WETLANDS HABITAT INVESTIGATIONS IN SITKA SOUND, ALASKA

A study to identify and characterize wetland habitats in Sitka Sound with recommendations for protecting important wetlands in the vicinity of Sitka.

by:

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ABSTRACT

This study was undertaken during 1979-80, to identify and characterize wetland habitats in Sitka Sound, Alaska, and document their use by both migratory and overwintering birds. Opportunistic sightings of mammalian use of wetlands were also recorded.

Based on plant species abundance, major wetland vegetation types were delineated within the coastal and freshwater wetlands of Sitka Sound. Each of the five major coastal wetland vegetative types was characterized by a single dominant plant species: *Puccinellia nutkaensis, Calamagrostis canadensis, Carex lyngbyaei, Elymus arenarius,* and *Calamagrostis nutkaensis.* The four freshwater wetland vegetation types were not dominated by a single plant species and thus were characterized as aquatic, marsh, wet meadow, and ericaceous shrub bog. The vegetation types of Sitka Sound were largely determined by soil type, in addition to elevation which necessarily influenced the degree of freshwater and duration of tidal inundation.

Data on bird species' use of wetlands and their adjacent waters were gathered over an entire year, with the most intense field observation concentrated during the spring and fall staging and migration periods. Related species were combined into species groups (loons and grebes, swans, geese, etc.) and sightings were grouped by two week periods, using highest counts as "peak values" for any given count period. Wetland habitat and adjacent waters within Sitka Sound were most heavily

used by various bird species groups during spring migration. Total bird use of the same area during fall migration and as overwintering habitat, though significant, was only about half that during spring migration.

The coastal wetland habitats of Sitka Sound constitute a minor proportion of the total land base of Sitka Sound, yet are extremely rich in nutrients and thus are highly important, particularly from a bird use standpoint. Recommendations are made to avoid and/or minimize man-caused adverse impacts in order to maintain these wetlands as productive and functional habitats.

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PURPOSE OF STUDY

The study was undertaken to provide baseline data on the wetlands of Sitka Sound and the year round use of these wetlands by birds. Wetlands throughout Sitka Sound were identified, then characterized by their dominant plant assemblages and the physical processes maintaining them. Concurrently, the extent to which local and migratory birds utilized the wetlands and their associated waters was determined on a seasonal basis. Information gathered during this one-year general reconnaissance study is intended to be used, in part, to formulate site-specific coastal management decisions where wetlands are involved.

CONCLUSIONS

The wetland plant communities of Sitka Sound were largely determined by soil type and elevation in addition to the degree and duration of tidal or freshwater inundation. Data from the transects completed during this study were used to stratify the plants of the coastal wetlands into five major vegetation types. Each coastal wetland type was characterized by a dominant plant species: *Puccinellia nutkaensis, Calamagrostis canadensis, Carex lyngbyaei, Elymus arenarius,* and *Calamgrostis nutkaensis.* The vegetation of freshwater wetlands was classified into four types by the degree of persistent freshwater flooding. The four freshwater types were aquatic, marsh, wet meadow, and ericaceous shrub bog. The maps and profiles of each wetland presented in this report can be used as baseline data to assess any future development plans proposed for the specific sites.

Avian surveys of the wetlands and their associated waters show that the greatest number of birds moved through Sitka Sound during spring migration. The largest species groups in all seasons were divers and sea ducks. Shorebirds were also abundant, but only during spring. Coastal wetlands were found to be the primary habitat of other common species groups, particularly the geese and dabblers. Freshwater wetlands were the primary habitat for trumpeter swan and for species seasonally rare to Southeast Alaska, including pied-billed grebe, hooded merganser, and American coot.

Wetlands comprise a very small proportion of the coastal area of Sitka Sound, probably less than one percent, as was found by Stephens and Billings (1967) to be true of Southeast Alaska in general. However, as limited as they are, they provide, acre for acre, the most fertile habitat for the bulk of the migratory and overwintering bird species of Sitka Sound. Wetlands provide valuable habitat and food for terrestrial and marine mammals as well. Wetlands are important for their primary productivity and export of detrital energy to adjacent estuarine and marine ecosystems.

HABITAT MANAGEMENT RECOMMENDATIONS

The coastal wetlands, including estuarine tidal flats and their associated waters, are among the most biologically productive components of the coastal ecosystems of Sitka Sound. The freshwater wetlands characterized as aquatic, marsh, wet meadow, and ericaceous shrub bog, were also found to be important habitat types. Because they occur to a very limited degree, it is imperative that developments affecting these areas be carefully implemented to avoid adverse environmental impacts. Information from this study can assist in the formation of general guidelines for habitat maintenance and protection of all wetlands within Sitka Sound. The data can be used as baseline information for evaluating impacts of site-specific projects. Federal law requires that developmental projects that may impact wetlands through discharge of dredged and fill materials, must be reviewed and authorized through the U.S. Army Corps of Engineers Section 10/404 permitting process.

General Recommendations

Environmental impacts within wetlands can vary depending upon the type, intensity, and duration of proposed projects. There is no substitute for on-site evaluation of projects by trained resource specialists. The following are general guidelines:

1. Permanent impacts resulting in the loss of valuable habitat can be avoided by not siting industrial operations, docking

and harbor facilities, land fills, roads or trails, log transfer and storage sites, or recreational and other permanent structures on coastal wetlands, including the salt marshes and estuarine tidal flats.

2. Temporary impacts should be planned during seasons and for locations where minimum impacts would result. Wildlife use of Sitka Sound wetlands varies on a seasonal basis. Coastal wetlands and adjacent waters are highly valuable to wildlife during spring. Disturbance during this season should be avoided. During summer, there is a lull in wildlife use of wetlands. During fall and winter, wildlife again make use of the coastal wetlands to a significant degree, particularly seaward from the mean high tide line. The "upland" portions of the wetlands between mean high tide and the forest edge are little used during fall and winter. The most important wildlife use period for freshwater wetlands, which generally freeze in winter, is from early spring through late fall.

3. The general productivity and degree of use by wildlife of individual wetlands must be considered in general and site-specific planning. Wildlife use varies from wetland to wetland within Sitka Sound. Those in the north area are used by high numbers and many species of wildlife, especially Port Krestof, Dry Pass, and Nakwasina. Wetlands in the south area

appear to have lower concentrations of wildlife, perhaps due to the size of the wetlands and their location along the rugged outer coast of Baranof Island. Totem Park Flats and Old Seaplane Turnaround Cove within Sitka's roaded area, are especially important to wildlife, particularly migratory birds.

4. Industrial operations and docking and/or harbor facilities should be located on the existing road system. Specific sites to be considered for this type of development are Jamestown and Sawmill bays and Sitka Channel, areas currently committed to developmental activities. The use of structural pilings is generally preferable to land fills in tideland areas.

5. Coastal wetlands off the road system, in both the north and south study areas, should be reserved for public use, recreation, and wildlife habitat. Traditional hunting, fishing, clamming, and general outdoor use should be considered when making land use decisions concerning these wetlands.

6. Off-road motorized vehicle use in wetlands, particularly coastal wetlands and tide flats, should be prohibited because of its adverse impacts upon vegetation, soils, and intertidal marine life, the very factors that make these wetlands biologically rich.

Specific Recommendations

1. On coastal wetlands, gravel removal may be allowed following U.S. Army Corps of Engineers 10/404 permitting procedures and case-by-case review by agency fish and wildlife biologists. Removal should be restricted to areas above mean tidal influence or those areas that show annual accretion of gravel. Removal should be designed to increase or improve water bird habitat.

2. Log storage and transfer sites should be located away from coastal wetlands, where possible along the rocky coastline. This can prevent degradation of valuable wetlands habitat and facilitate log handling in deeper water. Where this is not feasible or practical, log facilities should be located at the periphery of wetlands and reviewed individually through the U.S. Army Corps of Engineers 10/404 permitting process.

3. Where feasible upland alternatives exist, roads and road construction should be routed to avoid wetlands, particularly coastal wetlands and tideflats. Generally the further roads can be located from wetlands, the less disturbance there will be to wetland habitat values. However, a buffer zone of at least 50 feet should be maintained between any road right-of-way and the landward edge of the beach rye grass community or mean higher high water line in the absence of a beach rye grass community in coastal wetlands.

4. Where new residential development does occur adjacent to coastal wetlands, consideration should be given to leaving a strip of land in public ownership or open spaced greenbelt at least one-eighth mile in width to act as a buffer to disturbance of the wetlands. Roads, power, water, and sewer lines and other service needs should avoid routes that cross wetlands unless no feasible and practical alternative exists. Where utilities must cross wetlands, they should be buried, create no impediment to natural drainage patterns, and be constructed during times of least disturbance to wildlife.

5. The development of muskeg areas along the Sitka road system, if handled under general permit guidelines, should include stipulations to:

   a. evaluate muskeg areas within 500 feet of anadromous streams, lakes, or coastal wetlands to determine their contribution if any to stream flow during low flow periods. If significant flow exists, the muskeg should be considered sensitive to filling and no filling or draining should occur unless steps are taken to insure that water of high quality continues to contribute to maintaining base level flow in the stream. For all anadromous streams a minimum of 50 feet of riparian buffer should be maintained along both streambanks;

b. minimize turbidity or other forms of water quality degradation that occur off-site from the development;

c. use only clean rock fill, filter material or piling that is suitable for permanent structural foundation and will not create water quality problems; and

d. revegetate filled areas soon after development to retard surface runoff, control erosion, provide wildlife habitat and improve aesthetics.

6. Old Seaplane Turnaround Flats is one of the most important water bird habitats in the City of Sitka. The area is heavily used by waterfowl and shorebirds for feeding and resting. The rich mud flats and eelgrass beds should be maintained. All projects affecting tidelands in this area should be reviewed on a case-by-case basis by resource agencies.

7. Both Totem Park Flats and Indian River Flats should be maintained. Water bird use of both areas is indicative of species composition and timing of migration through Sitka Sound. Furthermore, the two areas lie adjacent Totem Park and thus form an integral part of this natural tourist, visitor, and local recreation area.

8. Swan Lake is the only freshwater lake easily accessible to most residents of Sitka. It provides a representative sample of freshwater habitats, important to many bird species, and a variety of public uses. The lake and its associated wetland communities should be maintained.

Mitigation

In those cases where impacts cannot be avoided on coastal wetlands, tide flats, or freshwater wetlands, each project must be evaluated on a case-by-case basis under the Corps of Engineers 10/404 permitting process. During their review, agency biologists should consider the following mitigative measures:

1. Location of Work. Options include picking locations within vegetation types which are the most extensive, least sensitive to damage, or of least value to wildlife in a given location. The beach rye grass community, although important from a soil stabilization standpoint, will often provide all three options in the coastal wetlands. When possible, projects should be located outside the normal flood plains of any rivers or streams, even when they run through coastal wetlands. Siting of projects should avoid tidal and near shore areas of high wildlife or marine productivity.

2. Timing of Work. Depending on the specific site(s) selected for the project, determine what period(s) of the year would cause the least damage to habitat and/or minimize disturbance to fish and wildlife. For those locations above mean high tide, winter is probably the best time. Below mean high tide, summer is preferable for minimizing impacts to summer bird life. The summer use of wetlands and estuaries by feeding and migrating juvenile salmonids and herring should be considered for dredge and fill operations on tidelands.

3. Avoid Land Fill. Where possible, pilings or elevated piers should be used for structural footings for roads and highways to prevent not only interruption of natural processes like tides, land accretion, or drainage patterns, but also disturbance, degradation, and elimination of valuable parcels of wetland habitat. Cost benefit analyses must measure not only direct impacts on wetlands, but any long-term loss in the general productivity of the wetland due to a given proposed project.

4. Habitat Improvement. Where possible, projects should be combined with habitat improvement projects, or designed in such a way as to improve habitat for one or more important species. Even in this case, a loss of general productivity of the entire wetland must be considered when making development trade offs.

5. Minimize Impacts of Access. Once complete, access routes to project sites should be removed, put-to-bed, or regulated to prevent undue impacts through habitat degradation or disturbance of wildlife.

STUDY AREA DESCRIPTION

The study area encompassed the shore lands and adjacent waters surrounding Sitka Sound in Southeast Alaska (Figures 1 and 2), including Port Krestof, Dry Pass, Nakwasina Passage, Katlian Bay, the roaded area within the City of Sitka, the small islands fronting the City of Sitka, Salmon River mouth, and the south shore of Sitka Sound to Goddard.

The following habitats as defined in the Sitka Coastal Zone Management Phase I report (Alaska Department of Fish and Game, 1979) were the focus of the study: freshwater wetlands, coastal wetlands and tidal flats, and the estuarine waters adjacent wetlands. The offshore waters of Sitka Sound, rocky islands, and sea cliffs were studied to a lesser extent.

Figure 1. Sitka Sound Wetlands Survey Area and Vegetation Transect Sites

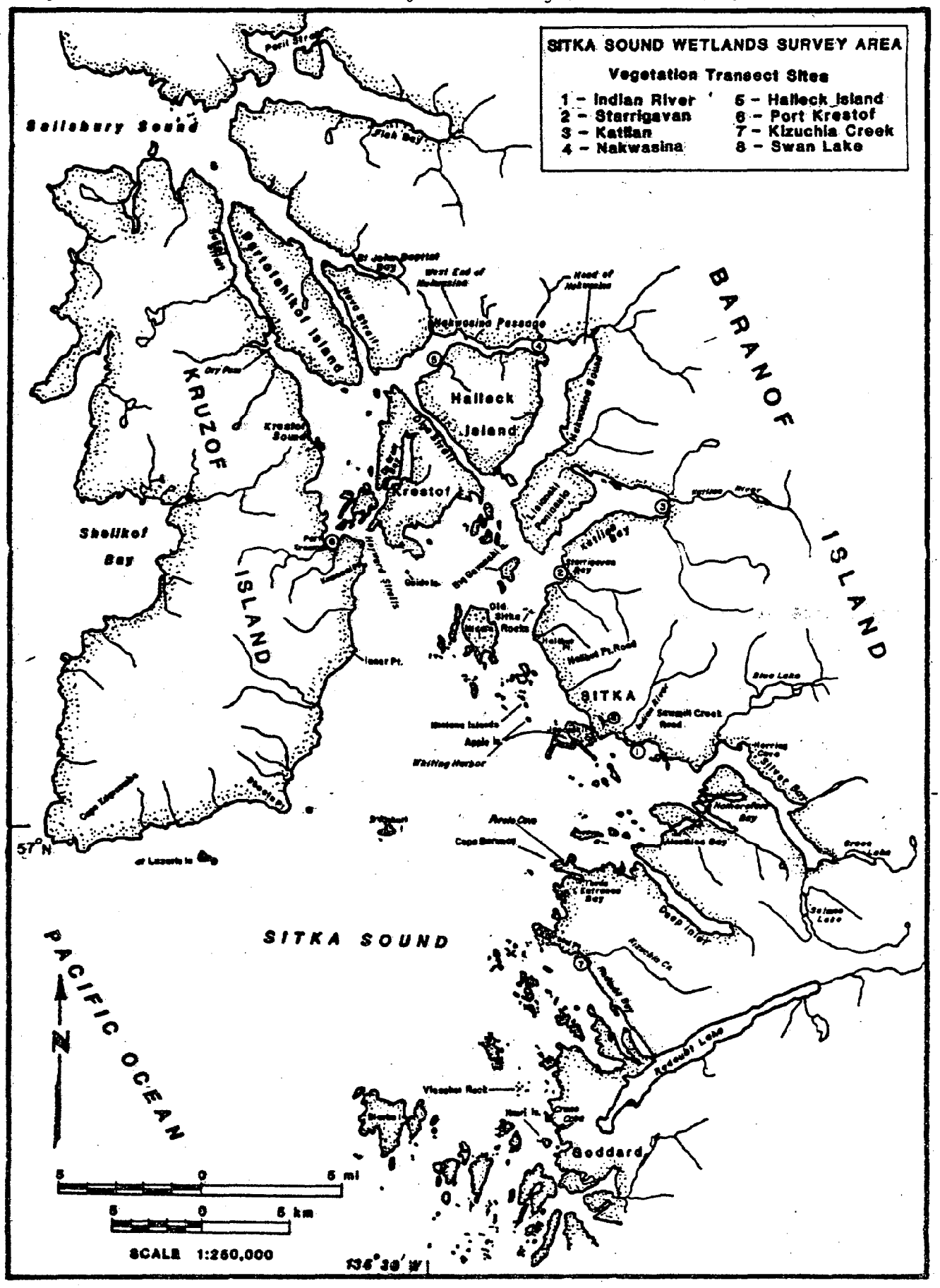
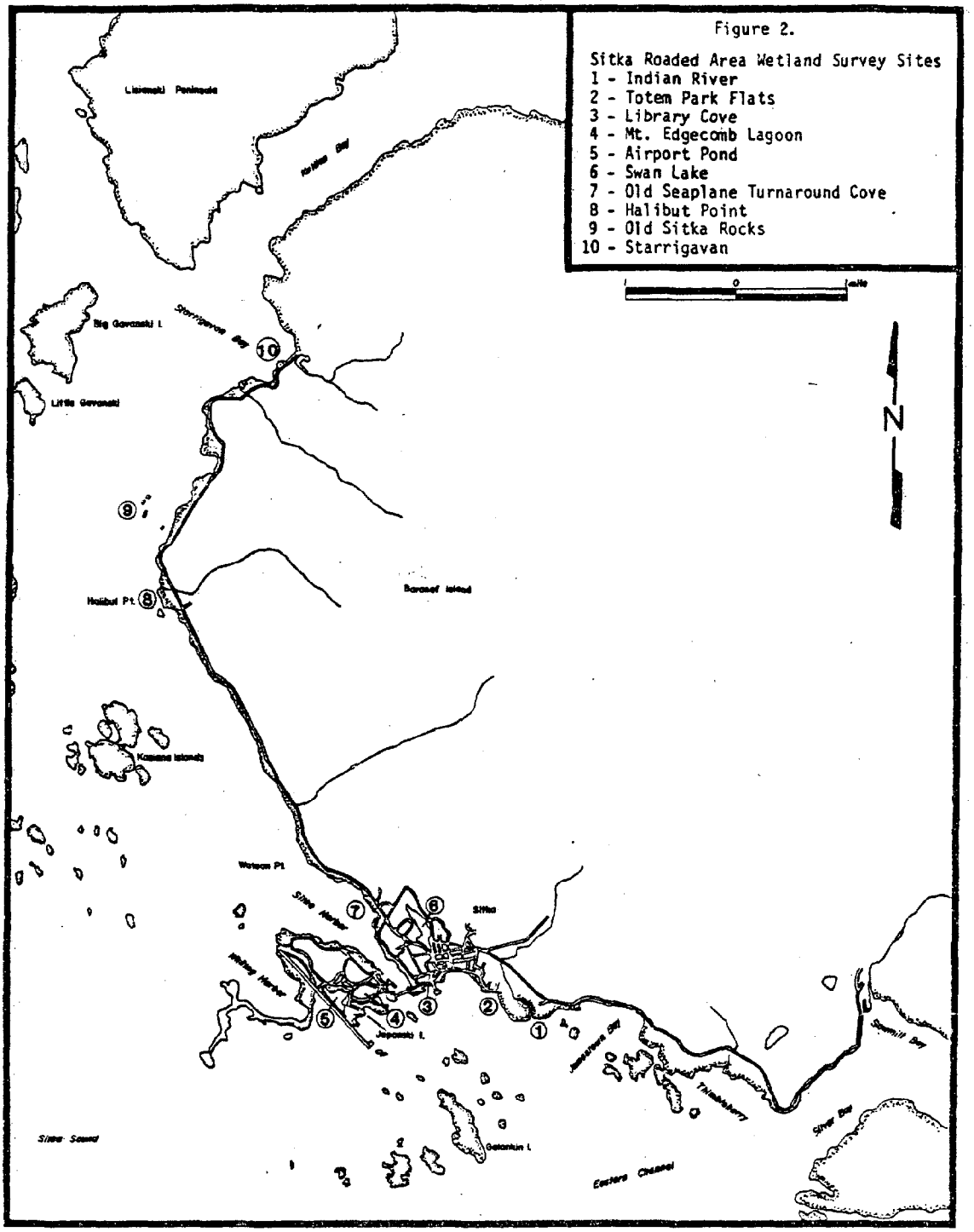


Figure 2. Sitka Roaded Area Wetland Survey Sites



METHODS

Vegetation

Seven sites were sampled for plant species composition and surface soil type to characterize the coastal wetlands of Sitka Sound. Wetlands at Starrigavan Creek, Katlian Bay, Nakwasina Passage, Halleck Island, Port Krestof, and Kuzuchia Creek were sampled during September 1979 and May-June 1980. Wetlands at Indian River were sampled during June 1980. One belt transect, consisting of one meter by one meter plots, was surveyed per wetland. The location of each transect was selected to include the major plant communities on each wetland. Each transect began in the intertidal zone with the first appearance of a vascular plant species, usually *Puccinellia nutkaensis*. The transect continued perpendicular to the tideline and extended to the alder *(Alnus* sp.*)* fringe. Data collected included the species present, the estimated percent cover of each species, and the surface soil type. In addition, one freshwater wetland site, located at the north end of Swan Lake, was surveyed. Information obtained at Swan Lake included plant species composition, soil type, and depth of surface water.

Plant specimens were collected as needed along the transect for positive identification and mounting for a permanent collection.

Plant specimens were pressed and dried in a plant press then mounted on poster board and covered with clear self-adhesive plastic. Hulten (1968) was used for plant species identification. Alan Batten of the University of Alaska Herbarium and Mary Muller of the U.S. Forest Service, provided identification of difficult species.

During June 1980, a standard surveyor's rod and transit were used to determine relative elevations along the transects. Bench marks with vertical tidal datum were not easily available in the remote areas surveyed. However, the mean higher high water (MHHW) tide line was inferred from plant community structure. Batten et al. (1978) found "the precise leveling done by NOS (National Oceanic Survey) at three study sites (in the Gulf of Alaska) shows that the marshes do not extend far seaward of mean higher high water... Generally, only a few tufts of *Puccinellia nutkaensis* and other halophytes are present at MHHW and the transition to the luxuriant. stands of *Carex lyngbyaei* that constitute the bulk of most marshes occurs substantially above this mark." Based upon this observation and using the MHHW level for Sitka Sound of 9.9 feet, the beginning elevation, and thus subsequent elevations for each transect could be determined within an estimated precision of plus or minus one foot.

High altitude, color infrared (CIR) photographs at a scale of 1:60,000 were used to map the major plant zones of seven wetlands. Vegetation information obtained through ground surveys was used to

correlate with the spectral differences between vegetation communities on the CIR photos. Acreages of vegetated and non-vegetated areas were calculated directly from the photos using a polar planimeter. Because all wetlands mapped were within 50 feet of mean sea level, vertical exaggeration of acreages on the photographs was assumed to be negligible, hence no corrections for distortion were made.

Birds

The coastal and freshwater wetlands and their adjacent waters were divided into three major categories based upon accessibility for bird surveying: 1) those adjacent the road system and thus accessible by car on a regular basis; 2) those north of the roaded area and accessible by open skiff under most weather conditions; and 3) those south of the roaded area and accessible by boat only under good weather conditions. The wetlands in each area were surveyed as often as weather and time permitted. Wetlands within the road system were surveyed weekly. Those to the north were surveyed bimonthly, and those to the south were surveyed approximately once a month.

