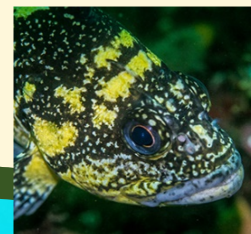
the OREGON NEARSHORE STRATEGY



2016

Oregon Department of Fish and Wildlife

OregonConservationStrategy.org

PDF Content Last Updated January 3, 2017

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Contact ODFW

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Cover Photos

Banner: Copper Rockfish, © Janna Nichols; Red Sea Urchin, © Scott Groth; Black Oystercatcher, © Kelsey Adkisson; Steller Sea Lions, ODFW; Bull Kelp, © Janna Nichols; Wolf Eel, © Taylor Frierson; Red rock crab, ODFW; China rockfish, © Laura Tesler

Featured image: Nearshore rocky reef, © Ian Chun

Oregon Conservation Strategy: The Oregon Conservation Strategy together with the Oregon Nearshore Strategy are the official State Wildlife Action Plan for Oregon. The Oregon Conservation Strategy provides details fish and wildlife, their habitats, and conservation needs throughout the state. This companion document can be viewed online or downloaded as PDFs.

NEARSHORE STRATEGY ACKNOWLEDGEMENTS

Many individuals, agencies, and organizations contributed to the 2016 update of the Oregon Nearshore Strategy. Any work that addresses the complexity and dynamics of the nearshore ocean, and the values and uses that Oregonians apply to it, relies on the interactive efforts of many people. Their constructive participation has helped to build a whole that is greater than the sum of its parts.

We thank the following people and organizations for their tremendous effort, vision and insight:

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To all Oregonians who shared their vision, values, and concerns for the future of Oregon's marine environment.

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Gregory K. Krutzikowsky, Kelsey Adkisson, Caren Braby, Dave Fox, Maggie Sommer, Thomas Swearingen, Ivan Kuletz, and Steve Rumrill

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the OREGON NEARSHORE STRATEGY




Chapter 1: Introduction

2016
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OregonConservationStrategy.org

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Feature Image: Nearshore Rocky Reef, © Ian Chun

CONSERVATION AND MANAGEMENT PLANNING – THE OREGON NEARSHORE STRATEGY

Photo Credit: Ian Chun

The Oregon Department of Fish and Wildlife's (ODFW's) Marine Resources Program has identified opportunities for ODFW and others to augment ongoing conservation and management efforts and support the long term sustainability of nearshore resources in Oregon. The result is the Oregon Nearshore Strategy (Nearshore Strategy). The information and recommendations contained in the Nearshore Strategy complement, rather than supplant, the core functions performed by ODFW and its resource management partners.

The **mission** of Oregon's Nearshore Strategy is:

To promote actions that will conserve ecological functions and nearshore marine resources to provide long-term ecological, economic, and social benefits for current and future generations of Oregonians.

To achieve this mission, the Nearshore Strategy provides information on nearshore marine fish and wildlife and related conservation needs in a broad social and ecological context. It does not create or propose regulations. The Nearshore Strategy presents recommendations for voluntary actions that can contribute to the sustainability of marine resources and ecological functions.

The information and recommendations in the Nearshore Strategy are the result of a collaborative process led by ODFW. Members of the public, ocean-related businesses (including fishing), recreational interests, conservation groups, government agencies, tribes, universities, and many other sectors contributed to the Nearshore Strategy, both during its initial development for publication in 2006 and in 2015 for the 10-year revision. The collaborative process has strengthened the Nearshore Strategy and provided the opportunity for participants with diverse backgrounds to build relationships while sharing their respective visions, values, and concerns for the nearshore environment. This cooperation between the Oregon Department of Fish and Wildlife and the public is essential to the **vision** guiding the Nearshore Strategy:

Oregon's nearshore marine resources are thriving in a healthy, functioning ecosystem due to cooperative efforts and support by current and future generations of Oregonians.

HOW THE NEARSHORE STRATEGY IS USED

One of the most important outcomes of the diverse inputs to the Nearshore Strategy process is the identification of a collective set of voluntary conservation and policy priorities that can guide strategic investment of time and funding in a manner consistent with public interest. The Nearshore Strategy is intended to facilitate action on priority nearshore issues and areas that are not specifically addressed by existing processes. The Nearshore Strategy highlights issues that transcend the authority of a single management entity or existing regulatory authority. It suggests how to augment the conservation and sustainability of Nearshore resources, so that when opportunity arises, collaborations can quickly mobilize to implement these broad strategies.

ODFW is an active participant in many management and policy processes — for example, the Pacific Fishery Management Council, which develops policy and management for federally managed marine fisheries species; and Oregon's Ocean Policy Advisory Council which is a forum for advancing policies related to the state's three-mile territorial sea. The Nearshore Strategy is not intended to supplant or redirect those activities; rather, it will help direct attention and resources to priority areas where they can have the most positive impact on nearshore fish and wildlife, their habitats, and the nearshore ecosystem as a whole.

For the purposes of this document, "nearshore" is defined as the area from the outer boundary of Oregon's Territorial Sea at 3 nautical miles to the supratidal zone affected by wave spray and overwash at extreme high tides on our ocean shoreline, and up into the portions of our estuaries where species depend on the saltwater that comes in from the ocean (Figures 1.1a and 1.1b). Oregon's nearshore environment is home to a vast array of fish, invertebrates, marine mammals, birds, algae, plants, and a diversity of other organisms. This region includes a variety of habitats ranging from open waters dotted with islands to submerged high-relief rocky reefs, soft sandy and muddy bottoms, broad expanses of sandy beaches interspersed with rocky headlands, mudflats, sloughs and channels in estuaries. These are the species and habitats that are the focus of the Oregon Nearshore Strategy. Each one is an integral part of a complex nearshore ecosystem interconnected through food webs, nutrient cycling, habitat usage, ocean currents, atmospheric forcing, and a multitude of other biological, physical, chemical, geological, and human use factors.

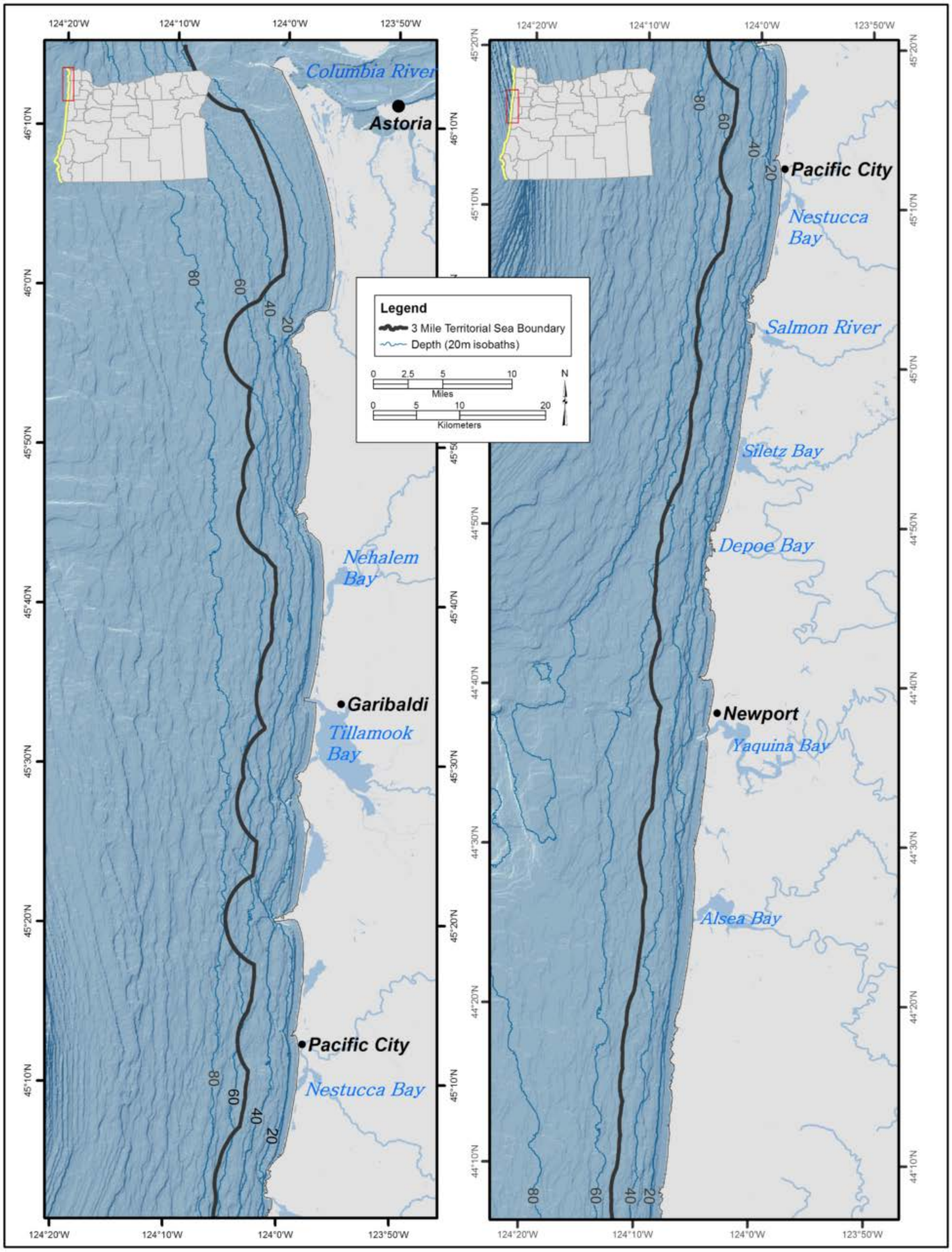

Figure 1.1a. Oregon's north coast. Oregon's Nearshore is defined as the area from the outer boundary of the territorial sea to the shoreline affected by extreme high tides and up into the estuaries where species depend on saltwater from the ocean.

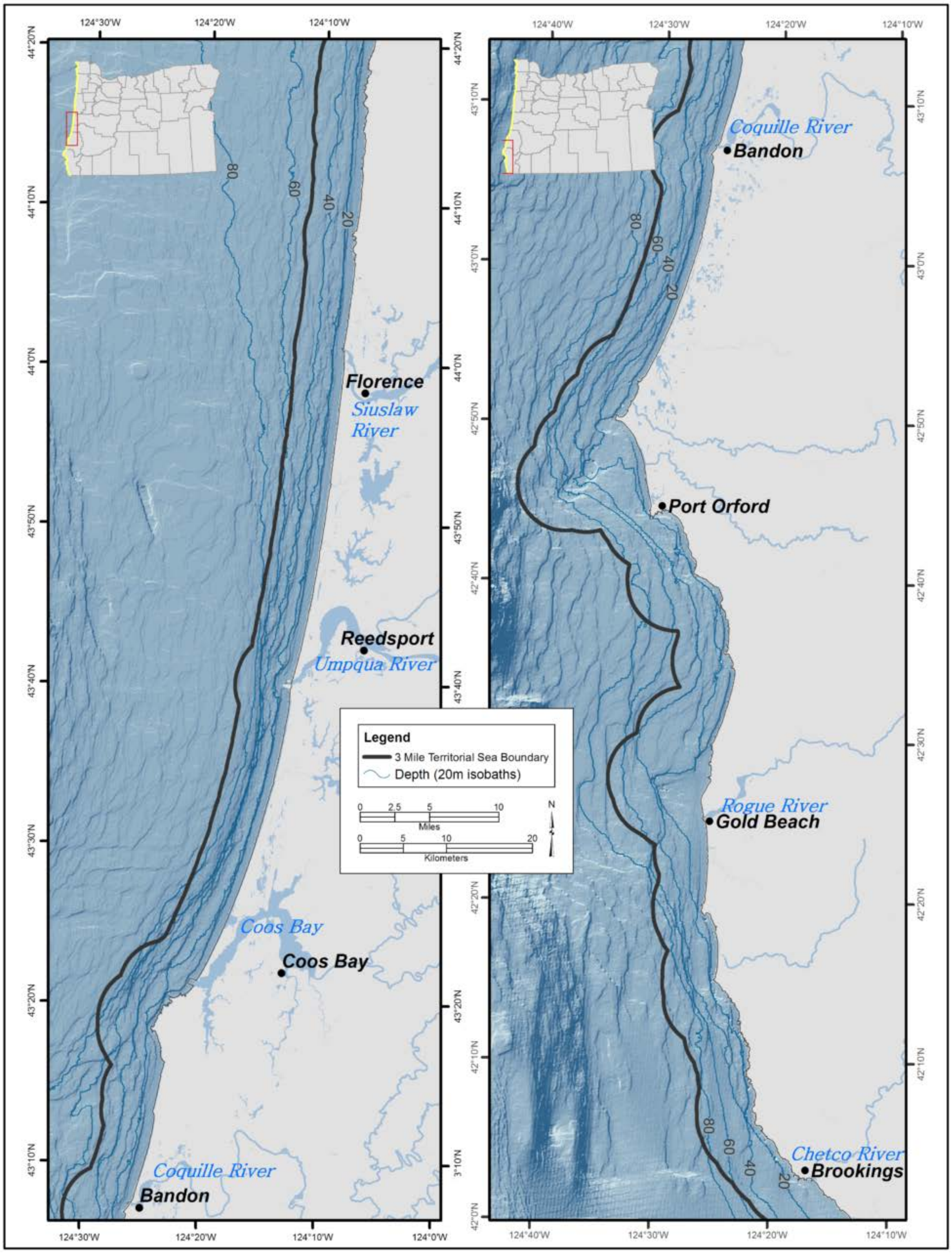

Figure 1.1b. Oregon's south coast. Oregon's Nearshore is defined as the area from the outer boundary of the territorial sea to the shoreline affected by extreme high tides and up into the estuaries where species depend on saltwater from the ocean.


the OREGON NEARSHORE STRATEGY




Chapter 2: Nearshore Context

2016
Oregon Department of Fish and Wildlife

OregonConservationStrategy.org

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Feature image: Bald Eagle and Common Murres at Yaquina Head, OSU Sea Bird Oceanography Lab

Photo Credit: ODFW

NEARSHORE STRATEGY CONTEXT

Oregon's nearshore fish and wildlife support recreational pursuits, businesses, commerce, and ecosystem services. Their natural bounty and beauty are part of what makes Oregon a great place to live, work, and play. Our understanding of species, habitats and ecosystem functions in Oregon's marine and estuarine waters is rapidly advancing, yet there is still much to be learned. At the same time, we are seeing unprecedented demands on these resources and broad stresses such global climate change and ocean acidification. The intention of this document is to set forth key areas for action to improve sustainability of Oregon's nearshore resources in the face of these increasing demands.

> The Nearshore Strategy uses the concept of **sustainability** as defined in Oregon law: "Sustainability means using, developing and protecting resources in a manner that enables people to meet current needs and provides that future generations can also meet future needs, from the joint perspective of environmental, economic and community objectives." (ORS 184.421(4))

As human populations and activities in and around our nearshore environments grow, so do human impacts on the fish, wildlife, and habitats found there. Coastal development, agriculture, fishing, boating, dredging, shipping, wastewater disposal, aquaculture, and energy development and consumption are just a few nearshore marine resource uses that benefit human communities. However, these activities also have the potential to adversely impact the health of our oceans and estuaries, and the ecosystem services they provide. The need for careful, proactive planning and management, balancing multiple uses, is clear.

> **Ecosystem services** are the benefits people obtain from ecosystems. These services can be broken into four categories:
>
> *Provisioning services* – such as food and product materials;
>
> *Regulating services* – that affect climate, floods, disease, wastes, and water quality;
>
> *Cultural services* – that provide recreational, aesthetic, and spiritual benefits; and

> *Supporting services* – such as photosynthesis and nutrient cycling.
>
> (Millennium Ecosystem Assessment 2005)

Growing pressures on marine resources reach beyond Oregon to regional, national, and global scales. This trend is sure to continue with future population growth and intensification of human activities. At the same time, the awareness of and interest in ocean conservation issues are growing. High-level studies and policy directives, such as the 2003 Pew Oceans Commission report, the 2004 U.S. Commission on Ocean Policy report, the 2006 West Coast Governors Alliance on Ocean Health, the 2010 Final Recommendations of the Interagency Ocean Policy Task Force and the subsequent National Ocean Policy Implementation Plan issued by the National Ocean Council in 2013, illustrate the intensifying focus on ocean conservation. There has been broad agreement at national and regional levels on the importance of utilizing effective ecosystem-based approaches to managing our oceans and coastal resources, raising public awareness of the importance of the marine ecosystem, and ensuring that the best available science is used by decision makers to maintain and balance productive ecosystems and sustainable economic development. At the local level, community organizations, local governments, citizen groups, and non-governmental organizations work to assist with research, conservation, management and policy.

In 2002, the U.S. Fish and Wildlife Service provided nationwide funding and momentum for wildlife conservation planning for each U.S. state and territory through the State Wildlife Grants Program. To receive future funds, each state and territory is required to develop a State Wildlife Action Plan, to undertake a comprehensive review of the Plan at least every 10 years, and to update it as needed. The purpose of State Wildlife Action Plans is to chart a course for conservation by promoting voluntary actions that benefit at-risk species and their habitats, and in so doing, reduce the likelihood of future federal or state Endangered Species listings.

The Oregon Department of Fish and Wildlife led the effort to develop Oregon's State Wildlife Action Plan. This was an ambitious project to synthesize the best available science and knowledge into a broad vision and conceptual framework for the long-term conservation of Oregon's native terrestrial, aquatic, and estuarine fish and wildlife, and their habitats. Oregon developed its Strategy in two parts. The Oregon Conservation Strategy, developed by ODFW's Conservation Program, focuses on species and habitats from the ocean shore inland. The Nearshore Strategy, developed by ODFW's Marine Resources Program, is the part of Oregon's State Wildlife Action Plan that focuses on nearshore marine fish and wildlife, their habitats, conservation needs and opportunities. The Nearshore Strategy also stands on its own for readers interested specifically in marine issues.

Conservation Strategies are living documents designed to be responsive to changing conditions and new information. Global climate change was added as a key conservation issue for Oregon in 2012. The potential effects of both global climate change and ocean acidification on Oregon's nearshore ocean were examined in supplements to the Nearshore Strategy that are now included here as Appendices A through D. The Oregon Conservation Strategy along with the Nearshore Strategy component underwent a comprehensive review in 2014 and 2015. The species, habitats and conservation concerns have been appraised in light of emerging issues, insights gained from newly available information, and the responses of wildlife to management actions. Much has been accomplished in the last decade, and the updates in this version of the Nearshore Strategy incorporate the new information to ensure that the Nearshore Strategy remains relevant in the coming decade.

REQUIRED ELEMENTS FOR STATE WILDLIFE ACTION PLANS

As part of the State Wildlife Grants Program, Congress specified eight required elements to be addressed in each state's State Wildlife Action Plan. Congress also directed that the strategies must identify and focus on species in greatest need of management attention while addressing the full array of wildlife and wildlife-related issues. The eight elements are (with notations on which sections in this document address each element):

1. Distribution and abundance of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife – see Nearshore Species, Nearshore Habitats and Appendices E and F;
2. Locations and relative condition of key habitats and community types essential to conservation of species identified in (1) – see Nearshore Habitats;
3. Problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats – see Nearshore Species, Factors Affecting Nearshore Species and Habitats, Nearshore Research and Monitoring Needs, Recommendations and Appendices A – D;
4. Conservation actions proposed to conserve the identified species and habitats, and priorities for implementing such actions – see Nearshore Strategy Species, Research and Monitoring Needs and Recommendations;
5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions – see Research and Monitoring, Recommendations and Conclusions;
6. Procedures to review the strategy at intervals not to exceed 10 years – see Recommendations and Conclusions;
7. Plans for coordinating the development, implementation, review, and revision of the plan with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats – see Nearshore Strategy Development, Recommendations and Conclusions; and
8. Broad public participation – see Nearshore Strategy Development, Recommendations and Conclusions

THE NEARSHORE STRATEGY – A BROAD APPROACH

The comprehensive social and ecological perspective found in the Nearshore Strategy mirrors many aspects of the developing concept of **marine ecosystem-based management**. Ecosystem-based management is an integrated approach that considers the entire ecosystem, including humans. Though there is consensus on the definition and key elements of marine ecosystem-based management, scientists and managers are now facing the challenge of implementing this concept. The scientific and regulatory communities currently have limited practical experience implementing this comprehensive approach, but efforts to do so are underway. This 2015 revision of the Nearshore Strategy utilizes the ecosystem-based management perspective and is designed to help guide its application.

> **Marine ecosystem-based management** is an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive, and resilient condition so that it may provide the services that humans want and need. Ecosystem-based management differs from most current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors. Specifically, ecosystem-based management:
>
> - emphasizes the protection of ecosystem structure, functioning, and key processes;
> - is place-based, focusing on a specific ecosystem and the range of activities affecting it;
> - explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species;
> - acknowledges interconnectedness among systems, such as between air, land and sea; and
> - integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences
>
> (Scientific Consensus Statement on Marine Ecosystem-Based Management 2005).

MANAGEMENT FRAMEWORK

A complex mix of laws, rules, and programs governs the use, conservation, and management of Oregon's marine resources. Other existing plans may affect the management of nearshore resources. Examples include fishery management plans and the Oregon *Territorial Sea Plan*. Multiple state and federal agencies and other public entities implement and enforce regulations for the comprehensive management of marine resources (Figure 2.1). In addition, public agencies, private non-profit organizations, volunteer groups, or private citizens undertake non-regulatory or voluntary resource conservation and management actions. State agencies have been established with different jurisdictions and authorities for addressing specific public needs. For example, ODFW is responsible for fish and wildlife resources, the Oregon Department of Environmental Quality is responsible for air and water quality, and the Department of State Lands is responsible for state-owned lands. The methods and forums for addressing any specific nearshore issue will depend on which state and federal agencies are involved. This Strategy is focused on providing recommendations for action within ODFW's jurisdiction. Statements or recommendations affecting other agencies are intended as guidance to those agencies, and are non-binding.

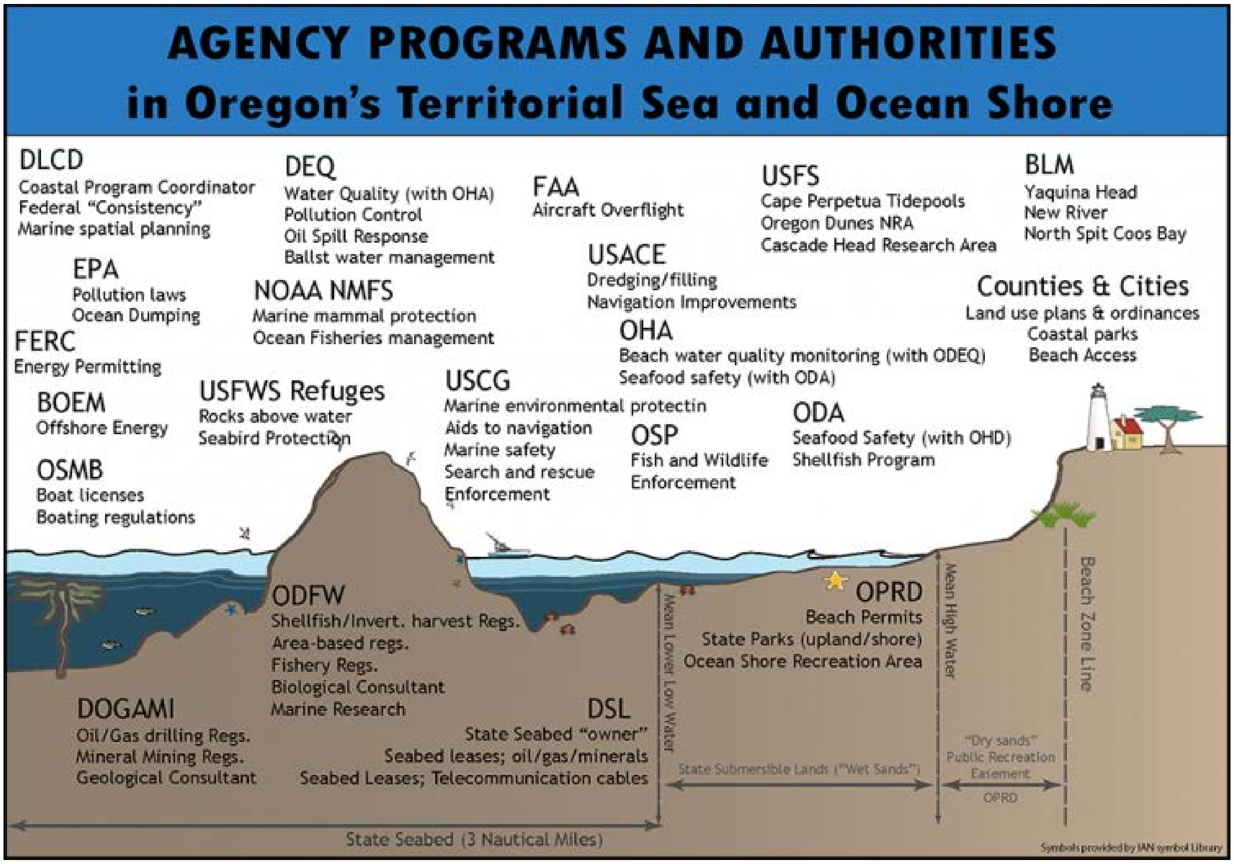

Figure 2.1 Agency programs and authorities for Oregon's state waters and ocean shores. Photo Credit: Oregon Department of Land and Conservation Development.

The Oregon Department of Fish and Wildlife

The Oregon Department of Fish and Wildlife (ODFW) is responsible for managing Oregon's fish and wildlife resources. ODFW's mission is "to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations."

Statutory Authority

As with all state agencies, legislatively adopted statutes confer ODFW's authority and jurisdiction (https://www.oregonlegislature.gov/bills_laws/Pages/ORS.aspx). The primary statutes governing ODFW are the Wildlife Code (ORS chapters 469 – 501) and the Commercial Fishing Code (ORS chapters 506 – 513). The Wildlife Code sets law for managing the state's wildlife, which includes mammals, birds, fish, amphibians, reptiles, and shellfish. The Commercial Fishing Code provides law and policy for managing commercial fisheries.

The Wildlife Code establishes and defines the Oregon Fish and Wildlife Commission, establishes and defines the ODFW, sets the overarching wildlife management policy, and defines laws, policies, and programs concerning management of Oregon's wildlife. The state's wildlife management policy balances the need to prevent serious depletion of any indigenous species with the need to provide the optimum recreational and aesthetic benefits for present and future generations of the citizens of this state.

The Commercial Fishing Code establishes jurisdiction over commercial harvest of “food fish”, sets forth a food fish management policy, and establishes provisions for commercial fishing licenses, permits, and programs. Food fish include fish, shellfish, and “all other animals living intertidally on the bottom.” The food fish management policy balances the need to maintain all species of food fish at optimum levels with the need to provide the optimum economic, commercial, recreational and aesthetic benefits for present and future generations of the citizens of Oregon.

Oregon Fish and Wildlife Commission

The Oregon Fish and Wildlife Commission (Commission) is a governor-appointed public body that provides overall policy guidance to ODFW, reviews and approves administrative rules that govern the implementation of fish and wildlife statutes, and provides a public forum for addressing state fish and wildlife issues. The Commission formulates general state programs and policies concerning management and conservation of fish and wildlife resources and establishes seasons, methods and limits for sport and commercial take. The Commission consists of seven members appointed by the governor for staggered four-year terms. One commissioner must be from each congressional district, one from east of the Cascades and one from west of the Cascades.

ODFW Agency Infrastructure

ODFW consists of the Commission, a commission-appointed director, and a statewide staff of approximately 1,200 permanent employees. The department carries out fish and wildlife laws, rules, policies, and commission actions through programs staffed by biologists, technical experts, and others. The primary programs include Fish Division, Wildlife Division, and Administrative Services Division. A program within the Fish Division, the Marine Resources Program, carries out state management actions for Oregon’s marine fish and wildlife resources. This Nearshore Strategy provides the framework for Marine Resources Program’s management of fish and wildlife within state ocean waters and estuaries.

ODFW Administrative Rules

State agencies implement statutes by adopting rules that define the details of agency programs and policies. These rules are recorded in a set of public documents referred to as Oregon Administrative Rules or OAR’s. The Oregon Fish and Wildlife Commission is the body that defines and adopts ODFW’s Administrative Rules. ODFW has numerous administrative rules governing its actions (http://www.dfw.state.or.us/OARs/index.asp).

Native Fish Conservation Policy

One set of rules particularly germane to the Nearshore Strategy is the *Native Fish Conservation Policy* (OAR 635-007-0502 through 635-007-0509). This policy provides the overall blueprint for ensuring conservation of native fish in Oregon, which includes marine fish and invertebrates residing in state waters (from shore out to 3 nautical miles). The policy’s goals include:

1. Prevent the serious depletion of any native fish species by protecting natural ecological communities, conserving genetic resources, managing consumptive and non-consumptive fisheries, and using hatcheries responsibly so that naturally produced native fish are sustainable;

2. Maintain and restore naturally produced native fish species, taking full advantage of the productive capacity of natural habitats, in order to provide substantial ecological, economic, and cultural benefits to the citizens of Oregon; and
3. Foster and sustain opportunities for sport, commercial, and tribal fishers consistent with the conservation of naturally produced native fish and responsible use of hatcheries.

> **Definitions:**
>
> **Native fish:** Fish species indigenous to Oregon, not introduced. This includes both naturally produced and hatchery produced fish.
>
> **Naturally produced fish:** Fish that reproduce and complete their full life cycle in natural habitats.

In 2015, ODFW developed a Marine Fishery Management Plan Framework (ODFW 2015) under the umbrella of the *Native Fish Conservation Policy*. The Framework provides a transparent and consistent process for developing state fishery management plans for marine fish and shellfish designed to maintain ecosystem integrity and sustainable fisheries. The primary components of marine FMPs under the Framework include: 1) identification and characteristics of the population being managed, 2) description of the current and desired biological status of the population, 3) assessment of factors causing gaps between current and desired population status, and 4) management strategies that address factors and provide metrics to assess the success of the strategies. The full Framework is available on the Marine Resources Program website.

Other State Agencies

Management of the nearshore environment is highly fragmented, with jurisdiction split among multiple state agencies (Figure 2.1). ODFW's legal jurisdiction covers management of fish and wildlife only. While ODFW can take action to control the take or harvest of animals, and has some authority concerning animal habitat, the Department does not have authority over such issues as water pollution, vessel traffic, or access to public lands (except on ODFW-owned land). These and other issues are under the jurisdiction of other state agencies. Those with the greatest connection to the Nearshore Strategy are listed below.

Department of State Lands (DSL)

The department is the administrative agency of the State Land Board. It manages the state's submerged and submersible land under navigable rivers, lakes, estuaries, and the territorial sea. It also administers a permit program for dredging and filling in state waters, a program for leasing rights to state submerged and submersible lands, and is responsible for managing commercial kelp harvest.

Oregon Parks and Recreation Department (OPRD)

The department has management authority over most of the Oregon coastline through two mechanisms. The OPRD has direct authority to manage activities within state parks, many of which include sandy or rocky shore areas. In cooperation with DSL, OPRD also manages Oregon's ocean shore—the publicly owned land between the extreme low water line and to the beach zone line (statutory vegetation line) along the entire length of Oregon's coast.

Department of Environmental Quality (DEQ)

The department is a regulatory agency charged with protecting the quality of Oregon's environment. DEQ is responsible for protecting and enhancing Oregon's water and air quality, for cleaning up spills and releases of hazardous materials, for testing for toxins in Oregon's environment, including its fish and wildlife resources, and for managing the proper disposal of hazardous and solid wastes. DEQ uses a combination of technical assistance, inspections and permitting to help public and private facilities and citizens understand and comply with state and federal environmental regulations. In addition to local programs, the U.S. Environmental Protection Agency (EPA) delegates authority to DEQ to operate federal environmental programs within the state such as the Federal Clean Air, Clean Water, and Resource Conservation and Recovery Acts.

Department of Land Conservation and Development (DLCD)

The department oversees implementation of the state's land use planning and coastal zone management programs. DLCD provides coordinated management planning for ocean and coastal state agencies through the Ocean Policy Advisory Council, the Oregon *Ocean Management Plan*, the *Territorial Sea Plan,* Estuary Plans and Statewide Planning Goals 16, 17, 18, and 19.

The *Territorial Sea Plan* was established to conserve and protect marine habitat by managing the resources and uses within the state's jurisdiction of the sea. In 2013, it was amended to include policies governing offshore renewable energy siting in state waters.

Oregon State Police (OSP)

The Oregon State Police enforce all laws, including fish and wildlife regulations. OSP's Fish and Wildlife Division works closely with ODFW to identify current issues and set enforcement priorities. Updating the *Cooperative Enforcement Plan* annually is part of this process.

Oregon Health Authority (OHA)

OHA administers public health programs, including making decisions on beach closures due to poor water quality or human food health risks such as biotoxins in shellfish.

Department of Agriculture (ODA)

The department is responsible for testing seafood commodities such as Dungeness crab and razor clams for contaminants. ODA also is responsible for leasing and regulatory functions for oyster and mussel aquaculture, and regulates the use of growth-retardant paints on boat hulls. The ODA is responsible for appointing members to various commodity commissions such as the Dungeness Crab Commission, the Salmon Commission, the Albacore Commission and the Oregon Trawl Commission.

Department of Geology and Mineral Industries (DOGAMI)

The department regulates surface mining and oil, gas and geothermal resource exploration. The agency also identifies and maps the state's geology and natural hazards. On the coast this includes tsunami and earthquake hazards, and coastal erosion.

Oregon State Marine Board (OSMB)

The Marine Board regulates boating activities in state waters. Through boater education and publications, the board can create public awareness of wildlife resources affected by boating activity.

Local Governments

Counties/Cities

County and city governments have authority in land use regulation and limited authority in ocean governance through 19 statewide planning goals and various Oregon Administrative Rules. These goals and rules give county governments the ability to direct land use planning, economic and coastal development, estuary use and planning, address transportation concerns and direct local government planning and zoning activities regarding state and local parks. Some enforcement of fish and wildlife laws and marine activities is done by county sheriffs. County commissioners and their constituents often have interest and involvement in ocean governance decisions that could affect local economies.

