

Appendix H: Classifying Oregon's Rocky Shores

1. Overview of Oregon's Rocky Shores

Oregon has developed a system of classifying its shoreline as a framework for managing various shoreline areas. Quite simply, this system is built so that the coast may be viewed in its entirety as part of a larger coastal environment or as smaller and smaller areas until at last the coast is seen as individual rocks and beaches with crevices and pools. The shoreline-classification system fits the work of the Ocean Policy Advisory Council in building management measures for Oregon's rocky shores. But the system also fits the work of other elements of Oregon's Coastal Management Program to address the emerging problems of beach sand supply, dune dynamics, and coastal erosion along Oregon's sandy beaches. The system thus reflects the Oregon coast: sandy beaches (or littoral cells) enclosed by rocky headlands (rocky cells). Cells, whether littoral or rocky, are the central unit of scale in this system.

Oregon's shoreline-classification system is structured to reflect and accommodate the unique properties of scale, linkage, and dynamics in the marine environment. These three conditions were previously acknowledged in the Oregon Ocean Resources Management Plan (1991) by designating a broad Ocean Stewardship Area, adopting a habitat-based approach to management, and designating specific resource sites for further planning to resolve management needs.

This is not a marine-habitat-classification system. It is, rather, a framework for describing and locating the various geomorphic units and their habitats along the coast. Other work will be needed to describe and classify Oregon's marine habitats which can then be located, referenced, or characterized at a variety of scales within the system below.

2. Environmental Considerations

a. Scale (Sizes)

The scale of the marine environment is vast; yet the scale of definable habitats and human use can be much smaller, often at a very precise location. The marine environment thus requires that management account for the tremendous differences in scales of reference. The concept of Large Marine Ecosystems, based on broad regional distinctions and characteristics, is the basis for Oregon's shoreline classification system, which also allows for increasingly fine scales of geographic and ecological resolution and for choosing appropriate scales of research and management.

b. Linkage (Connectivity)

Areas or locations in the ocean are linked by the continuously flowing masses of water and by migrating, roaming, or drifting marine plants and animals. Marine life in any given area is sustained by nutrients suspended in the flowing water column; the phytoplankton, which fix the sun's energy, are effectively part of the water mass, and eggs and larvae from animals at one site

are borne to habitat sites some distance away. There are virtually no points within the marine environment, off Oregon or anywhere else, that are isolated. Similar habitat conditions at distantly separated sites in a given region will have the same or very similar biotic communities. Likewise, pollutants from one source can effect marine areas far away. This linkage is modified by time. While some species take full advantage of the water flow and reproduce widely, the reproductive mode of other species is quite localized, which means that colonization to distant sites may take many, many years until the right conditions prevail.

c. Dynamics (Changes)

The dynamic conditions of the marine environment continuously change with a host of variables: tidal height, seasonal sunlight, storms waves, water depth, upwelling, riverine runoff, seafloor type or topography, etc. Oregon's marine environment is particularly influenced by the seasonal outflow of fresh water from the Columbia River and other coastal streams, and by upwelling created by summer winds. Large-scale events, such as an El Nino, punctuate these routine dynamics and increase complexity. These dynamic variables influence rocky shore areas and their management.

3. Kinds of Rocky Shores

a. Overview

For management purposes Oregon's rocky shores are grouped into two major categories:

- **Shoreline types** include rocky tidepool areas as well as associated submerged rocks or reefs and nearby rocks, which may be reached by foot from shore (regardless of hazard or convenience).
- **Offshore types** include underwater reefs or rocky islands accessible only by boat. Aircraft overflight and associated wildlife impacts are common to both nearshore and offshore sites.

These categories are based on a fundamental distinction in management related to human access. Access by foot to shoreline sites and related rocks or reefs at low tide creates a different set of management issues from access by boat to reefs or rocks farther from shore.

Oregon's rocky-shore types are described primarily on geomorphology and, to a lesser extent, on habitat type.

b. Shoreline Types

1.) Cliffs

As used here, cliffs are the steep seaward facing slopes of rocky headlands composed primarily of basalt (north coast) and metamorphic or highly resistant sedimentary rock (south coast) where wave action and other weathering agents have eroded a vertical or nearly vertical rocky slope with little or sparse vegetation which plunges directly into the ocean; the exposed slope is either

inaccessible or very dangerous to human trespass. Cliffs provide isolated nesting and resting habitat for seabirds, but can also enclose and thereby protect marine mammal or intertidal habitat along the toe of the cliff.