Each survey of a wetland and its associated waters emphasized observations of all avian species present, their relative abundance, and habitat use. Information on the effects of weather,

tides, and disturbance to birds was also recorded. Particular attention was focused on species in the following taxonomic groups: loons, grebes, swans, geese, dabblers, divers, sea ducks, cranes, coots, shorebirds, and seabirds. In three instances it was necessary to combine similar species within a genus to simplify identification under field conditions. These were greater scaup *(Aythya marila)* and lesser scaup *(A. affinis)*, Barrow's goldeneye *(Bucephala islandica)* and common goldeneye *(B. clangula)*, and short-billed dowitcher *(Limnodromus griseus)* and long-billed dowitcher *(L. scolo)*. In Sitka Sound, the more abundant of each of the species pairs were greater scaup, Barrow's goldeneye, and short-billed dowitcher. For this report, they are refered to as scaup, goldeneye, and dowitcher. A species and species group list is provided in Appendix I.

Data were gathered during four seasonal periods: fall (August 28 through October 31, 1979), winter (February 18 through February 29, 1980), spring (March 31 through May 31, 1980), and summer (June 1 through June 26, 1980). Data for all sightings were gathered on foot, via car, 13 foot open skiff, 29 foot power boat, fixed-wing aircraft, and helicopter.

Two aerial surveys using a Cessna 185 were made during fall and winter. Two observers conducted the fall survey on October 30, 1979. There was one observer on each side of the plane, and each

recorded his own observations. The entire study area was surveyed. The winter survey flown on February 25, 1980, used two observers, one on each side of the aircraft, plus one person who recorded their observations. The north area and the road system north of the airport were surveyed.

Following each bird survey, field notes were logged on a species list for each site. These data were divided into two-week periods to demonstrate change in species composition and abundance over time. Where more than one observation of a species occurred during a two-week period, the largest single sighting was used. This "peak value" method was preferable to an averaging method, due to the short stays of many species during migration and to the variable level of survey coverage due to weather and mode of travel. Species were then placed into groups based upon taxonomy and similar use of a habitat. Data from sites with comparable levels of survey coverage were combined to give a broad view of seasonal species composition and relative abundance.

The offshore waters, rocky islands, and sea cliffs of Sitka Sound were surveyed for avian species composition, abundance, and habitat use concurrent with wetlands surveys. These habitats were surveyed as time and logistics permitted. Those waters, islands, and sea cliffs en route between wetland sites were surveyed more often than those in other areas.

A reconnaissance survey of St. Lazaria National Wildlife Refuge was made on May 21, 1980. An estimate of breeding bird populations was accomplished by circling the island in a 29 foot power boat and going ashore to ground check for burrow nesters and nocturnal seabirds from 7pm until 3am. Final population estimates were made by Edgar Bailey of the U.S. Fish and Wildlife Service (Appendix II).

Data from surveys of marine waters, rocky islands, and sea cliffs were not incorporated with data from wetlands surveys, and are presented in a separate section.

A survey of active bald eagle *(Haliaeetus leucocephalus)* nest sites within the urban area of Sitka was conducted on May 22, 1980, using an Allouette III helicopter and two observers. Known nest sites were checked for activity and new sites were mapped as they were found.

Ten waterfowl collected by fall hunters in Sitka Sound were examined for stomach contents in a limited food habits study. The contents were preserved in buffered formalin solution and later examined to identify major food items.

Mammals

Observations of mammals associated with the wetlands were made on an opportunistic basis concurrent with avian surveys. Actual sightings and sign indicating presence of Sitka black-tailed deer *(Odocoileus hemionus sitkensis)*, brown bear *(Ursus arctos)*, river otter *(Lutra canadensis)*, and marten *(Martes americana)* were recorded. Sightings of harbor seal *(Phoca vitulina)*, northern fur seal *(Callorhinus ursinus)*, sea lion *(Eumetopias jubata)*, and humpback whale *(Megaptera novaeangliae)* were also recorded. No attempt was made to quantify mammalian use of the wetlands.

RESULTS AND DISCUSSION

Vegetation

Coastal Wetlands

Transect data indicated that five major vegetation types dominated the coastal wetlands in the Sitka Sound area. In the following discussion, the dominant plant species, surface soil type, elevation, and extent of tidal inundation for each vegetation type are presented. The five major types are: *Puccinellia nutkaensis, Calamagrostis canadensis, Carex lyngbyaei, Elymus arenarius*, and *Calamagrostis nutkaensis*. The occurrence of these types in relation to elevation for each of the seven wetlands studied are shown in Figure 3. Specific transects are addressed in the Survey Sites section. A plant species list is presented in Appendix III.

Puccinellia nutkaensis: This vegetation type usually occurred farthest seaward at low elevations and, thus, was most frequently inundated by saltwater. The dominant species was *Puccinellia nutkaensis*, alkalai grass, a short grass of not more than 12 inches in height. Asssociated species included intertidal algae, *(Fucus distichus* and *Gloiopeltis furcata)*, and succulents, *(Spergularia canadensis* and *Glaux maritima)*. A complete list of associated plants is found in Appendix III.

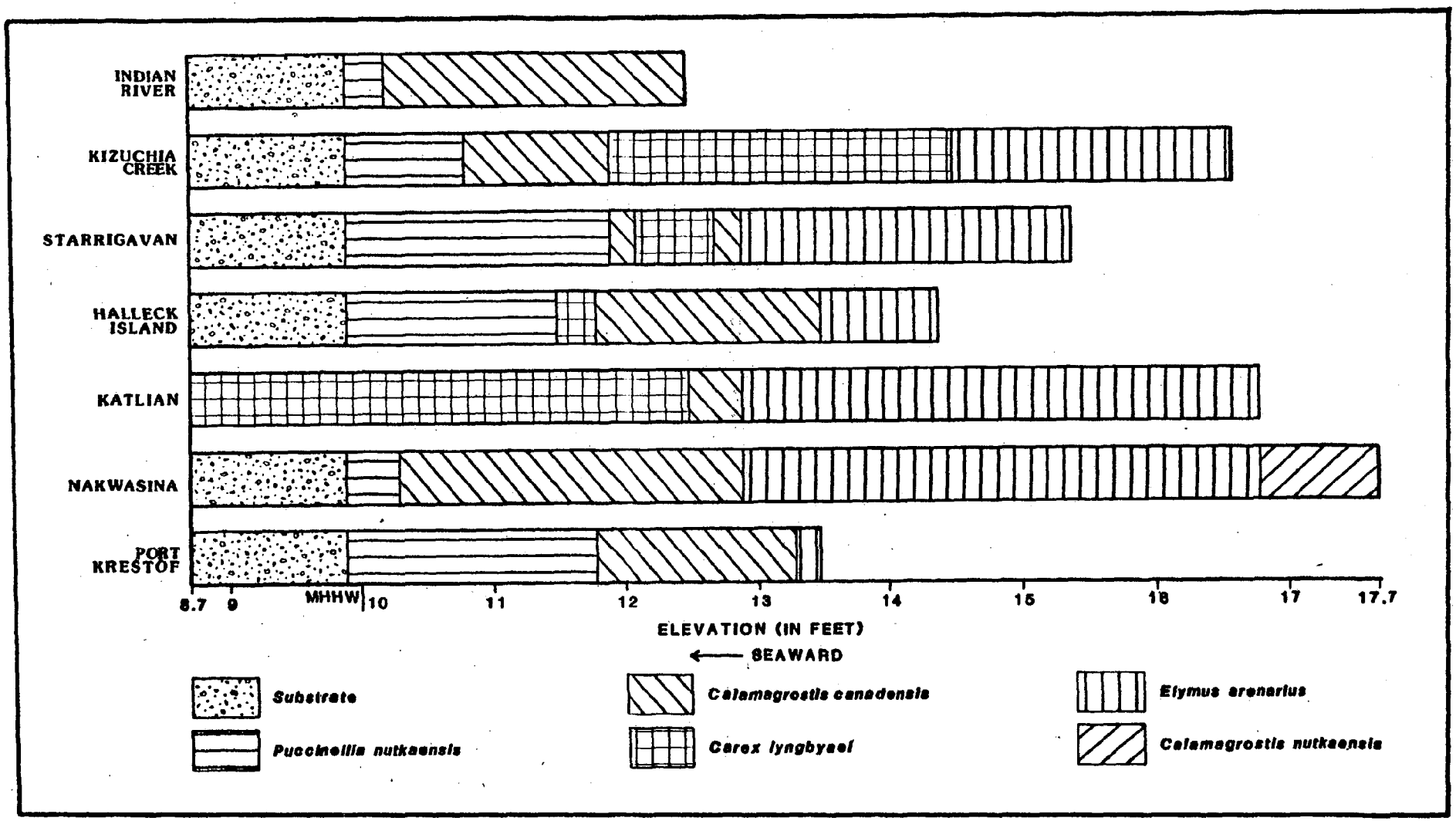


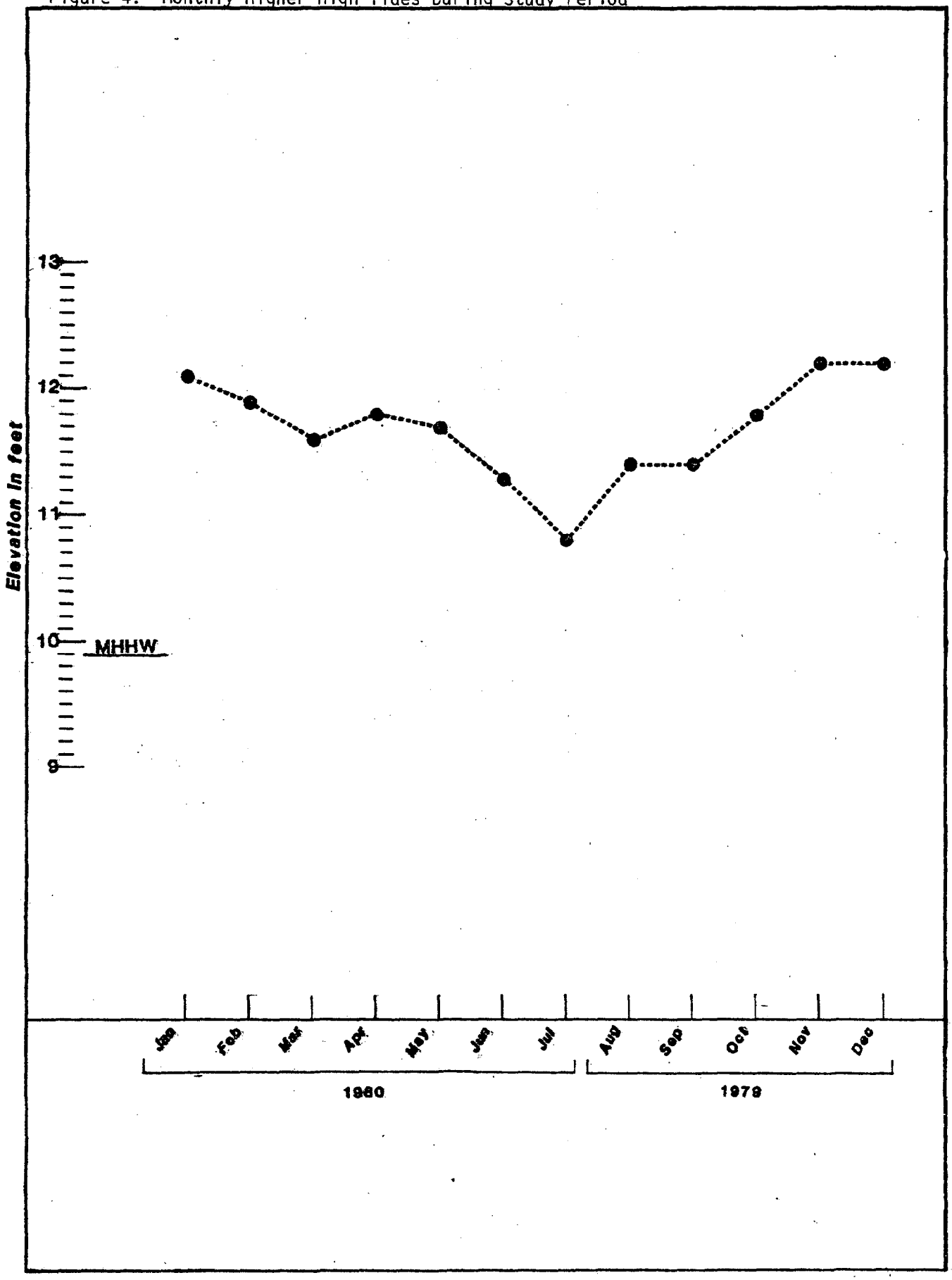
Figure 3. The Occurence of Six Plant Species as Dominants in Relation to Elevation Along the Vegetation Transects.

Plant cover by this community was sparse to moderate (5 to 60 percent), generally revealing large patches of silt and gravel substrate. The elevation ranged from +9.9 to +11.8 feet (MLLW). Tides inundated most of the community on a weekly basis. Inundations of the entire community occurred most frequently during winter storms when plants were dormant (Figure 4).

Calamagrostis canadensis: The next landward vegetation type was dominated by *Calamagrostis canadensis*, bluejoint, another grass species. This species formed dense tussocks and grew to three feet in height. Plant cover ranged from 60 to 90 percent. Associated species included *Carex lyngbyaei* and *Triglochin maritimum*. The substrate was silt overlying gravel with an increase in organic topsoil appearing on more inland plots. Elevations of this community ranged from +10.2 to +12.9 feet (MLLW). Tidal inundations occurred regularly during winter months and occasionally during summer storm surges.

Carex lyngbyaei: This vegetation type was dominated by the sedge, *Carex lyngbyaei*. This species often appeared in pure stands, but was also found with *Potentilla egedii*, *Calamagrostis canadensis*, and *Triglochin maritimum*. The substrate was silt with an increasing accumulation of organic matter on more inland plots. Plant cover of *Carex lyngbyaei* varied from

Figure 4. Monthly Higher High Tides During Study Period



20 to 100 percent. The community was found at a broad range of elevations from +8.7 to +14.5 feet (MLLW), and had nearly 100 percent cover between +10.5 and +12.7 feet (MLLW).

Tidal inundations were equally broad ranging. Flooding occurred as often as monthly and as infrequently as quarterly.

Carex lyngbyaei formed aerial branches, or stolons, which rooted at the end and formed new plants. It was therefore able to colonize mud flats at low elevations. Many of the seaward plants did not reproduce sexually, perhaps due to frequent tidal inundation. *Carex lyngbyaei* also put up green shoots earlier than other salt marsh species. Some were found to be green as early as February.

Elymus arenarius: This vegetation type was recognizable by its dominant species, *Elymus arenarius*, beach rye, a coarse grass that reached heights of five feet by late summer. The type tended to be mono-specific and the transition to it from more seaward communities was abrupt. Elevations of the community ranged from +12.8 to +16.8 feet (MLLW) and plant cover was often 100 percent. Tidal inundations were restricted to winter storm surges. The substrate was a well-drained, sandy soil with a variable surface layer of organic matter.

Calamagrostis nutkaensis: The last vegetation type occurred between the mono-specific *Elymus arenarius* community and the alder fringe. The most common species was *Calamagrostis nutkaensis*, reed bent grass, a tall grass similar in appearance to *C. canadensis*. A wide variety of species occurred within this vegetation type, including wildflowers that are thought to be intolerant of saltwater inundation. Some plants were also common in forest habitats, which indicated that this vegetation type was a transition between the coastal wetland and the adjacent forest. The substrate was a rich organic layer. Elevations for this community ranged from +16.8 to +17.7 feet (MLLW). Tidal inundation was infrequent and occurred only during winter storm surges. The community appeared to be influenced by factors other than tidal inundation. Batten et al. (1978) proposed freshwater seepage, soil drainage as controlled by topography, and substrate texture to be important factors influencing the distribution of plants in this transitional zone.

All of the dominant plant species of the five vegetation types are wildlife food plants. The seeds of all species are consumed primarily by dabblers, such as mallard *(Anas platyrhynchos)*, pintail *(A. acuta)*, and green-winged teal *(A. crecca)* (Hughes and Young, unpublished data; Crow, 1978; Bellrose, 1979). Salt marsh grass species were identified in the stomachs of dabblers collected by

hunters in Sitka Sound (Richard Sellers, pers. comm.). The protein-rich spring shoots of *Carex lyngbyaei* and *Elymus arenarius* were observed to be grazed by Canada goose *(Branta canadensis)* during this study.

Freshwater Wetlands

The transect at Swan Lake provided data on freshwater wetlands. Additional visits to wetland sites at Salmon Lake and upper Crane Cove indicated that Swan Lake supports vegetation typical of other freshwater wetlands in Sitka Sound.

To describe the vegetation, the plants were grouped according to a proposed classification of Alaska freshwater wetland species by morphology and habitat (Batten, 1980). The following plant groups were noted for Swan Lake:

Aquatic: Vegetation had floating or submerged leaves in sites permanently flooded. Actual water depth was not critical. Examples of aquatic plants found in Swan Lake included pond lily *(Nuphar polysepalum)* and pondweed *(Potamogeton gramineus)*.

Marsh: Vegetation was dominated by emergent plant species at sites flooded with more than 15 centimeters of water. Examples

of marsh plants found at Swan Lake included spikerush *(Eleocharis palustris)*, buttercup *(Ranunculus reptans)*, and horsetail *(Equisetum fluviatile)*.

Wet Meadow: Vegetation was dominated by grasses and sedges on soils characteristically flooded with less than 15 centimeters of water. Examples of wet meadow plants found at Swan Lake included the grasses *(Deschampsia beringensis* and *Calamagrostis canadensis)* and sedge *(Carex sitchensis)*.

Ericaceous Shrub Bog: This was similar to a muskeg where heath shrubs are codominant with sedges, mosses, and a few trees. The surface was hummocky and the soil wet and peaty. Examples of plants found at Swan Lake included Labrador tea *(Ledum palustre)*, sedge *(Carex pluriflora)*, moss *(Sphagnum* sp.*)*, and Sitka spruce *(Picea sitchensis)*.

A number of freshwater plant species are known to be food items for birds. The plant species list in Appendix V indicates which plants are possible food sources for birds in these freshwater wetlands.

Birds

The wetlands were surveyed on a seasonal basis for avian abundance, species group composition, and habitat use. Specific wetland sites are discussed in the Survey Sites section.

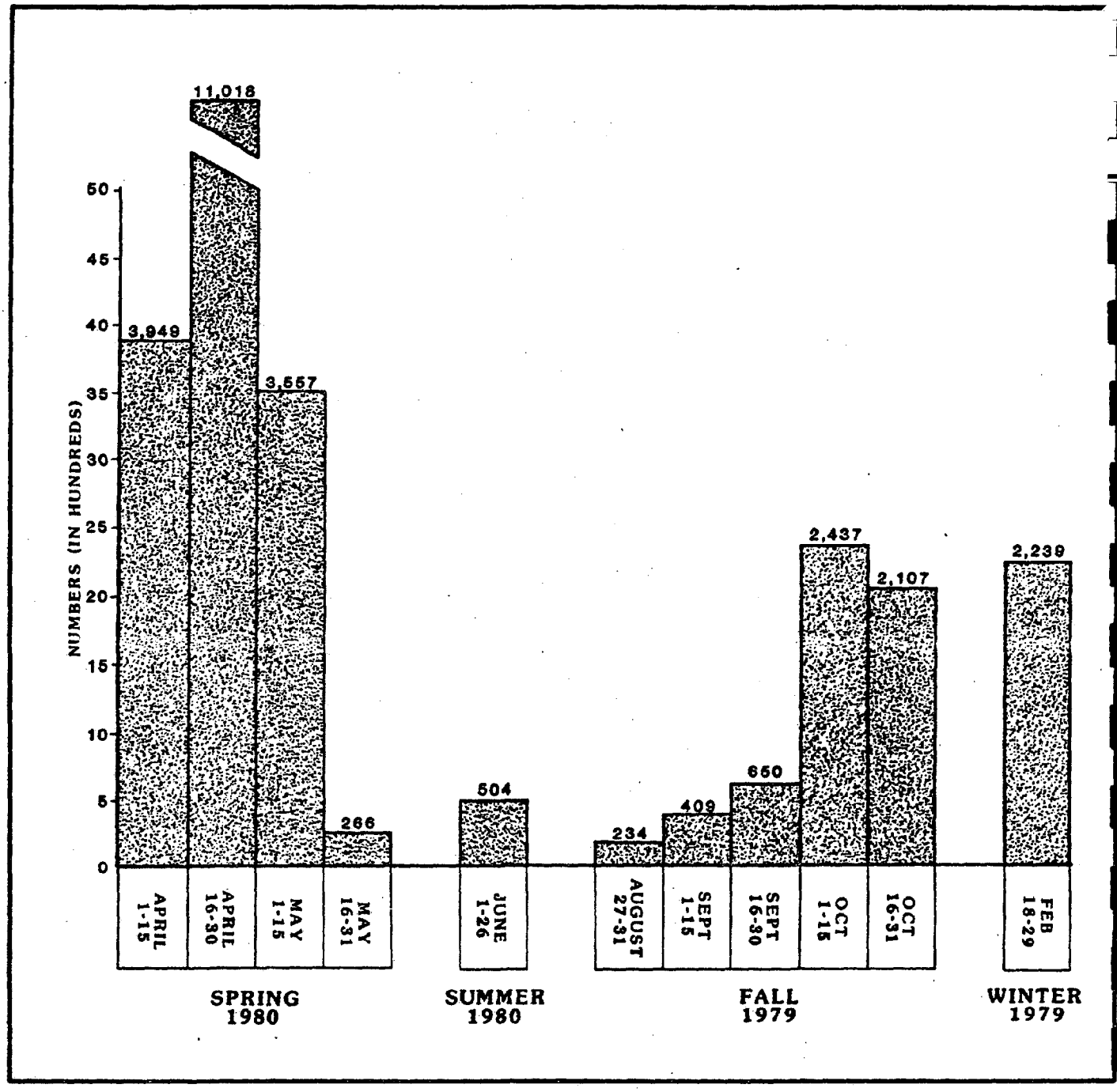
Abundance

Peak numbers of bird species groups moved through Sitka Sound during spring migration (Figure 5). The groups included loons and grebes, swans, geese, dabblers, divers, sea ducks, shorebirds, and seabirds. Birds generally remained only to feed and rest briefly before continuing north. Daily population levels fluctuated greatly at various survey sites. The peak of migration occurred during April 16-30. The numbers of migratory birds quickly tapered off, leaving few birds present by the end of May.

During May, the first broods produced by local breeding birds were sighted. In June, the population increased slightly by the return of non-breeders (either unpaired or immature individuals of species which nested farther north). By late June, the addition of flocks of molting male dabblers further increased bird numbers.

Fall migration took place from August through October. The height of migration occurred during October 1-30. Fewer birds and fewer species were sighted during fall migration than during spring migration. In 1979, fall numbers of birds in Sitka Sound may have been below normal, as many birds were

Figure 5. Seasonal Abundance of Selected Bird Species Groups Observed on Wetland Habitats.



able to bypass the area due to favorable conditions of good local weather and sufficient fat reserves.

Winter surveys conducted during February indicated numbers of birds were nearly equal to peak numbers of fall migrants. Species group composition and habitat use were the major differences between fall and winter seasons.

Species Group Composition

Table 1 shows the seasonal populations of selected bird species groups utilizing the wetland habitats of Sitka Sound. The values are total counts from the roaded and north areas only. The south area data were not used because surveys occurred less frequently due to logistical problems. Based upon less frequent observations, it is presumed that populations in the south area showed trends similar to those in the roaded and north areas.

