PRESERVE ANALYSIS : NETARTS SAND SPIT

Prepared by

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OREGON NATURAL AREA PRESERVES

ADVISORY COMMITTEE

to the State Land Board

Salem, Oregon

August, 1979

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PREFACE

The purpose of this preserve analysis is to document the significant natural values of Netarts Sand Spit in Cape Lookout State Park to aid in deciding whether to recommend the dedication of a portion of the spit as a natural area preserve within the Oregon System of Natural Areas. Preserve management, agency agreements, and management planning are therefore not a function of this document.

Netarts Sand Spit and its adjacent relatively undisturbed estuary have long been recognized together as one of Oregon's finest coastal features. The sand spit, without structures and with little human impact, is the most pristine sand spit in the state. With a diversity of geological and biological types, the sand spit has already attracted considerable amount of scientific research. The estuary has been used and continues as an important research location.

A number of individuals have contributed to the preparation of this document. Research personnel at the EPA Corvallis Environmental Research Laboratory including John Gallagher, Harold V. Kibby, and Marc Liverman have supplied information concerning marsh community ecology. Dale Snow of the Oregon Department of Fish and Wildlife provided information concerning the estuarine habitat. Dr. Robert M. Storm, Professor of Zoology, Oregon State University has generously helped in compiling a list of animals expected in the sand spit area. The background work on Netarts Bay prepared by a NSF Student Originated Study under the leadership of Stephen Shabica is also acknowledged.

SUMMARY

The northern three miles of Netarts Sand Spit in Cape Lookout State Park, Tillamook County is proposed as a state natural area preserve under the authority of ORS 273.562-273.597. The tract occupies approximately 603 acres and is presently in nearly natural condition.

The preserve will help protect the sand spit, an outstanding coastal feature. Included within the area are the following vegetation types: coastal strand; an unstabilized dune complex with dry and wet phases; stabilized foredune dominated and created by European beach grass; coniferous forest dominated by Sitka spruce; and, a pristine low salt marsh as well as areas of high salt marsh. Except for the forest, none of these types is presently represented in Oregon's natural area system.

Netarts Sand Spit has been the location of considerable research on salt marsh ecology and is also the site of early coastal archeological studies. No conflict is seen between present and future dispersed recreational use and the establishment of a natural area on the spit.

CONTENTS

Name of Natural Area

"Netarts Sand Spit Natural Area Preserve" is proposed as the name for this preserve. Netarts is an Indian name that McArthur has been unable to translate into English (McArthur 1974). The prefix Ne typically indicates localities of homes of certain Indian tribes or family groups. The choice of "Netarts Sand Spit" is intended to call to mind the area's entire physical features as well as its first inhabitants. Furthermore, the proposed name is compatible with the locally used name "Netarts Bay" referring to the adjoining estuary east of the spit.

Reasons for Preservation

The proposed preserve will include in the Oregon System of Natural Areas a wide range of coastal environments and the complex ecological relationships which exists between them. As one of the most undeveloped sand spit/estuary systems in the state, Netarts can serve, as it has already done, as a fundamental research resource for coastal process studies. The sand spit and associated estuary were identified as a suggested research natural area in Dyrness et al. (1975: 173) with the words, "a small, high-salinity estuary that is relatively undisturbed. Portion of the estuary and salt marsh required. High priority. Cape Lookout State Park adjoins salt marsh and controls sand spit." In a study for the Oregon Coastal Conservation and Development Commission, Wilsey and Ham Inc. (1974) stated, "The large, undisturbed bar at Netarts Bay, is perhaps, the best example of a dune ecosystem in Oregon".

Specifically, this area will help fill the following research natural area and/or habitat protection needs within the Sitka Spruce Zone of the Oregon Coast Ranges Province (Dyrness et al. 1975), none of which are presently protected in natural areas.

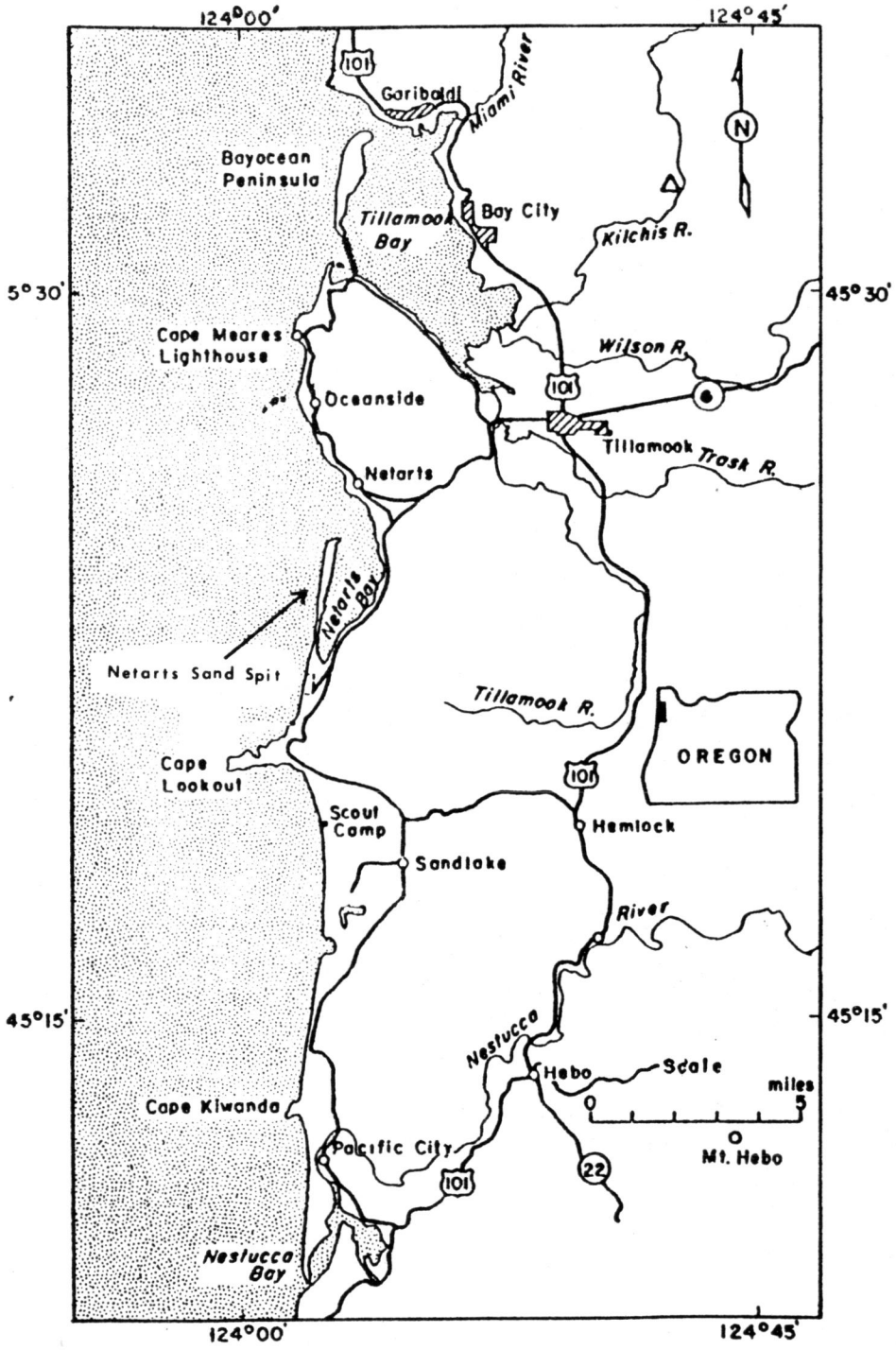


Figure 1. General location of Cape Lookout State Park.

Terrestrial Cells:

(1) Sitka spruce/salal community on ocean front

(2) Lodgepole pine/salal community on ocean front

(17) Coastal dune mosaic with variety of dune types

Aquatic Cells:

(9) Vernal ponds in sand dunes

Additional cells not listed in Dyrness et al. (1975):

(a) Salt marsh mosaic (intertidal)

(b) Estuarine sytem (intertidal and included very peripherally in protection zone)

(c) Open sand beach and shore (open coast)

Ownership and Boundary Selection

Ownership

All of the proposed preserve is part of Cape Lookout State Park, 10 km (6 mi.) south of Tillamook (Figure 1) and is owned and managed by the State Parks and Recreation Division of the Department of Transportation. State Park's ownership is bounded by mean high tide. Tidal lands below State Park's ownership are owned and managed as public trust lands by the State Land Board through the Division of State Lands.

Boundary Selection

The southern boundary, along the east-west quarter section line of Section 19 (T2S, R10W), was selected so as to include the relatively undisturbed segment of the sand spit and at the same time to locate the preserve at a distance from the most used parts of the park (Figure 2).

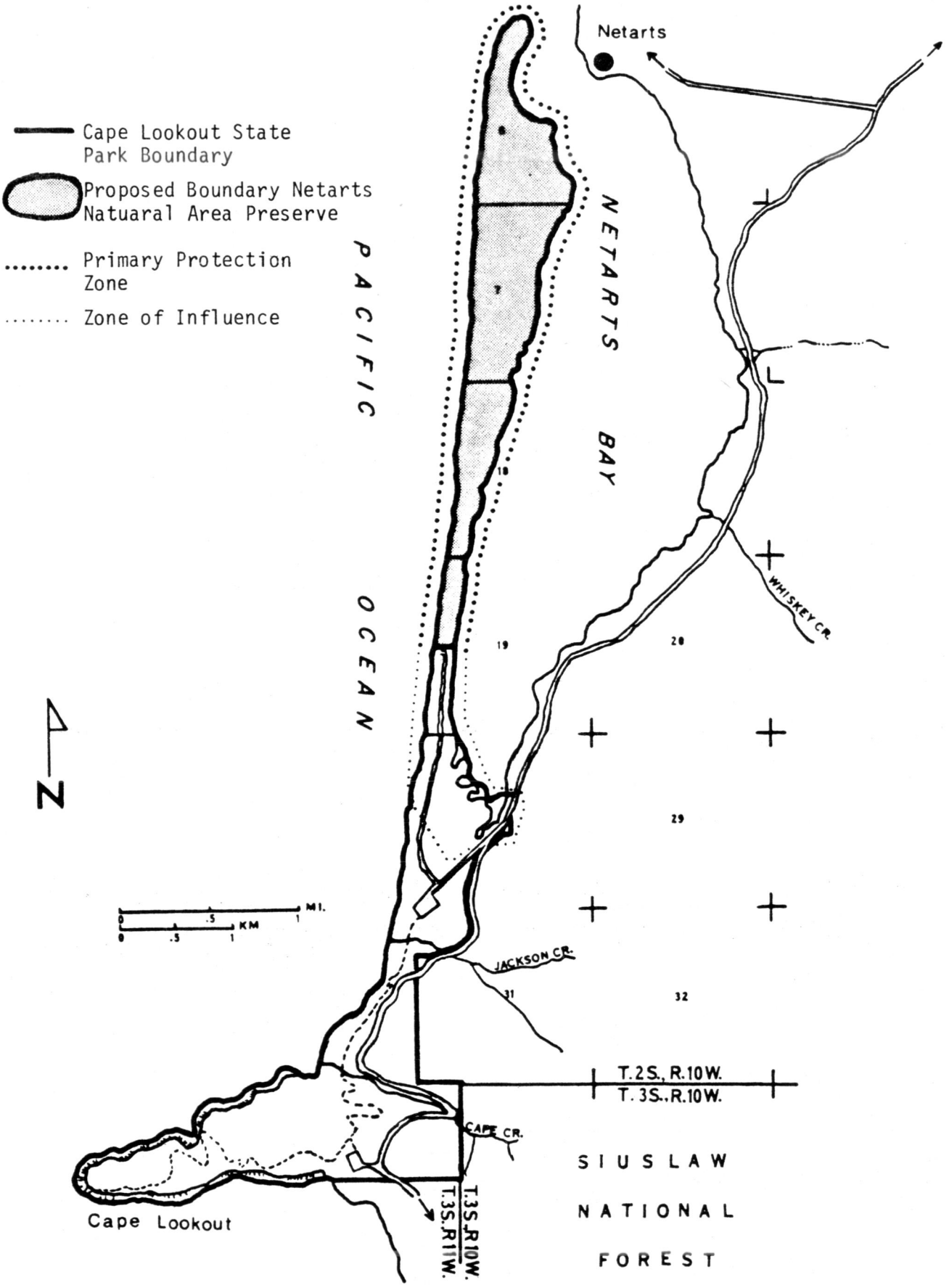


Figure 2. Cape Lookout State Park with proposed natural area preserve boundaries and protection zones and areas of influence.

Protection Zones

Protection zones within the proposed Netarts Sand Spit area are shown in Figure 2. Boundaries were chosen to protect the most significant natural area values on the spit, to include the greatest diversity of biotic systems, and to include areas that are and would be least effected by changes in the management of the surrounding area.

The following generalized criteria were used in determining primary protection boundaries:

1. Protection of an ecosystem, representative or unique, needed as part of the State System of Natural Areas
2. Protection of a population (or several populations) of plants or animals
3. Assurance of the defensibility of the preserve area, i.e., the area must be able to retain and/or develop its natural character
4. Preservation of the integrity of the preserve area, i.e., the area must substantially display its natural character
5. Assurance that the preserve is viable, i.e., that the area can perpetuate itself

Using these five criteria, the key features have been circumscribed in Figure 2 as "primary protection zone".

In conjunction with the primary protection zone is a "zone of influence" which is an area that has an important relationship to the primary protection zone (Figure 2). The following criteria were considered in delineating the zone of influence.

