Schlecht.
- C. aleuticum Hult.
- C. Fisherianum Ser.
- C. fontanum Baumg.
- Minuartia macrocarpa (Pursh) Ostenf.
- M. arctica (Stev.) Aschers.& Graebn.
- M. rubella (Wahlenb.) Graebn.
- Honckenya peploides (L.) Ehrh.
- Moehringia lateriflora (L.) Fenzl
- Silene acaulis L.

NYMPHAEACEAE
- Nuphar polysepalum Engelm.

RANUNCULACEAE
- Caltha palustris L.
- Coptis trifolia (L.) Salisb.
- Actea rubra (Ait.) Willd.
- Aconitum delphinifolium DC.
- Anemone Richardsonii Hook.
- A. parviflora Michx.
- A. narcissiflora L.
- Ranunculus trichophyllus Chaix.
- R. confervoides (E.Fries) E.Fries
- R. hyperboreus Rottb.
- R. Pallasii Schlecht.
- R. lapponicus L.
- R. Eschscholtzii Schlecht.
- R. Bongardi Greene

Table 10. Continued.

T. sparsiflorum Turez.

PAPAVERACEAE
Papaver alaskanum Hult.

FUMARIACEAE
Corydalis pauciflora (Steph.) Pers.

CRUCIFERAE
Cochlearia officinalis L.
Barbarea orthoceras Ledeb.
Rorippa islandica (Oeder) Borb.
Cardamine bellidifolia L.
C. pratensis L.
C. umbellata Greene
Capsella bursa-pastoris (L.) Medic.
C. rubella Reut.
Draba nivalis Liljebl.
Draba lactea Adams
D. borealis DC.
Arabis lyrata L.
A. hirsuta (L.) Scop.
Parrya nudicaulis (L.) Regel

DROSERACEAE
Drosera rotundifolia L.

CRASSULACEAE
Sedum rosea (L.) Scop.

SAXIFRAGACEAE
Leptarrhena pyrolifolia (D.Don) Ser.
Saxifraga oppositifolia L.
S. Eschscholtzii Sternb.
S. serpyllifolia Pursh
S. hirculus L.
S. flagellaris Willd.
S. bronchialis L.
S. punctata L.
S. bracteata D. Don
S. rivularis L.
S. Lyallii Englerd
S. unalaschcensis Sternb.
S. nivalis L.
S. foliolosa R.Br.
S. caespitosa L.
Heucher glabra Willd.
Tellima grandiflora (Pursh) Dougl.
Chrysosplenium tetrandrum (Lund) T.Fries

Table 10. Continued.

P. Kotzebuei

ROSACEAE
Spirea Beauverdiana Schneid.
Rubus chamaemorus L.
R. arcticus L.
R. spectabilis Pursh
Fragaria chiloensis (L.) Duchesne
Potentilla palustris (L.) Scop.
P. villosa Pall.
P. uniflora Ledeb.
P. hyparctica Malte
P. Egedii Wormsk.
Sibbaldia procumbens
Geum macrophyllum Willd.
G. calthifolium Menzies
G. Rossii (R.Br.) Ser.
Dryas integrifolia M.Vahl
Sanguisorba stipulata Raf.

LEGUMINOSAE
Lupinus nootkatensis Donn
Astragalus umbellatus Bunge
A. alpinus L.
A. polaris Benth.
Oxytropis Maydelliana Trautv.
O. nigrescens (Pall.) Fisch.
Lathyrus maritimus L.
L. palustris L.

GERANIACEAE
Geranium erianthum DC.

VIOLACEAE
Viola Langsdorffii Fisch.
V. epipsila Ledeb.

ONAGRACEAE
Epilobium angustifolium L.
E. latifolium L.
E. palustre L.
E. anagallidifolium Lam.
E. glandulosum Lehm.
E. behringianum Haussk.
E. Horanemannii Rchb.
Circaea alpina L.

HALORAGACEAE
Hippuris vulgaris

Table 10. Continued.

UMBELLIFERAE
- Bupleurum triradiatum Adams
- Cicuta mackenzieana Raup
- Ligusticum scoticum L.
- Conioselinum chinense
- Angelica lucida L.
- A. genuflexa
- Heracleum lanatum

CORNACEAE
- Cornus suecica L.
- C. canadensis L.

PYROLACEAE
- Pyrola asarifolia Michx.
- P. minor L.

EMPETRACEAE
- Empetrum nigrum L.

ERICACEAE
- Ledum palustre L.
- Rhododendron camtschaticum Pall.
- Loiseleuria procumbens (L.) Desv.
- Phyllodoce aleutica (Spreng.) Heller
- Cassiope Stelleriana (Pall.) DC.
- C. lycopodioides (Pall.) D.Don
- Andromeda polifolia L.
- Arctostaphylos uva-ursi (L.) Spreng.
- A. alpina (L.) Spreng.
- Vaccinium vitis-idaea L.
- V. ovalifolium Sm.
- V. uliginosum L.
- Oxycoccus microcarpus Turez.

DIAPENSIACEAE
- Diapensia lapponica L.

PRIMULACEAE
- Primula tschuktschorum Kjellm.
- P. cuneifolia Ledeb.
- P. egaliksensis Wormsk.
- Androsace chamaejasme Host
- Lysimachia thyrisflora L.
- Trientalis europaea L.

