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A System Of Classifying & Identifying Oregon's Coastal Beaches & Dunes

Oregon Coastal Zone Management Association, Inc.

Oregon Coastal Zone Management Association

This report was prepared as part of a larger document addressing various beach and dune planning and management considerations and techniques. Other segments of the document and additional materials are:

I. BACKGROUND ON BEACH AND DUNE PLANNING:

Background of the Study

An Introduction to Beach and Dune Physical and Biological Processes

Beach and Dune Planning and Management on the Oregon Coast: A Summary of the State-of-the-Arts

II. BEACH AND DUNE IDENTIFICATION:

A System of Classifying and Identifying Oregon's Coastal Beaches and Dunes

III. PHYSICAL AND BIOLOGICAL CONSIDERATIONS:

Physical Processes and Geologic Hazards on the Oregon Coast

Critical Species and Habitats of Oregon's Coastal Beaches and Dunes

IV. MANAGEMENT CONSIDERATIONS:

Dune Groundwater Planning and Management Considerations for the Oregon Coast

Off-road Vehicle Planning and Management on the Oregon Coast

Sand Removal Planning and Management Considerations for the Oregon Coast

Oregon's Coastal Beaches and Dunes: Uses, Impacts and Management Considerations

Dune Stabilization and Restoration: Methods and Criteria

V. IMPLEMENTATION TECHNIQUES:

Beach and Dune Implementation Techniques: Findings-of-Fact

Beach and Dune Implementation Techniques: Site Investigation Reports

*Beach and Dune Implementation Techniques: Model Ordinances**

VI. ANNOTATED BIBLIOGRAPHY:

Beach and Dune Planning and Management: An Annotated Bibliography

VII. EDUCATIONAL MATERIALS:

Slide show: *Managing Oregon's Beaches and Dunes*

Brochure: *Planning and Managing Oregon's Coastal Beaches and Dunes*

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A SYSTEM OF CLASSIFYING AND IDENTIFYING OREGON'S COASTAL BEACHES AND DUNES

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PREFACE

The following report presents the results of an in-depth analysis of beach and dune identification and classification systems conducted by the Oregon Coastal Zone Management Association, Inc. This report constitutes one element of an overall analysis of planning for and managing beaches and dunes as required by Oregon's Beaches and Dunes Goal.

This report was prepared by Christianna Crook, OCZMA Beaches and Dunes Study Team Research Associate, with assistance from other Study Team members composed of Carl Lindberg, Project Director, Wilbur Ternyik, Project Coordinator, Arlys Bernard, Project Secretary, and Kathy Fitzpatrick, Project Administrator.

In addition, valuable review and comments were made by the Beaches and Dunes Steering Committee composed of:

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Bill Burley, Program Biologist, The Oregon Natural Heritage Program of the Nature Conservancy
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I. INTRODUCTION

Beaches and dunes are found on those accumulations of sand which occur intermittently along the Oregon coast. They range in size from small pocket beaches between headlands to expansive dune sheets more than twenty miles long and three to four miles wide. Varying combinations of physical factors (e.g. wind, vegetation, and moisture, etc.) are capable of producing widely diverse beach and dune landforms. Each landform exhibits discrete physical capabilities as well as characteristic sensitivies to man's activities.

Dune forms exhibit varying states of stability. Areas of *open sand* occur where dune topography is controlled only by sand and wind. Lightly vegetated areas are considered to be in an *active* state and are continuously subject to erosion and accretion. Dunes are *conditionally stabilized* when they have sufficient vegetative cover to withstand wind erosion. Other dune forms can be *surface stabilized* or *older* (semi-cemented) *stable*. That is, they may exhibit vegetation with a thin layer of soil, or may have vegetation and extensive soil layer with semi-cemented underlying sands.

This report classifies, describes and discusses the physical and biological nature and general capabilities of coastal Oregon sand landform types. In addition, a checklist of physical and biological[1] features characteristic of each type is included to assist with field identification. A glossary of terms used in this report is presented in the concluding section.

II. BEACH

A relatively narrow, sloping zone of unconsolidated materials extending from the low tide line landward to the uppermost line of effective wave or tidal action.

A. Geomorphology

Beach materials range in size from fine sand, to pebbles and even small boulders and are supplied from the erosion of coastal cliffs, the reworking of ancient and recent coastal sand deposits, and from riverine sediment loads. Sand supply and beach formation processes occur in seasonal cycles in which beaches commonly experience sand removal during the winter and are rebuilt by the more gentle wave action associated with summer weather activity. Beaches are the coastline's

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[1] Illustrations indicate the degree of magnification or reduction.

primary defense against the erosive action of storm waves.

Sand dunes, cliffs and drift log accumulations may occur at the landward side of beaches. Some parts of the coastline are repeatedly interrupted with headlands, creating small pockets of cobble beaches. Elsewhere the seaward margins of vast dune sheets create extensive beaches.

1. Stable beaches

In terms of sand availability, beaches may be stable, eroding or accreting. A stable form is one which experiences neither a net loss nor gain in beach materials on an annual basis. Gentle summer waves replace the same amount of sand on the beach as was lost offshore during winter storms. Beaches which are presently stable include Sand Lake in Tillamook County and the region between the mouth of the Umpqua in Douglas County and mouth of the Coquille River in Coos County.

2. Eroding beaches

An eroding beach is one which annually experiences net sand loss. This can result from continuous excessive erosion, diminishing beach sand supplies, or both. Erosion occurs primarily during vigorous winter storms and may be heightened by such factors as a high spring tide which effectively increases wave height. A reduction in beach sand supply may result from dams, riprap, jetties, commercial removal, or other structures or activities which modify beach material transport or near shore currents.

Eroding beaches can often be recognized in their earlier stages by the development of a steeper than usual profile (Figure 1). Some

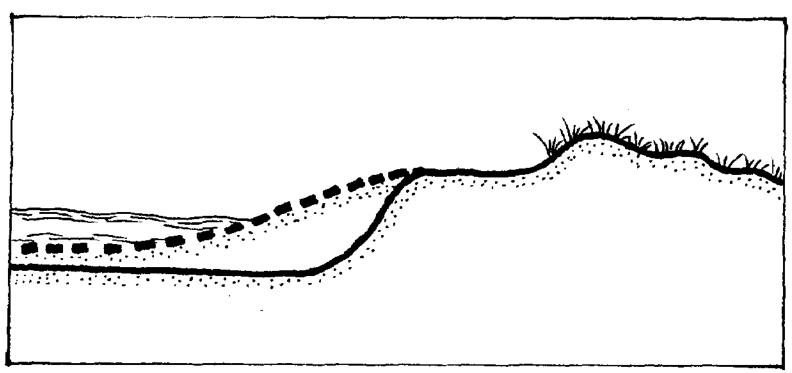


Figure 1. Steepened profile characteristic of an eroding beach.

eroding beaches may contain noticeable eroded embayments, or cusps, which are the result of local rip currents carrying sand away from the beach (Figure 2). Beaches presently in an eroding state include the beach from Peter Iredale Park, north to the Columbia River south jetty in Clatsop County and the area between Blacklock Point and Floras Lake in Curry County.

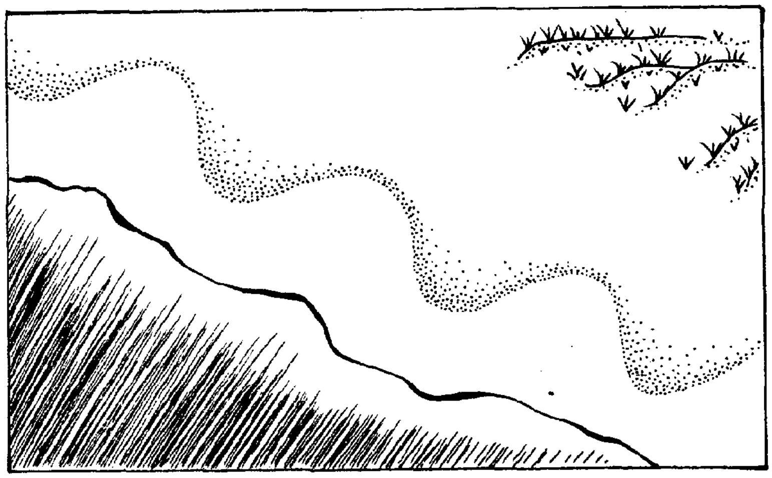


Figure 2. Beach cusps.

3. Accreting beaches

Any beach which has a low-tide margin experiencing net seaward growth due to an annual increase in sand supply is considered to be accreting. The development of small persistent dunes seaward of the foredune is indicative of this sand accumulation process. With continued accretion, the developing dunes will eventually grow and join to form a new foredune seaward of the previous one. Accretion at a site may be the result of escalated erosion elsewhere, beach or spit migration, natural and/or induced changes in off-shore currents, or structures and activities which modify beach material transport. To a limited extent, a beach may experience accretion due to the sand-trapping ability of dune grass. This is only likely to occur, however, when the near shore environment already favors accretion. Examples of accreting beaches include the area adjacent to the community of Surf Pines in Clatsop County, the north end of South Beach in Lincoln County, and just north of Gold Beach in Curry County.

B. Vegetation

High winds, waves and cyclic tidal inundation severely restrict vegetative growth in the beach zone. However, many types of seeds germinate easily in wet sand and a few hardy species may be found on the higher beach slopes in the summer and fall (Wiedeman, et. al., 1974, p. 25). Such plants are not found growing in great profusion. In fact, it may be that only one or two species, if any, will occur in a given beach area. These may occur as isolated individuals, and will commonly experience burial or destruction during the period of winter storms.

Three species which occur most commonly on the beach include American sea rocket (Cakile edentula), European sea rocket (Cakile maritima) and honkenya (Honkenya peploides). Although not peculiar to beaches, European beachgrass (Ammophila arenaria), sea lyme-grass (Elymus mollis) and seashore bluegrass (Poa macrantha) are occasionally found in this zone.

C. Attractions and Limitations

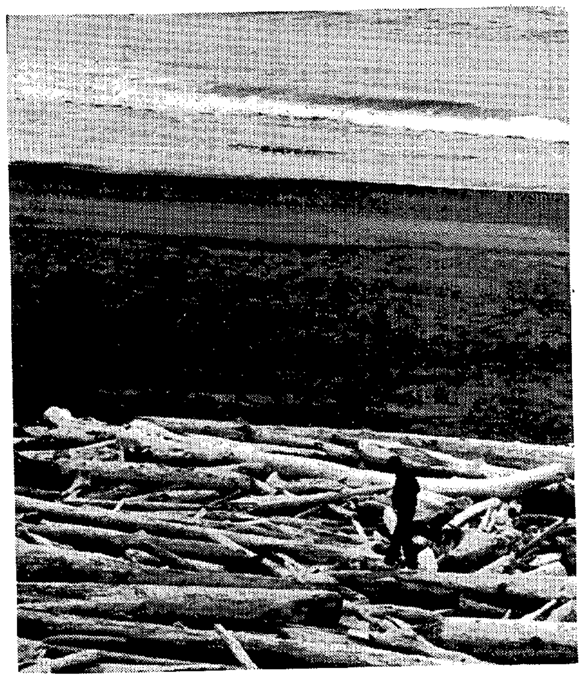
The beach is a highly attractive site for numerous recreational activities ranging from beachcombing to operation of off-road vehicles. It lends itself well to both solitary and group activities and, as a geologic feature, seems to be relatively tolerant of most transient activities. Management of this landform should consider such issues as (1) the desirability of allowing vehicle traffic and significant pedestrian use in the same areas, and (2) harrassment of shore bird species by various recreational activities.

D. Identification Checklist

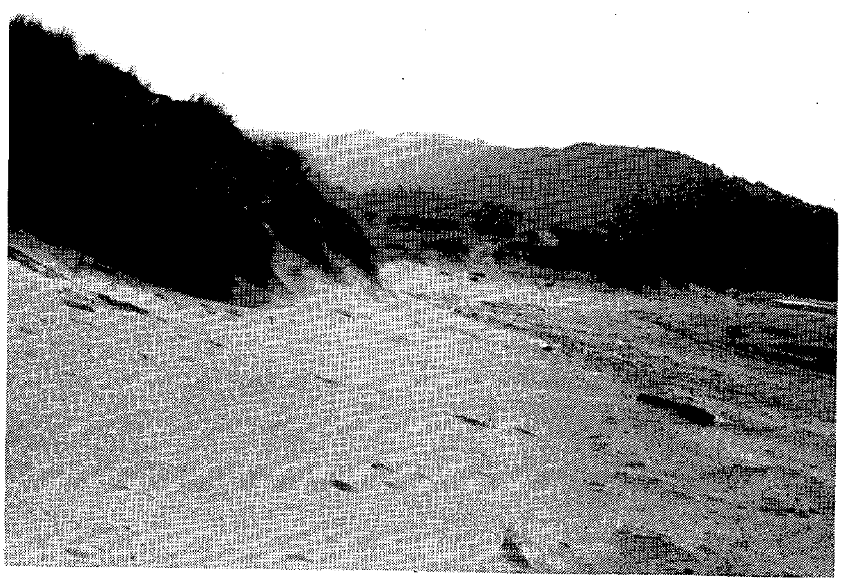
The beach can be recognized by the following characteristics:

1. The landward boundary of the beach may be characterized by one of the following:

   a. drift log accumulations,

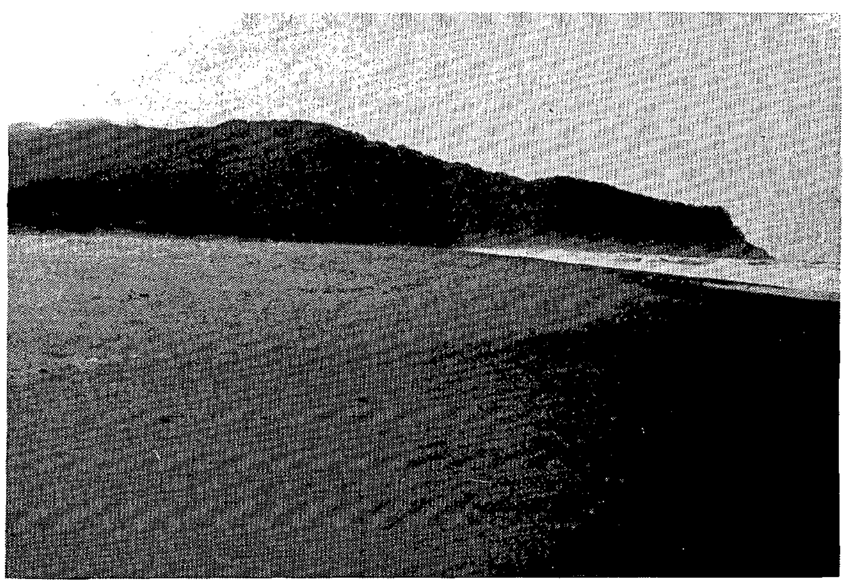


   b. foredune ridge, or



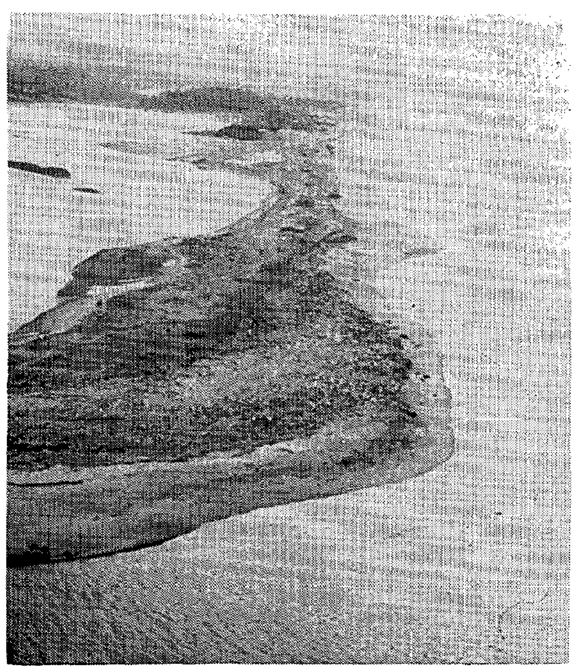
c. cliffs

2. Beaches may consist of fine to medium grained sands and exhibit a relatively gentle slope.



3. A steeper slope profile is exhibited by those beaches which consist of pebbles and/or boulders.

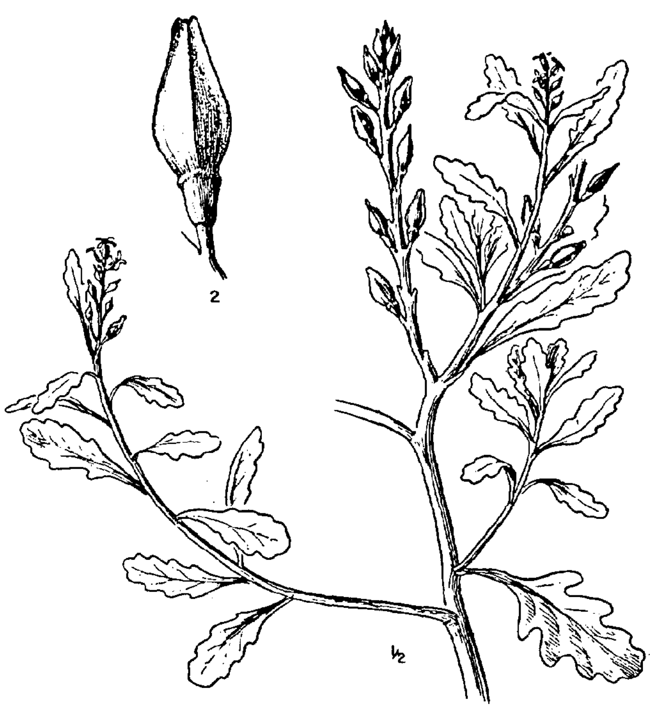
4. Erosion is sometimes caused by stationary rip-currents which eat embayments or cusps into the beach and foredune.



5. Accreting beaches may often be recognized by the development of embryo dunes seaward of the foredune.

6. The most commonly occurring beach vegetation includes the following:

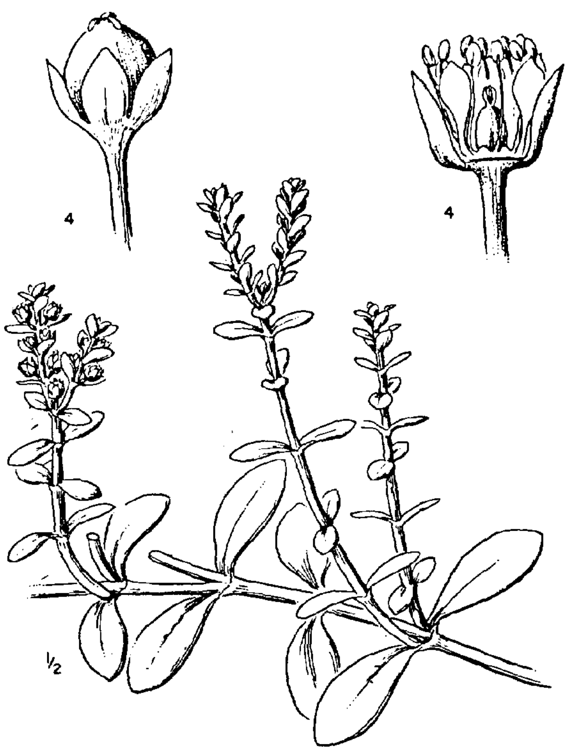
   a. American sea rocket (Cakile edentula),



flowers - purple to white

b. European sea rocket (Cakile maritima), similar to Cakile edentula except for the fruit, and

c. Honkenya (Honkenya peploides).



flowers -
greenish to
white

III. FOREDUNE

First ridge of sand situated immediately above the high tide line and parallel to the beach.

A. Geomorphology

The present day foredune of the Oregon coast has developed primarily in the last forty years as a result of the introduction of European beachgrass (Ammophila arenaria). First introduced for sand stabilization in the Coos Bay area in 1910 and the Clatsop Plains in 1935, this species became naturalized to the coastal sand areas. It spread along the coast forming a nearly continuous barrier ridge along the shore. European beachgrass prefers sites of continuous sand deposition. It grows seaward until it is halted by wave action at the high tide line. Embryo dunes form here at the landward edge of the beach in conjunction with vegetation and drift log accumulations where the velocity of the wind decreases suddenly, depositing the sand load (Figure 3). Continued

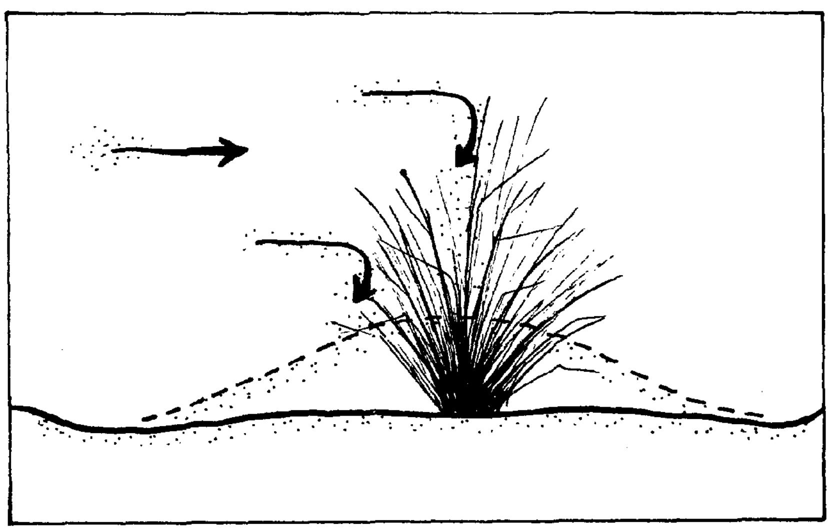


Figure 3. Sand deposition around a beach grass windbreak.

deposition may lead to the burial of the original obstacle. The driftlogs remain buried forming the base of the foredune but European beachgrass (Ammophila arenaria) can survive seasonal sand burial of up to three feet and for that reason is the primary foredune building agent. As sand builds up around the base of the plant, new roots and shoots grow from the stem joints (Figure 4). This traps more wind-blown sand above, while holding underlying sand within the complicated root network below.

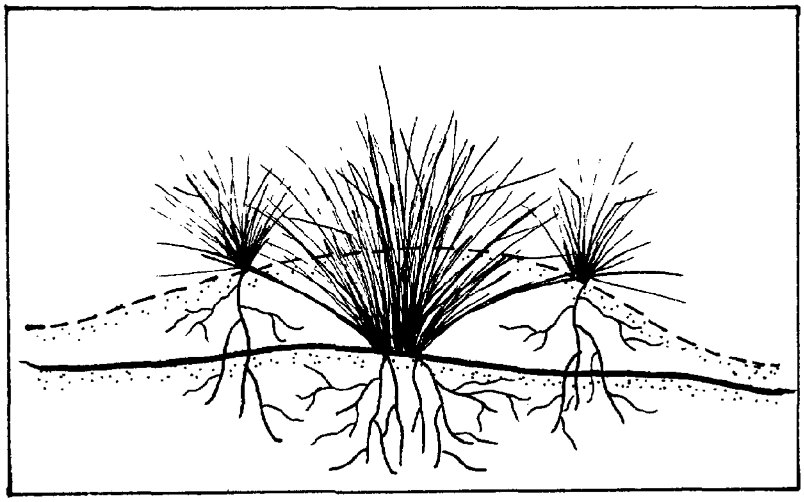


Figure 4. As European beachgrass is buried, new shoot and root growth develops at the dune surface.