Port Authorities

Established by enactments of state government, public ports develop, manage and promote the flow of waterborne commerce and act as catalysts for economic growth. Port commissioners and staff often are directly involved in the development and maintenance of ports and promote economic growth and recreational activities. Dredging, construction, security, and port infrastructure improvement is done through port authorities in conjunction with state and federal agencies.

Oregon Coastal Zone Management Association

The Oregon Coastal Zone Management Association is a non-profit organization representing counties, cities, ports, soil and water conservation districts and the Coquille Tribe on the Oregon coast. The group helps coordinate local government involvement in coastal transportation issues, coastal land use issues, coastal resource management, fisheries (sport and commercial) and develops objective information about the economy of the Oregon coast. It has no statutory or regulatory authority. The group also provides basic information to Congress and the U.S. Army Corps of Engineers regarding maritime traffic to help budget for harbor maintenance.

Oregon Coast Tribal Governments

Tribal government representatives work with the Governor's office, state agencies, local jurisdictions and other coastal program partners to discuss cultural and land use issues related to marine resources. In 2001, the Oregon Legislature enacted Senate Bill 770 which formalized the government-to-government relationship that exists between Oregon's Tribal governments and the State of Oregon. Currently, one seat for "coastal" tribal representation is reserved on the Ocean Policy Advisory Council and gives tribal governments the ability to assist in ocean management.

Federal Agencies

Several federal agencies have management authority over species, activities, or lands in the nearshore area. State and federal agencies share jurisdiction for many resource management activities. Federal agencies whose ocean management jurisdiction has the greatest connection to the Nearshore Strategy are:

Bureau of Ocean Energy Management (BOEM)

The Bureau of Ocean Energy Management's Renewable Energy Program is authorized by the Energy Policy Act of 2005 to issue leases, easements, and right-of-way grants for production and transmission of energy from renewable sources on the Outer Continental Shelf, such as marine hydrokinetic and offshore wind. BOEM's responsibilities are paired with those of other federal entities; however BOEM is the lead agency for offshore wind.

Federal Energy Regulatory Commission (FERC)

Under the authority of the Federal Power Act, the Federal Energy Regulatory Commission issues licenses for the construction, operation, and maintenance of most non-federal hydropower projects. This includes marine hydrokinetic projects sited in Oregon's Territorial Sea or the adjacent federal waters of the Pacific Ocean.

National Marine Fisheries Service (NMFS, or NOAA Fisheries)

This branch of the National Oceanic and Atmospheric Administration manages ocean fisheries under the Magnuson Stevens Fisheries Conservation Act, administers the Marine Mammal Protection Act, and co-administers the Endangered Species Act with U.S. Fish and Wildlife Service. Ocean fisheries management occurs through a regional advisory body known as the Pacific Fishery Management Council (see below), which makes recommendations to NOAA Fisheries.

U.S. Fish and Wildlife Service (USFWS)

The USFWS administers the National Wildlife Refuges in Oregon, and co-administers several federal laws including the Endangered Species Act. A complex of five National Wildlife Refuges include over 1,800 rocks and islands that are disconnected from the mainland and have land above mean higher high water in Oregon's territorial sea as well as rocky headlands and portions of estuaries. These include Bandon Marsh, Cape Mears, Nestucca Bay, Oregon Islands, Siletz Bay and Three Arch Rocks National Wildlife Refuges.

U.S. Army Corps of Engineers (USACE)

The Army Corps of Engineers is responsible for building and maintaining coastal navigational projects, placement of dredged materials, and administering federal permit programs for construction, dredging, and filling in ocean and other waters.

U.S. Coast Guard (USCG)

The United States Coast Guard is active in the protection of natural resources, including pollution prevention, response, and enforcement; enforcement of fisheries laws, and international agreements and foreign vessel inspections.

U.S. Environmental Protection Agency (EPA)

The EPA is responsible for protecting marine water quality under federal laws and regulates all point-source discharges into rivers, estuaries, and marine waters. The EPA protects coastal marine resources through a watershed approach and its regulatory and cooperative management programs.

Other Ocean Related Federal Agencies

Other federal agencies that manage coastal lands adjacent to the nearshore area include U.S. Bureau of Land Management (BLM) and U.S. Forest Service (USFS).

Policy Forums and Partnerships

Ocean Policy Advisory Council (OPAC)

The Ocean Policy Advisory Council was established in 1991, by the Oregon Legislature and represents ocean interest groups such as commercial, charter and sport fisheries, counties, port officials, recreationalists, conservation organizations, state agencies, and others. OPAC's purpose is to assist management agencies in discussions, recommendations, and advancement of policies related to the state's three-mile territorial sea. OPAC developed the Territorial Sea Plan to provide guidance for managing activities affecting ocean natural resources. OPAC provides a forum for addressing issues identified in the Nearshore Strategy that cut across agency jurisdictions.

International Pacific Halibut Commission (IPHC)

The International Pacific Halibut Commission (IPHC) is an international body that is dedicated to research and management of Pacific halibut stocks that occur in both U.S. and Canadian waters. The IPHC consists of three government-appointed commissioners for each country who serve their terms at the pleasure of the President of the United States and the Canadian government respectively.

Pacific Fishery Management Council (PFMC)

This is one of eight regional councils in the U.S. responsible for managing fisheries under the Magnuson Stevens Fisheries Conservation Act. PFMC is responsible for fisheries off of Oregon, Washington, and California. The Council consists of representatives from the west coast states, NOAA Fisheries, tribes, and citizens in, or associated with, commercial and sport fishing industries. The Council recommends fishery management actions to NOAA Fisheries.

Pacific States Marine Fisheries Commission

The Pacific States Marine Fisheries Commission (PSMFC) is dedicated to resolving interstate fishery issues. Representing California, Oregon, Washington, Idaho, and Alaska, the PSMFC does not have regulatory or management authority. Rather, it serves as a forum for data collection, information management and discussion, working for coastwide consensus between state and federal fishery management authorities. PSMFC addresses issues that fall outside individual state or regional management council jurisdiction.

Marine Spatial Management

Spatial management and marine spatial planning incorporate science and user needs to address ocean resource management issues in a geographic context. The scope, content and outcome of marine spatial planning can vary from an issue-specific to a broader ecosystem context. The planning process often takes a collaborative, proactive approach that works best with diverse interest groups. Because Oregon has one of the richest temperate marine ecosystems in the world, it is necessary to identify important ecological areas, setting strong ecological resource protection standards in the state's nearshore waters. Oregon has a long history of designating spatial areas for certain purposes and recently developed the Territorial Sea Plan (TSP) Part 5, which outlines state policy on renewable ocean energy siting in the ocean, and characterizes the more suitable areas for this development to occur.

ODFW was part of the TSP development process and is also engaged in other facets of marine spatial management. Most recently, Oregon completed designation of five marine reserves and nine associated marine protected areas in 2012 with the help of community groups working in collaboration with state agencies (Figures 2.2a and 2.2b). ODFW is the lead agency for managing these areas. In addition, a series of Marine Gardens, Habitat Refuges, Research Reserves, and Shellfish Preserves can be found along the Oregon coast and waters (Figures 2.2a and 2.2b). These were established individually from the 1960s through the 1990s to address specific issues.

The U. S. Fish and Wildlife Service also manages a complex of National Wildlife Refuges that encompass the more than 1800 islands off the Oregon coast as well areas on the coastal mainland. Federal wildlife refuges are above the mean high tide line. These islands are part of Oregon's nearshore environment and provide breeding and resting habitat for marine mammals and seabirds. Oregon put additional restrictions on boat operations in the waters within 500 feet of the islands at Three Arch Rocks to further protect wildlife from disturbance.

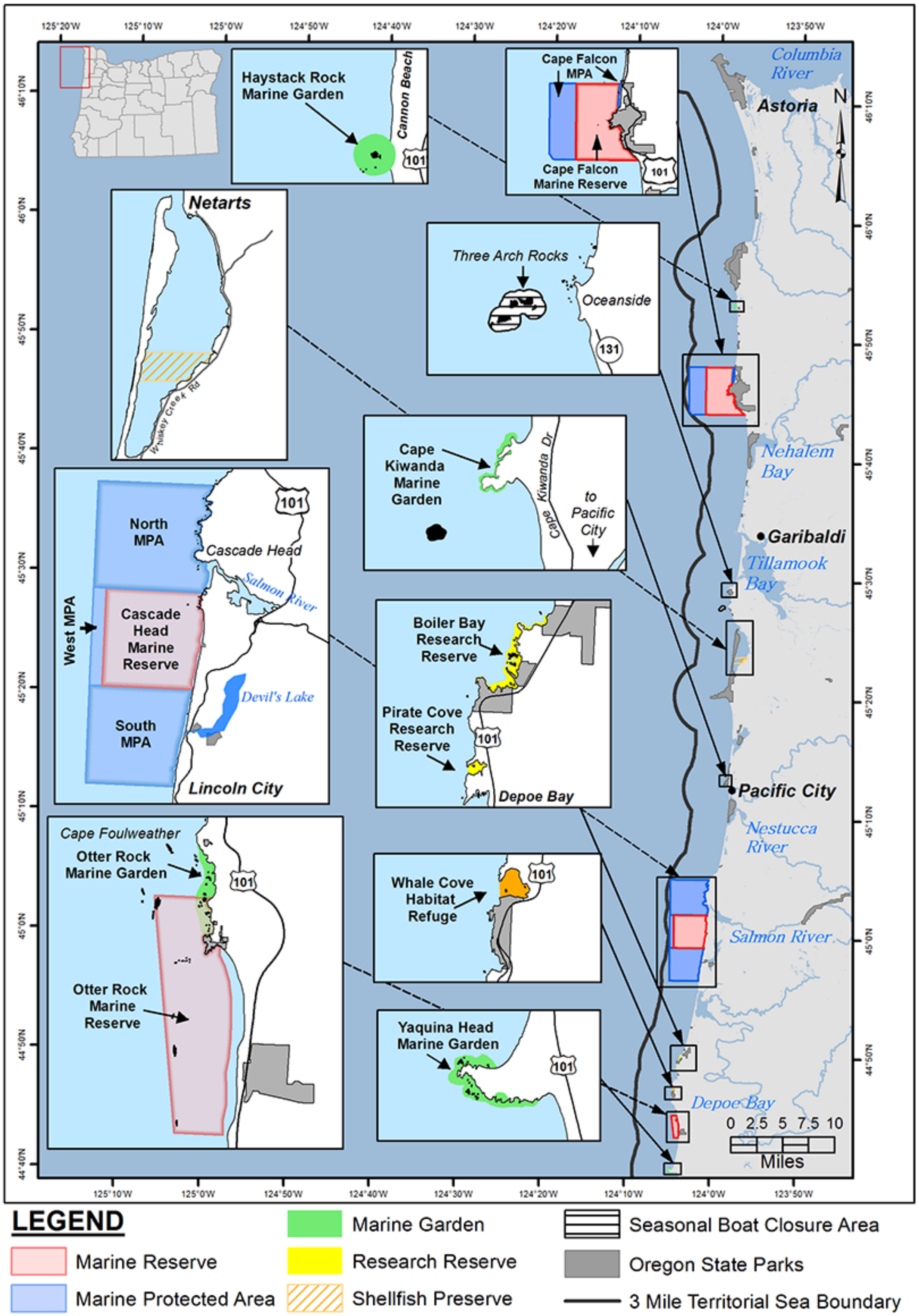

Figure 2.2a. North Oregon coast Nearshore spatial management areas.

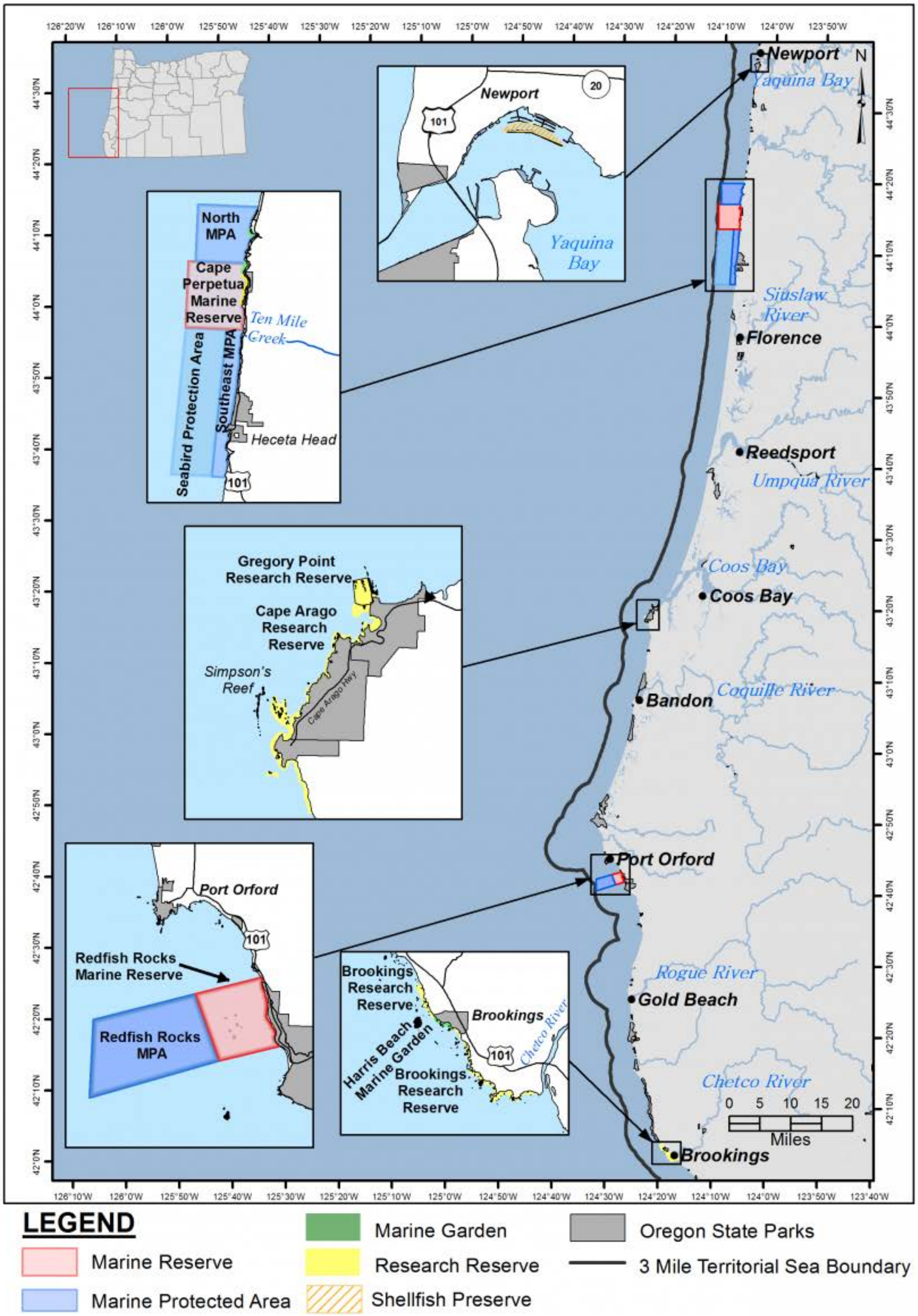

Figure 2.2b. South Oregon coast Nearshore spatial management areas.


the OREGON NEARSHORE STRATEGY




Chapter 3: Nearshore Strategy Development

2016
Oregon Department of Fish and Wildlife

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This PDF is a chapter of the Oregon Conservation Strategy, the official State Wildlife Action Plan for Oregon. The complete Oregon Conservation Strategy is available online at http://oregonconservationstrategy.org/. Since Conservation Strategy content will be updated periodically, please check the website to ensure that you are using the most current version of downloadable files.

Contact ODFW

For more information on the Oregon Nearshore Strategy or to provide comments, email ***Nearshore.Strategy@state.or.us*** *or write to Oregon Department of Fish and Wildlife, Marine Resources Program 2040 SE Marine Science Drive, Newport, OR 97365*

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Feature image: Eel grass, © Janna Nichols

Photo Credit: Oregon Coast Aquarium

NEARSHORE STRATEGY DEVELOPMENT

While the preparation of the Oregon Nearshore Strategy is initiated and the primary responsibility of the ODFW, the content is based on a collaborative process which includes subject matter experts, our state's citizens, resource users, and resource managers from other state and federal agencies. The original Nearshore Strategy (ODFW 2006) outlines who was involved in development of the Nearshore Strategy, how they were involved, and a summary of the input provided by participants. Similarly, the 2015 Oregon Nearshore Strategy reflects input we have received during the decade since the original document was published and during the public process over the past year. A summary of public and technical working group input received to date and the process for reviewing and updating the Nearshore Strategy is presented below.

PROCESS AND PARTICIPANTS

Internal Process

In 2012, ODFW conducted an update to the Nearshore Strategy to: 1) better integrate the Nearshore Strategy with the Oregon Conservation Strategy; 2) examine the effects of global climate change and ocean acidification on nearshore species and habitats; and 3) review the progress made in implementing the Nearshore Strategy and consider priorities for updating the Strategy during the 10 year review in 2015.

The 2015 revision included reviewing the Nearshore Strategy, integrating the work done in 2012 on climate change and ocean acidification, and collecting and analyzing new information on nearshore species, their habitats and factors affecting them. Published literature and electronic databases were examined, and input on current and future nearshore issues and needs were obtained from ODFW staff, other state agencies, tribes, external experts, and the public. The Oregon Conservation Strategy and Nearshore Strategy documents were better integrated.

Public Participation

A public process was undertaken to engage management partners, stakeholders, scientists, and other parties with an interest in Oregon's nearshore resources in updating the Nearshore Strategy. Avenues for public participation included: a technical working group, notifications of the update on the ODFW website seeking input, public meetings, and additional verbal or written public comment. This work was done in parallel with an update of the Oregon Conservation Strategy. In all, six opportunities for input at public meetings were provided in 2015 (Table 3.1).

Participants represented a broad array of groups and interests, including:

- Commercial and sport fishing interests and other ocean related businesses
- Conservation organizations
- Scientists, economists, and other subject matter experts
- Federal, tribal, state, and local government representatives
- Other interested citizens

These opportunities provided ODFW with input on issues and concerns for nearshore species and habitats in need of management attention, potential conservation actions, research and monitoring, and priorities for management.

Table 3.1. Public Meetings

Nearshore Strategy Topic	**Meeting Objectives**
January 2015April 2015 **Fish & Wildlife Commission** Nearshore Strategy review and update process progress reports	• Provide information on the Strategy, the review and update process and how members of the public can participate • Provide update on progress and present summary of proposed changes to species lists and definition of Nearshore • Identify priorities and opportunities for nearshore resource conservation and management • Opportunity for public input
July 2015Public Meetings **North Bend and Newport** Overview of updated Nearshore Strategy	• Provide overview of the updated Nearshore Strategy • Present proposed redefinition of Oregon's Nearshore • Present list of proposed Strategy Species • Present summary of updated information in Strategy including research and monitoring needs and Recommendations • Opportunity for public input
August 2015Fish & Wildlife Commission Integration of input into Nearshore Strategy public comment draft	• Present summary of changes to updated document • Present public input on public review draft • Present plans to finalize Strategy revision • Opportunity for public input

September 2015Fish & Wildlife Commission Adoption of updated Nearshore Strategy by Commission	• Present updated Strategy for adoption by Commission • Opportunity for public input

SUMMARY OF PUBLIC INPUT

A wealth of information on issues facing nearshore species and their habitats was received, during the initial development of the Nearshore Strategy as well as during the decade since it was first published. This section briefly captures major themes of this valuable information.

Species

Many people noted that although birds were included in the Oregon Conservation Strategy, this important component of the nearshore ecosystem was missing from the original Nearshore Strategy.

Limiting Factors

People shared their knowledge and concerns regarding limiting factors to sustainable nearshore resources, and identified a number of limiting factors. Limiting factors identified fall into eight general categories:

- **Lack of public awareness** about nearshore species, habitats, and issues facing nearshore resources. Education and outreach needs.
- **Inadequate data and analysis** for making appropriate management decisions. Insufficient data collection and analysis, limited life history information, the need for fishery independent surveys of abundance and the prolonged lag time for making use of data.
- **Loss or alteration of habitat** important to nearshore species and ecosystems. Both direct and indirect sources of nearshore habitat loss/alteration, including those related to global climate change and ocean acidification.
- **Water quality degradation** caused by anthropogenic factors that may negatively affect nearshore species and habitats. Point and nonpoint sources of pollution.
- **Wildlife disturbance** to nearshore species. Types of human activities that could cause wildlife disturbance.
- **Harvest issues** that could negatively impact nearshore species or habitats. Examples included general and localized overharvest, catch of non-targeted species, and lack of upper size limits for certain species to protect “mega-spawners” that can make substantial reproductive contributions to populations.
- **Management inadequacy**. Numerous regulations, conflicting regulations and authorities, and lack of coordination between management authorities.
- **Ecosystem imbalances**, such as imbalances in predator prey population dynamics and introduction of invasive species.

Conservation Actions, Research Needs, and Management Priorities

Public input on conservation actions, research needs, and priorities for management that could contribute to sustainable nearshore resources are summarized here. Ideas expressed pertain to actions that could be carried out by ODFW staff, partners in collaboration with ODFW, or by other groups or natural resource agencies independently of ODFW.

Input from participants fell into three general categories consistent with the Nearshore Strategy recommendations and the three overall goals: 1) education and outreach, 2) research and monitoring, and 3) policy and management. Summaries of the input provided for each of these categories is provided below.

Suggested Education and Outreach Actions

Information dissemination to public

Outreach and educational information is an essential component of successful conservation implementation. Building on existing programs and developing new methods to reach the public is needed to convey concepts for conservation.

- Use ODFW's Marine Resources Program website, local newspapers, social media and literature to share research and conservation actions.
- Display conservation and educational materials at public areas (including hotels, charter offices, angling shops, real estate offices, kiosks in malls, parks, marinas, boat ramps, and beach access points, other public areas).
- Continue to develop and implement fish release methods (aka "descender devices"). Make information widely available to anglers.
- Continue and increase ODFW representation at sportsmen shows, festivals, etc.
- Establish/strengthen outreach methods and opportunities for disseminating information to the public, stakeholders, industry, etc.

Workshops/forums

At times, education for stakeholders and the general public is needed on a more detailed and focused level than is possible with tools such as websites, printed material, or the media, in order to put conservation ideas and concepts into practice.

- Design and convene workshops tailored to educate the public or user groups on specific topics (e.g., fish, algae or invasive species identification workshops).

Suggested Research and Monitoring Actions

Species Information

Accurate accounting of stock abundance and harvest impacts is an important component of sustainable resource management. There are many nearshore species for which we do not currently have abundance estimates or complete life history information. In many cases, most or all of the information currently available on nearshore species is from catch landed in fisheries, which results in limited data. Information on abundance and other population characteristics from surveys independent of commercial or sport fishing is essential for managing nearshore species.

- Gather information for all key nearshore species, regardless of whether or not they are harvested.
- Develop stock assessment methods that accommodate the unique circumstances and habitats of nearshore species with the greatest management need.
- Collaborate with sport and commercial fishermen, university researchers, and others to gather information for exploited nearshore stocks.
- Inventory and monitor invasive species.
- Continue marine mammal population level monitoring.
- Encourage/assist in research on movement, behavior, and predator-prey relationships of adult and juvenile stages of nearshore species.
- Encourage/assist in research and monitoring of reef specific changes, dynamics, and species usage.

Estuaries

Estuaries, and species predominantly estuarine, were not covered in the initial version of the Nearshore Strategy. Input from public and technical working groups strongly supported the inclusion of estuaries and estuary management in the 2015 Nearshore Strategy and close coordination on estuaries with the updated Oregon Conservation Strategy developed by ODFW's Wildlife Division. Suggested actions:

- Conduct a comprehensive assessment of human and predator effects on harvested and non-harvested estuary species.
- Evaluate potential impacts of issues such as invasive species and aquaculture on estuarine fish, wildlife, and habitats.
- Develop a sampling and monitoring program to assess harvest rates, distribution patterns, pollutant indicators and species biology that will allow for more comprehensive management planning.
- Recognize, and where plausible integrate, linkages between estuary and nearshore marine environments in resource management.

Habitat

Habitat surveys of Oregon's nearshore environment are limited and much of the area has not been surveyed with advanced technologies capable of fine resolution. Substantial data gaps exist in regards to bathymetry, substrate, and habitat. Little is known about the shallow (<10 meters) habitat and bioassemblages and more information is needed to understand the complexity of the nearshore ecosystem and the effects of human interactions.

- Continue to develop habitat surveys using ODFW's remotely operated vehicle (ROV).
- Develop new cost effective survey techniques for nearshore habitats.
- Continue to collaborate with OSU on seafloor mapping projects
- Collaborate with interested stakeholders to supplement/increase current survey data and areas covered.

- Encourage/assist in research of reef-specific changes, dynamics, and species usage.
- Collaborate with DLCD in developing and updating estuary habitat maps.
- Encourage/assist in estuarine research to identify data/knowledge needed for management planning.

Monitoring

Monitoring species and habitat changes will help evaluate resource status and trends, judge the success of conservation and management efforts, and guide future management actions. Although some monitoring is done at present, such as for catch and effort, more is needed to examine changes and trends within Oregon's nearshore ecosystem. Many of the recommendations under the species and habitat subcategories above are also monitoring actions specific to those subcategories. The recommendations below are more ecosystem wide monitoring that could be done by ODFW or other appropriate parties. These include:

- Encourage/assist in monitoring of reef specific changes, dynamics, and species usage.
- Continue to assess/gather information on levels of human use and wildlife disturbances to intertidal habitats, animals, and plants.
- Conduct new surveys to assess habitat changes and species distribution changes.
- Monitor coastal and offshore development to identify potential impacts to nearshore resources.
- Monitor point and nonpoint source pollution problem areas (e.g., wastewater treatment/raw sewage discharges, pulp/paper mill effluent, increased nutrient loading from agricultural runoff, etc.).

Suggested Policy and Management Actions

Sport/Commercial Fisheries

Fisheries management is an integral component of sustainable nearshore resource management. Many concerns about current fisheries management were articulated by participants during public and technical working group meetings. Some suggested actions for improving sport/commercial fisheries management were:

- Increase marine sport fishery monitoring.
- Examine sport fishing activity and the current monitoring framework to improve data collection.
- Analyze current data collection methods and estimates of catch to improve stock assessment support for species in greatest need of management attention and "overfished" stocks.
- Collaborate with other agencies to support and ground-truth data collection methods.
- Continue to reduce bycatch/discard using incentives as well as gear research and development.

Non-Extractive Management Actions

Forage fish are an important component of the marine ecosystem off the U.S. West Coast, including Oregon's nearshore waters. There has been growing public interest in addressing the conservation needs of these species, which include round and thread herring, mesopelagic fishes, Pacific sand lance, Pacific saury, silversides, Osmerid smelts, and pelagic squids. In March, 2015, the Pacific Fishery Management Council prohibited the development of new directed commercial fisheries on these unmanaged forage fish species. Federal regulations implementing this prohibition are under development as of June, 2015. ODFW will develop an Unmanaged Forage Fish Fishery Management Plan (FMP) based on the Marine Fishery Management Plan Framework approved by the Oregon Fish and Wildlife Commission in 2015 (recognizing that there will be significant differences from a typical fishery management plan, as directed fishing will not be occurring). Oregon's Unmanaged Forage Fish FMP will include information on resource status, management, and history that are specific to Oregon, but will overall align very closely with the federal approach.

Socioeconomics

Coastal economies in Oregon are often directly or indirectly dependent on nearshore resources. The importance of improving the availability and use of socioeconomic information in nearshore resource management was emphasized by many. Suggested actions included:

- Work with coastal ports and stakeholders to characterize sport and commercial fishery contributions to coastal economies.
- Examine, at local and regional scales, economic impacts due to regulations.
- Look for ways to include incentives in fisheries and other nearshore resource management.

Communication and Coordination

One of the primary goals of the Nearshore Strategy is to improve communication and coordination between ODFW and the public, other resource management agencies, tribes, the fishing industry, universities, ports, local units of government, and non-governmental organizations. Suggested actions:

- Continue to facilitate the exchange and discussion of information about terrestrial activities that may negatively impact nearshore resources or the nearshore environment.
- Increase/develop coordination between state and federal management agencies, local units of government, ports, and non-governmental organizations.
- Encourage development of local groups to facilitate information and knowledge exchange between ODFW and local constituents. Look for ways in which local input can be folded into the management process.

Public Input on Review Draft

Unlike the wide reaching scope of extensive input received when the concept of the Nearshore Strategy was brand new a decade ago, the amount of public input received on the public review draft was more limited in 2015. Although public comment still encompassed a broad range of topics, it largely focused on fine tuning the updated version of the Nearshore Strategy. Comments expressed support for the redefined Nearshore area and inclusion of portions of estuaries. A variety of opinions were expressed on changes that could be made to the species lists and the information presented on species-habitat associations. The role of marine reserves in nearshore research and monitoring efforts was noted. The importance of explicitly incorporating climate change and ocean acidification effects in all aspects of the document was stressed. Staff analyzed public input received and modified the Nearshore Strategy as deemed appropriate.

SUMMARY OF CHANGES

The review, extensive input, new information and better integration resulted in a number of changes to both the Oregon Conservation Strategy and the Nearshore Strategy. A brief summary of changes relevant to the Nearshore Strategy follows:

- The term "Nearshore" was expanded to include all of Oregon's Territorial Sea, shoreline areas in the supratidal zone, and portions of Oregon's estuaries.
- Information on coastal communities was updated.
- The Nearshore Strategy was reorganized to make it easier to find information on species, habitats, factors and stressors affecting species and habitats, and research and monitoring needs, with new and updated information incorporated.
- Species lists were modified based on new information, better integration with the Oregon Conservation Strategy and inclusion of estuaries as part of the nearshore.
- The new federally-adopted Coastal and Marine Ecological Classification Standard was integrated to describe habitats.
- Extensive information on the effects of global climate change and ocean acidification on Oregon's nearshore and coastal waters was incorporated (see Factors Affecting Nearshore Habitats and Species and Appendices A – D).
- Better integration resulted in more links between the Oregon Nearshore Strategy and the Oregon Conservation Strategy, including an integrated Strategy Species list and a Nearshore Ecoregion in the Oregon Conservation Strategy.
- Updates to the recommended actions for 1) Education and Outreach; 2) Research and Monitoring; 3) Management and Policy.

Table 3.2. Summary of modifications to the Strategy Species List in the Oregon Nearshore Strategy component.

Change	Species
Strategy Species identified in Oregon Conservation Strategy now included in Oregon Nearshore Strategy	**Anadromous Fishes:** Chinook salmon (all listed SMUs[1]), Coho salmon (all listed SMUs), Chum salmon (All SMUs), Coastal Cutthroat Trout (Columbia River SMU), Pacific lamprey, Western river lamprey **Birds:** Black brant goose, Black oystercatcher, California brown pelican, Caspian tern, Fork-tailed storm petrel, Leach's storm petrel, Marbled murrelet, Rock sandpiper, Tufted puffin, Western snowy plover
Strategy Species moved to the Watch or Commonly Associated Species List	**Fishes:** Black and yellow rockfish, Bocaccio, Gopher rockfish **Marine Mammals:** California sea lion

Strategy Species added based on Oregon Nearshore Strategy criteria	**Fishes:** Pacific sandlance, Longfin smelt, Deacon rockfish (a cryptic species formally recognized as a new species in 2015, formerly consider to be Blue rockfish) **Invertebrates:** Blue mud shrimp, Native littleneck clam, Olympia oyster, Sunflower star **Marine Mammals:** Southern resident killer whale **Plants:** Native eel grass

[1] SMUs are Oregon's Species Management Units for native fish species. More information about SMUs and how they relate to ESA listings for salmonids can be found in the Oregon Conservation Strategy.

NEARSHORE STRATEGY REVIEW

The 2015 Nearshore Strategy was reviewed by multiple parties prior to completion to ensure that the eight required elements for a State Wildlife Action Plan are included and clearly presented, and that the document accurately captures the public and technical input received during development. One of the USFWS eight required elements is to develop procedures to review the Plan at least every ten years and update it if necessary. To remain consistent with the Oregon Conservation Strategy, the Nearshore Strategy will undergo a complete review on this timeframe. ODFW staff will report to the Oregon Fish and Wildlife Commission on the status of the Nearshore Strategy, its relevance to current nearshore resource issues and priorities, and implementation of its recommendations. This will be done in conjunction with reports on the Oregon Conservation Strategy annually to help evaluate if changes to Oregon's State Wildlife Action Plan are warranted more frequently.


the OREGON NEARSHORE STRATEGY




Chapter 4: Coastal Communities

2016

Oregon Department of Fish and Wildlife

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Feature image: Log ship docking, DLCD/ODFW

Photo Credit: ODFW

COASTAL COMMUNITIES

Social and economic information can provide insight into the relationship between nearshore natural resources and coastal communities. This information will also inform managers during the development and implementation of management policies and actions. Nearshore marine resources directly and indirectly provide many benefits to the coastal communities, visitors, the regional economy, and more broadly to Oregon citizens. Select demographic and economic information for the Oregon coast is summarized here. The focus is on some of the trends which are likely to be relevant to nearshore resource management over the next decade.

Human communities are part of the coastal ecosystem. The coast's environment, resources and geography affect where people live, the viability of different business opportunities, property values, and recreational opportunity availability. Feedback between the socioeconomic and ecological systems occurs in both directions. In one direction, the environmental qualities and resources of the area affect the economic base and culture of coastal communities. In turn, different types of economic systems, consumptive (e.g., fishing, mining) and non-consumptive (e.g., tourism, shipping) uses of natural resources, also influence the coastal ecosystem. Ecological understanding, public awareness, and policy initiatives will improve stewardship of the marine ecosystems. This knowledge can facilitate effective management of Oregon's nearshore resources in order to ensure sustainable use.