PLUMBAGINACEAE
- Armeria maritima (Mill.) Willd.

Table 10. Continued.

GENTIANACEAE
- Gentiana algida Pall.
- G. glauca Pall.
- Swertia perennis L.
- Menyanthes trifoliata L.

POLEMONIACEAE
- Polemonium acutiflorum Willd.
- P. boreale Adams

HYDROPHYLLACEAE
- Romanzoffia unalaschensis Cham.

BORAGINACEAE
- Eritrichium aretiodes (Cham.) DC.
- E. Chamissonis DC.
- Myosotis alpestris F.W.Schmidt
- Mertensia maritima (L.) S.F.Gray

SCROPHULARIACEAE
- Mimulus guttatus DC.
- Veronica americana Schwein.
- V. serpyllifolia L.
- V. Wormskjoldii Roem.& Schult.
- V. Stelleri Pall.
- Lagotis glauca Gaertn.
- Castilleja unalaschensis (Cham.& Schlecht.) Malte
- Rhinanthus minor L.
- Pedicularis verticillata L.
- P. labradorica Wirsing
- P. parviflora J.E.Sm.
- P. Langsdorffii Fisch.
- P. sudetica Willd.
- P. capitata Adams
- P. Oederi M.Vahl
- P. Kanei Durand

OROBANCHACEAE
- Boschniakia rossica (Cham.& Schlecht.) Fedtsch.

LENTIBULARIACEAE
- Pinguicula vulgaris L.
- P. villosa L.
- Utricularia vulgaris L.

PLANTAGINACEAE
- Plantago macrocarpa Cham.& Schlecht.
- P. maritima L.

Table 10. Continued.

RUBIACEAE
Galium boreale L.
G. aparine L.
G. triflorum Michx.
G. trifidum L.
CAPRIFOLIACEAE
Sambucus racemosa L.
Viburnum edule (Michx.) Raf.
VALERIANACEAE
Valeriana capitata Pall.
CAMPANULACEAE
Campanula lasiocarpa Cham.
C. uniflora L.
COMPOSITAE
Solidago multiradiata Ait.
S. lepida DC.
Aster sibiricus L.
Erigeron peregrinus (Pursh) Greene
Antennaria monocephala DC.
Achillea borealis Bong.
Matricaria matricarioides (Less.) Porter
Chrysanthemum arcticum L.
Artemisia Tilesii Ledeb.
A. arctica Less.
Petasites frigidus (L.) Franch.
P. hyperboreus Rydb.
Arnica Lessingii Greene
A. Chamissonis Less.
Senecio congestus (R.Br.) DC.
S. resedifolius Less.
S. pseudo-Arnica Less.
Prenanthes alata (Hook.) Dietr.
Hieracium triste Willd.

[a] Preliminary identification.

Table 11. Species composition, habitat and density indexes (maximum potential number[a]/km^2) of common bird nests on study plots in the Dog Salmon Study Area, Alaska Peninsula National Wildlife Refuge, 1986-87.

	Dwarf shrub meadow	Wet meadow grass meadow	Medium, low shrub thicket
Least sandpiper			
1986	1.8		
1987	10.8		
Short-billed dowit.			
1986	0.0		
1987	1.8		
Common snipe			
1986	0.0		
1987	1.8		
Orange-crowned warb.			
1986	1.8		90.9
1987	0.0		181.8
Yellow warbler			
1986			0.0
1987			181.8
Wilson's warbler			
1986	0.0		0.0
1987	1.8		181.8
Amer. tree sparrow			
1986	1.8	39.5	
1987	7.2	79.1	
Savannah sparrow			
1986	37.9	0.0	
1987	65.0	39.5	
White-crowned spar.			
1986			0.0
1987			90.9
Lapland longspur			
1986	18.1		
1987	16.3		
Common redpoll			
1986	0.0		0.0
1987	1.8		90.9

[a]Based on finding nests, territorial males or other "breeding behavior". Habitats listed and density indexes extrapolated only if area was $\geq$ 0.01 km^2 in size.

Table 12. Species composition, dates (surveyed once/week) and estimated density ($\bar{x}$ birds/km^2 ± 95% CI) of male or presumed male birds recorded by aural and visual observations on 11 variable circular plots within a 0.7 km^2 deciduous cottonwood forest, Dog Salmon Study Area, Alaska Peninsula Refuge, 1986-87.

Species[a]	Date of maximum density		Density	
	1986	1987	1986	1987
Tree swallow	Jun 19	Jun 12	3 ± 6	3 ± 6
Black-billed magpie	Jun 12	Jun 19	1 ± 1[b]	1 ± 4[b]
Black-capped chickadee	Jun 12	Jun 12	20 ± 20	7 ± 14
Gray-cheeked thrush	Jul 2	Jul 2	3 ± 6	12 ± 14
Hermit thrush	Jun 19	Jun 19	5 ± 5	12 ± 8
American robin	Jun 19	Jun 12	8 ± 8	7 ± 10
Northern shrike	Jun 19[c]		1 ± 2	0
Orange-crowned warbler	Jun 12	Jun 12	13 ± 8	12 ± 6
Yellow warbler		Jun 19	0	12 ± 10
Wilson's warbler	Jun 12	Jun 19	36 ± 16	34 ± 12
American tree sparrow	Jun 19		3 ± 4	0
Golden-crowned sparrow	Jun 19	Jun 19	9 ± 6	7 ± 4
White-crowned sparrow	Jun 19	Jun 12	4 ± 6	5 ± 4

[a]Other species recorded in cottonwoods but not tallied on plots were downy woodpecker and 2 female pine grosbeaks plus another unidentified (sex) pine grosbeak.
[b]Density/3 km^2.
[c]A brood of 4 juveniles also observed on plots this date but not used in estimate.