Loons and Grebes: Loons and grebes were present during spring and fall, but were especially abundant during winter. Common loon *(Gavia immer)* and yellow-billed loon *(Gavia adamsii)* were most often found along rocky shorelines. Red-throated loon *(Gavia stellata)* were usually found in estuarine waters adja-

	SPRING 1980				SUMMER 1980	FALL 1979					WINTER 1979
	APR 1-15	APR 16-30	MAY 1-15	MAY 16-31	JUNE 1-26	AUG 27-31	SEPT 1-15	SEPT 16-30	OCT 1-15	OCT 16-31	FEB 18-29
LOONS and GREBES	4	9	9	2	6	—	—	4	8	14	45
SWANS	10	—	—	—	—	—	—	—	—	—	—
GEESE	157	57	148	2	8	80	1	—	36	95	70
DABBLERS	833	657	404	47	67	107	42	35	290	448	625
DIVERS and SEA DUCKS	2371	5535	1336	209	393	11	85	518	1961	1501	1493
SHOREBIRDS	582	4756	1621	45	28	32	275	93	142	50	15
SEA BIRDS	2	4	39	4	2	4	6	—	—	1	1

Table 1. Seasonal Populations of Selected Bird Species Groups Observed on Wetland Habitats in Sitka Sound.

cent to wetlands. Arctic loon *(Gavia arctica)* were most numerous in the open waters west of Sitka. Loons tended to be found singly, except during spring when birds were paired. Grebes were most often found in small groups. Horned grebe *(Podiceps auritus)* was the most abundant grebe. Horned grebe often occurred with red-necked grebe *(Podiceps grisegena)* and the more uncommon western grebe *(Aechmophorus occidentalis)* in estuarine waters adjacent wetlands, particularly at Halleck Island and Nakwasina Passage. One species considered rare to Alaska, the pied-billed grebe *(Podilymbus podiceps)*, was found in Swan Lake during fall, spring, and summer.

Swans: Trumpeter swan *(Olor buccinator)*, a species known locally for its annual return to Swan Lake, was sighted on April 1. The swans preferred the wooded northwest shore of the lake where shoreline development has been minimal. Swans were observed feeding on the lake's aquatic vegetation. They are known to eat a variety of marsh and aquatic plants including the stems and leaves of pondweeds *(Potamogeton* sp.*)*, and the seeds of yellow-pond lily *(Nuphar polysepalum)* and sedges *(Carex* sp.*)*. Swans can consume as much as 20 pounds of moist leafy aquatic vegetation per day (Hansen et al., 1971). Whistling swan *(Olor columbianus)* was heard on April 23 at Dry Pass.

Geese: The Vancouver Canada goose *(Branta canadensis fulva)* was a probable year-round resident of Sitka Sound. White-fronted goose *(Anser albifrons)*, and black brant *(Branta bernicla nigricans)* were present during migration. During spring, geese were common on wetlands, including Katlian Bay, Lisa Creek, Nakwasina, Dry Pass, and Port Krestof, feeding on the protein-rich young shoots of *Carex lyngbyaei* and other salt marsh plants. Few geese were seen on wetlands during summer except at Dry Pass. Initially, geese were found on wetlands during fall surveys, but their numbers declined during the month of September. They may have moved up coastal streams to feed on salmon *(Oncorhynchus* spp.*)* eggs. During October, geese were recorded again on the wetlands. By late October, large flocks of migrating geese moved through Sitka Sound. Flocks could be seen flying offshore during periods of good weather and were probably overflying Sitka Sound. Had severe weather occurred when geese were migrating, larger numbers would probably have occurred on local wetlands.

During spring, small flocks of black brant were frequently found in marine waters off Inner Point, Kruzof Island. Black brant were reportedly seen at Dry Pass during the fall (Loyal Johnson, pers. comm.). There is a historical record of brant occurring during spring and fall around Kruzof Island (Gabrielson and Lincoln, 1959).

Dabblers: Dabblers were at their peak abundance during April 1-15. They were nearly always found in coastal wetlands, feeding and resting near the water's edge. Mallards were most abundant during spring and the most abundant dabbler during all seasons. Other common species in spring included pintail, green-winged teal, northern shoveler *(Anas clypeata)*, and American wigeon *(Anas americana)*. Blue-winged teal *(Anas discors)* were uncommon. Northern shoveler and blue-winged teal normally breed in the mid-western United States and Canada, an area under drought conditions during 1979-80. Likewise, data from waterfowl breeding pair surveys conducted by the U.S. Fish and Wildlife Service on Alaskan and Yukon breeding grounds in 1980, showed northern shoveler populations up 275 percent, and blue-winged teal 89 percent above average (King and Conant, 1980). It is probable that Sitka Sound was providing, in part, an alternative habitat for these waterfowl during migration. Sites where northern shoveler and blue-winged teal were observed included Indian River, Airport Pond, Nakwasina, and Port Krestof.

Summer populations of dabblers were low compared with other seasons and were composed primarily of flocks of molting males. No dabbler nests were found on surveys, but some local nesting by mallard and green-winged teal probably occurred.

Fall population levels of dabblers increased throughout October with mallard, pintail, green-winged teal, and American wigeon the dominant species. No northern shoveler or blue-winged teal were sighted.

Winter population levels of dabblers were higher than fall, indicating an influx of birds after October 30. Mallards were conspicuous at every wetland surveyed. One European wigeon *(Anas penelope)*, a species considered rare in Southeast Alaska, remained all winter at Starrigavan Creek wetland.

As previously mentioned, stomach sample examinations of birds from the north area taken during fall, indicated that dabblers fed heavily on the seeds of salt marsh grasses. Dabblers found along the roaded area during winter were often concentrated near several of the main intertidal sewage outfall locations, including Crescent Harbor and Old Seaplane Turnaround Cove.

Divers and Sea Ducks: Divers and sea ducks were grouped together due to their similar feeding habits. They were nearly always found in estuarine waters diving for fish and invertebrates. They were the most abundant species group during all seasons, with highest numbers in late April after the Pacific herring *(Clupea harengus pallasi)* spawning season. Several thousand surf scoter *(Melanitta perspicillata)* and

several hundred scaup were seen grouped in rafts at Old Seaplane Turnaround Cove and Old Sitka Rocks during late April. Harlequin duck *(Histrionicus histrionicus)*, black scoter *(Melanitta nigra)*, and white-winged scoter *(Melanitta deglandi)* were also abundant at this time.

By June, numbers of divers and sea ducks were composed of a few non-breeders, either unpaired birds or immatures. Most were found in rafts in north Krestof Sound near Dry Pass and Halleck Island, although scattered individuals were found throughout Sitka Sound.

Fall populations were lower than spring. However, birds were well distributed around the Sound rather than occurring in large rafts. During times of high tides or severe weather, greater scaup utilized freshwater habitats at Swan Lake and Airport Pond.

Winter abundance and distribution of most species was similar to fall. Oldsquaw *(Clangula hyemalis)* occurred in rafts of hundreds in the protected marine waters north of Redoubt Bay, as well as in scattered flocks near Indian River, Port Krestof, and Old Seaplane Turnaround Cove. Several Steller's eider *(Polysticta stelleri)*, a species that primarily winters in the Aleutian and Kodiak islands were sighted at Nakwasina, Goddard, and Library Cove.

Shorebirds: Shorebirds were locally abundant for a short period of time during spring migration. The peak shorebird migration occurred during April 15-30. Surfbird *(Aphriza virgata)*, black turnstone *(Arenaria melanocephala)*, and rock sandpiper *(Calidris ptilocnemis)* were particularly abundant on the intertidal gravel flats at Totem Park, Indian River, Lisa Creek, and Halleck Island. Dowitcher, western sandpiper *(Calidris mauri)*, and least sandpiper *(Calidris minutilla)*, were most common at estuarine sites including Port Krestof where intertidal mud flats provided preferred habitat. Rare and uncommon species for Southeast Alaska (USDA Forest Service, 1978) found during spring included red knot *(Calidris canutus)* and marbled godwit *(Limosa fedoa)*.

During summer, the few locally breeding shorebirds, including black oystercatcher *(Haematopus bachmani)* and spotted sandpiper *(Actitus macularia)*, were secretive and not often seen.

By August, northern breeding species, including ruddy turnstone *(Arenaria interpres)*, were moving through the Sound and could be found on various wetlands. One species found in estuarine waters or in tide rips was the northern phalarope *(Lobipes lobatus)*. Two major waves of shorebirds came during September 1-15 and October 1-15. Their numbers did not match spring populations.

During winter few shorebirds were present on wetlands. Most wintering species were those preferring rocky habitat such as black turnstone, surfbird, and rock sandpiper. Most of these birds were found on offshore islands and along high energy coasts including Viesokoi Rock and Inner Point, Kruzof Island.

Seabirds: Seabirds were not common to wetlands and tended to occur in open marine waters and on rocky islands and sea cliffs. Marbled murrelet *(Brachyramphus marmoratus)* was the most common seabird found in estuarine waters near wetlands. Murrelets were particularly abundant during late spring (May 1-15) in areas of fast currents such as Kresta Point and Hayward Strait. Their numbers decreased during summer as individuals departed from breeding grounds. Double-crested *(Phalacrocorax auritus)* and pelagic *(P. pelagicus)* cormorants are year-round residents in Sitka Sound. Cormorants were found feeding in estuarine waters adjacent to each wetland surveyed. In mid-April, cormorants were found by the tens in areas of concentrated Pacific herring *(Clupea harengus)* spawning activity between Kasiana and Apple islands. They were associated with surf scoters, which congregated by the thousands to feed upon herring eggs. By the beginning of May, adults had departed for breeding. Cormorant breeding colonies occur on Kruzof and St. Lazaria islands. Throughout the summer, only occasional birds were sighted. By fall, cormorants were again

regularly seen in nearshore waters at Indian River and Halibut Point. Cormorants were found to regularly roost on rock islands in Whiting Harbor next to the airport runway.

During fall, seabirds were regularly sighted in low numbers in inshore waters. A single rhinoceros auklet *(Cerorhinca monocerata)* and a single tufted puffin *(Lunda cirrhata)*, were seen during winter surveys.

Other Species: Herons - Great blue heron *(Ardea herodias)* were irregularly seen at Starrigavan, Katlian Bay, Halleck Island Marsh, Dry Pass, and Port Krestof during spring, fall, and winter. Great blue heron were occasionally seen at smaller embayments and tidal flats along the road system, including Old Seaplane Turnaround Cove and The Cove. Birds were not seen during the summer breeding season.

Raptors - Raptors found associated with wetlands in Sitka Sound included bald eagle, osprey *(Pandion haliaetus)*, merlin *(Falco columbarius)*, and American kestrel *(Falco sparverius)*. Peregrine falcons *(F. peregrinus)* are known to occur in Sitka Sound, but none were sighted during this study.

The bald eagle was a common year round resident in Sitka Sound. Eagles frequently foraged for fish over estuarine

waters or scavenged along the beaches and stream banks, especially during the fall salmon spawning period. A bald eagle nest site survey was conducted by helicopter on May 22, 1980. The results of that survey plus active nest site locations noted during ground surveys are presented in Appendix IV. One osprey was observed foraging over the estuarine waters of Halleck Island marsh during fall migration. American kestrel was sighted during spring migration at Port Krestof on two occasions.

Gulls - Gulls were abundant in Sitka Sound during all seasons. They were especially abundant during the fall salmon spawning period. On one occasion several thousand were found resting on the waters of Katlian Bay adjacent to several hundred gulls which were congregated around the streams at the head of the bay. Other sites where gulls were commonly found included: Swan Lake, Indian River, Totem Park, and Old Seaplane Turnaround Cove. The city dump was also a common site for gulls. The species composition of gulls in Sitka Sound varied over the seasons. Species found included: glaucous *(Larus hyperboreus)*, glaucous-winged *(L. glaucescens)*, herring *(L. argentatus)*, Thayer's *(L. thayeri)*, mew *(L. canus)* and black-legged kittiwake *(Rissa tridactyla)*. During summer, adult mew gulls were on breeding grounds, leaving mostly immature birds in Sitka Sound. Adult gulls returned during fall and numbers were highest during winter.

Dove - Rock dove pigeons *(Columba livia)* foraged on intertidal flats at low tides. They were fairly common within the roaded area of Sitka, but were never seen in the north or south areas. Library Cove was the most common site for rock dove. Two mourning doves *(Zenaida macroura)* were sighted on one occasion during fall migration at Lisa Creek wetland.

Hummingbird - Rufous hummingbird *(Selasphorus rufus)* were fairly common along the upper edge of salt marshes during spring and summer. They frequented areas where flowering plants and shrubs grew. Rufous hummingbird were also common during summer within the Sitka urban area where they were attracted to ornamental shrubs, flowers, and feeders.

Kingfisher - Belted kingfisher *(Megaceryle alcyon)* were fairly common during all seasons at wetlands. Kingfishers were found at Starrigavan, Old Seaplane Turnaround Cove, Katlian Bay, Cedar Cove, Dry Pass, Port Krestof, Salmon Lake, Three Entrance Bay, and Crane Cove.

Swallow - Tree swallow *(Iridoprocne bicolor)* commonly foraged over wetlands during spring and summer. Other species of swallows included violet-green *(Tachycineta thalassina)* and barn *(Hirunda rustica)*. Swallows were absent during fall and winter surveys.

Corvid - Common raven *(Corvus corax)* were regularly seen foraging in intertidal zones at Old Seaplane Turnaround Cove and the head of Nakwasina. Ravens were also found throughout the urban area and at the city landfill. Northwestern crow *(Corvus caurinus)* were common along beaches and intertidal flats.

Dipper - Dipper *(Cinclus mexicanus)* were only sighted at Starrigavan Creek, but probably occurred during late spring and summer along most swift-running freshwater creeks in Sitka Sound.

Sparrow - Savannah sparrow *(Passerculus sandwichensis)* were abundant at every wetland during spring and summer. Other sparrows seen on wetlands included golden-crowned *(Zonotrichia atricapilla)* and song *(Melospiza melodia)*.

Habitat Use

Bird habitats associated with wetlands were identified as freshwater wetlands, estuaries, coastal wetlands (including mud flats and salt marsh meadows), and gravel beaches. Avian habitat use is defined in Table 2 as primary (P) or secondary (S) depending on the extent to which birds used an area.

Table 2. Habitat Use by Selected Bird Species Groups in Sitka Sound.

	FRESHWATER WETLANDS	ESTUARIES	COASTAL WETLANDS	GRAVEL BEACHES	MARINE WATERS	ROCKY ISLANDS and SEA CLIFFS
LOONS and GREBES	S	P	NF	NF	P	NF
SWANS	P	NF	NF	NF	NF	NF
GEESE	NF	S	P	NF	P Black Brant	NF
DABBLERS	S	S	P	NF	NF	NF
DIVERS and SEA DUCKS	S	P	NF	NF	NF	NF
SHOREBIRDS	NF	S	P	P	NF	NF
SEABIRDS	NF	P	NF	NF	P	P

P- Primary S - Secondary NF - Not Found

Freshwater Wetlands: Surveys of Swan Lake provided data on avian use of freshwater wetland habitats. Freshwater wetlands supported a variety of plant and animal food items not usually found in saltwater influenced areas. Avian species found at Swan Lake that are wholly dependent upon freshwater habitat for food items, include trumpeter swan, pied-billed grebe, and American coot *(Fulica americana)*. Freshwater wetlands also provided secondary habitat for dabblers and divers. During stormy weather, high tides, and during peaks in migration, mallard, green-winged teal, scaup, bufflehead *(Bucephala albeola)*, and hooded merganser *(Lophodytes cucullatus)* were regularly found at Swan Lake.

Estuaries: Estuaries associated with stream mouths and wetlands provided essential food items of fish and invertebrates for loons, grebes, diving ducks, sea ducks, seabirds, and several species of shorebirds. Geese and dabblers were also occasionally seen resting in estuarine waters. Estuarine locations that provided protection from wind and waves were especially preferred sites during storms.

Coastal Wetlands: Coastal wetlands included tide-influenced mud flats and meadows. These areas were found to provide plant and animal food items as well as resting habitat for geese, dabblers, and shorebirds. In addition, coastal wetlands

were used by molting dabblers during summer. In winter, coastal wetlands were kept free of snow and ice by tidal action and birds were able to continue to feed in these areas.

Gravel Beaches: Gravel beaches supported invertebrate prey species that were important to shorebirds. Other common users of this habitat included gulls and crows.

Open Marine Waters: Seasonally, certain open marine waters within Sitka Sound were found to support significant concentrations of birds. These waters included Inner Point, Hayward Strait, Guide Island to Border Rocks, and the outer coast. The following is a brief description of each area.

Inner Point. Black brant were found offshore of Inner Point on two occasions during May. In both instances, a flock of about ten birds was sighted resting on the water. Black brant are known to occur in offshore waters during spring migration (Isleib and Kessel, 1973).

Hayward Strait. An increase of marbled murrelets was documented in Hayward Strait during spring, peaking to 100 birds during late May and early June. During fall, marbled murrelet numbers never exceeded 20. Other birds found in Hayward

Strait included double-crested cormorant, pelagic cormorant, white-winged scoter, surf scoter, common murre, pigeon guillemot, and northern phalarope.

Guide Island to Border Rocks. As in Hayward Strait, an increase of marbled murrelet from Guide Island to Border Rocks was noted during spring, totaling over 300 on several occasions. Other species found in this area included common loon, arctic loon, pelagic cormorant, white-winged scoter, surf scoter, common murre, pigeon guillemot and northern phalarope. Surf scoter numbered several thousand in this area during spring.

Outer Coast. All along the outer coast in the south area, small groups of birds were found during all seasons. Common loon, arctic loon, pelagic cormorant, surf scoter, common murre, and pigeon guillemot were commonly seen outside of Three Entrance Bay, in northern Redoubt Bay, and in waters northwest of Goddard. During winter, hundreds of oldsquaw were found in rafts in north Redoubt Bay. In more protected marine waters, small groups of wintering birds could be found. These included horned grebe, scaup, goldeneye, bufflehead, harlequin duck, surf scoter, common merganser, and red-breasted merganser. Sites included unnamed coves along the southeast coast of Lisianski Peninsula, No Thorofare Bay, Pirate Cove, and Redoubt Bay.

Rocky Islands and Sea Cliffs: Sitka Sound has numerous rocky islands and sea cliffs, some of which were often used for nesting, feeding, and resting habitat by birds. It is not known why birds used one area more than another similar area. Rocky islands and sea cliffs which were found to be used by birds include:

St. Lazaria. St. Lazaria is a rocky island located approximately 15 miles southwest of Sitka. The island is a National Wildlife Refuge and supports a seabird breeding colony of fork-tailed and Leach's storm-petrels, tufted puffins, common murres, double-crested cormorants, ancient murrelets, rhinoceros auklets, and glaucous-winged gulls. A survey of St. Lazaria was conducted on May 21, 1980. The findings of this survey are detailed in Edgar Bailey's memo (Appendix II).

North Area. Several rocky islands and sea cliffs in the area north of the road system, including Inner Point on Kruzof Island, Border Rocks, Old Sitka Rocks, and the islands fronting the City of Sitka, were found to be preferred resting sites by pelagic cormorants, harlequin ducks, bald eagles, oystercatchers, surfbirds, gulls, and crows. These sites were used particularly during the winter and spring seasons.

South Area. Sites in the south area were frequented by the same species as the North Area, plus black turnstone, rock sandpiper and surfbird. Locations included the rock outcroppings near Cape Baranof, Povorotini Point, Viesokoi Rock, and Naerie Rock. All of these sites seemed particularly important during winter with the exception of Naerie Rock, which was important in spring during the herring spawning period.

Mammals

Six mammal species were observed on wetlands or in estuarine waters during vegetation or avian surveys (Appendix V). Brown bear and Sitka black-tailed deer were only seen during spring, but sign indicated their presence in coastal wetlands during fall. Deer sign was also seen on wetlands during the winter. These species were observed primarily in the north area. River otter were sighted in nearshore waters and on steep rocky banks between the sea and spruce-hemlock forest. They were observed only in the north area, but probably occur in the south area as well.

Marine mammal species sighted in Sitka Sound included harbor seal, Steller sea lion, humpback whale, and northern fur seal. Harbor seals were seen in all seasons and observed in estuarine waters near coastal wetlands, primarily in the north area. They were most

abundant during the herring spawning period in early April. Sea lions were observed in winter and early spring near high energy, rock coasts. During fall, sea lions were found along rocky shorelines primarily in the north area. Humpback whales were observed within Sitka Sound only on two occasions when sighted in the waters between Starrigavan Bay and Big Gavanski Island in fall. Humpback whales were observed in spring in Shelikof Bay outside of Sitka Sound. A juvenile northern fur seal was sighted in Silver Bay during February.

Small microtine rodent (voles and shrews) use of the wetlands in Sitka Sound is unknown. Populations may be periodically high, particularly in freshwater wetlands sites. However, populations on coastal wetlands must be severely limited in those areas influenced by tidal action.

Coastal wetlands are important to both mink and river otter. Both species utilize wetlands directly, particularly for feeding. In addition, the production of nearshore marine organisms is substantially increased by the primary productivity of coastal wetlands, thus providing greater food supplies for both mink and otters some distance from the coastal wetland itself. Marine mammals benefit directly from the increased productivity of coastal wetlands which enhance the production of herring, salmonids, shellfish, bottom fish, and forage fish.

Of the large mammals, brown bear make the most use of coastal wetlands, primarily in spring for grazing. The sedges of the coastal wetlands are often the first plants to emerge in spring, thus providing high quality forage at a critical period when alternate sources of food are scarce. Later, in summer and fall, coastal wetlands adjacent to anadromous streams are again important to brown bears, which feed heavily on spawning salmon.

Freshwater wetlands, especially seepage or muskeg areas, which produce abundant skunk cabbage, are important to both brown bear and deer, which feed heavily on young skunk cabbage shoots during spring. Moreover, these same areas are often the first to become free of snow during spring, and thus provide much needed green vegetation.

Specific Survey Sites

This section describes the specific wetlands where vegetation transects and avian surveys were made. Results of seven of the vegetation transects are illustrated by plan view, profile, and percent cover of dominant plant species versus elevation. The transect sites for which illustrations are provided include Indian River, Starrigavan, Katlian, Nakwasina, Port Krestof, and Swan Lake. Percent cover and elevation data were not taken for Swan Lake.

Indian River

The coastal wetland located at the mouth of Indian River (Figures 6, 7, 8), included an approximately one acre wetland as well as the stream channel and estuary to the south. The substrate within the area was primarily silt and gravel. Indian River provides spawning habitat for up to 15,000 pink salmon *(Oncorhynchus gorbuscha)* and lesser numbers of other salmonid species, including coho *(O. Kisutch)* and chum salmon *(O. keta)*, Dolly Varden *(Salvelinus malma)*, and steelhead trout *(Salmo gairdneri)* (J. Parker, pers. comm.). Clams and mussels occur in the subtidal gravel flats. Eelgrass *(Zostera marina)* occurred in offshore silt-based beds.

Birds present at Indian River represented most species groups, and their seasonal numbers were indicative of the various stages of migration in Sitka Sound. The site was not well protected during heavy storms especially from the southwest. Some birds were able to find refuge on the lee side of tidally exposed gravel islands or on the wetland, but most birds moved out of the area to other more protected sites.

The wetland substrate was silt and gravel with a small amount of organic material. The southern exposure of the wetland, its relatively low elevation, and the presence of a slough

Figure 6. Indian River, Plan View.