COASTAL OREGON HISTORY

The land and waters of the Oregon coast were the setting for a dynamic aboriginal culture characterized by natural resource acquisition at many diverse localities (Moss and Erlandson 1996). Prior to European contact, Native Americans relied predominantly on fishing, hunting, gathering, and trading for sustenance. Their natural resource utilization occurred in a wide variety of environments, including sand spits, saltwater bays, tidal and intertidal estuaries, lake shorelines, river mouths and their ocean confluences. Archeological evidence of subsistence activities can be found along the Oregon coastline in the form of shell middens, fishing weirs, food processing sites, villages, and seasonal occupation camps. The types of resources utilized were directly related to the food sources available within their geographic locale. The diets of the aboriginal people primarily consisted of salmon, shellfish, plants, and land mammals. Native cultures in general were renowned for their maritime life styles, elaborate technology, high population densities, sophisticated art and architectural traditions, and sociopolitical complexity.

Coastal Oregon is geographically separated from the rest of the state by a low-lying mountain range that parallels the coastline. This geography had a direct effect on early European settlement patterns. Numerous small homesteads sprang up along the rivers and bottomlands where subsistence agriculture was possible. Early European settlers subsisted by gathering locally available resources, growing their own food in large subsistence gardens, and maintaining the few possessions they brought with them (ICF International 2010). In addition to their gardens and livestock, they also utilized many of the same resources as the Native Americans – wild berries, deer, elk, and estuarine animals such as clams, crab, and fish. Shelter, often in the form of log cabins, was the first priority on any new land claim. As these early families became more settled, larger houses and outbuildings were constructed. While local towns played important roles in trade and commerce, most early residents continued to live in rural areas. Many of the early towns along the Oregon Coast had brief periods of prosperity before disappearing.

In the modern era, marine resource harvest has increased as human demand for food and recreation has grown, and efforts have expanded from estuary and shoreline-based activities to include nearshore and more distant waters. Wild salmon populations and some shellfish production have been supplemented with hatcheries and aquaculture operations.

GENERAL COASTAL OREGON POPULATION DATA

A large proportion of the land in coastal Oregon is owned by the Federal government, the state, forest products companies, and other tribal or government entities (Figure 4.1). A large majority of coastal residents still live near the coastline or in narrow coastal river valleys. Based on the total amount of land in the region, the Oregon coast is sparsely inhabited. The eastern boundaries of five counties (Clatsop, Tillamook, Lincoln, Coos and Curry) approximate the range crest, while Lane and Douglas counties extend farther east to interior valleys. The aggregate density of the five coastal counties (excluding coastal Lane and coastal Douglas counties) was 31.6 persons per square mile in 2010. While the average density is low, the density within available private land suitable for residential development is higher than these figures suggest. Timberlands are 94 percent of the land base (Campbell et al. 2002). This situation has important implications which will to be subsequently discussed. State density was 39.9 persons per square mile in 2010 (Figure 4.2).[1] Oregon is 39th in density among all states (U.S. Census 2010). State density has approximately doubled since 1960 (Wilson and Fischetti 2010). Overall, the coastal population has slowly and steadily increased since the 1930’s (Figure 4.3).

In 2000, the population of the five coastal counties was 185,460 people—about 5.4 percent of Oregon’s total population. In 2010, the population was 193,730 in the five coastal counties, which was 5.1 percent of Oregon’s total population (Table 4.1). A higher proportion of retirement-age persons lived on the coast (22.0 percent) compared to the rest of Oregon (13.9 percent) in 2010 (Table 4.1 and Figure 4.4). The population growth rate for the Oregon coast, albeit slower than the rest of Oregon, has mostly occurred as a result of in-migration of both working age adults and retirees, though the retiree population has grown more than other age groups. Lincoln, Curry and coastal Lane counties have experienced a higher influx of retirees than the other coastal counties. The coast population has disproportionately more persons older than 50 years of age, and disproportionately fewer younger individuals. There is an out-migration of young adults searching for education and employment opportunities. Population growth due to births within the coastal region has actually declined. The slower rate of growth, age structure and in-migration pattern has a large bearing on the character of the coast’s economy (Swedeen et al., 2008).

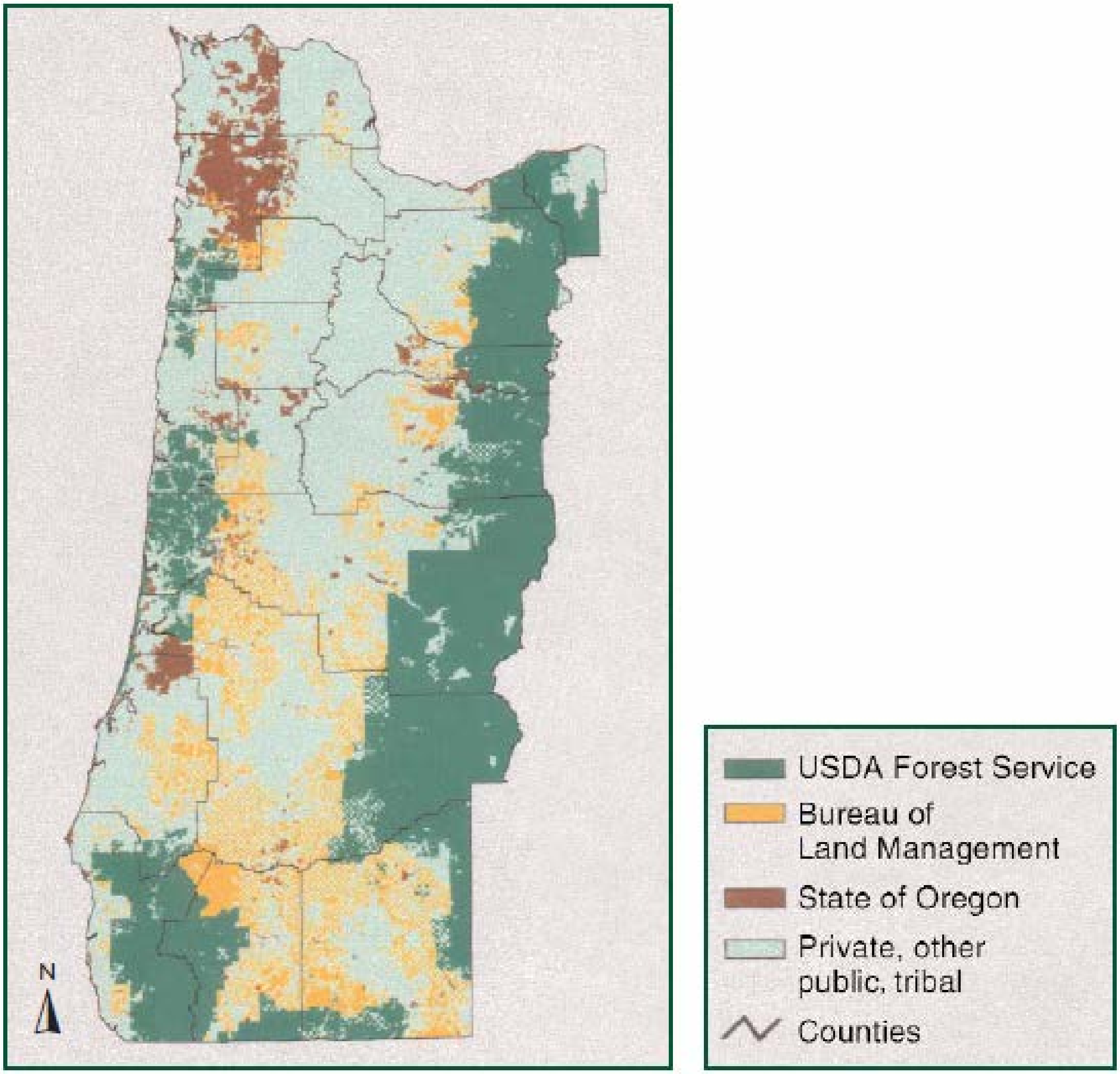

Figure 4.1 Land ownership in Western Oregon (Source: Campbell et al. 2002).

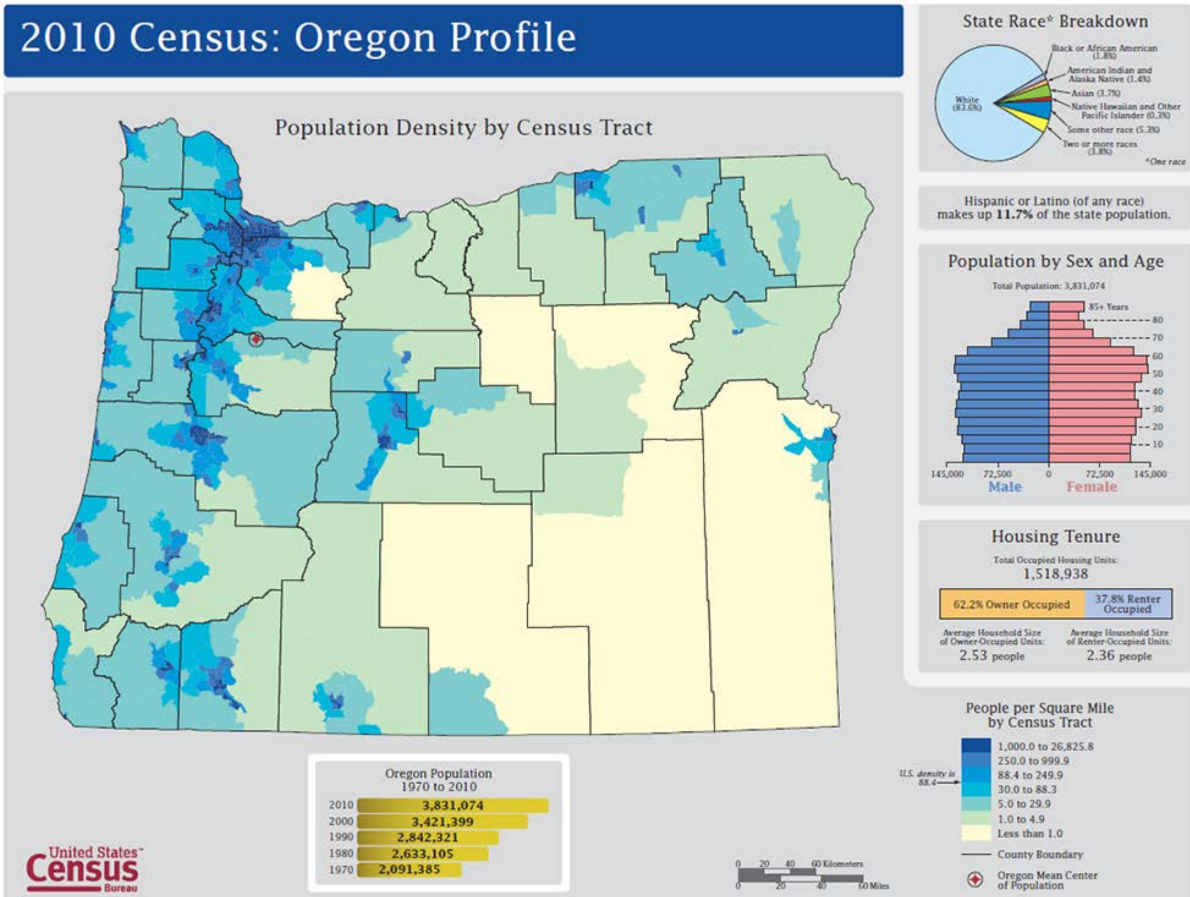

Figure 4.2. Oregon population profile (2010 U.S. Census).

Table 4.1. Oregon, Port Group, and Selected Cities Population and Housing Characteristics in Recent Years

		Population Characteristics									Housing Characteristics in 2010				
		2010							2012						
Port Group	County/City	Population	Under 18	18-64	65 and over	Median Age	White Share	Average House hold Size	Education 25+ H.S.	Individual Poverty Rate	Housing Units	Occupied Rate	Vacant Rate	Renter Occupied Rate	Vacant Second Home Rate
All	Oregon	3,831,074	22.6%	63.5%	13.9%	38.4	83.6%	2.47	89.2%	15.5%	1,675,562	90.7%	9.3%	34.3%	3.3%
	Coastwide	206,732	18.4%	59.6%	22.0%	48.3	90.2%								
Astoria	Clatsop	37,039	20.5%	62.8%	16.6%	43.2	90.9%	2.29	91.8%	15.8%	21,546	73.1%	26.9%	28.1%	19.9%
	Astoria	9,477	20.3%	62.6%	17.1%	41.9	89.2%	2.15	92.4%	20.5%	4,980	86.1%	13.9%	45.0%	4.6%
	Gearhart	1,462	17.4%	64.2%	18.4%	49.0	94.6%	2.25	96.4%	8.1%	1,450	44.8%	55.2%	11.2%	49.9%
	Cannon Beach	1,690	16.4%	63.8%	19.8%	46.4	88.4%	2.07	91.9%	26.9%	1,812	41.9%	58.1%	17.6%	54.1%
	Seaside	6,169	19.7%	62.6%	17.7%	41.9	88.6%	2.15	91.0%	17.7%	4,487	63.3%	36.7%	35.1%	28.1%
Tillamook	Tillamook	25,250	19.8%	59.3%	20.9%	47.5	91.5%	2.29	88.5%	17.2%	18,359	59.0%	41.0%	18.0%	33.8%
	Nehalem	271	16.2%	62.4%	21.4%	44.2	93.0%	2.34	95.8%	11.8%	155	74.8%	25.2%	20.6%	20.0%
	Tillamook	4,935	27.0%	59.0%	14.0%	33.7	86.5%	2.41	85.9%	29.9%	2,248	90.6%	9.4%	52.7%	0.8%
	Garibaldi	779	12.5%	59.4%	28.1%	55.1	94.7%	1.99	91.5%	20.7%	524	73.3%	26.7%	21.4%	19.5%
	Netarts	748	15.1%	64.4%	20.5%	52.8	95.3%	2.04	95.3%	6.9%	775	47.2%	52.8%	14.6%	44.0%
	Pacific City	701	13.7%	56.3%	30.0%	55.1	91.9%	2.06	97.2%	23.9%	705	48.2%	51.8%	11.8%	46.1%
Newport	Lincoln	46,034	17.3%	61.1%	21.7%	49.6	87.7%	2.20	89.3%	16.0%	30,610	67.1%	32.9%	23.8%	25.1%
	Depoe Bay	1,398	9.7%	60.5%	29.8%	56.6	92.9%	1.96	91.8%	15.4%	1,158	61.7%	38.3%	20.9%	26.3%
	Newport	9,989	20.0%	61.1%	18.9%	43.1	84.1%	2.22	88.0%	18.7%	5,540	78.6%	21.4%	39.3%	13.8%
	Siletz	1,212	24.5%	61.2%	14.3%	42.0	69.7%	2.67	83.3%	23.0%	483	92.8%	7.2%	25.1%	0.8%
	Toledo	3,465	24.8%	63.4%	11.8%	37.6	89.9%	2.60	86.4%	18.9%	1,474	90.3%	9.7%	36.4%	1.8%
	Waldport	2,033	15.8%	57.9%	26.2%	53.0	91.2%	2.08	89.2%	14.5%	1,196	81.4%	18.6%	28.2%	10.4%
	Yachats	690	4.9%	53.6%	41.4%	62.3	95.2%	1.72	94.5%	8.6%	807	49.6%	50.4%	18.6%	40.0%
Coos Bay	Coastal Lane	8,466	13.9%	49.7%	36.4%	57.0	92.5%								
	Florence	8,466	13.9%	49.7%	36.4%	57.0	92.5%	1.98	92.9%	11.9%	5,103	82.8%	17.2%	31.6%	7.3%
Coos Bay	Coastal Douglas	4,536	17.2%	54.7%	28.1%	51.9	93.1%								
	Reedsport	4,154	17.8%	55.0%	27.2%	51.2	93.0%	2.11	82.0%	21.9%	2,207	88.3%	11.7%	32.2%	2.8%
	Winchester Bay	382	11.0%	51.0%	38.0%	59.0	93.7%	1.88	84.1%	8.3%	270	73.0%	27.0%	22.6%	18.1%
Coos Bay	Coos	63,043	18.9%	59.7%	21.4%	47.3	89.8%	2.29	87.8%	17.3%	30,593	88.7%	11.3%	30.5%	4.0%
	Coos Bay	14,556	20.2%	60.8%	19.0%	41.5	86.6%	2.26	89.0%	18.6%	6,879	92.1%	7.9%	42.2%	1.4%
	Bandon	3,066	15.3%	54.7%	30.0%	53.4	92.6%	2.01	92.3%	14.6%	1,860	78.8%	21.2%	36.5%	10.6%
Brookings	Curry	22,364	15.7%	56.3%	28.0%	53.5	92.0%	2.12	90.8%	13.7%	12,613	82.6%	17.4%	25.4%	9.0%
	Port Orford	1,133	11.8%	59.4%	28.8%	54.7	93.3%	1.86	87.4%	27.4%	767	78.6%	21.4%	25.8%	10.2%
	Gold Beach	2,253	16.5%	60.8%	22.7%	50.6	91.5%	2.05	88.0%	14.7%	1,322	80.9%	19.1%	33.0%	7.4%
	Brookings	6,336	21.1%	54.7%	24.2%	46.9	92.2%	2.26	90.4%	8.0%	3,183	85.4%	14.6%	38.9%	6.9%

Notes:
1. The coastwide median age is estimated using average (weighted on total population) of the median age in the shown counties.
2. A "white" person is identified as a single race (white alone) with origins in any of the original peoples of Europe, the Middle East, or North Africa.
3. Income characteristics are from ACS based on 2008-2012 aggregations in 2012 dollars.
4. Cities are selected for proximity to ocean access harbors where commercial and recreational fishing occurs.
5. Poverty thresholds based on family status. Example poverty threshold for a two children and two adult family is about 50 percent median income.

Sources: Decennial Census 2010, and ACS aggregations for 2008-2012.

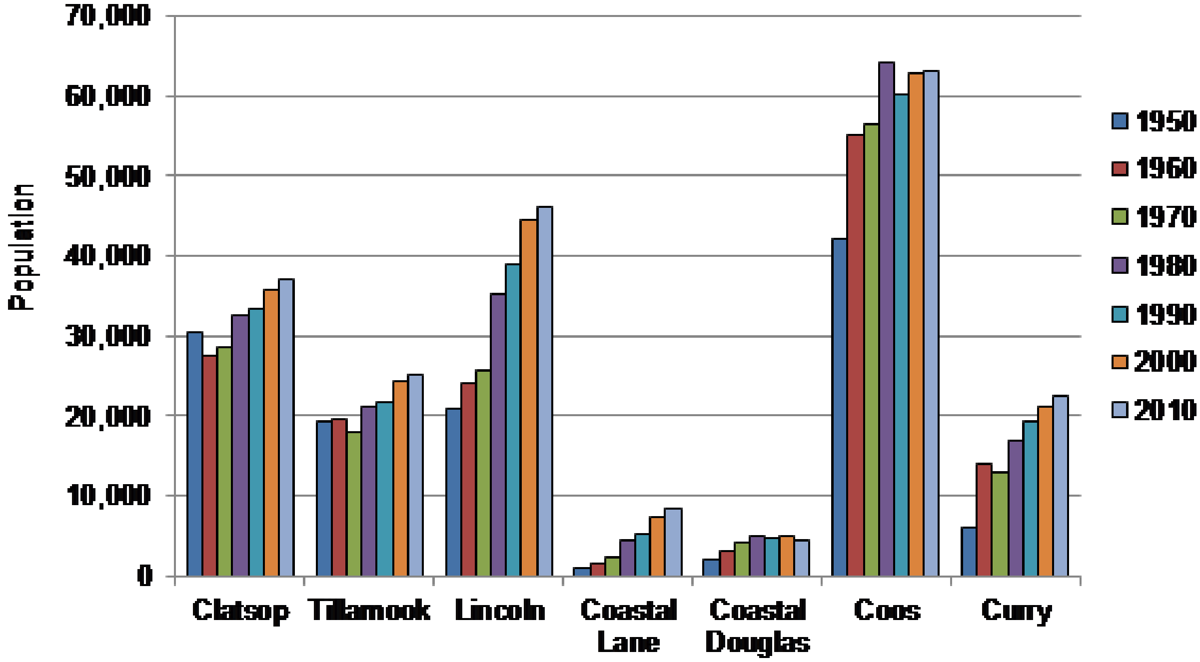

Figure 4.3. Population Growth in Coastal Counties in 1950 to 2010. Note that, coastal Lane and coastal Douglas counties are approximated by the cities of Florence and Reedsport/Winchester Bay, respectively (Source: 2010 U.S. Census). 2010 U.S. Census

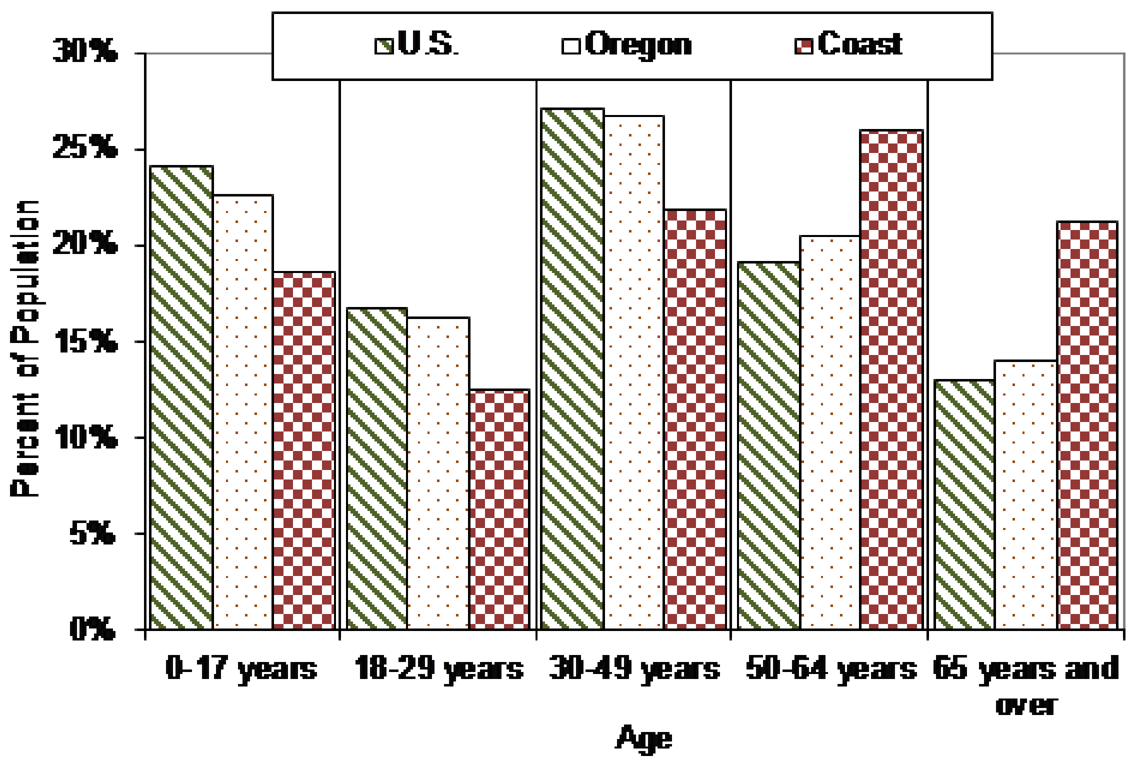

Figure 4.4. Age of population for U.S., Oregon, and Oregon Coast in 2010 (Sources: 2010 U.S. Census).

COASTAL OREGON ECONOMIC CHARACTERISTICS

Post European settlement, coastal economies were based on natural resource economic sectors in fishing, farming and logging. Opportunities in these industries generally have been declining in the last 35 years. There is considerable variation in sources of income among coastal counties. For example, Tillamook County has a large economic base from agriculture production, Lincoln County relies on commercial fishing and tourism, and timber production is still important to Coos County (TRG 2006 and 2014). The following discussion highlights the most important sectors of the regional economy.

Agriculture

Agriculture in Oregon's coastal areas is part of a lifestyle that contributes diversity to local economies. It also helps provide a buffer to the variable nature of the forestry, fishing and recreation industries. The agriculture industry has remained consistently strong in Tillamook and Coos counties.

Timber Industry

Timber harvest was increasing into the 1980's and has since decreased (OFRI, 2012). Tillamook and Coos Counties have experienced cyclical patterns in timber harvest, depending upon national demand for fiber and local availability of timber. However, harvest volumes and timber industry employment in these areas have generally been in decline. Coastal counties' timberlands are 94 percent of the land base (Campbell et al., 2002). There is a mixture of federal, state, and private timberland ownership in coastal counties (Figure 4.1).

Commercial Fisheries

Commercial fishing ports (Figure 4.5) are an active contributor to Oregon's statewide and coastal economy. The onshore landed component of Oregon's commercial fishing industry contributed $286 million in personal income to the state's economy in 2014 (Table 4.2), a three percent increase compared to the previous 10-year average. The Dungeness crab fishery alone contributed $70 million in 2014.

Many fish and shellfish move in and out of Oregon's 3 mile nearshore boundary throughout their lifecycles. Regardless of where they are harvested, the nearshore habitat and waters are an important component of many of Oregon's commercial fisheries including the Dungeness crab fishery, the commercial salmon fishery, coastal pelagic species fisheries (e.g., Pacific sardine, northern anchovy, etc.), the urchin fishery, clam fisheries and a variety of groundfish fisheries. Groundfish fisheries which target a variety of flatfish, roundfish, rockfish, sharks, skates and other species can be executed across the continental shelf with several gear types (trawl net, long line, trap, hook and line). Since the early 1990's, Oregon has managed a commercial fishery composed of small vessels (averaging 25 feet) which target several rockfish species (predominantly black and blue rockfish), cabezon, and greenling in nearshore waters primarily with hook and line or longline gear. Referred to as Oregon's "commercial nearshore fishery", a state limited entry permit framework was implemented in 2004. There were 121 permits issued in 2014. Many of these permitted vessels also target lingcod as do open access fishery vessels using the same gear types in nearshore waters. These nearshore groundfish fisheries had an economic contribution of about $2.1 million in personal income in 2014 (Table 4.2).

Oregon's commercial fisheries are an important contributor to local economies. Seafood buyers, processors and distributors provide a significant number of jobs in coastal ports and inland. While the majority of commercial fishery landings occur in three ports in Oregon (Astoria, Newport and Coos Bay), smaller ports on the southern coast (Bandon, Port Orford, Gold Beach and Brookings) have found a particular niche in supplying the demand for high-value live fish from nearshore waters.

Diverse and healthy ports are critical to the economic survival of fishing vessel owners and operators. Their businesses are dependent on fishing-related service businesses such as vessel dry dock facilities, mechanics, welders, refrigeration specialists, machine shops, marine electronics sales and service firms, professional services (attorneys and accountants) and marine suppliers. Particularly in Astoria and Newport, many vessel repair and provisioning businesses service and support distant water fishing activities. Fishing in areas such as the Bering Sea or North Pacific Ocean contributed more than $261 million of personal income in 2014 (Table 4.2) when this income is brought back to the state by skippers, crewmen and processor workers, and vessel/permit owners with residency in Oregon. Collectively, Oregon's ports are supporting a vibrant maritime infrastructure while supplying the increasing demand for sustainably managed seafood to both domestic and international markets.

Sport Fisheries

Many ports also support sport fishing (Figure 4.5). There were over one million marine finfish fishing trips, including lower bay fishing locations, in 2012 (TRG 2013). Based on 2014 estimates of sport landing totals for bottomfishing, sport charter boat fishing was most prevalent in Newport, Depoe Bay, Charleston and Garibaldi. Private boat sport fishing activity, in terms of numbers of trips, was greatest in Brookings, closely followed by Charleston and Newport. The estimated number of angler days for all of the fisheries used to make the current year economic contribution estimates are shown in Table 4.3 and Figure 4.6. In 2012, sport trips targeting bottomfish comprised 41 percent of all ocean sport trips, but only seven percent of all ocean and bay fishing trips, which reflects the significant difference in the focus of targeting effort in the bays.

Sport fishing trips target a range of species in both nearshore waters and in offshore waters, which occur outside of the Territorial Sea (beyond 3 nautical miles). Bottomfish fisheries occur primarily in nearshore waters, while tuna fishing almost always occurs far offshore. Halibut, salmon, and other target species are pursued in both areas. All combined sport fisheries trip spending generated $49.5 million in personal income in coastal economies (Table 4.4 and Figure 4.7). Sport bottomfishing was 13.3 percent of this economic contribution. These estimates include fishing trips in nearshore waters as well as all other ocean locations. The sport bottomfish fishery is an important component of many coastal economies, as it provides stable and consistent income for these communities during times when other seasonal fisheries (e.g., salmon and tuna) are not available.

Sport crabbing and clamming in Oregon bays and nearshore waters is also popular. The bay crab fisheries were the greatest component of harvest, accounting for approximately 60 percent of the total annual sport crab harvest, with the other 40 percent caught in the ocean (Ainsworth et al. 2012). The largest clam fisheries are for razor clams and for a group of clams collectively known as bay clams (including cockles, butter clams, gaper clams, and native littleneck clams) found, as the name implies, within the state's many bays and estuaries (Ainsworth et al. 2014). Bay clams are targeted for both sport and commercial harvest in Oregon.

Recreational fishing is a significant part of coastal economies. There is a direct link between recreational fishing, coastal tourism, and the service industry. Visiting fishermen and their families contribute substantially to local economies by purchasing licenses, fishing gear and boating accessories, as well as food, lodging and other services.

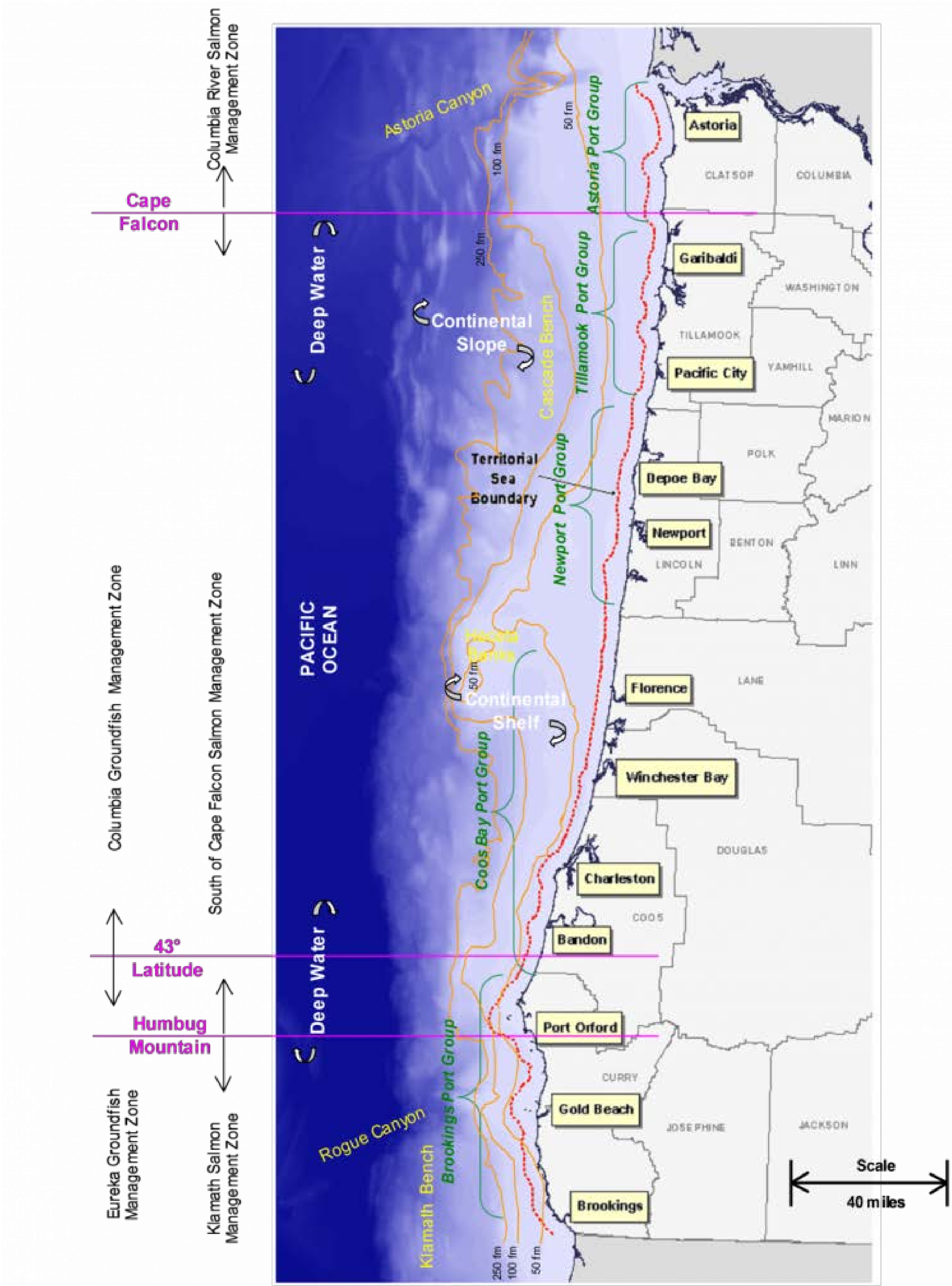

Figure 4.5. Port Groups and Fishery Management Zones (Source: Ocean and Coastal Program, Oregon Department of Land Conservation and Development). Photo Credit: Ocean and Coastal Program, Oregon Department of Land Conservation and Development.

Table 4.2. Economic Contributions from Commercial Nearshore and Other Fisheries by Port Groups in 2014.