1. Biological Influence. The zone contributes to nutrient flow or other biological aspects of the primary protection zone
2. Physical Influence. The zone constitutes a buffer between the primary protection zone and physical forces such as erosion or damaging winds

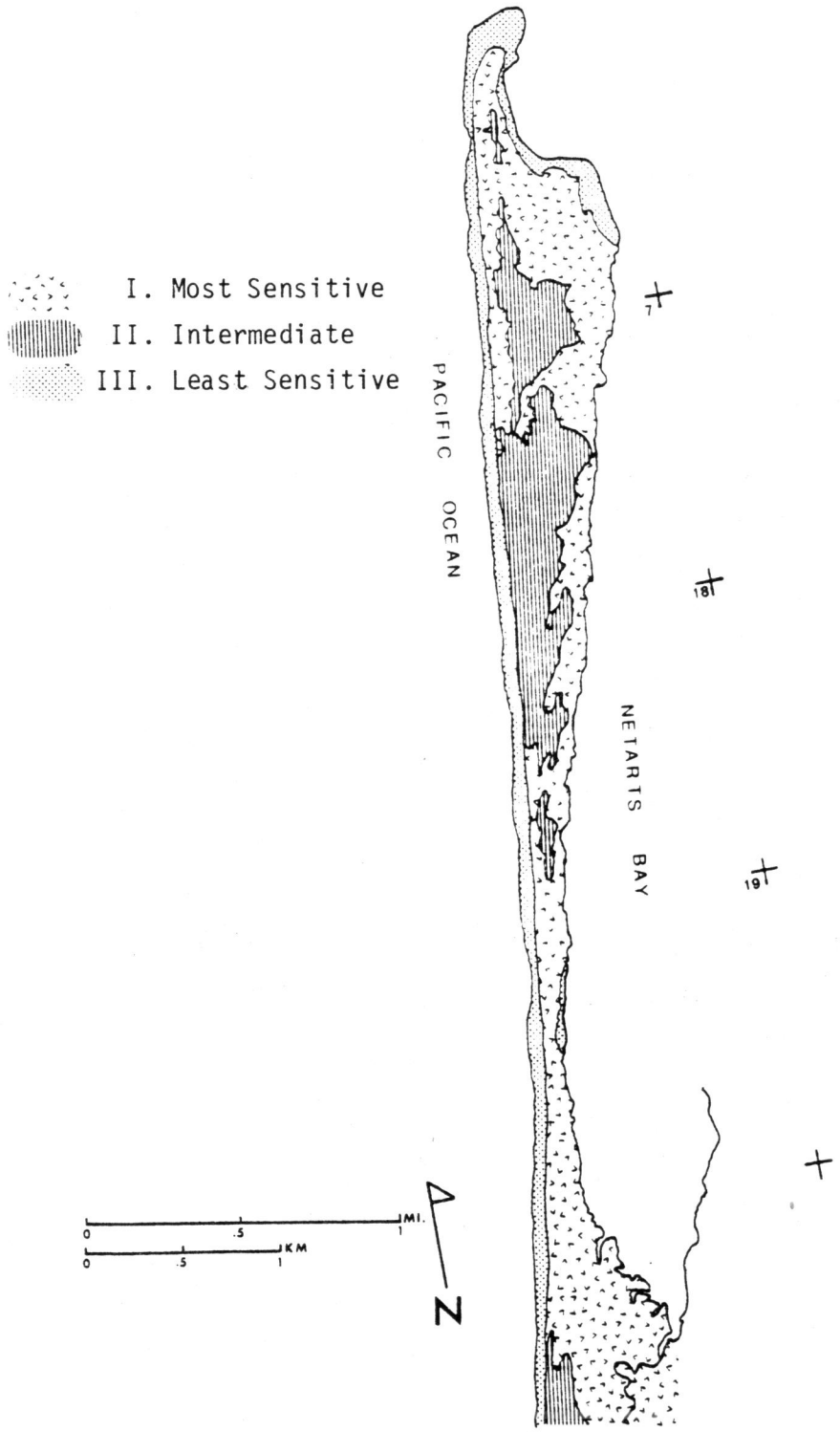


Figure 3. Sensitivity Classes, Netarts Sand Spit

3. Human Influences. The zone, by its vegetation or topography, affects access and/or presents a distance from a threat to the primary protection zone; threats might be due to the presence of damaging human activites such as eroding road cuts or intensive recreational development or use with associated trampling and soil compaction

Sensitivity Classes

The Netarts Sand Spit vegetation types have been grouped into three sensitivity classes (Figure 3) derived primarily from generalized vegetation patterns (see Figure 6).

Sensitivity Class I (the most sensitive class) includes the stabilized dunes and salt marsh. The continued stabilized state of these dunes is dependent on the maintenance of its vegetative cover. Removal of only a small amount of plant cover may start a chain reaction of renewed dune activity. The plant communities found in the salt marsh are easily damaged by trampling and are very slow to recover from damage as is evident from several trails found in the marsh.

Sensitivity Class II includes those areas that would normally recover relatively rapidly from disturbance and use in comparison with areas in Class I. These areas include the unstabilized dunes, the Sitka spruce forest, and other wooded areas. The unstabilized dunes can repair minor disturbances through naturally occuring aeolian processes. The Sitka spruce forest is, for the most part, impenetrable and could only be affect along its fringes. The other wooded areas would be impacted more heavily due to greater accessibility.

Sensitivity Class III includes those areas most able to withstand trampling and other human uses. The strand area is in this class due to its daily rejuvenation caused by wave action and almost total lack of vegetation.

General Description

Setting

Netarts Sand Spit extends north-northeastward 6 km (approx. 4 miles) from Cape Lookout. Its width ranges from 120 meters in the central section to 1.2 km toward the northern end. Eastward from the continuous sand beach which constitutes its far western margin bordering the Pacific Ocean, the spit presents an almost unbroken steep-faced foredune which reaches 15 meters in height in some places. This foredune has been breached several times historically, but has not been breached within the last 40 years. The planting of European beach grass, which began in 1951 and continued for several years, has contributed to the foredune's resistance to marine and aeolian erosion.

On the leeward side of the foredune, the spit supports three main terrestrial vegetation types, each occupying about one third of the spit's length. In the north is a dune system partially stabilized by European beach grass and various indigenous sand-binding plants. In the central portion is a dense forest of Sitka spruce with a dense shrubby understory of salal and evergreen huckleberry. The southern third contains a planted forest of shore pine and maritime pine, with Scotch broom, bracken fern, European beach grass, and salal forming a shrubby and grassy cover in the unforested portions.

Salt marsh constitutes a fourth and very important vegetation type. Marsh occurs in varying degrees of development on all but the most unstable northern portion of the bay side of the spit. Two salt marsh types, Low Sand Marsh and Immature High Marsh are represented in largely undisturbed

condition (Jefferson 1975). South of the proposed preserve at the head of the bay are extensive areas of Sedge Marsh and Mature High Marsh. These marshes together with the tidal flat form the transition zone between the terrestrial systems of the spit and the aquatic systems of Netarts Bay.

Netarts Bay, a 883 ha (2179 acre) estuary, measured at Mean High Water, is situated east of the sand spit which separates it from the open ocean. The only direct contact between the bay and the ocean is a 400 m-wide channel off the northern end of the spit. Because the estuary has a very small watershed (3626 ha) with little fresh water input, its waters are highly saline and exhibit little salinity stratification. Fresh water runoff is carried by 12 intermittent small streams. Whiskey Creek, the longest, is approximately 3.2 km (2 mi.) long. The watershed area has very steep slopes and unstable soils, resulting in extensive landslide hazard. The watershed has almost been completely logged, with operations beginning at the turn of the century and continuing to present. Sitka spruce, western hemlock, Douglas-fir, and red alder are the dominant trees over most of the watershed.

Settlement in the Netarts Bay area is limited to the communities of Wilson Beach (pop. 30) and Oceanside (pop. 160), none of which are incorporated (1970 populations).

Climate

The ocean is the single most important influence on the climate of this coastal area. Because of the general west-to-east flow of air in the mid-latitudes, most of the air masses reaching the Oregon coast have been influenced by up to several days of contact with the Pacific Ocean. This results in a great moderation of temperature. Temperatures in this area rarely exceed 38^{o} C (100^{o} F), and very seldom drop below

-18° C (0° F). January, the coldest month, has a mean temperature of 5.3° C (41.5° F). This is only 10° C (18° F) colder than the 15.3° C (59.6° F) mean for July, the warmest month, as measured at the Cascade Head Experimental Forest (31 km SSE, 50 m elevation).

Precipitation is also affected by proximity to the ocean and Coast Range. Rainfall is abundant on the coast as it is in most of western Oregon. Tillamook (18 km NE, 10 m elevation) receives about 2500 mm (98 inches) of rain per year. The rainfall is highly seasonal with a winter maximum. The months of November through March average more than 250 mm (10 inches) each, while July and August average only 50 mm (2 inches) each. See Table 1 and 2 for selected climatic data.

Table 1. Climatic Means, Tillamook, Oregon, elev. 10 m

Mean annual temperature	13.3° C	(50.6° F)
Mean January temperature	5.3° C	(41.5° F)
Mean January minimum temperature	2.2° C	(35.9° F)
Mean July temperature	15.3° C	(59.6° F)
Mean July maximum temperature	20.9° C	(69.7° F)
Average annual precipitation	2496 mm	(98.2 in.)
June through August precipitation	163 mm	(6.4 in.)

Source: U.S. Environmental Data Service Climatological Summary.

Wind is another climatic factor strongly influenced by proximity to the ocean. The Oregon coast experiences a yearly cyclic variation in wind direction and velocity. Severe winter storms bring the strongest winds as well as much of the total annual precipitation. These storms generally come on-shore from the southwest, the prevailing direction for the winter months. Although wind records for the Tillamook area are not extensive, physical evidence such as timber blowdown and dune form indicates that

winds in excess of 120 kmph (75 mph) are generated in these storms. The mean wind speed for Netarts and Cape Lookout during the winter is between 22 and 25 kmph (14 and 15.5 mph).

Spring is transitional for wind direction, and by early summer the prevailing winds are northerly to northwesterly. Summer winds average 16 and 19 kmph (10 and 12 mph) (Conversation with John Wade - researcher, OSU Atmospheric Science Department 8-16-78).

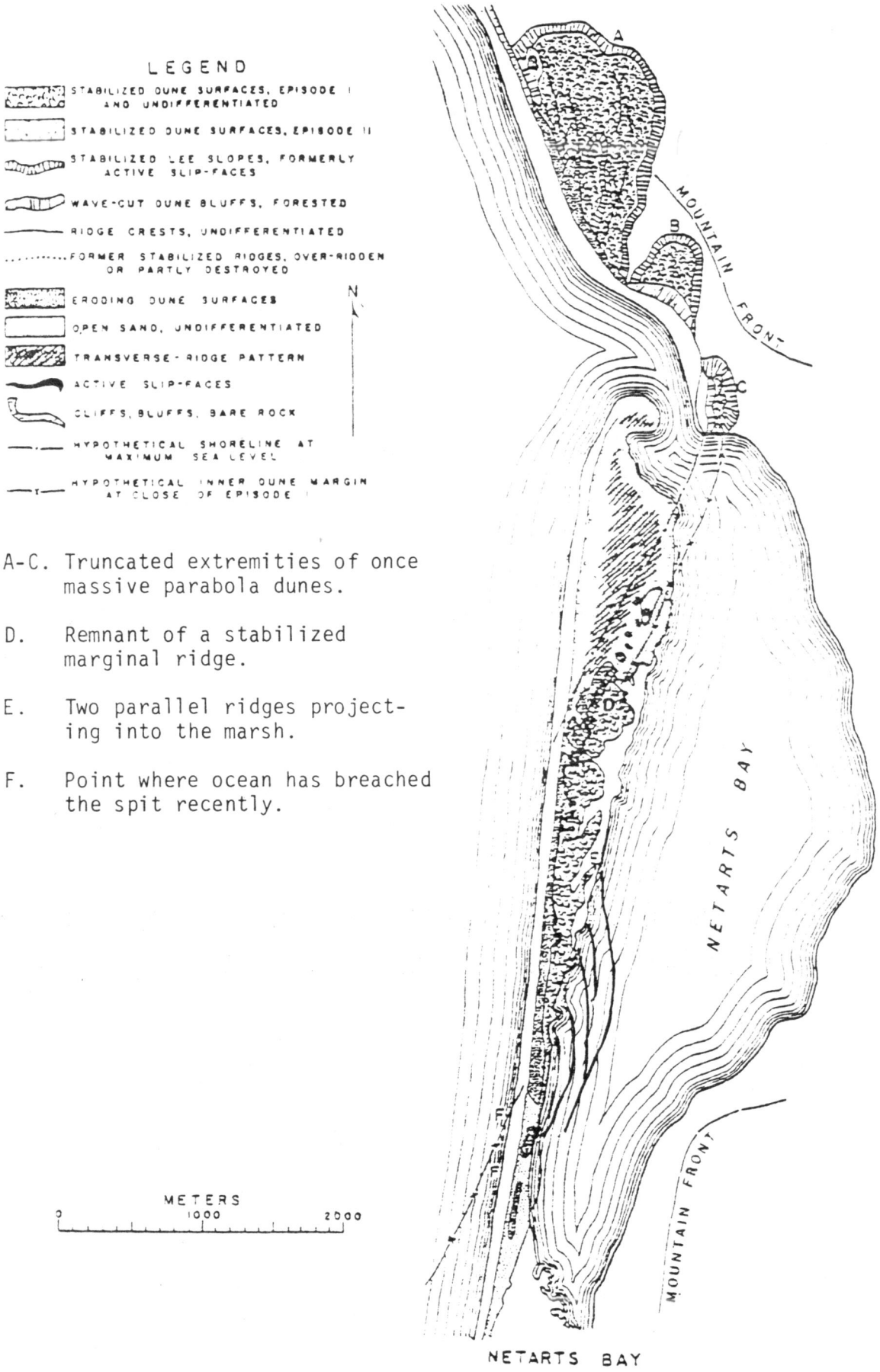
Table 2. Selected yearly average climatic data, Tillamook, Oregon

Year	Mean temp. °C	Departure from mean	High temp. °C	Low temp. °C	Total precip. cm	Departure from mean
77	10.2	0.00	31.1	- 8.9	230.2	- 0.5
76	10.3	0.11	30.0	- 8.3	158.3	-72.3
75	9.8	-0.39	33.8	- 5.5	269.0	38.3
74	10.2	0.00	34.4	-11.6	260.1	29.4

Source: U.S. Environmental Data Service Climatological Summary.