The dune thus increases in height and width until it merges with adjoining dunes to form a barrier ridge along the upper beach. This dune-ridge area stops and holds most of the sand blowing in from the beach and continues to grow until it reaches the maximum height dictated by local conditions, usually up to twenty-five or thirty feet. It may be bounded on the east by deflation plains, interior dunes, cliffs, marshes, lakes or estuaries.

The foredune is a naturally occurring geomorphic feature which, to some degree, acts as a dike during ocean storms. It's function transcends that of a simple barrier-wall because it has a sponge-like ability to absorb and mute the force of storm waves. Hitting the foredune, wave energy is dissipated over, around and, most critically into the dune. However, while it can act as an effective shock absorber, the foredune can occasionally sustain considerable damage during storms and may be unable to provide sufficient storm protection to inland sites, thus allowing adjacent deflation plains or hummock dunes to be exposed to the full force of maritime storms. In such instances, the area of potential hazard is extended beyond the foredune to include additional inland sites. Any excavation into, or construction modification of the foredune may increase this hazard potential.

Foredunes are among the most dynamic of landforms and will naturally vacillate between periods of being active (subject to wind and wave erosion and breaching) and being conditionally stable (wind stable but subject to wave erosion and breaching).

The term "foredune" is applied to this dune ridge wherever it occurs along the Oregon coast. This feature varies considerably in appearance, however, and to some degree in function, between the north coast (Clatsop County) and the central-south region.

The foredune ridge which occurs in the central and southern counties commonly varies between ten to thirty feet in height, is twenty to fifty feet wide at the base and often appears as a distinctive sea-wall ridge particularly when viewed from the beach. Storm hazard in this area is primarily associated with erosive storm waves and wind, impact from solid debris carried by the waves, and flooding of inland sites.

The foredune in the Clatsop area is commonly an extremely broad, low appearing feature. While it may reach heights of more than twenty-five feet, the gradient is so gentle, often five degrees or less, that it has a less distinctive sea-wall appearance. Storm hazard on the north coast (north of Seaside) is more commonly associated with inundation from sand than from erosion or debris impact. Wave run-up may be considerably reduced by the extensive traverse associated with the long, shallow, off-shore area and the extreme width of the foredune. However, storm-velocity winds are capable of transporting generous quantities of sand available in this region considerably inland. The gentle gradient common to Clatsop foredunes may also offer less obstruction to the wind. Thus, the "functional" width of the foredune (or the area impacted by maritime storms) in the Clatsop area can be as great as 800 feet depending on local conditions (Leach, 1978). The "foredune" under this designation, may contain more than one "ridge" so the term "foredune area" may be more applicable (Ternyik, 1978). Furthermore, while storm associated sand deposition can cause sand-blasting type damage and may result in subsequent excavation costs, this activity may be more aptly designated as "nuisance" rather than true "hazard" to life or property.

1. Active foredunes

Sand dunes are in an active state when they possess insufficient vegetative cover to retard wind erosion. In this condition the sand dune is experiencing active accretion and/or erosion.

On a static or accreting beach, an active foredune will commonly evolve towards the conditionally stable state. As the active foredune grows in height (up to thirty feet), it becomes an increasingly effective barrier and progressively less sand is deposited on the lee side of the dune and other sites inland. This offers somewhat greater protection from storm winds, but also seriously limits all fresh beach sand supplies to interior open sand areas.

Active foredunes may be most numerous in central and north coast areas. They occur, for example, in Clatsop County west of Slusher and Sunset Lakes and in Tillamook County at Neskowin North.

2. Conditionally stable foredunes

When foredunes exhibit sufficient vegetative cover to retard the erosive effects of the wind, they are termed conditionally stable. Obviously, the stability of a given foredune is conditional upon the maintenance of the vegetative cover.

While the conditionally stable foredune may not have any greater resistance to wave erosion than does an active foredune, it appears to recover more quickly from wave overtopping (Ternyik, 1978). However, any conditionally stable sand dune is prone to reactivation upon disturbance of the vegetative cover.

Examples of conditionally stable foredunes presently occur between Sunset beach and Gearhart in Clatsop County and at the community of Bayshore in Lincoln County.

B. Vegetation

1. Active foredunes

The active foredune receives such a substantial sand supply that it is occupied almost exclusively by European beachgrass (*Ammophila arenaria*). Some native dune grasses such as sea lyme-grass (*Elymus mollis*) may be found here but occur less commonly as they are less tolerant of continual sand burial.

2. Conditionally stable foredunes

The increasing height of the conditionally stable foredune restricts the inland passage of salt spray and sand. A new environment is thus created on the crest and the lee side of the foredune which is reflected in the vegetation at this site. European beachgrass (*Ammophila arenaria*), the most significant species which occurs on the foredune, becomes less important because it prefers the more fertile sites of sand deposition. Other species less tolerant of salt spray and sand deposition become established. The first to become established include, among others, such herbs as beachpea (*Lathyrus japonicus*), coast strawberry (*Fragaria chiloensis*) and seashore lupine (*Lupinus littoralis*). Later successional species may include such woody shrubs as salal (*Gaultheria shallon*), or kinnikinnick (*Arctostaphylos uva-ursi*) and an occasional shore pine (*Pinus contorta*).

The lee side of a foredune may exhibit vegetation characteristic of conditional stability and yet be experiencing erosion and undercutting on its windward side. Such circumstances indicate that the foredune was formerly in a conditionally stable state long enough for some vegetative succession to take place, and has only recently begun to experience erosion. The remaining foredune ridge has apparently been able to provide sufficient protection to the lee side to maintain existing vegetation. Should the oceanward side experience temporary in-filling with logs, sand and beach grass during the summer it could deceptively give the appearance of a completely conditionally stable foredune.

C. Attractions and Limitations

While the foredune may not be a primary recreational attraction in itself, it nonetheless experiences moderate recreational traffic. This is partially because it is a barrier which must be traversed in order to reach the beach. It is also used as a sheltered 'base camp' from which forays to the beach are made. However, because of its hummocky, semi-stable surface and the sharp tips of the European beachgrass, pedestrian traffic usually follows open pathways. This activity, referred to as "trailing", results in the development of open mobile sand trails. However, the continual replenishment of fresh sand in active dune areas commonly maintains sufficient fertility for beach grass regeneration. Thus, trailing is not necessarily a serious problem unless it is desirable for the active foredune to become conditionally stable (OCCDC, 1975). Conversely, the trailing which results from the passage of motorbikes and other off-road vehicles inhibits beach grass regeneration and creates troughs from which blowouts can develop.

The proximity of this landform to the ocean renders it at once highly attractive and yet extremely hazardous as a site for permanent structures. Construction of permanent structures which either project onto the beach or require any excavation of the foredune endangers the site and adjacent areas. Erosion intensification, interruption of natural sand movement, and wind-blown mobile sands are potential hazards associated with such disturbance. Additionally, the installation of riprap to protect structures impedes the natural flow of beach and foredune materials, possibly resulting in beach starvation at the site or elsewhere. Goal 18 specifically addresses the problem of development on active and other foredunes. No active dune, by definition, should harbor permanent structures as they may be subject to inundation or undermining due to moving sand. Permanent structures should be reserved for permanent landforms. Management of this landform should consider the highly dynamic mobile nature of this land/sea interface area.

D. Identification Checklist

The foredune can be identified by the following characteristics:

1. A sparsely or thickly vegetated sand dune ridge five to twenty-five feet high, running parallel to the beach.

2. The foredune is bordered by the beach and possibly drift logs on the west.

3. It commonly occurs adjacent to:

   a. hummock dunes, or

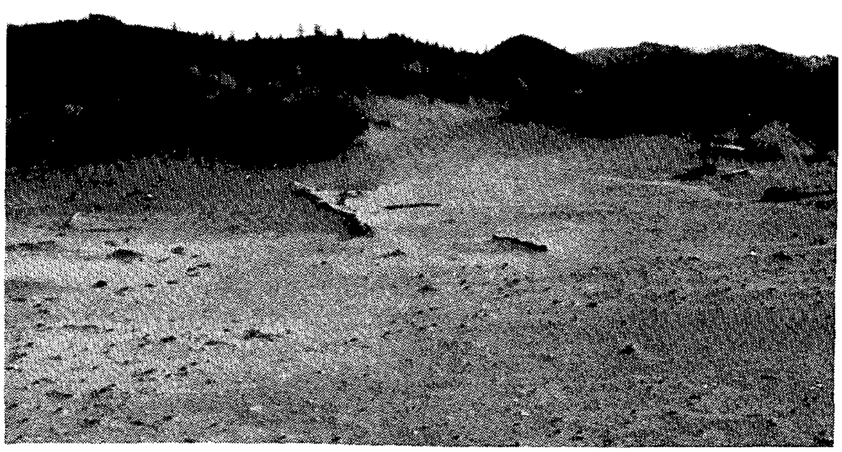
   b. the deflation plain on the east.

4. The active foredune may exhibit storm surge cuts. Logs and debris may be found here.

5. An eroding, formerly conditionally stable foredune may continue to exhibit vegetation characteristics of its conditionally stable state. (Coast strawberry is shown on the eroding face of a formerly conditionally stable foredune.)

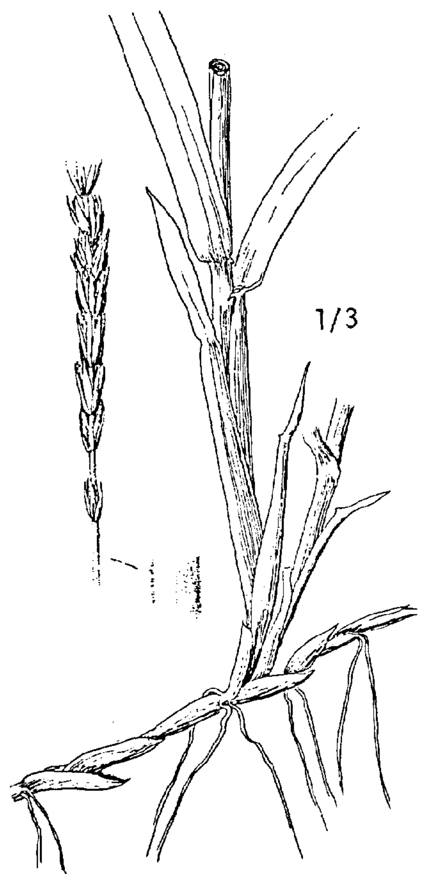
6. Drift logs may be exposed at the base of the windward face of the active foredune, particularly in the winter.

7. The vegetative cover of the active foredune is rather sparse and consists almost exclusively of European beachgrass (<u>Ammophila arenaria</u>).



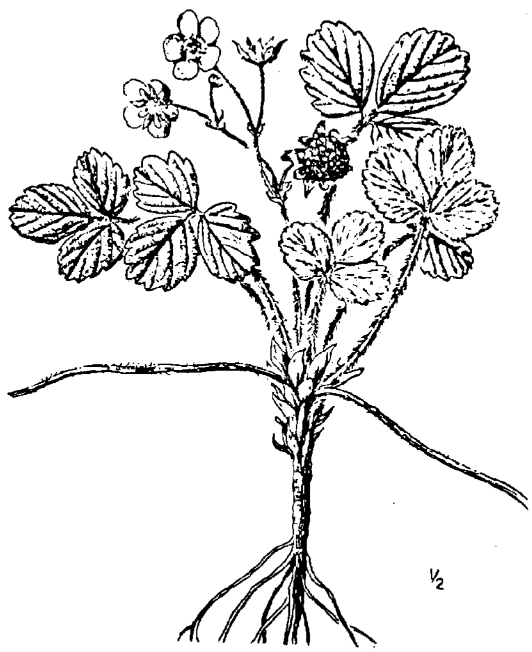
8. The conditionally stable foredune exhibits a very dense vegetative cover.

9. Sea lyme-grass (Elymus mollis) may also occur occasionally on the foredune in lesser amounts.



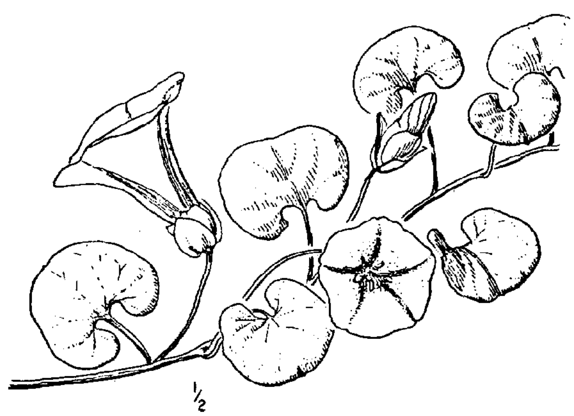
10. Species of the pioneer community found on the lee side of the conditionally stable foredune include:

    a. coast strawberry (<u>Fragaria chiloensis</u>),



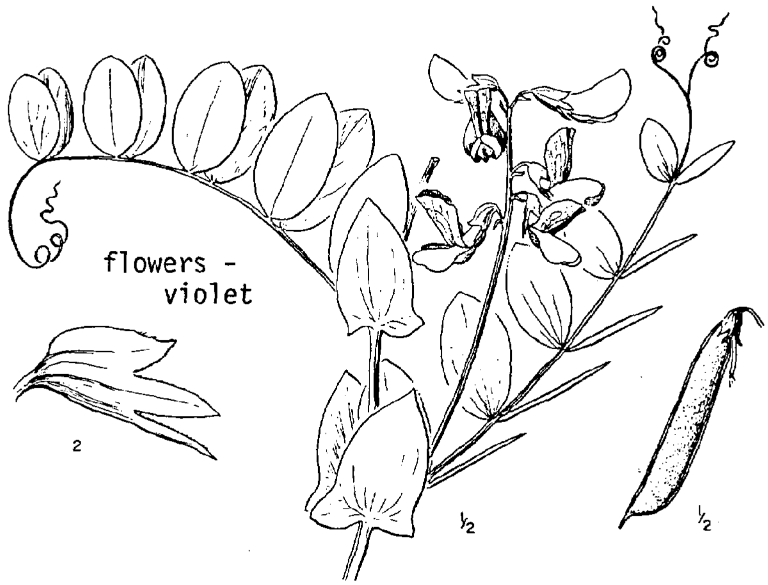
flowers - white to pinkish

    b. beach morning-glory (<u>Convolvulus soldanella</u>),



flowers - light pink to rose

c. beachpea (Lathyrus japonicus), and

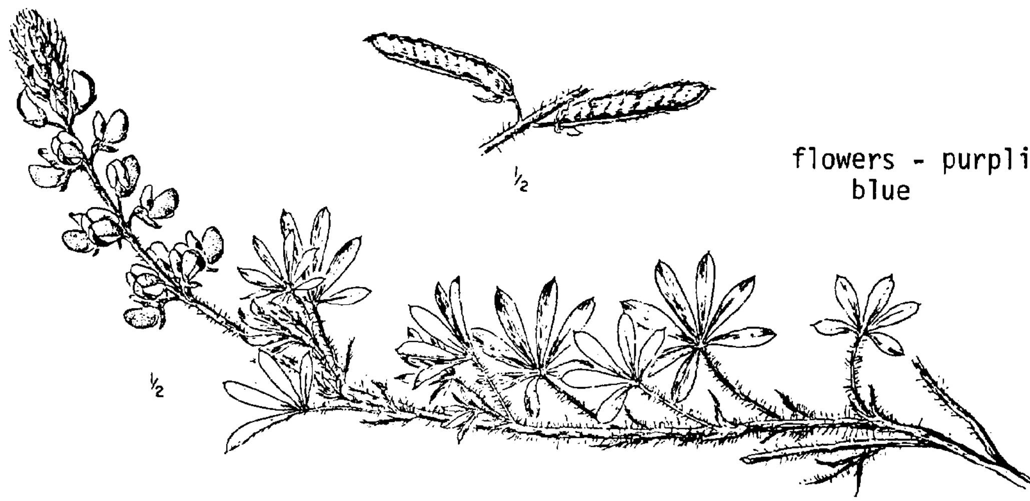


d. gray beachpea (Lathyrus littoralis).

flowers - white
to pink or
purple

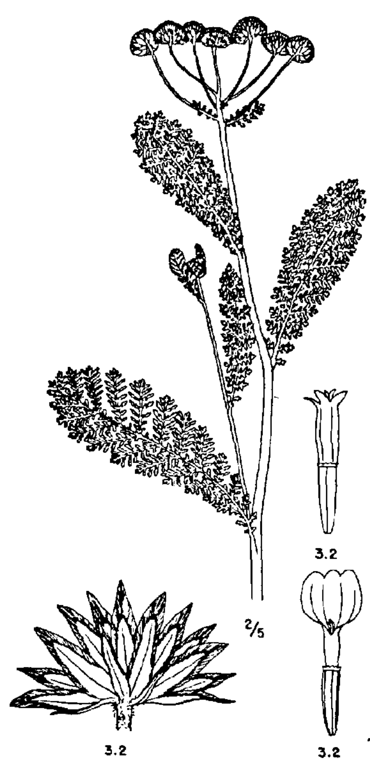
11. Four species appearing later in succession include:

a. seashore lupine (Lupinus littoralis),



flowers - purplish blue

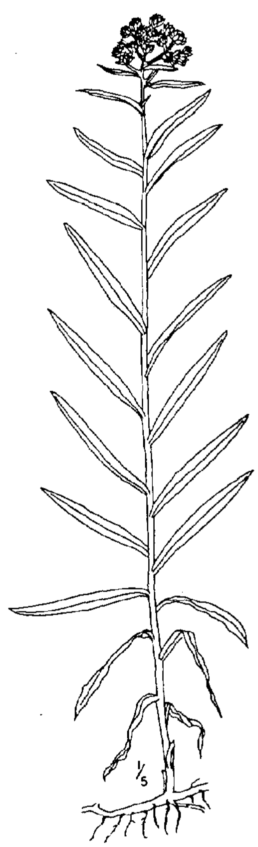
b. seaside tansy (Tanacetum douglasii),



flowers - yellow

c. western bracken fern (Pteridium aquilinum)

d. pearly everlasting (Anaphalis margaritacea)



heads - white

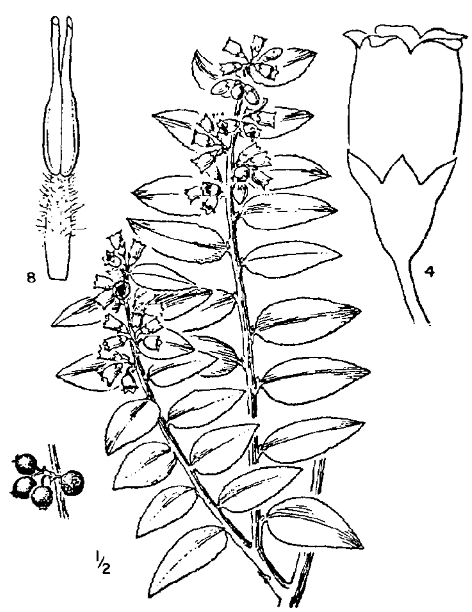
12. By the time the later successional species appear, many of the pioneer species are no longer apparent. The following shrub species belong to this latter successional group:

a. salal (<u>Gaultheria shallon</u>),

fruit - dark purple to black

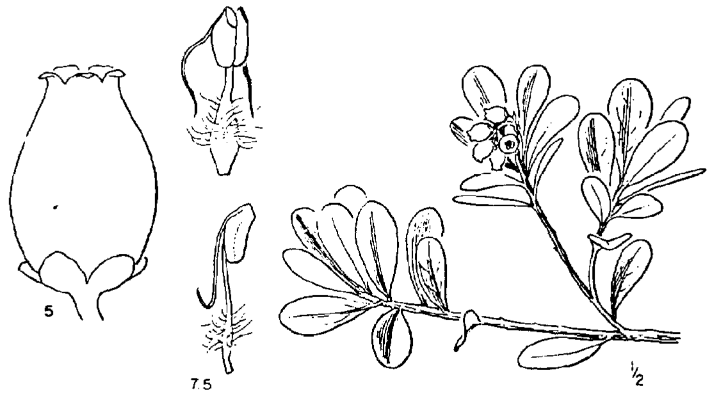
flowers - white to pink

b. evergreen huckleberry (<u>Vaccinium ovatum</u>),



flowers - white to pink

c. kinnikinnick (<u>Arctostaphylos uva-ursi</u>)



flowers - white to pink

d. hairy manzanita (<u>Arctostaphylos columbiana</u>)

flowers white to pale pink

IV. INTERDUNE FORMS

Interdune forms include those low areas between dunes which are often subject to the controlling factors of wind action, and/or high water table.

A. Deflation Plain

Broad plain which develops immediately inland from the foredune and is wind scoured to the level of the summer water table.

1. Geomorphology

A deflation plain is created by wind removal of dry sand particles inland from the foredune. Sand is thus removed only down to the lowered summer water table, because groundwater moisture binds sand particles together at this level. This may result in standing water during the winter when the water table is naturally higher. Sand transported inland from the deflation plain is deposited in interior dune regions. The best conditions for development of this landform probably occur behind a conditionally stable foredune, where the inland flow of sand, which could otherwise contribute to dunal development at this site, is cut off and the wind has more available energy for transport. If an active foredune exists, sand supplies are more readily passed over the ridge to form hummock dunes or open-sand dunes.

Examples of old, inactive deflation plains occur in some areas considerably inland from the foredune area. These are commonly occupied by forest communities and the water table is still quite high. These features probably developed adjacent to a foredune, but merged inland by subsequent beach accretion.

2. Vegetation

Components of the vegetation communities in the deflation plain vary according to specific site factors and the stage of successional development. In the early successional stages, grass, rush, and sedge communities occupy progressively wetter sites. Later successional stages are characterized by a low scattered shrub community, followed by the development of tall shrub thickets and eventually a shore pine forest (U.S.D.A., 1972, pp. 84-98). Water stands at, or near the surface most of the year in these sites.

The grass community occurs where water stands on the surface for two to three months of the year (vegetation covers about 80% of the ground). A few scattered shrubs and dwarfed shore pine are occasionally found in this community.

The rush community is found in sites where the water table stands on the surface for three or four months of the year (vegetation covers about 90% of the ground). Isolated shrub and tree seedlings also occur here. Coast willow (Salix hookeriana) seedlings are the most numerous.

Water stands on the surface of the sedge community for at least six months of the year. Vegetation covers about 95% of the ground.

3. Attractions and limitations

The primary attractions of the deflation plain appear to be the viewing of waterfowl and, when drained, the development of housing. Many deflation plain marsh communities provide habitat for a number of waterfowl, which is lost when the site is developed. Even when drained, the water table remains quite high and septic tanks, drainfields, and other buried structures may not be appropriate. Flotation and failure of such structures could occur with resulting pollution.