	Fishery												
	Groundfish								Subtotal	Fish	Distant	
Port Group	Nearshore	Total	Salmon	D. Crab	P. Shrimp	A. Tuna	P. Whiting	Other	Landed	Meal	Water	Total
Astoria	0.13	16.0	9.6	15.2	8.8	5.7	29.3	14.0	98.6	2.8	35.9	137.2
Tillamook	0.25	0.3	1.4	2.8	-	0.4	-	0.5	5.4	-	5.2	10.7
Newport	0.09	6.7	7.0	22.6	15.5	6.1	21.6	2.4	82.0	-	110.4	192.4
Coos Bay	0.12	5.8	8.8	22.5	17.8	5.4	0.0	2.2	62.6	-	6.3	68.9
Port Orford	0.63											
Brookings	0.35	6.2	2.7	5.7	2.2	0.4	0.0	0.5	17.5	-	1.8	19.3
Coast Total	1.56	35.0	29.6	68.8	44.3	18.0	50.9	19.6	266.1	2.8	159.5	428.4
State Level	2.13	36.0	30.6	69.6	49.2	18.8	56.8	21.2	282.2	3.7	261.3	547.2

Notes:
1. Economic contributions are expressed as personal income in millions of 2014 dollars.
2. Economic contributions are calculated with the Fisheries Economic Assessment Model (FEAM) originally developed by Hans Radtke and William Jensen for the West Coast Fisheries Development Foundation in 1988. The estimates include direct, indirect, and induced impacts, therefore include "multiplier effects."
3. The economic contributions at the port group area level do not sum to the statewide level because of trade leakages to the larger economy. The sum of distant water fisheries economic contribution in coastal communities has the additional consideration that some of the revenue is returned to Willamette Valley and Eastern Oregon communities, so is only reflected in the State economy.
4. The nearshore groundfish economic contributions at the state level include black and blue rockfish ($1.0 million), greenling ($0.2 million), cabezon ($0.2 million), lingcod ($0.5 million), and other rockfish species ($0.1 million).
5. The species group "other" in the most recent year includes economic contributions at the state level for sardines ($14 million), halibut ($2 million), sea urchins ($0.4 million), and many other fisheries.
6. The economic contribution from distant water fisheries includes the effects of vessel revenue returned to Oregon's economy from U.S. West Coast at-sea fisheries, Oregon home-port vessels landing in other U.S. West Coast states and Alaska, southern Pacific Ocean, and other fisheries. New fishing vessel construction, fishery management, and fishery research and training are not included.
7. The economic contributions for areas listed include smaller ports: Astoria area includes all Columbia River; Tillamook area includes Pacific City; Newport area includes Depoe Bay; Coos Bay area includes Florence, Reedsport and Bandon; Brookings area includes Gold Beach.

Source: Study and TRG (2015).

Table 4.3. Ocean and Inland Recreational Fisheries Trips (in thousands of anglers) from 2007 to 2012. Note that the Lower Columbia River mainstem spring/summer Chinook fishery includes trips in off-channel areas. Coast estuary other marine species trips most complete recent year available from RecFIN is for year 2002. The counts include trips when anadromous fish are the target species. The anadromous fish trips in 2002 based on data for "bay" waterway segments are subtracted from the RecFIN derived trip data in order to avoid double counting. It is assumed that other marine species trip counts after the subtraction do not change from 2002 in subsequent years. Lower Columbia River estuary other marine trips only available from Marine Recreational Fisheries Statistical Survey (MRFSS) data ending in Year 1999. The 1997 to 1999 three year average was assumed the trip count for subsequent years. Coast freshwater fisheries data was only available up to 2011. It is assumed trip counts do not change for 2012 (Source: TRG 2013).

Target Fishery	2007	2008	2009	2010	2011	2012
Ocean						
Salmon	88.3	30.4	84.5	53.3	48.8	67.3
Halibut	18.0	17.5	10.8	13.8	16.5	18.0
Tuna	12.1	7.1	10.4	11.4	10.8	16.0
Bottomfish	60.8	64.8	64.0	71.3	69.2	69.9
Subtotal ocean	179.1	119.9	169.6	149.7	145.3	171.2
Coast estuary and freshwater						
Fall salmon	199.5	154.0	253.1	305.5	525.6	525.6
Spr./sum. Chinook	25.9	25.3	39.4	77.8	86.0	86.0
Freshwater steelhead	107.5	79.0	79.9	104.4	84.7	84.7
Other marine species	94.2	94.2	94.2	94.2	94.2	94.2
Sturgeon	5.9	5.4	5.3	2.3	2.9	2.9
Subtotal Coast	433.1	358.0	471.9	584.2	793.4	793.4
Lower Columbia River						
Mainstem fall salmon/steelhead	20.9	19.2	41.3	31.0	31.8	41.6
Mainstem spr./sum. Chinook	11.5	6.0	10.3	25.5	8.8	8.5
Tributary fall salmon/steelhead	10.3	13.4	16.0	13.4	9.4	9.3
Other marine species	1.7	1.7	1.7	1.7	1.7	1.7
Sturgeon	21.2	20.7	22.7	16.4	11.7	8.9
Subtotal Lower Columbia River	65.5	61.0	91.9	87.9	63.3	69.9
Total	677.7	538.8	733.4	821.9	1,002.0	1,034.5

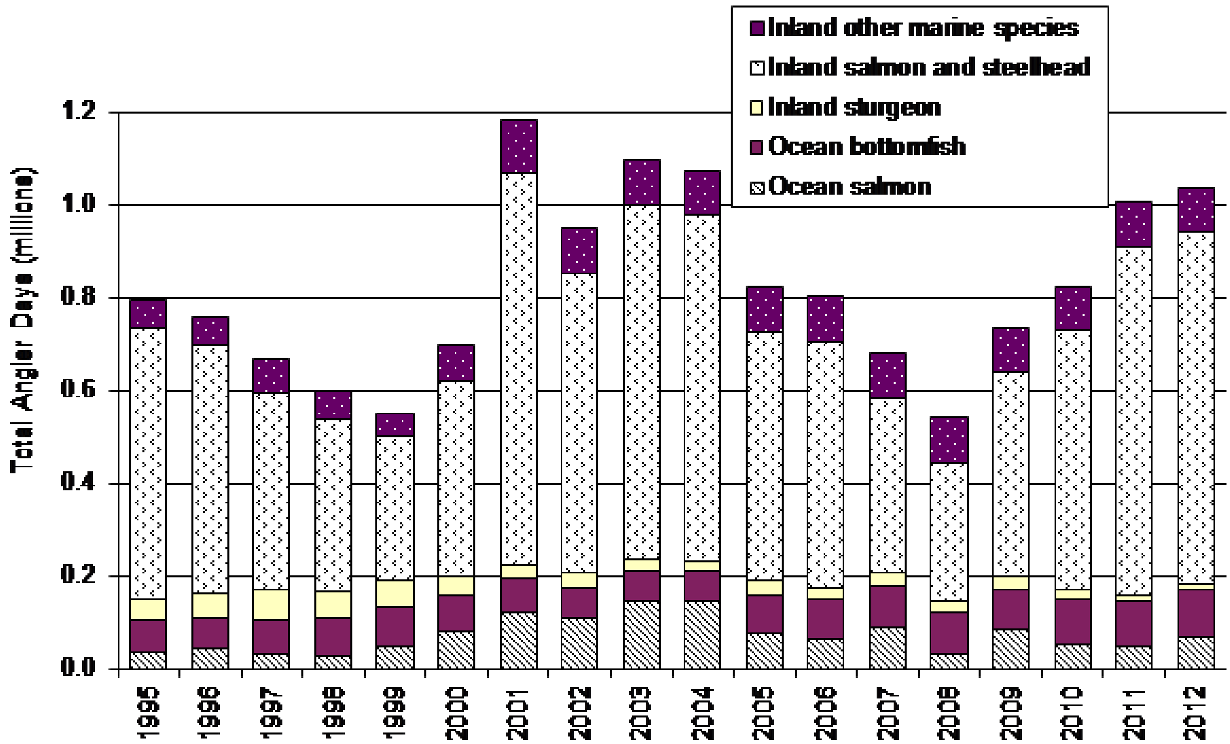

Figure 4.6. Recreational Angler Days for the Study Selected Fisheries in 1995 to 2012. Angler days are included when the fishing trip occurs in the ocean, inland marine areas (estuaries), and when the trip purpose is for certain species in coastal area freshwater locations. The ocean fisheries are separated by trip purpose being for salmon and bottomfish. If the trip purpose is for a combination of salmon and bottomfish, then it is classified as a salmon trip. The bottomfish fishery includes halibut and tuna trips. The only trips included at freshwater locations are when the trip purpose is for anadromous fish (Chinook and coho salmon, steelhead, and sturgeon). The freshwater locations are at locations approximated for being west of the Coast Range crest. There are gaps in data for the included fisheries. Coast inland freshwater trips repeat 2011 for 2012. Lower Columbia River mainstem salmon and steelhead trips are in the Columbia River Section 10 zone and include the popular fall Buoy 10 fishery for 1995 to 2012. Coast inland other marine species trips are only available for 1995 to 2002, with 2003 to present estimated by 2002. Coast estuary other marine species trips most complete recent year available from the Recreational Fisheries Information Network (RecFIN) is for year 2002. The counts include trips when anadromous fish are the target species. The anadromous fish trips in 2002 based on data for "bay" waterway segments are subtracted from the RecFIN derived trip data in order to avoid double counting. It is assumed that other marine species trip counts after the subtraction do not change from 2002 in subsequent years. Lower Columbia River other marine species trips are only shown for 1995 to 1999, with 2000 to present estimated by 1997-1999 average (Source: TRG 2013). TRG 2013

Table 4.4. Ocean and Inland Recreational Fisheries Economic Contributions in 2012. Economic contributions are expressed as personal income in millions of 2012 dollars and are at the coastwide economic level. Fall Columbia River mainstem salmon is sometimes referred to as the Buoy 10 salmon fishery. Other marine species is sometimes referred to as bottomfishing when it takes place in the ocean. Source: TRG 2013.

	Location					
		Coast Inland		Lower		
Target Fishery	Ocean	Salmon/ Steelhead	Marine Species	Columbia River	Total	Fishery Share
Ocean salmon	$3.26				$3.26	6.6%
Inland fall salmon		$23.47		$0.33	$23.79	48.1%
Inland steelhead		$3.78		$0.10	$3.88	7.8%
Inland spr./sum. Chinoo		$3.84		$0.37	$4.21	8.5%
Mainstem fall salmon				$1.73	$1.73	3.5%
Ocean halibut	$1.63				$1.63	3.3%
Ocean tuna	$1.45				$1.45	2.9%
Ocean bottomfish	$6.59				$6.59	13.3%
Other marine species			$2.33	$0.03	$2.37	4.8%
Sturgeon			$0.12	$0.44	$0.56	1.1%
Total	$12.92	$31.09	$2.46	$3.00	$49.46	100.0%
Shares	26.1%	62.9%	5.0%	6.1%	100.0%	

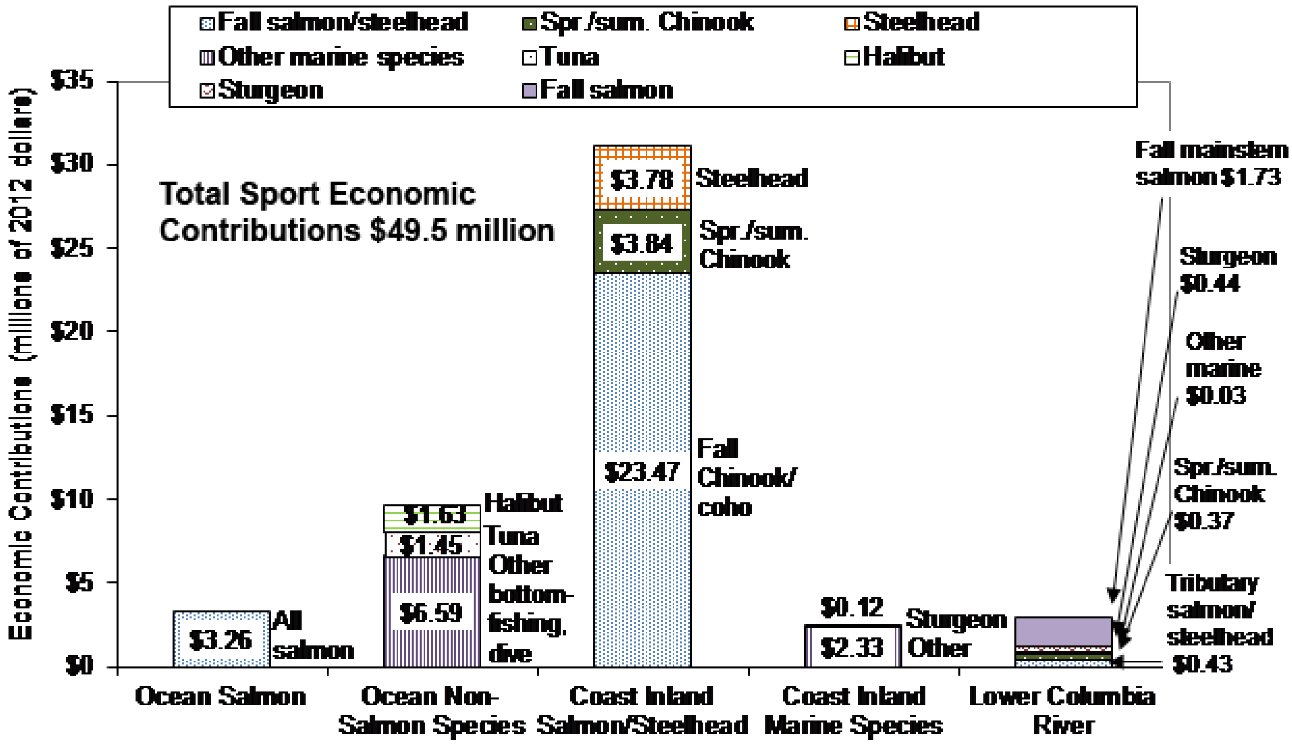

Figure 4.7. Recreational Ocean and Inland Fisheries Economic Contributions in 2012. Note that ODFW data is 2011, June 2013 extraction (TRG 2013). TRG 2013

Coastal Tourism

Tourism is a key component of the state's economy, and the Oregon coast is a major destination for visitors. Most coastal counties are experiencing steady growth in tourism. Visitation is increasing at state parks (White et al. 2012), and employment at motels/hotels and food service industries continues to increase.[2] The growth of tourism has served to diversify coastal counties' economic bases.

The Oregon coast marine environment attracts tourism for many experiences other than fishing. Because a trip purpose can be for more than one reason, it is difficult to measure economic contributions directly related to specific nearshore marine resources. At a more general level, the 2013-2017 Oregon Statewide Comprehensive Outdoor Recreation Plan identified ocean and beach recreational activities as the Oregon population's fourth highest outdoor recreation activities in 2011 (OPRD 2013). Half of Oregon's households visited the Oregon coast in 2010 (LaFranchi and Daugherty, 2011). A study published almost two decades earlier (Rettig 1989) reported on the diverse motives for Oregon coast tourism visitation and various activities in which visitors participated (Figure 4.8). The two studies (Rettig 1989, LaFranchi and Daugherty 2011) provided similar information with roughly 10% or fewer coastal visitors reportedly participating in fishing activities (Figures 4.8 and 4.9).

Wildlife viewing generates more regional economic contributions than recreational hunting and fishing activities combined in Oregon (USFWS 2008). At almost $1.7 billion, Oregon ranked in the top ten states in the nation for economic output related to wildlife viewing in 2011, with an estimated 1.44 million wildlife watchers (USFWS 2014). Although these numbers were not broken down by specific activities within regions within the state, earlier studies provide some insights.Total generated expenditures on the coast were nearly $160 million in 2008 (Dean Runyan Associates 2009). Statewide wildlife watching per trip expenditures were estimated at $66 per day (USFWS 2014). For whale watching alone, O'Connor, et al. (2009) reported that more than 375,000 tourists participated on the Oregon coast in 2008, resulting in nearly $1.6 million in direct expenditures and an additional $28.2 million in indirect expenditures. This was more than a two-fold increase in direct expenditures over 10 years (O'Connor et. al. 2009). LaFranchi and Daugherty (2011) also describe the positive economic effects of non-consumptive uses of coastal resources. It is clear that non-consumptive use of the nearshore marine ecosystem is a significant tourism driver. Non-consumptive recreational users of the nearshore ecosystem have been described as a renewable resource for Oregon's coastal communities because of their important economic and cultural contributions (Eardley and Conway 2011).

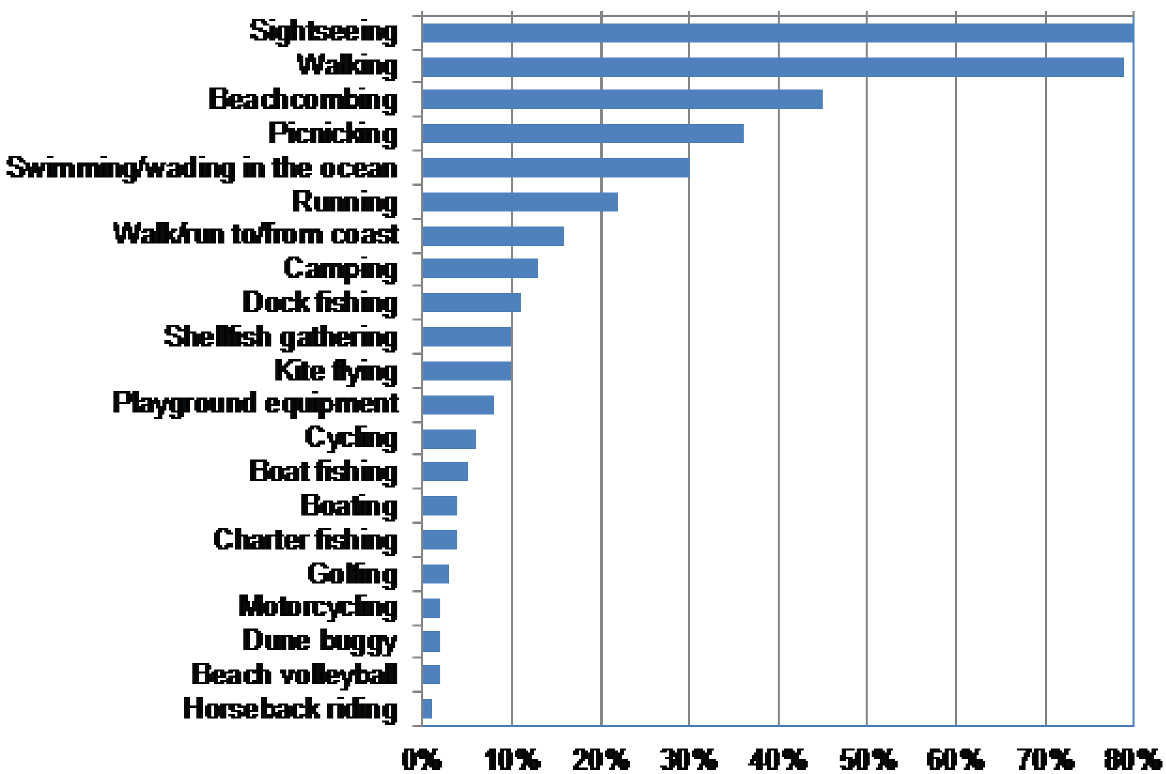

Figure 4.8. Oregon Coast visitor activities. Note that frequencies cannot be added because they are from a multiple response type question. Activities reported with less than one percent are: tennis, diving, water skiing, and windsurfing/sailing. Source: Rettig 1989.

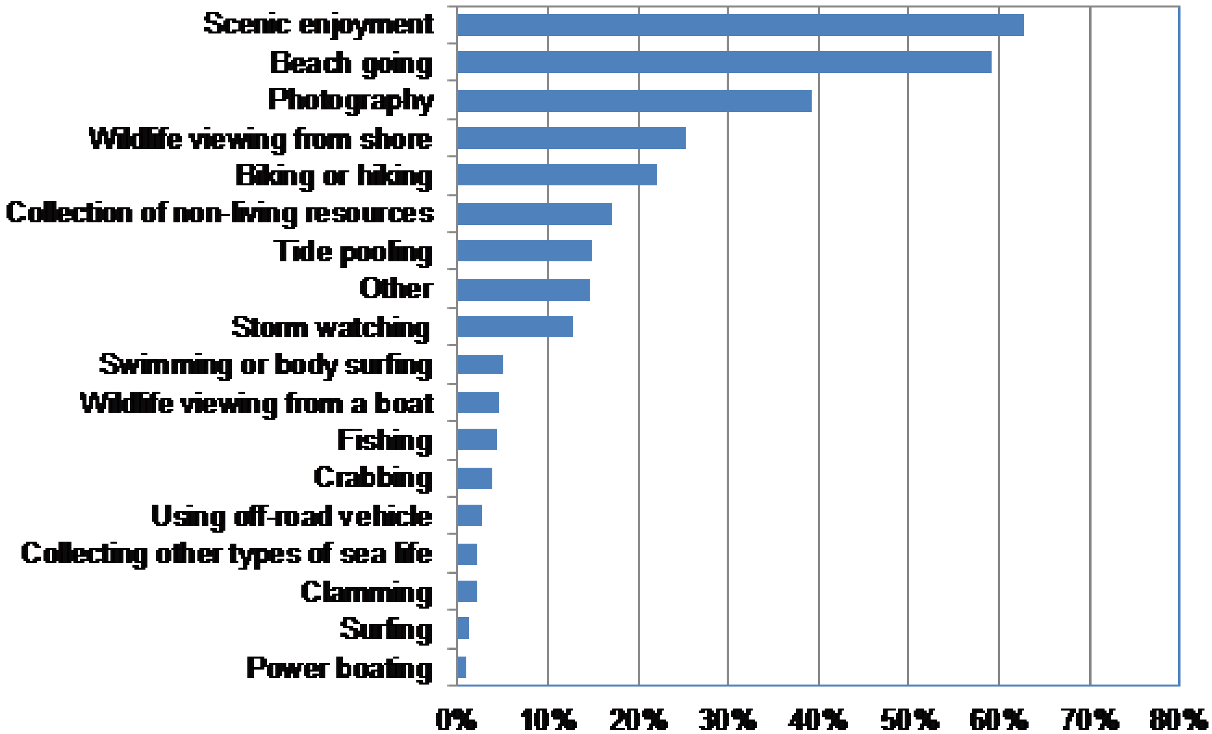

Figure 4.9. Participation in coastal activities as a percent of all survey respondents. Activities not reported in this figure with less than one percent are: skim boarding, kayaking, personal watercraft (e.g., jet skis) , kite boarding, free diving/snorkeling, SCUBA diving, sail boating, windsurfing, hang-gliding/parasailing, spear fishing or diving for abalone, and tow-in surfing. Source: LaFranchi and Daugherty 2011.

Restoration and Protection Projects

Conservation protection and restoration projects have economic benefits. Some of the benefits are identifiable and can easily be measured. For example, agency and contractor labor and materials/services payments for management and construction projects will be re-spent in communities generating economic activity that will include the "multiplier" effect. Knowledge about the payments and their source, coupled with economic input-output modeling procedures, provide the measurements. Other benefits are more tenuous to trace and economic effects are more difficult to estimate because they will not have such direct connections to the market place. Economic benefit analysis would require extensive on-site knowledge of biological, ecological, and physical process interrelationships as well as clever ways to assess human appreciation of the setting and interrelations to formulate economic benefit estimates. A growing body of literature describes these tenuous economic benefits in terms of ecosystem services (Heal et.al 2005, Fisher et.al. 2009). It is recognized that the natural environment provides ecosystem services that increases individual welfare, but quantifying a measure of change is difficult. Economic benefit studies of conservation and restoration projects generally provide economic impacts of a defined activity but only acknowledge the broader social values.

There are several examples of economic benefits analysis studies for Oregon coastal communities. It was of interest to stakeholders to know the economic effects in Port Orford that occurs from establishing the Redfish Rocks Marine Reserve. A study found that ongoing and instigated research, planning, and management activities were adding about one-third more of the existing commercial and recreational fishing to the area's marine related economic effects (TRG 2013). It was known that the activity was taking place, but the magnitude was a surprise to local officials. Another study reviewed the economic benefits of a salmon habitat restoration project on the lower Coquille River (Sheeran and Hesselgrave 2012). It was a more typical analysis of a restoration project whereby short-term restoration project supervision and construction as well as long-term recreation and commercial fishing economic impacts were included.

Protected and restored environments can promote economic development and reduce the need for state and federal intervention in land uses to protect environments. People are attracted by the use benefits (e.g. fishing, hunting, surfing, wildlife viewing) and the sense of increased individual welfare. Environmental stressors often accompany economic development. The stresses span coastal ecosystem elements and have cumulative impacts (Crain et al. 2008). The challenge is to understand how to best manage and mitigate these impacts. Emerging conservation practices such as ecosystem-based management that accounts for ecosystem service valuation hold substantial promise for protecting coastal marine systems (NatureServe 2015). Carrying out the practices will require a combination of public and private initiatives for success. Ecological understanding, public awareness, and policy initiatives will improve stewardship of the marine ecosystems. This knowledge can facilitate effective management of Oregon's nearshore resources in order to ensure sustainable use.

Other Regional Export Income

In some coastal areas, many small manufacturing and service companies export their products outside the region, which also contributes to local economic growth. Industries such as boat building and water-transportation occur in the region. Lincoln County has a growing marine technology economic sector (TRG 2014). High amenity areas such as the Oregon coast also tend to attract "footloose" entrepreneurial businesses, economic activities which are not dependent on the specific location's resources for viability. As such, writers, artists, computer hardware and software developers, and other small coastal entrepreneurs sell products outside the coastal area and bring income into regional economies. The cumulative economic contribution of these smaller industry sectors is important along the coast.

Real Estate Investment and Development

Real estate development often occurs in tandem with tourism development in high amenity locations. In the state of Oregon, 3.3% of all homes are vacant second homes (Table 4.1). In contrast, 54% of all homes are vacant second homes in Cannon Beach; 34% of all homes in Tillamook County are vacant second homes, as are 25% of all homes in Lincoln County. This rate of investment in second homes throughout the coast has significant impacts on both housing affordability and availability. Should a substantial portion of these investors retire to these second homes during the next decade, the cultural, social and political dynamics of many coastal communities will be affected.

COASTAL OREGON EMPLOYMENT AND RETIREMENT CHARACTERISTICS

Coastal Oregon is far more dependent on employment income from tourism and natural resources than the rest of the state. Coastal Oregon counties have 24% fewer persons employed in higher paying management, business and science occupations than the state average (28% /37%), and 30% more persons involved in service and natural resource occupations ([23% + 12%] / [18% + 9%]) than the state average (Table 4.5). Table 4.6 further highlights the coastal economic dependency on tourism and natural resource industries. Twenty percent of coastal employment is in the natural resource and tourism (arts, entertainment, and accommodations) industries compared to the state average (thirteen percent). The combined state average for employment in manufacturing, professional, education, health care and education sectors is 44%, in comparison the coastal average is 34% in these sectors. In particular, there are fewer persons employed in education and health care on the coast. Among the coastal counties, Tillamook County has fewer service jobs and more natural resource jobs.

Coastal Oregon is also more dependent on retirement income than the rest of the state. During the period from 2004 to 2013, the number of jobs (full and part time) overall in the state of Oregon increased almost 6% (Table 4.7). During that same time frame, the number of jobs actually decreased nominally (<1%) on the coast. This occurred despite the fact that the coastal population grew over that time period (Figure 4.3). An important reason for this disparity between number of jobs and coastal population growth is illustrated by data related to coastal retirement patterns. As previously mentioned, the coast has proportionally fewer persons under age 49 than both the United State and the state of Oregon, and a substantially higher proportion of persons of retirement age (Figure 4.4). Retirement income is derived from investments and transfer payments (social security).[3] Over half (51%) of personal income on the coast is derived from investments and transfer payments (Figure 4.10). This is 31% higher than the state average, and 46% higher than the proportion of personal income derived from investments and transfer payments at the national level. This dependence on retirement income increased across all coastal counties between 2003 and 2012 (Figure 4.11). Much of the improvement in average coastal income during this time frame reflects retirement migration patterns, and thus household income from sources other than earned income among working families (Figure 4.12). A large proportion of the baby boom generation has yet to retire, so these trends are not likely to abate during the next decade.

Table 4.5. Civilian Employment by Occupation.

	Fishery											
	Groundfish								Subtotal	Fish	Distant	
Port Group	Nearshore	Total	Salmon	D. Crab	P. Shrimp	A. Tuna	P. Whiting	Other	Landed	Meal	Water	Total
Astoria	0.13	16.0	9.6	15.2	8.8	5.7	29.3	14.0	98.6	2.8	35.9	137.2
Tillamook	0.25	0.3	1.4	2.8	-	0.4	-	0.5	5.4	-	5.2	10.7
Newport	0.09	6.7	7.0	22.6	15.5	6.1	21.6	2.4	82.0	-	110.4	192.4
Coos Bay	0.12	5.8	8.8	22.5	17.8	5.4	0.0	2.2	62.6	-	6.3	68.9
Port Orford	0.63											
Brookings	0.35	6.2	2.7	5.7	2.2	0.4	0.0	0.5	17.5	-	1.8	19.3
Coast Total	1.56	35.0	29.6	68.8	44.3	18.0	50.9	19.6	266.1	2.8	159.5	428.4
State Level	2.13	36.0	30.6	69.6	49.2	18.8	56.8	21.2	282.2	3.7	261.3	547.2

Notes:
1. Economic contributions are expressed as personal income in millions of 2014 dollars.
2. Economic contributions are calculated with the Fisheries Economic Assessment Model (FEAM) originally developed by Hans Radtke and William Jensen for the West Coast Fisheries Development Foundation in 1988. The estimates include direct, indirect, and induced impacts, therefore include "multiplier effects."
3. The economic contributions at the port group area level do not sum to the statewide level because of trade leakages to the larger economy. The sum of distant water fisheries economic contribution in coastal communities has the additional consideration that some of the revenue is returned to Willamette Valley and Eastern Oregon communities, so is only reflected in the State economy.
4. The nearshore groundfish economic contributions at the state level include black and blue rockfish ($1.0 million), greenling ($0.2 million), cabezon ($0.2 million), lingcod ($0.5 million), and other rockfish species ($0.1 million).
5. The species group "other" in the most recent year includes economic contributions at the state level for sardines ($14 million), halibut ($2 million), sea urchins ($0.4 million), and many other fisheries.
6. The economic contribution from distant water fisheries includes the effects of vessel revenue returned to Oregon's economy from U.S. West Coast at-sea fisheries, Oregon home-port vessels landing in other U.S. West Coast states and Alaska, southern Pacific Ocean, and other fisheries. New fishing vessel construction, fishery management, and fishery research and training are not included.
7. The economic contributions for areas listed include smaller ports: Astoria area includes all Columbia River; Tillamook area includes Pacific City; Newport area includes Depoe Bay; Coos Bay area includes Florence, Reedsport and Bandon; Brookings area includes Gold Beach.

Source: Study and TRG (2015).

Table 4.6. Civilian Employment by Industry.

	Oregon	Coast	Clatsop County	Tillamook County	Lincoln County	Coos County	Curry County
Civilian employed population 16 years and over	1,736,894	78,766	16,779	10,374	19,870	23,722	8,021
Agr., forestry, fishing and hunting, and mining	3%	5%	5%	10%	3%	5%	5%
Construction	6%	7%	7%	8%	7%	6%	7%
Manufacturing	11%	8%	9%	10%	6%	8%	7%
Wholesale trade	3%	2%	2%	1%	1%	2%	1%
Retail trade	12%	14%	13%	12%	16%	15%	13%
Transportation and warehousing, and utilities	4%	5%	4%	7%	4%	5%	5%
Information	2%	2%	1%	1%	2%	2%	2%
Finance+insurance, real estate+rental+leasing	6%	5%	6%	5%	5%	4%	5%
Professional, sci., mgmt., and admin.+waste m	10%	7%	8%	5%	8%	8%	5%
Education services, health care and social ass.	23%	19%	19%	17%	17%	22%	20%
Arts, entertain., rec., and accommodation+food	10%	15%	17%	13%	19%	12%	15%
Other services, except public administration	5%	5%	4%	4%	5%	5%	7%
Public administration	5%	7%	6%	6%	6%	7%	9%

Notes: 1. Includes civilian employed population 16 years and over.
2. Coast includes Clatsop, Tillamook, Lincoln, Coos, and Curry Counties.
Source: American Community Survey (ACS) 2009-2013 estimates.

Table 4.7. Total Full-Time and Part-Time Employment (Number of Jobs) in 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Oregon	2,138,888	2,200,655	2,262,100	2,310,797	2,301,983	2,202,030	2,172,448	2,202,269	2,221,495	2,265,005
Coast	103,683	106,214	107,869	109,558	108,281	104,131	102,611	101,847	101,335	102,812
Clatsop	22,251	22,806	23,319	24,223	24,593	23,723	23,441	23,324	23,443	23,700
Tillamook	12,886	13,156	13,451	13,751	13,515	13,231	13,173	12,927	12,602	12,962
Lincoln	25,596	26,159	26,572	27,070	26,968	25,967	25,509	25,105	25,113	25,434
Coos	31,862	32,757	33,118	33,036	32,104	30,598	30,096	30,295	29,894	30,289
Curry	11,088	11,336	11,409	11,478	11,101	10,612	10,392	10,196	10,283	10,427

Notes: 1. People holding more than one job are counted for each job they hold.
Source: U.S. Bureau of Economic Analysis.

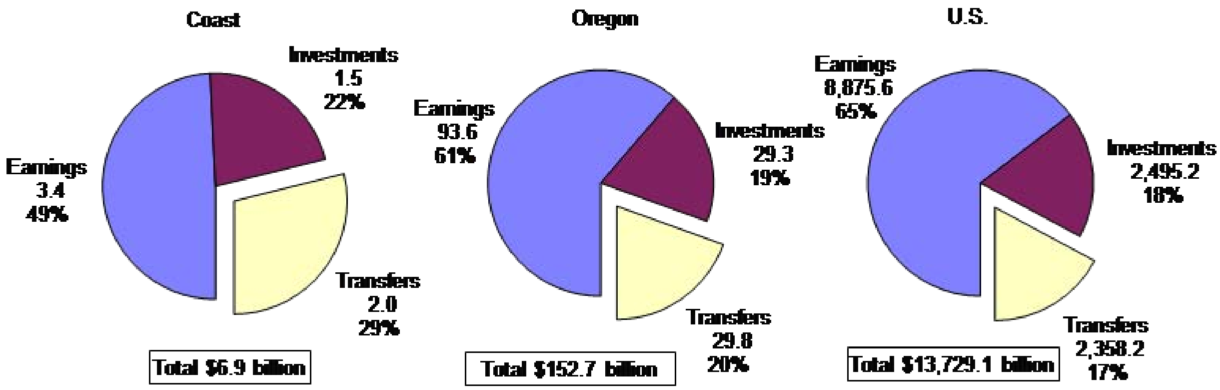

Figure 4.10. Sources of personal income to coastal counties, Oregon, and U.S. in 2012 Source: U.S. Bureau of Economic Analysis.