Table 13. Species composition, habitat and density indexes (maximum potential number$^{\#}$/km^2) of common bird nests on study plots in the Braided Creek Study Area, Alaska Peninsula National Wildlife Refuge, 1985-86.

	Dwarf shrub meadow	Wet meadow grass mead.	Medium, low shrub thicket	Dwarf shrub meadow dwar shrub mat	Low shrub thicket
Tundra swan					
1985		6.5			
1986		6.5			
Mallard					
1985				0.0	
1986				9.1	
Northern pintail					
1985			0.0		
1986			6.4		
American wigeon					
1985			0.0	9.1	
1986			6.4	0.0	
Willow ptarmigan					
1985	0.0		25.6	18.2	
1986	5.5		51.3	9.1	
Greater yellowlegs					
1985		0.0	0.0	0.0	
1986		6.5	6.4	18.2	
Least sandpiper					
1985	30.4				
1986	22.1				
Dunlin					
1985	0.0				
1986	2.8				
Short-billed dow.					
1985	0.0				
1986	13.8				
Common snipe					
1985	5.5	12.9		9.1	
1986	5.5	19.4		0.0	
Red-necked phal.					
1985	0.0	19.4			
1986	2.8	0.0			
Parasitic jaeger					
1985	0.0				
1986	2.8				
Gray-cheeked thrush					
1985			6.4		
1986			0.0		
American Robin					
1985			6.4		
1986			6.4		
Orange-crowned warb.					
1985			89.8	18.2	
1986			70.5	27.2	

Table 13. Continued.

Yellow warbler					
1985			19.2		
1986			12.8		
Wilson's warbler					
1985			134.6	18.2	
1986			134.6	0.0	
Amer. tree sparrow					
1985	2.8	12.9	32.1	27.2	
1986	2.8	38.8	32.1	45.4	
Savannah sparrow					
1985	46.9	25.9	19.2	18.2	90.9
1986	52.5	25.9	44.9	0.0	90.9
Fox sparrow					
1985		0.0			
1986		6.4			
Gold-crowned spar.					
1985	2.8		134.6	27.2	
1986	5.5		115.4	54.5	
White-crowned spar.					
1985	0.0		141.0	36.3	
1986	2.8		89.7	81.7	
Lapland longspur					
1985	35.9				
1986	27.6				
Common redpoll					
1985	2.8		38.5	0.0	
1986	2.8		51.3	9.1	

[a]Based on finding nests, territorial males or other "breeding behavior". Habitats listed and density indexes extrapolated only if area was $\geq$ 0.01 km^2.

Table 14. Species, habitat and density indexes (maximum potential number[a]/ha[2]) of common bird nests on study plots in the Lawrence and Brass Valley Study Area, Alaska Peninsula National Wildlife Refuge, 1985-86.

	Dwarf shrub meadow	Dwarf shrub meadow, dwarf shrub mat	Wet meadow, grass meadow	Brass meadow	Tall forb meadow	Med.,low shrub thicket	Med., tall shrub thicket	Fluviatile waters and shorelines
Red-breast. merg.								
1985						0.0		
1986						23.2		
Willow ptarmigan								
1985	0.0				17.1	89.3		
1986	12.9				5.7	0.0		
Least sandpiper								
1985	50.6			0.0				
1986	77.4			75.6				
Common snipe								
1985	0.0					0.0		
1986	12.9					23.2		
Bank swallow								
1985							0.0	0.0
1986							17.5	59.5
Hermit thrush								
1985							27.8	
1986							70.2	
Orange-crown. warb.								
1985					0.0			
1986					11.5			
Yellow warbler								
1985					17.1	89.3	83.3	0.0
1986					0.0	0.0	0.0	70.2
Wilson's warbler								
1985					17.1		27.8	
1986					68.9		0.0	
Savannah sparrow								
1985	151.9	117.3	65.8	0.0	170.6	267.9	27.8	
1986	38.7	111.1	26.5	100.8	125.0	116.0	0.0	
Fox sparrow								
1985					0.0		0.0	83.3
1986					170.6		83.3	0.0
Gold.-crown. spar.								
1985		29.3			136.5	89.3	277.8	
1986		0.0			143.5	69.6	17.5	
Pine grosbeak								
1985							0.0	
1986							17.5	
Common redpoll								
1985						0.0		
1986						23.2		

[a]Based on finding nests, territorial males or other "breeding behavior". Habitats listed and densities extrapolated only if area was ≥ 0.01 km^2 in size.