Geology and Geomorphology

Historical Geology. The Astoria Formation is a body of sedimentary sandstone about 610 m thick (Mangun 1967: 93), underlying most of the area between Cape Meares and Cape Lookout. This formation is composed of sediments derived from erosion of the Coast Range and deposited in a shallow coastal area during the early Miocene (about 25 million years ago). While the Astoria Formation was being deposited, basalts were extruded through the Astoria Formation onto the sea floor. These extrusions were contemporaneous with the basalt flows of the Columbia River Gorge area and occurred between 15 and 20 million years ago. The area was then uplifted and erosion became the dominant geomorphic process. Coastal streams



A-C. Truncated extremities of once massive parabola dunes.

D. Remnant of a stabilized marginal ridge.

E. Two parallel ridges projecting into the marsh.

F. Point where ocean has breached the spit recently.

Figure 4. Historical Geomorphology of Netarts Sand Spit, from Cooper, 1958.

cut their valleys, carrying the soft Astoria sandstones seaward, leaving the resistant basalt bodies as the headlands we now know as Cape Lookout and Cape Meares. Netarts Bay, occupies a shallow eroded basin in the Astoria Sandstone between these two headlands.

The sand spit was formed by a combination of marine and aeolian processes. Waves meeting the shoreline, deposited sand derived from continental glacial outwash which is piled and sculptured by the wind (Mangun 1967). Cooper (1958) has shown that Netarts spit is the eroded remnant of a large parabola dune complex which developed while the shoreline was considerablly west of its present position (Figure 4). The northeast-trending dunes now prominent features of the spit, were marginal to a group of large parabola dunes, the terminal remnants of which are on the mainland between Netarts and Oceanside (Figure 4). It is quite possible that Netarts Bay was a freshwater lake at that time, and it is likely that its outlet, if one existed at all, was at the south end of the embayment (Cooper 1958).

After natural stabilization, this dune complex was extensively eroded by the ocean. The present outlet of the bay is probably due to a series of severe storms which breached the dunes at a weak point. The old southern outlet was subsequently closed by a barrier ridge. This southern area has been breached in this centruy, but not since 1940, and it is unlikely that it will again act as an outlet for the bay since the existing one is well established and cultural stabilization of the foredune well developed (Cooper 1958).

Geomorphology. As an active dune system, the spit was composed entirely of unconsolidated mobile sand. Most of this sand has since been stabilized by vegetation of both natural and artifical origin. Only the

ocean beach and northern 1/3 of the spit are still active. Native sand-binding plants are unable to protect this area from erosion, and blowouts regularly start new movements of sand. Moreover, both bay and ocean currents are actively eroding this area. There was a 9 percent decrease in the size of the spit's head which occurred between 1939 and 1962 (Shabica et al. 1976).

The central third of the spit supports a closed forest with a dense shrubby understory. This area is considered to be permanently stabilized against aeolian erosion. This dense forest, like the more open forest to the south, is however susceptible to undercutting by the ocean during intense storms. Such undercutting can lead to a rejuvenation of aeolian erosion and to possible damage of the forest through slumping and/or burial by sand. This process is presently occurring on the northwest border of the forest. Buried soil horizons can be seen on the beach side of the steep foredune bearing witness to past blowout and subsequent restabilization.

Soils and Hydrology

Soils. Forested portions of the proposed natural area are totally within the Netarts soil series. The Netarts series is found in association with moderately steep to strongly sloping stabilized dunes. Netarts soils make up most of the acreage of the older stabilized dunes (U.S.D.A., SCS 1964: 49).

> The surface is black to grayish brown, and loose to very friable. The subsoil is dark brown to reddish brown. It has very firm nodules consisting of iron-cemented sand grains and is underlain by yellowish-brown and grayish-brown, very friable fine sand.
>
> Natural drainage is excessive, runoff is very slow, and permeability is very rapid. The available water-holding capacity is very low; root penetration is deep. The hazard of wind erosion is severe. The soil is low in organic matter and fertility, and is very strongly acid. (U.S.D.A., SCS 1964: 49)

There is no description of the soils developed on the salt marshes bounding the bay.

Hydrology. The geology of an area affects the source, movement, and quantity of ground water. The entire study area is underlain by compacted sand which allows little runoff. In the solum of the dune and forest, there is considerable storage capacity in the deeper fresh/brackish water lens. There are no streams flowing onto the spit, making fog, dew, and rainfall the only sources of fresh water. There are ephermeral ponds found within the dune complex that come and go with the shifting sand and changing season.

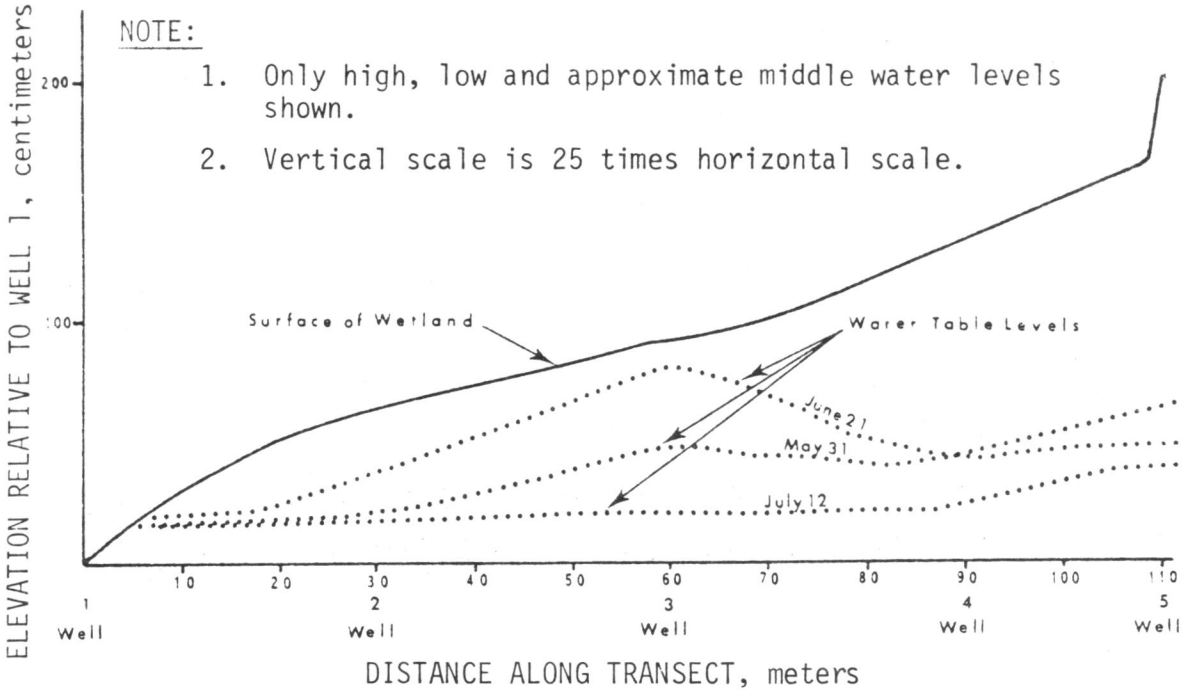


Figure 5. Relative water table profiles for three dates in 1978 along a transect in a low sand marsh, Netarts Sandspit (Source: Lewis and Liverman 1979).

Among several studies currently underway on Netarts Sandspit salt marshes, is an investigation of the soil moisture and water table regime in the marsh (Lewis and Liverman 1979). A freshwater lens is perched above the more

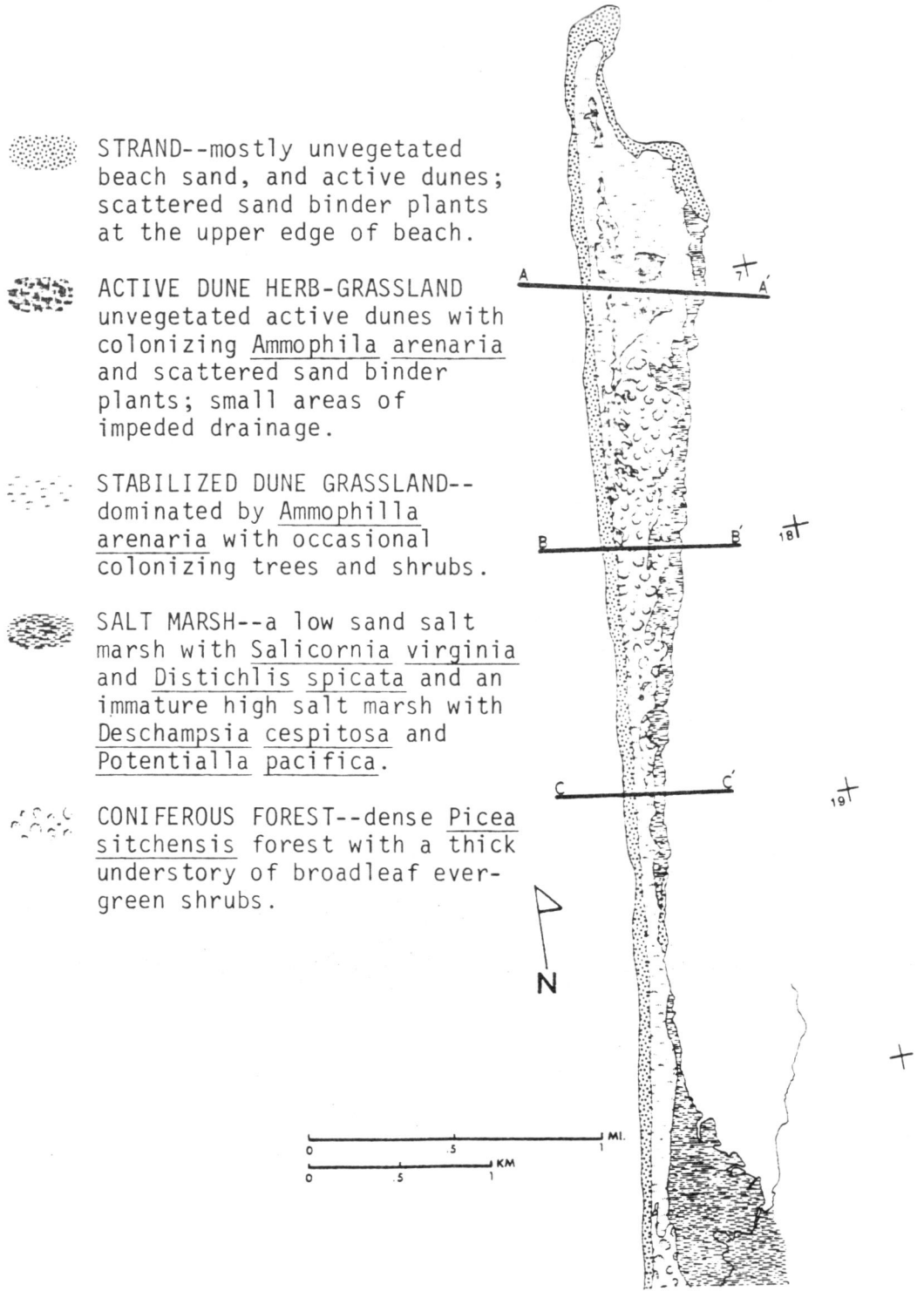


Figure 6. Vegetation, Netarts Sand Spit area.

dense estuarine saline water. The relative change in water table with reference to, and with distance from, the outer edge of the marsh (well 1) to the upper edge of the marsh (well 5) is shown in Figure 5 for three dates in 1978. The higher water table on June 21 followed a period of precipitation. The July 12 level followed a period without precipitation. The water table was continuously at, or above, the sand/mud flat surface at well 1. The water table reached close to the surface at the middle marsh position (60 m), possibly being depressed at the lower marsh position by impermeable substrate. The same pattern shown in Figure 5 was observed along two other transects.

Vegetation and Flora

Reflecting an extremely dynamic physical environment, the vegetation of Netarts Sand Spit can only be characterized momentarily. Inspection of the 1939 air photographs of the spit reveals extensive stretches of strand vegetation which today is a stabilized dune. Within Franklin and Dyrness' (1973) Picea sitchensis Zone, the spit embraces five broad physiognomic vegetation types: (1) strand; (2) unstabilized dune herb-grassland; (3) a stabilized dune grassland; (4) salt marsh; and (5) coniferous forest (Figure 6). Of these, the salt marsh and coniferous forest are the most stable but even these types show variation over the time of air photo records (1939-present). Most of these types include several plant communities.

Strand vegetation. Mostly situated at the upper edge of the beach above and intermingled with storm-tossed logs and at the base of the fore-dune, strand vegetation consists of a distinct assemblage of scattered herbaceous plants. Strand species are capable of withstanding salt spray,

intense wind, wide variation in temperature, sand blast, sand burial, high moisture stress, and low soil organic matter. The physical environment is dominated by shifting sand, periodic wave attack, and continuous salt spray. Typical species of the strand vegetation which are widely spaced include:

Abronia latifolia
Ammophila arenaria
Cakile edentula var. californica
Carex macrocephala
Convolvulus soldanella
Elymus mollis
Festuca rubra
Franseria chamissonis
Glehnia leiocarpa
Lathyrus japonicus var. glaber
Lathyrus littoralis
Lupinus littoralis
Poa macrantha
Polygonum paronychia
Sanicula arctopoides
Tanacetum camphoratum
Vicia gigantea

Except for Ammophila arenaria (European beach grass) these are all native sand binders but none compare in competitive ability to the Ammophila. Approximately 48 ha (20 percent of the proposed natural area) is presently included in this vegetation type; however, most of this area is bare sand. It is anticipated that this area will remain in dynamic equilibrium. Cyclic rejuvenation occurs every few years as beach logs get rolled around. This area of disturbance is not being invaded by shrubs or forest and will not be unless sea level drops relative to the land and a new foredune is formed. No area of strand vegetation exists in Oregon's natural area system under any jurisdiction.