4. Identification check-list

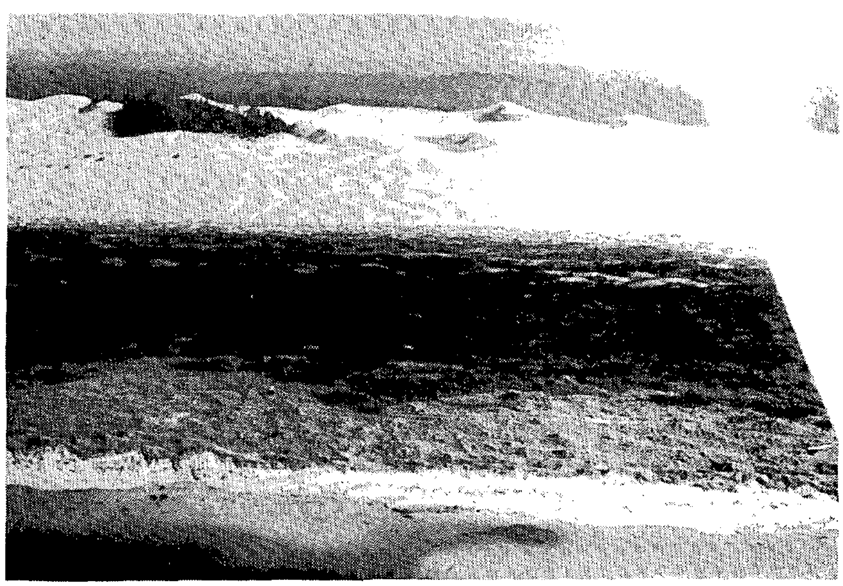
The deflation plain may be identified by the following features:

1. It is a low plain bordered on its ocean side by a foredune.

2. The deflation plain may be bordered on the eastern boundary by:

   a. hummock dunes or,

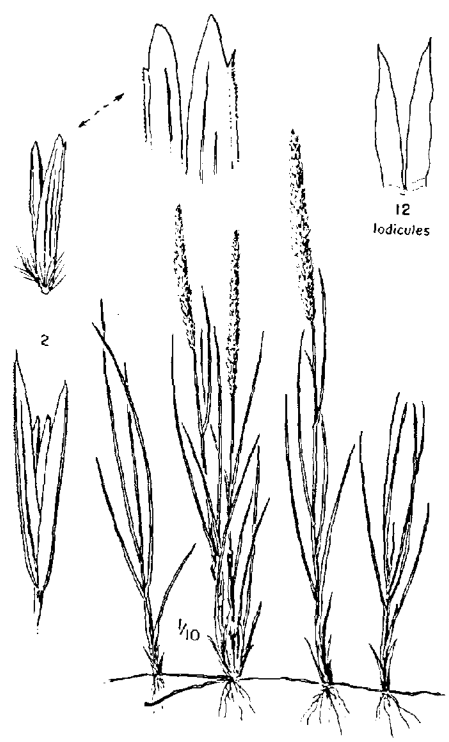
   b. transverse-ridge dunes.



3. It may contain standing water several months of the year.

4. Important species of the deflation plain grass community include:

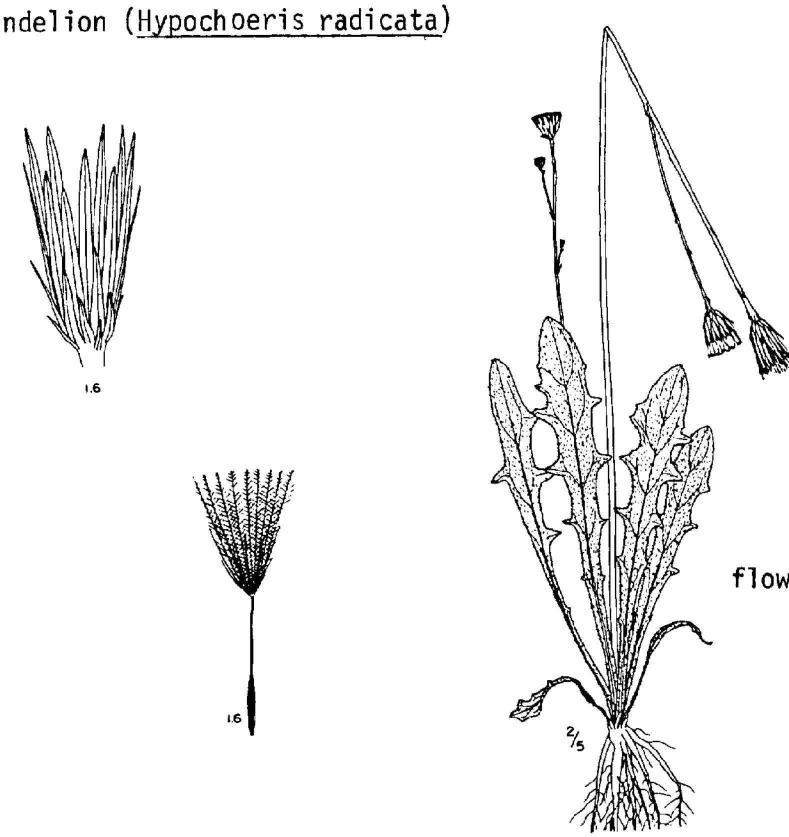
   a. European beachgrass (Ammophila arenaria),



b. seashore lupine (<u>Lupinus littoralis</u>)

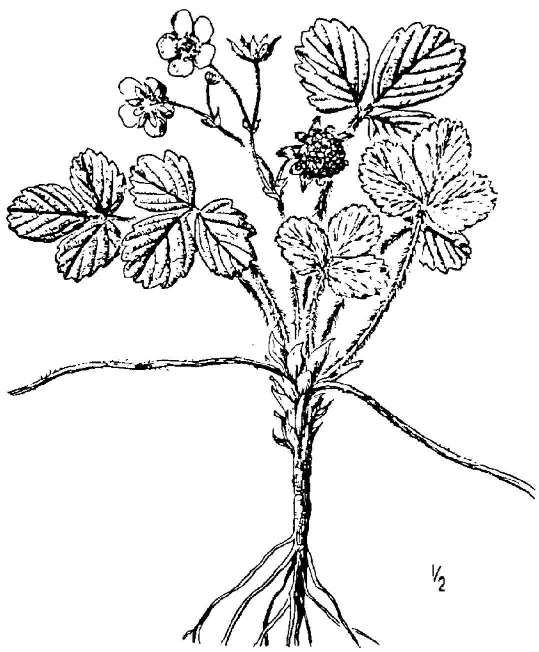
flowers - purplish blue

c. false dandelion (<u>Hypochoeris radicata</u>)



flowers - yellow

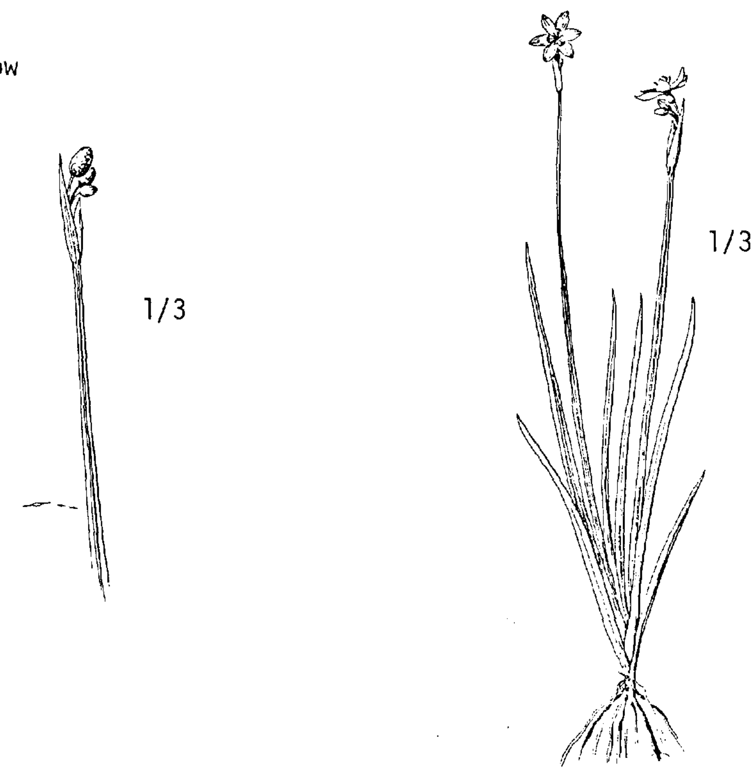
d. coast strawberry (Fragaria chiloensis)



flowers - white
to pinkish

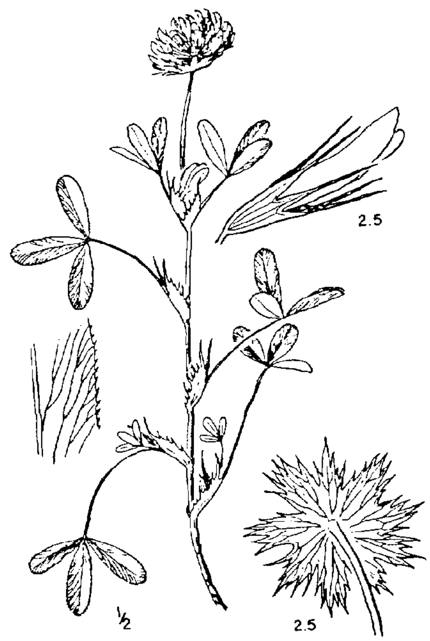
e. yellow-eyed grass (Sisyrinchium californicum)

flowers - yellow



5. The following plants are most common in the rush community:

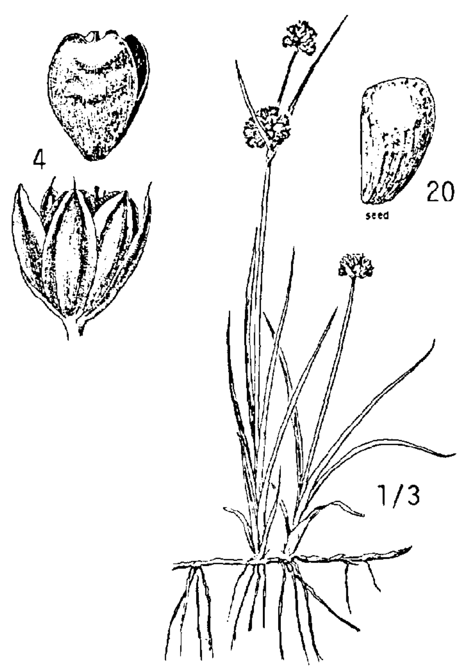
   a. spring-bank clover (Trifolium wormskjoldii).



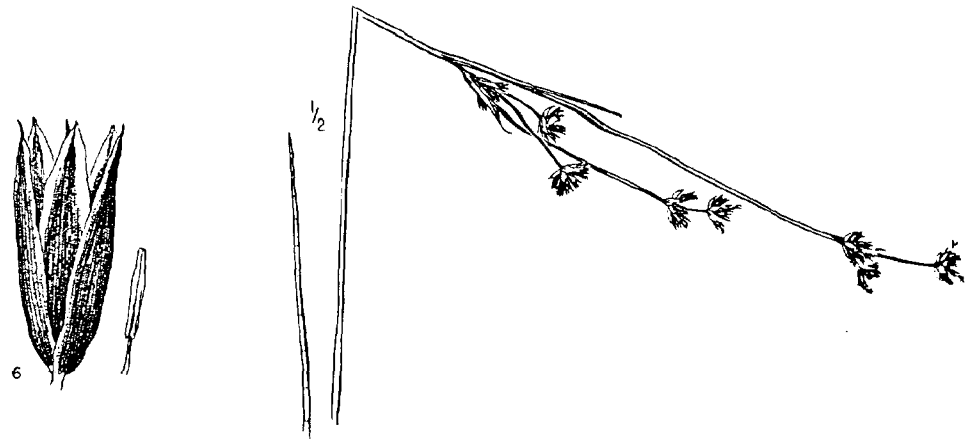
flowers - purplish-red
often white-tipped

   b. Rushes are important here. (They may be identified by a round stem.)

      (1) sickle-leaved rush (Juncus falcatus)



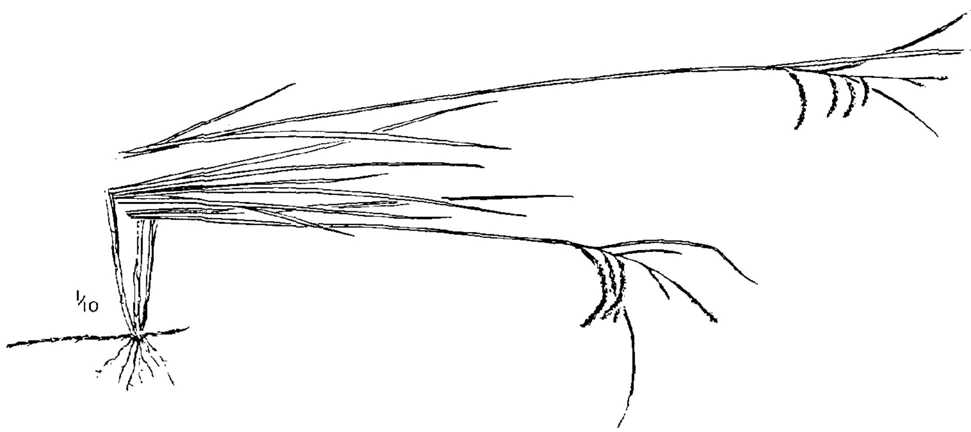
(2) brown-headed rush (Juncus nevadensis)

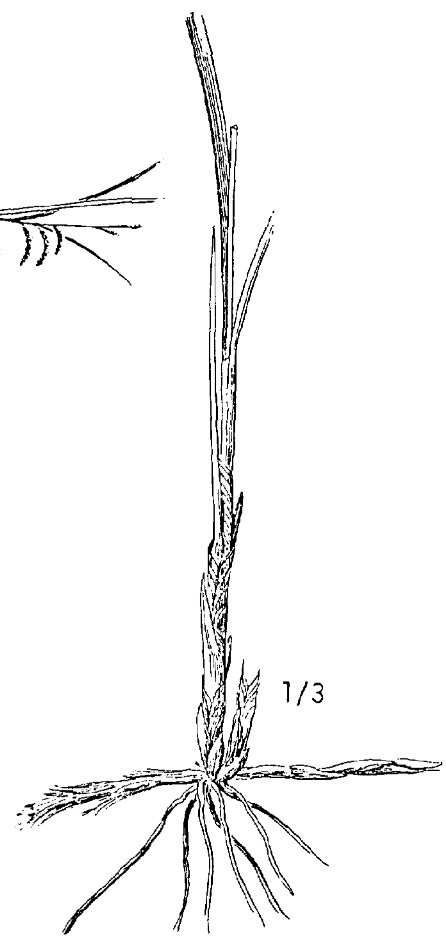


6. The most important species of the sedge community are:

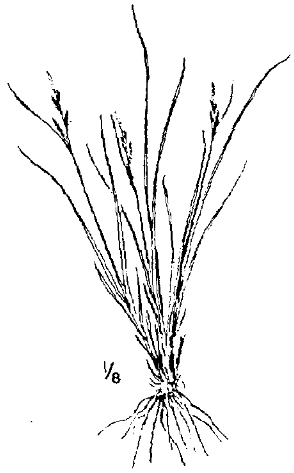
   a. Sedges (which have stems with edges) are the most critical species. They include:

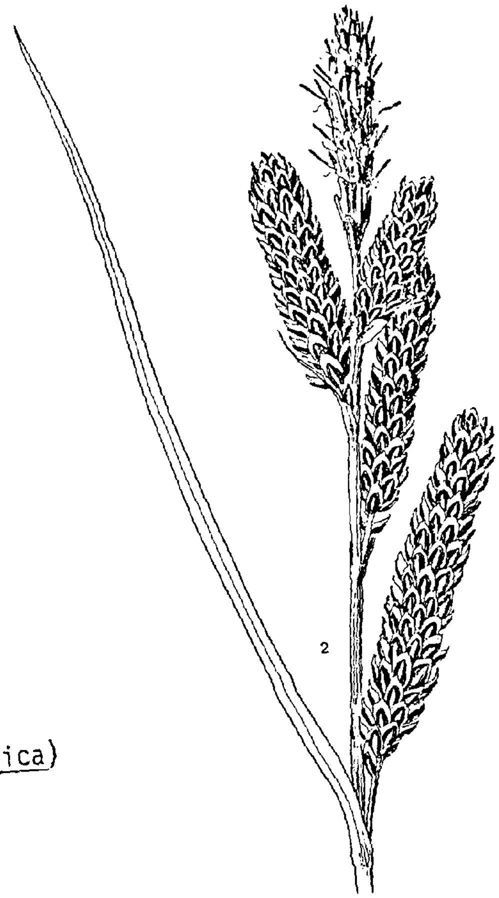
      (1) slough sedge (Carex obnupta)



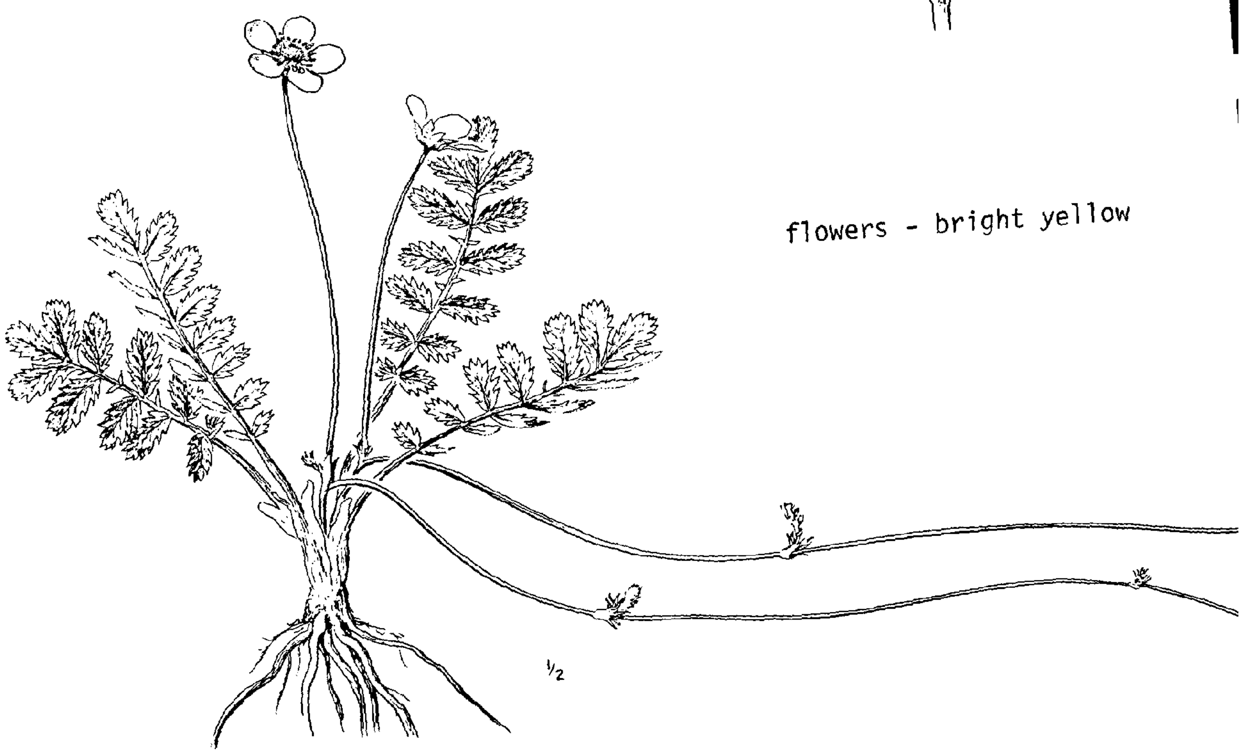


(2) hindis sedge (<u>Carex hindsii</u>)



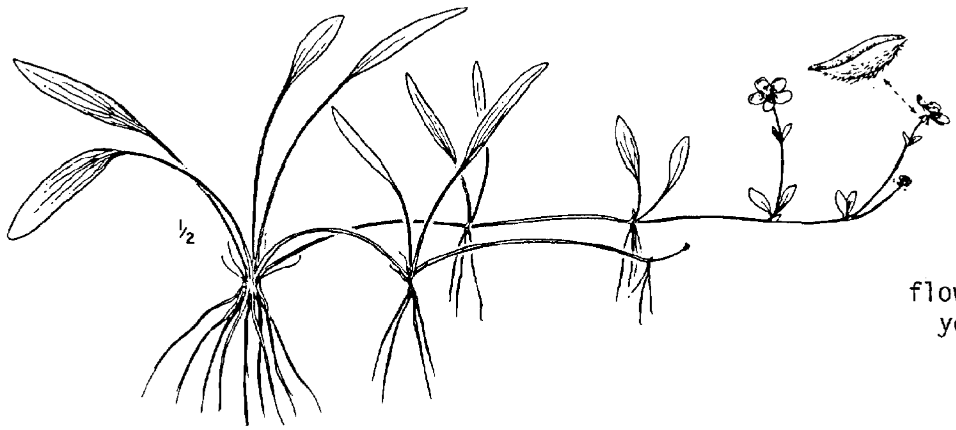


b. Pacific silver weed (<u>Potentilla pacifica</u>)