Table 15. Observed use of habitats by 108 avian species recorded on study plots and adjacent areas in three study areas (D = Dog Salmon, B = Braided Creek, L = Lawrence/Grass valleys) on the Alaska Peninsula, 1985-87. b = confirmed breeder, ? = suspected breeder, D, B or L alone = present in area but conducting other activities in habitats not necessarily directly related to nesting or territory defense (e.g., foraging, roosting, maintenance); n = observed in cottonwood deciduous forest, but not breeding, nn = suspected breeding in cdf; nnn = confirmed breeder in cdf.

	Avian habitat class[a]															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
RTLO[b]		DB															L
PALO	D		L														
COLO	B,bD		L														
HOGR			L														
RNGR	?B,bD		L														
NOFU			L														L
Shearwater sp.																	
DCCO			L														
PECO			L														
Cormorant sp.		D	L														
WHSW	bDBL	DB					bDB	DB									D
GWFG																	BL
EMGO																	
BLBR				L													L
CAGO																	
AGHT	DBL	DBL					D								7D		
MALL	DBL	DB						B	bB	bL							
NOPI	BL	DB						B		B				bB			
NSHO	B																
GADW	L																
AMWI	DBL	DB					bDB							D, bB			
GRSC	DBL	DB								DB							
HARD		DBL															
BLSC	DL	D															
SUSC			L														
WWSC	D	B	L														
COGO		D															
BAGO	D	DL															
COME		DB															
RBME	DBL	DBL					B							bL			D
OSPR																	
BAEA		DBL			bD	bL	B										
NOHA								D	B					B			
RLHA					bD	bL		D									BL
GOEA														B		B	
MERL																	
PEFA						L											
GYRF						bL											
Willow ptar.							L	bB,DL	BL			bL		B	L	B	
Rock ptar.											b?BL						
SACR							DB	bDB	B					B		B	L
LEGP				L													
SEPL		b?B,L		L							b?BL						
GRYE	L	L		L			DB	b?DB	bB					b?B,D			
LEYE																	L
WATA				L													
SPSA	D	DB															BD
WHIM				L													
HUBO				L													

Table 15. Continued.

	Avian habitat class[a]																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
BARG				L													
RUTU				L													
SAND				L													
WESA	L			L			bDL,B	bDBL	L			bL		BD			B
LESA	L	L															
PESA											bTL						
ROSA	L			L													
DUNL														B			
SBDO	L			L			D	bDB									
COSN							bB,bTD,L	bL,DB	B			L	B	DBL	D		
RNPH	BL						bTL	bB									D
REPH	BL		L				bTL	bB						B			
PAJA	B	B					B	bB,D									BL
LTJA								D									
BOGU			L														
MEGU	bTDB,L	bTDB,L	L				B	DB	B				B	B			
GWGU	B	BL	L	L		bL		B						B		B	BD
BLKI			L	L		bL											
SNGU			L													bL	
ARTE	bTD,B	bTD,B	L														
ALTE			L														
PIGU						bL											
MAMU			L														
TUPU			L														
HOPU			bTL														
GHOBIRD						bL											
SEOW								bD,B	B			L	B	B	DL		
BEKI	B	BL															
DOWBIRD																bDB	L
TRESBIRD	DB	DB					DB	DB									B
VOSW														B	B	B	
BARS	DBL	bBL,bTD					DB	DB	B								B
CLSW							L	L						B	bDL,bTB	B	
BBWABIRD	D	DBL	L					B	B					B		B	
CORA		DB	L		bD,bTBL									BL	bTBL,D	B	
BCCHBIRD												L				BL	
AMDI		bTBL							B					bTB	bTB	B	
BCTHBIRD														bD,B	bL,bTDB	B	
RETHBIRD		DBL			D				B					bTB	bTB,D	bD,B	
AMROBIRD		DB			D												BL
YWAG																	L
AMAR											bBL,bTD			L	L	B	
AMPI		L	L					L			D	L		DB	b7,L	BL	
MSHRBIRD			L					B				bTL		bTDBL	bTDL	B	
OCHABIRD							D	bTD	bTB			L		bTDB	bTDBL	B	
YWARBIRD							L	bTB				bL		bTDBL	bTDBL	B	
WIWABIRD		L					D	D	bTB				bTB	bD,bTB	bTB,D	B	
ATSPBD	DB	B					bDB	bD,bTB	bB			BL		BL,bTDB	bTL,B	B	
SAVS		L		L			bL,bTDB	bD,bTBL	bTB	bL		BL		bTB	bTDBL	B	
FOSP		BL										BL		bDBL	bTDBL	B	
GCSPBIRD		L			D			bB,D	bL,bTL					bDB	bTDB	B	L
HCSPBIRD	D				D		D	bTB,D	bB					D		B	L
LALO							DB	bDB	B		bTD					B	
SNBL				L							bTL,D						DB
RUBU																	L
Rosy finch														D	bL		
PIGRBIRD							bTD	bB,D	bTB					bBL,bTD	bTBL	DB	
COREBD														D			
NORE																	

[a] 1 = Lacustrine waters and shorelines, 2 = Fluviatile waters and shorelines, 3 = nearshore and/or inshore (marine) waters, 4 = Beaches and tidal flats, 5 = Inland cliffs and block-fields, 6 = Coastal cliffs and block-fields, 7 = Wet meadow and grass meadow, 8 = Dwarf shrub meadow, 9 = Dwarf shrub meadow and dwarf shrub mat, 10 = Grass meadow, 11 = Alpine (grass) meadow, 12 = Tall forb meadow, 13 = Low shrub thicket, 14 = Medium and low shrub thicket, 15 = Medium and tall shrub thicket, 16 = Artificial habitats, 17 = species observed once or too rarely to determine habitat affinities. Also note that all observations are not absolute and all inclusive of habitats used; these are observed uses of habitats.