Many cliff sites are in public ownership: State Parks and Recreation, U.S. Forest Service, Bureau of Land Management or U.S. Fish and Wildlife Service. Others, such as the Sea Lion Caves area or cliffs south of Cape Arago are in private hands. Most are planned and zoned as part of the respective coastal county land use plan. Cliffs are included as coastal shorelands under Statewide Planning Goal 17.

2.) Rocky Intertidal

Rocky intertidal areas encompass a variety of hard, rocky sites covered and uncovered daily by the tide and areas subject to splash and spray many feet above water level. Most are wave-eroded bedrock platforms with associated remnant rocks and boulders. At some sites, boulder fields at the base of a rocky cliff predominate. Exposure to the ocean varies from site to site: most are exposed or semi-exposed; a few are partially protected.

All rocky intertidal sites are held in trust by the State Land Board for the owners: the people of Oregon. Management is complex; the areas are administered jointly by the Division of State Lands exercising ownership responsibilities on behalf of the State Land Board and by the Department of Parks and Recreation for public recreation under the Beach Bill. The Department of Fish and Wildlife regulates harvesting, collecting, or taking of animals.

Because use of associated reefs and rocks is often directly related to attractiveness and activities of a rocky intertidal site, rocky intertidal areas are the central element of coordinated management efforts along the entire rocky shoreline.

3.) Associated Reefs

At some rocky-shore sites, submerged bedrock or boulders form reefs in direct association with rocky intertidal areas. These associated reefs, below Extreme Low Water, are generally geologic extensions of rocky intertidal or cliff areas along the shore. Reefs may also be associated with rocks which are exposed above the water at high tide.

These Associated Reefs within the Territorial Sea are held in trust by the State Land Board for the people of Oregon. The Department of Fish and Wildlife controls harvest of fish and shellfish through general regulations. The Department of Parks and Recreation has no management authority or responsibility for submerged reefs.

4.) Associated Rocks

Rocks projecting above Mean High Water occur in association with many rocky intertidal sites. Some are large and significant, as at Yaquina Head or Cape Arago, while others are small and have no name or designation.

Almost all rocks above Mean High Water within Oregon's territorial sea are designated as part of the Oregon Islands National Wildlife Refuge. The Division of State Lands has jurisdiction below Mean High Water.

c. Offshore Rocky Types

These sites are generally accessible only by boat or aircraft. These reefs and rocks have valuable habitat that may be similar to those nearer shore, but physical isolation at sea generates a unique set of management requirements and opportunities.

1.) Offshore Reefs

The reefs in Oregon's Territorial Sea are submerged rock formations (but may also include individual rocks that project above the surface) with a variety of composition: bedrock with pinnacles reaching toward the surface, boulders, cobbles, and, in some cases, intermixed gravel or sandy patches. All are exposed to high-energy ocean currents and wave mixing. These reefs provide diverse, valuable habitat for marine life.

Offshore reefs within three miles of shore are under the jurisdiction of the Division of State Lands as submerged lands. The Division has general authority to lease submerged lands and specific authority to lease for the commercial harvest of kelp, which grows only on a rocky substrate. Sport and commercial harvest of fish and shellfish is regulated by the Department of Fish and Wildlife.

Oregon has not historically managed offshore reefs as distinct or unique habitats. However, Oregon is establishing a planning framework to provide a basis for future management of uses and resources of reef areas because of four factors:

- increasing use of these areas for commercial and sport fin fishing, commercial and sport diving, and invertebrate harvest;
- interest in leasing portions of reef areas for kelp harvest and mariculture;
- lack of in-depth information about living resources, habitats, and ecological relationships among and within reef complexes;
- high biological productivity and habitat important to threatened and endangered species.