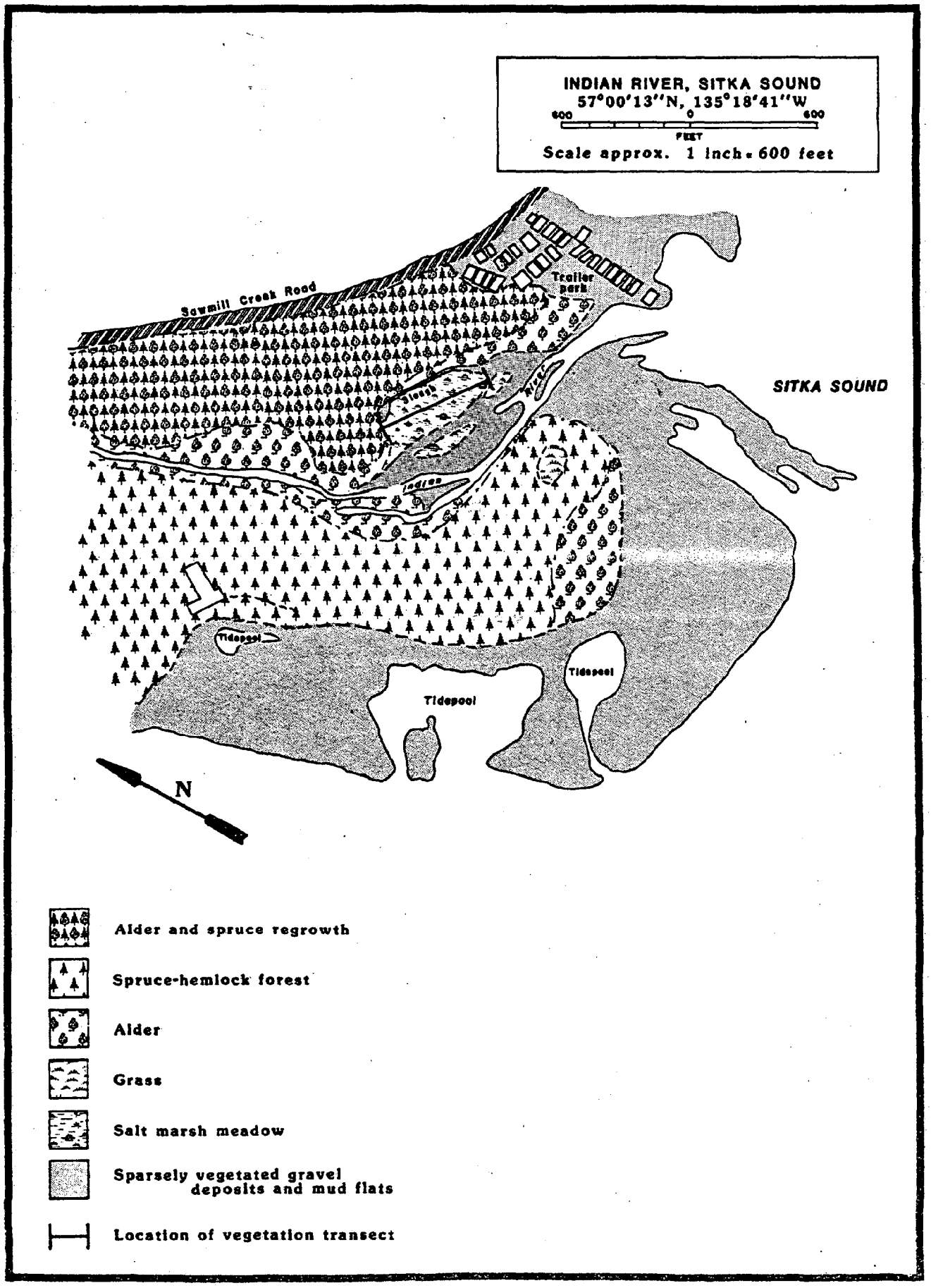
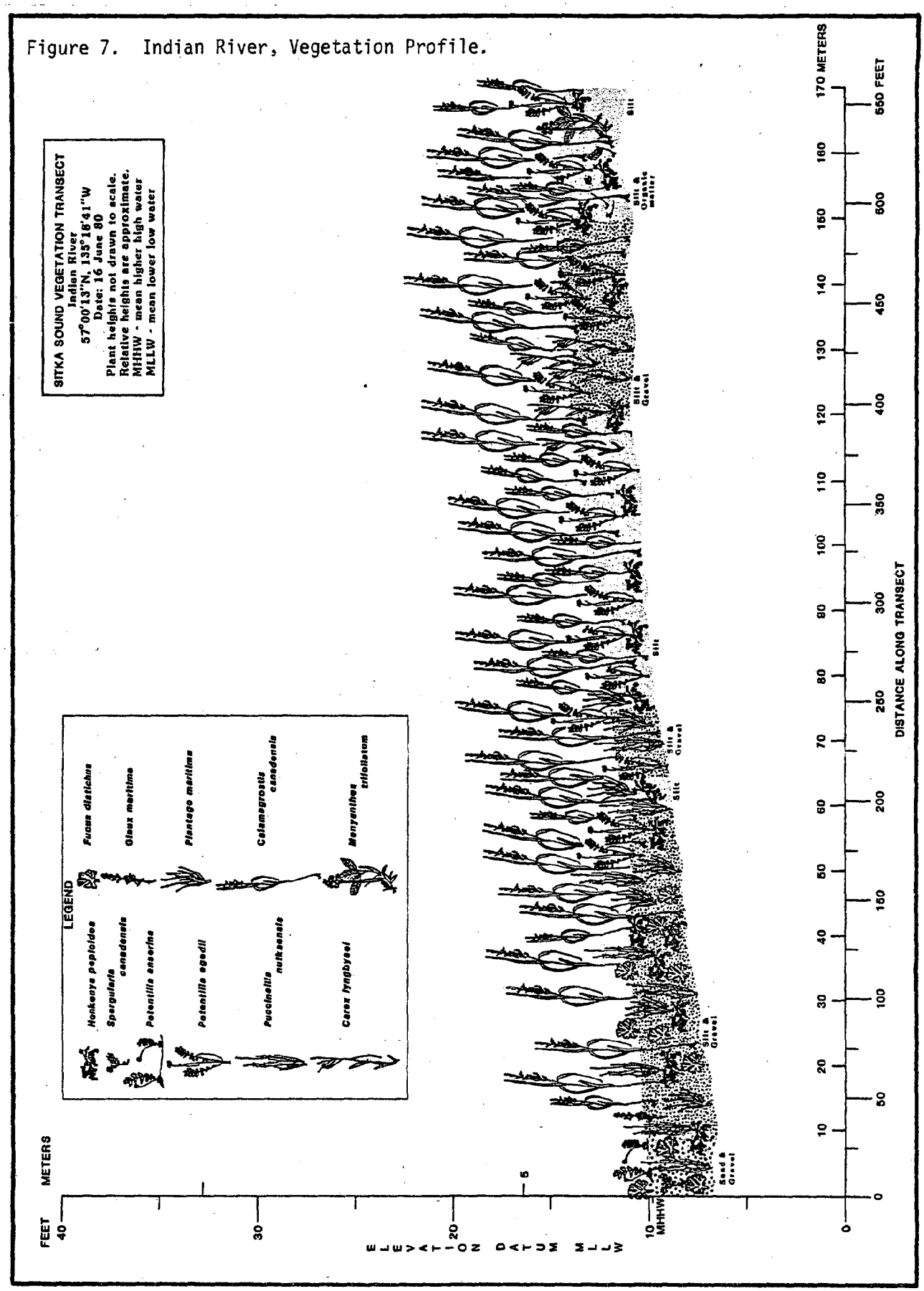


Figure 7. Indian River, Vegetation Profile.



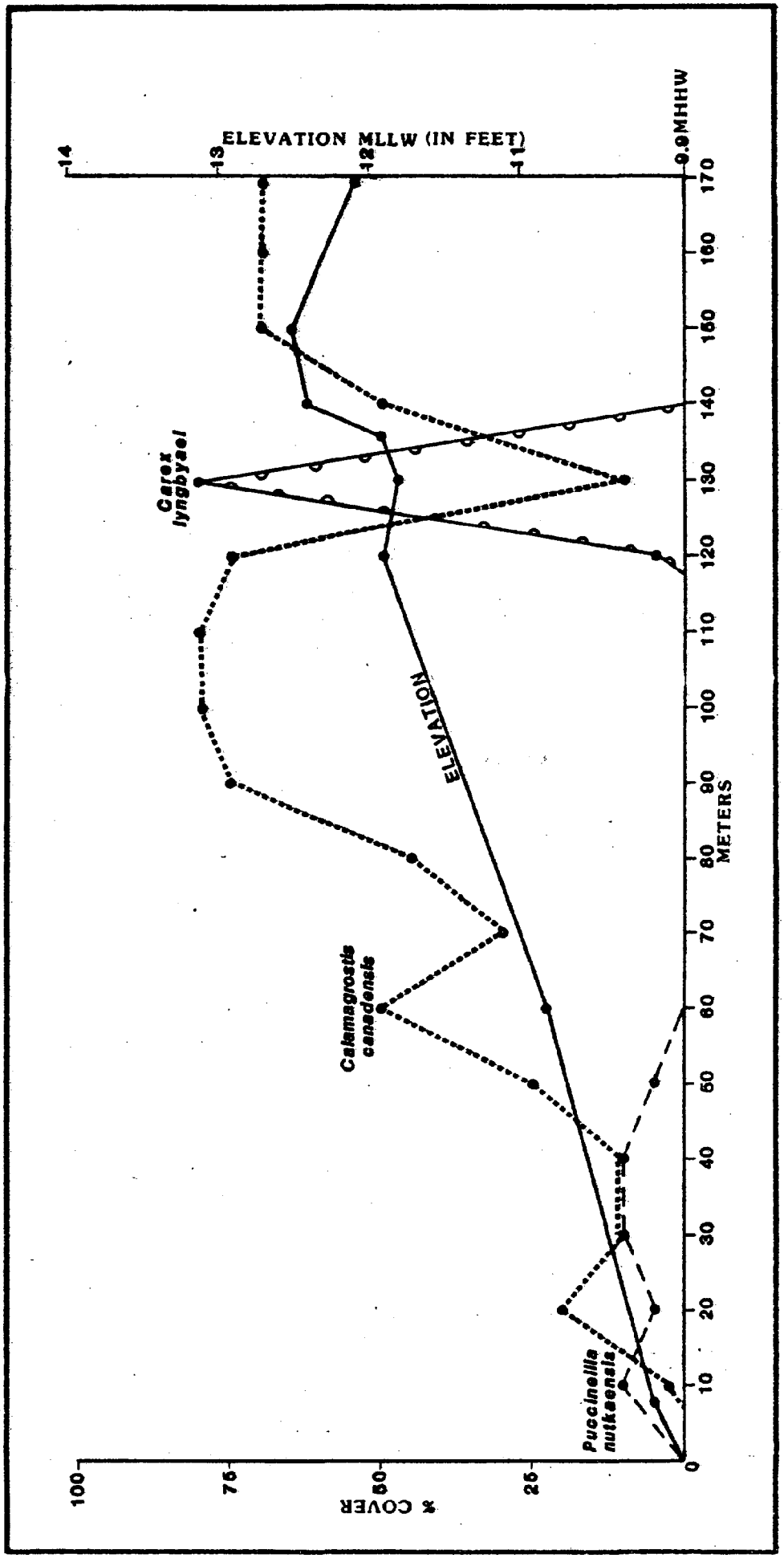


Figure 8. Indian River, Plant Species Percent Cover and Transect Elevation.

that conducted saltwater to the side and rear of the wetland, resulted in tidal inundation of the area during most higher high tides, especially storm tides. *Calamagrostis canadensis* grew in tussocks, giving the plants additional strength and resistance to tide flow plus additional height above the salt water. *Carex lyngbyaei* was present especially in small sloughs indicating the silt soil type in these areas. No *Elymus arenarius* was present due to the silty soil type and the low elevation of the wetland. Few freshwater plant species grew at the landward end of the transect.

Avian surveys of the wetland, the river, and the estuarine bay indicated that Indian River was used by most species groups throughout the year. Numbers of birds were moderate in relation to other sites except during peaks of migration. Newly arrived spring migrants seemed to occur here before other sites within the roaded area. Shorebirds were the most abundant species group, but divers and sea ducks were present year round.

Species found and peak numbers observed during four seasons include:

Spring - red-necked grebe (2), double-crested cormorant (17), brant (1), northern shoveler (23), canvasback (1), scaup (59), goldeneye (50), harlequin duck (25), common

merganser (9), black oystercatcher (3), black turnstone (1,000), and pigeon guillemot (2).

Summer - common loon (2), mallard (1), pintail (1), blue-winged teal (2), scaup (3), and harlequin duck (19).

Fall - horned grebe (5), pelagic cormorant (9), great blue heron (1), Canada goose (1), scaup (40), goldeneye (57), harlequin duck (54), surf scoter (180), common merganser (7), black turnstone (80), western sandpiper (2), and marbled murrelet (1).

Winter - mallard (12), scaup (10), goldeneye (32), surf scoter (6), and common merganser (1).

During all seasons, gulls, crows, and ravens roosted and scavenged on the Indian River gravel flats, at times in the hundreds. Crows seemed to have a rookery in the surrounding trees. Bald eagles were also seen on occasion, especially during the salmon spawning period during September.

Starrigavan

The coastal wetland (Figures 9, 10, 11) was located at the north end of the roaded area where Starrigavan Creek flowed into Starrigavan Bay. A causeway was built across the estuary and intertidal flat in 1957 and the stream now flows through two culverts. The stream, estuary, and shorelands have been

Figure 9. Starrigavan, Plan View

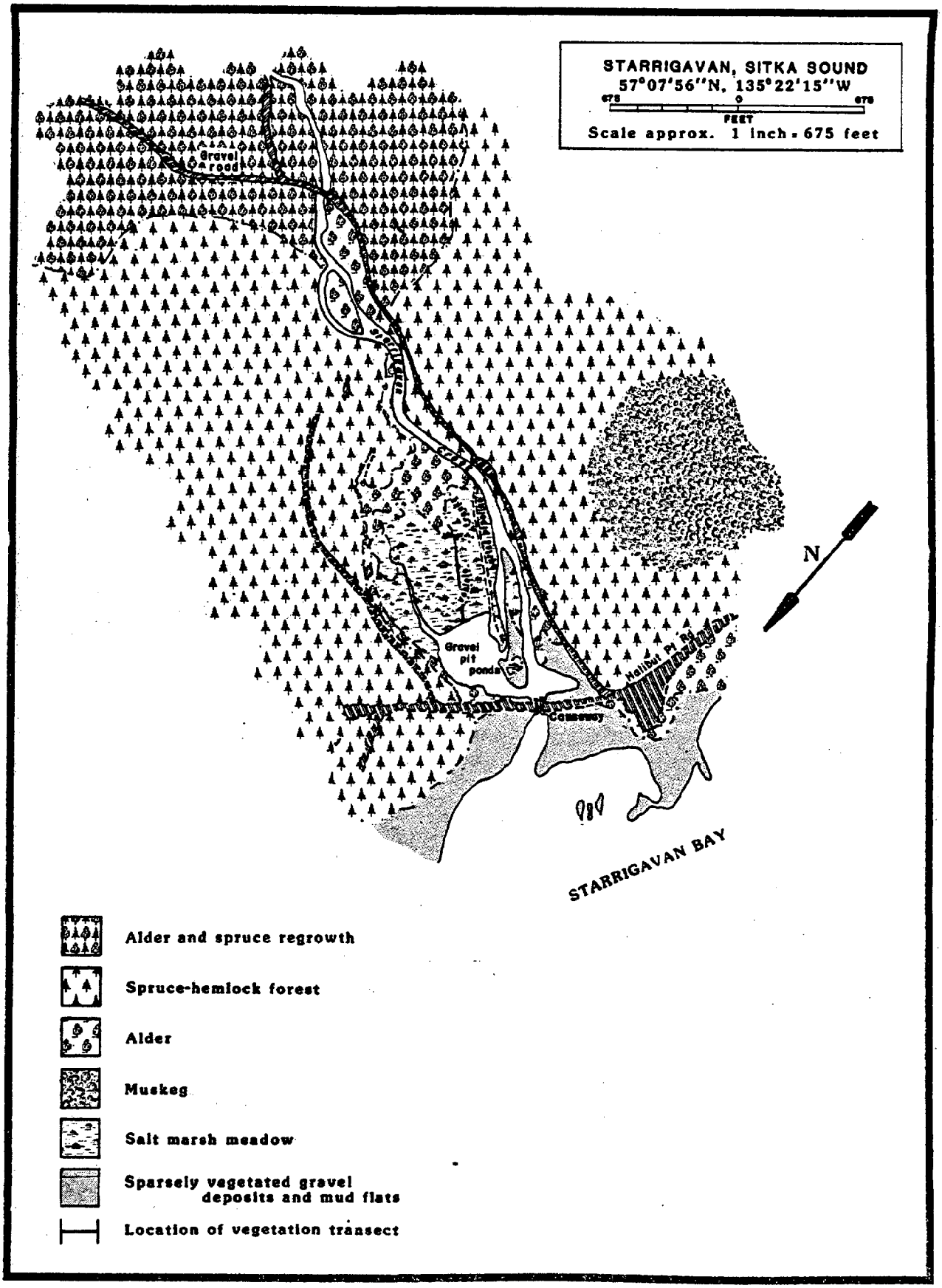


Figure 10. Starrigavan, Vegetation Profile.

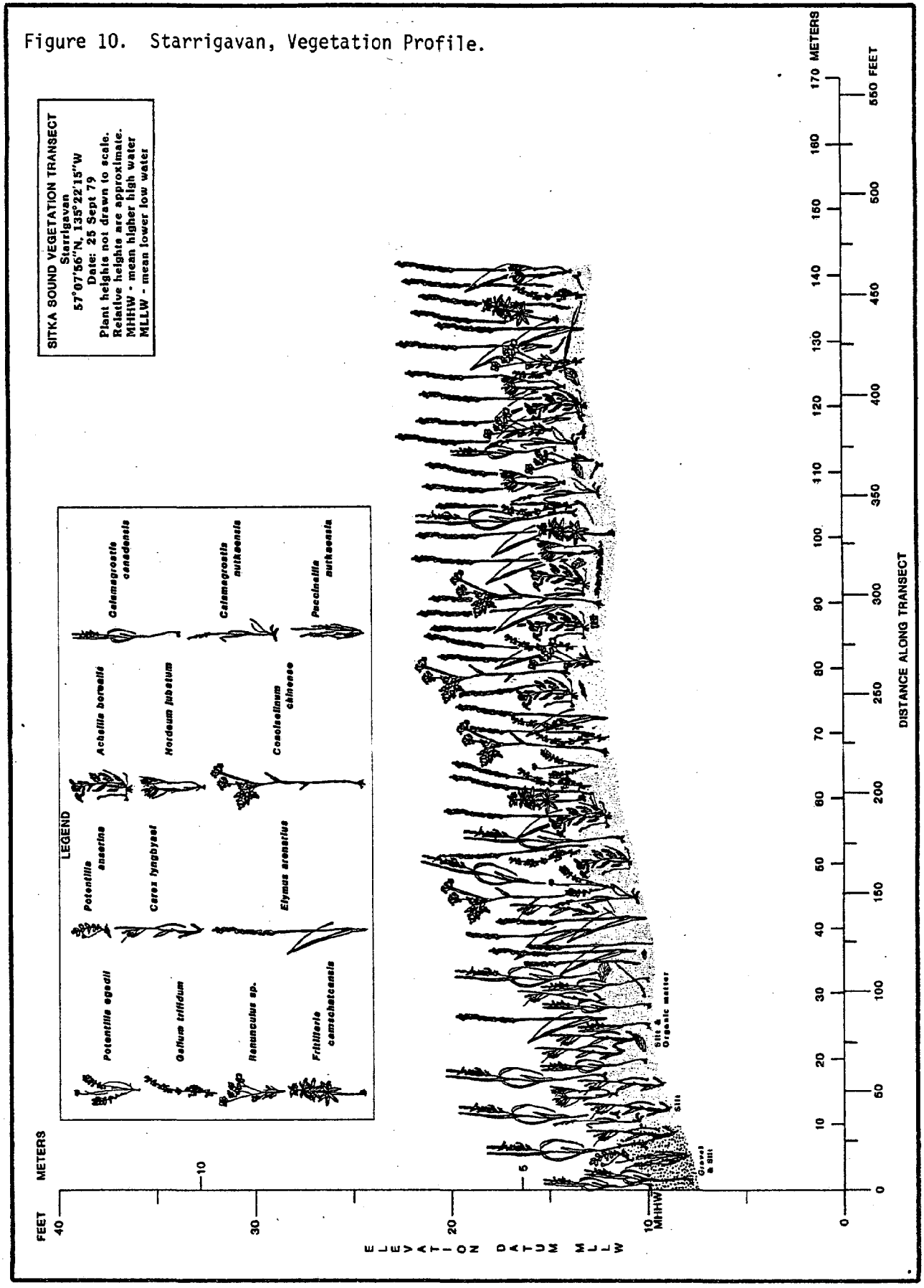
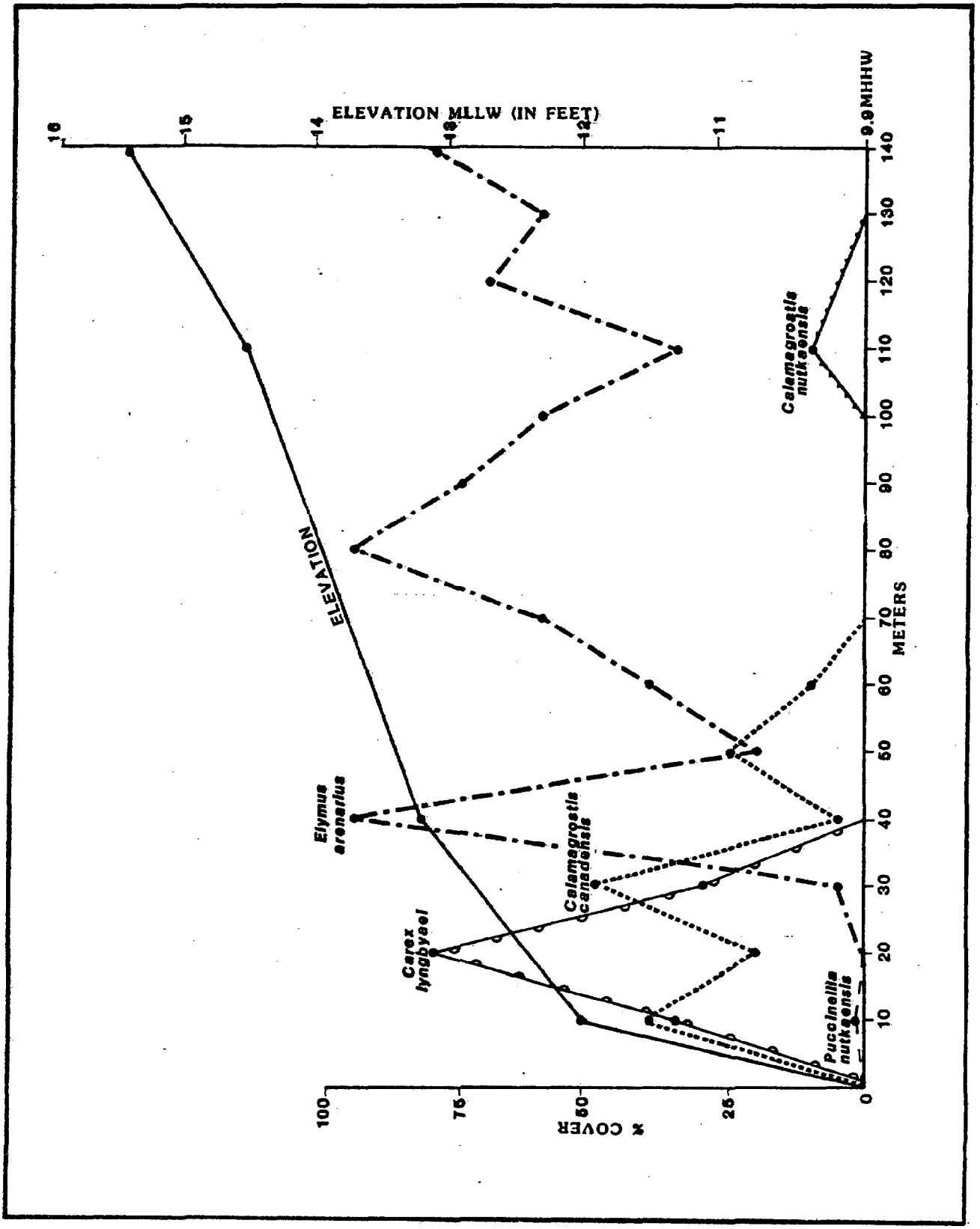


Figure 11. Starrigavan, Plant Species Percent Cover and Transect Elevation.



used as an ADF&G incubation and rearing facility, and a U.S. Forest Service campground occurs on the north side. Pink, coho, and chum salmon spawn in the creek. Ponds dug for gravel extraction lie between the causeway and the wetland. These silt-filled ponds supported a bed of eelgrass. The Starrigavan watershed was logged in 1974 (Ronald Welsh, pers. comm.).