[b] Alpha species codes for birds in the North American Bird Banding Manual July 1980 (Appendix C).

Table 16. Relative capture indexes[a] (captures/100 trap hrs) of small mammals in the Dog Salmon Study Area, Alaska Peninsula National Wildlife Refuge, 21 June - 1 August, 1986 and 24 June - 24 July 1987.

Habitat & date	Captures/100 trap hrs						Trap check interval (hrs) (mean ± SE)	N	Number of traps set x N
	Sorex spp.[b]	Microtus oeconomus	Clethrion. rutilus	Lemmus trimucronatus	Zapus hudsonius	Mustela nivalis			
Wet mead., grass mead., mud., low shrub thicket									
June									
1986	0.00	0.00	0.00		0.00	0.00	10.5 ± 1.3	6	414
1987	0.02	0.27	0.02		0.35	0.00	12.4 ± 0.6	5	350
July									
1986	0.75	0.05	0.00		0.00	0.00	9.4 ± 1.1	9	621
1987	0.06	0.60	0.12		0.33	0.03	12.0 ± 0.7	4	280
Dwarf shrub meadow									
June									
1986	0.00	0.00	0.00	0.00			10.5 ± 1.3	6	414
1987	0.00	0.14	0.02	0.02			12.4 ± 0.6	5	350
July									
1986	0.39	0.00	0.00	0.00			9.4 ± 1.1	9	621
1987	0.18	0.90	0.00	0.00			12.0 ± 0.7	4	280
Deciduous cottonwood forest									
June									
1987		0.16	2.42				12.4 ± 0.6	5	350
July									
1987		0.63	3.35				12.0 ± 0.7	4	280

[a] Recaptures not included.
[b] S. cinereus and S. obscurus.

Table 17. Relative capture indexes[a] (captures/100 trap hrs) of small mammals in the Braided Creek Study Area, Alaska Peninsula National Wildlife Refuge, 24 June - 7 August 1985 and 27 May - 29 August 1986.

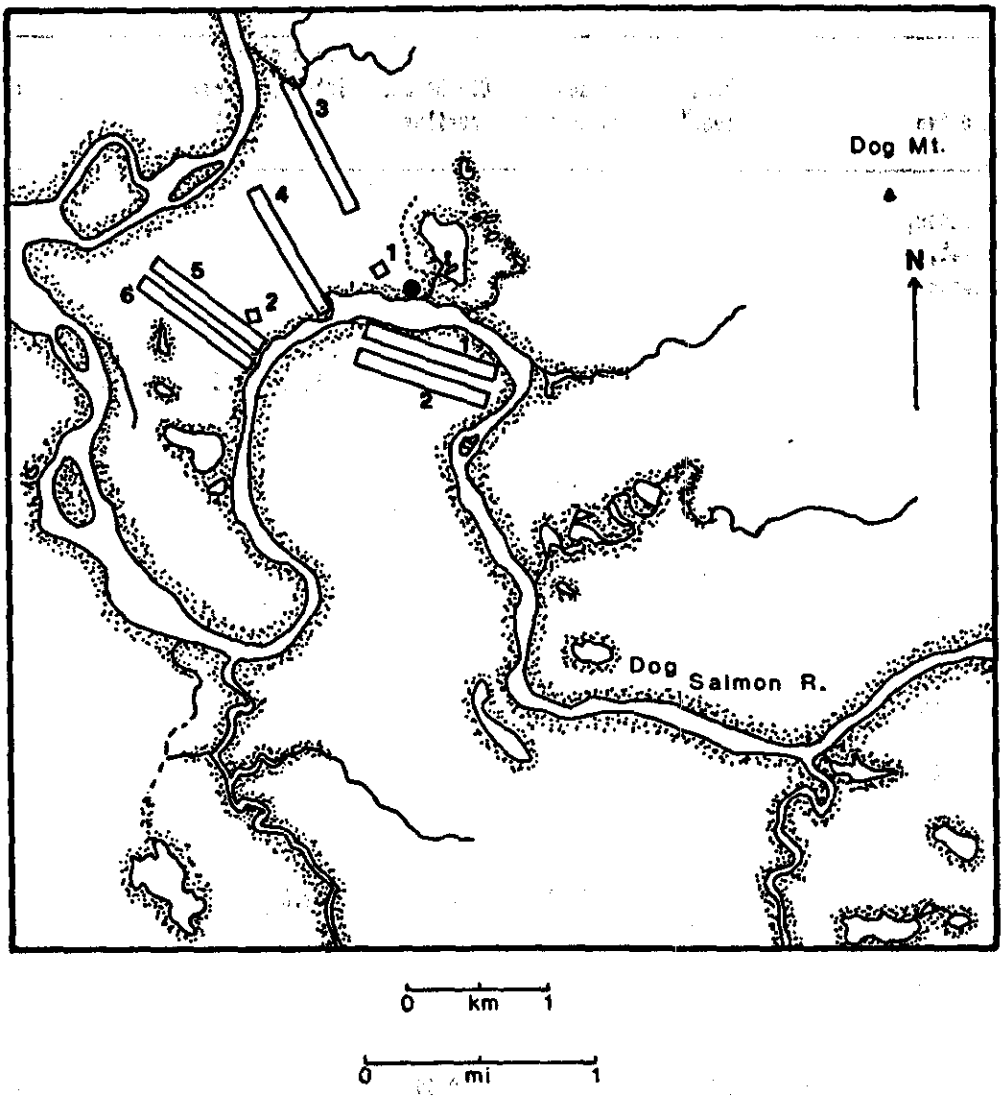
Habitat(s) and dates	Sorex cinereus	Clethrion. rutilus	Mustela nivalis	Trap check interval (hrs) (mean ± SE)	N	Number of traps set x N
Med., low shrub thicket[b]						
May						
1986	0.00	0.00	0.00	12.0	5	490
June						
1985	0.00	0.01	0.01	22.7 ± 1.1	5	490
1986	0.01	0.00	0.00	12.0	5	490
July						
1985	0.08	0.00	0.00	11.4 ± 0.4	6	588
1986[c]	0.14	0.05	0.00	12.0	6	588
August						
1985	0.09	0.01	0.00	12.1 ± 0.3	5	490
1986	0.36[d]	0.07	0.00	12.0	6	588
Dwarf shrub mead.						
May						
1986	0.00			12.0	5	500
June[e]						
1985	0.01			13.1 ± 0.6	9	900
1986	0.00			12.0	5	500
July						
1985	0.00			12.4 ± 0.5	5	500
1986[f]	0.04			12.0	4	400
August						
1985	0.01			22.5 ± 1.5	3	300
1986	0.09			12.0	6	582