2.) Offshore Rocks or Islands

Offshore rocks (or islands, as they may be named) occur singly (Tillamook Rock), in small clusters (Redfish Rocks), or in association with many other rocks and submerged reefs (Orford Reef). Many of these rocks are identified in the Oregon Ocean Resources Management Plan as sensitive habitat for marine mammals and seabirds. Birds and mammals use these rocks for breeding and rearing of young, resting, and feeding. The degree of use and habitat value to a species or mix of species varies from rock to rock depending on differences in geologic

composition, soil cover, vegetation, slope angle or orientation, relationship to other habitat areas, distance from shore, proximity to human use, etc. These rocks are center points for a wider range of feeding, foraging, and reproductive activities, which may take animals hundreds, if not thousands, of miles from the site. In some cases, these rocks are nesting sites for birds which migrate from South America or New Zealand and are thus of international importance in species protection.

Above Mean High Water, almost all offshore rocks are designated as wilderness and managed as part of the National Wildlife Refuge system administered by the U.S. Fish and Wildlife Service (a few are under jurisdiction of the Bureau of Land Management; one is privately owned). Below Mean High Water, the Oregon Division of State Lands has jurisdiction over the seabed while the Department of Fish and Wildlife regulates fish and shellfish harvest.

4. Oregon's Shoreline Classification System

[click here for an outline of Oregon's Shoreline Classification System.]
[click here for a map of Oregon's Shoreline Classification System]

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a. Ecoregion: Northern California Current Ecoregion

Large marine eco-regions are characterized by distinct hydrography, submarine topography, biological productivity, and interrelated food webs. They are increasingly recognized as the level at which nations must frame their marine-resource management programs, including research. The Northern California Current Ecoregion encompasses the majority of the region included in the scope of the Pacific Northwest Marine Research Program, a coordinated program established by Congress in 1991 to "improve marine research on water quality and ecosystem health.

Oregon's entire coastline lies within this region, which extends from Cape Mendocino, California to Vancouver Island, British Columbia, and which extends seaward from the shoreline approximately 500 to 1000 kilometers across the broad, slowly southward-flowing California Current. This is a recognized Large Marine Ecosystem, one of 28 that have been identified around the world as of 1991.

b. Domains

A domain subdivides an ecoregion, such as the Northern California Current Ecoregion, into cross-shelf zones based on oceanographic characteristics influenced primarily by depth of water. Oregon's Ocean Stewardship Area, described in the Oregon Ocean Resources Management Plan, extends from the shoreline seaward to the toe of the continental margin. Three domains (modified from Bottom et al. 1989) can be described for this ocean area:

1.) Nearshore Domain

The ocean environment from shore to about 50 meters deep. This domain is significantly affected by wave energies that reach the bottom, vertical mixing, and seasonal along-shore and cross-slope sediment movement. This nearshore domain is influenced by discharge from coastal rivers and estuaries, and is shallow enough to permit kelp-reef habitats. In winter this domain is affected by the northward flowing Davidson Current, which displaces the California Current seaward. Oregon's territorial sea and rocky shores are within the Nearshore Domain.

2.) Shelf Domain

The area over the continental shelf and upper slope where waters are more than 50 but less than 200 meters deep.

3.) Oceanic Domain

The marine environment principally beyond the depth of the continental shelf and upper slope, more than 200 meters deep.

c. Regions:

The Northern California Current Ecoregion and Nearshore Domain are divided into three regions (modified from Bottom et al. 1989). Two regions lie off Oregon:

1.) Columbia River to Coos Bay, OR

Between the Columbia River and Coos Bay, ocean conditions are dominated by interaction between the warmer, low-salinity waters of the Columbia River Plume and seasonal upwelling of cold, nutrient-rich waters nearer the coast. For purposes of shelf and oceanic domains, this region may be more appropriately divided at Cascade Head. For purposes of classifying Oregon's shoreline areas, this region may be further divided into two provinces (described in next section).

2.) Coos Bay, OR to Cape Mendocino, CA

This southern region has been described as reaching between Cape Blanco, OR, and Cape Mendocino, CA, based on distinctive ocean current conditions apparently set up by deflection of southward-flowing currents around Cape Blanco. This dividing line is probably appropriate for shelf and oceanic domain-management considerations. However, for purposes of classifying Oregon's rocky-shore areas, the dividing line is most appropriate at the mouth of Coos Bay just north of Cape Arago. Oregon will need to coordinate its management of rocky shores in this region with the State of California.

d. Provinces:

Within regions are coastal provinces, shore lengths identified primarily by homogeneity (similarity of characteristics) of geographic or geologic features. Along the Oregon coast are three provinces but only two have rocky shores.