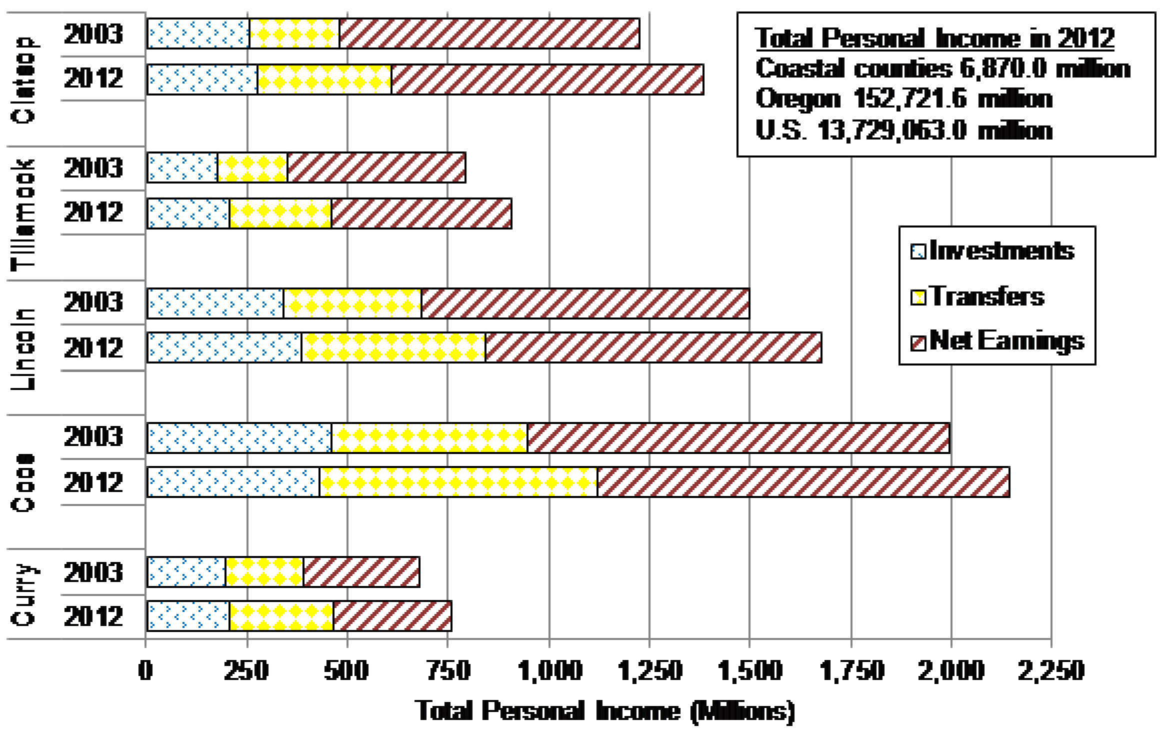

Figure 4.11. Coastal Counties Total Personal Income in 2003 and 2012. Adjustment to 2012 dollars made with the GDP price deflator developed by the U.S. Bureau of Economic Analysis. Source: U.S. Bureau of Economic Analysis.

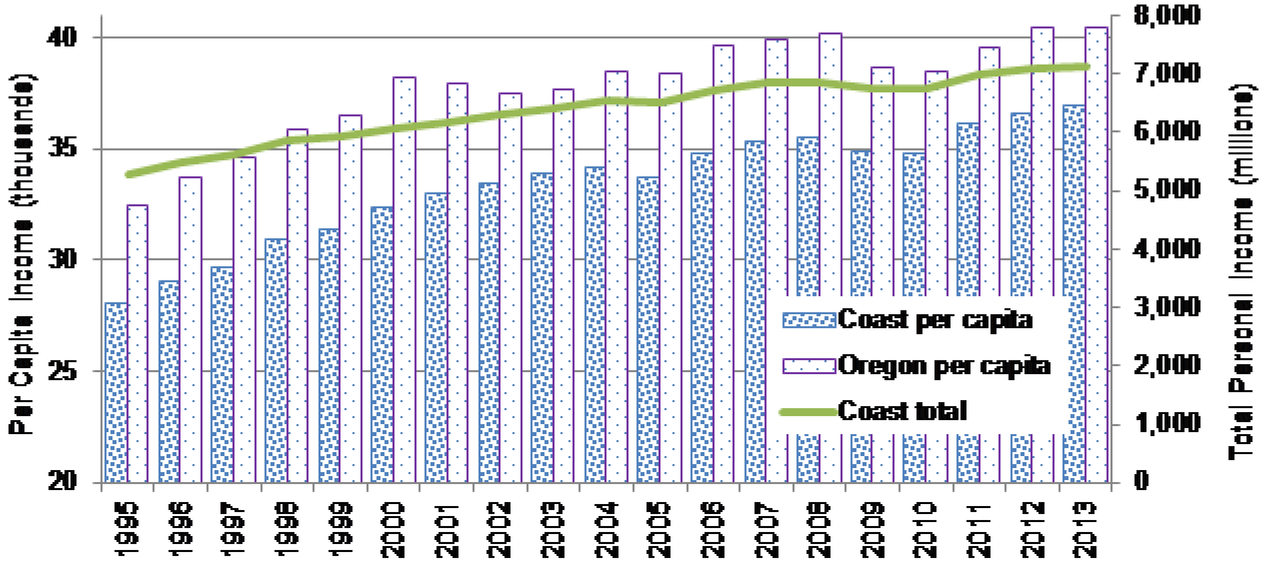

Figure 4.12. Coastwide and Statewide Per Capita Total Personal Income and Coastwide Total Personal Income in 1995 to 2013. Per capita total personal income (thousands) adjusted to 2014 dollars using the GDP price deflator developed by the U.S. Bureau of Economic Analysis. Coast includes Clatsop, Tillamook, Lincoln, Coos, and Curry Counties. Source: U.S. Bureau of Economic Analysis, CA1-3 personal income summary, downloaded March 2015.

[1]. Unless otherwise noted, the presented demographic data are from the U.S. Bureau of Census decennial census 2010 information or the American Community Survey (ACS) aggregations for 2008-2012.

[2]. ACS tourism data were used for estimating this trend. The included North American Industrial Classification System industry categories are in a satellite account titled Arts, entertainment, recreation, accommodation, and food services. See Zemanek (2014) for an explanation of the accounting.

[3]. Transfer payments of social security benefits include SSI (disability) income.


the OREGON NEARSHORE STRATEGY




Chapter 5: Nearshore Species

2016
Oregon Department
of Fish and Wildlife

OregonConservationStrategy.org

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This PDF is a chapter of the Oregon Nearshore Strategy, the marine component of the official State Wildlife Action Plan for Oregon. The complete Oregon Conservation Strategy is available online at http://oregonconservationstrategy.org/. Since Conservation Strategy content will be updated periodically, please check the website to ensure that you are using the most current version of downloadable files.

Contact ODFW

For more information on the Oregon Nearshore Strategy or to provide comments, email ***Nearshore.Strategy@state.or.us*** *or write to Oregon Department of Fish and Wildlife, Marine Resources Program 2040 SE Marine Science Drive, Newport, OR 97365*

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Banner: Copper Rockfish, © Janna Nichols; Red Sea Urchin, © Scott Groth; Black Oystercatcher, © Kelsey Adkisson; Steller Sea Lions, ODFW; Bull Kelp, © Janna Nichols; Wolf Eel, © Taylor Frierson

Feature image: Lingcod on rocky reef, © Scott Groth

Photo Credit: Janna Nichols

NEARSHORE SPECIES

Species that are key to ecosystem function and health are at the heart of the State Wildlife Grants Program. The Program (discussed in the Nearshore Strategy Context section) specifies inclusion of a Strategy Species list, and directs states to:

- address the full array of wildlife and wildlife related issues,
- prevent species from being listed as threatened or endangered,
- keep common species common, and
- focus on species in greatest need of management attention that are indicative of the diversity and health of the State's wildlife and habitats.

The 2006 Oregon Conservation Strategy and Nearshore Strategy documents each contained a separate list of Strategy Species to focus management and conservation needs in accordance with the guidelines of the State Wildlife Grants program. In this revision, these two lists are merged into one that is included in the Oregon Conservation Strategy. The updated Nearshore Strategy also includes a copy of the nearshore Strategy Species list, with the subset of species relevant just to the nearshore. This chapter describes the process and criteria ODFW Marine Program used in developing the list of nearshore Strategy Species, and provides information about those species.

The State Wildlife Grant elements helped guide the ODFW Marine Program in developing a method to identify key nearshore species whose conservation needs are of the greatest interest to managers. Strategy Species are those species of the greatest concern and which meet the State Wildlife Grants Program requirements for State Wildlife Action Plans. Additionally, the Oregon Nearshore Strategy designates Watch List Species (those that do not meet the Strategy Species criteria, but which may in the future when sufficient data is available to make that determination), and Commonly Associated Species, (including common nearshore species whose conservation needs can best be met through habitat management or through management of communities of organisms).

Species information was used in conjunction with information about the habitats, factors and stressors affecting species and habitats, conservation research and monitoring needs, and public input to formulate overall recommendations.

Nearshore Strategy Species – Species determined to have conservation needs in greatest need of management attention *and* to have the greatest potential for benefit from management actions. Strategy Species provide a focus for planning and prioritizing specific conservation, management, and research actions by ODFW and other partners.

Nearshore Watch List Species – Identified as important nearshore species that do not require immediate management action, but may in the future. Managers should be aware of conservation needs and potential factors affecting these species and that sufficient data for these species may be lacking.

Nearshore Commonly Associated Species – Species identified to be important to nearshore environments, whose conservation needs can best be met through management affecting habitats or communities of organisms.

NEARSHORE STRATEGY SPECIES

Nearshore Strategy Species species were determined by ODFW to be in greatest need of management attention. Identification as a nearshore Strategy Species does not necessarily mean the species is in trouble. Rather, those identified as Strategy Species have some significant nearshore management and/or conservation issue connected to that species that is of interest to resource managers.

Development of the 2015 Strategy Species list began with a review of the original list of Strategy Species developed a decade ago, including species that utilize the nearshore but that had only been included in the Oregon Conservation Strategy. The species that were still recognized as species of concern, at risk, important, or a priority by federal or state agencies, stakeholders, experts, non-government organizations, scientific researchers, tribes or other conservation processes were included on the revised list. In addition, a comprehensive list of species that occur in the nearshore was evaluated for potential new additions to the Strategy Species list. To maintain a nearshore ecosystem focus, attention was focused on both harvested and non-harvested species that predominantly occur, or are common, within Oregon's nearshore environment.

To assist with the identification of Strategy Species, the following information was compiled from published literature (see References section), available online data, scientific databases, and personal communication from experts, for each species on the list:

- taxonomic information
- distribution, including species geographic range and depth
- harvest/collection information, including sector(s) (commercial, sport, aquarium trade, and/or scientific/medical research) and whether targeted or incidental catch
- life history information, including mode of reproduction, fecundity, timing of reproduction, timing of egg/larval/juvenile stages, longevity, age at maturity, and migratory behavior or seasonal distribution
- habitat use for each life history stage
- trophic interactions, including prey, predators, and competition

- population status information, including whether a population assessment has been conducted, listed as overharvested, listed as a threatened or endangered species, whether species has experienced a population decline, whether the species is rare, has small range or is endemic, if species has specialized habitat requirements, and if the species has low productivity.

This information was used to help examine the conservation needs of each species with regards to four separate criteria (each weighted equally). Each species was evaluated for each of these four criteria to identify those species in greatest need of management attention:

1) *Species status* – examples of species status include overharvested, rare, declining population throughout its range or in Oregon.

2) *Ecological importance* – examples of ecological importance include habitat forming, habitat engineer, keystone species, prey species.

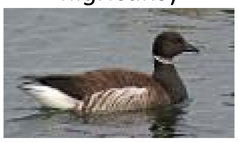
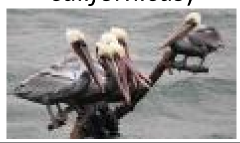
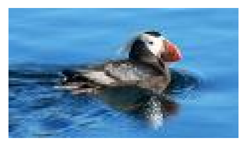
3) *Vulnerability to human or natural factors* – examples of vulnerability include susceptible to oil spills or water pollution, life history traits that render it particularly vulnerable (low productivity, specialized habitat requirements, climate change or ocean acidification effects, etc.), or there are significant data gaps or research needs on vulnerability for that species.

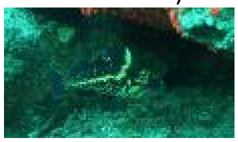
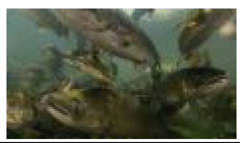
4) *Economic/social/cultural importance* – examples of importance to humans include commercially important, recreationally important, culturally important to Oregon tribes, flagship or sentinel species.

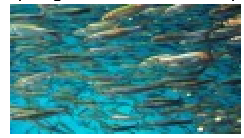
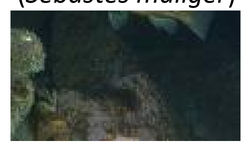
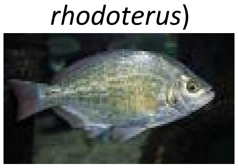
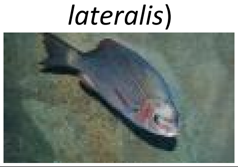
Those species whose conservation needs were determined to best be met through existing management affecting habitats or communities of organisms were separated from the list. Through extensive examination, deliberation, and consultation with subject matter experts, 74 species were identified as nearshore Strategy Species. These species, or distinct populations, were determined to have conservation needs in greatest need of management attention *and* to have the greatest potential for benefit from management actions. Changes to the nearshore Strategy Species list include: one marine mammal was removed and three species of fishes were moved to the nearshore Watch List; 16 Strategy Species, six anadromous fishes and ten birds, identified in the Oregon Conservation Strategy that utilize nearshore habitats were included; and nine new species were added. The nine new Strategy Species added include: three fishes, one of which is a newly discovered species; four invertebrates; one marine mammal; and one plant.

Table 5.1 presents the list of all 74 nearshore Strategy Species, including notes on special needs, limiting factors, data gaps and conservation actions for each species. This information is provided for use by managers, research and monitoring projects or programs, those producing education and outreach materials, planners, and the general public. Readers should note that the management jurisdiction varies for each species. For instance, some nearshore Strategy Species are managed by ODFW, others by NOAA Fisheries or USFWS, and many species are under shared management authority by multiple resource agencies and institutions.

Table 5.1. List of Nearshore Strategy Species. Click the links in the table below for more information on each species.

Birds				
Black Brant (*Branta bernicla nigricans*) 	**Black Oystercatcher** (*Haematopus bachmani*) 	**California Brown Pelican** (*Pelecanus occidentalis californicus*) 	**Caspian Tern** (*Hydroprogne caspia*) 	**Fork-tailed Storm Petrel** (*Oceanodroma furcata*) 
Leach's Storm Petrel (*Oceanodroma leucorhoa*) 	**Marbled Murrelet** (*Brachyramphus marmoratus*) 	**Rock Sandpiper** (*Calidris ptilocnemis*) 	**Tufted Puffin** (*Fratercula cirrhata*) 	**Western Snowy Plover** (*Charadrius alexandrinus nivosus*) 
Fishes				
Big skate (*Raja binoculata*) 	**Black rockfish** (*Sebastes melanops*) 	**Blue rockfish** (*Sebastes mystinus*) 	**Brown rockfish** (*Sebastes auricluatus*) 	**Cabezon** (*Scorpaenichthys marmoratus)* 

Fishes				
[Canary rockfish] (*Sebastes pinniger*) 	**[China rockfish]** (*Sebastes nebulosus*) 	**[Chinook salmon]** (*Oncorhynchus tshawytscha*) Fall Run – Lower Columbia SMU, Mid–Columbia SMU, Snake SMU, Spring/Summer Run – Coastal SMU, Rogue SMU, Lower Columbia SMU, Mid Columbia SMU, Lower Snake SMU, Upper Snake SMU, Willamette SMU 	**[Chum salmon]** (*Oncorhynchus keta*) Lower Columbia SMU; Coastal SMU 	**[Coastal cutthroat trout]** (*Oncorhynchus clarki clarki*) Lower Columbia SMU 
[Coho salmon] (*Oncorhynchus kisutch*) Coastal SMU; Rouge SMU; Klamath SMU; Lower Columbia SMU 	**[Copper rockfish]** (*Sebastes caurinus*) 	**[Deacon rockfish]** (*Sebastes diaconus*) Note: See Frable et al., 2015 for description of this newly discovered cryptic species formerly consider to be Blue rockfish 	**[Eulachon]** (*Thaleichthys pacificus*) Southern DPS 	**[Grass rockfish]** (*Sebastes rastrelliger*) 

Fishes				
Green sturgeon (*Acipenser medirostris*) Northern DPS; Southern DPS 	Kelp greenling (*Hexagrammos decagrammus*) 	Lingcod (*Ophiodon elongatus*) 	Longfin smelt (*Spirinchus thaleicthys*) 	Northern anchovy (*Engraulis mordax*) 
Pacific herring (*Clupea pallasii*) 	Pacific lamprey (*Entosphenus tridentatus*) 	Pacific sand lance (*Ammodytes hexapterus*) 	Pile perch (*Rhacochilus vacca*) 	Quillback rockfish (*Sebastes maliger*) 
Redtail surfperch (*Amphistichus rhodoterus*) 	Rock greenling (*Hexagrammos lagocephalus*) 	Shiner perch (*Cymatogaster aggregata*) 	Spiny dogfish (*Squalus acanthias*) 	Starry flounder (*Platichthys stellatus*) 
Striped perch (*Embiotoca lateralis*) 	Surf smelt (*Hypomesus pretiosus*) 	Tiger rockfish (*Sebastes nigrocinctus*) 	Topsmelt (*Atherinops affinis*) 	Vermilion rockfish (*Sebastes miniatus*) 
Western River Lamprey (*Lampetra ayresii*) 	White sturgeon (*Acipenser transmontanus*) 	Wolf-eel (*Anarrhichthys ocellatus*) 	Yelloweye rockfish (*Sebastes ruberrimus*) 	Yellowtail rockfish (*Sebastes flavidus*) 

Invertebrates

Blue mud shrimp

(*Upogebia pugettensis*)

California mussel

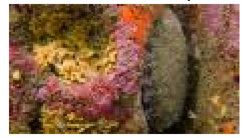
(*Mytilus californianus*)

Dungeness crab

(*Cancer magister*)

Flat abalone

(*Haliotis walallensis*)



Native littleneck clam

(*Leukoma staminea*)

Ochre sea star

(*Pisaster ochraceus*)

Olympia oyster

(*Ostrea lurida*)

Pacific giant octopus

(*Enteroctopus dofleini*)

Purple sea urchin

(*Strongylocentrotus purpuratus*)

Razor clam

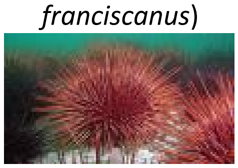
(*Siliqua patula*)

Red abalone

(*Haliotis rufescens*)

Red sea urchin

(*Mesocentrotus franciscanus*)



Rock scallop

(*Crassadoma gigantea*)

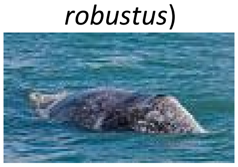
Sunflower star

(*Pycnopodia helianthoides*)

Marine Mammals

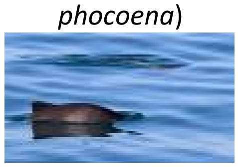
Gray whale

(*Eschrichtius robustus*)



Harbor porpoise

(*Phocoena phocoena*)



Northern elephant seal

(*Mirounga angustirostris*)

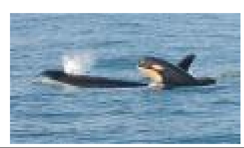
Pacific harbor seal

(*Phoca vitulina*)

Killer Whale

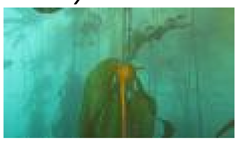
(*Orcinus orca*)

Southern Resident DPS



Steller sea lion

(*Eumetopias jubatus*)

Plants and Algae			
Bull kelp	**Native eelgrass**	**Sea palm**	**Surf grass**
(*Nereocystis luetkeana*)	(*Zostera marina*)	(*Postelsia palmaeformis*)	(*Phyllospadix spp*.)
			

WATCH LIST SPECIES

Brandt's cormorant is a Watch List species. They nest on islands and rocky headlands along the Oregon coast and forage in Nearshore waters. Photo Credit: Bird Research Northwest.

ODFW identified a handful of species from the comprehensive species list to be placed on a Watch List. Watch List Species (Table 5.2) were determined to be important nearshore species that do not require immediate management action, but may in the future. Managers should be aware of conservation needs and potential factors that could affect these species and consider them for future nearshore Strategy Species status if sufficient data can be gathered to support the change. Examples of future information that may warrant status change include a change in harvest status, or the occurrence of an anthropogenic or natural event (water pollution, climatic event, etc.).

Table 5.2 Watch List Species

Watch List Birds	Comments
Brandt's Cormorant (*Phalacrocorax penicillatus*)	Utilizes rocky cliffs and islands for nesting. Forages in nearshore habitats. Sensitive to environmental change. Localized population fluctuations.
Cassin's Auklet (*Ptychoramphus aleuticus*)	Nests in burrows on offshore islands with no mammalian predators. Vulnerable to nesting area disturbance, predation, oil spills and environmental change.
Common Murre (*Uria aalge*)	Nests in colonies on offshore islands and coastal cliffs with no or minimal mammalian predators. Vulnerable to nesting area disturbance, predation, oil spills and environmental change. About 66% of the population from British Columbia to California nest in Oregon.
Pelagic Cormorant (*Phalacrocorax pelagicus*)	Utilizes rocky cliffs and islands for nesting. Forages in nearshore habitats. Sensitive to environmental change.
Pigeon Guillemot (*Cepphus columba*)	Population potentially declining, data inadequate. Vulnerable to ground predators, oil spills and environmental change. Breeding attempts may fail during climatic shifts (e.g., climate change).
Sanderling (*Calidris alba*)	Highly dependent on specific nearshore feeding areas during migration. Susceptible to coastal habitat disturbance, degradation and destruction. Current population size unknown. Populations highly variable among years. Potential for long term declines.
Rhinoceros Auklet (*Cerohinca monocerata*)	Nests in burrows on offshore islands. Forages in nearshore waters while nesting. Prefers nesting sites on cliffs and elevated areas to aid in take-off. Sensitive to nesting disturbance and oil spills.

Watch List Fishes	Comments
Black-and-yellow rockfish (*Sebastes chrysomelas)*	Low to moderate productivity. Commercial harvest. Periodic recruitment dependent on favorable oceanic conditions. OR northern extent of range.
Blue shark (*Prionace glauca*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.
Bocaccio (*Sebastes paucispinis)*	Low productivity. Northern stock population abundance unknown.
Brown Irish lord (*Hemilepidotus spinosus*)	Recreational harvest. May be getting reported as Red Irish lord. Little known about abundance.
Brown smoothhound (*Mustelus henli*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.
Buffalo sculpin (*Enophrys bison*)	Recreational harvest. Little known about abundance.
Butter sole (*Isopsetta isolepis*)	Commercial and recreational harvest. Population status unknown.

Watch List Fishes	Comments
California halibut (*Paralichthys californicus*)	Certain years found and caught on OR's south coast. Population status unknown.
California skate (*Raja inornata*)	Late maturation, longevity, and low productivity. Inadequate population status information.
Common thresher (*Alopias vulpinus*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.
Curlfin turbot (sole) (*Pleuronichthys decurrens*)	Commercial harvest. Population status unknown.
English sole (*Pleuronectes vetulus*)	Sport and commercial harvest. Formal stock assessment has been conducted.
Flathead sole (*Hippoglossoides elassodon*)	Commercial harvest. Population status unknown.
Giant wrymouth (*Cryptacanthodes giganteus*)	Concerns that they're being caught and reported/confused with Monkeyface pricklebacks. Inadequate population status information.
Gopher rockfish (*Sebastes carnatus*)	Low productivity with periodic recruitment dependent on favorable oceanic conditions. Inadequate population status information.
Leopard shark (*Triakis semifasciata*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge. Collected for public aquarium display.
Monkeyface prickleback (*Cebidichthys violaceus*)	Concerns regarding potential of increased harvest in OR (actively harvested in CA).
Pacific angel shark (*Squatina californica*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.
Pacific sanddab (*Citharichthys sordidus*)	Commercial and recreational harvest.
Pacific sandfish (*Trichodon trichodon*)	Forage fish. Population status unknown and life history information limited.
Pacific sardine (*Sardinops sagax*)	Forage fish known to have large population fluctuations thought to be linked to environmental change, but mechanisms not understood. Target of commercial fisheries.
Pacific staghorn sculpin (*Leptocottus armatus*)	Recreational catch. Little known about abundance.
Red Irish Lord (*Hemilepidotus hemilepidotus*)	Minor commercial and recreational harvest. Collected for public aquarium display. Population status unknown.
Rock sole (*Lepidopsetta bilineata*)	Commercial and recreational harvest. Population status unknown.
Salmon shark (*Lamna ditropis*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.

Watch List Fishes	Comments
Sand sole (*Psettichthys melanostictus*)	Commercial and recreational harvest. Population status unknown.
Shortfin mako shark (Bonito shark) (*Isurus oxyrinchus*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.
Soupfin shark (*Galeorhinus galeus*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge.
Spotted ratfish (*Hydrolagus colliei*)	Low productivity.
White shark (*Carcharodon carcharias*)	Global concern regarding shark harvest and management. Low productivity. Lack of scientific knowledge regarding movements, spawning season, spawning grounds, and fecundity of females, population abundance.

Watch List Invertebrates	Comments
Butter clam (*Saxidomus gigantean*)	Important commercial and recreational species. Subtidal broodstock unknown. Limited information on essential habitat.
California sea cucumber (*Parastichopus californicus*)	May be important agents of bioturbation; during feeding and reworking of surface sediments, they can alter the structure of soft-bottom benthic communities.
Cockle clam (*Clinocardium nuttallii*)	Important commercial and recreational species. Subtidal broodstock unknown. Limited information on essential habitat.
Coonstripe or Dock shrimp (*Pandalus danae*)	Population status in Oregon unknown. Target of commercial fishery in CA.
Fat gaper clam (*Tresus capax*)	Important commercial and recreational species. Subtidal broodstock unknown. Limited information on essential habitat.
Flat-tipped piddock (*Penitella penita*)	Important commercial and recreational species. Subtidal broodstock unknown. Limited information on essential habitat.
Market squid (*Doryteuthis opalescens*)	Important prey. Used in medical research. Commercial and recreational harvest.
Oregon triton (*Fusitriton oregonensis*)	Potential for extended planktonic larval duration up to 4.5 years. Commercial harvest of all snails prohibited. Oregon state seashell.
Red rock crab (*Cancer productus*)	Potential for harvest concerns. Not actively managed (though has regulations in place). Population status and trend information lacking.

Watch List Marine Mammals	Comments
Sea otter (*Enhydra lutris)*	Documented sporadic occurrences along the OR coast thought to be strays from WA rather than established OR population. Population status in OR unknown.

OTHER COMMONLY ASSOCIATED SPECIES

Some species which did not meet criteria to be included in the nearshore Strategy Species or nearshore Watch Lists were identified to be important to nearshore ecosystems. These species were included on the list of commonly associated species (Appendix F). The conservation needs of these species will most likely be met through habitat management or management of communities of organisms.


the OREGON NEARSHORE STRATEGY




Chapter 6: Nearshore Habitats

2016
Oregon Department of Fish and Wildlife

OregonConservationStrategy.org

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PDF Content Last Updated November 7, 2016

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Contact ODFW

For more information on the Oregon Nearshore Strategy or to provide comments, email ***Nearshore.Strategy@state.or.us*** *or write to Oregon Department of Fish and Wildlife, Marine Resources Program 2040 SE Marine Science Drive, Newport, OR 97365*

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Photo Credit: Janna Nichols

NEARSHORE HABITATS

The coastal and marine habitats described here encompass the area from the 3 nautical mile outer limit of Oregon's territorial sea, where water depths average 66 m and range from 17 m to 194 m, to the supratidal areas of the shoreline affected by wave spray and overwash at extreme high tides and the portions of estuaries where species depend on the saline waters which enter from the Pacific Ocean. These are the waters and habitats that define the Nearshore ecoregion and are the focus of the Nearshore Strategy. This chapter describes how to classify habitat types and the major habitat types found in Oregon's nearshore, including: neritic, soft bottom subtidal, rocky subtidal, rocky shore, sandy shore and estuaries. Riverine portions of estuaries are currently covered in the Oregon Conservation Strategy.

OCEANOGRAPHIC CONTEXT – THE CALIFORNIA CURRENT SYSTEM

The distinct suite of oceanographic features and physical forcing agents that help define the Nearshore ecoregion include the northern portion of the California Current System and the annual seasonal upwelling/downwelling cycle that are responsible for its high productivity (Figures 6.1 and 6.2). The eastern boundary current called the California Current System is a part of the North Pacific gyre that moves cold water from the North Pacific toward the equator. It has a southward flowing current over Oregon's shelf and slope and a northward flowing undercurrent over the slope in spring and summer. In winter, the current over the shelf consists primarily of the northward flowing Davidson current (Figure 6.1).

During spring and summer, winds blowing from a northerly direction drive an upwelling system that brings cold, nutrient-rich, and oxygen-poor waters from depth up onto the continental shelf (Figure 6.2a). The upwelling process is highly variable on many time scales and is generally stronger and more persistent on the south Oregon coast and more intermittent on the central and northern Oregon coast. In addition to nutrients derived from upwelling, river discharge from the Columbia River provides a major source of nutrients to the Oregon continental shelf, especially along the north coast. The upwelling and river-plume nutrients fuel high phytoplankton productivity which drives an extremely productive marine ecosystem off of Oregon. In the fall and winter months winds blowing from a southerly direction cause seasonal downwelling that bring well oxygenated water from the surface downward in the water column (Figure 6.2b).

Superimposed on these large-scale processes are smaller scale eddies, gyres, fronts, and other oceanographic phenomena, which together serve to create a complex spatially and temporally dynamic ecosystem.

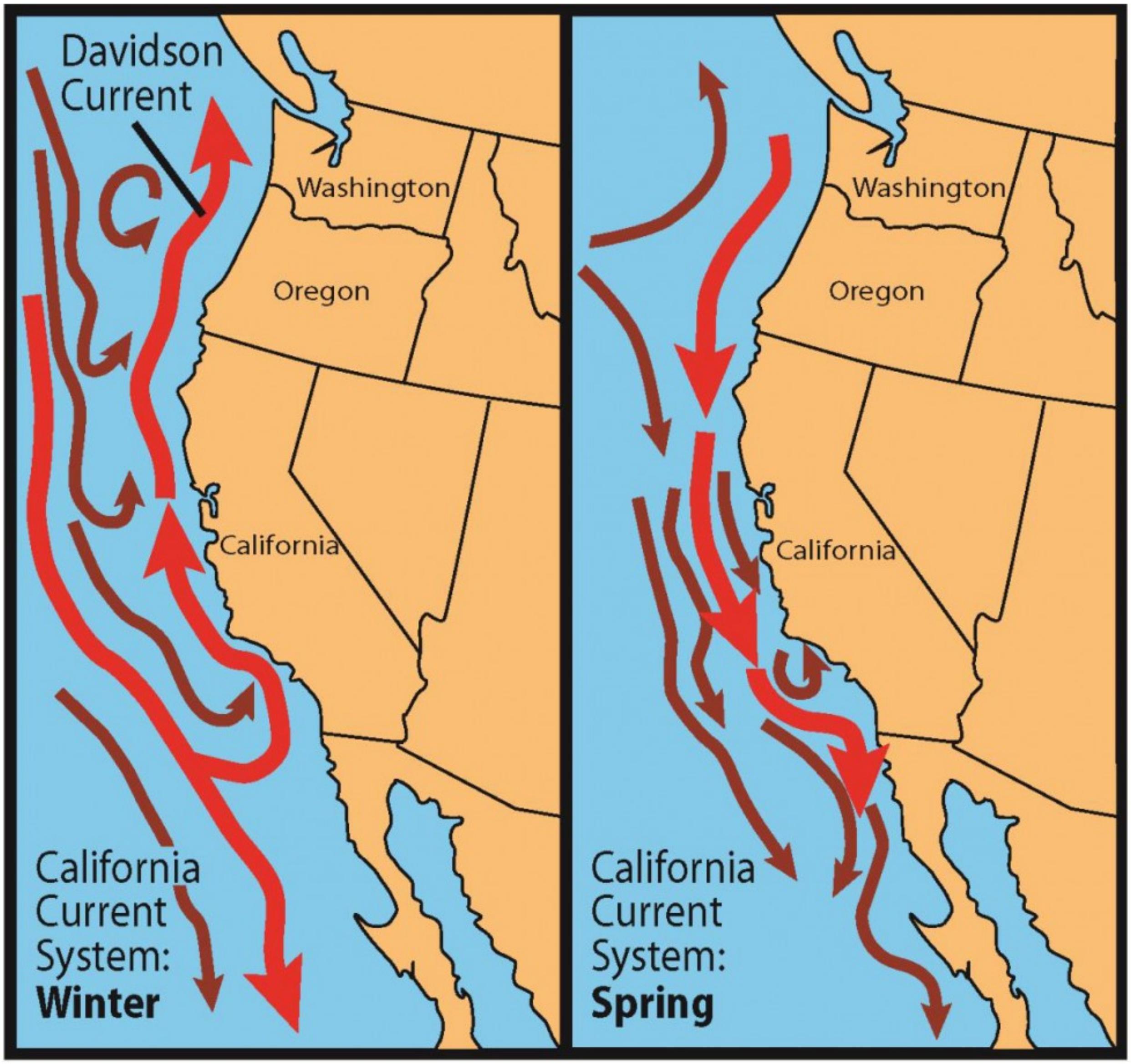


Figure 6.1. The California Current System typically varies seasonally. (Source P. T. Strub).