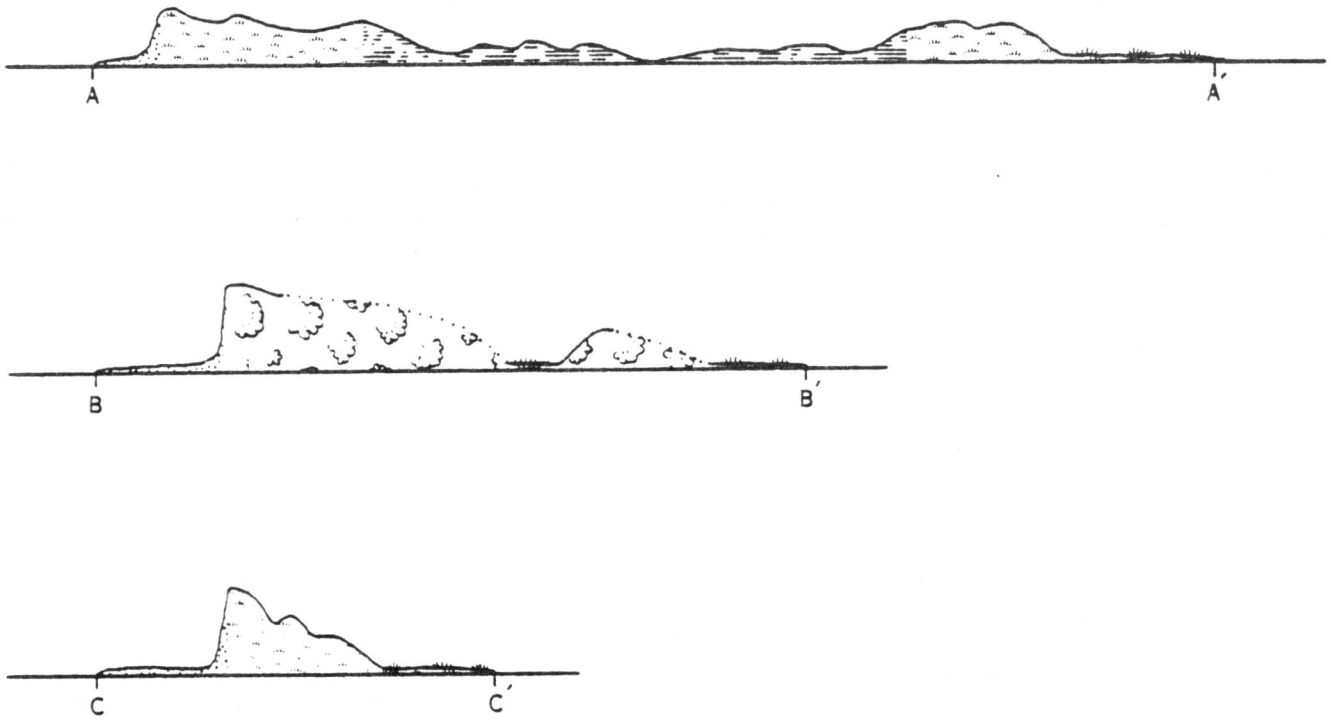
Unstabilized dune herb-grassland. Really a successional vegetation type between strand and stabilized dune, this type dominates the northern one-quarter of the sand spit and is found on a complex of recently formed transverse ridges, a fine grained pattern of dunes transverse to the wind. This vegetation type includes two distinct phases: a dry dune phase and a wet swale phase. The dry dune phase is being colonized by the same sand binders listed under the strand vegetation type with Ammophila arenaria the dominant. About 60 percent of this phase is exposed sand. The wet swale phase, with impeded drainage and winter and early spring

accumulations of water, is colonized by Juncus lesueurii, J. falcatus, Eleocharis macrostachya and a number of herbs. About 30 percent of the wet phase is unvegetated. This type is also subject to extreme seasonal change.

Stabilized dune grassland. Occupying the dominant feature of the sand spit, the foredune, this vegetation type is characterized by, and partially a creation of, Ammophila arenaria (European beach grass). A strong sand binder, European beach grass traps and builds-up the foredune system. The foredune, could also be an erosional artifact of the partial destruction of a once larger parabola dune projected as having existed in this area by Cooper (1958). Interspersed in this predominantly tall grassland are other sand binders including Lathyrus japonicus, L. littoralis, and Lupinus littoralis. Isolated individuals of Picea sitchensis, Pinus contorta, Rosa nutkana and Vaccinium ovatum are found scattered within this grassland, evidence of an early successional stage. Much bracken fern (Pteridium aquilinum) is present.

There is little exposed sand in this type and when exposed, as with pedestrian paths and vehicular tracks, the scarred area is subject to deflation. Introduction of two other alien species, Cytisus scoparius (Scotch broom) and Senecio jacobea (tansy ragwort) poses a possible short-term threat to this grassland. But, given thirty to fifty years, much of the dune grassland will succeed to forest unless storms reinitiate the dune development. The stabilized dune grassland must be viewed as an artificial vegetation element due to the preponderance of alien species. However, this vegetation type is widespread along Oregon's coast (Wiedemann et al. 1969, Wiedemann 1966, Dicken 1961) and is also presently unrepresented in Oregon's natural area system.

In low protected pockets east of the stabilized foredune is another phase of grassland dominated by Deschampsia cespitosa and Calamagrostis nutkaensis. This tall grassland, often a meter or more in height, occupies



LEGEND

Strand

Stabilized Dunes

Active Dunes

Coniferous Forest

Salt marsh

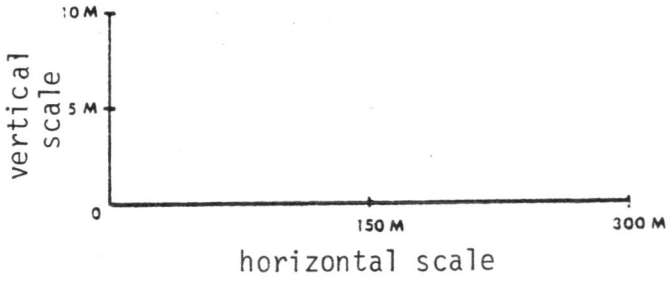


Figure 7. Schematic diagrams of selected transects across Netarts Sand Spit. Transect positions correspond to Figure 6.

wetter areas and had been a source of hay for homesteaders. This wet grassland grades into the adjacent high salt marsh.

Salt marsh. Fringing the eastern margin of the sand spit is a band of marsh which has been classified by Jefferson (1975) into two salt marsh types: Low Sand Marsh and Immature High Marsh.

The Low Sand Marsh is found east of areas of somewhat lower sand dunes and receives blown sand from the dune system to the west. This type gradually grades into the estuarine sand tidal flat which is exposed at low tide. At its outer margin, colonizing the sand tidal flat, is a sparse stand of Scirpus americanus. A broad band of low closely vegetated salt marsh succeeds the open colonizing fringe, and is dominated in various combinations by Salicornia virginica, Distichlis spicata, and Jaumea carnosa. At its upper edge, are found scattered clumps of Deschampsia cespitosa and Grindelia integrifolia. The limits of the Low Sand Marsh are often delineated by a thin ribbon of Elymus mollis. Frenkel et al. (1978) have described this marsh in greater detail. No area of Low Sand Marsh is presently protected in Oregon's Natural Area System.

Distinctively different is the Immature High Marsh, a type found east of the forested foredune. The high marsh is marked by an abrupt step, varying from 40 to 120 cm between the estuarine sand flat and the high marsh. Usually, the Immature High Marsh does not have a grading colonizing fringe. The high marsh is dominated by Deschampsia cespitosa, Potentilla pacifica, and Aster subspicatus with Juncus lesueurii and Trifolium wormskjoldii marking its upper edge. Often there is an abrupt change in slope from the high marsh to the upland characterized by coniferous forest (Figure 7).

Frenkel et al. (1978) studied the plant community relationships in the Netarts salt marsh with respect to tide levels (Appendix I). The Low Sand Marsh lower edge is flooded by moderate tides (2.1 m (7 ft)) while the high marsh is only innundated by high tides (2.6 m (8.5 ft)). Both types have ribbons of stranded Zostera marina (eel grass) which flourishes in the shallow estuary and is washed-up by tidal action. The decaying mats of Zostera may lead to shallow depressions in the marsh which, in a few cases, turn into small ponds.

Coniferous forest. Occupying approximately 45 ha (18 percent of the preserve area), the coniferous forest clothes and stabilizes the foredune and is found in the center part of the preserve area (Figure 6). Dominated by Picea sitchensis of relatively low stature and structurally modified by wind and salt spray, the forest is exceedingly dense. Other important trees include Pinus contorta, Myrica californica, and Tsuga heterophylla. Given the exposed position of Netarts Sand Spit, it is expected that Picea forest is the potential natural vegetation for the spit. The forest was estimated to be about 50 years old (Shabica et al. 1976).

The understory of coniferous forest is marked by dense thickets of Gaultheria shallon, Vaccinium ovatum, and Rosa nutkana. Where the conifers are most dense, the deeply shaded forest floor is clear of vegetation. At the edge of the forest or where the trees are less dense, shrub vegetation becomes impenetrable. There was little evidence of recent fire in this forest but the build-up of fuels was considerable. The recency of the forest probably related to the impact of wind and wave action on the spit; and although we may consider the eventual stabilization of the spit by Sitka spruce forest, the possibility of wave erosion of this spit will continue to exist.

Flora. Selected plant species together with the vegetation type in which they occur are shown in Appendix II. As might be expected with a coastal sand spit habitat, there are few plant species which might be regarded as rare, threatened, or endangered. An exception to this was the observation of Cordylanthus maritimum ssp. palustris, an annual of rare distribution in California in low salt marshes and with only one known Oregon location in a Low Sand Marsh in Coos Bay. This species was observed during the summer of 1977 as a small population in a low marsh plant community toward the middle of the sand spit. This is the most northern distribution known for this species which is listed by Siddall (1977) in a "provisional list of the rare, threatened, and endangered plants of Oregon". The species was also listed as "threatened" in the "Review of status of vascular plants and determination of 'criticial habitat'" (Federal Register 40(127), Tuesday, July 1, 1975). The following two seasons, the, the population was searched for but not found.

Stellaria humifusa, a salt marsh species, was also listed by Siddall (1977) but is now known to be widespread in salt marshes in northern Oregon and Washington. This small herb occurs in a "middle marsh" position on Netarts Sand Spit.

Faunal Features

A brief survey of the animals and their habitats in the Netarts Bay area has been reported by Shabica et al. (1976). Appendix III-V lists fauna observed or expected on Netarts Sand Spit based on Shabica et al. (1976) and recently compiled by Professor Robert M. Storm, Oregon State University. Much of the following material follows Shabica et al. research as appears applicable to the sand spit. Three habitats are present in the sand spit area: salt marsh, sand spit/spruce, and sand spit/beachgrass. Each of these habitats was sampled by Shabica et al. (1976) by trapping and field observations.

Only a vagrant shrew was encountered in the salt marsh by Shabica et al. (1976), however, we noted many runways of racoons that use the marsh on the way to their estuarine fishery. We also observed black-tailed deer in the high marsh.

"The sand spit/spruce habitat contained resident populations of vagrant shrews, Townsend chipmunks, deer mice, and ermine. Dense growth of salal and Sitka spruce protected small mammals from raptorial birds, and provided abundant seeds and berries for herbivorous species.... The highest number of deer mice in any habitat were trapped in this area.... Racoons, blackbears, and black-tailed deer were seen on the periphery of the sand spit forest" (Shabica et al. 1976:151).

In the sand spit/beachgrass habitat, vagrant shrew and deer mice were noted and in the lower areas, Townsend voles. Black-tailed deer and racoons were also abundant.

The bird life of Netarts Bay has been studied at least since 1901 (Shabica et al. 1976). Many studies and collections have been made since then. The Bay has long been a center for bird observation and it is difficult to separate this aquatic habitat from the adjacent sand spit.

Shabica et al. (1976) recorded 41 bird species on the bay during the summer, 1975 census. Late August represented the peak for bird species except for gulls. Gulls, (both western, glaucous-winged, ring-billed, and California), were the dominant genus. Double-crested cormorants, great blue herons, common crows, mallards, semipalmated plovers, and barn swallows were the most common species in addition to numerous small shore birds.

Great blue herons are obvious residents, often seen on the bay. Shabica et al. (1976: 160) noted that "often more than 150 herons were observed on

the bay, and on one census 246 herons were counted." That the heron use the spruce forest as a roosting area is evidenced by white dung deposits on many trees and shrubs. A heron rookery has been reported from the spit (personal communication with Wayne Rifer (TNC)). A bird list appears in Appendix IV.

The productivity of the bay, lack of human disturbance, presence of intact adjacent habitats, abundance of food (including marine sources and eel grass) contributes to the abundant bird life.

Educational and Scientific Values

The proposed natural area potentially has numerous educational and scientific values. The salt marsh in particular has already been a site of scientific study, primarily because of its pristine condition. Although some archaeological work including an excavation has been conducted on the spit, Newman (1959), the potential for further study is great. The coastal dune mosaic of at least four dune types and their associated ecosystems presents an excellent opportunity to study the relationships of these systems within a close and undisturbed area. Questions concerning the morphology and development of the sand spit have not been addressed since Cooper (1958). Both the student and the scientist can find many benefits in studying an area with the knowledge that the site is to remain in its natural state, to be effected only by the action of nature. The area's relative robustness due to its size and linearity permits accomodation of sizeable (20-30 person) educational groups for outside field observational activities.

There should be no conflict between the educational and scientific use of this area and the dominant recreational use of the park. In fact, the research at the spit should substantially benefit park management by serving as a location for research on naturally stabilized dunes and aid in park interpretive programs.