1.) Alsea-Nehalem

This region extends from the north side of Tillamook Head to the south side of Heceta Head near Florence. The shoreline is dominated by relatively recent uplifted marine sedimentary rock formations punctuated by resistant basalt formed as offshore volcanoes, underwater lava flows, or tongues of the great Columbia River basalt flows that reached the sea. Rocky shores tend to be clustered at these resistant headlands or other features with stretches of sandy beaches up to 15 miles long between.

2.) Umpqua Dunes

This province extends almost 60 miles between Sea Lion Point at Heceta Head north of the Siuslaw River and the mouth of Coos Bay. The shore is dominated by a long sandy beach backed by dune sheets one to three miles wide. The Umpqua River estuary divides this province. Most of the dunes along this stretch of coast are within the Oregon Dunes National Recreation Area administered by the U.S. Forest Service. This is not a rocky-shore province but is included in this overall categorization of Oregon's shoreline.

3.) Klamath Mountain

This province reaches from the mouth of Coos Bay to the Oregon-California border. The shoreline is dominated by geological features distinctive of the Klamath Mountain metamorphic province. From Cape Arago and Cape Blanco, an uplifted marine terrace forms most of the cliff except where punctuated by resistant rock at a few places such as Coquille Point. Between Port Orford and the Chetco River, rocky-shore types (major and minor headlands, rocky cliffs, offshore stacks and rocks, and submerged rocky reefs) are dispersed widely and somewhat uniformly. Other than the Coquille River, coastal streams have relatively steep gradients and few or small estuaries or sand spits.

e. Rocky-Shore Segments: 10 - 50 km

Segments are lengths of coastline (subdivisions of provinces) within which rocky-shore cells are grouped based primarily on geographic proximity and on human use pressures and patterns of development, travel, and access. Within a segment are a mix of rocky-shore types, and other shore types such as sandy beaches and estuary mouths.

1.) Segments within the Alsea-Nehalem Province

a.) Neahkahnie Segment

Tillamook Head (north side near Seaside) to south face of Neahkahnie Mountain: This segment includes rocky-shore areas clustered at two major headlands --Cape Falcon/Neahkahnie

Mountain and Tillamook Head. US 101 is located on the inland side of these rocky headlands due to rugged topography that limits access to rocky-shore sites. The entire segment is easily reached from the Portland metropolitan area via Ore 6 to Tillamook and the more heavily used US 26 to Cannon Beach/Seaside. This segment has high visitor usage.

b.) Kiwanda Segment

Cape Meares (north side) to Road's End at Lincoln City: This segment includes rocky-shore areas clustered at four major headlands. Except at its southern end at Lincoln City, US 101 is inland of the shore through most of the segment so access to rocky-shore sites is via county or secondary roads. Access to the southern end of the segment is via Ore 18 from Portland/Salem to Lincoln City and to its northern end via Ore 6 from Portland to Tillamook. The segment is between population centers.

c.) Yaquina Segment

Fogarty Creek State Park to Seal Rock: The shores of this segment include long sandy beaches punctuated by headlands or other rocky-shore features. US 101 runs adjacent to the shore along most of the segment. Rocky shores in this segment are well known, popular, and heavily used by visitors. There is also significant growth in development and population in the area. The segment is accessible from the Willamette Valley via US 20 directly to Newport and Ore 18 from Portland/Salem to Lincoln City.

d.) Yachats Segment

North side of Yachats at Smelt Sands Beach to Sea Lion Rock (south side of Heceta Head): This segment has steep mountains and rugged shores with limited access opportunities from US 101 which runs along the shore. Overall access to the segment is via OR 126 from Eugene to US 101 at Florence or via US 20 from Corvallis to Hwy 101 at Newport. The segment has limited population and limited developed recreation, centered primarily around Yachats.