Starrigavan wetland covers approximately 30 acres. Visible impacts to the wetland included a buried pipeline and off-road vehicle trails, both of which have channelized water and altered plant communities. A vegetation transect was established across the wetland from pond edge to alder fringe, crossing some of the vehicle trails. Little intertidal flat exists at Starrigavan due to the presence of the gravel pit ponds. A small amount of *Puccinelli nutkaensis* grew along the upper edge of the pond. *Calamagrostis canadensis* was interspersed with *Carex lyngbyaei* on the silt and gravel substrate. *Carex lyngbyaei* predominated on silty soils found in sloughs. The usually mono-specific community of *Elymus arenarius* contained more freshwater herbaceous plants than found on other transects. Herbaceous plants, such as *Achellia borealis*, dominated the vehicle track areas.

Avian use of Starrigavan was divided into two areas, inside and outside of the causeway. Dabblers and shorebirds tended to be found inside the causeway on the ponds or in sloughs. Divers and sea ducks were usually found in the deeper waters outside the causeway.

Surveys indicated that small numbers of dabblers and shorebirds, and large numbers of divers, used the Starrigavan area. Species and peak values include:

Spring - mallard (4), northern shoveler (2), European wigeon (2), scaup (100), surf scoter (72), black turnstone (40), western sandpiper (15), and pectoral sandpiper (15).

Summer - mallard (1), green-winged teal (2), and northern shoveler (2). No nests were found, but it is probable that green-winged teal nested there. A common merganser with brood frequented the lower stream reach.

Fall - the predominant species groups found included loons, grebes, and divers. Of note were harlequin duck (25), common merganser (9), and pectoral sandpiper (5).

Winter - mallard (43), European wigeon (2), and goldeneye (23) numbers were higher in winter than in fall.

Eagles and gulls were present during all seasons. However, their numbers were highest in the fall during the salmon spawning period.

Katlian

A coastal wetland covering approximately 160 acres occurs at the head of Katlian Bay (Figures 12, 13, 14). The wetlands are branced by distributaries of two major drainage systems; Katlian River and South Fork Katlian River. Pink, coho, and chum salmon spawned in both river systems. A large run of Dolly Varden spawns in the South Fork Katlian River. The forests east of the wetland were logged in 1961-62 (Ronald Welsh, pers. comm.). During the logging operation, several gravel pits were dug in the wetland for road building materials. Due to the geomorphic position of Katlian Bay, the wetlands and adjacent waters are fairly protected from infrequent northerly storms occurring during late fall and winter. However, the steepness of the mountains and the narrowness of the bay funnels more frequent southwesterly winds through Katlian, forcing birds to move to more protected sites, such as Cedar Cove or areas in Nakwasina Sound.

The wetland substrate was predominately gravel overlaid in most areas by silt. A layer of organic material was developed

Figure 12. Katlian, Plan View.

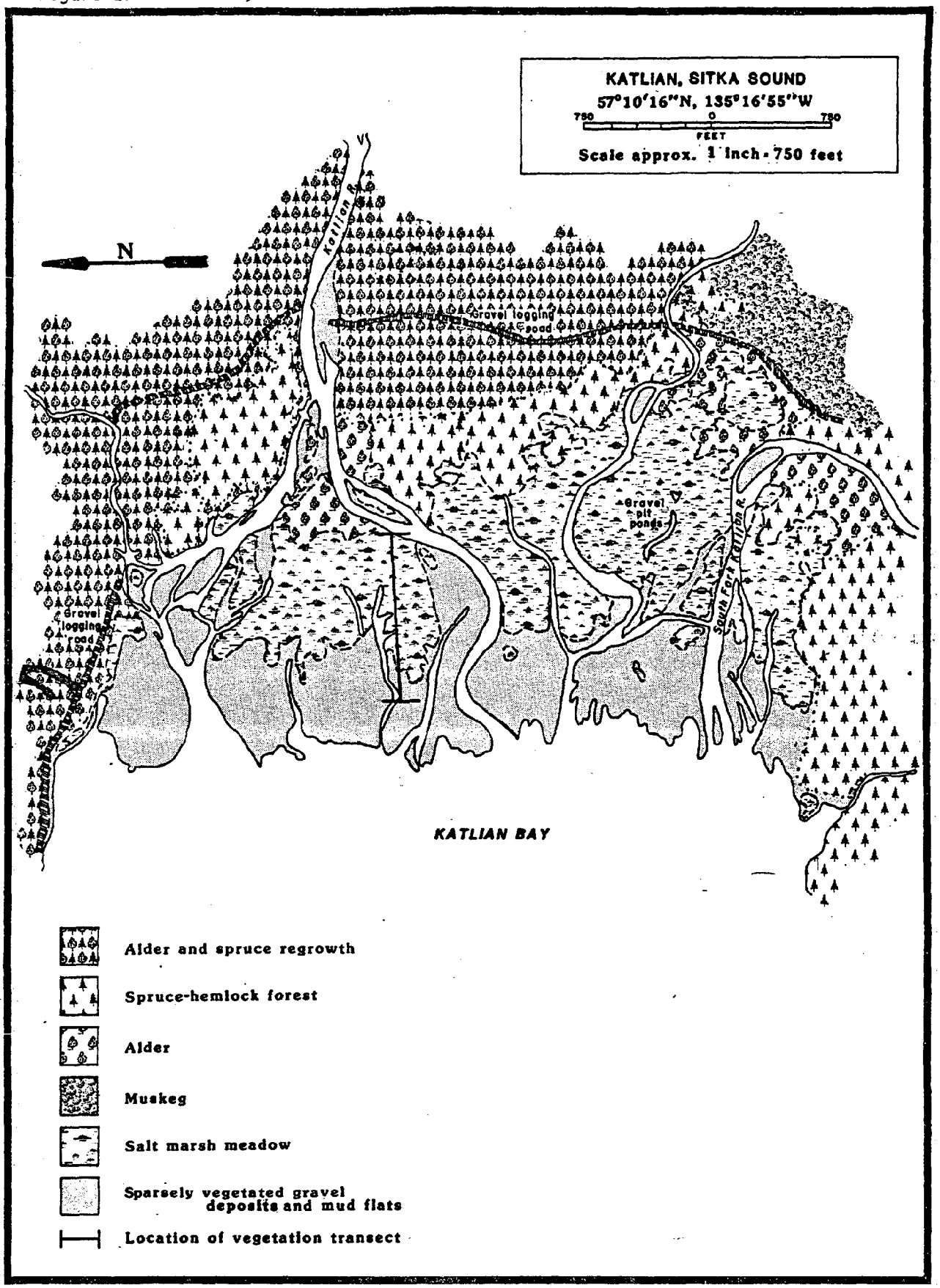
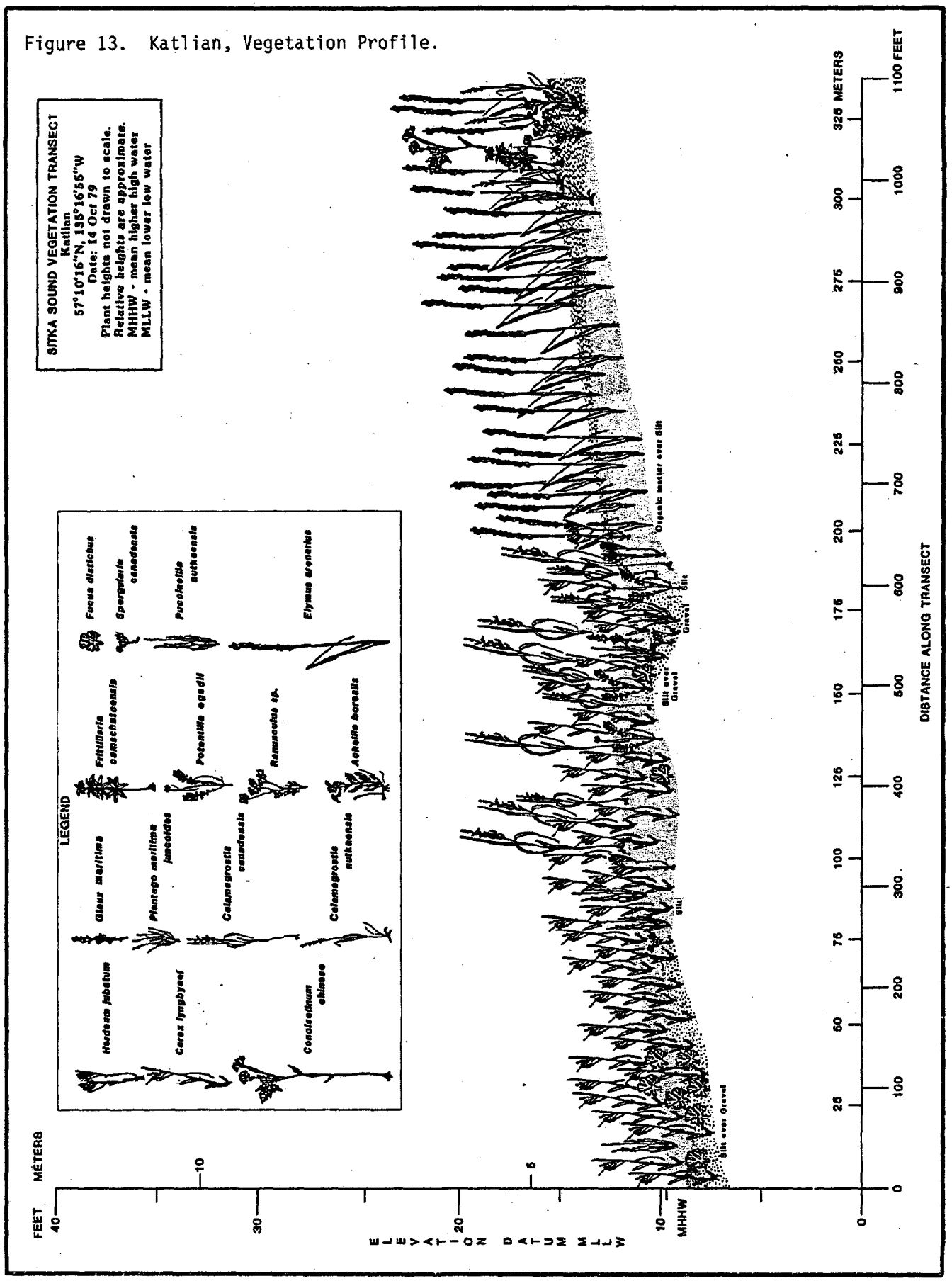


Figure 13. Katlian, Vegetation Profile.



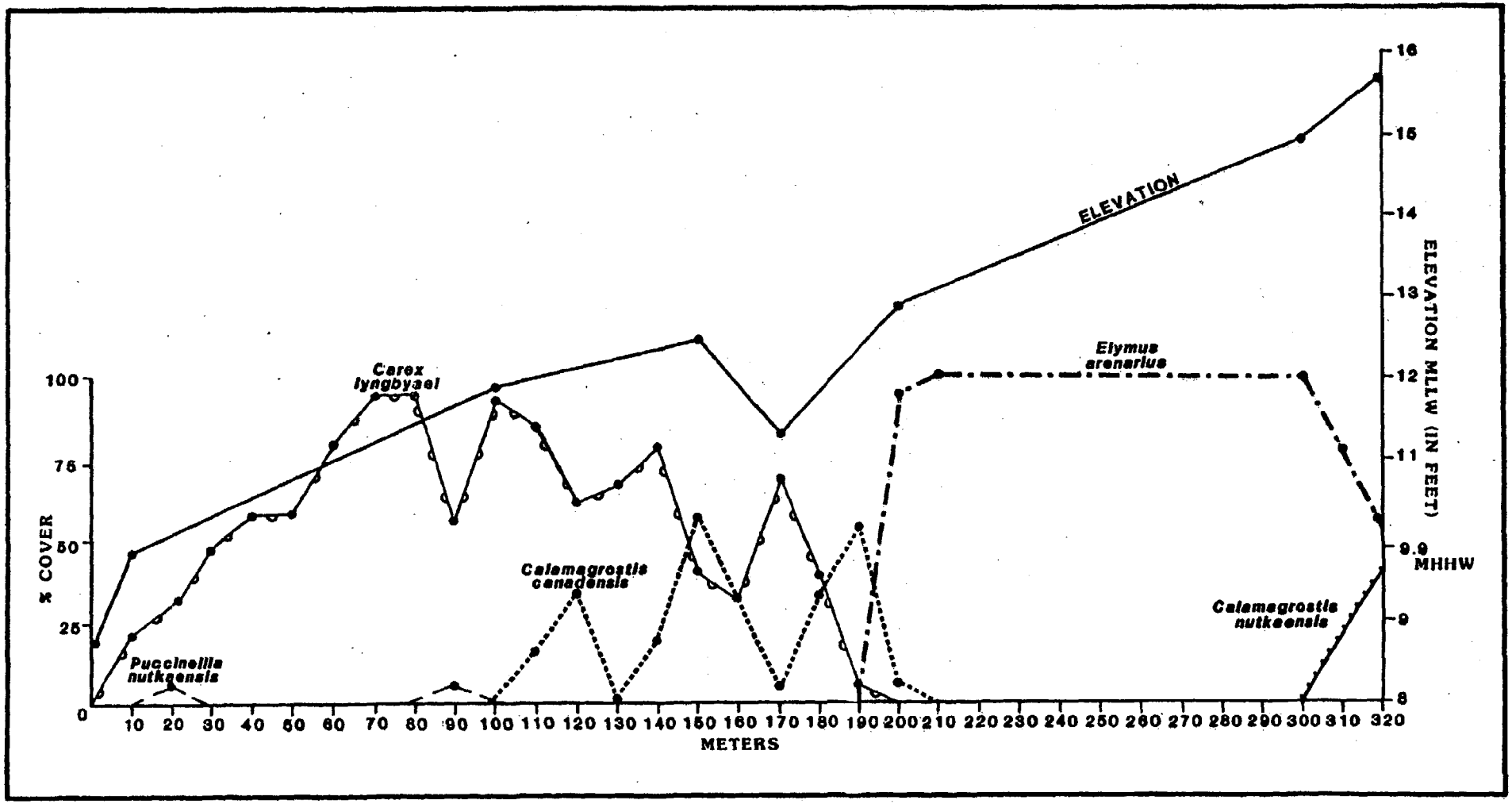


Figure 14. Katlian, Plant Species Percent Cover and Transect Elevation.

in the more upland areas. *Carex lyngbyaei* grew on the silt-covered flats down to the 8.7 ft MLLW elevation. This species was only found above 11 ft MLLW at other wetland sites in Sitka Sound. Many of the *Carex lyngbyaei* plants closer to the tide line were sterile, non-flowering plants reproducing by means of underground branching roots or stolons. Very little *Puccinellia nutkaensis* was found at Katlian. The upper portion of the transect reflected the well-drained organic soil and freshwater influence of the rivers. *Elymus arenarius* and *Calamagrostis nutkaensis* grew in luxuriant meadows ending in a fringe of alder.

Bird use of the coastal wetlands at Katlian varied with the seasons as it did at all other sites. Birds present in spring included arctic loon (3), Canada goose (6), white-fronted goose (1), mallard (100), northern shoveler (2), goldeneye (100), harlequin duck (25), black turnstone (40), dowitcher (25), western sandpiper (20), and dunlin (20). Shorebird numbers were lower than expected given the large mud flat at Katlian Bay. Due to its eastern location, Katlian may not be in a geographically advantageous location with respect to shorebird migration flyways.

Summer use of Katlian was minimal. The only waterfowl sighted during June were non-breeding buffleheads and a common merganser brood.

Numbers of birds increased again during fall migration, but did not equal spring numbers. Species found included mallard (40), goldeneye (87), white-winged scoter (12), black turnstone (35), pectoral sandpiper (15), and dunlin (1). Hundreds of gulls came to the river banks and tidal flats during the fall salmon spawning period. Bald eagle and northwestern crow also congregated by the tens to scavenge the beaches. On one occasion over 3,000 gulls were found resting on the waters of Katlian Bay, including several hundred gulls found onshore at the river banks.

Nakwasina

A coastal wetland covering 154 acres (Figures 15, 16, 17) was surveyed at the east end of Nakwasina Passage. Much of the wetland is a gravel flat overlaid by a layer of silt and organic soils. An unnamed stream bisected the flat and supported pink and coho salmon spawning during the fall. The land upstream was logged in 1965 (Ronald Welsh, pers. comm.). Several pits dug for gravel extraction remain and a gravel roadbed runs along the east shore.

The most notable feature of the vegetation community was the lack of a *Carex lyngbyaei* community. *Carex lyngbyaei* was

Figure 15. Nakwasina, Plan View.

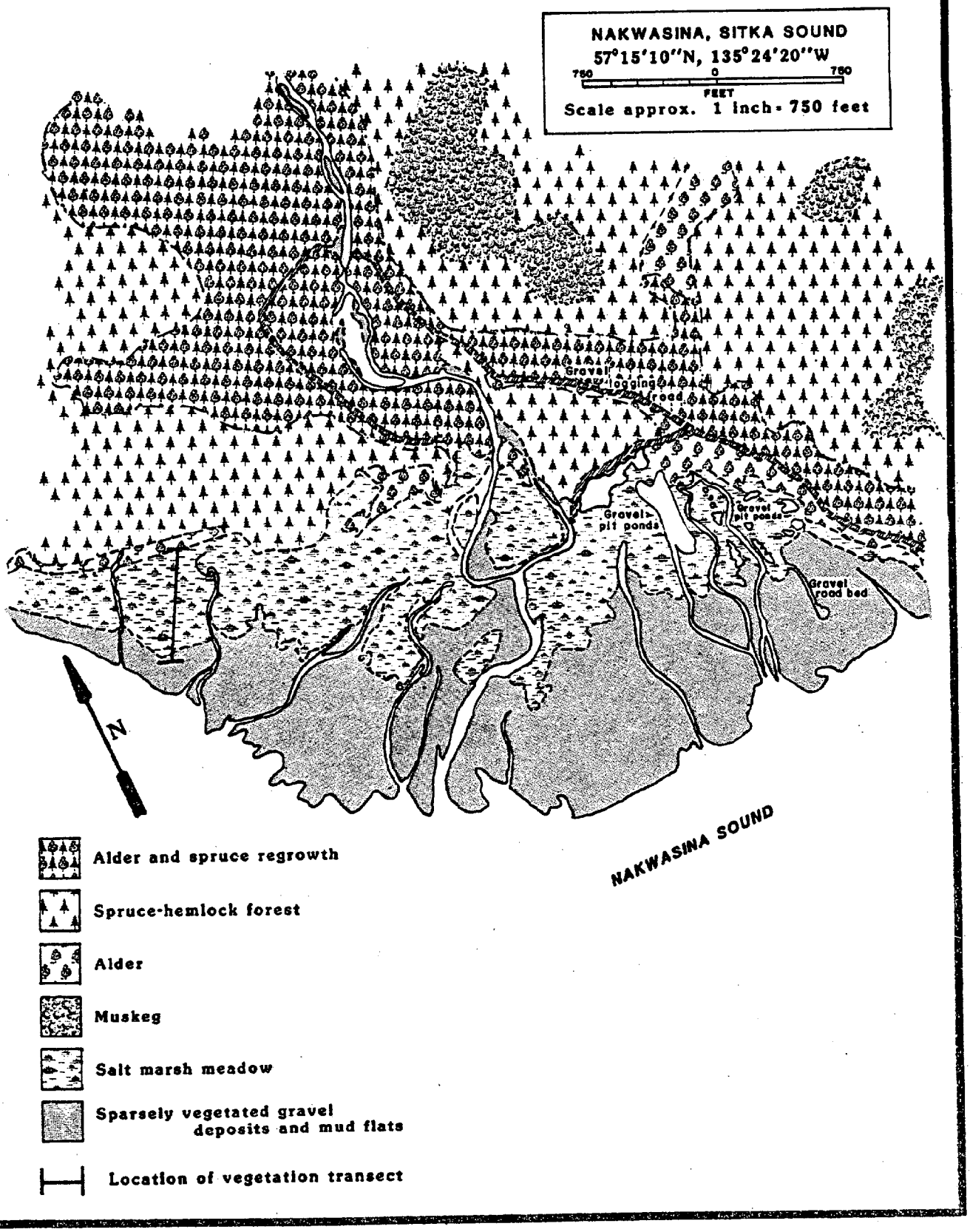
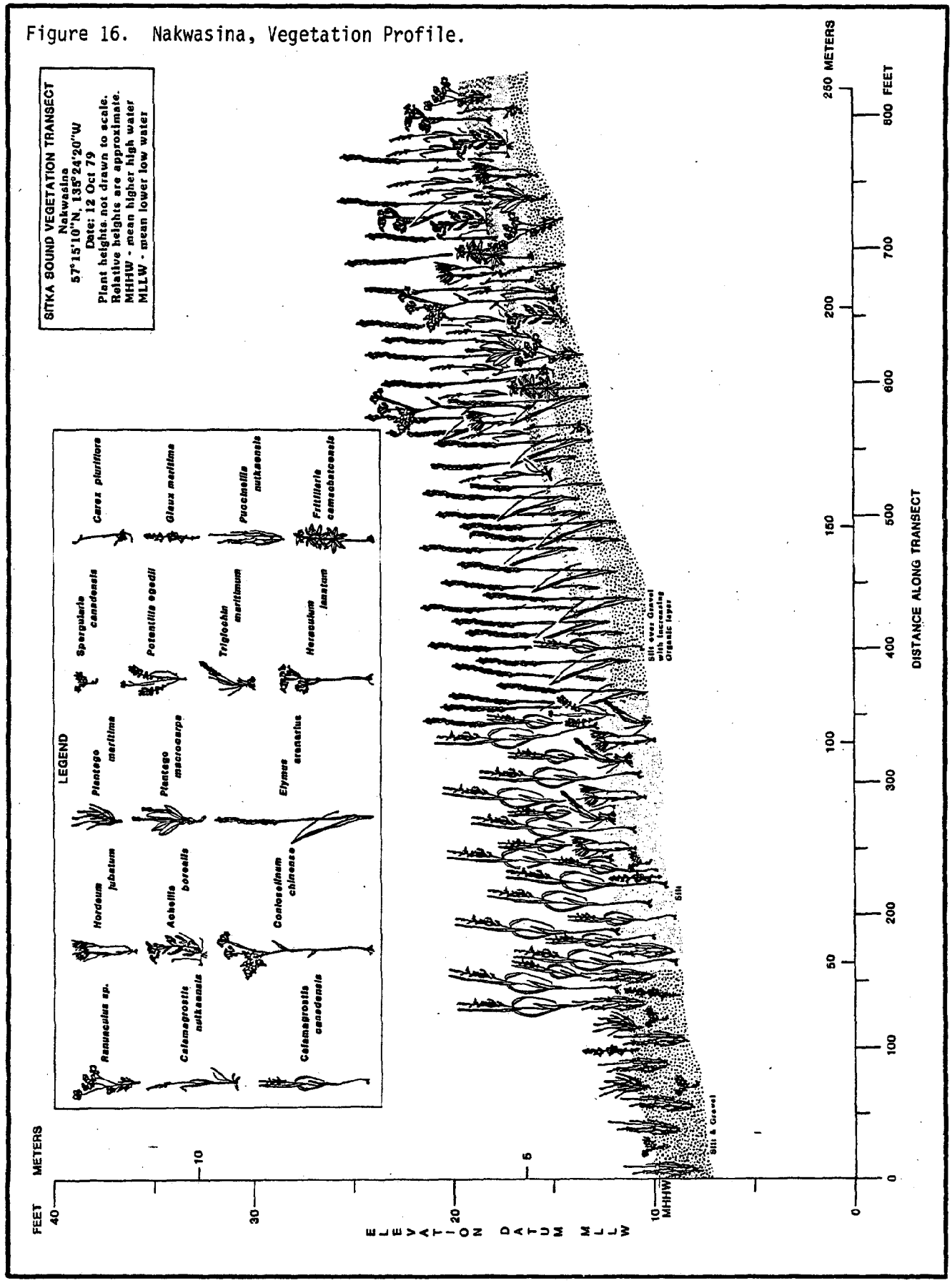


Figure 16. Nakwasina, Vegetation Profile.