[a] Recaptures not included.
[b] Combines both grids in this habitat.
[c] Includes 1 Aug.
[d] One captured preliminarily identified as S. obscurus.
[e] Includes 30 Jun-4 Jul.
[f] 1-2 Aug.

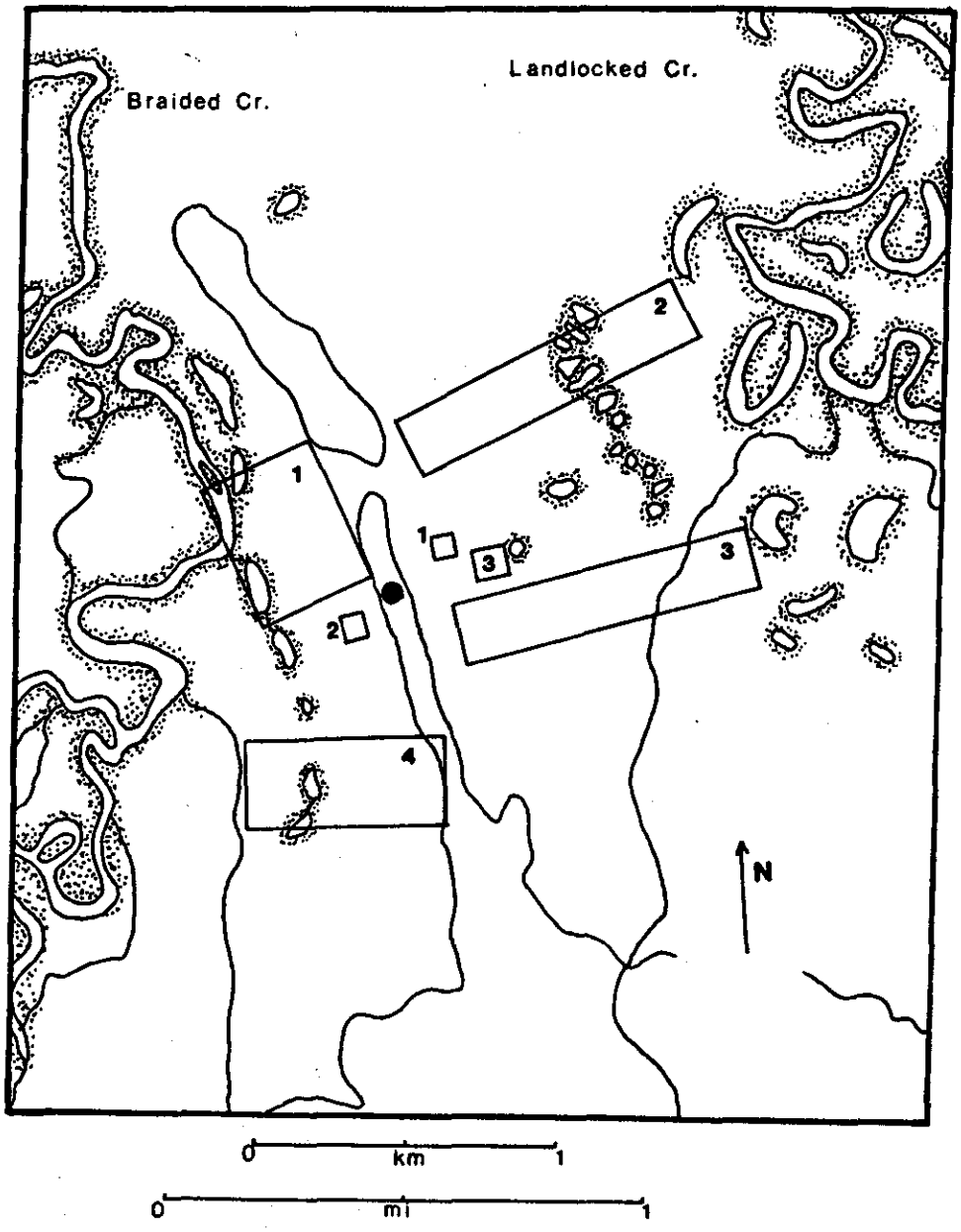
Table 18. Relative capture indexes[a] (captures/100 trap hrs) of small mammals in the Lawrence Valley Study Area, Alaska Peninsula National Wildlife Refuge, 3-31 July 1985 and 22 May-28 July 1986.