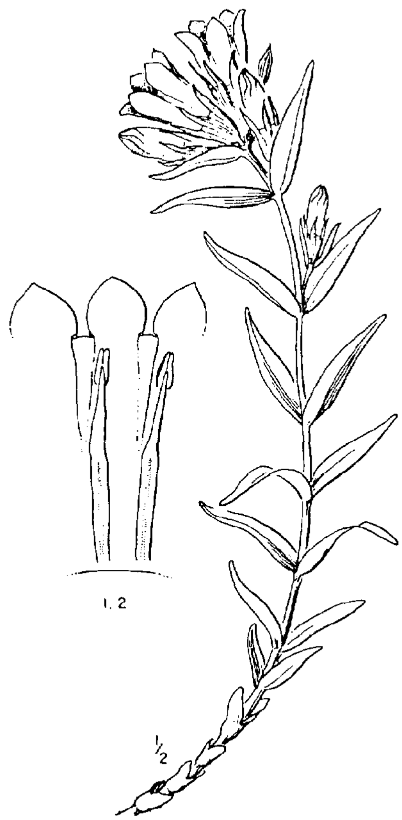
flowers - bright yellow

c. creeping buttercup (Ranunculus flammula)



flowers - yellow

d. king's gentium (Gentiana sceptrum)



flowers - blue to purplish-blue

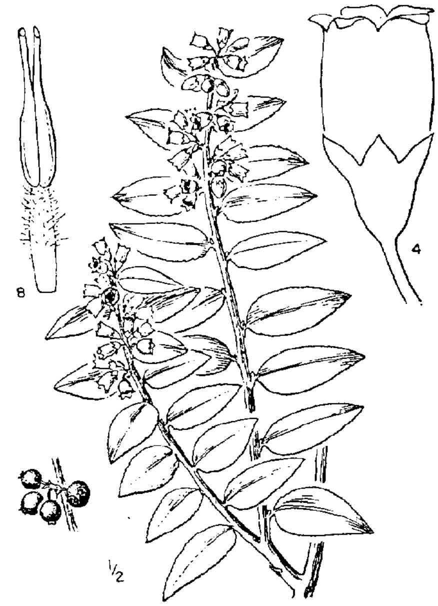
7. The low, scattered shrub community is characterized by the following species up to six feet in height:

   a. coast willow (Salix hookeriana) dominates,

   b. salal (Gaultheria shallon),

flowers -
white to pink

c. evergreen huckleberry (Vaccinium ovatum),

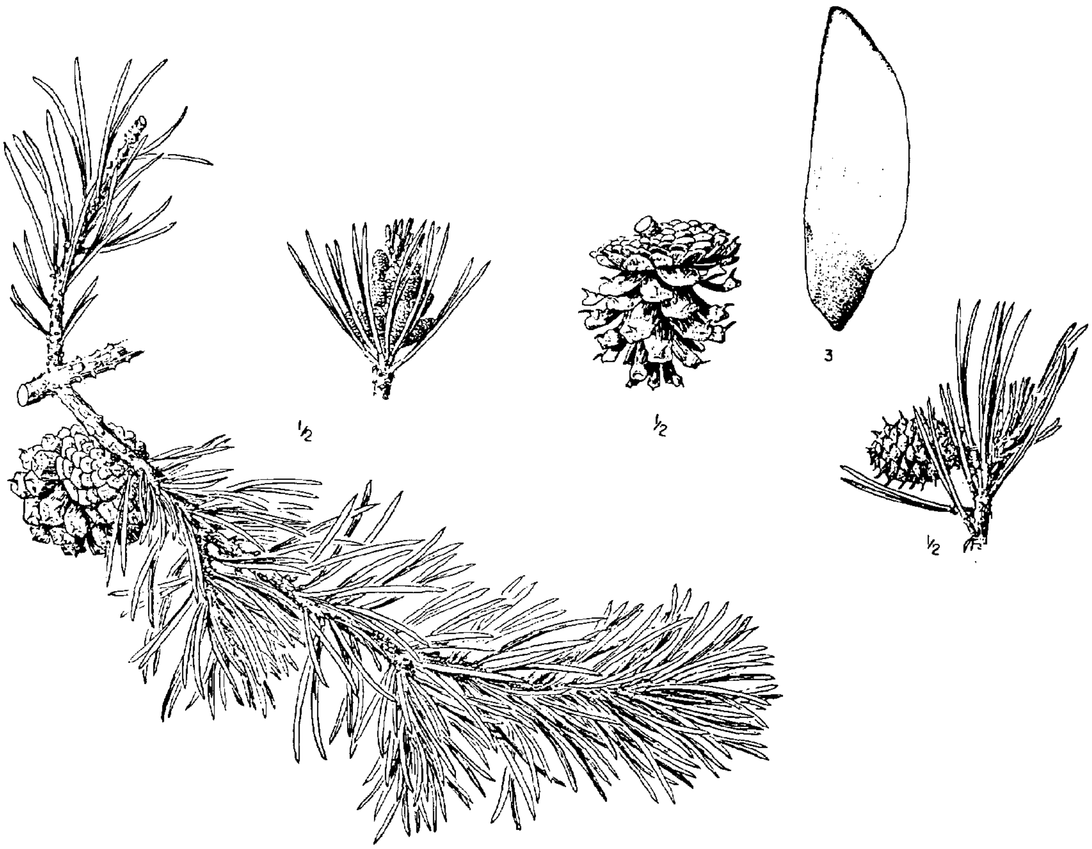


flowers - white to pink

d. wax myrtle (Myrica californica), and

fruit - reddish-brown

e. shorepine saplings (Pinus contorta).

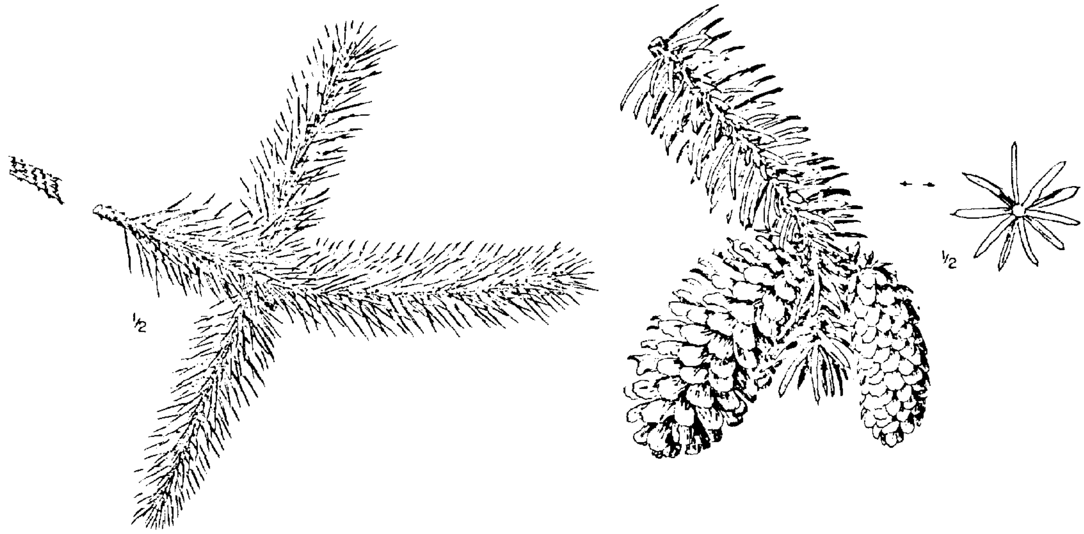


8. The tall shrub thickets follow the low, scattered shrub association and is composed of the foregoing shrubs and trees ranging in height from six to twenty feet.

9. The next successional stage on the deflation plain is the shorepine forest. The plant community includes the following:

   a. shorepine dominates (Pinus contorta). See drawing above.

b. sitka spruce (Picea sitchensis)



c. occasionally trees of:

(1) wax myrtle (Myrica californica), and

(2) coast willow (Salix hookeriana)

½

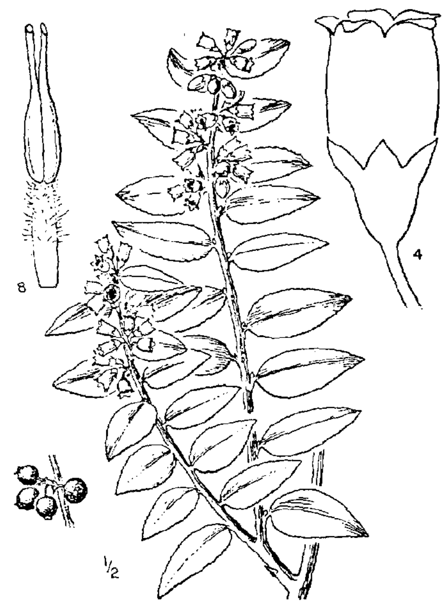
d. a sparce occurrence of shrubs:

(1) salal (Gaultheria shallon), and

9 6

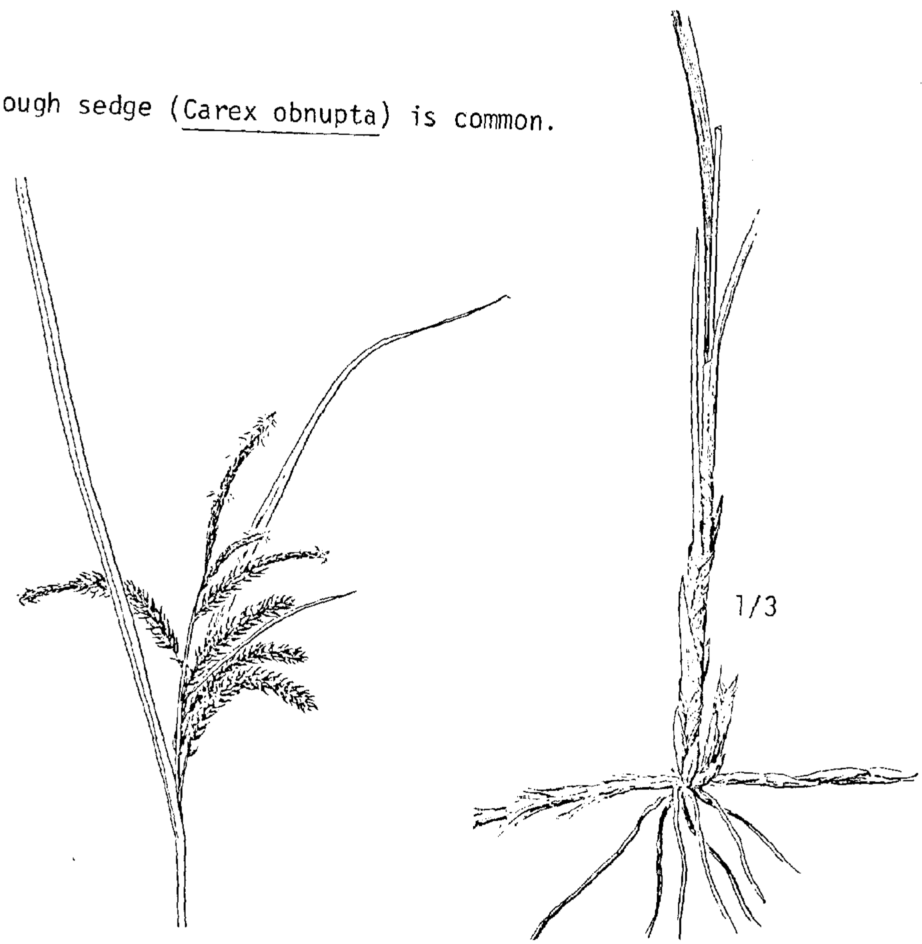
flowers - white to pink

(2) evergreen huckleberry (<u>Vaccinium ovatum</u>)



flowers - white to pink

e. slough sedge (<u>Carex obnupta</u>) is common.



B. Seasonally Wet Interdune Area

Interdune sites which are commonly occupied by standing water only part of the year.

1. Geomorphology

Low lying sites which contain surface water during some part of the winter are found in association with many sand landform types. Swales between oblique-ridge dunes, the basal area between hummock or transverse-ridge dunes, and low areas within older stable dune units, all provide examples of sites which may be wet part of the year. Water table is probably high even during the summer when all trace of surface water has disappeared.

2. Vegetation

Although the surface can range from bare sand through marsh associations to mature forest, some vegetative cover is most common. Any of those communities occurring in the deflation plain may be found here. Some sites may exhibit mottled clayey soils indicative of prolonged saturation.

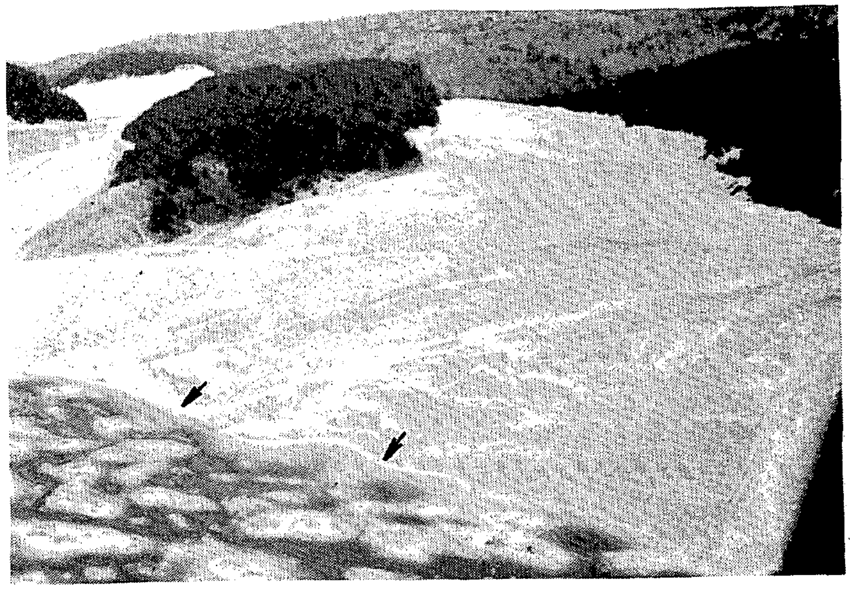
3. Attractions and limitations

Characteristic attractions and limitations of these sites would be similar to those of the deflation plain. Any development proposals for occasionally wet areas in older stable dune forms should address the potential water table limitations here.

4. Identification check-list

Occasionally wet interdune sites may be identified by the following characteristics:

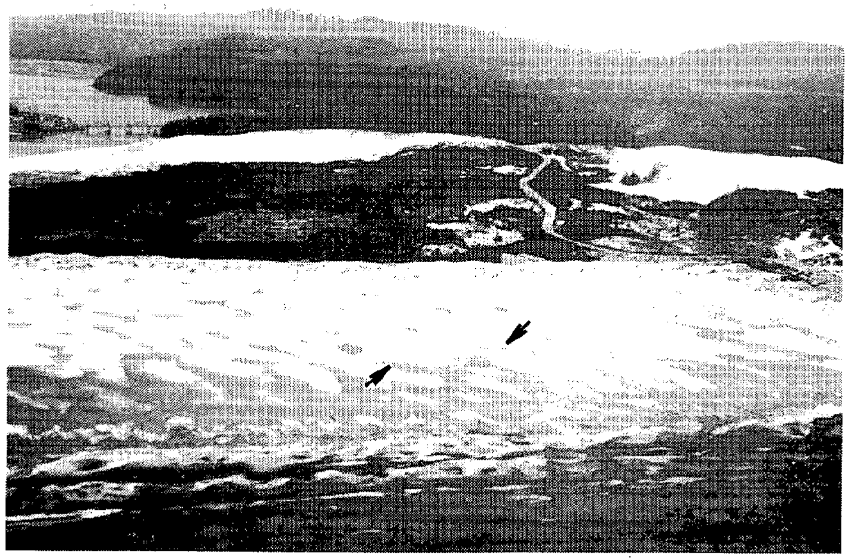
1. The site exhibits standing surface water during only part of the



2. Occasionally wet interdune areas may occur as follows:

   a. vegetated areas between open sand dune ridges,

b. nonvegetated sites between open sand dune ridges, or



c. swales between parallel-ridge dunes,

d. low sites in older forested dunes (may be affected by underlying impermeable iron lenses), or

e. swales between hummock dunes which may be a functional extension of the adjacent deflation plain.

V. INTERIOR DUNE FORMS - VEGETATED

A. Hummock Dunes

Fields of vegetated sand dune mounds most commonly occuring inland from the foredune or deflation plain.

1. Geomorphology

Hummock dunes, like the foredune, are primarily created by the mound building activities of European beachgrass (Ammophila arenaria). These dunes form as fields of hillocks rather than linear ridges because there is no natural linear vegetation and sand accumulation boundary (such as the beach), and sand supply and wind patterns are rendered inconsistent and discontinuous by the foredune barrier ridge.

Hummock dunes most commonly occur either immediately inland from the active foredune or inland from the deflation plain. Sand is supplied from either or both of these source regions. Patches of hummock dunes are also found within open sand areas on occasion. In general, hummock dunes range from ten to thirty feet in height and twenty to thirty feet at the base. In their active form they may be only sparcely vegetated and thus actively migrating. Active hummock dunes occur in the southwestern region of Bayocean Spit in Tillamook County and west of Lily Lake in Lane County. A vegetative cover sufficient to make hummock dunes wind stable creates a conditionally stable form, examples of which are found at the north end of Bayocean Spit in Tillamook County and at South Beach in Lincoln County.

2. Vegetation

The most prevalent vegetation found on hummock dunes is European beachgrass (Ammophila arenaria). Other secondary components include seashore lupine (Lupinus littoralis), seashore bluegrass (Poa macrantha), and coast strawberry (Fragaria chiloensis). Later successional growth is similar to that on the lee side of the conditionally stable foredune and may frequently exhibit shrubs or dwarfed trees in the more protected sites. The depressions in those hummock dune areas which have a high winter water table may be occupied by marsh vegetation including sedges and rushes.

3. Attractions and limitations

This area has attractions to both pedestrian and off-road vehicle recreation. Some areas have been used for home sites.

The proximity of active hummock dunes to the active foredune and their natural interaction is of critical importance. Often one blends into the other imperceptably and the boundary is somewhat hypothetical. One cannot be managed in isolation from another.

Hummock areas are often used by off-road vehicle recreationalists but limited visibility can create hazards, particularly for pedestrians.

Those areas which have a high winter water table may develop "quicksand-like" conditions in the low areas (U.S.D.A., 1972, p. 76). High water table areas are also highly sensitive to development and would be particularly unsuitable for either septic tanks or buried pipelines due to the possibility of structure flotation and failure (Ibid, p. 83).

High wind scour and blowout potential also limit the development possibilities of this dune landform. Stabilization planting should be undertaken and consistently maintained during and after any construction.

4. Identification check-list

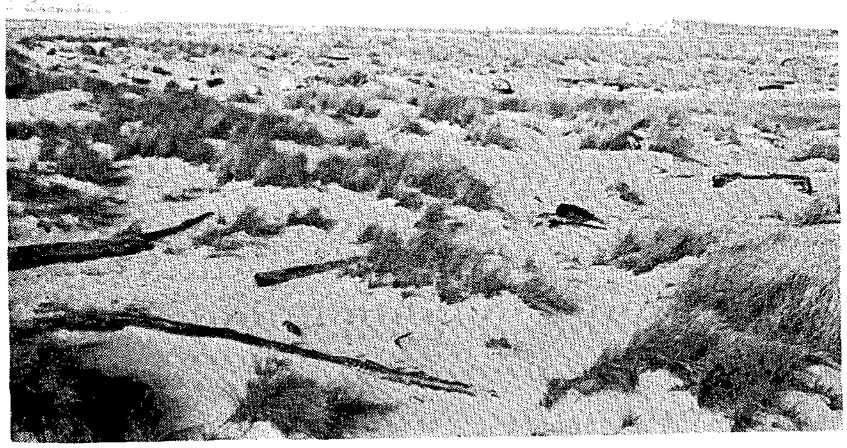
Hummock dunes can be identified by the following characteristics:

1. Hummock dunes occur where clumps of vegetation cause deposition of windblown sand

2. They occur as fields of individual, vegetated sand hummocks

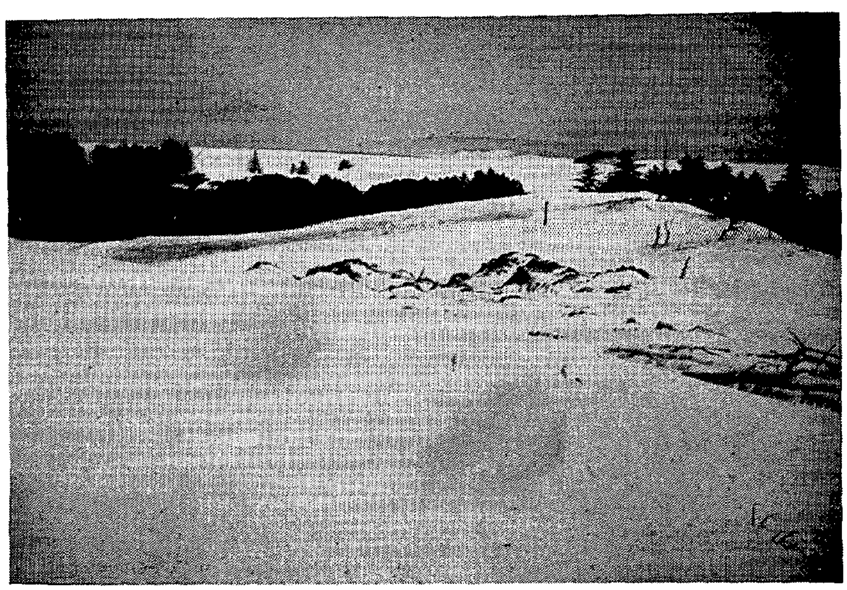
3. Hummock dunes occur either:

   a. leeward of an active foredune, or

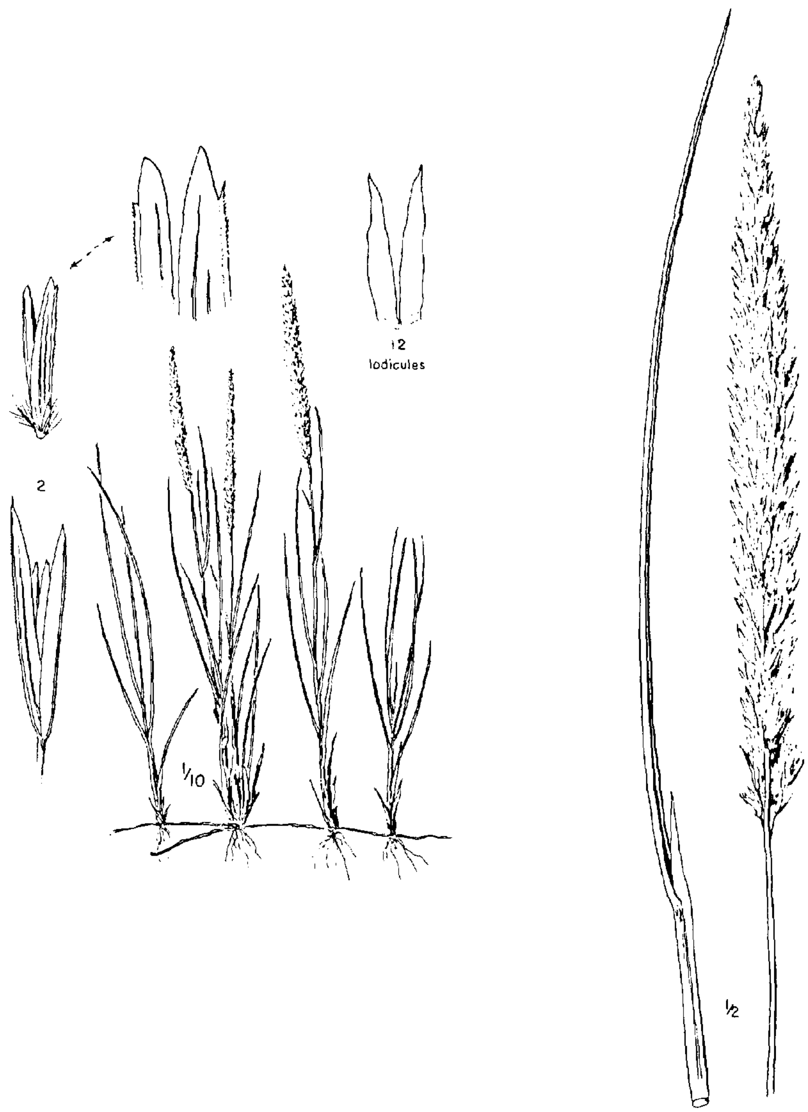


b. inland from the deflation plain, or

c. in isolated hummock fields within open sand areas.