Historic and Contemporary Resource Use

Historic Use

Aboriginal History. The Netarts area was occupied by a tribe known as the Tillamook (Killamuck, Kilenook, Calonex, and 48 other variations!) Indians. The Tillamooks were coastal representatives of a large linguistic family called the Salish which occupied much of Washington, Idaho, Western Montana, and British Columbia. Tillamook territory was bounded by the Pacific and the Coast Range summit, and extended from Tillamook Head in the north to the Nestucca River area in the south.

As hunters and gatherers, these people lived in well established villages with dwellings of cedar planks, bark, and soil. Their diet, especially in the Netarts Bay settlements, relied heavily on shell fish and salmon.

The pre-European (prior to 1775) population of the Tillamook Indians is estimated at over 2000. As is especially typical of tribes who were friendly to the white man, the Tillamook Tribe was ravaged by disease shortly after first contact. Smallpox and syphilis ran rampant through the settlements, and by 1851 the total Tillamook population was estimated to be 88. The last of the "pre-treaty" Tillamook died before 1900. It is estimated that 200 to 300 demonstrated decendants of the Tillamook are alive today (Taylor 1974). Newman (1959) has excavated a village site on the spit.

European Settlement History. The first formal survey of the Netarts Bay area was conducted by a government team in 1856. The Homestead Act was passed in 1862, and the first settlers arrived in 1865. The first areas to be claimed were the tide lands along the eastern shore of the bay. These areas were desirable because they provided access to salmon

and oysters in the bay, and because the marshes could be managed for grazing and the production of marsh hay. Dikes and tide gates were constructed in some of the marshes to increase their agricultural value.

The seemingly inhospitable sand spit supported its first white settlers prior to 1880, and virtually all of the shore line was claimed and occupied by 1903. Transportation on the spit was by trail to the south across Cape Lookout, and by ferry across the mouth of the bay to the mainland (Shabica et al. 1976:179).

In addition to grazing, oysters and salmon provided income for the settlers. Native oysters were so plentiful that a small industry developed to ship oysters to San Francisco. The accidental introduction of Japanese oyster drill (Ocenebra japonica) in 1957 effectively ended the oyster export industry (Shabica et al. 1976:185).

Residential use of the spit declined rather quickly and had mostly disappeared by about 1920. Development since that time has concentrated on the northeast shore of the bay around the settlement of Netarts. Residential growth of the Netarts area has accelerated rapidly in the last 10 years, and with the popularity of second homes and recreational land investments, it does not appear that this trend will be reversed in the near future. Lack of water in the area is such that little development outside the community of Netarts is expected. Netarts has a sewage treatment facility which is to be constructed in the near future and which will, also tend to concentrate development within the community. The Tillamook County Comprehensive Plan is in the draft stage but the intended growth boundary for the community of Netarts will correspond closely with the proposed boundary of the Netarts sewage system.

Cape Lookout State Park - Acquisition and Development. First acquisition of land for Cape Lookout State Park was a gift from the U.S. Lighthouse Service on September 3, 1937, of 975 acres (395 ha). Eleven additional tracts were purchased between 1935 and 1965. The most recent acquisition was 28 acres (11 ha), acquired in 1977. Sand dune stabilization by planting European beach grass started in November, 1951, extending over a period of several years. Park improvements began early in 1952 by constructing a road into the area, a caretakers cottage, a large car parking area, a day-use camp with a water and sanitary facilities, bathhouse and a large overnight camp. Dedication of the park took place on September 23, 1954 (Armstrong 1965).

Contemporary Use: Recreational

Since the dedication, many persons have visited the park to see the coastal forests and enjoy the sandy beach. In 1977 the 247 overnight camping sites were used by an estimated 91,000 recreationists. The park is open throughout the year for camping. The 100 unit picnic area and more than 5 miles of improved hiking trails were also enjoyed by 223,970 day visitors. Visitors to the park hike on both sides of Netarts Sand Spit but mainly on the beach side. The Oregon Coast Trail as proposed would have a portion of its length on the beach side of the spit. The trail would be marked with the trail system's logo and mileage on cedar posts. Crossing between the north tip of the spit and the community of Netarts would have to be arranged for in advance by individual using the trail. The spit is also used by clammers, beach combers, and bird watchers. Water fowl hunting, particularly Brant hunting, from boats is popular on the bay side. As the majority of Oregon Coast Trail users will travel the beach side of the spit, no conflict is seen between the establishment of the preserve and the trail. Hunting within the park boundaries is prohibited.

During the summer of 1978, the State Parks and Recreation Branch circ-

ulated questionnaires at Cape Lookout State Park for the purpose of aiding the development of the park's master plan. Protection of scenic resources, wildlife and wildlife habitat, vegetation, and archeological sites were rated very high among respondents questioned about Netarts Sand Spit. Most people responding to the question concerning the type of protection desired indicated that a "Research Natural Preserve" classification was appropriate for the area. A similar response was expressed to a student-conducted survey in 1975 (Shabica et al. 1976).

Contemporary Use: Scientific

The Environmental Protection Agency is presently conducting research on the spit concering the function of the coastal salt marsh. The purpose of the research is to study primary production, organic matter decomposition and nutrient exchange between the salt marsh and the estuary. Additional marsh studies concerning hydrology, soil and plant relationships, and plant anatomy are underway. Besides research in the natural sciences, the spit has been the site for archaeological projects.

Cape Lookout State Park in general, and Netarts Sand Spit in particular, contains substantial materials of archaeological importance. There are eight inventoried sites on the spit, both house pits and shell middens. Dr. Newman of the University of Oregon conducted some excavations on the spit in the early 1950's. Little work has been done since with the exception of an inventory. The spit is being considered for nomination to the National Register of Historic Places. Both federal and state legislation and park regulation prohibit removal or destruction of archeological artifacts unless part of an approved dig.

Economic Value

Most considerations of the economic impact of dedication as a natural area preserve are problematic; the area is already a state park and it is

protected from resource extraction or development for commercial purposes. The economic benefits to local communities and businesses, to the extent that the recreationists spend money in the local area to support their activities, will not diminish with the dedication of the proposed preserve.

Leases and Easements

No leases or easements currently affect the area recommended for preservation as a natural area. The U.S. Coast Guard had a telephone line permit along the spit south of the proposed natural area but released their permit arrangements in 1973.

Access

Land access to Netarts Sand Spit is gained by foot through the developed section of Cape Lookout State Park. Day-use visitors park in the 335 space lot south of the campground. This lot provides direct access to the beach just north of Cape Lookout. Most day-use visitors wishing to hike along the spit travel north along the beach from this area. An additional beach access point from the north end of the campground is also provided for campers.

A sandy two-track road begins at the north end of the campground. The 2.5 km road provides easy foot access to a point just south of the proposed preserve boundary. It is effectively gated against vehicular traffic. Park personnel have the key to the gate and only park vehicles or other authorized vehicles are permitted to travel this track.

The spit is also accessible on all shores by private boat, although boat landing on the bay side is considerably more common and less hazardous than ocean side approaches. Most of the private boat landings are for recreational purposes such as clamming or hunting in the bay area. Such landings are only possible during high tide, or at a very few places on the end where continually submerged channels are close to the spit during low tide.

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APPENDIX I

Salt Marsh Vegetation of Netarts Sand Spit

(Source: Frenkel et al., 1978)

In association with a comprehensive study of salt marsh vegetation in Oregon and Washington, a study site was established on Netarts Sand Spit. The format for the description of the vegetation at this site follows that incorporated into a report for 19 other sites.

Use of standard species codes is made in a number of figures in this appendix. For reference, these codes are made-up of the first two letters of the genus and the first two letters of the species and species may be determined from the list in Appendix II.

Site description. The only Low Sand Marsh studied in Oregon (two Washington marshes were Low Sand), Netarts Sand Spit marsh is located in Cape Lookout State Park on the bay-side (east) of the 10 km-long sand spit which forms the western side of one of Oregon's most intact estuaries. The study site extends over about 1 km, and is centered about 3 km north of the campground (Figure 26). Two broad types of marsh are evident along the bay-side of the spit: a Low Sand Marsh type which colonizes the low gradient sand flat and presents a gradual gradient to upland and a Mature High Marsh type which is elevated abruptly 40 to 120 cm above the sand flat. The latter type shows signs of retrogradation, while the former appears to be prograding. The two types correlate with upland characteristics. Where the sand spit dune system is low and weakly stabilized, the Low Sand Marsh prevails. Where the upland is marked by stabilizing Picea and Pinus forest the Mature High

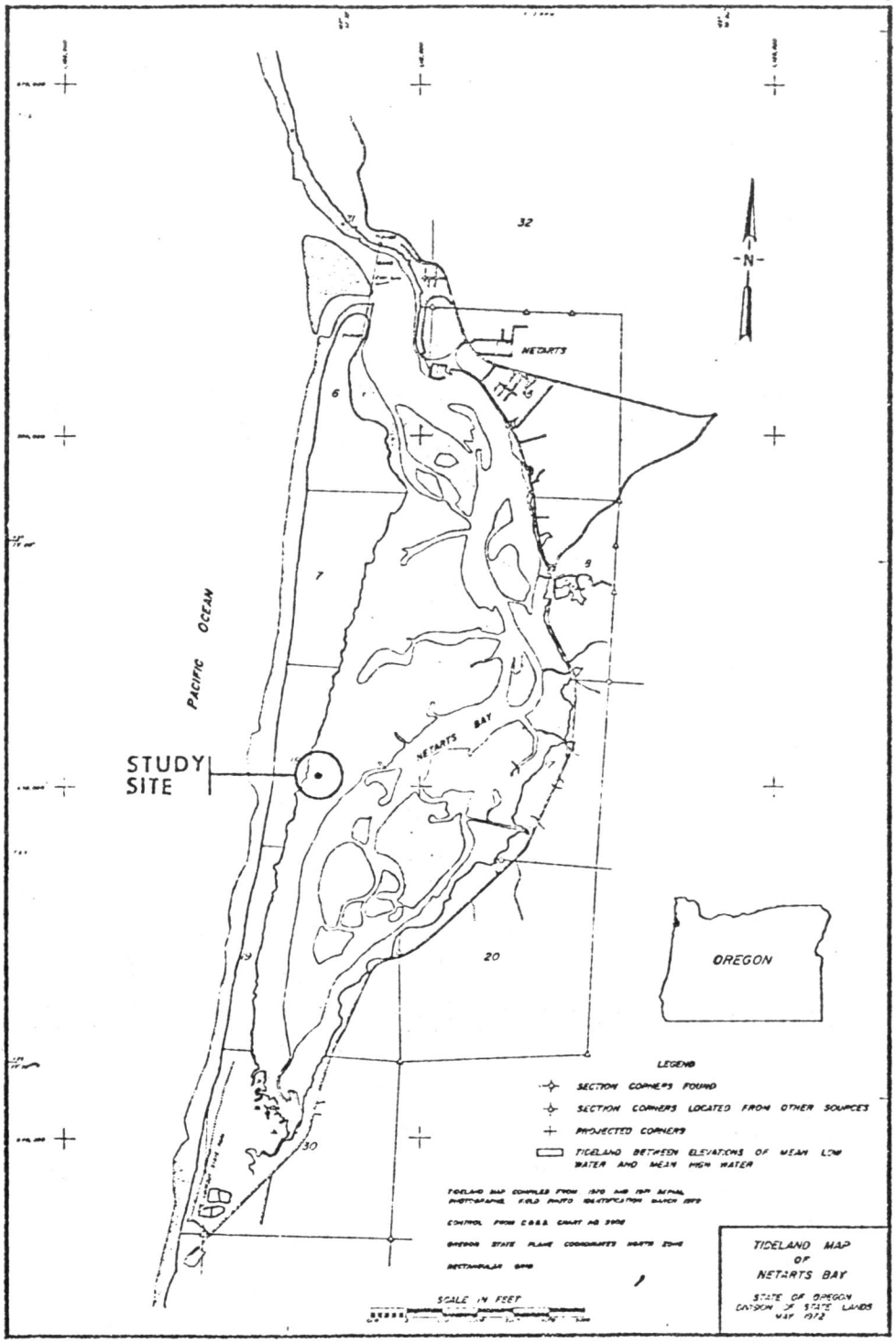


Figure 26. Location of Netarts Bay study site, NT1.

Marsh type is common. This dual type is hypothesized as being caused by historical breaching of the sand spit causing scouring of the marsh vegetation by ocean waves and the occurrence of the Low Marsh Type. Commonly colonizing the sand flat at the outer edge of the low sand marsh is Scirpus americanus, suggesting freshwater seepage. For the high marsh, freshwater seepage is suggested, in places, at the upper portion of the marsh by the presence of Carex obnupta. Jefferson (1975) recognized the two types of marsh but judged the high marsh as Immature High Marsh. From the species composition we suggest it is better classified as Mature High Marsh. Presently, intensive studies of marsh function (pers. comm. J. Gallagher), salinity variation (pers. comm. M. Liverman) and marsh plant anatomy (pers. comm. D. Seliskar) are taking place.

Both the marsh and estuary have been little disturbed. Historically homesteading has occurred on the spit and there was cattle grazing but this must have occurred at least 50 years ago. Creek development is very sparse. Drift log accumulation is slight. A very important influence on the marsh vegetation are rafts of Zostera marina which become stranded and decompose, often killing marsh vegetation. It appears that "pans" and other depressions in the lower marsh may have their origin from this phenomena.

Upland vegetation can be classed in two types: stabilized sand dunes dominated by Ammophila arenaria and stabilized sand dunes dominated by Picea sitchensis and Pinus contorta.