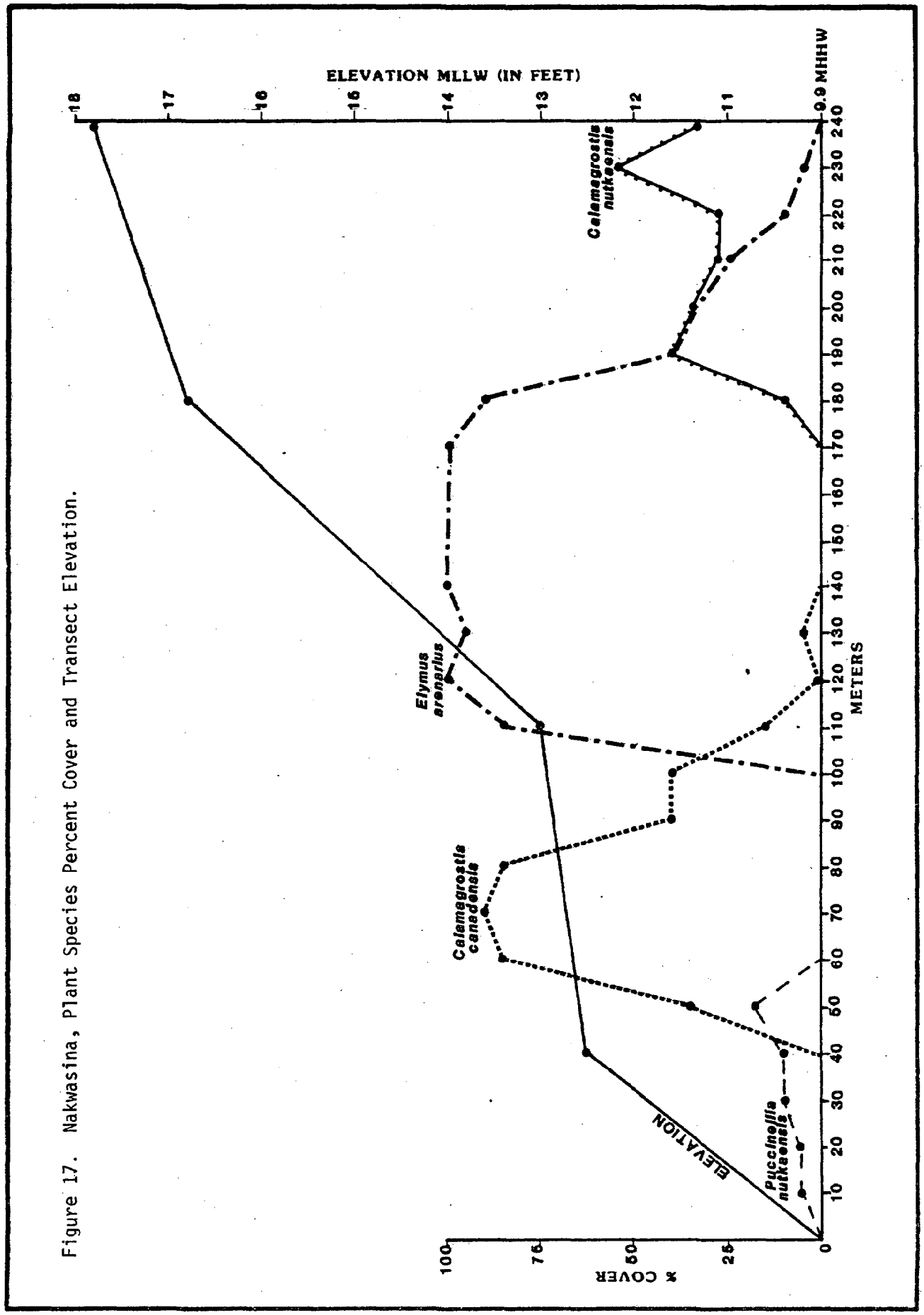


Figure 17. Nakwasina, Plant Species Percent Cover and Transect Elevation.

present only in scattered colonial patches. It probably did not form a major community here due to the shallowness of the silt layer and the presence of well-drained gravel and organic soils. An extensive *Calamagrostis nutkaensis* community situated between the *Elymus arenarius* community and the fringe of alder indicated freshwater influence on the upper edge of the wetland.

Bird use was relatively high during all seasons. The protected environment and rich marine life of Nakwasina Passage probably attracted birds to this area. Birds often moved between the four different wetlands of Nakwasina Passage when disturbed. Birds found here during spring included Canada goose (2), mallard (100+), blue-winged teal (1), European wigeon (1), goldeneye (250), and sandhill crane *(Grus canadensis)* (1).

During summer, flocks of molting male mallards (20) and blue-winged teal (2) were found on the intertidal flats. The area surrounding the gravel pit ponds was possible nesting habitat for green-winged teal, but no nests were found during summer surveys. Mergansers probably nested upstream.

During fall, populations tended to be lower than spring. The mallard population was surprisingly low (2), but green-winged

teal (80), another dabbler species, were abundant. Other species included goldeneye (45), bufflehead (6), common merganser (15), surf scoter (75), black turnstone (15), and common snipe (1).

Species diversity was lower during winter, but numbers tended to be higher including, mallard (150), green-winged teal (11), goldeneye (60), and bufflehead (8).

Bald eagle were abundant during spring (35) and fall (10).

Port Krestof

The Port Krestof site (Figures 18, 19, 20) was located at the southern end of Krestof Sound. Port Krestof is a large intertidal flat of 158 acres with a protected deep water cove. Tidal currents from Sitka Sound circulated marine water via Hayward Strait and the west channel. Freshwater came from two large unnamed streams at the south end and several smaller creeks around the periphery of the cove. Pink salmon were found spawning in the larger streams. Small wetland meadows were located around the stream mouths and along the flanks of Bare Island in the center of the flats. Port Krestof was used by Sitkans for fishing and crabbing as well as boat moorage. One small offshore island was clear cut in about 1961 (Ronald Welsh, pers. comm.).

Figure 18. Port Krestof, Plan View.

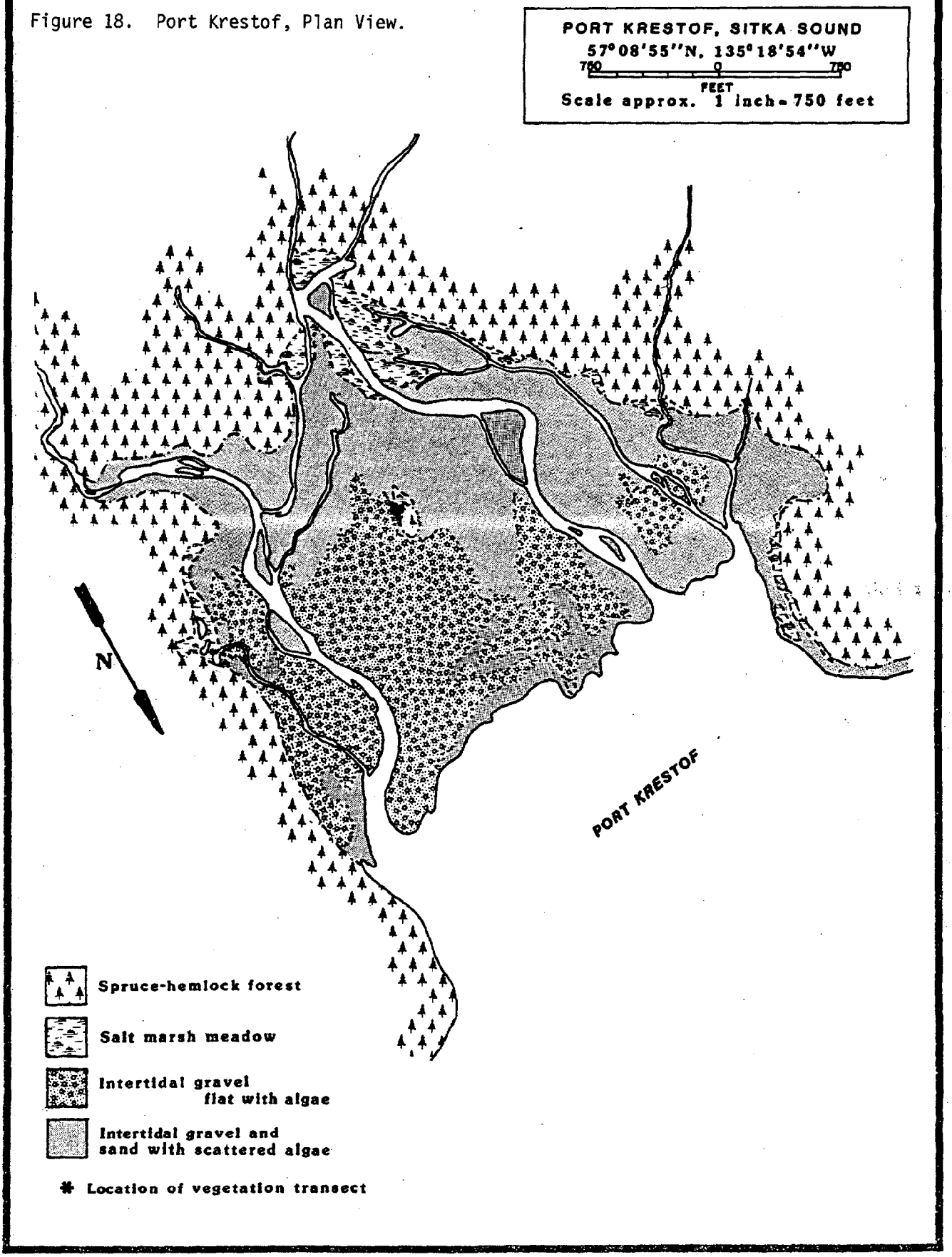
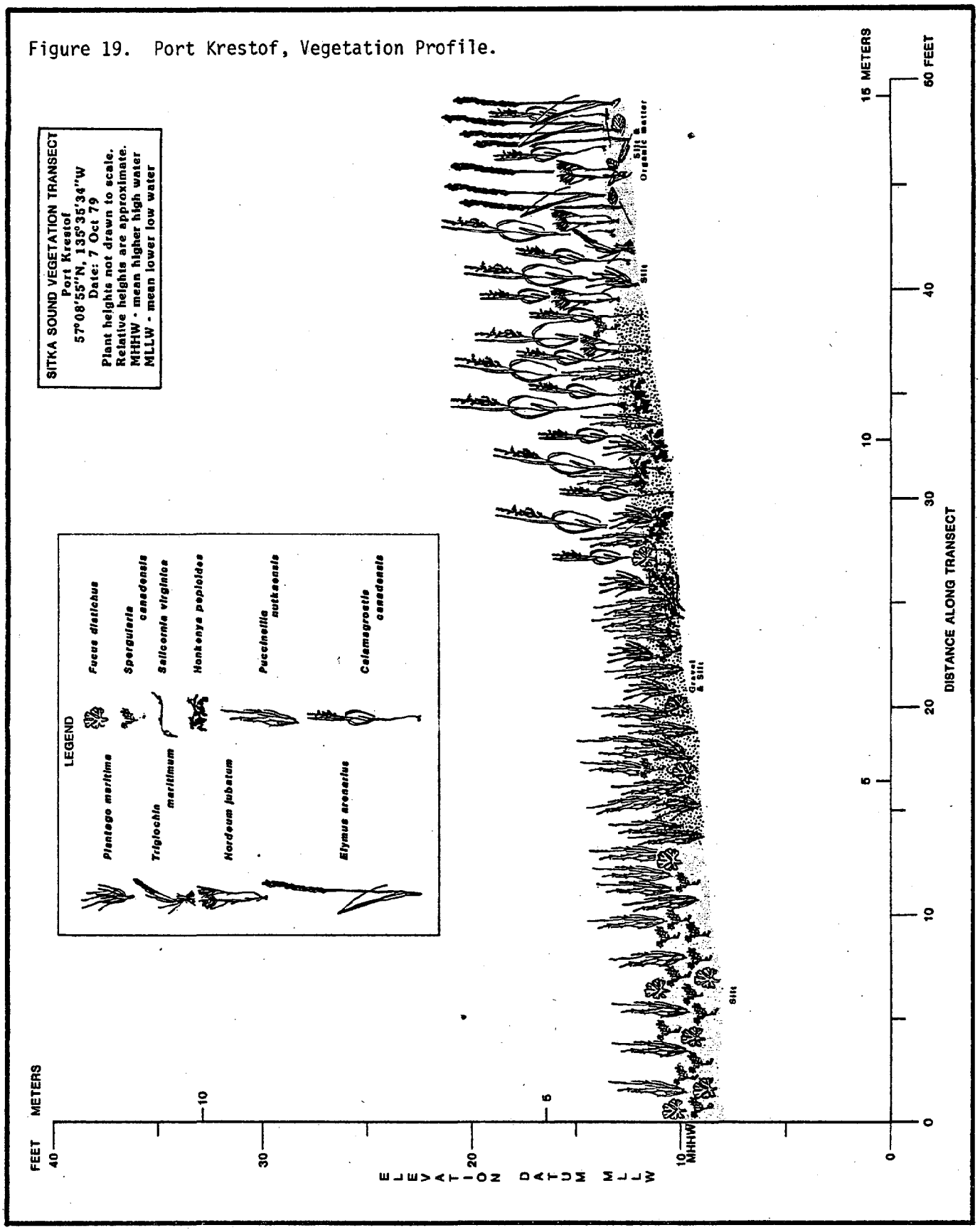


Figure 19. Port Krestof, Vegetation Profile.



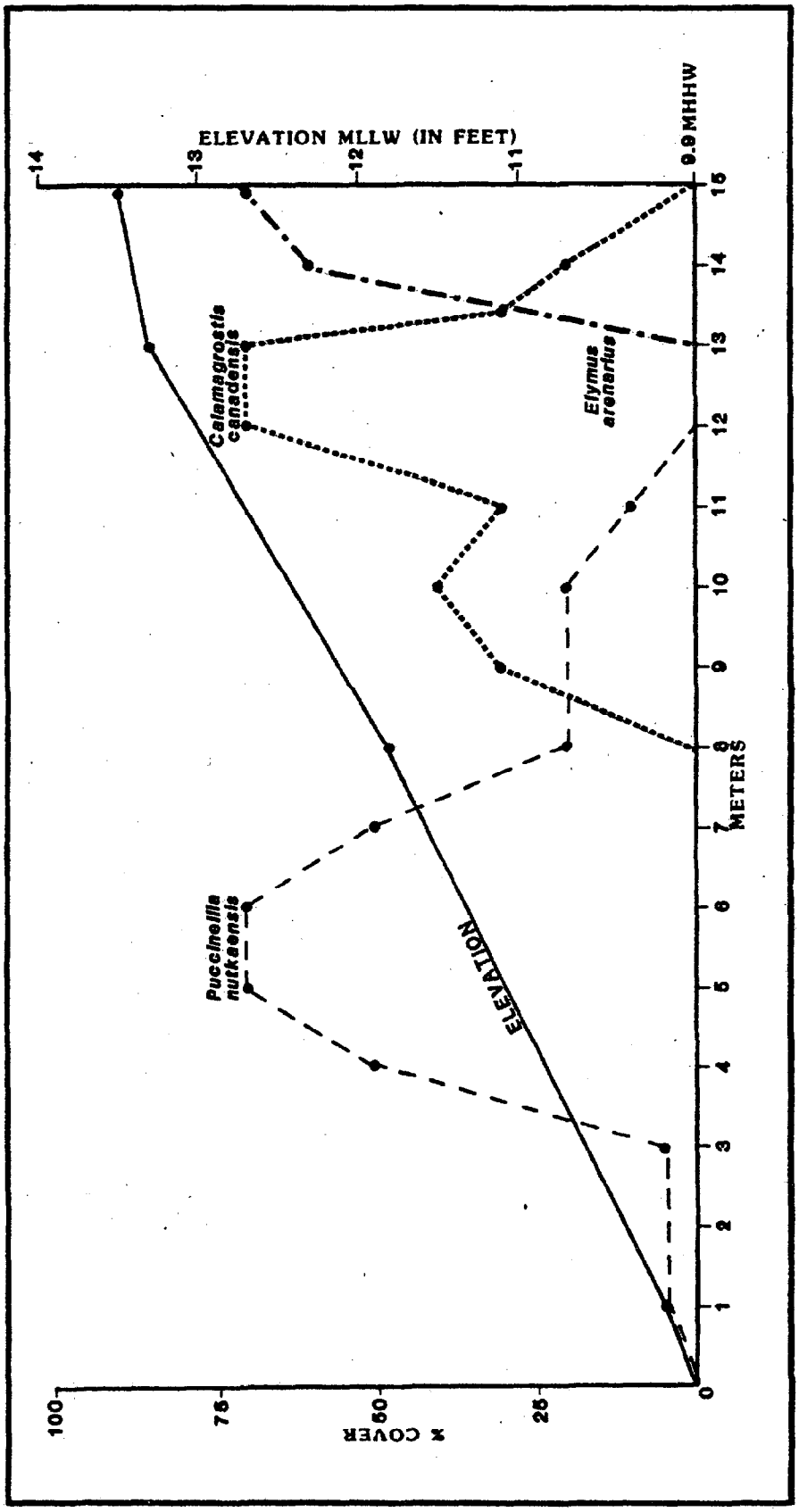


Figure 20. Port Krestof, Plant Species Percent Cover and Transect Elevation.

The vegetation transect on Bare Island is illustrated in Figure 19. The soil was gravelly with some overlying silt. *Carex lyngbyaei*, although present, was not in sufficient quantities to be designated a separate vegetation type. Other salt marsh meadows at Port Krestof were of similar composition with *Puccinellia nutkaenis* growing at the lower elevations and a mixture of grasses, sedges, and forbs comprised the rest of the meadow. A thin band of *Elymus arenarius* circled most of Port Krestof and separated the spruce-hemlock forest from the intertidal flats and saltwater. Very little freshwater wetland vegetation of the *Calamagrostis nutkaensis* type grew at Port Krestof. Few wildflower species grew on the wetlands.

Birds used this site heavily during migration. Port Krestof seemed to lie along a migration route through Krestof Sound, as flocks of white-fronted geese and American wigeon were seen flying overhead and many other species, particularly shorebirds, were found here in much larger numbers than sites further to the east. In general, all surveys found relatively high numbers of geese, dabblers, and shorebirds in Port Krestof. Sea birds drifting in from Hayward Strait regularly occurred here in small numbers.

The following is a summary of important species and peak numbers:

Spring - white-fronted goose (50), green-winged teal (40), blue-winged teal (3), northern shoveler (30), bufflehead (70), black-bellied plover (10), and marbled godwit (2). Small shorebird species including semi-palmated plover, western sandpiper, least sandpiper, and dunlin totaled over 700 individuals. A pair of bald eagles nested on Bare Island.

Summer - initially, a few species of birds, including Canada goose (4), mallard (10), blue-winged teal (2), and white-winged scoter (2) were recorded during summer surveys, but by the end of June few birds were seen.

Fall - birds were present from August through October. Abundant species included mallard (150), pintail (50), American wigeon (50), goldeneye (50), oldsquaw (2), and northern phalarope (30).

Winter - only aerial surveys were flown. Goldeneye (60), harlequin duck (19), and surf scoter (32), and 20 dabblers of mixed species were sighted.

Swan Lake

Swan Lake (Figures 21, 22) is centrally located within the urban area of Sitka. It is bordered on the south and east by two convening streets and on the north and west by a small wetland of less than one acre and a fringe of spruce forest. Two small creeks, Wrinkleneck and Arrowhead, supply inflowing

Figure 21. Swan Lake, Plan View.