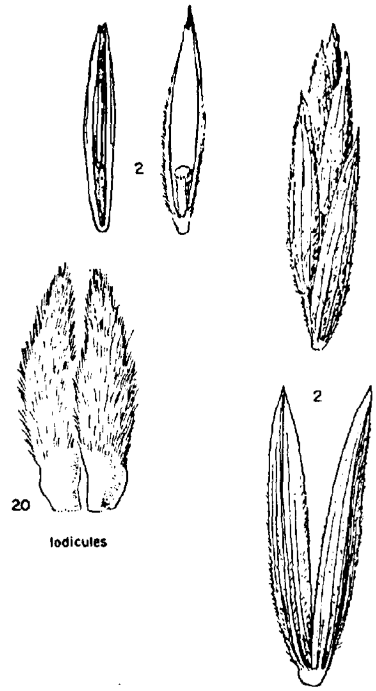


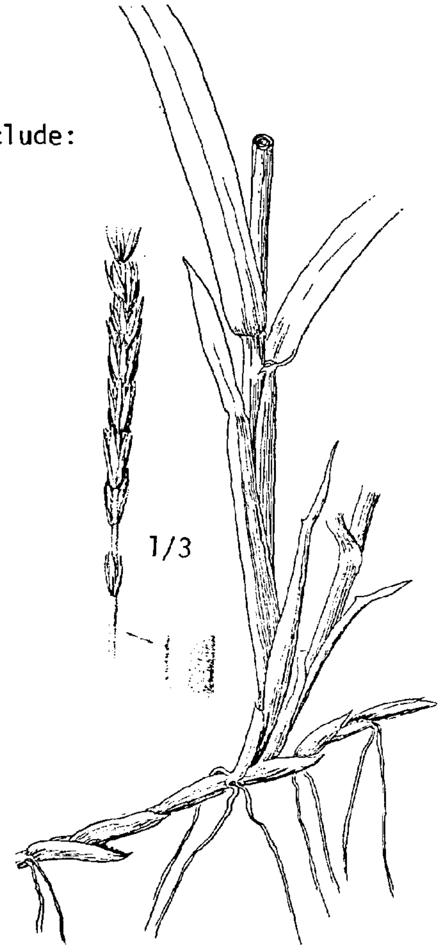
4. European beachgrass (Ammophila arenaria) forms the primary component of the vegetation community of active hummocks.



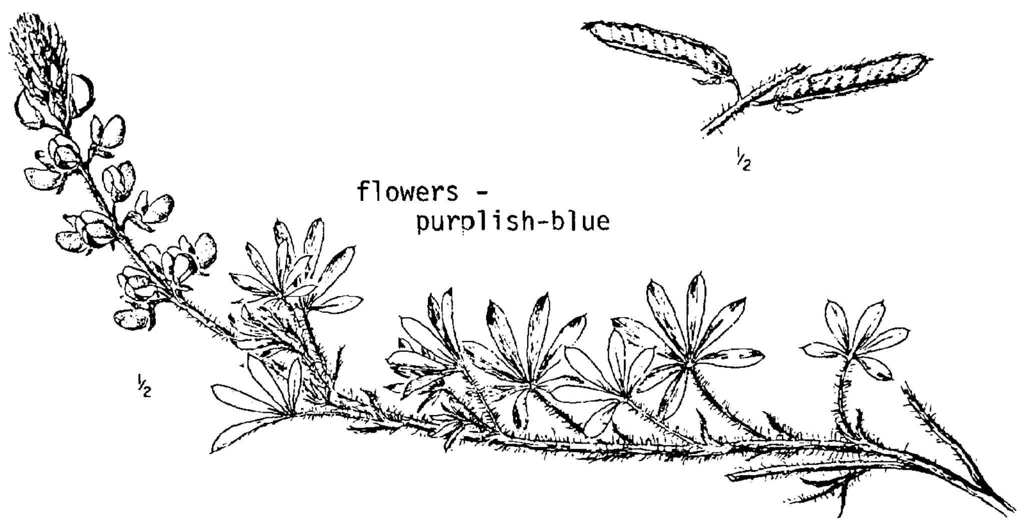
5. Other species which may occur here include:

a. sea lyme-grass (Elymus mollis)

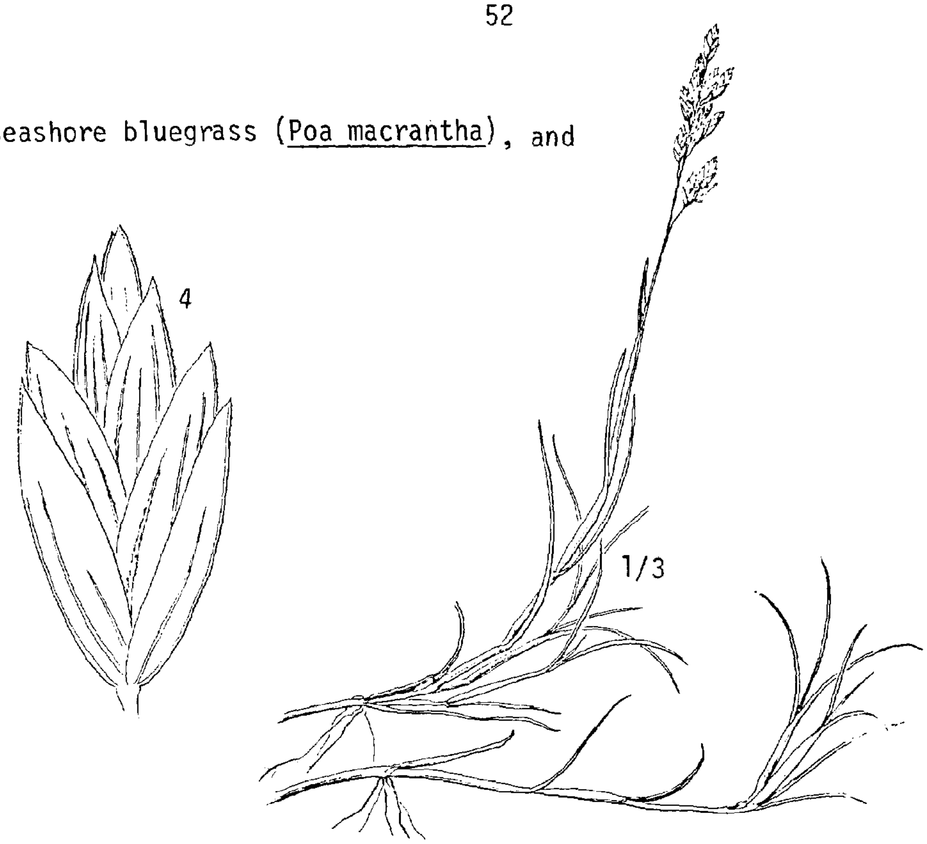




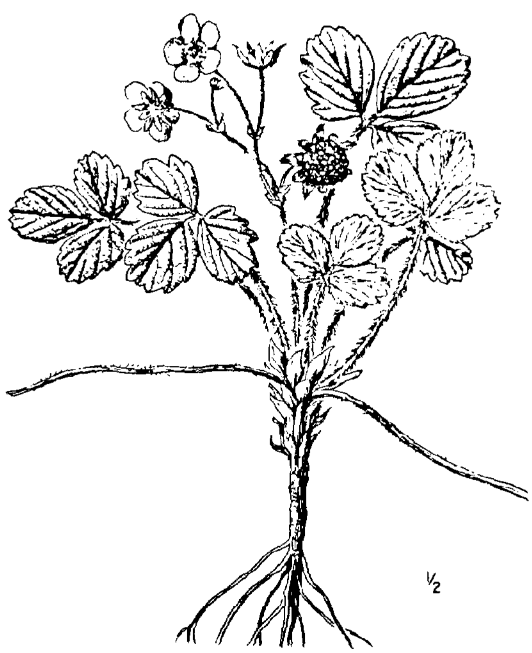
b. seashore lupine (Lupinus littoralis)



c. seashore bluegrass (<u>Poa macrantha</u>), and



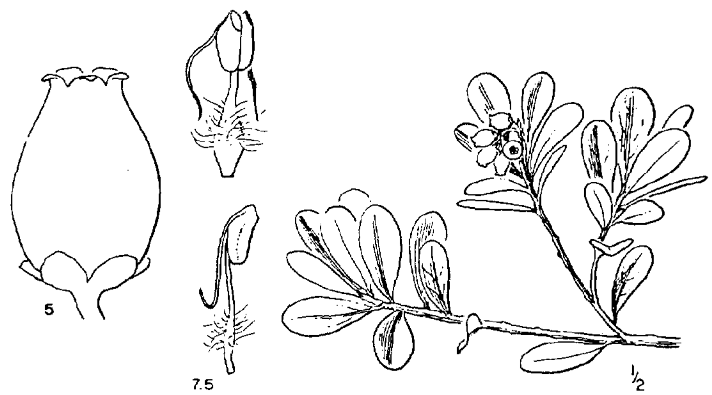
d. coast strawberry (<u>Fragaria chiloensis</u>).



flowers - white to
pinkish

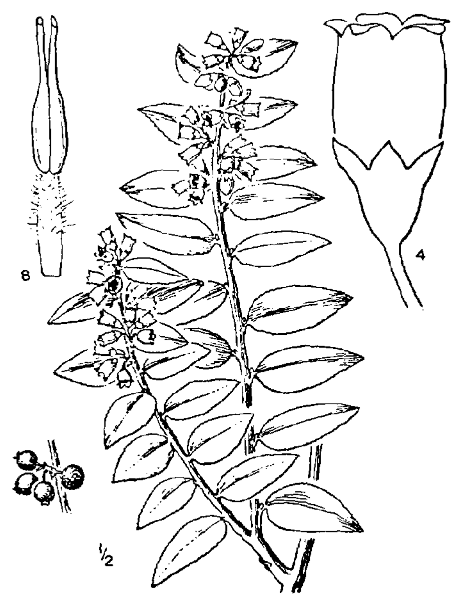
1. Hummock dune areas which have experienced prolonged successional growth indicating conditional stability may display the following species:

   a. kinnikinnic (Arctostaphylos uva-ursi),



flowers -
white to pink

   b. evergreen huckleberry (Vaccinium ovatum),

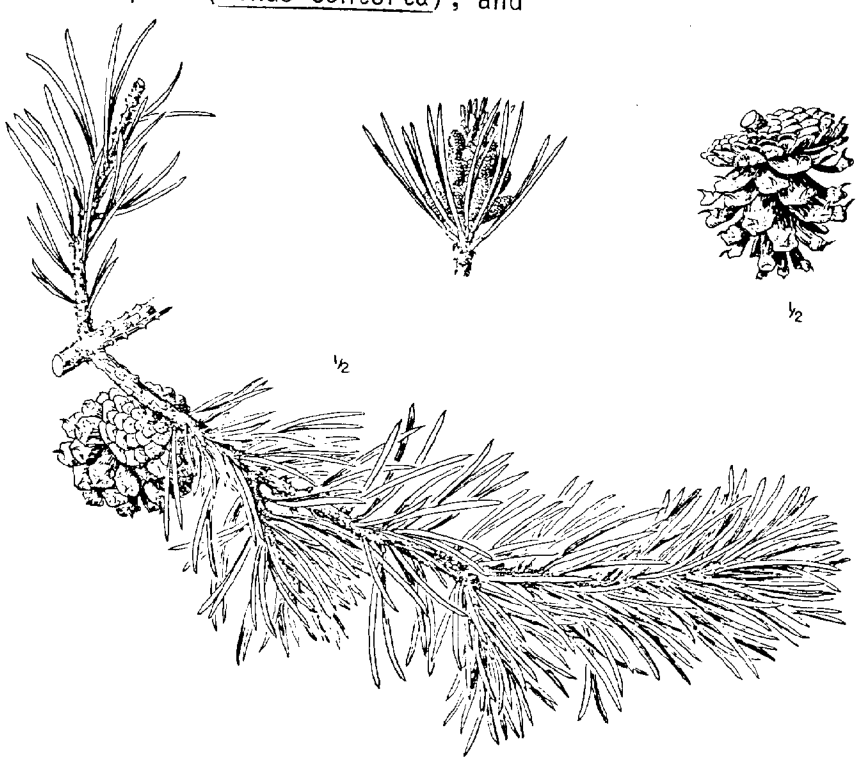


flowers -
white to pink

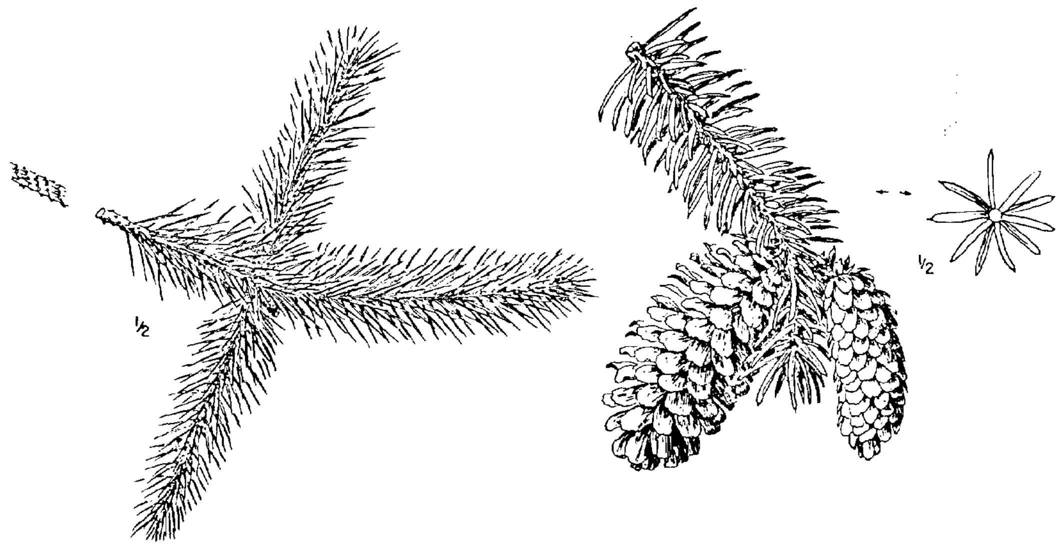
c. salal (Gaultheria shallon),

flowers -
white to pink

d. shore pine (Pinus contorta), and



e. sitka spruce (Picea sitchensis).



B. Surface Stabilized Dunes

Dunes of any form which possess a weakly developed thin soil and underlying unconsolidated sands.

1. Geomorphology

These dunes have been stabilized with vegetation long enough for soil to begin forming. This process may have taken hundreds or possibly a few thousand years.

Surface stable dunes are wind stable so long as the weakly developed soil is not seriously disturbed. The underlying sand materials are prone to reactivation, particularly if excavations are oriented toward prevailing winds. Parabola dunes commonly occur in this landform. Occasionally, buried soils and iron bands may impede permeability. Surface stable dunes occur in the central portion of the Tillamook Spit in Tillamook County and are intersperced throughout the dune sheets in Lane, Douglas and Coos Counties.

2. Vegetation

Forest associations occur most commonly in this unit although meadow communities are not unknown. Native herbs, shrubs and trees, not unlike the later successional species found on conditionally stable foredunes, are found here although species proportions, size of individuals and biomass density are considerably different. Because of the favorable environment provided by an abundance of moisture, mild climates and surrounding forest productivity, coastal forests, particularly the shrub layer, may be nearly impenetrable.

3. Attractions and limitations

The forested surface-stabilized dunes offer attractive sites for a number of man's activities because they are sheltered and somewhat more stable than most other dune forms. Such reactional activities as camping and picnicking, as well as the placement of dwellings and other structures, are popular activities.

Caution must be used in developing these sites, however, because of some inherent limitations. The dunes are only surface stabilized and are prone to reactiviation if the surface vegetation and soil are disturbed. Furthermore, windfallen trees are common along the edge of new clearings posing potential hazard for development.

Many surface stable dunes are underlain by older, buried soils and iron lenses which restrict vertical permeability. This is typical of the subsurface stratigraphy in open dune sand and older stable dunes as well. Septic tank viability could be threatened by local high water due to these impermeable lenses.

Water drawdown could also be a problem in this unit if stabilizing vegetation is affected. Pollution of the groundwater is also a potential problem for the development of this landform.

4. Identification check-list

Surface-stable dunes can be identified by the following characteristics:

1. Dunes having a thin, weakly developed soil.

2. The sands underlying the soil are unconsolidated and will easily reactivate with sufficient disturbance.

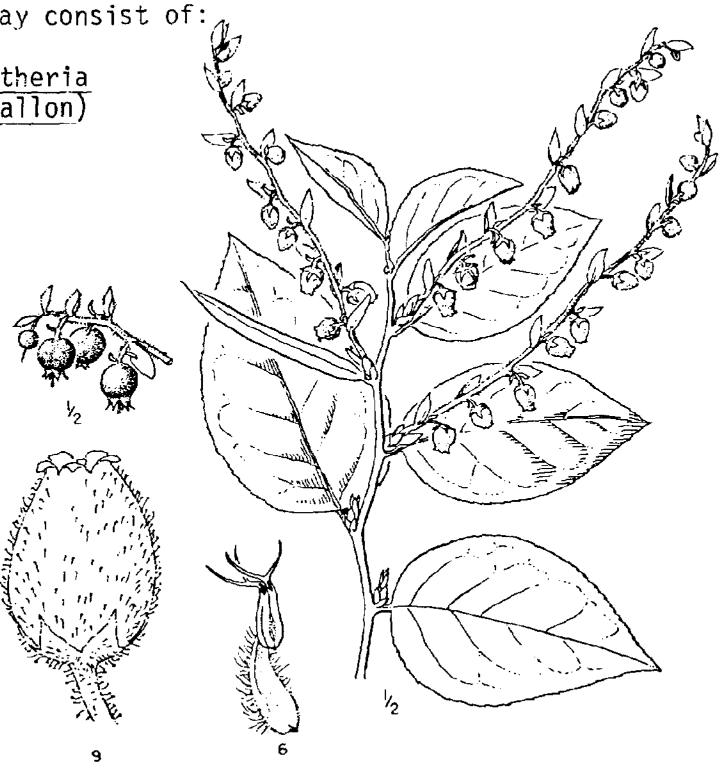
3. Forests most commonly cover the surface-stable dunes.

4. The forested, surface-stable dune is characterized by the following vegetation:

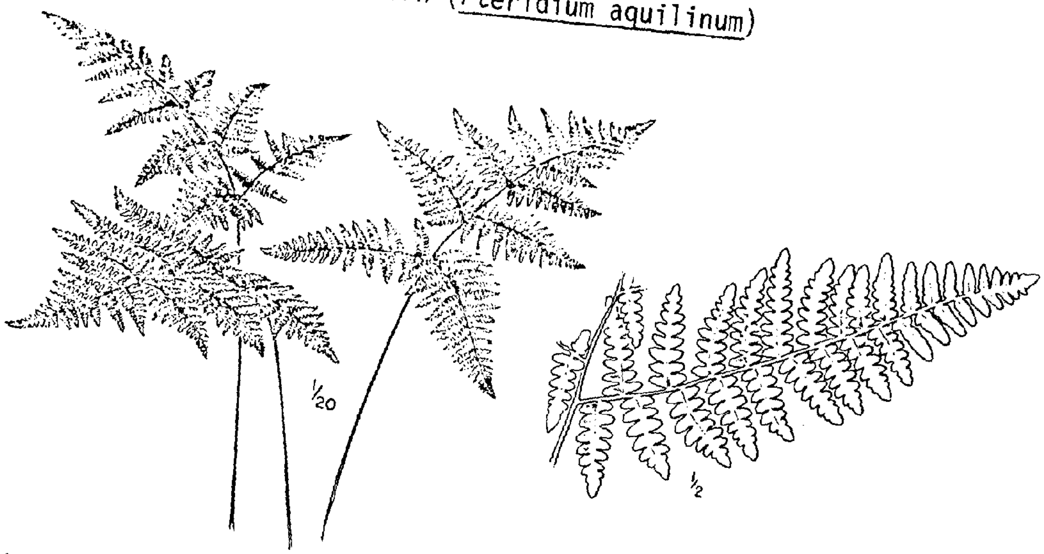
   a. The understory may consist of:

      (1) salal (Gaultheria shallon)

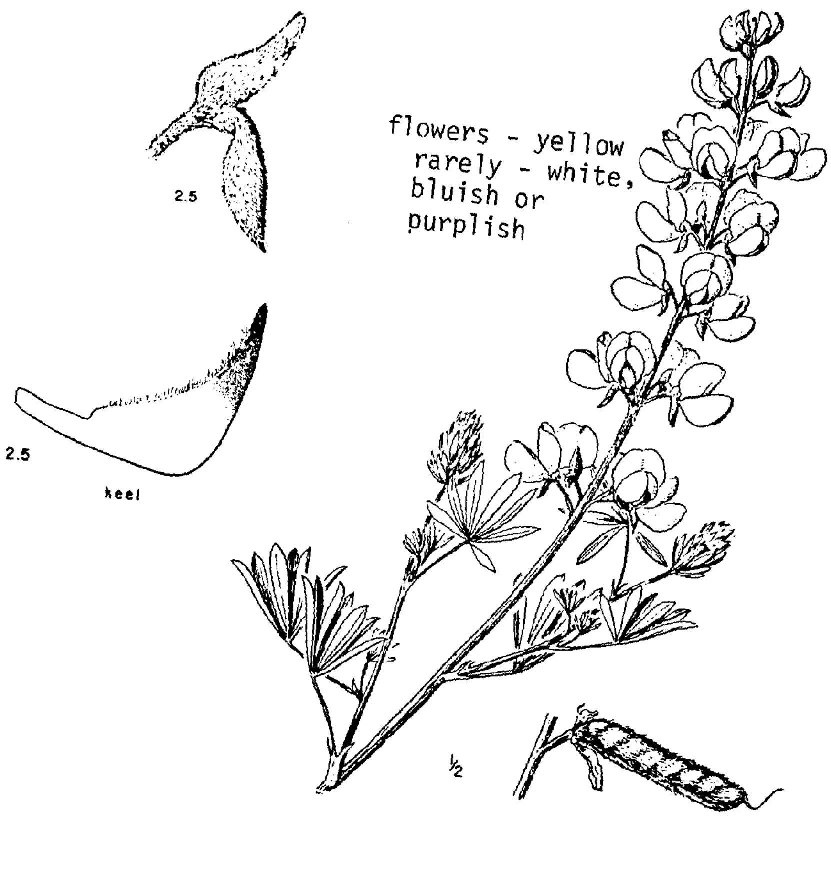
      flowers - white to pink



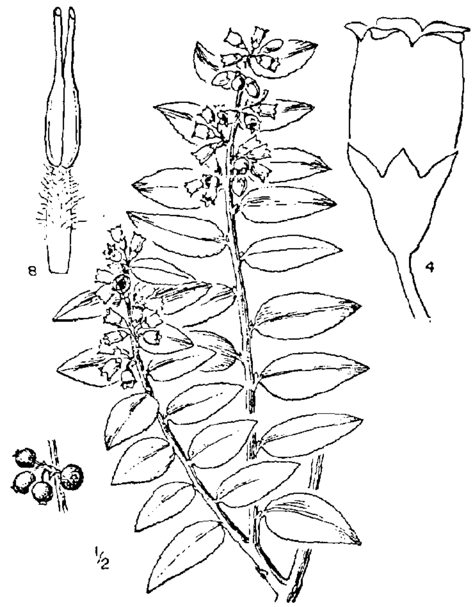
(2) western bracken fern (<u>Pteridium aquilinum</u>)