2.) Segments within Klamath Mountain Province

a.) Seven Devils Segment

Yoakum Point (mouth Coos Bay) to Devil's Kitchen (south of Coquille Point): This segment includes rocky shores of the most northerly outcroppings of true Klamath Mountain geologic types, as well as rocky shores of uplifted and tilted marine sediments. Although US 101 is inland of rocky shores in this segment, it is relatively accessible from the major travel corridor of I-5 via Ore 42 from Roseburg and the more heavily used Ore 38 from Eugene. The area has a large population center in Coos Bay/North Bend, and is a popular recreation destination.

b.) Port Orford Segment

Blacklock Point (north of Cape Blanco) to Sisters Rocks (south of Port Orford): This segment contains a mix of shore types reflecting a transition from Klamath Mountain geology/shoreline to more recent sediments in uplifted marine terraces from Port Orford north. Access to this segment is via US 101 from the south or north; there is no direct east-west access.

c.) Ferrelo Segment

Hubbard Mound (north of Rogue River) to Winchuck River (Oregon/California border): This segment typifies the geologic and rocky shoreline features of the Klamath Mountain Province. Major communities and development centers are Brookings and Gold Beach. Access to sites in this segment is from US 101 which runs directly along the shore; east-west access from I-5 is somewhat indirect; via US 199 from Grants Pass to US 101 at Smith River, CA; and via Ore 42 from Roseburg to Bandon. The area is relatively remote from major population centers in Oregon.

f. Rocky-Shore Cells (1 - 5 km) and Sites (10 - 500 m)

1.) Cells

Cells are major shore features with a predominant set of similar shore types. On the Oregon coast, there are two types of cells: littoral (sandy shore) cells, where nearshore circulation is enclosed between headlands; and rocky cells composed of headlands, capes, and associated reefs or rocks.

Within rocky-shore cells, there may be a mix of cliffs, rocky intertidal areas, associated reefs, associated rocks, offshore reefs, and offshore rocks and islands. Some sandy or cobble shores may be present but not enough to alter the overall

North Oregon Coast Rocky Shore Cells and Site Names

South Oregon Coast Rocky Shore Cells and Site Names

classification of the area as a rocky-shore cell. In the Alsea-Nehalem Province on the northern coast, these cells tend to be distinctive headlands or capes with several associated sites. In the Klamath Mountain Province on the south coast, these cells tend to be less topographically pronounced in the overall landscape. Cells are at the human scale of geographic identity and usage.

2.) Sites

Sites are specific geographic features or locations within a cell. They may be a rock or cluster of rocks, a particular cove or cliff, or other specific feature. These sites may also have a mix of rocky-shore types and even have sandy or cobbled beaches when mapped at this scale.

Within a site will be habitat features and surfaces at a very fine scale of less than 10 meters.

g. Features and Surfaces < 10 m (Habitat Scale)

For every rocky-shore site there are unique habitat features and surfaces. Prior to this Territorial Sea Plan, Oregon had no systematic inventory of

rocky-shore features by which to classify habitats. A reconnaissance-scale inventory has been completed for this plan which will serve as a basis for more detailed habitat studies in the future. Rocky-shore habitats will eventually be classified within an overall marine-habitat-classification system to be developed by the Oregon Department of Fish and Wildlife in coordination with the Ocean Policy Advisory Council.

5. Sources

The following were used to generate Oregon's shoreline-classification system:

- o Management of Living Marine Resources: A Research Plan for the Washington and Oregon Continental Margin (Bottom, Jones, Rodgers, and Brown, 1989) provides the scientific and conceptual framework for describing, researching, and managing Oregon's ocean area in terms of its larger marine ecosystem setting.
- o Terminology for geomorphic units and habitats along the tropical coast of Western Australia (Semeniuk, 1986) provided a conceptual model for systematically describing and naming geomorphic features (land forms) in decreasing scales of reference from a broad "regional" level to large, medium, small, and fine scale.
- o Regional Sediment Dynamics and Shoreline Instability in Littoral Cells of the Pacific Northwest (Peterson et al. 1992) delimited the extent of littoral cells along the Oregon coast within which sand is more or less trapped and recirculated between rocky headlands.
- o Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979) is the basis for many coastal-habitat-classification systems in the U.S., including Oregon's estuarine-habitat-classification system, which is now part of the Oregon Coastal Management Program.
- o Oregon Marine and Estuarine Classification Systems (Starr, 1979), proposed to modify Cowardin et al. to the Oregon situation.
- o A Marine and Estuarine Habitat Classification System for Washington State (Dethier, 1990) added several considerations to Cowardin et al. to accommodate the added complexity of the open ocean environment.