Plant communities. Ten transects including 155 microplots were distributed so as to fully describe the variation of marsh and marsh-upland ecotone vegetation (Figure 27). Plant community structure was relatively simple (Figure 28). Two types of low marsh communities

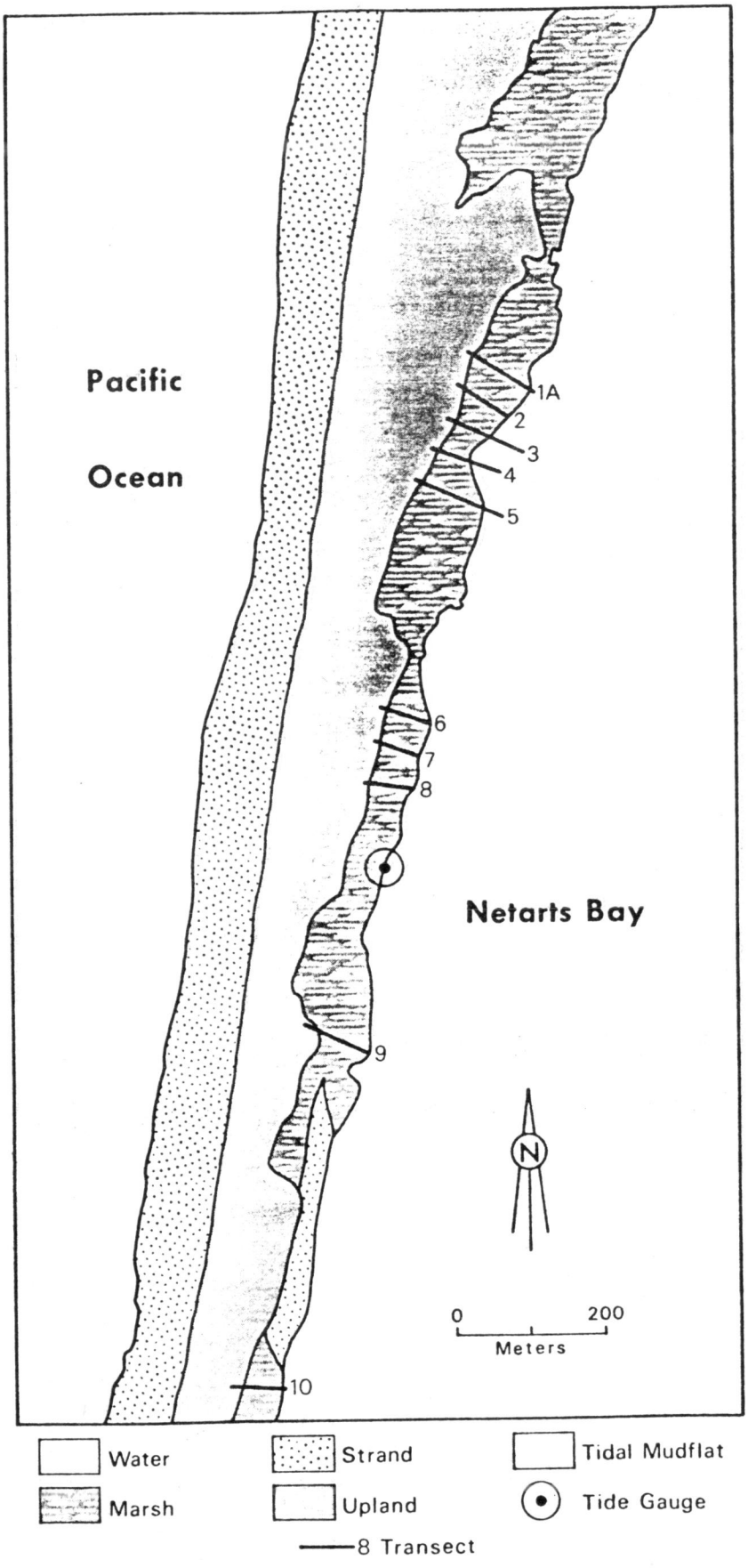


Figure 27. Netarts Sand Spit study site with approximate locations of transects.

were common: a single species community with Scirpus americanus and a more diverse community characterized by Salicornia virginica, Jaumea carnosa, and Plantago maritima. Distichlis spicata was also dominant in this community but ranged well into the upper marsh. A single type of upper marsh prevailed dominated by Deschampsia cespitosa, Potentilla pacifica, Juncus balticus and Agrostis alba. All of these upper marsh species ranged into the transition between marsh and upland. The transition zone community was marked by the entry of Juncus lesueurii, Aster subspicatus, Trifolium wormskjoldii, and Achillea millefolium. Elymus mollis was often important in identifying the transition zone, as well.

Transects and transition zone. Figures 29 to 32 illustrate typical transects with profiles across Netarts Sand Spit marsh. Transect NT1-1A typifies the transects across a high marsh as can be seen by the 1.2 m nickpoint at the outer edge where Salicornia virginica is dominant. A slight "levee" forms corresponding with dominance by Deschampsia and Atriplex. The transition zone was defined in the field by the sudden appearance of Potentilla and Elymus mollis. Upland was defined by forest and shrub species which enter at an abrupt change in slope. One transect, NT1-4, illustrates the pattern for the low sand marsh where Scirpus americanus forms a colonizing fringe followed by a low marsh community marked by Distichlis, Salicornia and Jaumea. A high marsh assemblage follows with Potentilla dominant, and a transition zone identified by the entry of Elymus mollis.

Upland vegetation was assessed along the 10 transects with 6 macroplots and 102 line segments. The tree canopy reflected the typical species found on stabilized dunes:

Figure 28. Plant community table, Netart Sand Spit study site.

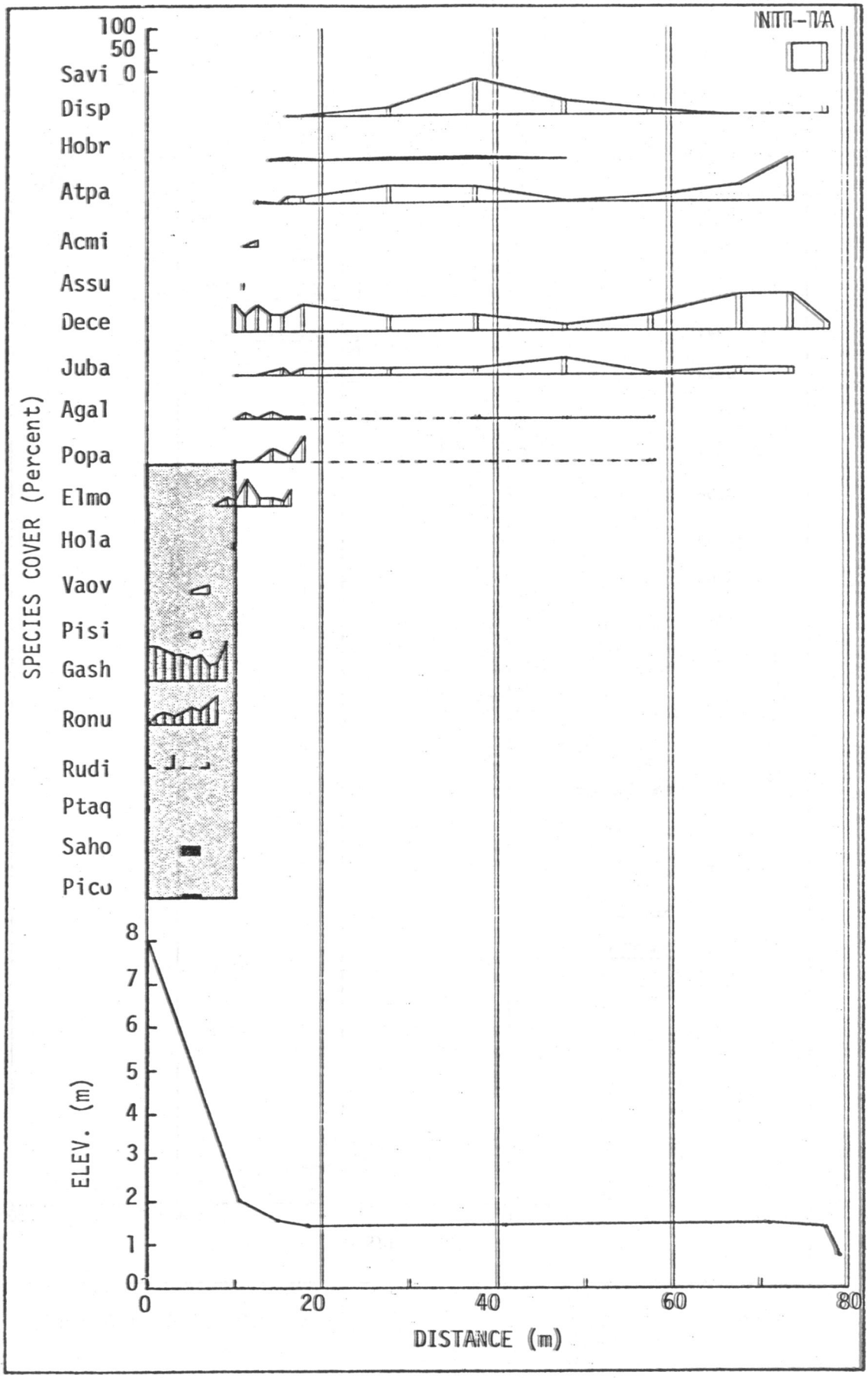


Figure 29. Plant species cover along transect NTI-1A at Netarts Sand Spit study site.

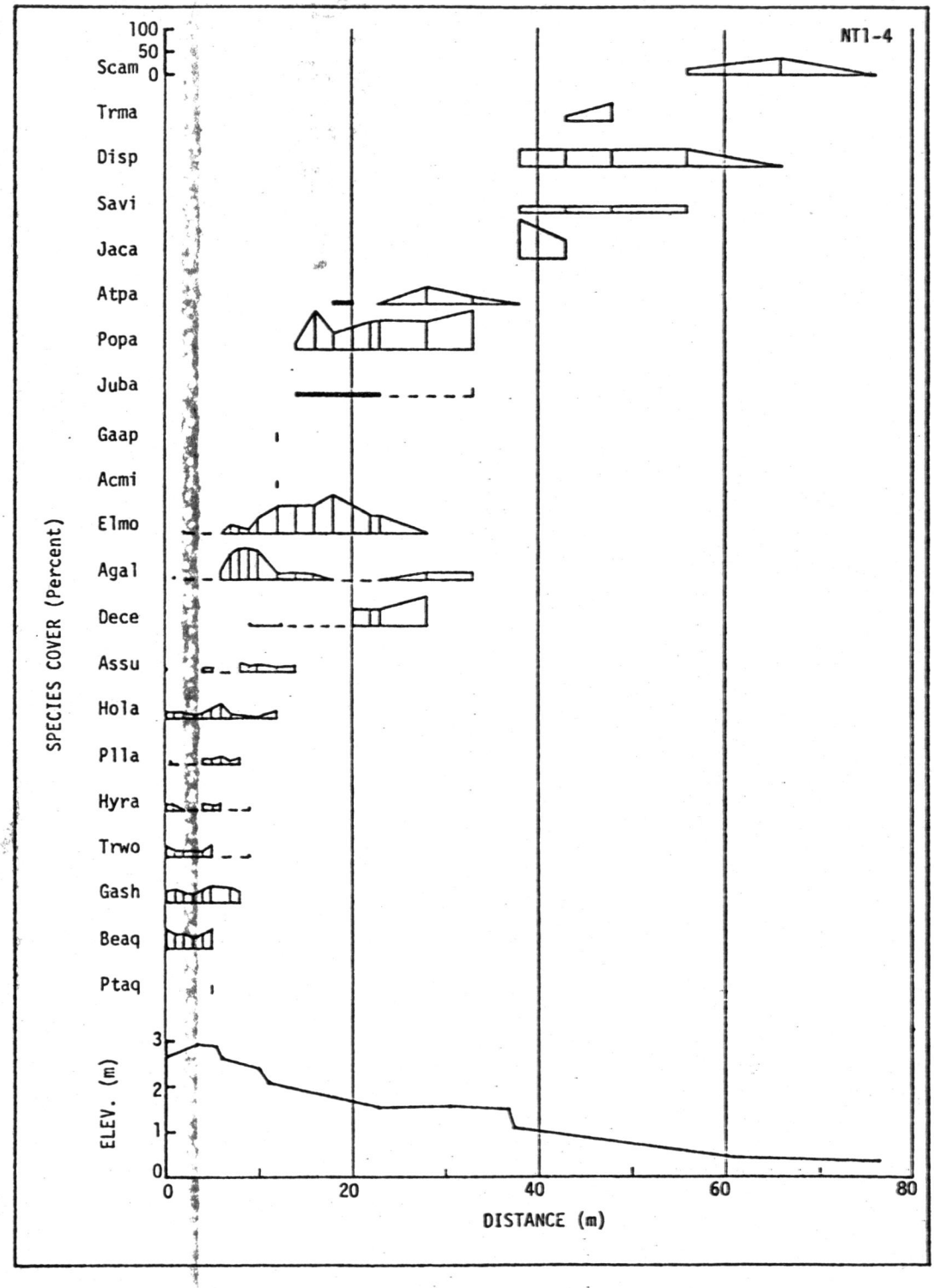


Figure 30. Plant species cover along transect NT1-4 at Netarts Sand Spit study site.