(3) tree lupine (<u>Lupinus aboreus</u>),



(4) evergreen huckleberry (Vaccinium ovatum) and

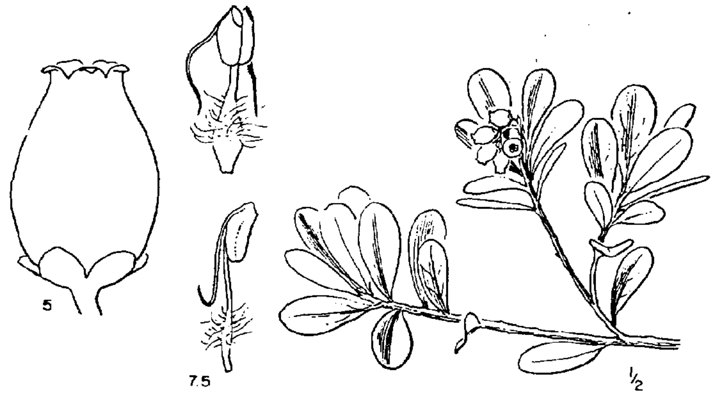


flowers - white to
pink

(5) western rhododendron (Rhododendron macrophyllum).

flowers - pink
to deep rose
rarely white

(6) The more open sites may contain kinnikinnick (Arctostaphylos uva-ursi) and

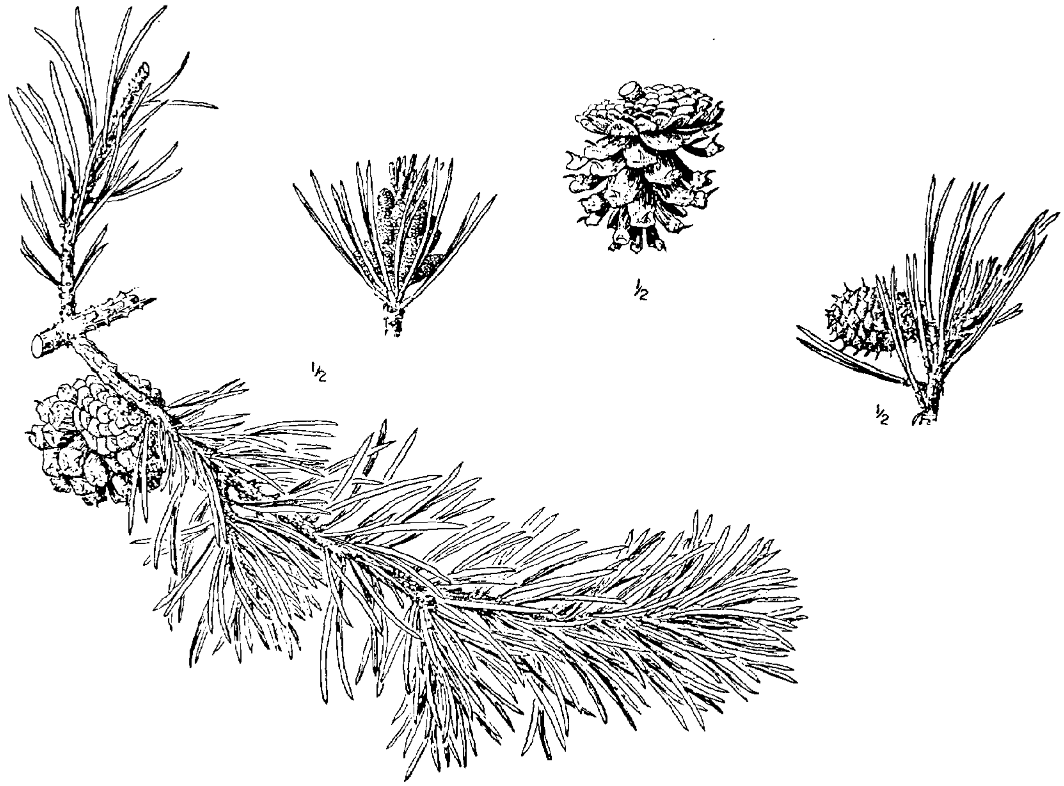


flowers - white to pink

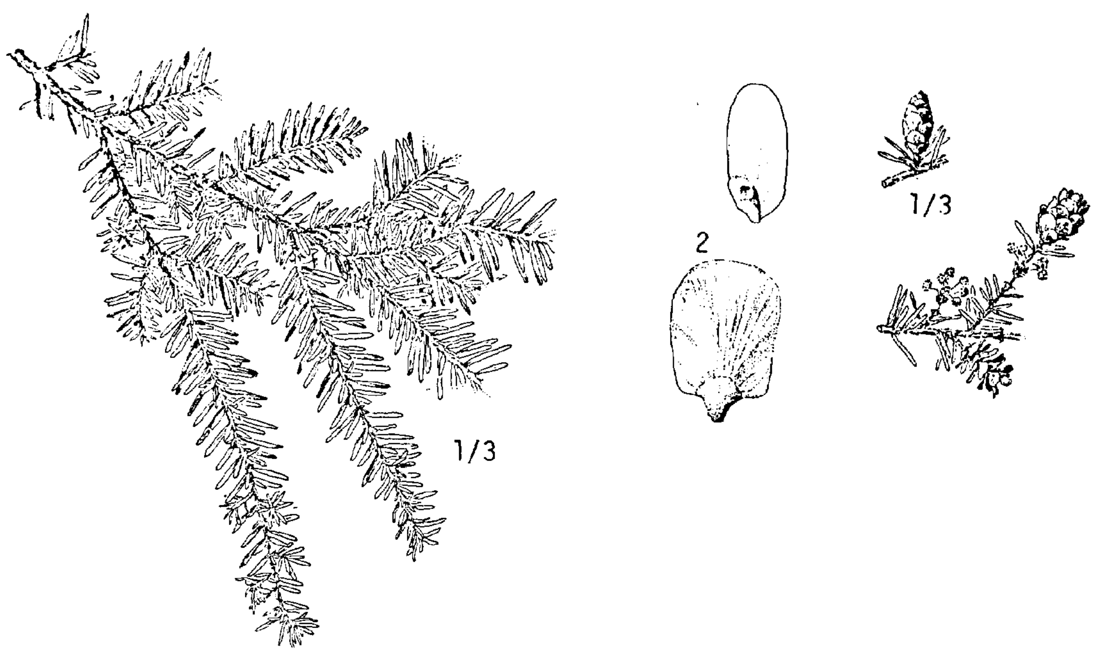
(7) hairy manzanita (Arctostaphylos columbiana).

flowers - white to pale pink

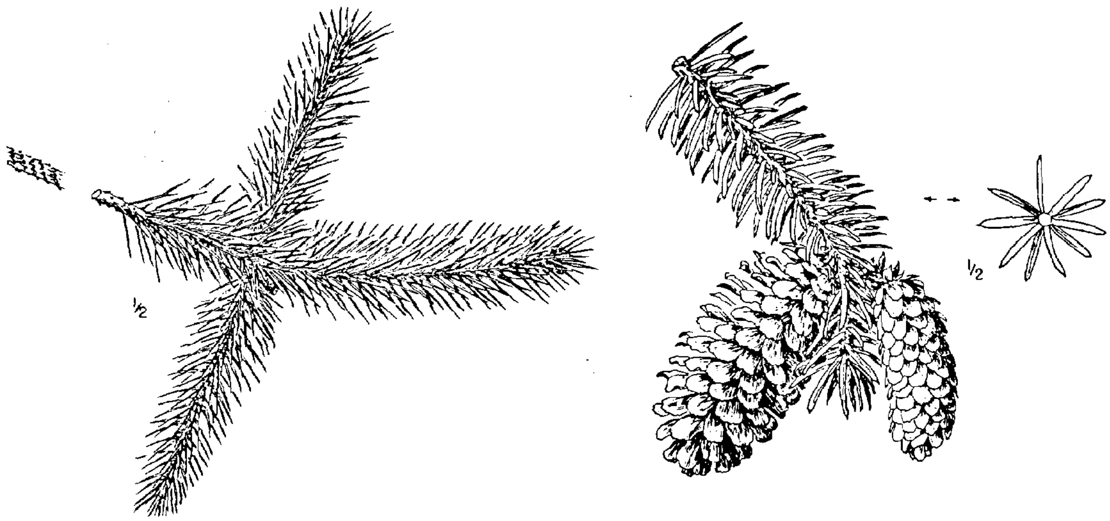
b. The forest canopy consists primarily of shore pine (<u>Pinus contorta</u>) but also may include:



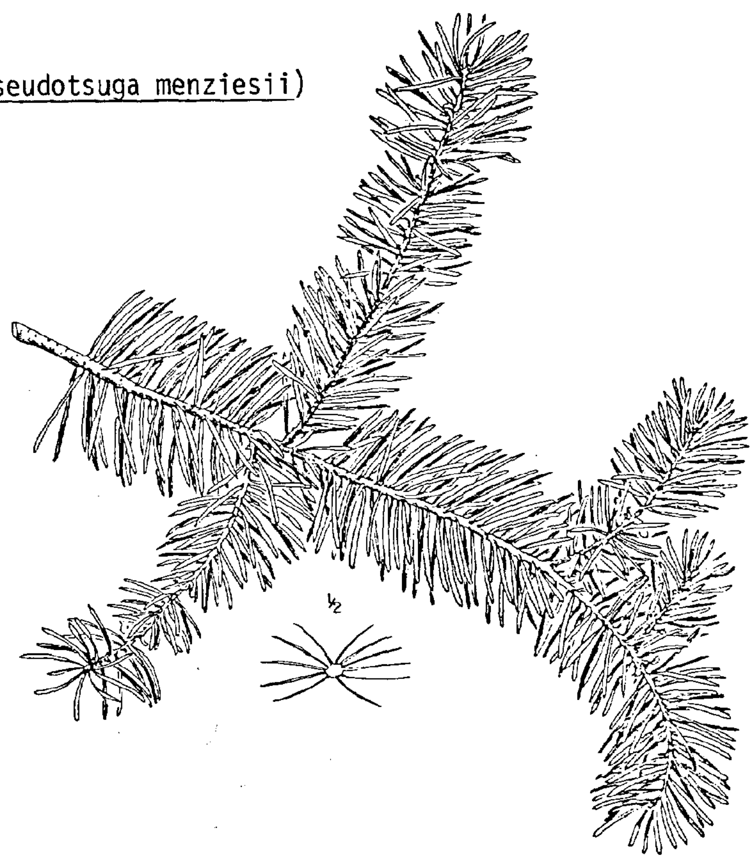
(1) Western hemlock (<u>Tsuga heterophylla</u>) in moist sites,



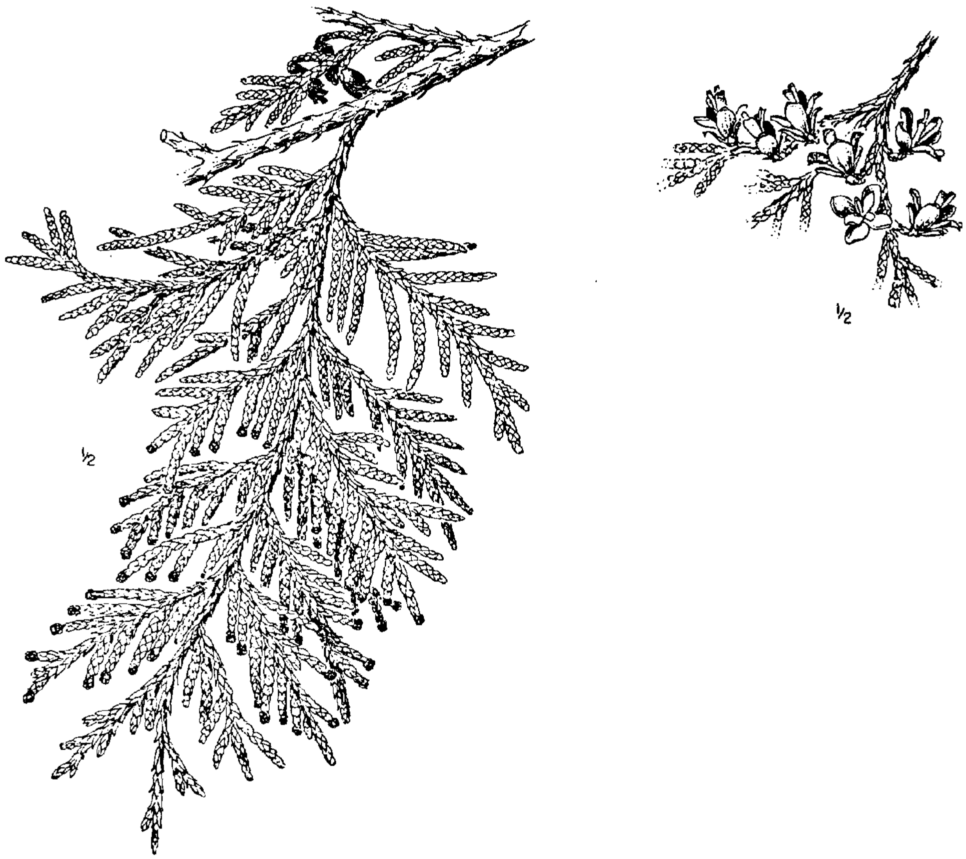
(2) sitka spruce (Picea sitchensis)



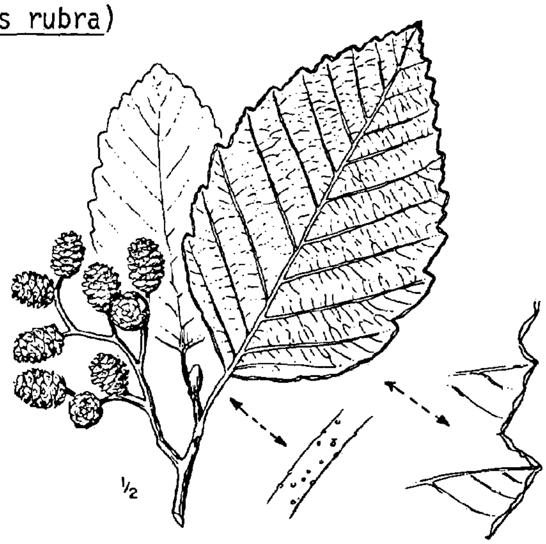
(3) douglas-fir (Pseudotsuga menziesii)



(4) western red cedar (<u>Thuja plicata</u>) and



(5) red alder (<u>Alnus rubra</u>)



C. Older Stable Dunes

Older sand dunes of any form which possess both a deep, well-developed soil and moderately cemented underlying sand.

1. Geomorphology

This dune type has been stabilized with a vegetative cover long enough for a relatively deep soil to develop and for the underlying sands to acquire some stability. The sub-surface sands exhibit varying degrees of cementation. The iron bands and buried soils which are found in the surface stable dune occur more frequently here and are more pervasive.

Although these sands will form a cliff where excavated, sloughing and landsliding are common. This is often intensified when saturation occurs due to subsurface impermeable iron lenses.

This landform may contain layers of loose sand overlying or underlying the semi-cemented strata but it is wind stable throughout the cemented layers.

2. Vegetation

Forests, often the coastal climax forest, most commonly occur here although natural grass areas may be found as well. The same species as occur in the surface-stable dune classification also occur here. A more even mixture of forest species is often found with less predominance of shore pine, and the forest canopy may be more dense with a resulting less dense shrub layer.

3. Attractions and limitations

The older stable dune presents an attractive site for recreational activities and residential development. The limitations associated with mobile sands do not exist with this landform. When excavated, the semi-cemented sands will maintain a cliff and are wind stable. However, sloughing is common, particularly in the winter months. This tendency is accentuated during groundwater recharge months by the impermeable iron bands which commonly run horizontally through this unit. Infiltering groundwater is concentrated above these bands, saturating the sands causing collapse where cliffs exist. This same phenomenon, which forms a perched water table, results in conditions highly unfavorable to septic tank siting, consequently, septic tank failure is not uncommon in this landform.

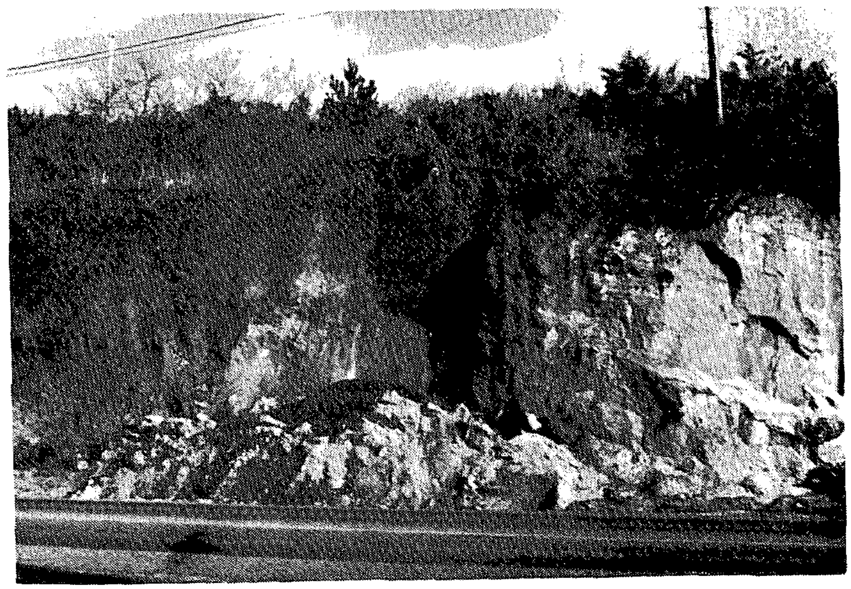
4. Identification check-list

Older stable dunes can be identified by the following characteristics:

1. The presence of a moderately well developed soil.

2. The underlying sands are somewhat consolidated and often exhibit horizontal iron bands which offer varying resistance to erosion and impede vertical percolation of groundwater.

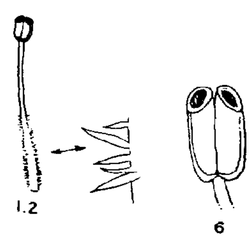
3. Underlying sands will form a cliff where cut, but sloughing is common.

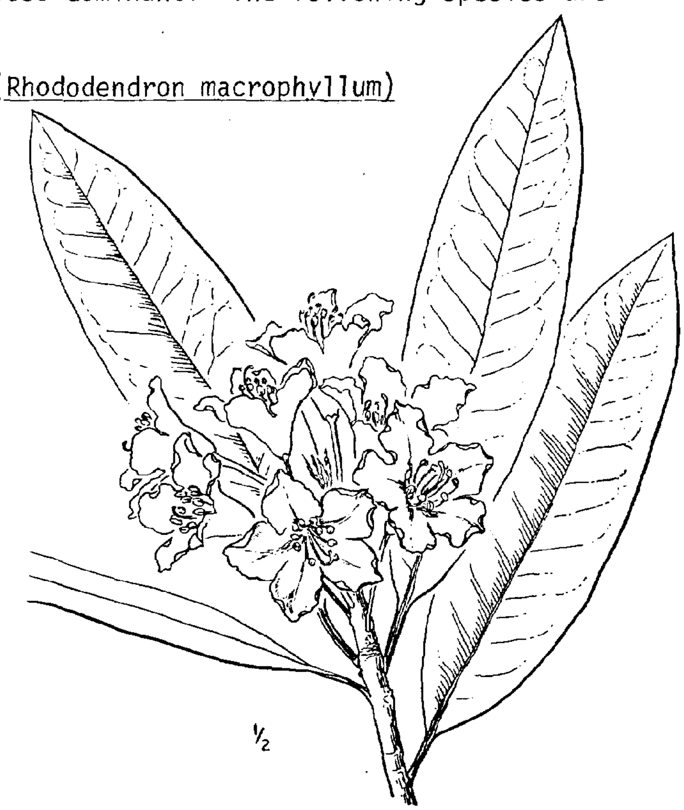


4. Vegetation species which occur on the older-stable dune are essentially the same as the surface-stable dune but species proportions vary. Shore pine and salal are less dominant. The following species are common to this landform:

   a. western rhododendron (Rhododendron macrophyllum)

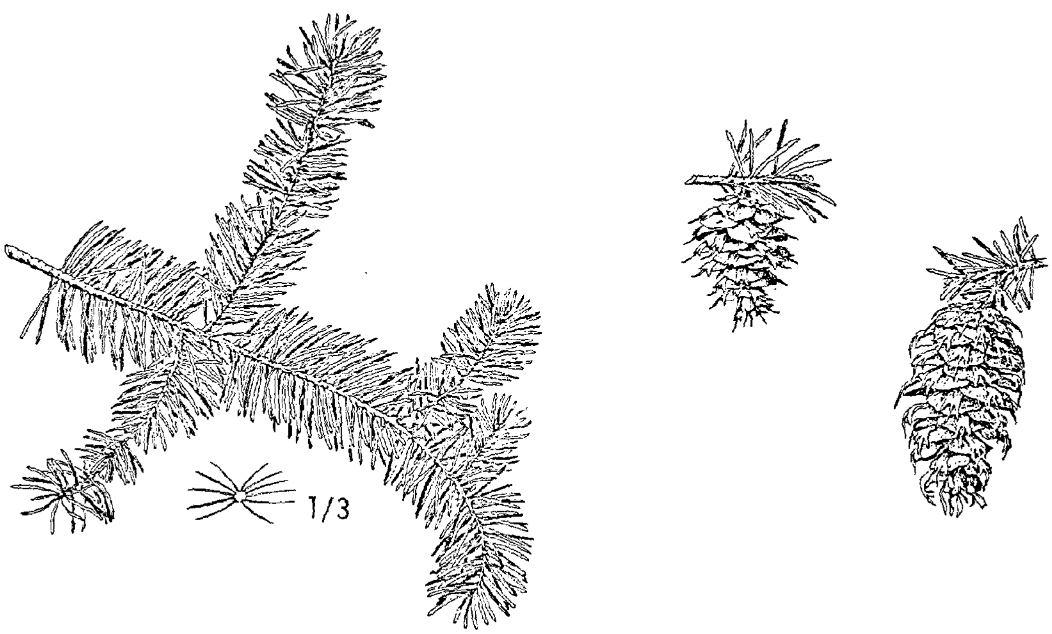
flowers - pink to
  deep rose, rarely white



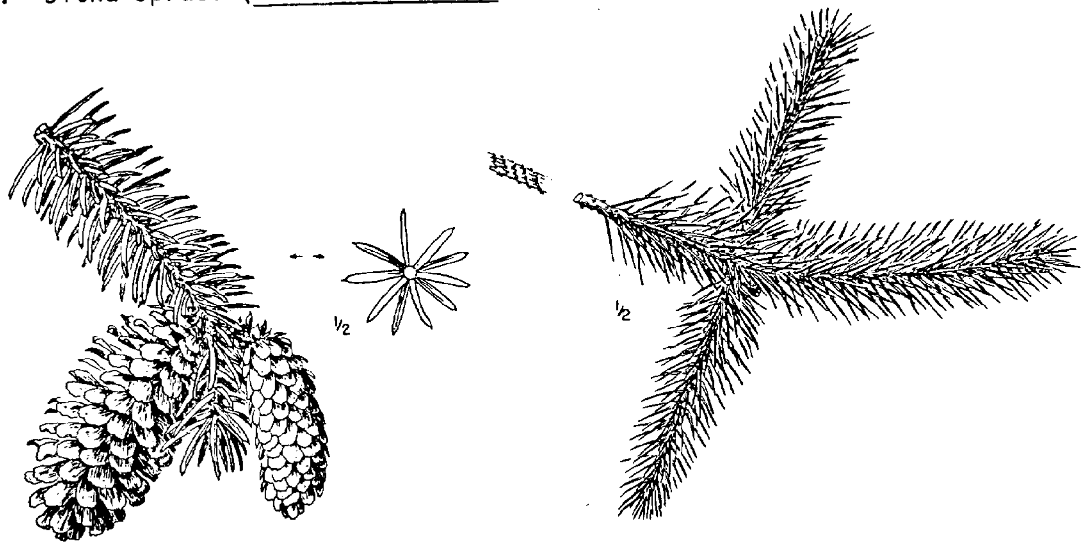


b. western hemlock (<u>Tsuga heterophylla</u>)

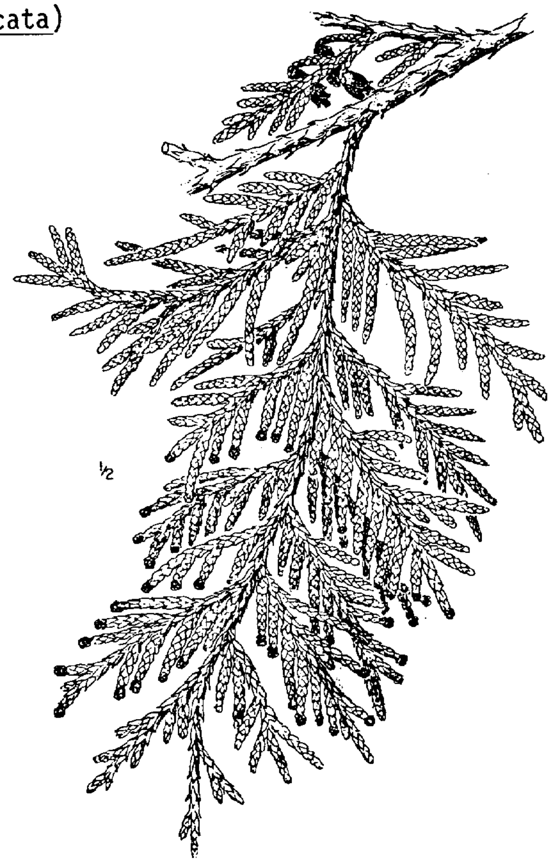
c. douglas-fir (<u>Pseudotsuga menziesii</u>)



d. sitka spruce (Picea sitchensis)



e. western red cedar (Thuga plicata)



D. Parallel-Ridge Dunes

Multiple sand dune ridges which occur more or less parallel to, and inland from, the foredune.