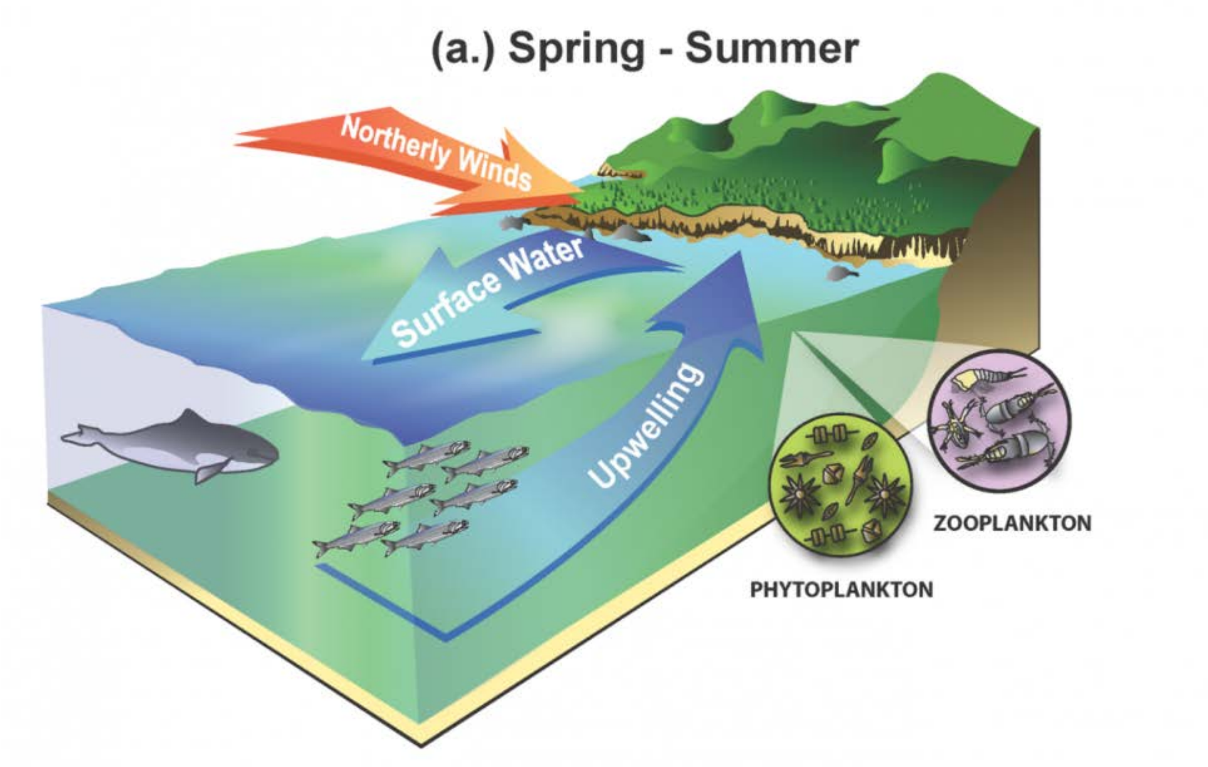


Figure 6.2a. Annual seasonal cycle of spring-summer upwelling.

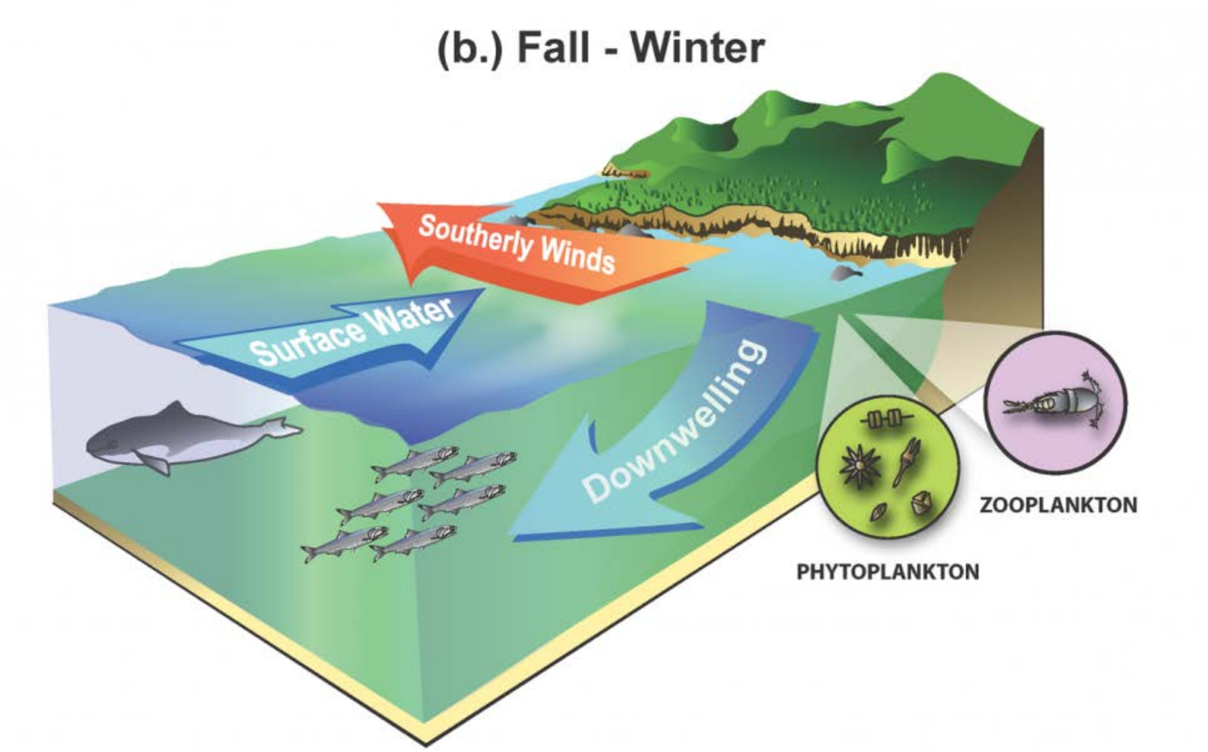


Figure 6.2b. Annual seasonal cycle of fall-winter downwelling.

CMECS FRAMEWORK

In 2012 the Coastal and Marine Ecological Classification Standard (CMECS) was adopted in the United States (Federal Geographic Data Committee 2012) as a means to provide a common framework for describing habitat, using a simple, standard format and common terminology (Figure 6.3). The goal of using CMECS is to both enhance scientific understanding and to advance ecosystem-based and place-based resource management through better communication. As the name implies, CMECS is increasingly being incorporated into scientific descriptions and being used in management documents. For the 2016 Oregon Nearshore Strategy, components of the CMECS classification framework have been incorporated – in particular, the CMECS approach to evaluating and describing habitats.

The CMECS framework is flexible. It allows classification and description of habitat using one or both of its two broad based settings and one or more of its components. Not all settings or components need be used for all purposes. It is designed so that the components selected can effectively describe the ecological units observed to the level of detail needed by a broad range of users across a wide variety of spatial and temporal scales. The components utilized may vary depending on the objective, but the common system of standards provides comparability. For example, both anthropogenic and naturally-occurring physical structures in an environment are geoform components in CMECS. Geoform components describe the physical structure of the environment across spatial and temporal scales without affecting the larger classification of the system, subsystem, or zone. It helps to think of systems, subsystems, and zones as being like nouns, with geoform and other components being like adjectives used to describe that noun. Biotopes, the combination of abiotic habitat and associated species in the CMECS framework have yet to be fully described for most coastal and marine waters in the U. S. including Oregon.

The Biogeographic Settings have a hierarchical structure composed of Realm, Province, and Ecoregion. The hierarchical structure of Aquatic Settings are composed of System, Subsystem and Tidal Range. Tables 6.1 and 6.2 provide the reader with an overview of the Biogeographic and Aquatic Settings for the species and their habitats in Oregon's coastal and marine waters encompassed in the Strategy.

The descriptions of familiar Nearshore habitats (below) will include some of the relevant CMECS components for each habitat described. Use of CMECS is just beginning. It will evolve over time as it is put to more use and information that has been collected is put into the framework. This is a work in progress that is anticipated to benefit scientific research and monitoring efforts, management decisions and conservation efforts and actions over the decades to come.

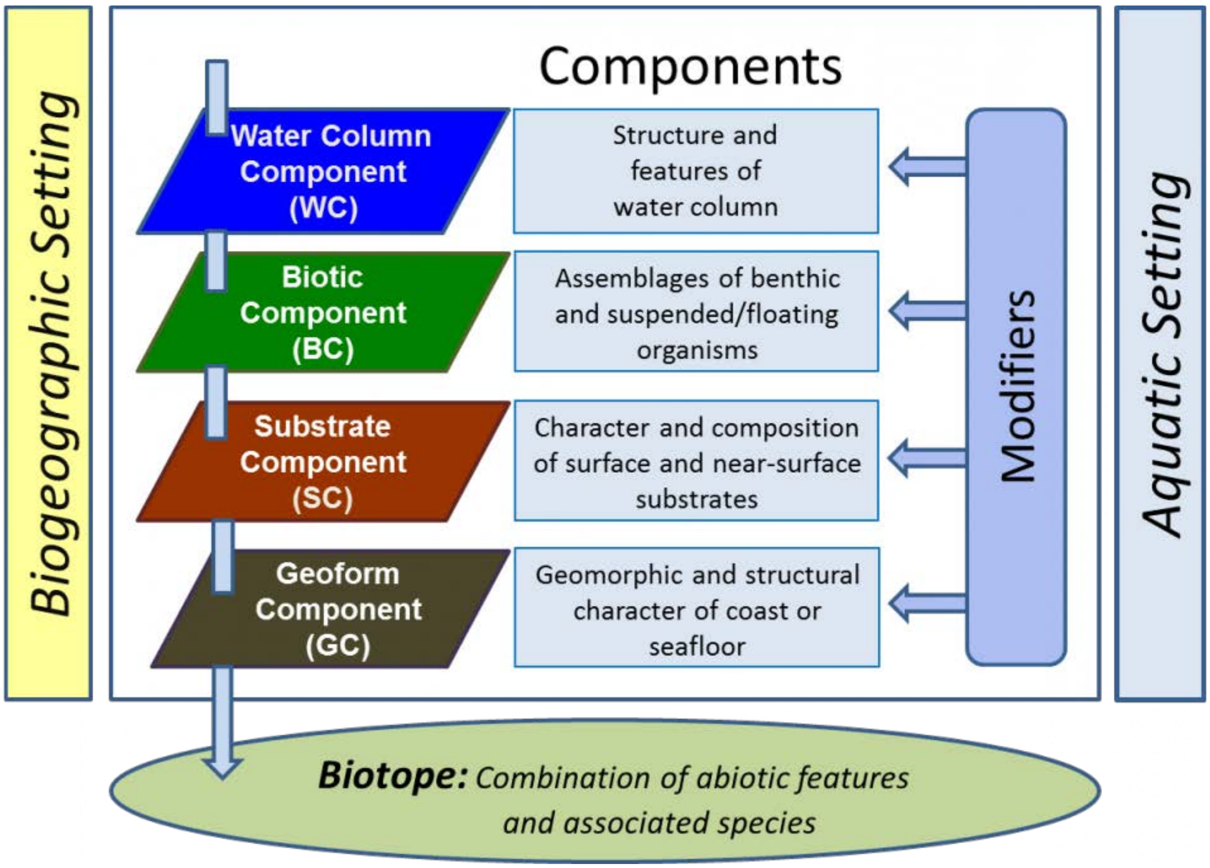


Figure 6.3. Overview of the Coastal and Marine Ecological Classification Standard framework (Source FGDC 2012).

Table 6.1. Overview of the hierarchical structure of the Biogeographic Setting for Oregon's Coastal and Marine Habitats

Hierarchical Level	Definition[1]	Oregon's Coastal and Marine Habitats
Realm	Very large regions of coastal, benthic, or pelagic ocean across which biota are internally coherent at higher taxonomic levels, as a result of a shared and unique evolutionary history. Realms have high levels of endemism, including unique taxa at generic and family levels in some groups. Driving factors behind the development of such unique biota include water temperature, historical and broad scale isolation, and the proximity of the benthos.	Temperate Northern Pacific
Province	Large areas defined by the presence of distinct biota that have at least some cohesion over evolutionary time frames. Provinces will hold some level of endemism, principally at the level of species. Although historical isolation will play a role, many of these distinct biota have arisen as a result of distinctive abiotic features that circumscribe their boundaries. These may include geomorphological features (isolated island and shelf systems, semi-enclosed seas); hydrographic features (currents, upwellings, ice dynamics); or geochemical influences (broadest-scale elements of nutrient supply and salinity).	Cold Temperate Northeast Pacific
Ecoregion	Areas of relatively homogeneous species composition, clearly distinct from adjacent systems. The species composition is likely to be determined by the predominance of a small number of ecosystems and/or a distinct suite of oceanographic or topographic features. The dominant biogeographic forcing agents defining the eco-regions vary from location to location but may include isolation, upwelling, nutrient inputs, freshwater influx, temperature regimes, ice regimes, exposure, sediments, currents, and bathymetric or coastal complexity.	Oregon, Washington, Vancouver Coast and Shelf

[1] The definitions in CMECS were drawn from Spalding et al. 2007.

Table 6.2. Overview of the hierarchical structure of Aquatic Settings for Oregon's Coastal and Marine habitats

System	Subsystem	Tidal Range	Oregon's Coastal and Marine Habitats[2]
Marine[3] Defined by salinity which is typically ~ 35 parts per thousand, but may vary considerably especially in areas near river mouths. Includes all non-estuarine waters from the coastline to the central oceans. The landward boundary of this system is either the linear boundary across the mouth of an estuary or the limit of the supratidal splash zone affected by breaking waves.	Offshore: Extends from the 30 meter depth contour to the continental shelf break, which generally occurs between 100 – 200 meters depth.	Subtidal: The substrate is continuously submerged in this zone and includes those areas below Mean Lower Low Water (MLLW).	Neritic, Rocky Subtidal, Soft Bottom
	Nearshore: Extends from the landward limit of the Marine System to the 30 meter depth contour.	Subtidal: The substrate is generally continuously submerged in this zone and includes those areas below MLLW.	Neritic, Rocky Subtidal, Soft Bottom
		Intertidal: The substrate is regularly and periodically exposed and flooded by tidal action. This zone extends from MLLW to Mean Higher High Water (MHHW).	Rocky Shores, Sandy Beaches
		Supratidal: This zone includes areas above MHHW that are affected by wave splash and overwash but does not include areas affected only by wind-driven spray. This zone is subjected to periodic high wave energy, exposure to air, and often to variable salinity.	Rocky Shores, Sandy Beaches

System	Subsystem	Tidal Range	Oregon's Coastal and Marine Habitats[2]
Estuarine[4] The Estuarine System is defined by salinity and geomorphology. This System includes tidally influenced waters that (a) have an open-surface connection to the sea, (b) are regularly diluted by freshwater runoff from land, and (c) exhibit some degree of land enclosure. The Estuarine System extends upstream to the head of tide and seaward to the mouth of the estuary. Head of tide is identified as the inland or upstream limit of water affected by a tide of at least 0.2 foot (0.06 meter) amplitude. The mouth of the estuary is defined by an imaginary line connecting the seaward-most points of land that enclose the estuarine water mass at MLLW. Islands are included as headlands if they contribute significantly to the enclosure.	Estuarine Open Water: The Estuarine Open Water Subsystem includes all waters of the Estuarine System with a total depth greater than 4 meters, exclusive of those waters designated Tidal Riverine Open Water.	Estuarine Open Water Subtidal: The substrate is generally continuously submerged in this zone and includes those areas below MLLW.	Estuaries
	Estuarine Coastal: The Estuarine Coastal Subsystem extends from the supratidal zone at the land margin down to the 4 meter depth contour in waters that have salinity greater than 0.5 (during the period of average annual low flow).	Estuarine Coastal Subtidal: The substrate is generally continuously submerged in this zone and includes those areas below MLLW.	Estuaries
		Estuarine Coastal Intertidal: The substrate in this zone is regularly and periodically exposed and flooded by tides. This zone extends from MLLW to MHHW. The Coastal Intertidal is exposed regularly to the air by tidal action.	Estuaries
		Estuarine Coastal Supratidal: This zone includes areas above MHHW; areas in this zone are affected by wave splash and overwash. It does not include areas affected only by wind-driven spray, which may extend further inland.	Estuaries

[2] The habitats identified here are described and classified by additional Water Column, Geoform and/or Substrate Components.

[3] The Oregon Ocean Management Plan established that the marine interest of Oregon and its citizens extends to seaward to the continental margin which includes the Offshore and portions of the Oceanic CMECS subsytems, which fall outside the focus of the Nearshore Strategy which focuses on species and habitats within the Oregon Territorial Sea.

[4] The Riverine Open Water and Riverine Coastal subsystems are parts of the Estuarine Strategy Habitat not addressed in this document. Although these subsystems are critically important to the ecology of estuaries they are not the primary habitat for the species covered here. Riverine portions of estuaries are addressed in Estuary Strategy Habitat section of the Oregon Conservation Strategy.

NEARSHORE HABITAT MAPPING

Habitat survey data, collected using modern high-resolution sonar technologies, now cover approximately 53% of Oregon's Territorial Sea. This is a major improvement from the approximately 6% of the Territorial Sea that had been mapped with these advanced technologies, when the original Nearshore Strategy was published in 2006. Habitat maps using these new data and the CMECS substrate classification have been created (Figures 6.4a and 6.4b) and are a significant improvement over previous maps. The areas that have now been mapped were chosen strategically and include almost all of Oregon's rocky subtidal reefs. Similarly, recent mapping efforts have updated previous estuary maps completed in the 1970's with more recent data and have started to map some of the CMECS components (see the estuaries section of this chapter).

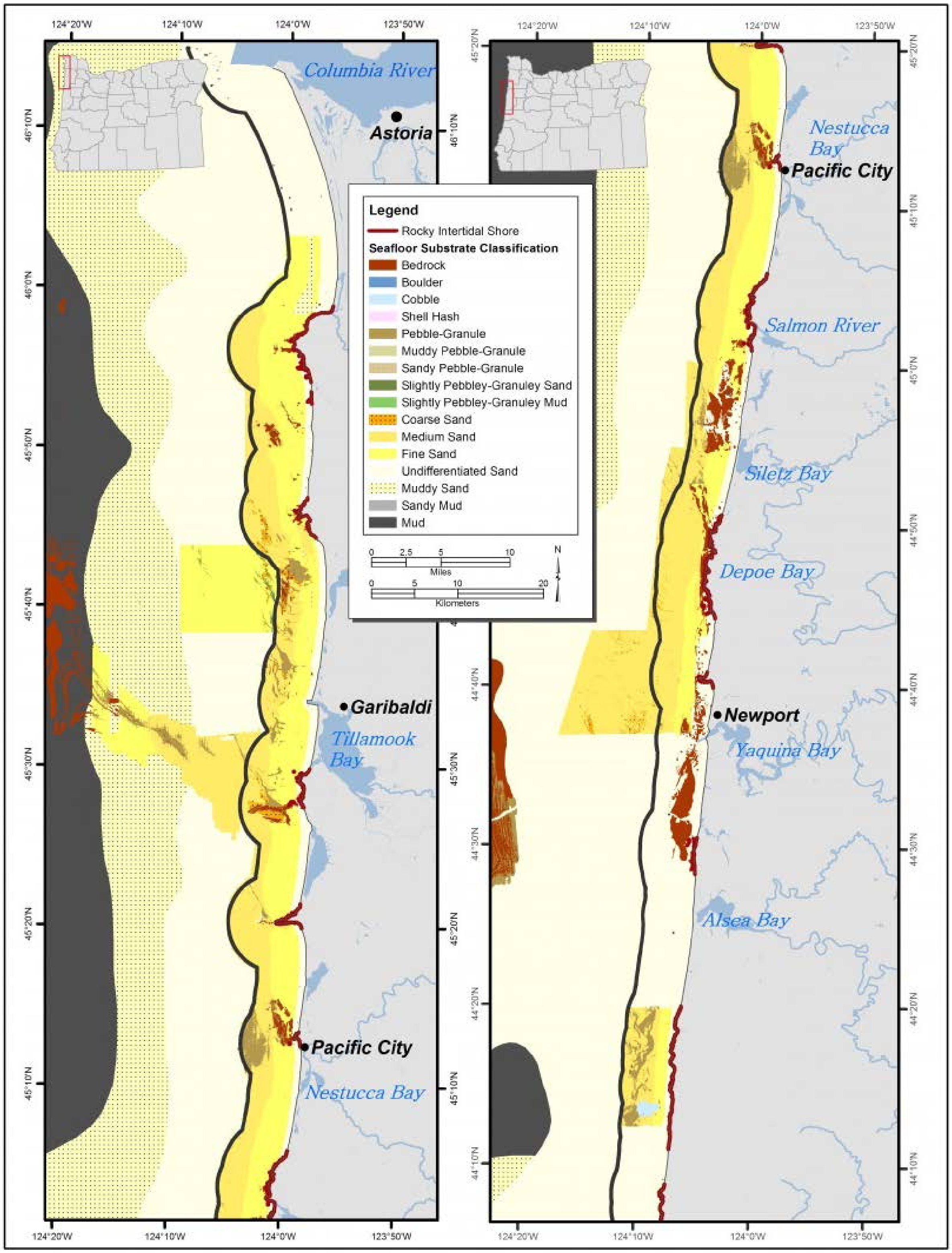


Figure 6.4a. North Oregon coast bottom substrates in marine system. Note that several abrupt boundaries evident on the map are artifacts of surveys locations not abrupt substrate changes.

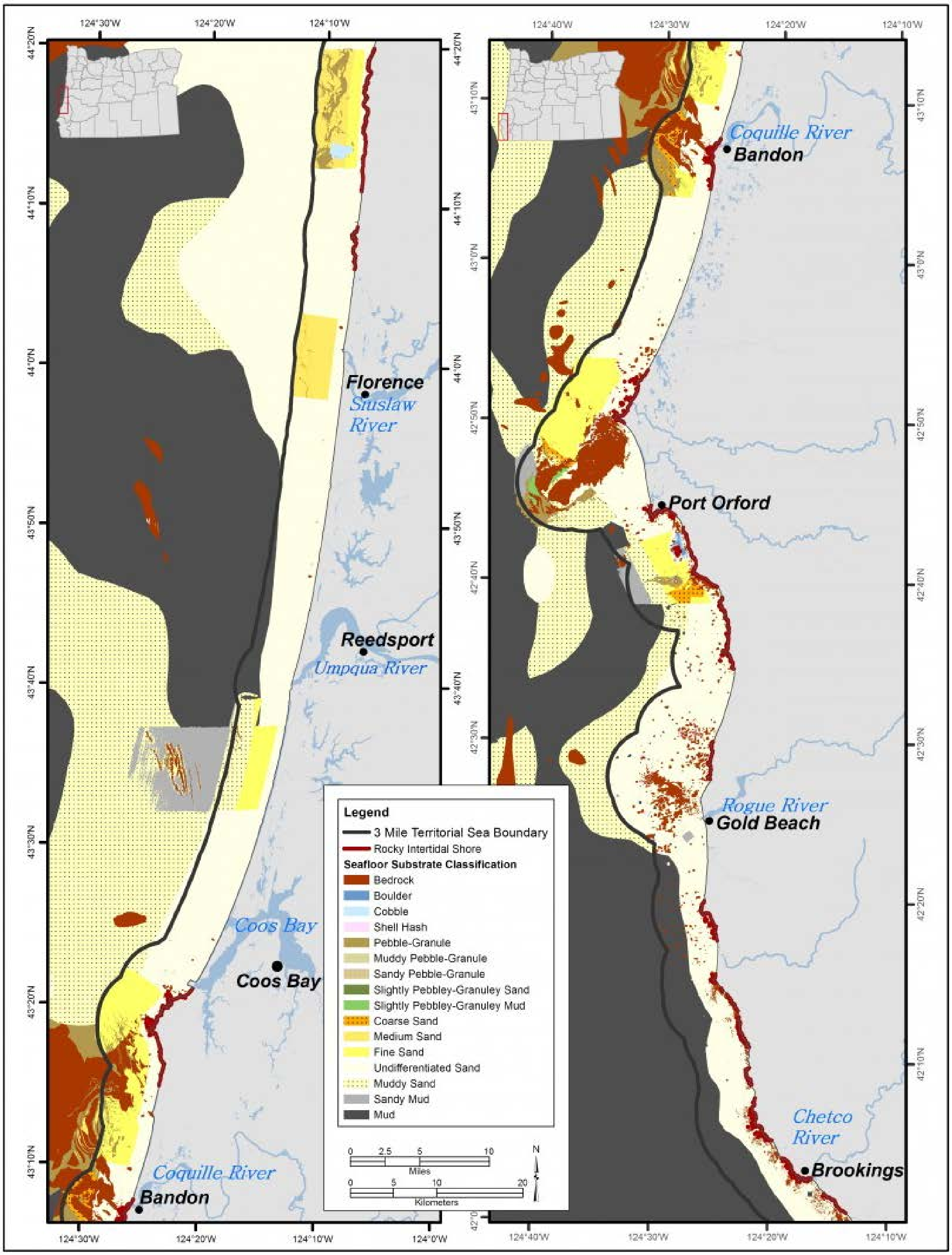


Figure 6.4b. South Oregon coast bottom substrates in marine system. Note that several abrupt boundaries evident on the map are artifacts of surveys locations not abrupt substrate changes.

SPECIES-HABITAT ASSOCIATIONS

Habitat associations for nearshore Strategy Species, Watch List Species, and commonly associated species are identified to provide insight into the biological communities affiliated with specific habitats. This combination of abiotic habitat information and their associated species will help define the CMECS biotopes (areas of uniform environmental conditions, habitat, and assemblages of animals and plants) for Oregon's coastal and marine environment.

Habitat association matrices for specific life history stages of Strategy Species provide information about the distribution of these species in the Nearshore (Table 6.3). Strategy Species that have any part of their life history commonly occur in a specific habitat are included in the species-habitat association. Readers should assume that information provided on species-habitat associations is based on published literature for the west coast of the U. S. and may or may not specifically be known for Oregon. However, there is Oregon-specific information available for many species such as kelp greenling (Figure 6.5). General habitat association matrices for Watch List Species and commonly associated species can be found in Appendix E and F, respectively.

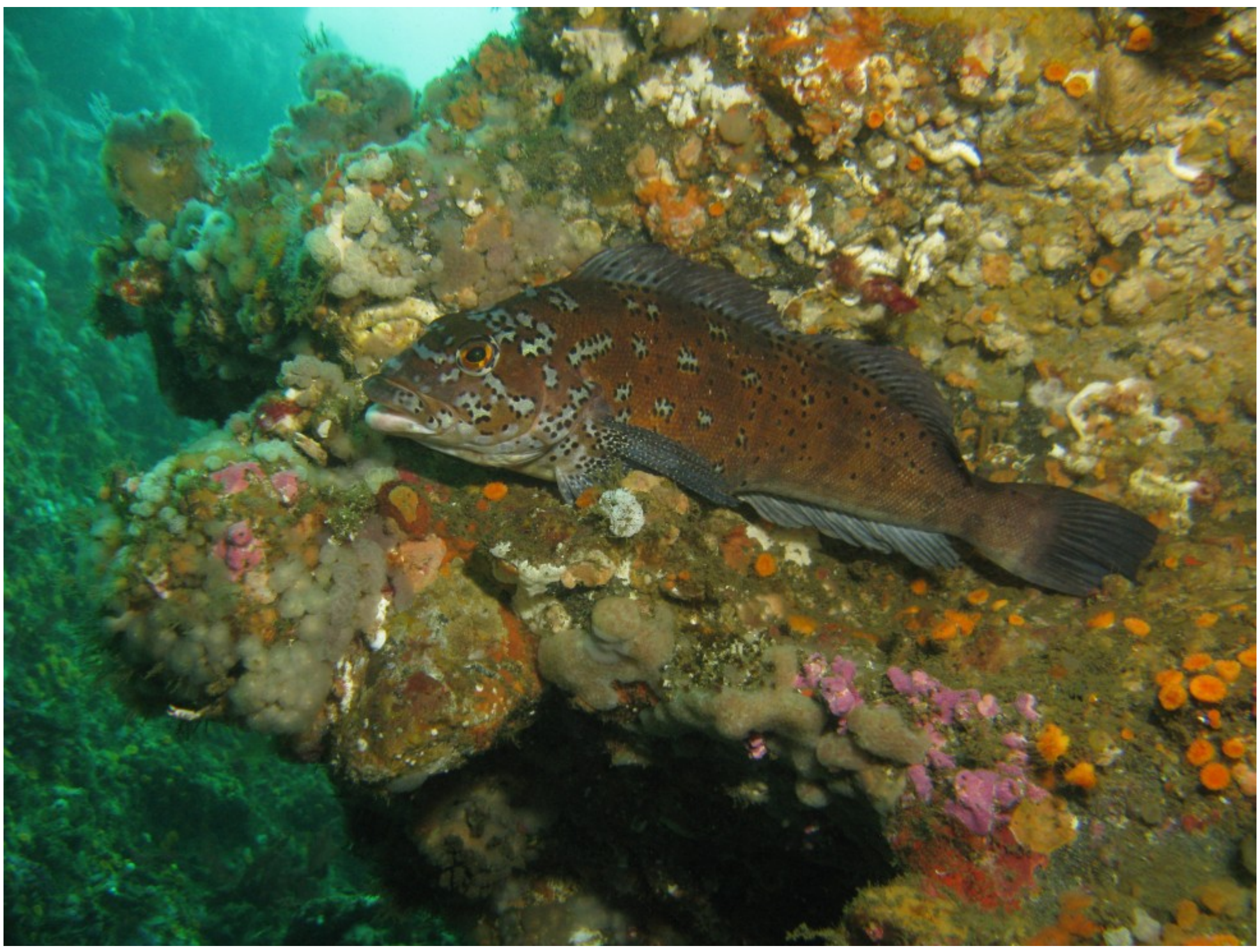


Figure 6.5. Kelp greenling in subtidal rocky reef habitat. Photo Credit: © Janna Nichols

Table 6.3. Strategy Species habitat usage, by life history phase: Adult (A), Spawning/Mating (S/M), Eggs/Parturition (E/P), Larvae (L), Juveniles (J)

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Birds								
Black brant *Branta bernicla nigricans*						A		Estuaries used by wintering and staging adults; feeds on marine and estuarine vegetation.
Black oystercatcher *Haematopus bachmani*	A, S/M, J	A, S/M, J				A, J		Breeding pairs use same territory over many years; feeds on small mollusks and invertebrates. Nests primarily above the supratidal zone on both islands and rocky headlands.
California brown pelican *Pelecanus occidentalis californicus*					A			Breeds and nests near coast but not in nearshore area. Feeds primarily on small marine fish.
Caspian tern *Hydroprogne caspia*		A, S/M, J			A	A, S/M, J		Forages in bays and estuaries for fish. Nests on estuarine islands.
Fork-tailed storm petrel *Oceanodroma furcata*					A			Breeds and nests in rocky cliffs or sandy burrows primarily on offshore islands. Forages at ocean surface.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Leach's storm petrel *Oceanodroma leucorhoa*					A			Breeds and nests on offshore islands. Forages by hovering or skimming over water; feeds primarily on small crustaceans.
Marbled murrelet *Brachyramphus marmoratus*					A			Nests inland in old growth forests. Forages by diving; feeds on small fishes.
Rock sandpiper *Calidris ptilocnemis*	A, J					A, J		Forages in nearshore waters during winter.
Tufted puffin *Fratercula cirrhata*	S/M,				A			Winters at sea, spends spring and summer months in the nearshore; nests on coastal headlands and offshore islands.
Western snowy plover *Charadrius alexandrinus nivosus*		A, S/M, E/P, J						Resident or short-ranged migrant.
Fishes								
Big skate *Raja binoculata*				A, S/M, E/P, J				Soft seafloor spawning habitat. May be affected by wave energy development.
Black rockfish *Sebastes melanops*	J		A, J	J	A, L, J	A, J	S/M, E/P	
Blue rockfish *Sebastes mystinus*	J		A, S/M, J	J	L, J	J	E/P	
Brown rockfish *Sebastes auriculatus*			A, S/M, E/P, J			A, S/M, E/P, L, J		
Cabezon *Scorpaenichthys marmoratus*	J		A, S/M, E/P, J		L, J	A, S/M, E/P, L, J		