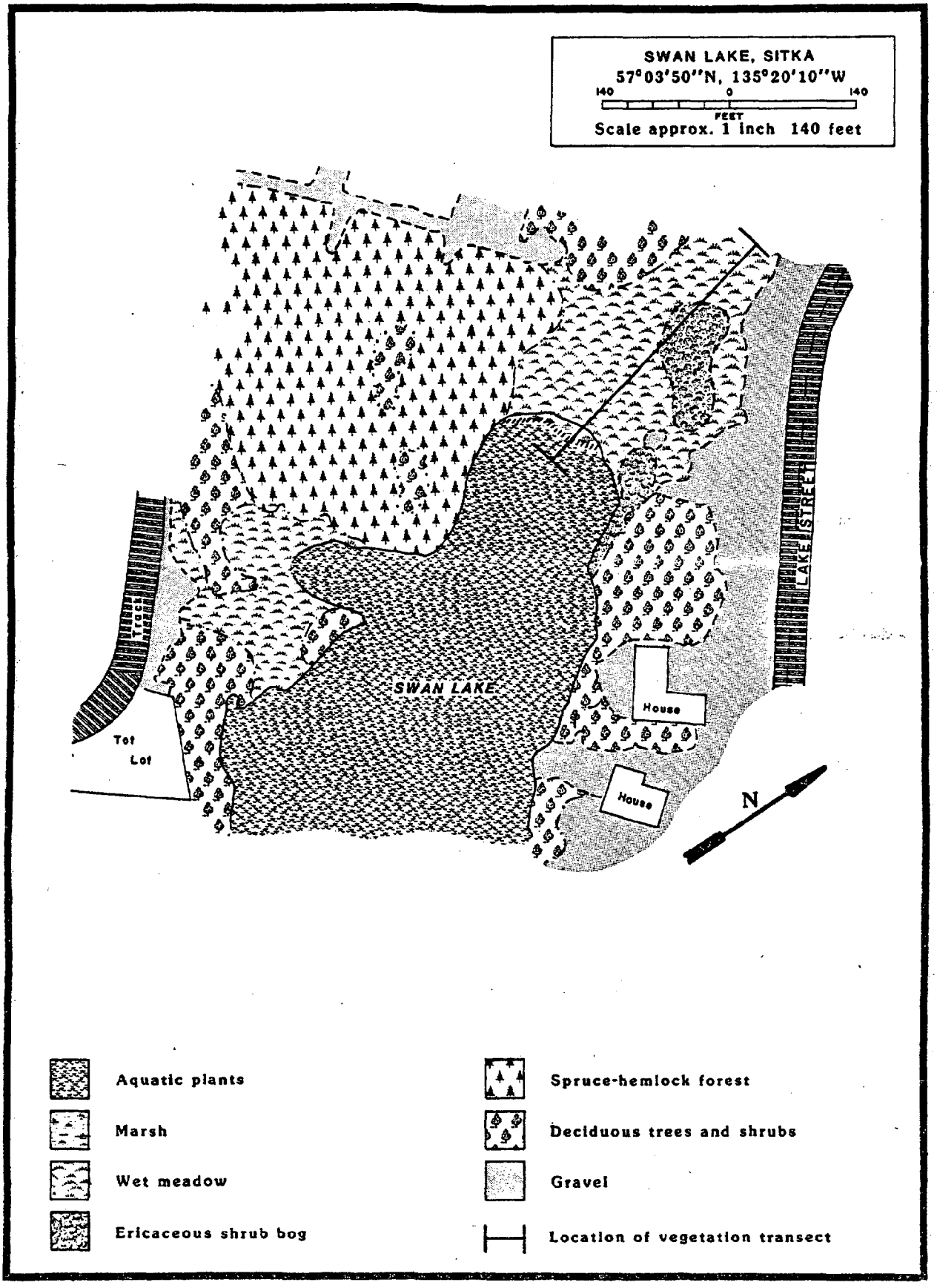
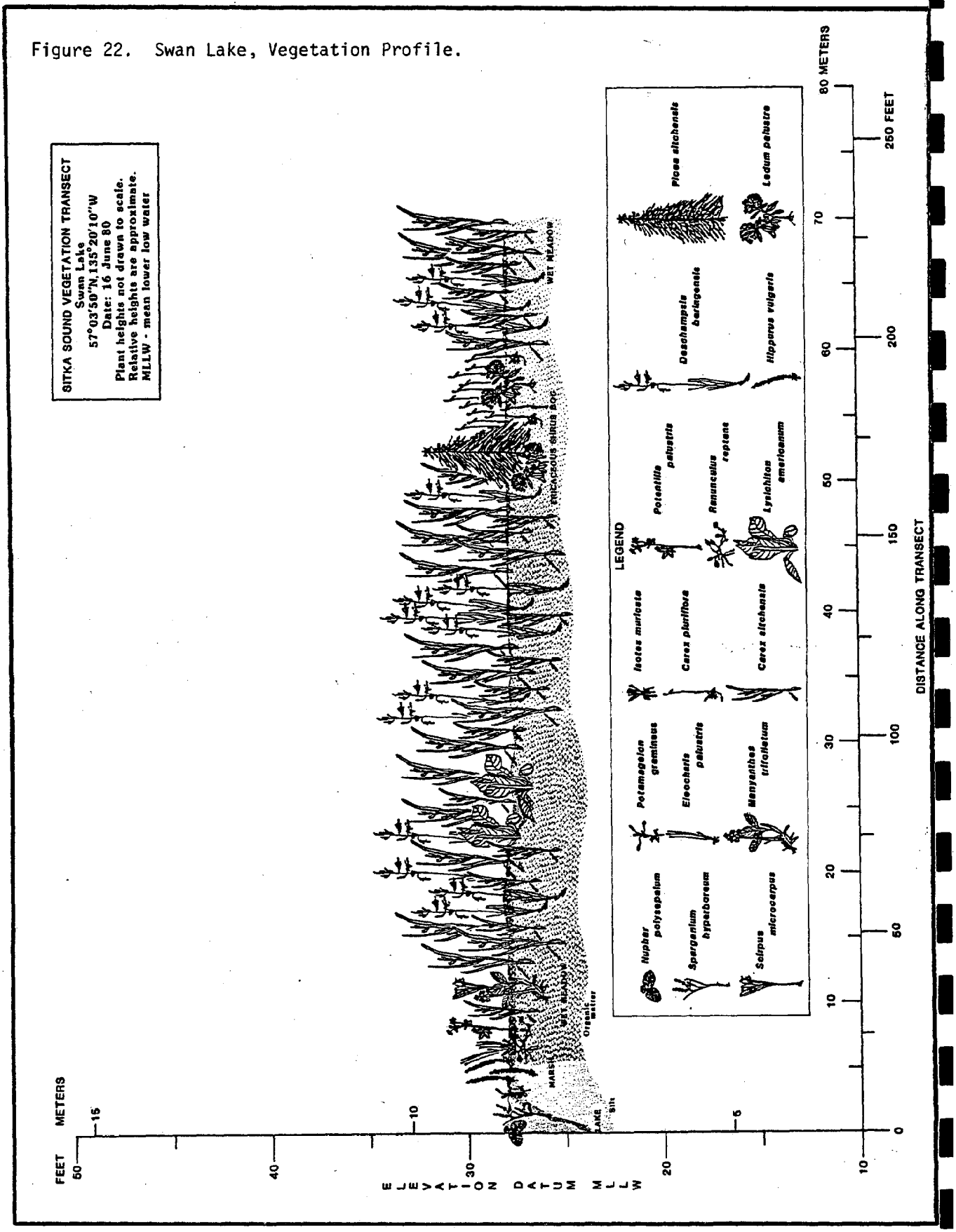


Figure 22. Swan Lake, Vegetation Profile.



water while overflow exits via a single culvert. The lake supports fish and invertebrates and attracts birds to the center of Sitka.

A wide variety of plants, many of them known to supply food for birds, were recorded on the vegetation transect through the freshwater wetland. Plant species composition was largely determined by the presence of persistent water over the soil (Batten, 1980). Plants were classified into four categories describing their habitat. They included aquatic, marsh, wet meadow, and ericaceous shrub bog. A complete species list is presented in Appendix V, with known avian food plants indicated.

Bird use of Swan Lake varied on a seasonal basis as with coastal sites, but geese, sea ducks, shorebirds, and seabirds were not found here. Hence, Swan Lake does not indicate overall avian seasonal events in the Sitka Sound area. However, certain species which require freshwater wetland habitat were found only at Swan Lake. Additionally, species rare to Southeast Alaska, including pied-billed grebe *(Podilymbus podiceps)*, American coot *(Fulica americana)* and hooded merganser *(Lophodytes cucullatus)* were found here, making Swan Lake an important habitat and unique bird viewing area.

The following is a summary of year round bird sightings and peak values:

Spring - Ten trumpeter swans were observed on the lake on March 31 and April 1. They fed and rested in the northwest portion of the lake where aquatic food plants occurred. The area also provided the least amount of noise and disturbance from traffic, people, and dogs. Besides trumpeter swan, other species found included pied-billed grebe (2), mallard (2), greater scaup (35), bufflehead (12), and American coot (1). Most birds, especially the divers, used the lake during storms or high tide periods, for feeding and resting.

Summer - summer bird use of Swan Lake was much lower. A red-throated loon was present on one occasion and a pied-billed grebe was present intermittently throughout the month of June.

Fall - birds were often found here during storms and high tides. Species included horned grebe (1), pied-billed grebe (1), green-winged teal (13), American wigeon (2), scaup (23), hooded merganser (1), and American coot (3).

Winter - during ice-free periods in winter, the lake was used by scaup, hooded merganser, and American coot.

Totem Park Flats

The Totem Park survey area included the west and south shores of the gravel beach peninsula adjacent to Sitka National Historical Park. The Totem Park beach is a gentle intertidal slope interspersed in areas by tide pools which appear to be remnants of past gravel extraction operations. Little vascular plant vegetation appeared on the beach. A thin line of *Elymus arenarius* bordered the upland spruce forest and indicated the storm tide line. Algae and eelgrass beds were found on the seaward end of the beach.

Throughout all seasons, Totem Park was primarily used by sea ducks and shorebirds with the highest numbers of birds occurring during spring. Birds entering Sitka Sound from the south seemed to be attracted to the broad intertidal gravel flats and shallow waters of Totem Park. The following is a summary of the most numerically abundant bird species and peak values:

Spring - surfbird (1,500), black turnstone (1,500).

Summer - whimbrel *(Numerius phaepus)* (7), harlequin duck (25).

Fall - surf scoter (50).

Winter - harlequin duck (10), white-winged scoter (6), and surf scoter (6).

Library Cove

Library Cove was enclosed on three sides by rock fill with only the south end open to salt water. The mud and gravel bottom was covered during high tides. A storm drain from city streets and Swan Lake emptied on the north end and an untreated sewage outfall also discharged into the Cove.

The area was particularly attractive to dabblers and divers during winter because the Cove was protected during northerly storms and the outfall provided a source of food. Migrating waterfowl began to arrive here in mid-October and were gone by mid-April. Mallard (46) and scaup (47) were the most abundant waterfowl found. Less abundant waterfowl included bufflehead, surf scoter, and Steller's eider.

Other birds regularly using the site during low tide included gulls, bald eagles, rock dove, northwestern crow, and starling *(Sturnus vulgaris)*.

Mt. Edgecomb Lagoon

Mt. Edgecomb Lagoon (Sealing Cove) was enclosed by rockfill between Japonski, Charcoal, Alice, and Harbor islands. It is

open to salt water on the southeast side between Alice and Harbor islands. The bottom of the lagoon supported a large eelgrass bed. The lagoon provides moderate protection for birds during storms.

Birds were most often found here resting or feeding during calm to moderate weather at all tidal stages. Fall migrants included scaup (28) and green-winged teal (1). The lagoon was used regularly during winter, especially by diving ducks. Spring migrants included common loon (1) and bufflehead (5). Summer use was primarily by non-breeding bufflehead.

Airport Pond

Airport Pond was located between Japonski Island, Charcoal Island, and the airport runway. The shoreline was composed of rock and gravel fill material and supported grasses, forbs, and some alders. The shape of the pond and its few rock islands provided a partial refuge for birds during strong winds. The water in the pond was brackish and has no known direct connection with the sea.

Birds were most abundant during high tides and some storms. This site is used more for resting and refuge, rather than for

feeding. Birds were not unduly disturbed by local traffic, despite the proximity of the runway, cars, people, and the lack of cover. Newly arrived migrants were disturbed by jet traffic and would often leave the pond as aircraft arrived and departed.

The seasonal use of Airport Pond includes the following:

Spring - spring migrants included scaup (40), bufflehead (10), mallard (2), pintail (3), blue-winged teal (4), and whimbrel (2).

Summer - scaup (11) continued to use the pond during summer. They were last seen in the third week of June. Other late migrants or non-breeders included pintail (1) and American wigeon (1). The only killdeer *(Charadrius vociferus)* sighted in Sitka Sound during the study occurred here.

Fall - fall use began with the return of scaup (50) in mid-October. Other important species included bufflehead (10), surf scoter (3), and mallard (3).

Winter - winter use was curtailed when the pond was frozen. During times when portions of the pond were ice-free, scaup (6) and bufflehead (5) were found.

Old Seaplane Turnaround Cove

Old Seaplane Turnaround Cove was enclosed by Watson Point and the Thomsen Harbor facilities. The cove was bordered by rock, gravel, and mud flats and was found to be partially protected from storms. An untreated sewage outfall discharged onto the tidal flats.

The seasonal use of Old Seaplane Turnaround Cove includes the following:

Spring - Old Seaplane Turnaround Cove was one of the most heavily used bird habitats within the City of Sitka during spring. Scaup and white-winged scoter appeared to be using the site as a staging area, congregating here before moving north. Unusual spring sightings included black scoter *(Melanitta nigra)*, marbled godwit *(Limosa fedora)*, and red knot *(Calidris canutus)*.

Summer - the most common species found during summer included bald eagle, gulls, common raven, and northwestern crow.

Fall - the first fall migrating flock of dabblers were seen in early September. Mallard were the most abundant fall species.

Winter - diving ducks and sea ducks were the primary

users of Old Seaplane Turnaround Cove during winter. Important sightings included sanderling *(Calidris alba)* and western sandpiper.

Halibut Point

Halibut Point included a gravel beach peninsula located along a primarily rocky shoreline. Granite Creek, a salmon spawning stream, flows into the gravel beach. Only minimal salt marsh vegetation occurred between the beach and the upland forest community. The beach received wave action during most storms and provided little refuge for birds.

Avian use of Halibut Point occurred primarily during migration. During spring, goldeneye (7), harlequin duck (3), and surf scoter (40) comprised the nearshore species. Onshore, black oystercatcher (2), whimbrel (5), spotted sandpiper *(Actitus macularia)* (1), wandering tattler *(Heterosceus incanus)*, and rock sandpiper (3) were found. Total numbers of birds in fall were greater, but consisted of fewer species. Included were pintail (1), harlequin duck (75), surf scoter (3), western sandpiper (2), and rock sandpiper (150).

Summer use of Halibut Point was low with harlequin duck (3), spotted sandpiper (1), and bald eagle sighted. Winter use was also low with harlequin duck (5) found on surveys of the area.

Old Sitka Rocks

Old Sitka Rocks were located offshore between Halibut and Harbor points in an area where herring spawned heavily during early April. Bird use during spring was exceptionally high. During the latter half of April, thousands of birds rafted near the rocks. Surf scoter (3,000) were the most numerically abundant species found. Green-winged teal (7), scaup (10), goldeneye (30), white-winged scoter (10), and black scoter (30) also occurred. Shorebirds (600), cormorants (40), and harlequin duck (200) lined the rocks and shoreline. Gulls and bald eagles were also found.

Old Sitka Rocks had very little use during summer, fall, and winter and appeared deserted in comparison with spring. Black oystercatchers probably nested on several of the rock islands. A few gulls and eagles were found perched on the rocks during all seasons.

Cedar Cove

Cedar Cove was located on the north side of Katlian Bay. A narrow land bridge from Baranof Island to Lisianski Peninsula separates the Cove from Lisa Creek in Nakwasina Sound. A small stream that supported pink salmon spawning, flowed in at

the head of the Cove. A small salt marsh was located at the head of the cove on either side of the stream. Cedar Cove appeared to be protected during most storms.

Seasonal bird use and species composition in Cedar Cove were similar to most of the coastal wetlands in the north area. Birds moved easily between Cedar Cove, Lisa Creek, and Katlian Bay, especially when disturbed. Cedar Cove contained a large number of birds during spring including mallard (67), goldeneye (425), and bald eagle (30).

Lisa Creek Marsh

Lisa Creek emptied into a small cove on the southeastern side of Nakwasina Sound. A broad tide flat of gravel and silt substrate extended on either side of the creek. Lower and more seaward levels supported sparse succulent vegetation. The upland meadows were primarily *Elymus arenarius* with some grasses and forbs. The upland forest was logged in 1964 (Ronald Welsh, pers. comm.). A long, narrow pond on the tidal flat left by gravel extraction supported little vegetation. No waterfowl were observed using the pond.

The tidal flats and estuarine waters of Lisa Creek supported representatives of most bird species groups. Spring use was

concentrated at the shoreline surrounding a deep bay just north of the creek. Dabblers and divers fed and rested there. Abundant species included mallard (100) and goldeneye (300). Canada goose (3) were found during early spring on the flats. Shorebirds including black turnstone (400) fed along the gravel spits jutting out from the edge of the tidal flat. By June, only two locally breeding common merganser *(Mergus merganser)* were found there. Divers and sea ducks, including a raft of migrating surf scoters (100), used the area during mid-September. No dabblers or geese were seen during fall. Gulls and crows were especially abundant during the mid-September salmon spawning period. In winter, mallard (7) and goldeneye (25) were found using the area.

Head of Nakwasina

This marsh is the furthest east of the four Nakwasina marshes. The substrate was composed primarily of silt and organic soils, with patches of silt-gravel. An unnamed river draining a large watershed meandered through the wetland. The river was eroding away the east bank of the river mouth at the time of the surveys. Avian use of this wetland was weather dependent, especially during strong northerly or southerly winds. The forested mountain slopes to the north were logged in 1963 (Ronald Welsh, pers. comm.).

Birds tended to congregate in the small, protected cove west of the wetland and the river mouth.

The seasonal use of the head of Nakwasina includes the following:

Spring - divers and sea ducks were the most common species groups occurring during spring and included scaup (36), goldeneye (250), and bufflehead (50). Other waterfowl included Canada goose (7), mallard (100), blue-winged teal (1), and northern shoveler (4).

Summer - during summer, molting male mallards (20) were present in addition to blue-winged teal (2).

Fall - during fall, populations rose from summer levels. Numerically abundant species included Canada goose (6), mallard (10), American wigeon (15), scaup (75), goldeneye (150), surf scoter (500), black turnstone (40), and surfbird (20).

Winter - horned grebe (8), mallard (50), scaup (30), goldeneye (70), and surf scoter (65) were recorded.

Nakwasina Passage

The Nakwasina Passage wetland was a strip one-half mile wide and extending for nearly three miles along the north side of Halleck Island. Wetland habitat was primarily a strip of

herbaceous vegetation along each shoreline. At some points the wetland developed into small meadows of *Carex lyngbyaei* and *Calamagrostis canadensis*. *Elymus arenarius* was common in both the meadows and along the shoreline strip.

Birds were attracted to this area in the largest numbers during storms. The highest numbers of birds, primarily divers and sea ducks occurred during winter. Birds were not abundant during other seasons. Canada goose (2), mallard (30), goldeneye (40), common merganser (10), red-breasted merganser (10), spotted sandpiper (1), and marbled murrelet (7) were found on spring surveys. Marbled murrelet (2) were found in the adjacent estuarine waters during fall. Abundant species found during winter surveys included yellow-billed loon (1), red-throated loon (1), red-necked grebe (1), horned grebe (4), western grebe (2), mallard (39), scaup (2), goldeneye (40), bufflehead (8), Steller's eider (2), white-winged scoter (6), surf scoter (35), and common merganser (3).

West End of Nakwasina Passage

This site consists of a peninsula at the west end of Nakwasina Passage plus the sheltered waters in the lee of the offshore islands. The vegetation on the peninsula at the west end of Nakwasina Passage was comprised of salt marsh species of grasses and sedges found elsewhere in Sitka Sound.

The seasonal use of the west end of Nakwasina Passage includes the following:

Spring - a high diversity of bird species found during spring included red-necked grebe (1), horned grebe (1), pelagic cormorant (1), great blue heron (1), Canada goose (2), mallard (120), green-winged teal (3), European wigeon (1), American wigeon (10), scaup (15), goldeneye (40), bufflehead (70), common merganser (51), semipalmated plover (3), semipalmated sandpiper (1), western sandpiper (1), least sandpiper (12), and dunlin (2).

Summer - a common merganser brood (5) was sighted here during summer.

Fall - the most numerically abundant species included goldeneye (120) and surf scoter (100).

Winter - common species included mallard (66) and goldeneye (83).

Halleck Island Marsh

Halleck Island Marsh is a coastal wetland located along the northwest coast of Halleck Island exposed to Nakwasina Sound, Krestof Sound, and Olga Strait. The soil of the tidal flat was silty with gravel near the stream channels and increasing

organic material towards the uplands. A survey transect at this site showed vegetation to be composed of all five Sitka Sound coastal wetland plant communities.

Avian species were diverse in nearly all seasons and included the following:

Spring - Canada goose (30) were found feeding and resting in the sedge and grass meadows. Mallard (40) and shorebirds, including black turnstone (400), dowitcher (13), surfbird (300), western sandpiper (100), rock sandpiper (150), and dunlin (50), were found near tideline. Scaup (20), goldeneye (60), bufflehead (15), and surf scoter (8) occurred in the adjacent estuary.

Summer - surveys in June showed no birds on land, but non-breeding white-winged (20), surf (85), and black scoters (20) occurred in the adjacent estuary.

Fall - unusual migratory species included golden plover *(Plurialis dominica)* and osprey *(Pandion haliaetus)*. Sandhill cranes were sighted flying through a pass just north of the marsh (Don Williamson, pers. comm.). Other species included horned grebe (4), mallard (100), green-winged teal (10), goldeneye (200), oldsquaw (1), white-winged scoter (50), surf scoter (200), black turnstone

(10), and northern phalarope (10).

Winter - winter birds included yellow-billed loon (1), arctic loon (1), red-necked grebe (2), horned grebe (6), scaup (4), goldeneye (14), bufflehead (15), white-winged scoter (4), and surf scoter (80).

Dry Pass

Dry Pass is a shallow bay located at the northwest end of Krestof Sound. The "pass" consists primarily of mud and gravel tidal flats at low tide. The eastern arm of the bay extends north forming a pass to Sukoi Inlet. Water flows between Sukoi Inlet and Krestof Sound at high tide. The middle portion of Dry Pass is a rock-strewn mud flat at low tide, bordered by a thin band of salt marsh vegetation. The west arm contains a long and narrow wetland divided by an unnamed stream that was found to support spawning salmon. Tidal inundation of this arm is restricted by a rocky peninsula at its mouth. Vegetation in the marsh exhibited more freshwater influence than the other coastal wetlands studied, probably a result of freshwater being backed up during tidal inundation. Past impacts to the area included a logging operation completed about 1966 (Ronald Welsh, pers. comm.), a log transport road built along the forest edge on the south

side of the west arm, and two gravel-filled piers built for log transfer, which extended into deep water beyond the wetland.

The seasonal use of Dry Pass included the following:

Spring - birds of all species groups except seabirds were sighted during spring surveys. Most notable were Canada goose (100), mallard (80), redhead *(Aythya americana)* (2), scaup (100), bufflehead (80), white-winged scoter (100), surf scoter (150), black scoter (10), greater yellowlegs *(Tringa melanoleucus)* (15), and black turnstone (35). Whistling swans were heard, but not seen.

Summer - rafts of non-breeding sea ducks were sighted at the mouth of Dry Pass, but few other birds were seen in the area. Geese were heard, but not sighted on the wetlands.

Fall - Canada goose (75), white-fronted goose (30), mallard (40), scaup (40), and surf scoter (100) were the dominant species. Black brant were also reported (Loyal Johnson, pers. comm.). Aerial surveys during fall showed concentrations of geese to be higher than at any other study site.

Winter - relatively large numbers of Canada goose (70) were found. Other species found included mallard (46),

goldeneye (94), and white-winged scoter (121). The population of white-winged scoters was the highest found during winter within Sitka Sound.

Three Entrance Bay

Three Entrance Bay receives its name from the presence of two islands partially blocking the Bay's three openings to Sitka Sound. The shoreline around the bay is rocky, and provides minimal tideland habitat except for a small meadow at the far east end. A small stream enters the bay at this point, creating a sloping mud bottom and an eelgrass bed. The surrounding uplands were primarily comprised of muskeg.