1. Geomorphology

Each ridge in a group of parallel-ridge dunes originally formed as a foredune on an accreting beach. As the beach grew seaward, vegetation advanced to keep pace with the upper beachline. New dune mounds and eventually a new foredune developed oceanward of the previous one. Continued accretion resulted in the eventual development of a series of parallel ridges bordering the beach. The sand dunes of the Clatsop Plains are classic examples of this type. Here the dunes are very broad, gently sloping features aligned in a general north-south direction, parallel to the beach. Other, often discontinuous examples occur in association with accreting beach areas, such as in those areas of jetty construction. Parallel-ridge dunes appear to be developing at the north end of South Beach in Lincoln County. A very pronounced example of this feature occurs adjacent to the north end of Heceta Beach in Lane County. These are extremely steep ridges, unlike the Clatsop Plains variety.

2. Vegetation

Vegetation associations in parallel-ridge dunes become increasingly diverse and mature progressing inland, and range from European beachgrass (Ammophila arenaria) on the existing foredune, landward through native herbs, shrubs and forest species, many of which have been planted through sand stabilization projects (e.g. Clatsop Plains).

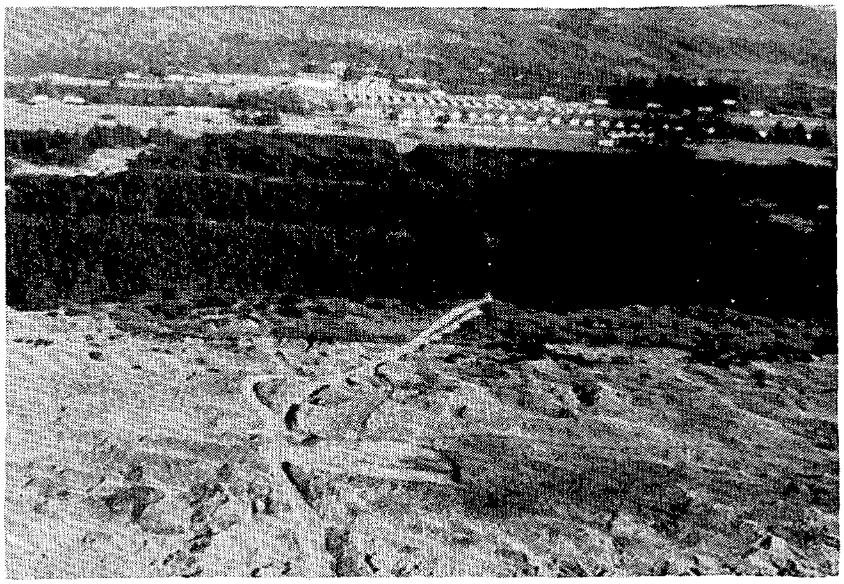
3. Attractions and limitations

This landform probably has the same attractions and limitations as conditionally stable hummock dunes and surface stabilized dunes. Due to reactivation of a major portion of the sand in the Clatsop Plains, most examples of this landform are in a conditionally-stable state although areas of surface-stabilized conditions do occur.

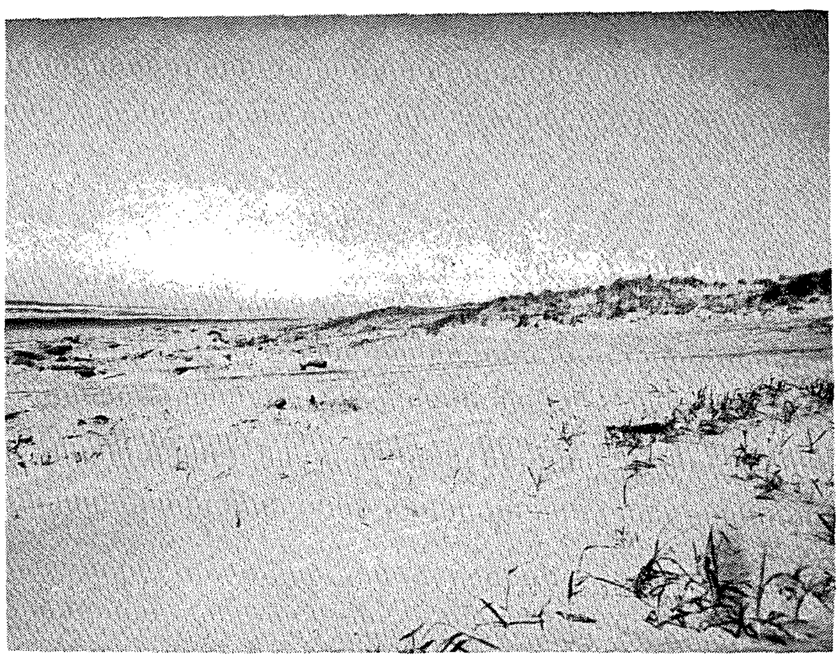
4. Identification check-list

Parallel-ridge dunes can be identified by the following characteristics:

1. They occur in groups, running more or less parallel to the beach.



2. The Clatsop Plains variety commonly possess a very gentle angle of slope, whereas limited occurrences on the central and south coast are steeper.



3. Because they occur in a region of accreting beaches, portions of a newly forming foredune may occur seaward of the present foredune.

VI. INTERIOR DUNES - NONVEGETATED

This category includes those large areas of active sand which are located primarily on the sand sheets (sand deposits of considerable depth and breadth overlying subsurface coastal terraces) along the central Oregon coast. These dunes are mostly vegetation free and therefore, are formed primarily in response to wind and sand supply. Moisture and topographic factors provide morphological controls of secondary importance.

The western boundary of open dune sand areas is generally located east of the deflation plain, but is occasionally found immediately adjacent to the foredune. The western section is essentially a nonvegetated equivalent of the hummock dunes. Open sand areas derive their sand supply from the deflation plain and foredune (Figure 5). However, open sand

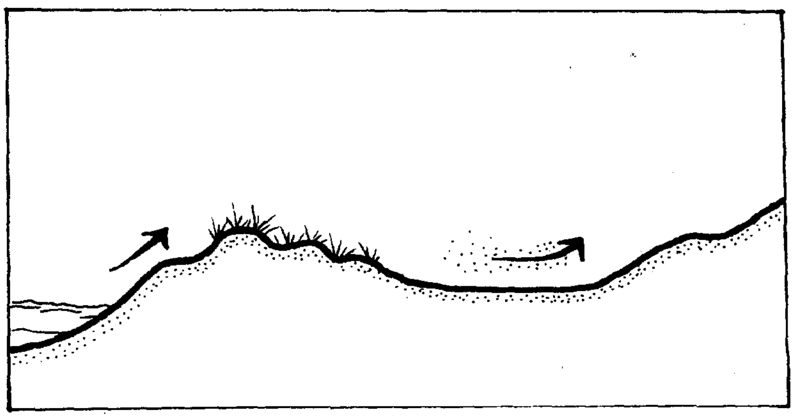


Figure 5. Beach, foredune and deflation plain supply sand to interior open sand areas.

landforms located downwind from conditionally stable foredunes or vegetated deflation plains could dwindle due to sand starvation because little sand escapes beyond these well-vegetated landforms. Open sand dunes move inland under the influence of onshore winds while the sand supply is captured by the foredune. Consequently, open sand areas are growing ever smaller, as increasingly large deflation plains are formed in their wake.

The pattern of dune development and reactivation is nowhere more complicated than on the open sand sheets. Sand deposited in these areas during Pleistocene and post-Pleistocene sea level fluctuations has been "reworked" several times, varying from one area to another. Because of this, buried soils, iron bands, islands of mature forest, and actively eroding older dune strata are common features coexisting within active sand areas.

A. Transverse-ridge Dunes

Low northeast/southwest oriented, nonvegetated sand dune ridges which most commonly migrate in a southeasterly direction.

1. Geomorphology

Transverse-ridge dunes are primarily features of the summer environment. They are undulating, sinuous ridges which are formed essentially perpendicular to the northwest winds of summer and which are greatly modified in shape during winter storms. Their orientation is northeast/southwest; migration takes place in semi-parallel ridges moving in a southeasterly direction (Figure 6).

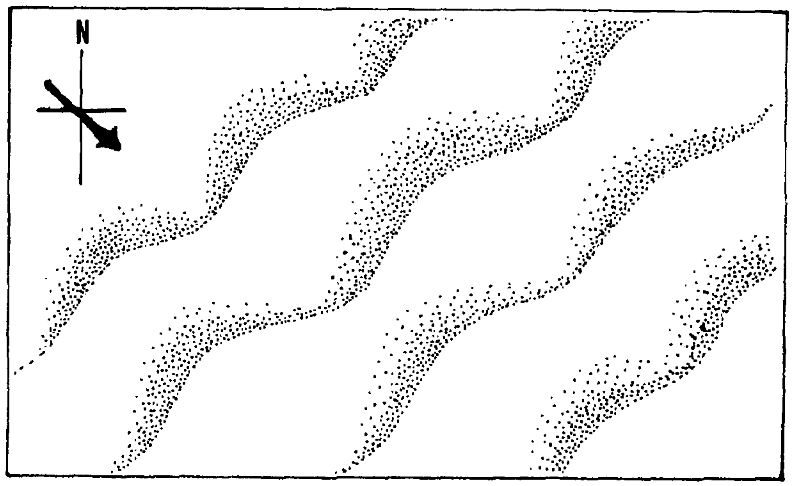


Figure 6. Transverse-ridge dunes form approximately perpendicular to northwest summer winds.

Transverse-ridge dunes are a low relief feature, five to twenty feet high composed of a gentle sloping windward face (five to twenty-five degrees) and a relatively steeper slip face (sixty to seventy degrees). The distance between crests is highly variable, but generally ranges between seventy-five and 150 feet. Where breaches occur, these dunes reveal a highly complex interior cross-bedding. This feature is produced when layers of sand from an advancing dune are deposited obliquely on the dune in its path.

Transverse-ridge dunes occur in groups. They are commonly found on the eastern fringe of the deflation plain. However, Lund (1973) reports that thirty years ago transverse dunes often extended from the beach east into the lower part of the oblique-ridge dunes. This occurred prior to the introduction of European beachgrass (Ammophila arenaria).

A zone of seasonally wet transverse-ridge dunes is often found on the eastern fringe of a deflation plain with a high winter water table. Transverse-ridge dunes commonly extend from the eastern edge of the deflation plain into the zone of the massive oblique-ridge dunes, often "riding" up over the surface of the latter.

Transverse-ridge dunes occur in Lane County on the major open sand strip between the Siuslaw and Siltcoos rivers and on the open sand areas west of north Ten Mile Lake in Coos County.

2. Vegetation

Although transverse-ridge dunes comprise a basically open dune sand unit, isolated areas of vegetation may occur in the depressions between crests. These are primarily associated with the deflation plain and will consist of the various plant types associated with that landform.

3. Attractions and limitations

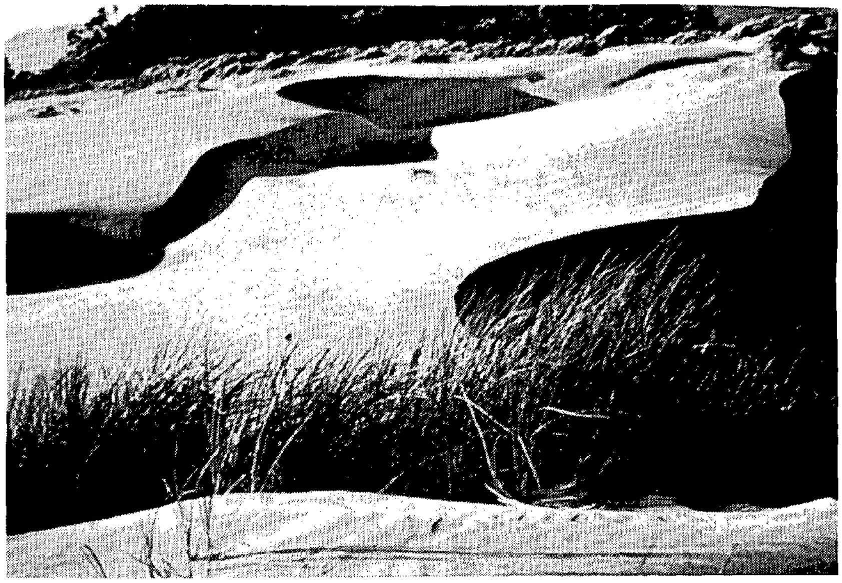
This unit appears to be highly attractive to off-road vehicle users and, to a lesser extent, pedestrian traffic. It has a high tolerance level to most recreational activities, however, facilities such as parking lots and road construction are not suited to this formation. (In some cases stabilization plantings could render such developments feasible; however, these are commonly relatively infertile sand areas (U.S.D.A., 1972, p. 105).

Factors which could create hazards are occasional areas of quicksand in wet depressions between transverse dune ridges, poor visibility in an area used by both off-road vehicle enthusiasts and pedestrians, and inundation or undermining of structures by moving sand.

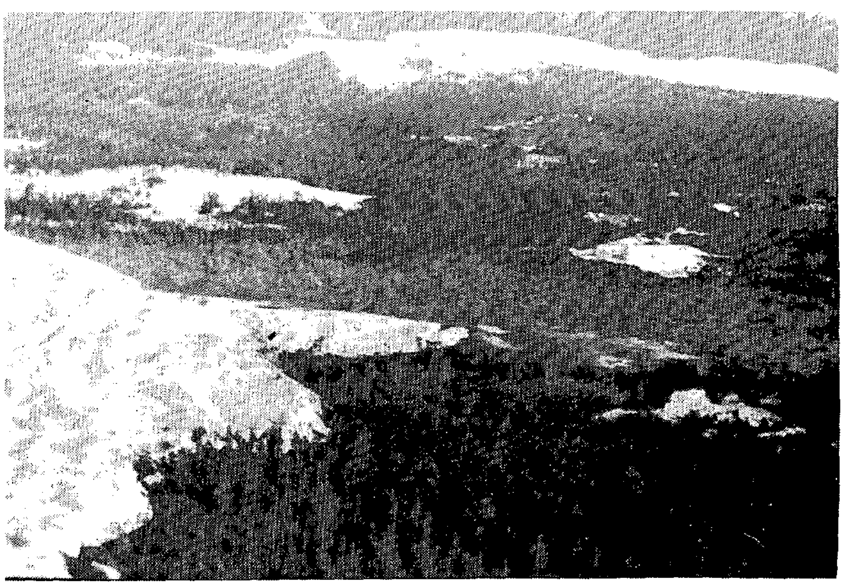
4. Identification check-list

Transverse dunes may be identified by the following features:

1. This dune form occurs as a low (five to twenty-five foot) sinuous ridge with a gently sloping (five to twenty-five degree) windward face and a steeper (sixty to seventy degree) lee face.



2. Transverse-ridge dunes exhibit a northeast/southwest trend and occur in groups on the large, open sand areas along the south central coast.



3. Transverse-ridge dunes often ride up over the western flanks of the massive oblique-ridge dunes.

4. Marsh-type vegetation may occur between ridges where these dunes overlap onto the deflation plain.

B. Oblique-Ridge Dunes

Massive, generally easterly trending and migrating, nonvegetated ridge dunes found on central Oregon coastal sand sheets.

1. Morphology

The most dominant and obvious dune form in the open sand is the oblique-ridge type. Like the transverse-ridge, it is dynamic in nature. However, unlike the transverse-ridge, which is produced by unidirectional wind flow, the oblique dune is formed both by the northwest summer and southwest winter winds, experiencing its most energetic movement during winter storms (Ternyik, 1978). Its somewhat sinuous axis is oriented at an angle (obliquely) to both dominant seasonal wind sources (Figure 7). Primary controlling factors in the development of the oblique-ridge dune

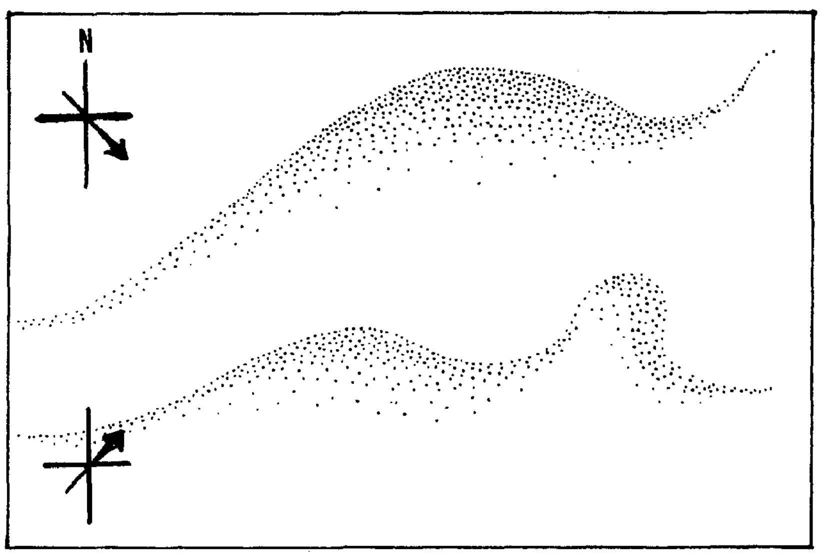


Figure 7. Oblique-ridge dunes form obliquely to both northwest and southwest dominant seasonal winds.

are an abundant sand supply, nearly constant onshore winds and coastal forests which act as wind breaks (Cooper, 1958).

Sands are moved inland by the onshore winds both in the summer (northwest wind) and the winter (southwest wind). Coastal forests which exist on the sand sheets break the flow of the low-level winds, causing them to deposit their sand load at the forest margin. Sand is thereby deposited at a site until the height of the dune thus produced equals or exceeds that of the windbreak. Sand is then precipitated over the eastern face of the dune (of the precipitation ridge) by onshore winds (Figure 8). In this way, the dune moves slowly inland inundating the

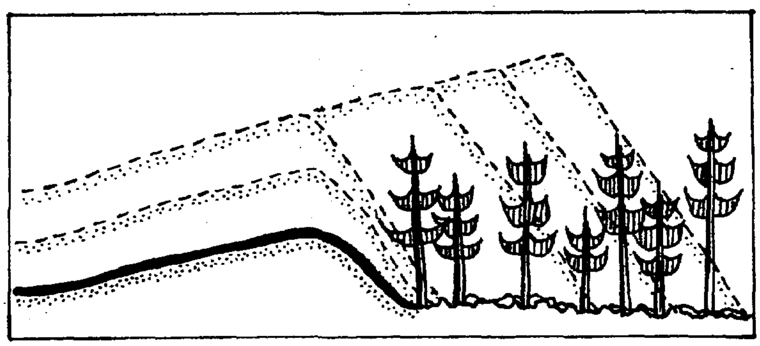


Figure 8. Accumulation and advance of the oblique-ridge dune.

forest as it goes (Cooper, 1958). The ridge does not actually migrate, but the ridge crest operates rather like a stationary transverse dune, the upper lee face of which develops to the south in the summer and to the north in the winter in response to dominant seasonal wind direction (Figure 9). The windward face has a gentle slope (five to thirty degrees)

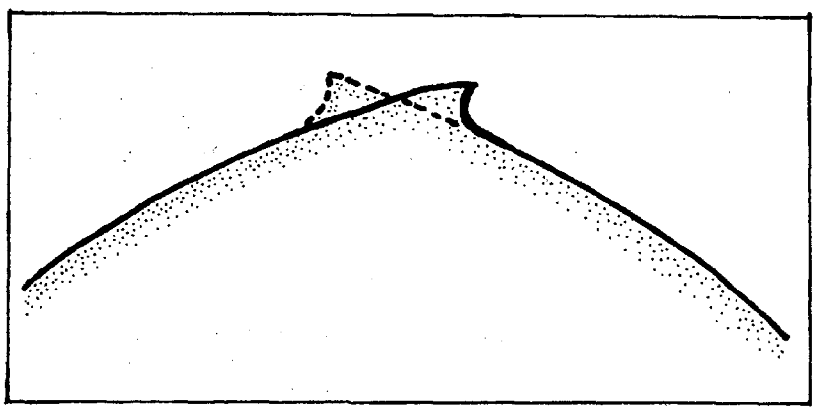


Figure 9. The ridge position of the oblique dune is modified by seasonal winds.

while the lee face is considerably steeper with a gradient of sixty to seventy degrees.