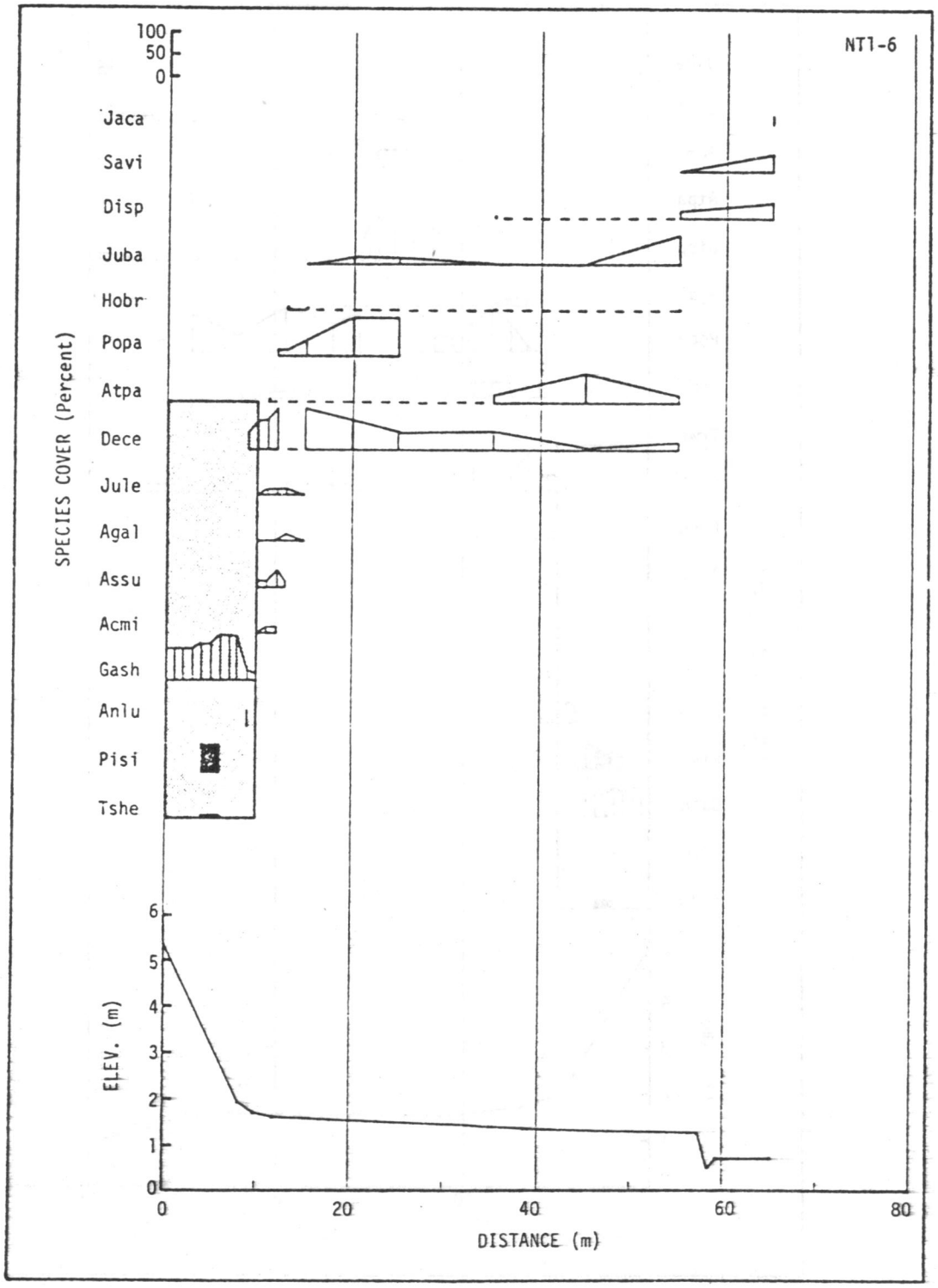


Figure 31. Plant species cover along transect NT1-6 at Netarts Sand Spit study site.

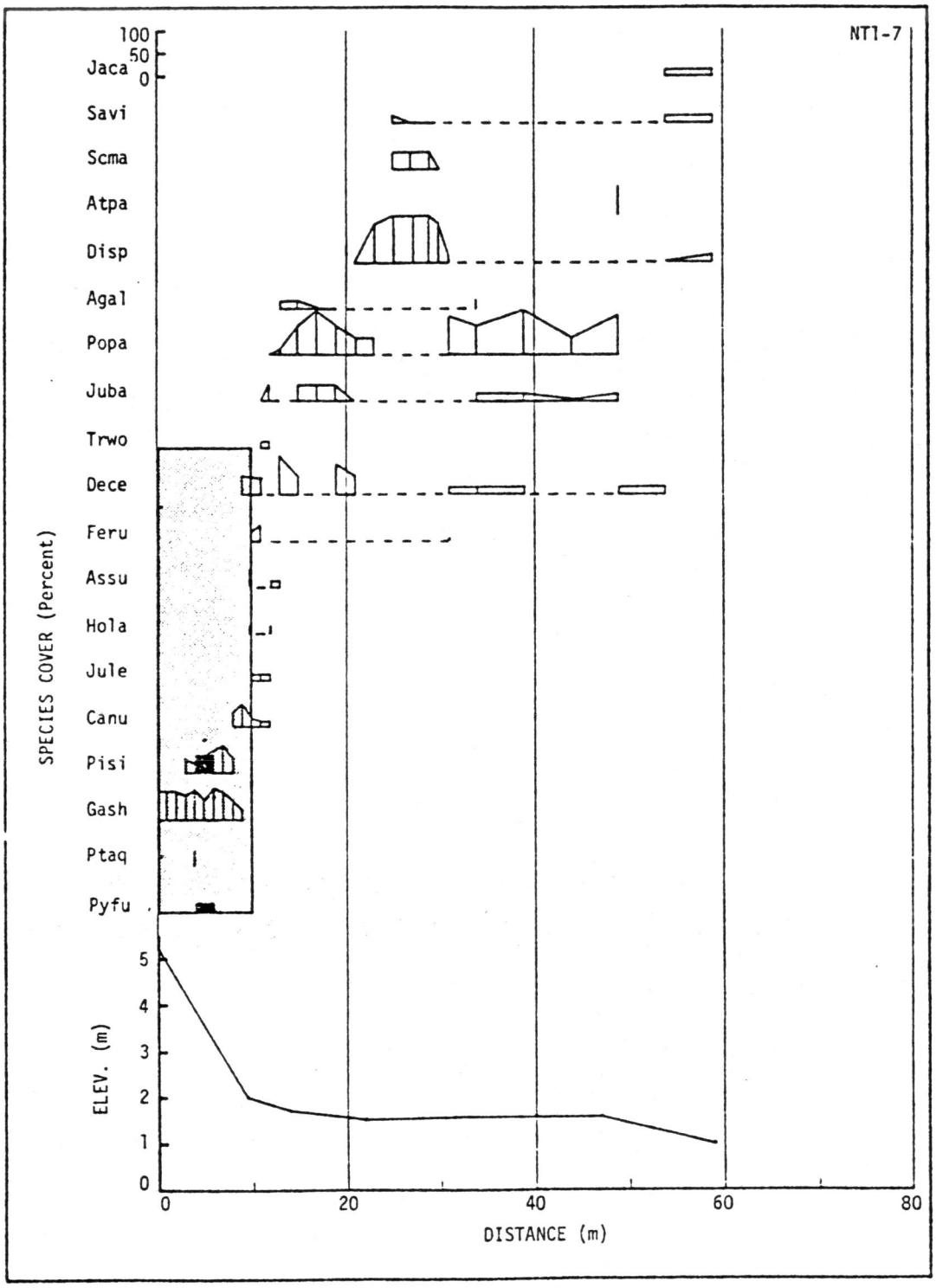


Figure 32. Plant species cover along transect NT1-7 at Netarts Sand Spit study site.

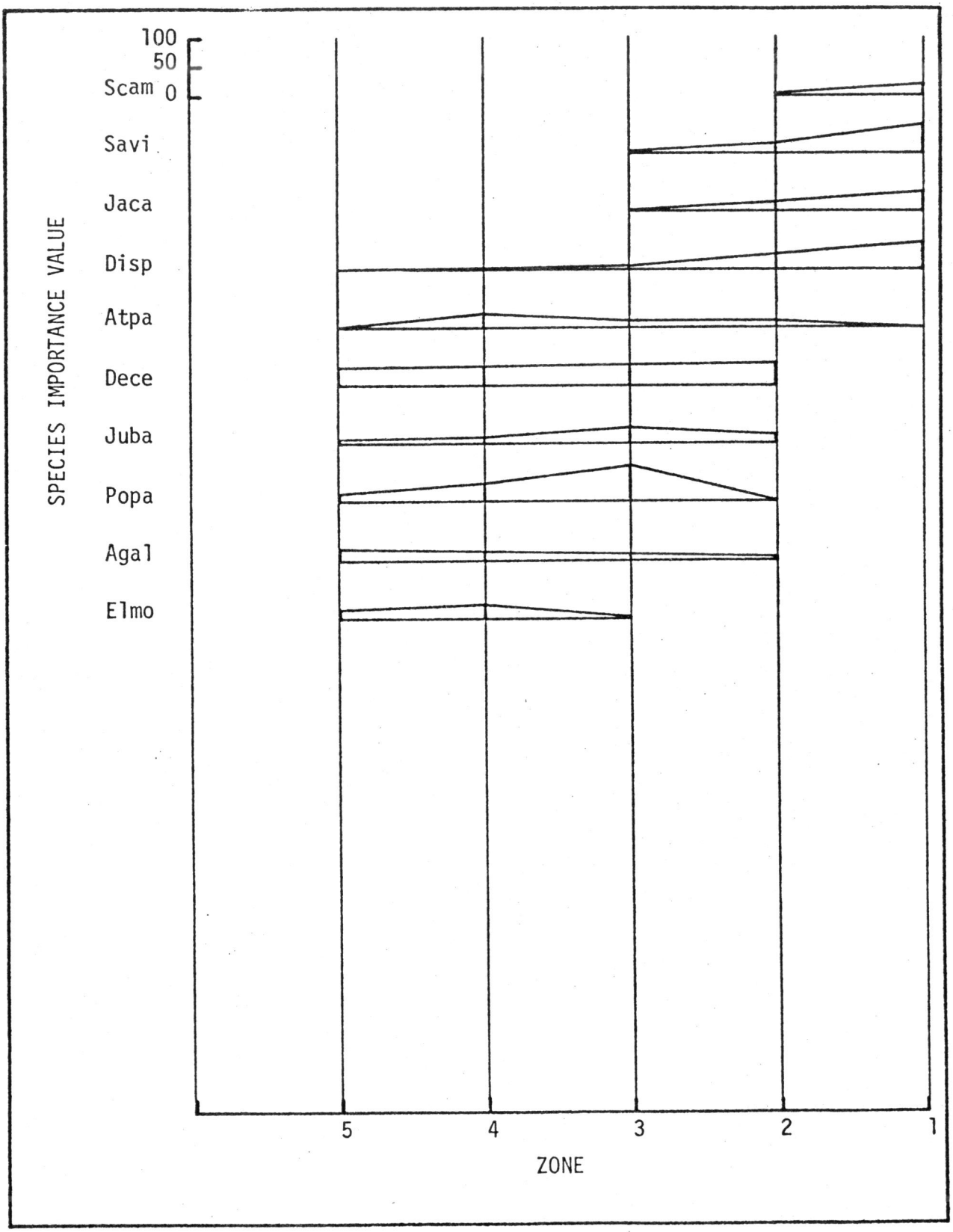
	Freq. (%)	Avg. Cover (%)	B.A. (m^2/ha)
Myrica californica	10	2	0.1
Picea sitchensis	60	19	2.8
Pinus contorta	40	5	0.5
Pyrus fusca	10	2	0.2
Salix hookeriana	20	2	0.3
Tsuga heterophylla	20	1	0.2

Understory shrub and herb vegetation reflects the two upland vegetation types mentioned earlier: open stabilized sand dune (o) and forested dunes (f) as is shown in the following roster of species with frequencies in excess of 10 percent:

	Freq. (%)	Avg. Cover (%)
(o) Agrostis alba (?)	20.6	4.0
(o) Ammophila arenaria	17.6	11.6
(o) Angelica lucida	11.8	1.9
(o) Aster subspicatus	30.4	2.3
(o) Calamagrostis nutkaensis	10.8	3.3
(o) Deschampsia cespitosa	12.7	2.6
(o) Elymus mollis	34.3	7.9
(o) Festuca rubra	16.7	2.4
(f) Gaultheria shallon	68.6	35.2
(o) Holcus lanatus	32.3	2.8
(o) Juncus lesueurii	36.3	3.0
(f) Picea sitchensis	27.4	6.3
(o/f) Pteridium aquilinum	14.7	4.1
(f) Rosa nutkana	18.6	4.8
(o) Trifolium wormskjoldii	22.5	2.3

Six transects were in forest or partially forested upland, and four were in open stabilized dunes.

Selected Species Importance Values by Zone at Netarts Sand Spit Study Site, NTl



APPENDIX II

Tentative List of Vascular Plants on Netarts Sand Spit

(Compiled by Robert E. Frenkel)

This list was prepared from collected, observed, and expected vascular plant species in the area of the sand spit. The list is most complete for the salt marsh community. Nomenclature follows Hitchcock and Cronquist (1973) but authorities have been dispensed with in preparation of the list.