The seasonal use of the Three Entrance Bay included the following:

Spring - common loon (1), Canada goose (3), bufflehead (30), harlequin duck (3), common merganser (2), and red-breasted merganser (9). Diving ducks were found during all seasons.

Summer - no birds were seen in the bay during summer surveys.

Fall - no birds were seen in September. Mallard (10) and bufflehead (10) were found in October.

Winter - bird use in winter was significantly higher. Important species included horned grebe (6), scaup (14), goldeneye (20), bufflehead (45), harlequin duck (6), common merganser (3), and red-breasted merganser (5).

Kizuchia Creek Marsh

The coastal wetland was located in a small bay north of Redoubt Bay. The shallow tidal flat almost filled the entire bay. Kizuchia Creek drained a steep valley to the east and discharged through the wetland. A small unnamed creek also meandered through the wetland. The surrounding uplands were covered with spruce forest.

Avian use of the area reflected patterns similar to those found in north Sitka Sound. Seasonal findings included the following:

Spring - herring spawning attracted divers such as goldeneye (75), bufflehead (50), and white-winged scoter (20). Dabblers included mallard (20). Canada goose (30) were also found. A mixed flock of shorebirds (150) including semipalmated plover, western sandpiper, least sandpiper, and dunlin were found feeding on the tidal flats.

Summer - no birds were found during summer. An active

bald eagle nest site was found on adjacent Caution Island.

Fall - dabblers, pintail (10), green-winged teal (10), and American wigeon (25), were found in early September. During October horned grebe (5), mallard (25), common merganser (10), harlequin duck (10), and white-winged (50), and surf scoter (10) were found.

Winter - horned grebe (3), scaup (15), goldeneye (10), bufflehead (20), harlequin duck (2), surf scoter (6), common merganser (10), and red-breasted merganser (8) were found in adjacent estuarine waters.

Crane Cove

Crane Cove was a tidal pond with a narrow entrance to the sea. The cove had freshwater inflow from a small creek which flowed through a series of shallow pools. The surrounding wetland vegetation was dominated by low-growing species found primarily in freshwater wetlands including *Carex pluriflora* and *Dodecatheon pulchellum*. Salt marsh species occurred on the lower edges of meadow slopes. An extensive bed of eel-grass and surf grass *(Phyllospadix scouleri)* occurred in the bottom of the Cove. The upland vegetation was muskeg and a stunted spruce-hemlock forest. Investigation of the wetlands at the head of the cove showed that geese use this area during spring, fall, and winter. Goose sign was found on the flats.

Seasonal findings included:

Spring - Canada goose (4), bufflehead (10), and greater yellowlegs (10) were found.

Summer - summer use was sparse and included non-breeding mallard (2).

Fall - bufflehead (5) and hooded merganser (2) were found.

Winter - winter use of Crane Cove was higher in comparison to other seasons. Horned grebe (1), bufflehead (9), surf scoter (4), common merganser (2), and red-breasted merganser (2) were seen.

Goddard and Hot Springs Bay

Goddard was located at the south end of the study area, composed of several small bays around the community of Goddard. The bays were protected by offshore islands and offered moderate protection from storms. The bays were of varying depths and generally rocky. Little wetland habitat existed along the rocky shoreline.

No birds, other than a few pelagic cormorants and gulls, were found here during spring, summer, and fall. During winter, mostly divers were found in the bays. Species included horned grebe (1), redhead (1), scaup (16), goldeneye (3), bufflehead (20), oldsquaw (2), Steller's eider (1), and common merganser (1).

Boat traffic associated with residences at Goddard and the hot springs constituted a form of disturbance, but the lack of wetland habitat was the probable cause of the low bird numbers.

ACKNOWLEDGEMENTS

I would like to gratefully acknowledge the following people for their assistance with field activities, their willingness to share their knowledge of Sitka Sound, their advice, and their overall support.

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Richard Smith
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APPENDIX I

Avian Species and Species Groups
Sighted on Surveys of Wetlands in Sitka Sound -
common and scientific names from Kessel and Gibson, 1978

Common Name	Scientific Name
Loons and Grebes:	
Common loon	*Gavia immer*
Yellow-billed loon	*Gavia adamsii*
Arctic loon	*Gavia arctica*
Red-throated loon	*Gavia stellata*
Red-necked grebe	*Podiceps grisegena*
Horned grebe	*Podiceps auritus*
Western grebe	*Aechmophorus occidentalis*
*Pied-billed grebe	*Podilymbus podiceps*
Cormorants:	
Double-crested cormorant	*Phalacrocorax auritus*
Pelagic cormorant	*Phalacrocorax pelagicus*
*Red-faced cormorant	*Phalacrocorax urile*
Herons:	
Great blue heron	*Ardea herodias*
Swans:	
Whistling swan	*Olor columbianus*
Trumpeter swan	*Olor buccinator*
Geese:	
Canada goose	*Branta canadensis*
Brant	*Branta bernicula*
White-fronted goose	*Anser albifrons*
Dabblers:	
Mallard	*Anser platyrhynchos*
*Gadwall	*Anas strepera*
Pintail	*Anas acuta*
Green-winged teal	*Anas crecca*
Blue-winged teal	*Anas discors*
*Northern shoveler	*Anas clypeata*
*European wigeon	*Anas penelope*
American wigeon	*Anas americana*
Divers and Seaducks:	
Canvasback	*Aythya valisineria*
*Redhead	*Aythya americana*
Greater scaup	*Aythya marila*
Lesser scaup	*Aythya affinis*
Common goldeneye	*Bucephala clangula*
Barrow's goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*

Oldsquaw	*Clangula hyemalis*
Harlequin duck	*Histrionicus histrionicus*
*Steller's eider	*Polysticta stelleri*
White-winged scoter	*Melanitta deglandi*
Surf scoter	*Malanitta perspicillata*
Black scoter	*Melanitta nigra*
*Hooded merganser	*Lophodytes cucullatus*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Raptors:	
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Merlin	*Falco columbarius*
American kestrel	*Falco sparverius*
Cranes:	
Sandhill crane	*Grus canadensis*
Coots:	
*American coot	*Fulica americana*
Shorebirds:	
Black oystercatcher	*Haematopus bachmani*
Semipalmated plover	*Charadris semipalmatus*
Killdeer	*Charadrius vociferus*
American golden plover	*Pluvialis dominica*
Black-bellied plover	*Pluvialis squaterola*
*Marbled godwit	*Limosa fedoa*
Whimbrel	*Numenius phaeopus*
Greater yellowlegs	*Tringa melanoleucus*
Lesser yellowlegs	*Tringa flavipes*
Spotted sandpiper	*Actitus macularia*
Wandering tattler	*Heteroscelus incanus*
Ruddy turnstone	*Arenaria interpres*
Black turnstone	*Arenaria melanocephala*
Northern phalarope	*Steganopus tricolor*
Common snipe	*Capella gallingago*
Short-billed dowitcher	*Limnodromus griseus*
Long-billed dowitcher	*Limnodromus scolo*
Surfbird	*Aphriza virgata*
*Red knot	*Calidris canutus*
*Sanderling	*Calidris alba*
Semipalmated sandpiper	*Calidris pusilla*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Baird's sandpiper	*Calidris bairdii*
Pectoral sandpiper	*Calidris melanotos*
Rock sandpiper	*Calidris ptilocnemis*
Dunlin	*Calidris alpina*
Gulls:	
*Glaucous gull	*Larus hyperboreus*
Glaucous-winged gull	*Larus glaucescens*

Herring gull	*Larus argentatus*
Thayer's gull	*Larus thayeri*
Mew gull	*Larus canus*
Bonaparte's gull	*Larus philadelphia*
Black-legged kittiwake	*Rissa tridactyla*
Seabirds:	
Fork-tailed storm-petrel	*Oceanodroma furcata*
Leach's storm-petrel	*Oceanodroma leucorhoa*
Common murre	*Uria aalge*
Pigeon guillemot	*Cepphus columba*
Marbled murrelet	*Brachyramphus marmoratus*
Ancient murrelet	*Synthiliboramphus antiguus*
*Rhinoceros auklet	*Cerorhina monocerata*
Horned puffin	*Fratercula corniculata*
Tufted puffin	*Lunda cirrhata*
Doves:	
Rock dove	*Columba livia*
Mourning dove	*Zenaida macroura*
Hummingbirds:	
Rufous hummingbird	*Selasphorus rufus*
Kingfisher:	
Belted kingfisher	*Megaceryle alcyon*
Swallows:	
Violet-green swallow	*Tachycineta thalassina*
Tree swallow	*Iriodoprocne bicolor*
Barn swallow	*Hirundo rustica*
Corvids:	
Common raven	*Corvus corax*
Northwestern crow	*Corvus caurinus*
Dippers:	
Dipper	*Cinclus mexicanus*
Sparrows:	
Savannah sparrow	*Passerculus sandwichensis*
Golden-crowned sparrow	*Zonotrichia atricapilla*
Lincoln's sparrow	*Melospiza licolnii*
Song sparrow	*Melospiza melodia*

* Rare in Southeast Alaska (U.S. Department of Agriculture, Forest Service, 1978).

APPENDIX II
UNITED STATES GOVERNMENT

memorandum

U. S. FISH AND WILDLIFE SERVICE

1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503
(907) 276-3800

TO: Kim Sandberg
~~Bill Huges~~, ~~Sitka~~

FROM: Wildlife Biologist, Refuges - Anchorage

DATE: 8 JUN 1980

SUBJECT: St Lazaria National Wildlife Refuge Seabird Reconnaisance

I want to thank you again for taking us to St Lazaria Island on May 21, 1980. Through a brief visit, I learned much about the island, but it was unfortunate that your Avon was inoperable. George Willet's 1912 estimates of breeding seabirds for the island (Bird Lore 14: 419-426) are as follows according to the "Catalog of Alaskan Seabird Colonies:"

Fork-tailed Storm-Petrel - 4,000	Common Murre - 600
Leach 's Storm-Petrel - 40,000	Pigeon Guillemot - 300
Pelagic Cormorant - 300	Rhinoceros Auklet - 150
Black Oystercatcher - 8	Horned Puffin - 24
Glaucous-winged gull - 600	Tufted Puffin - 4,000
	Total - 50,000 birds

Estimates of seabird numbers, especially burrow-and crevice-nesters, vary considerably with time of day, season, and weather. Judging from the amount of grass-covered slopes and burrows noted, I believe our visit coincided with the presence of a high percentage of the total breeding population of Tufted Puffins,

My independent estimates based on the number of burrows and birds, amount of habitat, and comparisons with numerous other islands I have visited was also 2,000 pairs. We saw no Horned Puffins, and the few that have been reported in the past may not have yet arrived. I noted only about 12 evident pairs of Pelagic Cormorants plus 30 immature birds. There also were at least six Double-crested Cormorants; working the island closer in with an inflatable boat probably would have revealed more cormorants, particularly in one grotto.

Cormorants nesting locales are highly variable from year to year; so hundreds may use the island in some years. My estimate of the Glaucous- winged Gull population was only about 40 pairs, and I saw only four Pigeon Guillemots, Willet's report of 300 guillemots is surprising since the island lacks the colluvium that these birds prefer. Perhaps more gulls and guillemots appear later in the spring. My estimate of Common Murres was 1,400. Judging from burrow characteristics and flight sounds of a few birds after dark, Rhinoceros Auklets are present probably in about the numbers reported by Willet.

We did find one new species on the island - Ancient Murrelets. An egg (last year's) was found in a burrow, and they were regularly heard calling after dark. I would guess that about 100 pairs nest on the island.

Storm-petrels are the island's chief nesting species. Thousands were flying about when we left at 3:00 A.M., and all areas with soil, including relatively level spots beneath spruce stands are riddled with burrows. Many birds of both species were pulled from holes, and most had begun incubating. In places 3-4 holes m^2 were evident, and the population of storm-petrels must exceed 100,000 pairs. I feel Leach 's Petrels outnumber their congener about 3:1. Surely it would be worth quantifying the storm-petrel populations with random quadrats to determine average burrow density, occupancy, and the ratio between the two species. Further scrutiny could also divulge a few Cassin's Auklets, which would make St Lazaria only the fourth known site in Alaska with all five nocturnal species (Buldir, Forrester and Patton islands).

No Pergrine Falcons were present, but at least 11 Bald Eagles (3 immatures) were sighted, and one nest in a spruce was located. One eagle was observed attempting to catch storm-petrels and another was surprised on the ground where it probably captured a seabird. River otter predation on storm-petrels is heavy, and gulls and crows also take their toll.

The rugged nature of the island ; its rank vegetation, including extensive salmonberry; frequent bad weather; lack of easy landing sites, and the fact that most of the birds are nocturnal combine to protect it from excessive numbers of human visitors, despite the close proximity to Sitka and the fact that large numbers of small boats anchor in the lee of the island. We saw little evidence of human use, and the high number of storm-petrels obviously indicates that no significant visitor use problem yet exists. Nevertheless, both the bird populations and the number of visitors should be periodically monitored. It would be interesting to know how many people do land there. Perhaps an island register in a waterproof box located at the isthmus, the only logical landing site, would

be worthwhile. As long as little or no disturbance occurs, a few people can truly have an awesome experience, which in turn inculcates a better understanding and appreciation for areas like this with such a phenomenal concentration of life.

As previously discussed, let's try for Hazy Island next summer!

Ed Bailey

cc: Kim Sundberg, ADF&G

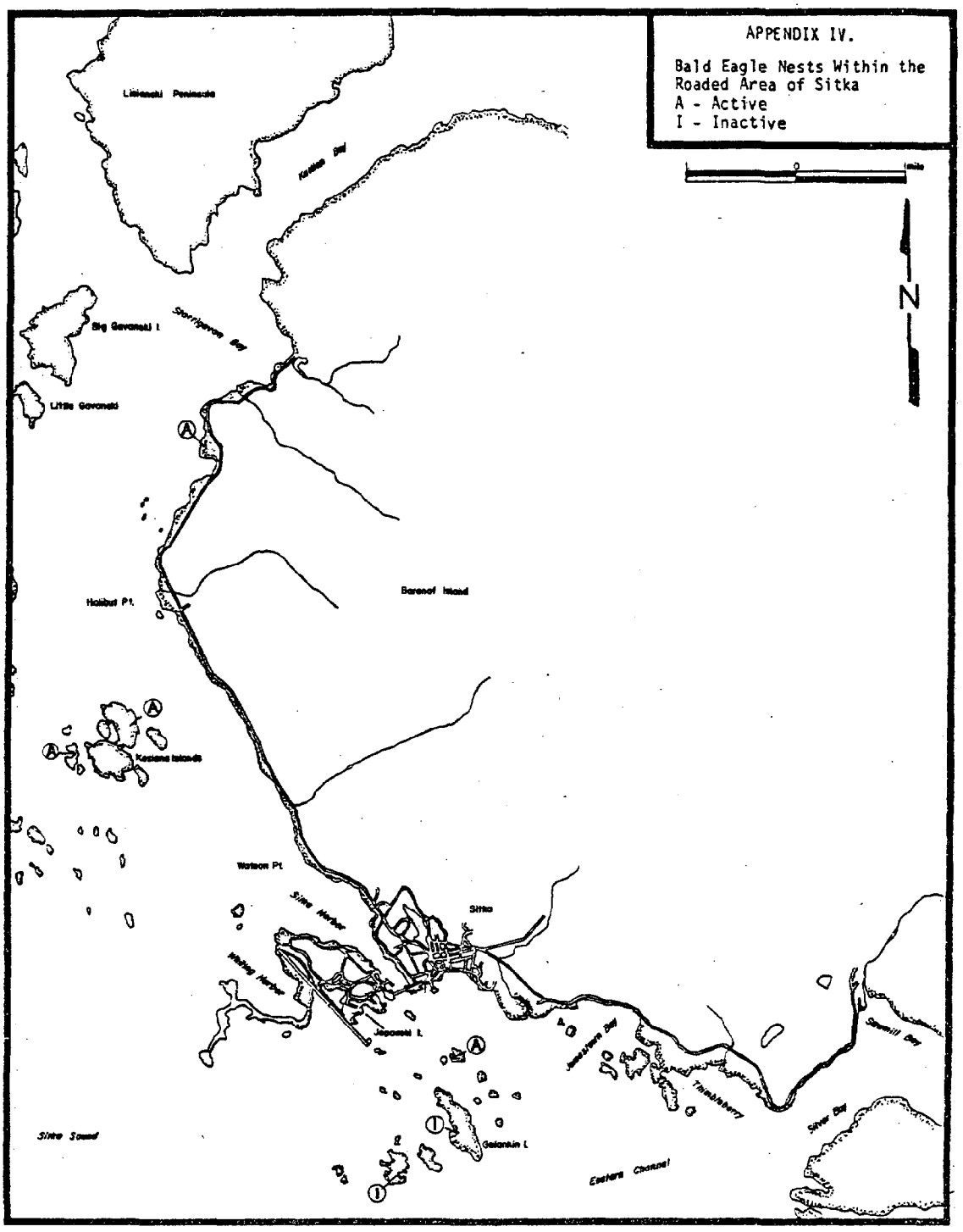
APPENDIX III

Coastal Wetland Plant Species - Sitka Area
(from saltwater to upland freshwater)

	Common Name
Aquatic	
**Zostera marina*	eelgrass
MARSH SPECIES:	
Puccinellia nutkaensis community:	
**Puccinellia nutkaensis*	alkalai grass
Spergularia canedensis	sand spurry
Glaux maritima	sea milkwort
**Plantago maritima juncoides*	plantain
Honkenya peploides	beach pea
Salicornia virginica	pickelweed
Calamagrostis canadensis community:	
**Calamagrostis canadensis*	bluejoint
**Triglochin maritimum*	arrow grass
Potentilla anserina	silverweed
Carex lyngbyaei community:	
**Carex lyngbyaei*	sedge
Potentilla egedii	Pacific silverweed
Elymus arenarius community:	
**Elymus arenarius*	beach rye
**Conioselinum chinense*	hemlock parsley
Calamagrostis nutkaensis community:	
**Calamagrostis nutkaensis*	reed bent grass
Hordeum brachyantherum	-
Hordeum jubatum	squirrel tail
Deschampsia beringensis	-
Festuca sp.	fescue grass
**Glyceria pauciflora*	manna grass
Bromus pacificus	brome grass
Plantago macrocarpa	plantain
**Carex pluriflora*	sedge
**Eleocharis palustris*	spikerush
Galium trifidum	bedstraw
Sanguisorba sp.	burnet
Oenanthe sarmentasa	-
Ligusticum scoticum	beach lovage
Achellia borealis	yarrow
Castilleja sp.	indian paintbrush
Ranunclus sp.	buttercup

Geranium erianthum	cranesbill
Fritillaria camschatcenses	chocolate lily
Heraculum canatum	cow parsnip
Epilobium sp.	fireweed
Menyanthes trifiliata	buckbean
**Juncus articus*	rush
**Juncus bufonius*	rush
Dodecatheon pulchellum	shooting star

*Wildlife food source (Bellrose, 1978; Hughes and Young, unpublished data)


APPENDIX IV.
Bald Eagle Nests Within the Roaded Area of Sitka
A - Active
I - Inactive
0
mile
N
Big Goveznki I.
Little Goveznki
Halibut Pt.
Baranof Island
Kasiana Islands
Watson Pt.
Sitka Harbor
Sitka
Japonski I.
Galankin I.
Sitka Sound
Eastern Channel

APPENDIX V

Mammal Sightings in Sitka Sound

Brown bear (*Ursus arctos*)

May 29, 1980	Lisa Creek	1 two year old cub
May 29, 1980	Nakwasina Passage	sow and 2 one year old cubs

Sitka black-tailed deer (*Odocoileus hemionus sitkensis*)

May 5, 1980	Head of Nakwasina Sound	2 (sex unknown)
May 15, 1980	Lisa Creek	6 bucks
May 15, 1980	Nakwasina Transect Marsh	7 bucks
May 15, 1980	Port Krestof	1 (sex unknown)
May 29, 1980	Cedar Cove	1 buck
June 20, 1980	Three Entrance Bay	2 (sex unknown)
June 20, 1980	Kizuchia Creek	1 doe
June 22, 1980	Katlian Bay	2 (sex unknown)

River otter (*Lutra canadensis*)

April 7, 1980	Katlian Bay	1
May 2, 1980	Katlian Bay	3
May 3, 1980	Port Krestof	1
May 15, 1980	Cedar Cove	2
June 18, 1980	Nakwasina Transect Marsh	1

Harbor seal (*Phoca vitulina*)

October 2, 1979	Indian River	1
October 7, 1979	Dry Pass	1
October 7, 1979	Halleck Island Marsh	1
October 7, 1979	Port Krestof	1
October 12, 1979	Nakwasina Transect Marsh	1
October 14, 1979	Katlian	1
October 17, 1979	Starrigavan	1
October 21, 1979	Port Krestof	1
February 25, 1980	Off causeway	1
April 10, 1980	Kizuchia Creek	10
April 14, 1980	Port Krestof	1
May 5, 1980	Lisa Creek	1
May 5, 1980	Nakwasina Passage	1
May 29, 1980	Lisa Creek	1
May 7, 1980	Kizuchia Creek	2
June 6, 1980	Port Krestof	1

Steller sea lion (*Eumetopias jubata*)

October 12, 1979	Lisianski Peninsula	2
October 14, 1979	Katlian Bay	4
October 30, 1979	6-mile Halibut Point Road	5
February 19, 1980	3-mile Halibut Point Road	4
February 25, 1980	offshore of the causeway	10
April 10, 1980	north of Viesokoi Rock (south area)	10

Humpback whale (*Megaptera novaeangliae*)

October 29, 1979	off Starrigavan Bay	2
October 30, 1979	off Starrigavan Bay	2
April 26, 1980	Shelikof Bay	2

Northern fur seal (*Callorhinus ursinus*)

February 26, 1980	Silver Bay	1

APPENDIX VI

Freshwater Plants on Vegetation Transects in Sitka Sound

Scientific Name	Common Name
Aquatic:	
**Nuphar polysepalum*	pond lily
**Sparganium hyperboreum*	burreed
**Potamageton gramineus*	pondweed
**Utricularia vulgaris*	bladderwort
**Ruppia spiralis*	wigeon grass
**Ceratophyllum demersum*	coontail
Callitriche verna	water starwort
Marsh:	
Eleocharis palustris	spikerush
**Hippuris vulgaris*	marestail
Isotes muricata	quillwort
**Ranunculus reptans*	white water buttercup
**Equisetum fluviatile*	horsetail
Wet Meadow:	
Potentilla palustris	marsh fivefinger
**Equisetum arvense*	horsetail
**Juncus bufonius*	rush
**Juncus filifermis*	rush
**Juncus ensifolius*	rush
Ranunculus sp.	buttercup
**Scirpus microcarpus*	bulrush
Sanguisorba sp.	burnet
**Carex sitchensis*	sedge
**Calamagrstis canadensis*	bluejoint
**Deschampsia beringensis*	-
Angelica genuflexa	-
Muskeg:	
Picea sitchensis	Sitka spruce
Ledum palustre	labrador tea
Carex pluriflora	sedge
**Lysichitum americanum*	yellow skunk cabbage
Maianthemum dilatatum	false lily-of-the-valley
Prunella vulgaris	self-heal
Sphagnum sp.	moss

*Wildlife food source (Bellrose, 1976; Hughes and Young, unpublished data)