The oblique dunes may reach heights of 180 feet along the eastern edge and may occur in groups with 500 feet or more between ridges. They attain great lengths, averaging over 3,000 feet while some are nearly a mile long (Cooper, 1958). They are commonly bounded on their ocean-ward side by transverse-ridge dune systems and often terminate at their eastern extremity in a precipitation ridge, actively invading older forested dunes (Figure 10). A system of oblique-ridge dunes may form a

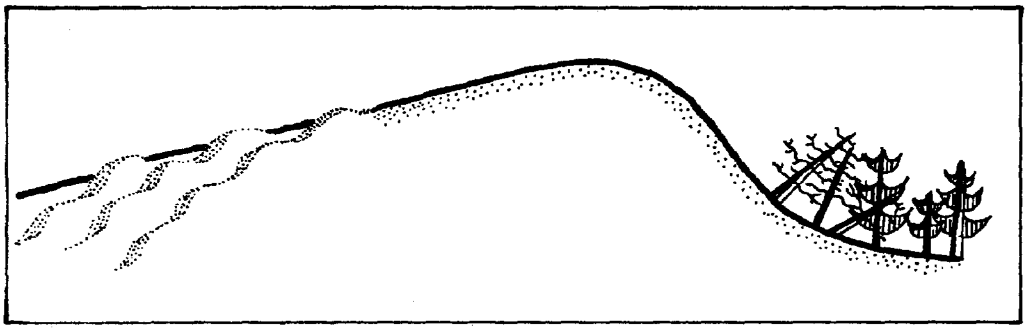


Figure 10. Transverse-ridge dunes riding up over the flanks of an oblique-ridge dune which terminates in a precipitation ridge.

nearly continuous eastward advancing precipitation ridge, often called the active ridge.

The world's distribution of the oblique-ridge dune is limited to the central Oregon coast and occurs on the sand sheets of Lane, Douglas and Coos Counties. Good examples are found between the Siuslaw and Siltcoos Rivers in Lane County and just north and south of the Douglas-Coos Counties boundary.

2. Vegetation

Sparse, marsh-type vegetation may occasionally occur in the depressions between ridges within this landform. These are areas of high water table and are classified as occasionally wet interdune areas. Isolated areas of hummock dunes may also occur on the surface of this landform.

3. Attractions and limitations

Recreationalists use the oblique-ridge dunes on foot, on horseback and in off-road vehicles. These dunes dominate the landscape and capture the imagination of visitors. Impact of recreationalists on this landform is reportedly negligible (U.S.D.A., 1972) although research on Atlantic Coast dunes indicates that considerable sand transport can occur from ORV traffic. This phenonemon would not commonly be considered a serious problem in areas of open windblown sand, however, it could prove to be a contributing factor to such problems as rapid dune advance on interdune lakes, such as at Cleawox Lake in Lane County where ORV traffic is quite heavy.

Oblique-ridge dunes do, however, pose potential hazards for recreationalists from naturally camouflaged tree cast openings in the ground.

Although the oblique-ridge dune is poorly suited to the development of permanent structures (U.S.D.A., 1972), some development has occurred here. Stabilization plantings, if carried out and maintained properly, can alleviate potential development problems. A primary obstacle, however, is that due to the oblique-ridge dunes' mobility and incompatability with legal boundaries, access to key downwind sites for the purpose of stabilization plantings may not be readily available to the developer. Water table limitations mentioned in relation to the surface stabilized and older stable dunes also apply to this dune form.

Recently, concern has been expressed for the survival of these unique dune forms. It has been predicted that these features could disappear within seventy-five years due to sand starvation (U.S.D.A., 1972, p. 110). Those processes, both natural and man-induced which threaten this feature include:

1. The eastward expansion of the deflation plain due to foredune stabilization which cuts off sand supply to the area (Figure 11).

2. Stabilization plantings for developmental and protection purposes.

3. Natural revegetation of the open dune sand areas. The sand sheets of the central Oregon coast, on which these dunes occur have experienced several periods of dune reactivation and subsequent revegetation in the last few thousand years (Cooper, 1958). Sands which were reactivated, probably by fires, experienced restabilization through the natural readvance of indigenous species. This pattern of revegetation could well repeat itself today.

Due to the combination of foredune development and resulting deflation plain advance, stabilization plantings and natural revegetation, the oblique-ridge dunes will almost certainly disappear in the foreseeable future, unless man intervenes.

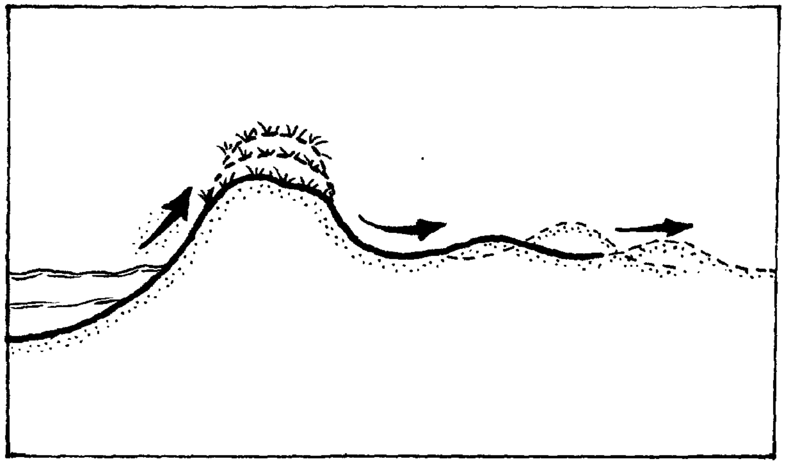
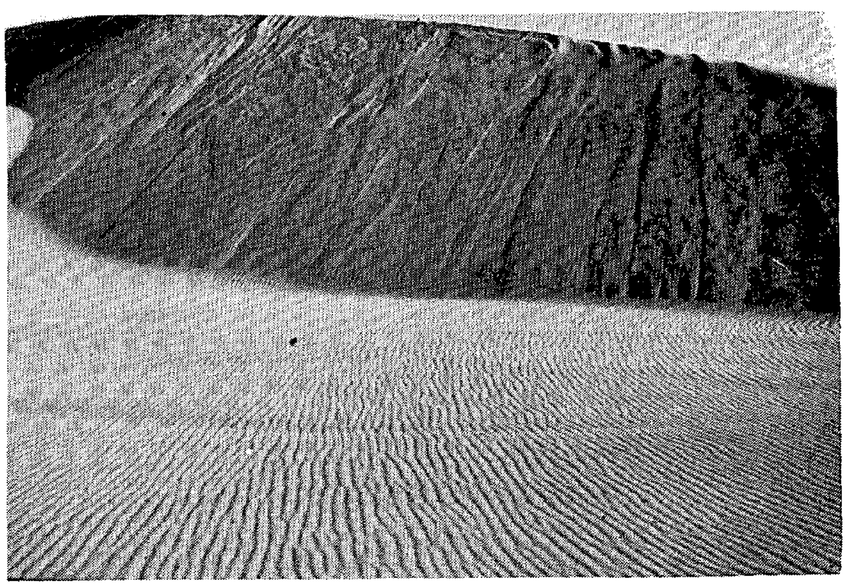


Figure 11. Eastward expansion of deflation plain. Sand supply is interrupted by the growing foredune.

4. Identification check-list

The oblique-ridge dune can be identified by the following characteristics:

1. The massive size of the oblique ridge dune is probably its most distinctive characteristic.

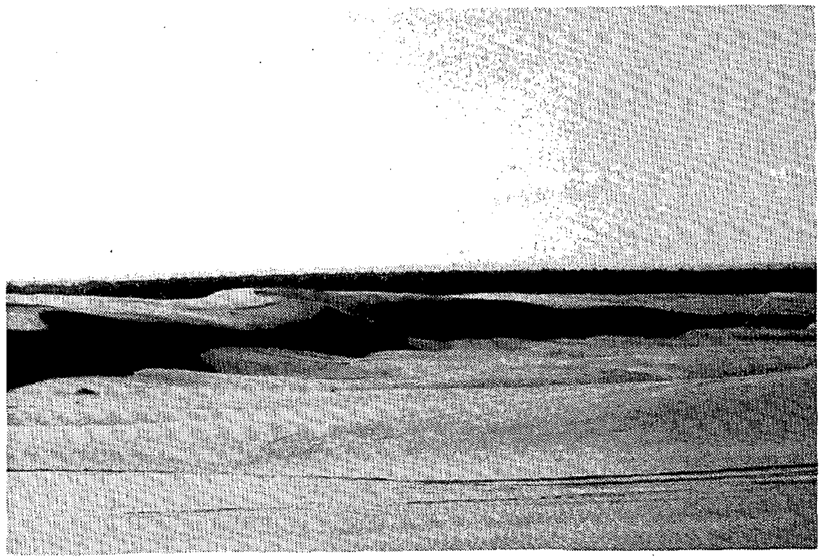


2. It consists of:

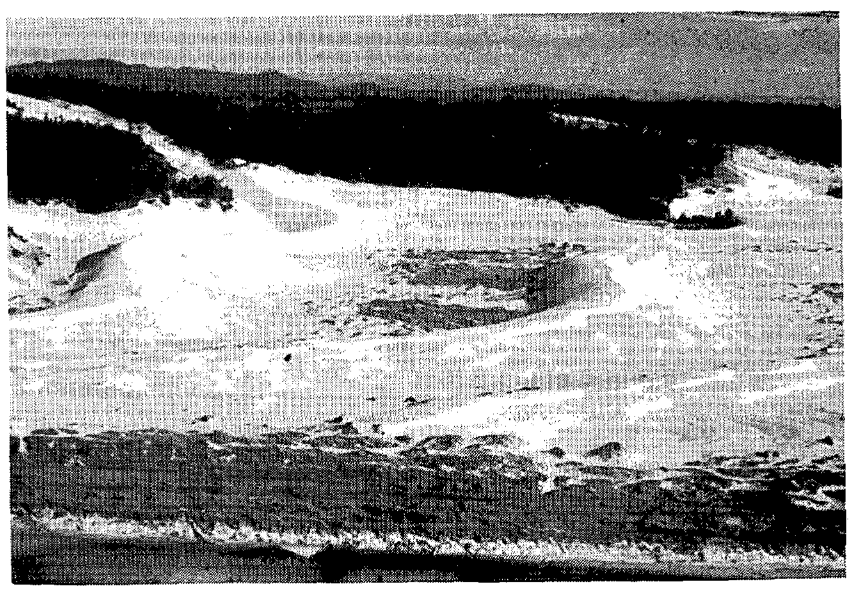
   a. a long, sinuous inland moving ridge gently sloping on its windward flanks, and

   b. very steeply sloping at its high eastern terminus where it may be encroaching on older forested dunes.

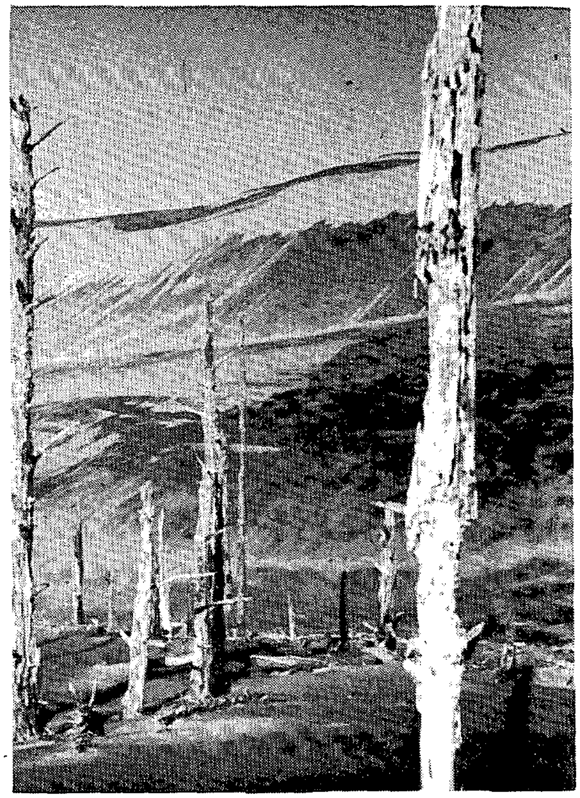
3. The slopes of this dynamic landform are most commonly vegetation-free.



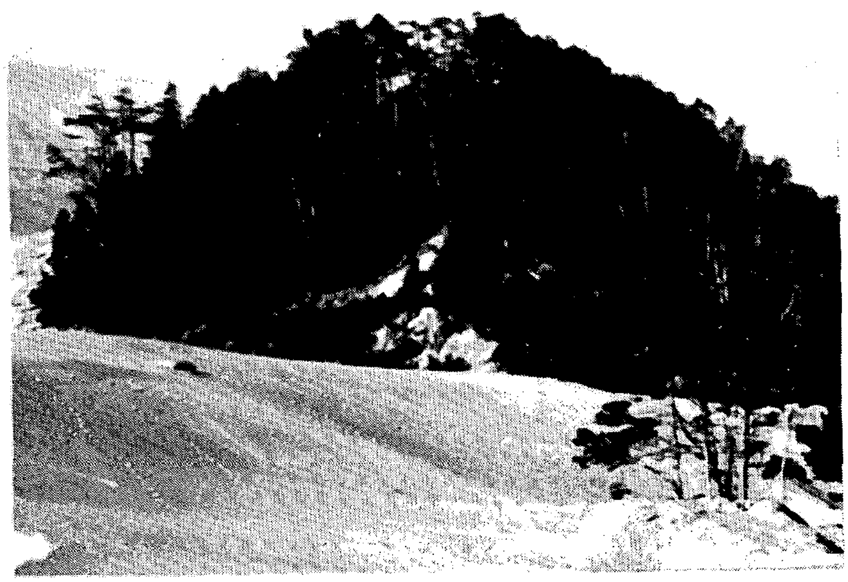
4. The oblique dune landscape appears as a series of undulating waves of sand.



5. Passage of the precipitation ridge may leave exhumed forests in its wake.



6. Islands of surface stable dunes are occasionally found within this open sand landscape.



C. Recently Reactivated Forms

Reactivation of active, conditionally stable and surface stable dunes can occur when binding vegetation and/or the protective soil layer is removed and the site is exposed to erosive winds. The amount of disturbance required for reactivation varies from site to site. Sensitivity to reactivation will depend upon those factors which influence sand cohesiveness, including vegetative cover and cementation such as that which often occurs within the older stabilized dunes. The orientation of the disturbed site to prevailing winds is also of critical importance.

1. Blowout

Localized zone of moving sand within an otherwise vegetated area, which forms a depression from wind erosion on its windward side and an area of accumulation at its terminus.

a. Geomorphology

A blowout is the result of wind scouring within an otherwise conditionally stable or surface stable dune (Figure 12). A blowout

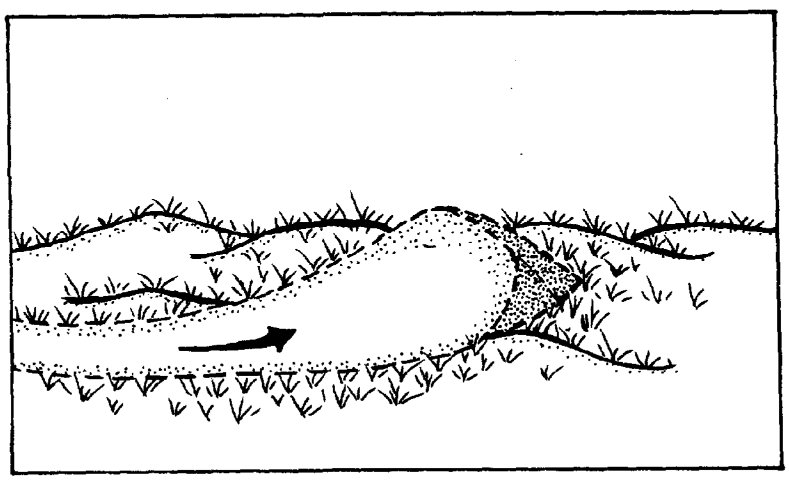


Figure 12. Small blowout within beach grass environment.

may breach the host dune and threaten others in its path. This feature may be only a few feet across and several feet long in the early development stages. However, it can develop into a landform hundreds of feet across and more than a mile long (parabola dune). Smaller blowouts are relatively common features of recently stabilized areas. Once a blowout is begun, especially in the foredune, the trough created tends to funnel the wind, increasing its velocity, and thereby enlarging the blowout.

b. Vegetation

This is a vegetation free landform which is surrounded by vegetated dunes on at least three sides.

c. Attractions and limitations

This feature is probably not suitable for any particular activity or structure.

The potential impacts of a blowout on downwind sites include sand blasting, sand burial and/or heightened storm impact. Areas which may be prone to blowout activity (i.e. recently planted sites or beach grass areas which experience considerable use) should be carefully watched particularly if significant impact inland is probable.

d. Identification check-list

A blowout may be identified by the following features:

1. A blowout is a somewhat elongated, mobile sand landform which occurs within otherwise surface stable or conditionally stable dunes.

2. Parabola Dune

Massive unidirectional trough of deflation terminating in a zone of accumulation within an otherwise vegetated area.

a. Geomorphology

A parabola is essentially a trough blowout of major size which is enclosed on three sides by older vegetated dunes and on the fourth, its source area, by open sand usually of the oblique-ridge type (Figure 13). The initial development of a parabola requires a stable vegetated

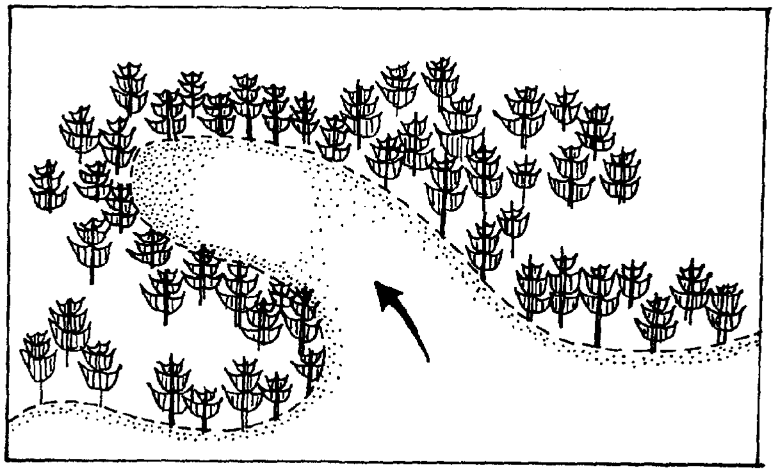


Figure 13. Parabola blowout moving through forested dunes.

site downwind with a point of weakness for the moving sand to break through, considerable volume of source sand, and a unidirectional wind source. Parabolas move inland from their open sand source, through the vegetated area, in a direction parallel to the unidirectional wind source. They can be seen oriented either to the northwest winds of summer or the southwest winds of winter. They may be a hundred feet or more across and extend to nearly a mile in length. Parabolas are named for the similarity that their perimenter bears to the parabolic curve.

b. Vegetation

This is essentially a vegetation free landform although less active forms may exhibit occasional vegetated hummocks.

c. Attractions and limitations

Recreationalists are attracted to this landform for walking, viewing, riding horses, and operating off-road vehicles. The only limitations on these activities are the sensitivity of the fringe-areas' vegetation to trampling and the possible nuisance of sand blasting.

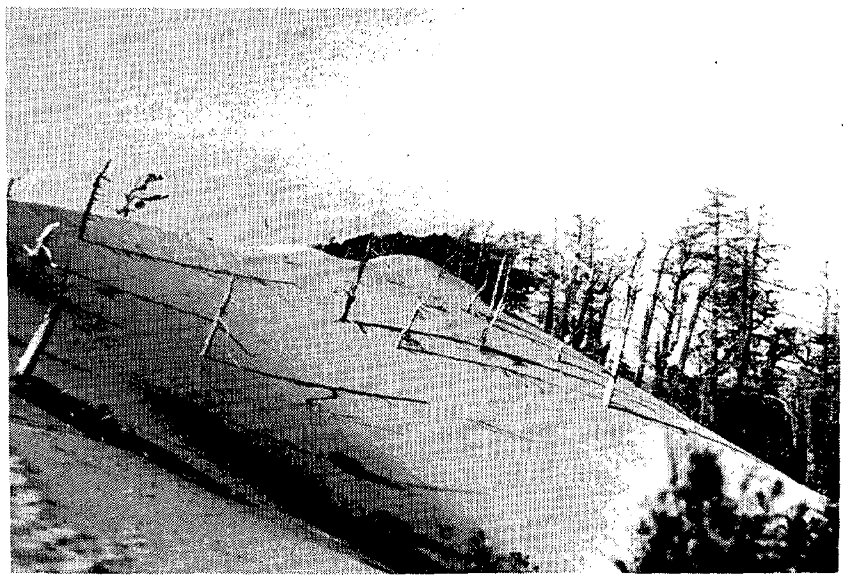
Any development involving permanent structures would be subject to the same limitations as those associated with the oblique-ridge dunes although sand blasting may be a greater problem in this landform.

d. Identification check-list

A parabola dune may be identified by the following characteristics:

1. This feature creates an elongate finger of sand cutting through old forested dunes.

2. The terminus (advancing end) of well-developed parabola dunes commonly creates a precipitation ridge advancing on older forested dunes.



VII. GLOSSARY OF TERMS

Accretion: Oceanward advancement of the beach through the ongoing accumulation of sand at its edge.

Active Dunes: Partially vegetated dunes that migrate, grow and diminish according to wind, sand supply and vegetation cover. (May apply to the foredune or hummock dunes.)

Beach Cusps: Embayments of various widths and slopes cut into the beach by the cellular circulation of onshore and offshore currents.

Blowout: Localized zone of deflation within an otherwise vegetated area.

Conditionally Stable Dune: A dune which presently has sufficient vegetation cover to retard wind erosion but which is vulnerable to reactivation upon disturbance of this cover.

Deflation: The erosion of sand or soil by the wind.

Embryo Dune: Low, newly forming dune mounds.

Erosion: To wear away by the action of water, waves or wind.

Lee: The side that is sheltered from the wind.

Older Stable Dune: Dunes of any form which possess both a deep, well-developed soil and semi-cemented underlying sand.

Onshore Winds: Winds which are moving toward or onto the shore from open water.

Precipitation Ridge: High, steeply sloping slip face of large oblique-ridge and parabola dunes.

Rip Current: A strong relatively narrow current flowing outward from a shore which results from the inland flow of waves and wind-driven water.

Sandsheet: Sand deposits of considerable depth and breadth overlying sursurface coastal terraces.

Surface Stabilized Dune: Commonly forested dunes which possess a thinly developed soil and are underlain by loose unconsolidated sands.

Wind Stable Dune: Those dunes which possess sufficient vegetation and/or soil cover to retard wind erosion.

Windward: The side or direction from which the wind is blowing.

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