S = Strand, Stablized Dunes, Active Dunes; C = Coniferous Forest; M = Salt Marsh

Scientific Name	Common Name	Occurence
Abronia latifolia	yellow sandverbena	S
Achillea millefolium	western yarrow	S
Agrostis alba	redtop	SM
Aira caryophyllea	silver hairgrass	S
Aira praecox	early hairgrass	S
Alnus rubra	red alder	C
Ammophila arenaria	European beachgrass	S
Anaphalis margaritacea	pearly everlasting	S
Angelica hendersonii	sea-coast angelica	S
Angelica lucida	sea-watch	SM
Anthoxanthum odoraturm	sweet vernal grass	S
Arctostaphylos uva-ursi	kinnikinnick	CS
Aster subspicatus	Douglas's aster	MS
Atriplex patula	common orache	M
Berberis aquifolia	Oregon grape	S
Blechnum spicant	deer fern	C
Brodiaea hyacinthina	hyacinth brodiaea	S
Bromus pacificus	Pacific brome	S
Calamagrostis nutkaensis	Pacific reedgrass	S
Cakile edentula v. californica	American sea rocket	S
Carex lyngbyei	Lyngby's sedge	M
Carex macrocephala	large-headed sedge	S
Carex obnupta	slough sedge	MCS
Cardionema ramosissima	sand mat	S
Castilleja littoralis	beach paintbrush	S
Cerastium arvense	field chickweed	S
Cirsium hallii	Hall's thistle	S
Cordylanthus maritimus v. palustris	salt marsh bird's beak	M
Cuscuta salina	salt marsh dodder	M
Cytisus scoparius	Scotch broom	S

Scientific Name	Common Name	Occurrence
Dactylis glomerata	orchard grass	S
Deschampsia cespitosa	tufted hairgrass	MS
Distichlis spicata	salt grass	M
Elecoharis macrostachya	creeping spike-rush	S
Eleocharis palustris	common spike-rush	M
Elymus glaucus	western rye grass	S
Elymus mollis	dune wildrye	SM
Epilobium franciscanum	Pacific willow herb	S
Equisetum spp.	horsetail	S
Festuca rubra	red fescue	SM
Fragaria chiloensis	coastal strawberry	S
Franseria chamissonis	silver beachweed	S
Galium aparine	cleavers	SM
Galium trifidum	small bedstraw	SM
Galium triflorum	sweet bedstraw	SM
Gaultheria shallon	salal	CS
Geranium molle	soft geranium	S
Glaux maritima	saltwort	M
Glehnia leiocarpa	beach silver-top	S
Gnaphalium purpureum	purple cudweed	S
Grindelia integrifolia	Willamette Valley gumweed	M
Heracleum lanatum	cow-parsnip	S
Holcus lanatus	common velvet grass	S
Honkenya peploides	honkenya	S
Hordeum brachyantherum	meadow barley	M
Hypochaeris radicata	spotted cats-ear	S
Jaumea carnosa	jaumea	M
Juncus balticus	Baltic rush	M
Juncus falcatus	sickle-leaved rush	S
Juncus lesueurii	salt rush	SM
Lathyrus japonicus	maritime peavine	S
Lathyrus littoralis	gray beach pea	S
Lathyrus palustris	marsh peavine	M
Lonicera involucrata	bearberry honeysuckle	CS
Lupinus littoralis	seashore lupine	S
Maianthemum dilatatum	false lily-of-the-valley	C
Marah oreganus	Oregon wild cucumber	S
Montia sibirica	western spring beauty	C
Myrica californica	Pacific wax-myrtle	C

Scientific Name	Common Name	Occurence
Oenanthe sarmentosa	Pacific water-parsley	M
Orthocarpus castillejoides	paintbrush owl-clover	M
Oxalis oregana	Oregon oxalis	C
Phleum pratense	timothy grass	S
Picea sitchensis	Sitka spruce	C
Pinus contorta	shore pine	C
Plantago lanceolata	ribwort plantain	S
Plantago maritima	seaside plantain	M
Poa macrantha	seashore blue grass	S
Polygonum paronychia	beach knotweed	S
Polystichum munitum	sword fern	C
Potentilla pacifica	Pacific silverweed	M
Prunus spp.	cherry	C
Pteridium aquilinum	bracken fern	S
Puccinellia pumila	dwarf alkaligrass	M
Pyrola aphylla	leafless pyrola	C
Pyrus fusca	western crab apple	C
Rhododendron macrophyllum	Pacific rhododendron	C
Rosa nutkana	Nootka rose	CS
Rubus spectabilis	salmonberry	C
Rubus ursinus	Pacific blackberry	C
Rumex acetosella	sheep sorrel	S
Sagina crassicaulis	stick-stemmed pearl-wort	M
Salicornia virginica	pickleweed	M
Salix hookeriana	Hooker's willow	C
Sambucus racemosa	red elderberry	C
Sanicula arctopoides	beach snake-root	S
Scirpus americanus	American bullrush	M
Scirpus maritimus	seacoast bullrush	M
Senecio jacobaea	tansy ragwort	S
Sisyrinchium californicum	golden-eyed grass	S
Solidago spathulata	sticky goldenrod	S
Spergularia canadensis	Canadian sandspurry	M
Spergularia macrotheca	beach sandspurry	M
Spiraea douglasii var. douglasii	Douglas's spiraea	S
Stellaria calycantha	northern starwort	S
Stellaria humifusa	low starwort	M
Tranacetum camphoratum	seaside tansy	S
Trifolium repens	Dutch clover	S
Trifolium wormskjoldii	springbank clover	MS
Triglochin concinnum	graceful arrow-grass	M
Triglochin maritimum	seaside arrow-grass	M
Tsuga heterophylla	western hemlock	C

Scientific Name	Common Name	Occurence
Vaccinium ovatum	evergreen huckleberry	C
Vaccinium parvifolium	red huckleberry	C
Vicia gigantea	giant vetch	S
Viola adunca	western long-spurred violet	S
Viola glabella	western yellow violet	CS
Zostera marina	eel-grass	M
Zostera nana	dwarf eel-grass	M

APPENDIX III

Amphibians and Reptiles Most Likely to Seen on Netarts Sand Spit

(Compiled by Dr. R.M. Storm)

The following list was compiled based on sitings, relationships to habitat conditions, and reported animals in Shabica *et al*. (1976). This list is preliminary.

Order	Scientific Name	Common Name
	CLASS AMPHIBIA	
Caudata	*Plethodon vehiculum*	Western redback
	Taricha granulosa	Rough-skinned newt
Anura	*Bufo boreas*	Western toad
	Hyla regilla	Pacific treefrog
	Rana aurora	Red-legged frog
	CLASS REPTILIA	
Squamata	*Gerrhononotus coeruleus*	Alligator lizard
	Thamnophis ordinoides	Northwestern garter snake
	Thamnophis sirtalis concinnus	Common garter snake

Appendix IV

Mammals Most Likely to be Seen on Netarts Sand Spit

(Compiled by Dr. R.M. Storm)

* = Probable occurence

P = Possible occurence

Order Marsupialia
Family Didelphidae

Didelphidae marsupialis. Common opossum. Near park. *

Order Insectivora
Family Soricidae

Sorex vagrans. Vagrant shrew. Throughout. *
Sorex obscurus. Dusky shrew. P
Sorex pacificus. Pacific shrew. P
Sorex trowbridgii. Trowbridge's shrew. Wooded areas. *

Family Talpidae

Neurotrichus Gibbsii. Shrew-mole. P
Scapanus orarius. Coast mole. Open areas with grass. *

Order Chiroptera
Family Vespertiliondae

Myotis lucifugus. Little brown bat. P
Myotis evotis. Long-eared myotis. P
Ephesicus fuscus. Big brown bat. P
Plecotus townsendii. Lump-nosed bat. P

Order Lagomorpha
Family Leporidae

Sylvilagus bachmani. Bush rabbit. Seen in park. *
Lepus Americanus. Snowshoe hare. In spruce-pine forest. P

Order Rodentia
Family Aplodontidae

Aplodontia rufa. Mountain beaver. Probably not enough water. P

Appendix IV (con't)
Mammals Most Likely to be Seen on Netarts Sand Spit

Family Sciuridae

Eutamias townsendii. Townsend's chipmunk. Forest and brush. *
Spermophilus beecheyi. California ground squirrel. May have invaded. P
Tamiasciurus douglasii. Chickaree. Forest. *
Glaucomys sabrinus. Northern flying squirrel. Trees may not be big enough. P

Family Cricetidae

Peromyscus maniculatus. Deer mouse. Throughout. *
Neotoma cinerea. Bushy-tailed woodrat. Wooded areas. *
Arborimus albipes. White-footed vole. Forest. P
Microtus townsendii. Townsend's vole. Grassy moist areas. P
Microtus oregoni. Creeping vole. Clearings or forest edge. P

Family Zapodidae

Zapus trinotatus. Pacific jumping mouse. Open forest. P

Family Capromyidae

Myocaster coypus. Nutria. Droppings seen on east side of spit. *

Order Carnivora
Suborder Fissipeda

Family Canidae

Canis latrans. Coyote. Tracks sighted. P

Family Ursidae

Ursus americanus. Black bear. P

Family Procyonidae

Procyon lotor. Raccoon. Many tracks. *

Family Mustelidae

Mustela frenata. Long-tailed weasel. P
Mutela vison. Mink. P
Spilogale putorius. Spotted skunk. Forest. P

Family Felidae

Lynx rufus. Bobcat. Doubtful. P

Appendix IV (con't)
Mammals Most Likely to be Seen on Netarts Sand Spit

Order Artiodactyla
Family Cervidae

Odocoileus hemionus. Mule deer. Blacktail, many tracks, Known occurence.

APPENDIX V

Birds Most Likely to be Seen on Netarts Sand Spit

(Compiled by Dr. R.M. Storm)

Not listed are any of the usual coastal water and shorebirds. M = Migrant, T = Transient.

Possible Birds of Spruce-Pine and Bush Areas

Turkey vulture (Cathartes aura)
Red-tailed hawk (Buteo jamaicensis)
Bald eagle (Haliaeetus leucocephalus) - T
Marsh hawk (Circus cyaneus) - T
Peregrine falcon (Falco peregrinus) - M
Blue grouse (Dendragapus obsucrus)
Band-tailed pigeon (Columba fasciata)
Screech owl (Otus asio)
Great horned owl (Bubo virginianus)
Rufus hummingbird (Selasphorus rufus)
Red-shafted flicker (Colaptes cafer)
Pileated woodpecker (Dryocopus pileatus) - T
Yellow-Bellied sapsucker (Sphyrapicus varius)
Hairy woodpecker (Dendrocopos villosus)
Downy woodpecker (Dendrocopos pubescens)
Flycatchers (Empidonax sp.)
Western woodpewee (Contopus sordidulus)
Olive-sided flycatcher (Nuttallornis borealis)
Violet-green swallow (Tachycineta thalassina)
Tree swallow (Iridoprocne bicolor)
Gray Jay (Perisoreus canadensis)
Steller's Jay (Cyanocitta stelleri)
Common raven (Corvus corax)
Northwestern crow (Corvus carurinus)
Black-capped chickadee (Parus atricapillus)
Chestnut-backed chickadee (Parus rufescens)
Common Bushtit (Psaltriparus minimus)
Red-breasted nuthatch (Sitta canadensis)
Brown creeper (Certhia familiaris)
Wrentit (Chamaea fasciata)
Winter wren (Troglodytes troglodytes)
Bewick's wren (Thryomanes bewickii)
Robin (Turdus migratorius)
Varied thrush (Ixoreus naevius) - M
Hermit thrush (Hylocichla guttata) - M
Swainson's thrush (Hylocichla ustulata)

Townsend's solitaire (Myadestes townsendi) - T
Golden-crowned kinglet (Regulus satrapa)
Ruby-crowned kinglet (Regulus calendula)
Cedar waxwing (Bombycilla cedrorum)
Starling (Sturnus vulgaris)
Hutton's vireo (Vireo atricappilla)
Warbling vireo (Vireo gilvus)
Orange-crowed warbler (Vermivora celata)
Nashville warbler (Vermivora ruficapilla)
Yellow warbler (Dendroica petechia) - M
Black-throated warbler (Dendroica nigreslens) - M
Townsend's warbler (Dendroica townsendii) - M
Hermit warbler (Dendroica occidentalis)
MacGillivray's warbler (Oporornis tolmiei)
Wilson's warbler (Wilsonia pusilla)
Brewers blackbird (Euphagus cyanocephalus)
Brown-headed cowbird (Molothrus ater)
Western tanger (Piranga ludoviciana)
Evening grossbeak (Hesperiphona vespertina) - T
Purple finch (Carpodacus purpureus)
Pine siskin (Spinus pinus)
Common goldfinch (Spinus tristis)
Red crossbill (Loxia curvirostra) - T
Rufous-sided towhee (Pipilo erythrophthalmus)
Gray-headed junco (Junco caniceps)
Chipping sparrow (Spizella passerina)
White-crowned sparrow (Zonotrichia leucophrys)
Golden-crowned sparrow (Zonotrichia atricapilla) - M
Fox sparrow (Passerella iliaca) - M
Lincoln's sparrow (Melospiza lincolnii)
Song sparrow (Melospiza melodia

Possible Birds of Open Grassland and Marsh Areas

Mallard (Anas platyrhynchos)
Marsh hawk (Circus cyaneus)
Sora (Porzana carolina)
American Coot (Fulica americana)
Common Snipe (Capella gallinago)
Short-eared owl (Asio flammeus)
Belted kingfisher (Megaceryle alcyon) - T
Barn swallow (Hirundo rustica)
Long-billed marsh wren (Telmatodytes palustris)
Western bluebird (Sialia mexicana)
Yellowthroat (Geothlypis trichas)
Western meadowlard (Sturnella neglecta)
Red-winged blackbird (Agelaius phoeniceus)
Savannah sparrow (Passerculus sandwichensis)
Vesper sparrow (Pooecetes gramineus)

GOALS OF THE OREGON NATURAL AREA SYSTEM[1/]

1. All public lands and waters within the state that constitute natural areas are subject to alteration by human activities unless such public lands and waters are preserved and protected for the use and benefit of the people of this state.

2. Natural areas are valuable to the people of this state for educational and scientific uses, for habitats for plant, animal and marine species, for the preservation of the paleontological resources and the natural historic features of such public lands and waters, for public benefits from the features of such public lands and waters and for the purpose of preserving such public lands and waters as living museums of the natural heritage of this state.

3. It is the public policy of the State of Oregon to secure for the people of this state the benefits of an enduring resource of natural areas by establishing a system of natural area preserves and by providing for the management and protection of such natural area preserves.

GOALS OF NATURAL AREA PRESERVES ADVISORY COMMITTEE

1. Cooperate in developing a coordinated program of preserving representative samples of Oregon's typical and unique ecosystem types or natural features by dedicating natural area preserves on public lands.

2. Provide educational and research opportunities in Oregon through access to natural area preserves as basic resources.

3. Compile and periodically update a comprehensive list of natural area locations in Oregon, and maintain a list of natural area preserves needs.

4. Assure perpetual protection to dedicated natural area preserves and maintain preserves in as nearly a natural condition as possible.

5. Encourage the establishment of natural area preserves on qualified areas that appropriate local governments, resource agencies or citizens recommend to the State Land Board and advisory committee.

6. Recommend natural area preserves in suitable locations throughout the state, including those within and near Oregon's population centers.

7. Publish and disseminate appropriate information about natural area preserves.

[1/] Goals taken from Natural Area Statute, ORS 273.567.