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Canary rockfish *Sebastes pinniger*	J		A, E/P, J	J	L, J		S/M	Will inhabit artificial reefs.
China rockfish *Sebastes nebulosus*			A, E/P, J		L, J		S/M	Will inhabit artificial reefs.
Chinook salmon *Oncorhynchus tshawytscha*			A		A, J	A, J	A, J	Anadromous; substantial data gaps regarding habitat usage in nearshore waters; sometimes caught near rocky reefs and in open neritic waters.
Chum salmon *Oncorhynchus keta*					A, J	A, J	A, J	Anadromous; substantial data gaps regarding habitat usage in nearshore.
Coastal cutthroat trout *Oncorhynchus clarki clarki*					A, J	A, J	A, J	Anadromous; substantial data gaps regarding habitat usage in nearshore waters.
Coho salmon *Oncorhynchus kisutch*					A, J	A, J	A, J	Anadromous; substantial data gaps regarding habitat usage in nearshore waters.
Copper rockfish *Sebastes caurinus*			A, J	J	E/P, J	A, S/M, E/P, L, J		Will inhabit artificial reefs.
Deacon rockfish *Sebastes diaconus*	J		A, S/M, J	J	A, L, J	A, J	J	Newly described cryptic species found in OR waters.
Eulachon *Thaleichthys pacificus*					A, L, J	A, L		Anadromous; spawn in fresh water. Also school offshore.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Grass rockfish *Sebastes rastrelliger*	J		A, E/P, J	J	L			Shallow rocky reefs; sometimes found in tidepools.
Green sturgeon *Acipenser medirostris*	A		A	A	A	A, S/M, E/P, L, J		Northern DPS listed as species of concern. Uses all nearshore waters and estuaries. Most marine-oriented of sturgeon species.
Kelp greenling *Hexagrammos decagrammus*			A, S/M, E/P, J		L, J	A, S/M, E/P, L, J		Will inhabit pilings and jetties.
Lingcod *Ophiodon elongatus*			A, S/M, E/P, J	A, J	L, J	A, S/M, E/P, L, J		Will inhabit pilings and jetties.
Northern anchovy *Engraulis mordax*					A, S/M, E/P, L, J			Pelagic forage fish; commonly found in nearshore kelp beds and bays.
Pacific herring *Clupea pallasii*					A, J	A, S/M, E/P, L, J		Pelagic forage fish. Utilizes estuary spawning habitat in OR.
Pacific lamprey *Entosphenus tridentatus*							A	Anadromous. Requires fine gravel beds in freshwater for spawning. Gaps in knowledge of habitats used in marine life history phase.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Pile perch *Rhacochilus vacca*			A	A		A	S/M, E/P, J	Rocky shores; around kelp, pilings and underwater structures. Unknown habitat associations for some life history stages.
Quillback rockfish *Sebastes maliger*			A, E/P, J	J	L, J	A, S/M, E/P, L, J		Will inhabit artificial reefs.
Redtail surfperch *Amphistichus rhodoterus*				A		S/M, J	E/P	Juveniles and adults found in estuaries along CA and OR coasts. Unknown habitats for some life history stages. Estuaries and sandy surfzone.
Rock greenling *Hexagrammos lagocephalus*			A, E/P, J	A		S/M, J	E/P	Found in subtidal algae beds and rocky reefs during spawning.
Shiner perch *Cymatogaster aggregata*			A	A		A, J	S/M, E/P	Adults are common in estuaries as prey for salmonids.
Spiny dogfish *Squalus acanthias*			A, J	A, E/P, J	A, S/M, J	A, E/P, J		
Starry flounder *Platichthys stellatus*			L, J	A, S/M, J	E/P, L	A, S/M, E/P, L, J		Will inhabit areas with pilings.
Striped perch *Embiotoca lateralis*			A, J		A	A, J	S/M, E/P	Unknown habitats for most life history stages.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Surf smelt *Hypomesus pretiosus*		S/M, E/P		S/M	A, L, J	A		Extremely specialized habitat requirements for spawning beaches (temperature for substrate and air, light). Intertidal spawning habitat on beaches.
Tiger rockfish *Sebastes nigrocinctus*			A				S/M, E/P, L, J	Rocky reefs. Note that this is designated shelf rockfish in federal FMP, but defined as nearshore fish in ORS and is a component of both commercial and sport fishery harvest in nearshore waters. Will inhabit artificial reefs.
Topsmelt *Atherinops affinis*			A	A	A, J	A, S/M, E/P, L, J		Specialized spawning habitat in shallow waters with vegetation for eggs to adhere to.
Vermilion rockfish *Sebastes miniatus*			A, J	J	L, J		S/M, E/P	Rocky reefs; life stage history gaps. Will inhabit artificial reefs.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Western river lamprey *Lampetra ayresii*							A	Anadromous. Movements and habitat use of adult life stage for the approximately 10 weeks they are in marine habitats poorly understood, but thought to be limited to nearshore and estuarine areas.
White sturgeon *Acipenser transmontanus*				A		A, L, J		Anadromous. Movements in marine habitats poorly understood.
Wolf-eel *Anarrhichthys ocellatus*			A, S/M, E/P, J		J		L	Benthic, rocky subtidal.
Yelloweye rockfish *Sebastes ruberrimus*			A, E/P, J				S/M, L	Will inhabit artificial reefs. Juvenile usage of nearshore.
Yellowtail rockfish *Sebastes flavidus*	J		A, S/M, E/P, J	A, S/M, E/P, J	L, J			Juvenile usage of nearshore.
Invertebrates								
Blue mud shrimp *Upogebia pugettensis*						A, S/M, J		Marine water dependent estuarine species.
California mussel *Mytilus californianus*	A, S/M, J		A, S/M, J		E/P, L			Rocky intertidal, pilings.
Dungeness crab *Cancer magister*		A, E/P, J		A, S/M, E/P, J	L	A, S/M, J		Oceanic conditions linked to larval survival. Will inhabit pilings.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Flat abalone *Haliotis walallensis*			A, E/P, J		S/M, E/P, L			Rocky subtidal, gaps in life history knowledge.
Native littleneck clam *Leukoma staminea*	A, J	A, J		A,J	S/M, E/P, L	A		Marine water dependent estuarine species. Distinct from introduced Manila littleneck clam (*Venerupis philippinarum*).
Ochre sea star *Pisaster ochraceus*	A, J		A, J		S/M, E/P, L	A		Rocky intertidal and subtidal. Keystone species. Recent population decline due to sea star wasting syndrome.
Olympia oyster *Ostrea lurida*						A, S/M, E/P, L, J		Shells sometime found on the outer coast, but no coast wide surveys have been conducted.
Pacific giant octopus *Enteroctopus dofleini*	A		A, S/M, E/P, J	A, E/P	J			Rocky shore, found in low intertidal.
Purple sea urchin *Strongylocentrotus purpuratus*	A, J		A, J		S/M, E/P, L			Associated with habitat with adequate algae for foraging.
Razor clam *Siliqua patula*		A, J		A, J	S/M, E/P, L			Susceptible to disease and natural events such as El Niño. Increased occurrence of closures due to domoic acid concentrations in recent years.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Red abalone *Haliotis rufescens*	A, E/P, J		A, E/P, J		S/M, E/P, L			Do not mate at northern end of range (Cape Argo, OR).
Red sea urchin *Mesocentrotus franciscanus*	A, J		A, J		S/M, E/P, L			Adjacent to kelp forest habitat.
Rock scallop *Crassadoma giganteus*	A, S/M, J		A, S/M, J		S/M, L, J		E/P	Will inhabit pilings and jetties.
Sunflower star *Pycnopodia helianthoides*			A	A	S/M, E/P, J			
Algae and Plants								
Bull kelp *Nereocystis luetkeana*			A, S/M, E/P, J		S/M, E/P			Shallow subtidal. Reproduce by spores, with alternating generations.
Native eelgrass *Zostera marina*				A, S/M, E/P, J	S/M, E/P	A, S/M, E/P, J		Angiosperm. Shallow estuarine and marine waters with muddy or sandy bottoms. Requires clear waters.
Sea palm *Postelsia palmaeformis*	A, S/M, E/P, J				S/M, E/P			Mid to low intertidal. Reproduce by spores, with alternating generations.
Surf grass *Phyllospadix spp.*	A, S/M, E/P, J				S/M, E/P			Low intertidal and shallow subtidal. Areas exposed to high wave action. Angiosperm.

Strategy Species	Rocky Shore	Sandy Beach	Rocky Subtidal	Soft Bottom Subtidal	Neritic	Estuarine	Habitat Unknown	Comments
Marine Mammals								
Gray whale *Eschrichtius robustus*				A, J	A, J			Mating and parturition occurs within lagoons in Baja California. Feed in soft bottom. Animals from Pacific coast feeding group summer in OR waters.
Harbor porpoise *Phocoena phocoena*				A	A, S/M, E/P, J		A, S/M, E/P, J	
Killer whale *Orcinus orca*					A, S/M, E/P, J	A, J	A, S/M, E/P, J	Southern resident DPS have been tracked in OR waters.
Northern elephant seal *Mirounga angustirostris*		A, S/M, E/P, J	A, J		A, J	A		Mating and parturition is on sandy beaches. In OR pups have been born at Cape Arago.
Pacific harbor seal *Phoca vitulina*	A, J	A, S/M, E/P, J	A, J		A, S/M, J	A, S/M, E/P, J		
Steller sea lion *Eumetopias jubatus*	A, S/M, E/P, J		A, J		A, J	A		Mating and parturition on islands, rocky shores. Most reproductive activity in OR occurs on the south coast.

Photo Credit: Geoff Shester, Oceana

NERITIC (OPEN WATER)

The neritic habitat includes the waters and biological communities living in the water column over the continental shelf. The neritic habitat is characterized by CMECS as including the nearshore and offshore marine subsystems, and includes the surface, upper water column, pycnocline, and lower water column layers. Neritic habitat also occurs beyond the planning area, westward to deeper oceanic habitats that start at the continental shelf break at approximately the 200 m depth contour. The waters of the neritic habitat are in constant motion. The California Current System, seasonal upwelling and downwelling, El Niño/La Niña events and changes in the Pacific Decadal Oscillation are all examples of physical events that move the waters in this habitat over varying time scales. The water is replaced many times over during an average human lifetime. The setting for the CMECS biotic component of this habitat is planktonic biota and the plankton varies with the water mass. The ecology of the neritic habitat is affected by processes taking place at scales varying from global to local. The dynamics of the neritic habitat affect all of the other habitats described later in this section.

Physical Environment

Many physical and chemical environmental factors affect neritic ecology. These factors include but are not limited to solar light and radiation influence, salinity, temperature, layer position, physical mixing, hydrostatic pressure, biogeochemical composition, atmospheric exposure and influence, surface and under water currents, swells, waves, and water mass movements. Many of these factors can change by location and time of year. The neritic habitat encompasses many water column habitats that shift, expand, and contract over time and space in both predictable and stochastic patterns.

Coastal upwelling is perhaps the most defining feature of Oregon's neritic habitat with its alternating upwelling-relaxation events. Upwelling is a water column hydroform, described by CMECS as an upwardly-directed current caused by divergence of water masses. In spring and summer months, strong northerly winds push surface and upper water layers westward towards the deep ocean. This movement causes deep, cold, oxygen-poor but nutrient-rich waters to rise to the surface near the coast replacing the water that was driven offshore. These nutrients, brought to the upper layers of the water column help propagate and sustain the rich biota of Oregon's coastal waters. The relaxation events, when the northerly winds briefly cease or reverse, allow the upper water layer to move back towards shore bringing its rich biotic content with supplies of food, larvae, and juvenile organisms. In fall and winter months when winds blow predominantly from the south, the surface and upper water layers move shoreward and downward in a process called downwelling. Downwelling is an important part of the annual seasonal cycle that forces oxygen rich waters from the upper layers downward in the water column. Surface water temperatures provide a good indication of these seasonal wind forcing differences that bring the cold, nutrient-rich waters to the surface in the summer (Figure 6.6a) and the warmer waters from offshore to the coast in the winter Figure 6.6b).

Large-scale changes in water masses, temperatures and currents result in changes in plankton species composition and abundance, which impact the survival and distribution of organisms within coastal and oceanic ecosystems. These large scale oceanic events, such as El Niño/La Niña and the Pacific Decadal Oscillation, occur at multi-year or decadal time scales. Recently, scientists have made strides in understanding how El Niño/La Niña events and the warm and cool regimes of the Pacific Decadal Oscillation influence Oregon’s coastal and marine water ecosystem.

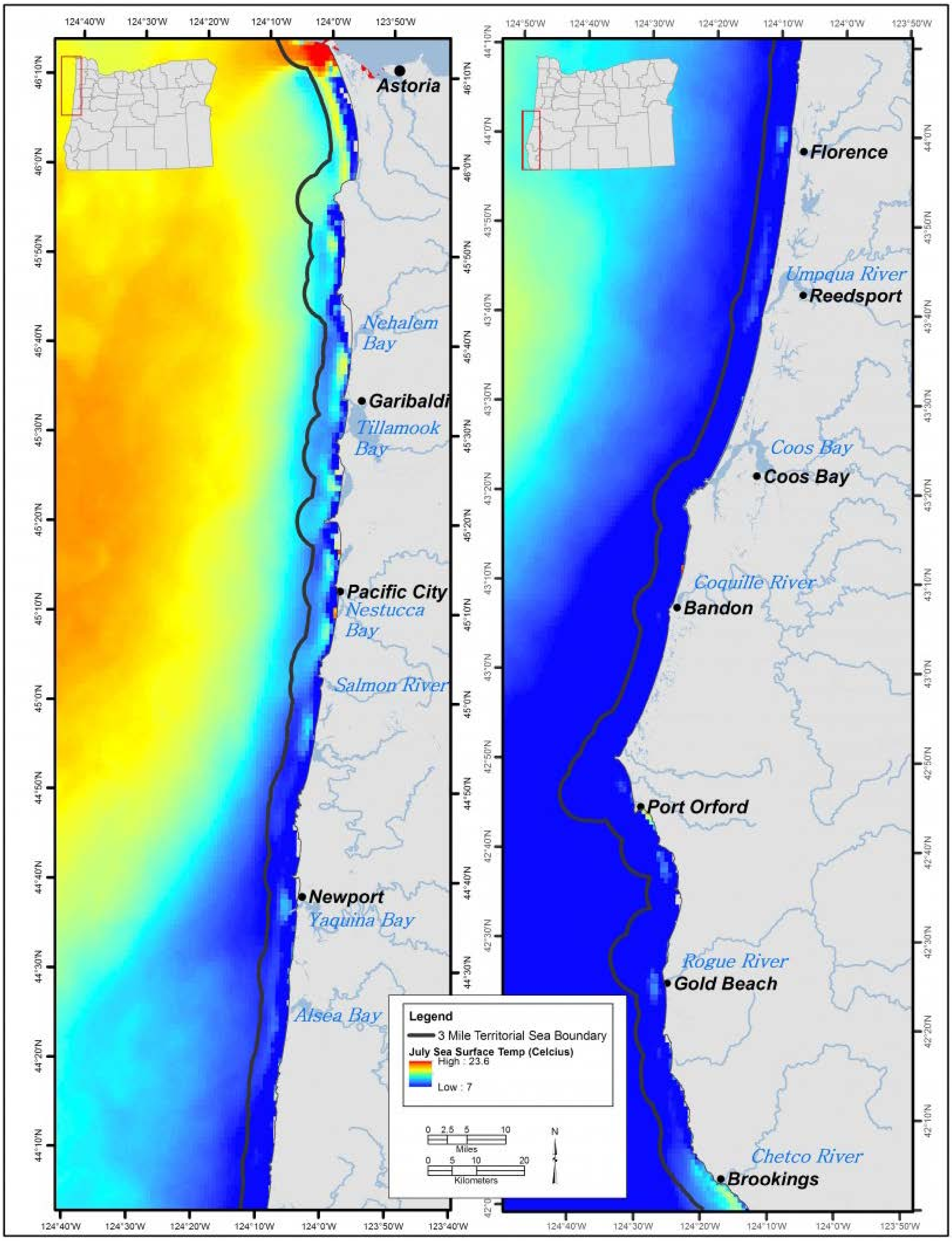


Figure 6.6a. Average sea surface temperature for July (1997 – 2003). Note colder water nearshore. (Source: Juan-Jorda Masters Thesis/College of Oceanic and Atmospheric Sciences/ Oregon State University/2006.

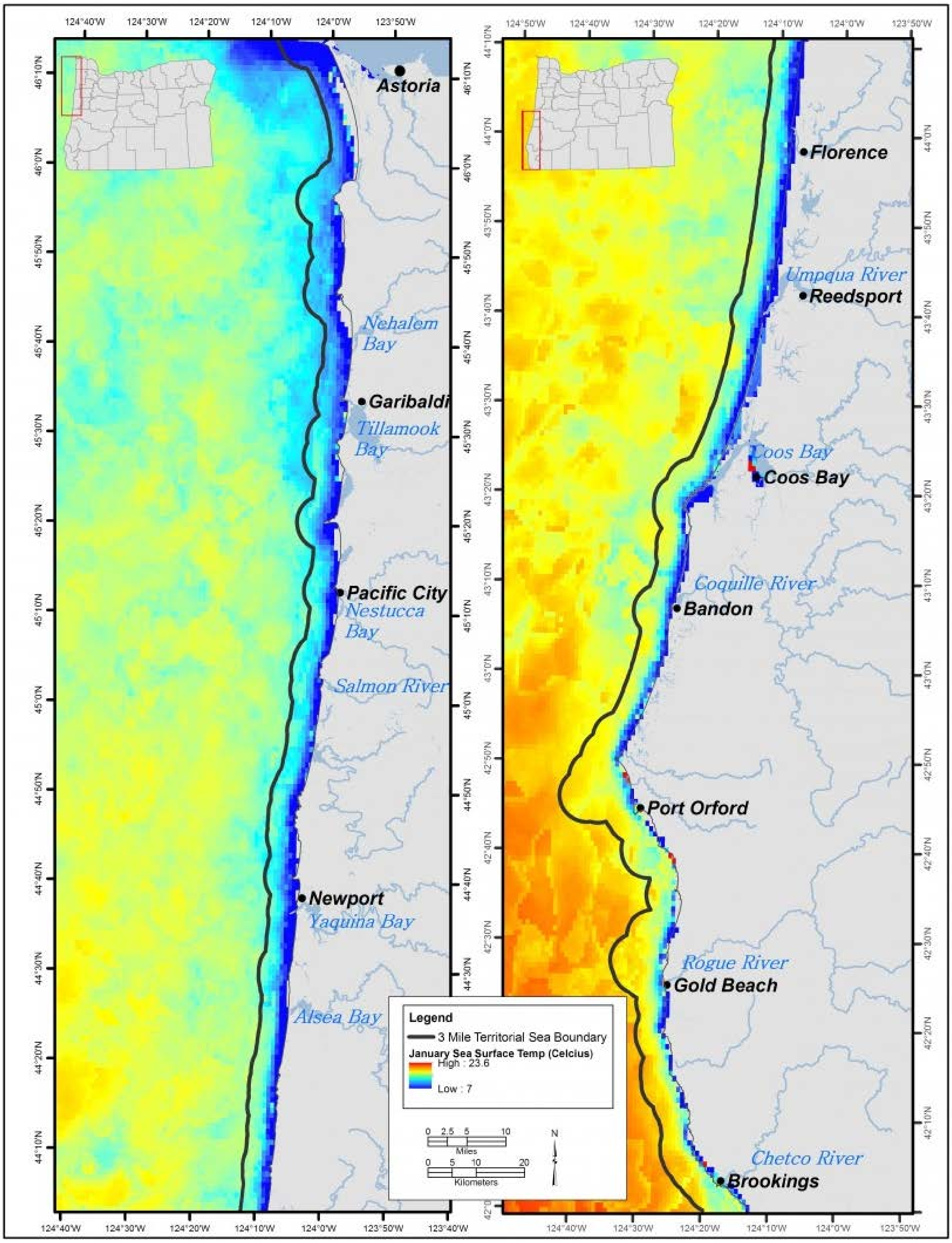


Figure 6.6b. Average sea surface temperature for January (1997 – 2003). Note warmer water nearshore. Source: Juan-Jorda Masters Thesis/College of Oceanic and Atmospheric Sciences/ Oregon State University/2006.

Another water column component that affects Oregon's neritic habitats is river plumes. CMECS does not characterize the marine waters affected by these plumes as estuarine because they are not meaningfully enclosed by landforms. Riverine waters entering the ocean often carry high concentrations of nutrients, create gradients in salinity, cause physical mixing, and create areas of high turbidity. Large river plumes, such as that from the Columbia River, may serve as a microhabitat within neritic habitats and can potentially act as biogeographic barriers between marine areas to the north and south. The Columbia River plume stretches hundreds of miles offshore and shifts predictably over the course of each year. In the summer the plume spreads south and offshore from the river's mouth, while during the winter the plume is found to the north of the river mouth and is usually directly adjacent to the coast. This plume has important ecological effects, not only to neritic habitats, but to nearshore and offshore habitats as well. The oceanographic fronts created by the Columbia River plume in the marine systems generate productive conditions that attract many species of invertebrates, fish, seabirds, and marine mammals.

Biological Characteristics

Neritic habitats support two basic types of marine organisms: plankton and nekton. Planktonic organisms live in the water column and are incapable of swimming against currents, instead drifting with them. Plankton are often categorized as either phytoplankton or zooplankton. Phytoplankton are microscopic photosynthesizing organisms (e.g., diatoms), and are the primary producers that form the base of the marine food web. Huge surges in phytoplankton populations, known as "blooms," are commonly associated with upwelling events. Zooplankton are heterotrophic organisms that range in size from microscopic single-celled organisms to enormous jellyfish a meter or more in diameter. Some plankton, called holoplankton, like many diatoms, copepods, krill and jellyfish spend their entire lives as drifters in the water column. Many species like sea urchins, mussels, crabs, some snails and many fishes have planktonic stages as eggs or larva, called meroplankton, before either settling to the bottom or growing large enough to be nekton. The CMECS biotic component uses these planktonic classes and subclasses to describe the open water neritic zone. They can be further refined by taxonomic groups and communities that are dominant in any given area of interest. Dramatic changes in plankton communities occur in Oregon waters with water masses changes. For example warm water species are brought in to nearshore water with El Niño events.

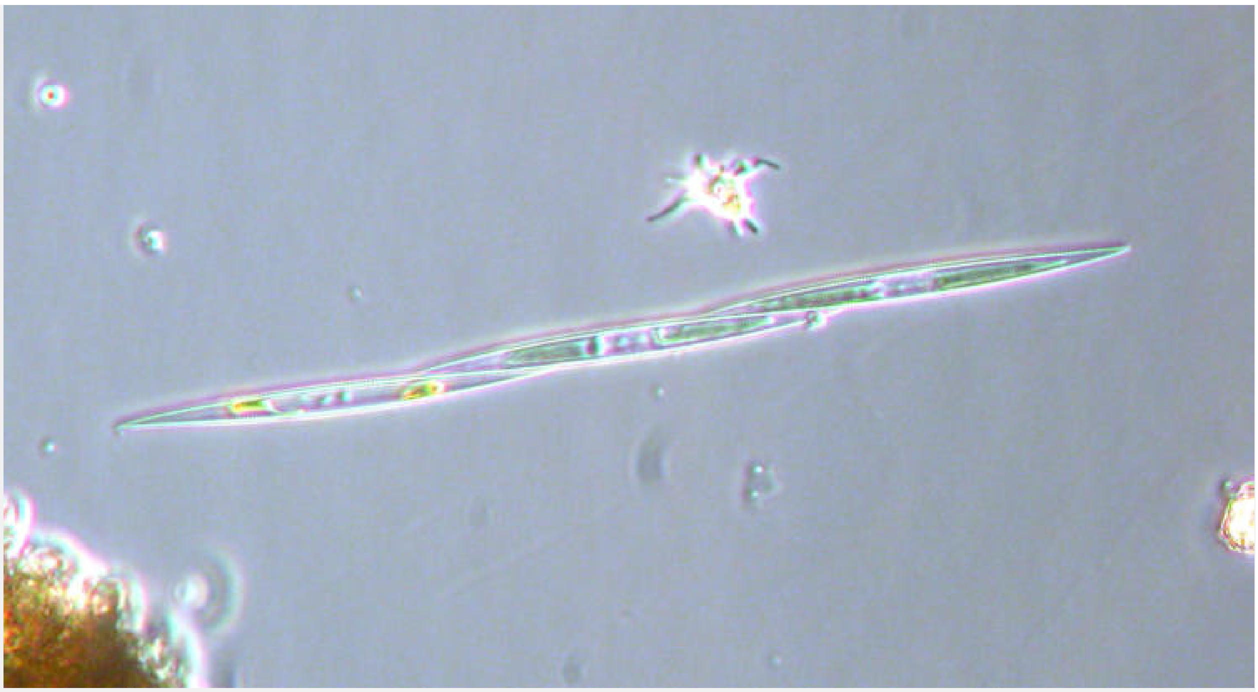
In contrast, nektonic marine organisms are capable of swimming against currents and include animals such as adult crustaceans, mollusks, and vertebrates. Highly migratory and schooling species are typical of nekton in neritic habitats. Many species of invertebrates, fish, birds, and marine mammals travel and forage exclusively or occasionally within this habitat.

Many nearshore Strategy, Watch List and commonly associated species utilize the open water neritic habitat during their life history (Table 6.3, Appendix E and F). Many forage fishes such as northern anchovy, Pacific herring, topsmelt, surfsmelt, Pacific sandlance and longfin smelt feed in this open water neritic habitat. Juvenile rockfish are found in the water column. Breeding birds such as tufted puffin and common murre are central place foragers that feed on the forage fish and other species while nesting. In all, 59 of the 73 nearshore Strategy Species depend on this habitat for some phase of life. This is also the habitat that supports primary production by phytoplankton and secondary production by zooplankton, which is at the base of the food web for the nearshore ecosystem. Ocean currents transport and disperse larvae and juveniles of many invertebrate and fish species throughout the region.

Human Use

Human uses of the neritic habitat include commercial and recreational fishing, nonconsumptive recreational pursuits such as boating or whale watching, scientific research, commercial maritime transportation, and military operations. Development of renewable energy sources from both wind and waves is an emerging use of the neritic habitat.

STRATEGY SPOTLIGHT: HARMFUL ALGAL BLOOMS IN MARINE WATERS



Pseudo-nitzschia is a genus of diatom that can produce domoic acid, a neurotoxin that causes amnesiac shellfish poisoning. Often found as chains of overlapping cells, Pseudo-nitzschia algal blooms can cause illness or death in seabirds and marine mammals that consume forage fish that accumulate the toxin when they eat the algae. Amnesiac shellfish poisoning can cause short term memory loss, brain damage and death in humans that consume toxic shellfish. Closures of shellfish fisheries due to human health concerns from domoic acid accumulation can have devastating effects on local economies. Photo Credit: ODFW

Phytoplankton, the microscopic algae that live in marine waters and drift with ocean currents, are a key component of the marine ecosystem. These primary producers at the base of the food web create the food directly consumed by many marine animals. The productivity of the marine waters off of the Oregon coast, like that of all ocean waters, is closely tied to this primary production of food from sunlight, water, carbon dioxide and nutrients by phytoplankton. Filter feeding bivalve shellfish such as clams, mussels, scallops and oysters extract and ingest these algae along with small drifting animals, called zooplankton, as they pump water through their bodies to feed and respire. Similarly, many forage fish species such as northern anchovy, Pacific herring and Pacific sardine feed on both phytoplankton and zooplankton.

However some types of phytoplanktonic algae produce biotoxins that accumulate in animals that eat them causing illness and death in seabirds and mammals higher up the food web. Other types of these algae produce surfactant-like proteins that create foam on the water's surface. Seabirds exposed to the foam lose the waterproof coating on their feathers which keeps them dry resulting in death from hypothermia or a restricted ability to fly. Problems occur when there are blooms of these types of algae. These harmful algal blooms (HABs) cause losses of natural resources, economic losses to coastal communities, and have resulted in human illnesses and deaths. Although these blooms largely occur in the open water habitats off our coast the effects of HABs are often most acutely felt along the shorelines.

The most direct effects on people along the west coast of the U.S. result from biotoxins produced in two types of HABs. Blooms of dinoflagellates in the genus *Alexandrium* produce saxitoxin, a neurotoxin that causes paralytic shellfish poisoning in humans. Blooms of diatoms in the genus *Pseudo-nitzchia* produce domoic acid that causes amnesic shellfish poisoning in humans. Paralytic shellfish poisoning cases were first recorded on the west coast of North America in 1793, when members of Captain George Vancouver's crew became sick after eating a breakfast of mussels collected from the shores of what is now British Columbia, Canada. Paralytic shellfish poisoning can cause death from respiratory failure due to paralysis. Amnesic shellfish poisoning causes gastrointestinal and neurological disorders in humans and can be life-threatening. *Pseudo-nitzchia* is known to have been present off the west coast since at least the 1920s, but the first documented outbreak of problems related to poisoning from domoic acid on the U.S. west coast occurred in 1991 with a die off of sea birds in California and contamination of razor clams and Dungeness crabs in Washington, Oregon and California. Although never confirmed, 25 cases of amnesiac shellfish poisoning were suspected in Washington during the 1991event.

Monitoring for these HABs and sampling shellfish for food safety have resulted in closures or opening delays for both recreational and commercial shellfish fisheries in Oregon as well as in Washington and California over the years. Fisheries for razor clams, California mussels, Dungeness crab, northern anchovy and several other species have been affected. These closures have had economic consequences for coastal communities, but are necessary for public safety. Monitoring efforts can be conducted at two levels: sampling waters to monitor the phytoplankton for HABs and sampling organisms that consume phytoplankton to monitor for the accumulation of the disease causing toxins. The Oregon Department of Agriculture currently monitors several species of shellfish for accumulation of biotoxins. From 2005 to 2012, ODFW in collaborations with OSU, UO and the NOAA Northwest Fisheries Science Center utilized funds from a federal to develop an integrated HAB monitoring and event response program. For ODFW, this resulted in monitoring phytoplankton directly at ten sites along the Oregon coast which provided ODA with an early warning system about potential HAB events. This work also stimulated collaborative research leading to insights into the occurrence of HABs off our coast. Oregon has not directly sampled its coastal waters for HABs since 2012 due to a lack of ongoing funding to do so. To assure human safety, monitoring of selected bivalve shellfish species for biotoxins by ODA continues in Oregon and has expanded in scope to include Dungeness crab for the foreseeable future due to events in 2015 and early 2016. Information about recreational harvest closures for shellfish can be found on the ODA website.

While HABs are often localized events, research suggests that the frequency and spatial extent of HABs off the west coast has increased over the last several decades. A geographically extensive and long lasting bloom of *Pseudo-nitzchia* that affected marine wildlife and fisheries along the west coast began in the spring of 2015. The bloom stretched from Alaska to California and persisted far longer than what is considered normal. Scientists called this an unprecedented event. Some west coast fisheries remained closed through May of 2016. NOAA‘s Northwest Fisheries Science Center provides an excellent overview and more information on HABs.

Photo Credit: ODFW

SOFT BOTTOM SUBTIDAL

Soft bottom subtidal habitat includes all of the unconsolidated substrate areas (e.g., mud, sand, granule pebbles and various mixes thereof) on the ocean bottom. Soft bottom subtidal habitats are characterized by CMECS as being within the subtidal zones of the nearshore and offshore marine subsystems. Subtidal soft bottom habitats are diverse based on distinct organism assemblages that are influenced by differences in substrate type (sand vs. mud), organic content and bottom depth. The distribution and relative abundance and mixes of these substrates are not yet well described for much of Oregon's nearshore ocean waters.

Physical Environment

The primary substrate types in Oregon's soft bottom subtidal areas range from sand to pebble. CMECS defines unconsolidated mineral substrates based on particle diameter. Here we consider soft bottom habitats to be composed of the various mixes defined by CMECS of particles <64 mm in diameter. Because the Oregon coast is primarily an exposed, high energy environment, most soft bottom subtidal areas are sandy. However, mud can be the more prevalent substrate type in areas receiving less energy from water movement, including isolated and sheltered areas, and deeper areas. The distribution of these unconsolidated sediment types in Oregon waters is influenced by currents in both the nearshore and offshore subsystems. Areas close to outfalls and discharge pipes would be expected to show localized differences based on the displacement of substrate and the increased availability of organic and small particulate material. The smaller the particle size, the smaller the pores (or spaces between the particles) are. Pore size dictates the amount of water and the water chemistry of the substrate, which can define what types of organisms can live in that sediment.

Biological Characteristics

Most soft bottom subtidal communities are dominated by infaunal (burrowing) invertebrates such as polychaete worms. However, other organisms such as crustaceans, echinoderms and mollusks may be locally abundant. Common epifauna (found on the sediment surface) can include species of shrimp, crabs, snails, bivalves, sea cucumbers, and sand dollars. Dungeness crab are an important component of soft bottom subtidal communities and are found both on the surface as well as buried in the substrate. Sea pens (*Ptilosarcus* sp.), colonial relations to sea anemones, are common on more muddy bottoms.

Common fish in this area include several species of flatfish (e.g., sanddab, English sole, and sand sole), and important burrowing forage species such as Pacific sand lance and sandfish.

Species associated with soft bottom subtidal habitats provide a spectrum of ecosystem services. Most widespread but least apparent of these services are the nutrient cyclers: deposit feeders and microbes living within the sediments. Emergent species such as sea pens in more quiet areas are only found in this habitat. There are a vast array of worms and other invertebrates that live in the soft subtidal bottom. Soft bottom habitats are important to many Strategy, Watch List and other commonly associated species at various life stages (Table 6.3, Appendix E and F). For example, big skate, starry flounder, sand sole, Pacific sand lance burrow or cover themselves to hide in these sediments. Gray whales feed by sifting buried amphipods from the sediments. Many invertebrates like razor and native littleneck clams live in the subtidal soft bottom habitat. Both juvenile and adult Dungeness crab forage here and sometimes hide in these soft sediments. The young of commercially valuable fish species can often be found here and utilize these areas as nursery habitat. The young of many species use the nearshore area for foraging, and are themselves prey for larger fishes and birds. Sand lance is a particularly valuable forage species for birds, other fishes, and marine mammals. Diving birds such as the common murre forage for food for their young in soft bottom areas taking juvenile flat fish back to their chicks while they are nesting.

Human Use

Commercial and recreational harvest of Dungeness crab, surf perch, and species of nearshore flatfish are the principal human uses of the soft bottom subtidal habitat. Sand and mud from dredging projects are sometimes deposited over soft bottom habitats. Soft bottom subtidal habitats could also soon be utilized for siting renewable energy projects and their associated infrastructure. Finally, the soft bottom subtidal offers many opportunities for scientific research.

STRATEGY SPOTLIGHT: A LOOK AT SOFT BOTTOM SPECIES AND HABITATS

This remotely operated vehicle (ROV) is a tool ODFW uses to survey the ocean bottom and its inhabitants. Photo Credit: ODFW

Soft substrates make up much of the Nearshore subtidal bottom habitat. Two of Oregon's most economically valuable commercial fisheries, Dungeness crab and pink shrimp, occur in soft bottom habitat. Like many crustaceans, both of these species begin their lives as plankton drifting in the water column with the ocean currents before settling out to the bottom as they develop and grow. Both of these species can be found as adults in Oregon nearshore waters as well as in the deeper waters outside and adjacent to Oregon's territorial sea. Though the pink shrimp fishery is primarily conducted in deeper waters outside of Oregon's territorial sea, roughly half of the crab pots targeting Dungeness crab are typically set in Oregon's Nearshore waters at depths of 30 fathoms or less.