Habitat(s) & dates	Sorex spp.[b]	Zapus hudsonius	Clethrion. rutilus	Trap check interval (hrs) (mean ± SE)	N	Number of traps set x N
Dwarf shrub meadow, dwarf shrub mat, tall forb meadow						
May 1986	0.03	0.00		11.7 ± 0.3	8	720
June 1986	0.13	0.02		12.1 ± 0.1	9	810
July 1985	0.01	0.02		11.1 ± 0.9	23	920
1986	0.04	0.00		11.9 ± 0.2	10	900
Dwarf shrub meadow, dwarf shrub mat, med., tall shrub thicket						
May 1986	0.00	0.00	0.00	12.0 ± 0.1	8	648
June[c] 1986	0.09	0.11	0.02	11.9 ± 0.2	9	729
July 1985	0.37	0.08	0.00	9.1 ± 0.5	28	1,120
1986	0.02	0.02	0.07	11.9 ± 0.2	10	810

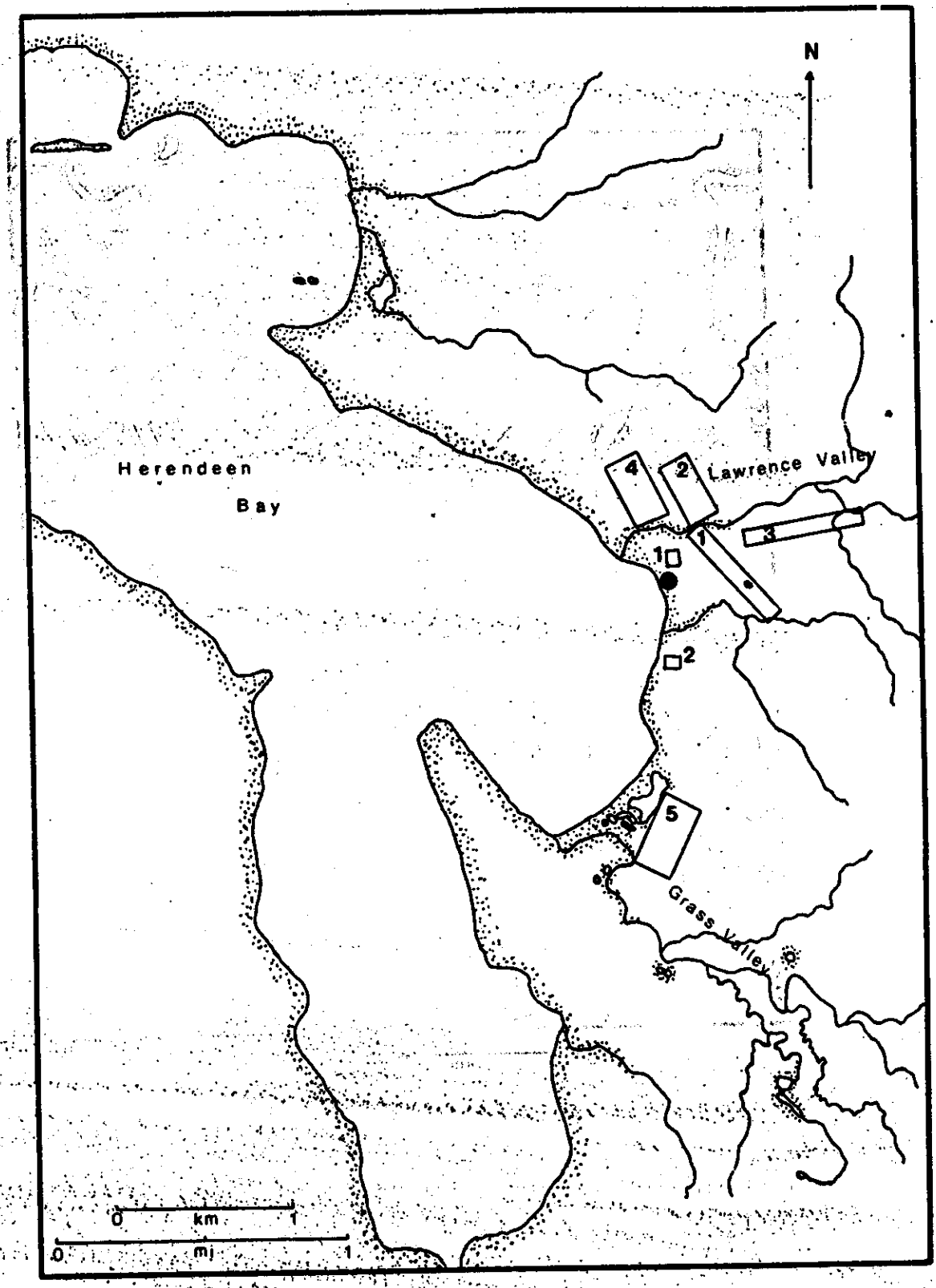
[a] Recaptures not included.
[b] S. cinereus and S. obscurus.
[c] Includes 1 July.



Appendix 1. Dog Salmon Study Area, Alaska Peninsula National Wildlife Refuge, 1986-87. Long plots 1-6 are bird plots; the 2 small boxes are small mammal grids; black circle is field camp. The dotted trail extending north from the field camp shows the 11 variable circular plot stations in the cottonwood deciduous forest. This map was modified from USGS 1:63,360 topographic quadrangle Ugashik B-4.



Appendix 2. Braided Creek Study Area, Alaska Peninsula National Wildlife Refuge, 1985-86. Large plots (1-4) are bird plots; smaller plots (1-3) are small mammal grids; black circle is field camp. The oblong features on which the field camp is located (and extends NW) is the landing strip and also 100' contour. This map was modified from USGS 1:63,360 topographic quandrangle Chignik C-2.



Appendix 3. Lawrence/Grass Valley Study Area, Alaska Peninsula National Wildlife Refuge, 1985-86. Large plots (1-5) are bird plots; smaller plots (1-2) are small mammal grids); black circle is field camp. This map was modified from USGS 1:63,360 topographic quadrangle

Appendix 4. Alpha species codes for birds in the North American Bird Banding Manual (July 1988) used in Table 15.

RTLO	Red-throated loon
PALO	Pacific loon
COLO	Common loon
HOGR	Horned grebe
RNGR	Red-necked grebe
NOFU	Northern fulmar
DCCO	Double-crested cormorant
PECO	Pelagic cormorant
WHSW	Whistling (tundra) swan
GWFG	Greater white-fronted goose
EMGO	Emperor goose
BLBR	Black brant
CAGO	Canada goose
AGWT	American green-winged teal
MALL	Mallard
NOPI	Northern pintail
NSHO	Northern shoveler
GADW	Gadwall
AMWI	American wigeon
GRSC	Greater scaup
HARD	Harlequin duck
BLSC	Black scoter
SUSC	Surf scoter
WWSC	White-winged scoter
COGO	Common goldeneye
BAGO	Barrow's goldeneye
COME	Common merganser
RBME	Red-breasted merganser
OSPR	Osprey
BAEA	Bald eagle
NOHA	Northern harrier
RLHA	Rough-legged hawk
GOEA	Golden eagle
MERL	Merlin
PEFA	Peregrine falcon
GYRF	Gyrfalcon
SACR	Sandhill crane
LEGP	Lesser golden plover
SEPL	Semipalmated plover
GRYE	Greater yellowlegs
LEYE	Lesser yellowlegs
WATA	Wandering tattler
SPSA	Spotted sandpiper
WHIM	Whimbrel
HUGO	Hudsonian godwit
BAGR	Bar-tailed godwit
RUTU	Ruddy turnstone
SAND	Sanderling
WESA	Western sandpiper
LESA	Least sandpiper

Appendix 4. Continued.

PESA	Pectoral sandpiper
ROSA	Rock sandpiper
DUNL	Dunlin
SBDO	Short-billed dowitcher
COSN	Common snipe
RNPH	Red-necked phalarope
REPH	Red phalarope
PAJA	Parasitic jaeger
LTJA	Long-tailed jaeger
BOGU	Bonaparte's gull
MEGU	Mew gull
GWGU	Glaucous-winged gull
BLKI	Black-legged kittiwake
SAGU	Sabine's gull
ARTE	Arctic tern
ALTE	Aleutian tern
PIGU	Pigeon Guillemot
MAMU	Marbled murrelet
TUPU	Tufted puffin
HOPU	Horned puffin
GHOW	Great-horned owl
SEOW	Short-eared owl
BEKI	Belted kingfisher
DOWO	Downy woodpecker
TRES	Tree swallow
VGSW	Violet-green swallow
BANS	Bank swallow
CLSW	Cliff swallow
BBMA	Black-billed magpie
CORA	Common raven
BCCH	Black-capped chickadee
AMDI	American dipper
GCTH	Gray-cheeked thrush
HETH	Hermit thrush
AMRO	American robin
YWAG	Yellow wagtail
WHWA	White wagtail
WAPI	Water pipit
NSHR	Northern shrike
OCWA	Orange-crowned warbler
YWAR	Yellow warbler
WIWA	Wilson's warbler
ATSP	American tree sparrow
SAVS	Savannah sparrow
FOSP	Fox sparrow
GCSP	Golden-crowned sparrow
WCSP	White-crowned sparrow
LALO	Lapland longspur
SNBU	Snow bunting
RUBL	Rusty blackbird
PIGR	Pine grosbeak
CORE	Common redpoll
HORE	Hoary redpoll