This short video was captured by ODFW's Marine Resources Program researchers using a remotely operated vehicle equipped with a high definition camera transiting over soft bottom habitat in Nearshore waters. Although many soft bottom dwelling species live in the sediments out of view of the camera, both pink shrimp and Dungeness crab as well as a number of other species that live in or on the soft bottom are seen in their natural habitat. Adult pink shrimp, several sea whips, an adult Dungeness crab, a sea anemone, and a sunflower star are in the first section of the video. The second section captures video of newly settled juvenile Dungeness crabs in high densities. The final video clip shows a small section of a vast sand dollar bed.

Photo Credit: Ian Chun

ROCKY SUBTIDAL

Rocky subtidal habitat includes all hard substrate areas of the ocean bottom. The geologic origin substrate components include cobble and boulder in the CMECS unconsolidated mineral substrate class and bedrock and megaclasts in the rock substrate class. Anthropogenic origin hard substrates are also here. Anthropogenic reefs include any areas where hard, persistent material has been placed either purposely or accidentally by humans. Examples include rock jetties at the entrance to many bays, shipwrecks, anchoring systems for renewable energy projects, and unburied portions of underwater cables or pipelines. Rocky subtidal areas are often referred to as reefs, rocky reefs, rocky banks, pinnacles, or “hard bottom.” Rocky subtidal habitats, including both the natural and anthropogenic components, are characterized by CMECS as being within the subtidal zones of the nearshore and offshore marine subsystems. Although most areas are never exposed to air, the CMECS subtidal definition does include areas that are exposed intermittently each month when tide levels fall below the Mean Lower Low Water (MLLW) level. Rocky subtidal habitats are found in both the nearshore subsystem and offshore subsystem and some of the differences are discussed below.

Some rocky subtidal areas are extensions of shoreline rocky features such as headlands, cliffs, or rocky intertidal habitat, while others exist as isolated regions of rock surrounded by habitat with soft bottom substrate. Rocky reefs have varied topography; some may barely come above the surrounding seafloor, while others may rise from the seafloor many meters, or extend above the surface to form islands in the Territorial Sea. There are more than 1,800 islands off the coast of Oregon, the bases of which form rocky subtidal habitat.

Physical Environment

The physical characteristics of rocky subtidal habitats reflect proximity to shore, depth of the water, local seafloor geology, erosional forces, and biological influences. The geology of many rocky subtidal areas mimics the geology of adjacent landforms, often consisting of erosion-resistant basalts or metamorphic rock common in Oregon’s rocky headlands. Over geologic time, the underwater rock features have been uplifted, bent, deformed, and alternately exposed to ocean and terrestrial erosional forces as successive ice ages and geologic forces caused massive sea level changes. These forces have shaped a variety of physical habitat features within reefs, including flat rocky benches, stacks, jagged ridges, broken boulder fields, and a vast number of cracks and crevices that provide shelter and substrate to abundant life.

Oceanographic processes and features strongly influence the rocky subtidal environment. Subtidal reefs are exposed to pounding wave action, underwater currents, and the physical and chemical properties of the water. These factors in turn influence the biological communities on the reefs. Generally, nearshore reefs are more exposed to wave action than offshore reefs, and the wave action is much stronger in winter than during summer. Wave action is a key factor in determining the types of organisms that can live on the very shallow reefs. Ocean currents vary widely by location, time of year, and over tidal cycles. Currents influence reefs in a variety of ways including direct erosion, sand scour or burial of reef areas, and movement of organisms to and from reefs, including plankton and larva. Large-scale or long-term variation in the ocean environment such as upwelling, seasonal current directional shifts, shifts in ocean circulation, water temperature variation, local and global weather patterns, ocean acidification, and biological processes combine to determine the ambient chemical and physical composition of the water in rocky subtidal habitats. The CMECS water column components can be used to describe important features of the waters surrounding and overlying rocky reefs that are important in shaping the biological communities which live there.

The 30 m depth contour is defined by CMECS as the boundary for the nearshore subsystem and the offshore subsystem. Nearshore rocky reefs differ from offshore reefs in some key physical characteristics. Light penetration is adequate to support algal life on nearshore reefs, while offshore reefs support far less algal growth. For example kelp is only found in nearshore subsystem rocky areas. Wave action, currents, and storms produce a higher energy environment on nearshore reefs than their deeper counterparts. Organisms adapted to higher energy environments are more prevalent in the nearshore area. On some reefs, strong currents can scour and seasonally bury or expose the rocks with sand, considerably influencing the types of organisms that can utilize those rocky subtidal environments.

The difference in detail in the new habitat maps, compared with those available for the 2006 version of the Nearshore Strategy is striking. Use of the CMECS substrate component system also provides far more detail. A good example is the area off Cape Arago (Figure 6.7) where at a larger scale the differences are very apparent.

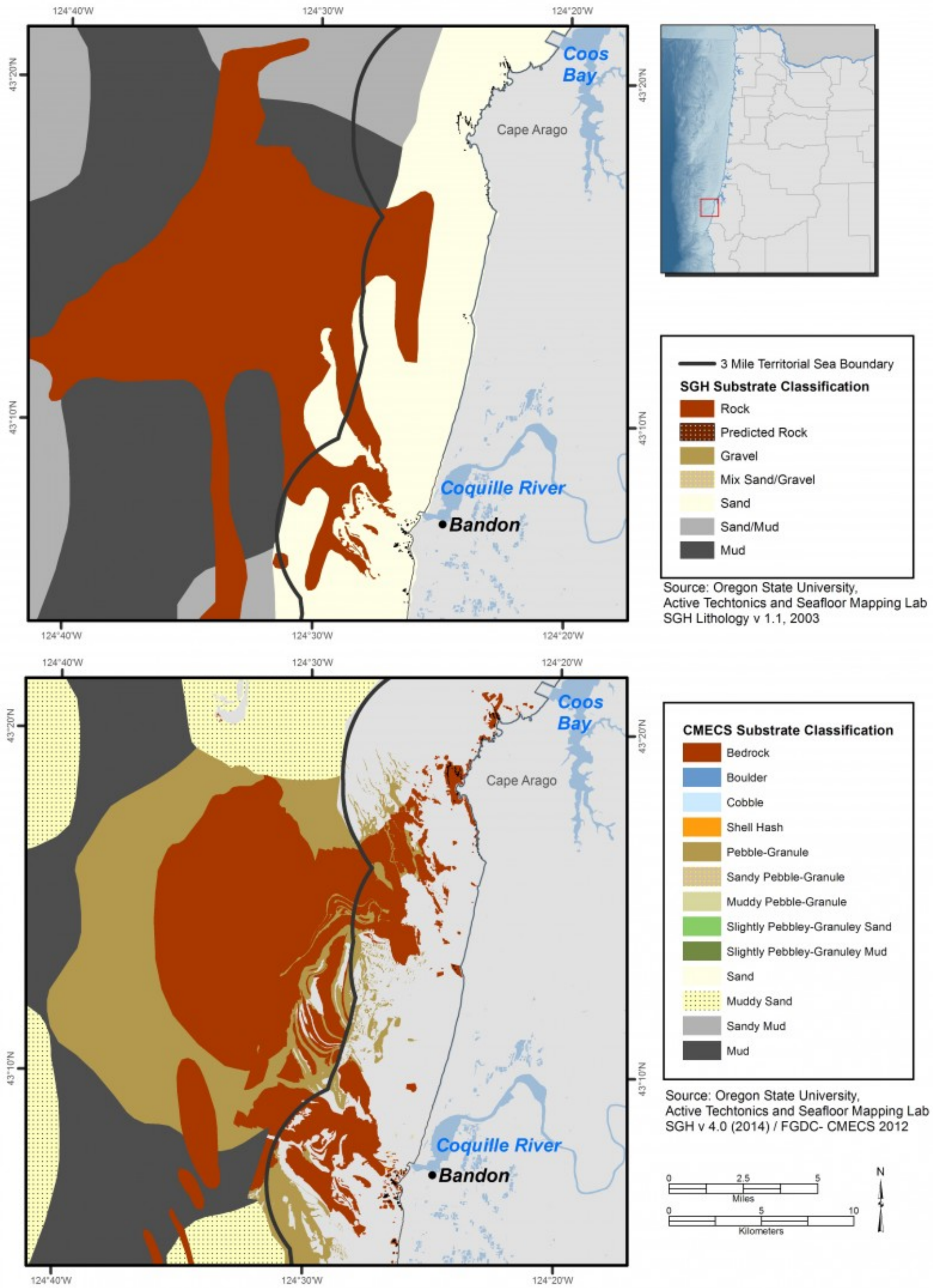


Figure 6.7. Detail map of the area off Cape Arago, Oregon included in original version of the Oregon Nearshore Strategy (top) and map of the same area that incorporates data from surveys with modern sonar technologies and the CMECS classification of substrate components (bottom).

Biological Characteristics

Subtidal rocky reefs are known for their abundant and diverse biological communities. The variety in topography, substrate characteristics, and depths within and among rocky reefs produces a plethora of microhabitats, often within relatively small geographic areas. This in turn provides for a diversity of species adapted to life in these different microhabitats. Habitat-forming organisms, such as kelp or attached invertebrates, provide additional microhabitats used by reef species.

Most nearshore rocky reefs have rich algal, invertebrate, fish, bird, and marine mammal communities. Depending on water depth, light penetration, wave energy, and other physical and biological processes, algae and macroalgae can provide extensive or sporadic cover and food for other species in the nearshore subsystem. Algae and macroalgae include encrusting forms that grow close to the rock surface, turf forms that can create a dense layer up to a foot thick or more, subcanopy forms that provide added subsurface habitat structure, and canopy forms that create kelp "forests" which may break the surface of the water. Offshore rocky reefs in deeper water do not have kelp forests. Free-swimming (nektonic), drifting (planktonic), and attached invertebrates are common in both the nearshore and offshore rocky subtidal habitats.

Many Strategy, Watch List, and other commonly associate species inhabit rocky subtidal habitats (Table 6.3, Appendix E and F). Fishes such as black, blue, china, deacon, copper and quillback rockfish, wolf eel, pile and stripped perch, lingcod, cabezon and greenlings, along with a large variety of smaller sculpins, gunnels, poachers, blennies and others are associated with rocky subtidal habitat. Diving seabirds and marine mammals forage extensively in rocky subtidal areas. A wide variety of filter or suspension feeding invertebrates attach to hard substrates such as sponges, anemones, barnacles, bryozoans, hydrozoans, tunicates, and coldwater corals. Mobile invertebrates abound here as well. Red and purple urchins, red and flat abalone eat algae attached to the rocks. Ochre, sunflower and other sea stars forage in subtidal rocky habitats as do crabs, shrimps, brittle stars, nudibranchs, chitons, and worms.

The diversity of producers and consumers found in the rocky subtidal creates complex food webs and interdependencies among organisms. Reefs are linked to surrounding environments by ocean currents and organism movements. Reef topographic structure often slows currents, enhancing the local community's ability to capture drifting organisms, an effect enhanced by the occasional presence of large kelp beds. Many organisms move on and off reefs, some in large-scale migrations and others in short feeding forays to other areas. While most nearshore reef fishes occupy both nearshore and offshore reefs, there are differences in depth preferences of some species and life history stages.

Several fish species depend on nearshore rocky reefs during early life history stages before moving off to deeper reefs, the continental shelf, or other areas as they grow. Conversely, some fish depend on estuaries or rocky intertidal habitat for early life history stages before moving to rocky subtidal areas as adults. For example kelp greenling, cabezon, and grass rockfish tend to be more prevalent on the nearshore reefs. Canary and yelloweye rockfish move from nearshore to offshore reefs as they grow. Many fish species are entirely dependent on reefs for parts of their life cycle, while others are visitors. Common visitors include herring, smelt, sharks, ratfish, and salmon.

Ecological linkages within and between rocky subtidal habitats help to shape their biological communities and the diversity of species found in this habitat type. Currents bring in planktonic organisms and transport drifting larvae to and from disparate rocky subtidal habitats. The location of reefs with respect to other “upstream” or “downstream” reefs has a dramatic effect on the types, abundance, and recruitment rates of the reef’s communities and organisms. This complexity of organism interrelationships makes the outcome of natural or human disturbance to reefs difficult to measure or predict.

Additional Biological Component: Kelp Beds

Bull kelp forms extensive kelp beds in places along the Oregon coast. The extent of these kelp beds changes with oceanographic conditions each year as this alga lives up to about 18 months at most. Photo Credit: Bastet Photography

Kelp beds are a significant subset of Oregon’s rocky subtidal habitat. CMECS classifies kelp beds as a biotic component of Oregon’s rocky subtidal habitat, and more specifically as canopy-forming algal beds. Kelp beds, found on many of Oregon’s nearshore rocky reefs, consist of an aggregation of one or more species of brown macroalgae that generally grow from the seafloor to the ocean surface and form a floating canopy of kelp. While kelp beds can be found all along the Oregon coast, the strip of coast from Cape Arago south contains approximately 92 percent of the state's kelp beds (Figures 6.8a and 6.8b). Most kelp beds in Oregon consist of bull kelp (*Nereocystis luetkeana*). While kelp beds appear common due to their visibility from shore, they are actually relatively scarce habitats in Oregon's waters, covering less than one percent of the nearshore area.

The presence and attributes of kelp beds depend on a number of physical and biological variables. The primary variables determining where kelp might exist include water depth and substrate availability. In Oregon's waters, kelp beds only form on rocky substrate and are limited to the nearshore subsystem. Beyond that depth, low light levels on the seafloor limit the growth of kelp. However, light and substrate are not the only limiting factors; many rocky reefs in the appropriate depth range rarely or never support kelp beds. Factors that may limit kelp on these reefs include seasonal sand burial of the reef, sand scour of the rocks, overexposure to wave and storm energy, locally high turbidity, lack of nutrients, distance of the reef to "seeding" sources of kelp, abundance of organisms that consume kelp (e.g., sea urchins), and competition with invertebrates and other algae for rock substrate available for attachment.

Kelp beds in Oregon display pronounced seasonal and annual variation in extent and density. Bull kelp beds grow rapidly in spring and summer, followed by a winter period when storms dislodge much of the algae, leaving little or no surface canopy. The biomass of kelp beds can also vary ten-fold or more from year to year due to interannual variation in the combinations of physical and biological variables that affect their growth.

Kelp beds are biologically rich habitats due to both the primary productivity of the kelp and the effect kelp beds have on the surrounding environment. Bull kelp is one of the fastest growing organisms in the world, annually providing a large biomass available for consumption directly or as detritus after the kelp dies. Kelp furnishes a vertical habitat structure that otherwise would not exist on the reef. Kelp beds also slow water currents and reduce waves and wind chop, helping to trap drifting larva and nutrients and providing shelter.

Kelp beds and their canopies can also support a rich understory of algal and attached invertebrate cover. On Oregon reefs, dense understory algae coverage gives way to dominant invertebrate cover at about 5 to 10 m water depth. Thick kelp cover reduces light penetration and can limit the density of understory algae. The kelp bed and underlying reef support a diverse array of fish and invertebrate species and provide cover and foraging areas for diving seabirds and marine mammals. In Oregon, the mix of fish species on kelp bed and non-kelp bed reefs is similar. In most parts of the world where kelp beds have been studied, reefs with kelp beds have much higher densities of fish than similar reefs without kelp. In Oregon, this does not appear to be the case. However, there have been no quantitative comparative studies to confirm this.

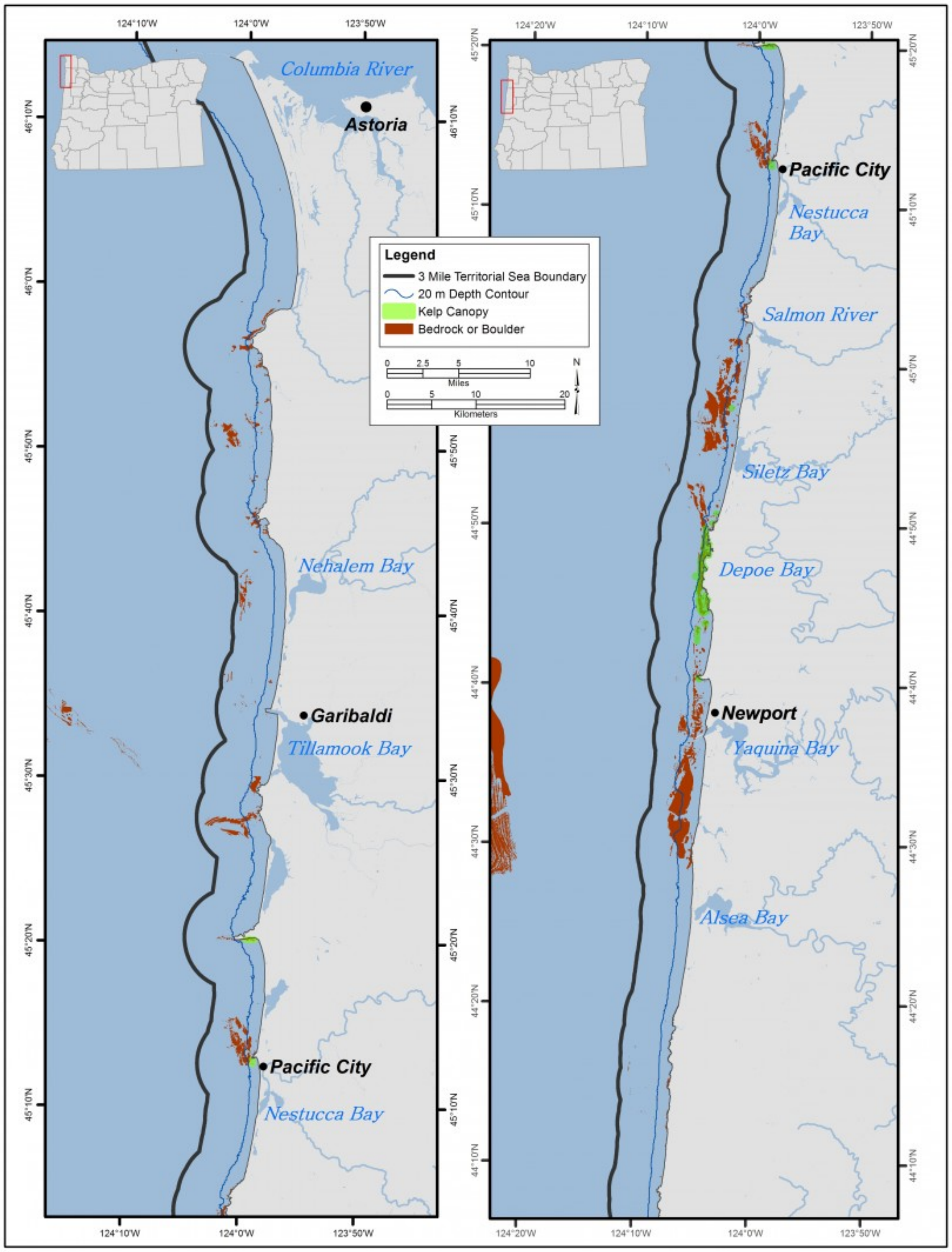


Figure 6.8a. Kelp beds along the north Oregon coast. Map shows maximum extent of kelp beds based on surveys.

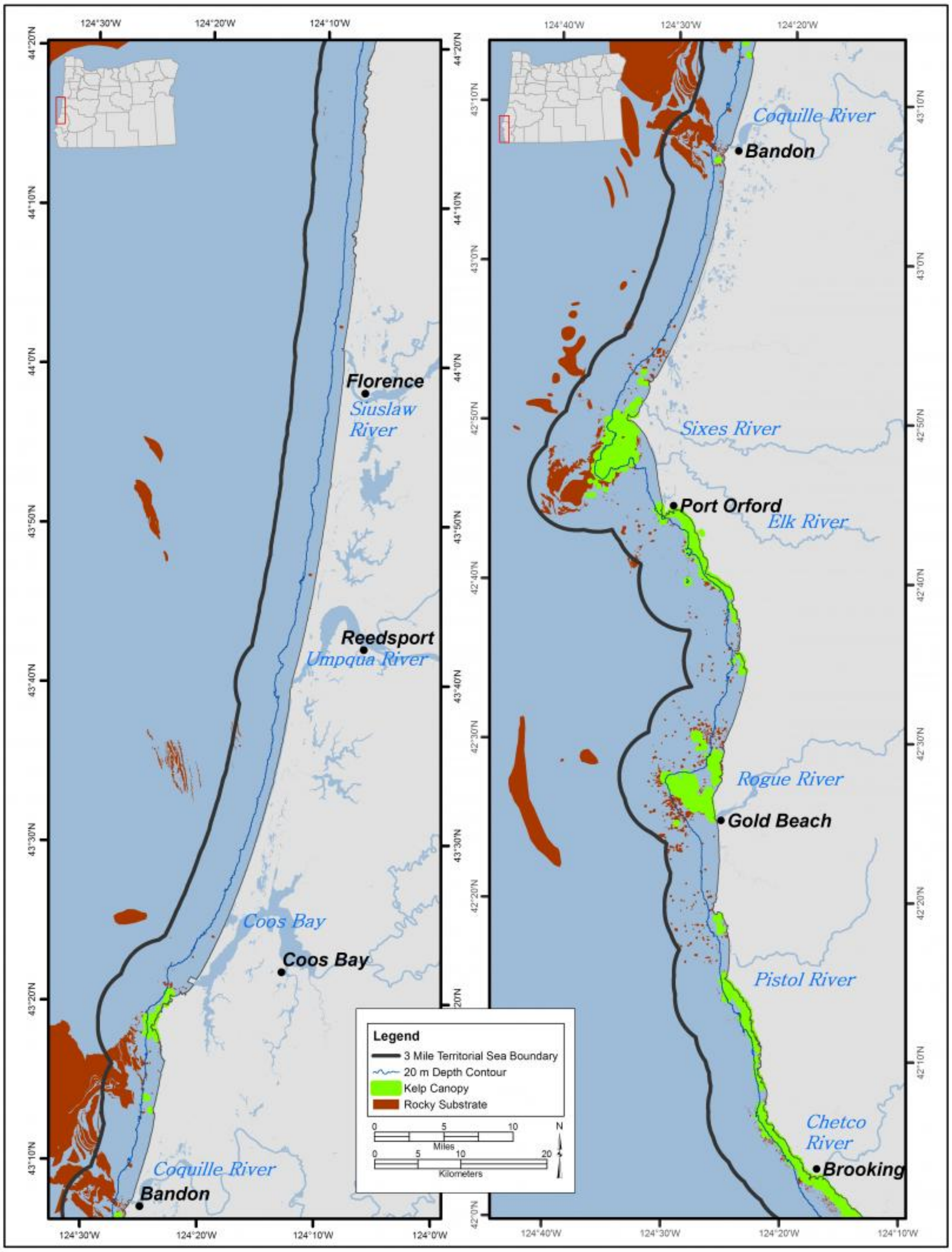


Figure 6.8b. Kelp beds along the south Oregon coast. Map shows maximum extent of kelp based on surveys.

Human Use

Human uses of nearshore rocky reefs include fishing, scientific research, sightseeing, and a number of other recreational and industrial pursuits. Commercial and recreational fishing for many types of rockfish species, lingcod, cabezon, and kelp greenling are the primary human uses of this habitat to date. SCUBA diving and underwater photography are among the other less prevalent uses. Much of the commercial live fish fishery takes place on shallow nearshore reefs. Recreational anglers also favor shallow nearshore reef, if they are available. Commercial fishing effort targeting nearshore species tends to be higher on the south coast and recreational effort more prevalent on the north coast. A unique potential commercial use is the harvest of kelp. Commercial kelp harvest has been tried several times in Oregon on a small scale in the past. Currently there is no commercial harvest of kelp. Many reefs are used recreationally by SCUBA divers, sea kayakers, boaters, and surfers. Reefs with extensive kelp beds and islands provide sightseeing and bird watching opportunities for coastal residents and visitors. However, many reefs have no features extending to the ocean surface, and thus many people are unaware of the teeming life existing just below the water's surface.

STRATEGY SPOTLIGHT: SAMPLING SUBTIDAL ROCKY HABITAT

A video lander designed by ODFW being retrieved after sampling rocky subtidal habitat. Photo Credit: ODFW

Many nearshore species that inhabit subtidal rocky reefs are important both ecologically and economically. Black, blue, China, deacon, copper and quillback rockfishes, cabezon, kelp greenling, lingcod, sea urchins and abalone are examples. Investigating and sampling the fish and wildlife species that inhabit rocky reefs is thus of great interest to scientists and fishery managers. But sampling rocky reef habitats has proven to be challenging.

Bottom trawls, a sampling method widely used in soft bottom marine habitats to help assess populations of fish, cannot be used effectively in rocky habitat as the nets tend to get hung up and entangled on the rough rocky bottom. Modified trawl gear can be used in some rocky locations, but its use can dramatically alter the rocky habitat by displacing rocks along with things such as anemones and corals that live on those rocks.

A variety of visual sampling methods have been used in rocky reef habitats over the years including SCUBA and remotely operated vehicles surveys. More recently video landers developed for use in Oregon waters by ODFW staff have been utilized to sample rocky reef habitat. Each method has pluses and minuses. Some highlights of video collected from a video lander provide a glimpse into life in rocky reef habitat. ODFW is using all of these visual survey techniques to sample the community of species that inhabit rocky reefs to investigate how best to use these sampling techniques to assess populations, examine the community structure, and refine our knowledge of habitat utilization by these species.

Photo Credit: Gregory Krutzikowsky

SANDY BEACHES

Sandy beaches are a widespread feature of the entire Oregon coast and make up approximately two-thirds of the coastline. Their distribution is interrupted by rocky shores, rocky headlands, river mouths, estuaries, and human constructions. Oregon's sandy beaches are characterized by CMECS as marine nearshore areas in the intertidal and supratidal zones that are composed of very fine to very coarse sand substrate; they extend in a continuum from the Mean Lower-Low Water line to the areas above the Mean Higher-High Water line that are affected by wave splash and overwash at extreme high tides, but not areas affected only by wind-driven spray. Sandy beaches stretch inland until they are stopped by a continuous line of vegetation, debris, rocks, or other barrier. Everything beyond the reach of the waves and splash zone is considered terrestrial habitat.

Physical Environment

Oregon's sandy beaches are high-energy environments that experience significant wave and wind energy. Several million cubic meters of sand are transported to the nearshore area annually by river systems. Seasonal variation in wind and wave energy and currents move substantial amounts of sand onto or off beaches, which results in significant changes in beach character as underlying rock structures (bedrock and/or cobble) are exposed. In some areas, patches of ancient forest where the land dropped during past subduction zone earthquakes may become exposed. Currents and wave energy are other significant factors in moving sands onto or off of beaches at elevations that are frequently immersed; the lateral width of the beach will govern the area over which current and wave energy is dispersed, and hence determines the slope of the beach as sands are deposited or swept away. At higher elevations that are dry and experience infrequent immersion by tides, wind is the predominant factor in distributing sand, and can create windrows and mobile dunes from a few centimeters to several meters tall, while dunes further inland may be several stories high.

The lateral (north-south) extent of sandy beaches is punctuated by rivers or rocky headlands where the transition from sand to volcanic rock can be quite abrupt. Rivers can frequently become "bar-bound" during the summer and early fall months when river flows diminish due to reduced precipitation, and the energy of flowing water is in sufficient to maintain an open, flowing channel to the sea. In such cases, the river or stream will flow *through* the sand in its final stages. Bar-bound rivers are generally freed by fall rains on the Oregon coast that increase river flows and wash sand out of the river mouths to re-establish a channel of flow. Fall rains and the breaking of blocking bars are important in restoring access to fresh-water streams for anadromous fishes.

The supratidal zone and upper range of the intertidal zone are subject to the greatest variation in temperature and moisture and the least physical energy from the ocean. The intertidal zone, particularly its lower reaches, receives much greater physical energy from waves and currents, and also experiences the least variation in temperature.

Biological Characteristics

The movement of sand by water and wind energy makes sandy beaches largely unsuitable for rooted and attached organisms. However, between the grains of sand in the intertidal zone is a vast multitude of life too small to see with the naked eye, including diatoms, harpacticoid copepods, amphipods, and algae, among others. Larger invertebrates can be found here as well, including crustaceans, mollusks, and diverse worm taxa. Many of the resident invertebrates burrow in the sand during periods of exposure for protection from desiccation and/or predation, and emerge to forage as tides permit.

Biological communities of the upper intertidal and supratidal zones of sandy beaches are often based on the resources provided by the incoming tides and deposited at the high tide line. Once in the intertidal zone, the detritus is broken down by the mechanical force of waves pounding against the shore and the industry of the many organisms that live and forage there. Organisms of the mid and lower intertidal, particularly the small invertebrates, provide food resources for numerous larger invertebrate, fish, and bird species. Some marine mammals intentionally use this zone to rest, hauling themselves out of the ocean to lay on the sand.

Strategy, Watch List, and commonly associated species that are associated with general sandy beach habitats, or specific to distinct sandy beach types, are listed in Table 6.3, Appendix E and F), respectively. Surf smelt use particular beaches to lay their eggs in the intertidal zone. Native littleneck and razor clams burrow below the sand and feed on plankton when the ocean water covers them. Western snowy plover nest either in the supratidal zone or above and feed in the intertidal sandy areas. Sanderlings gather in loose flocks in the winter months to feed on the rich array of invertebrates under the sand as the waves recede. Harbor seals rest on sandy beaches and northern elephant seals come ashore to molt, usually in the supratidal zone.

Human Use

Harvesting razor clams at low tide is a popular beach activity. Photo Credit: ODFW

Sandy beaches attract substantial human use at all levels of the intertidal and supratidal. Their easy access and wide variety of organisms and ecological processes attract scientific interest. Thanks to their uniform, comfortable surface, sandy beaches are valued for a wide variety of recreational activities including sightseeing, picnicking, walking, running, agate-hunting, and kite flying. Lower portions of beaches are also launch and recovery areas for surfers, windsurfers, kite boarders, sea kayakers, and some sailboats, power boats, and personal watercraft. Wildlife found at sandy beaches is highly valued by humans for everything from bait or dinner to instructional or aesthetic uses. Driving is permitted on some Oregon beaches, but not all. All beaches in Oregon are free for the public to access.

Photo Credit: Gregory Krutzikowsky

ROCKY INTERTIDAL

Oregon's rocky shores, often referred to as rocky intertidal or tidepool areas, form parts of the shoreward boundary of the nearshore planning area and can extend from the extreme low tide to the extreme high tide. They are characterized by CMECS as marine nearshore areas in the Intertidal and Supratidal zones, which include all hard substrate areas along the shoreline that are alternately exposed and covered by tides or are affected by wave splash and overwash, but not areas affected only by wind-driven spray. Everything beyond the reach of ocean waves is considered terrestrial habitat. The substrates making up Oregon's rocky shores include both volcanic and sedimentary bedrock as well as megaclasts, boulder, cobble and human-made (anthropogenic) structures. Some rocky shore areas are extensions of other shoreline rocky features such as headlands or cliffs, others exist as isolated regions of rock surrounded by sandy beach habitat, and some are anthropogenic in origin, having been deposited intentionally or unintentionally by humans. Oregon's coastline has approximately 152 linear miles of rocky shore habitat, and some 20 miles of jetties.

An example of a naturally-occurring geoform component found in Oregon's rocky shores would be a tidepool. Some of the anthropogenic geoforms found in Oregon's rocky shores include breakwaters, jetties, and rip rap deposits. All rocky shore habitats in Oregon are contained entirely within the Strategy's planning area.

Physical Environment

The physical characteristics of rocky shores reflect local shoreline geology, exposure to ocean waves and currents, and biological influences. The Pacific Ocean exerts tremendous energy on Oregon's rocky shoreline, eroding coves, widening crevices, and reducing bedrock to rubble. On the north and central coast volcanic basalt dominates the hard shoreline, but sedimentary sandstone and mudstone rock can found at several locations. Between Coos Bay and the Coquille River the geology is characterized by sedimentary rock. South of the Coquille River, headlands and rocks are primarily remnants of ancient metamorphic rocks over 200 million years old. Because of the variety of geologic origins and processes, Oregon's rocky shores consist of an assortment of cliff faces, wave-cut platforms, boulder fields, outcrops, and rubble. Each geoform presents a unique mixture of habitats that provide shelter and substrate to support a wide variety of life.

Ocean forces and weather strongly influence rocky intertidal environments. Tides are the primary influence on organisms and communities. The physical environment of intertidal areas changes dramatically as the tide rises and falls, alternately covering everything with salt water or exposing it to air, fresh water from rain and runoff, and the sun. Wave exposure also has a primary influence on this environment. Intertidal areas protected from waves due to shoreline orientation or geology provide dramatically different habitat than areas directly exposed to wave action. Local alongshore currents and ocean circulation processes introduce additional variables in the habitat, including sand scour of rocks, seasonal sand burial of rocky areas, and transport of nutrients, larvae, and adult organisms to and from intertidal sites.

Biological Characteristics

Rocky shore habitats are known for and crucial to their abundant and diverse biological communities. The variety in tidal elevations, wave exposure, and geologic structure within and among intertidal habitats produces a variety of microhabitats, often within relatively small geographic areas. This, in turn, provides for a diversity of species adapted to life in these different microhabitats. Organisms contribute to the variety of habitats as well. For instance, mussels and algae attach themselves to the rocks, sometimes in huge numbers, providing additional structure and biogenic habitat used by intertidal species. Anthropogenic geoforms often take on similar biological characteristics of natural rocky shore geoforms, with similar biological communities using them.

Biological communities associated with rocky intertidal habitat include algae, marine plants, attached and mobile invertebrates, fish, marine mammals and birds. Strategy, Watch List, and other commonly associated species that utilize rocky shore habitat can be found in Table 6.3, Appendix E and F. Algae cover many intertidal areas with dense growth, often layered with several different species. Surfgrass, a marine vascular plant, often forms thick beds in lower intertidal areas, providing additional habitat structure for invertebrates and fish. Most rocky shore areas are extensively covered with attached invertebrates. Common types of attached organisms include sponges, anemones, barnacles, bryozoans, tunicates, and mussels. The rocks, algae, and attached invertebrates provide homes for a variety of mobile invertebrates such as crabs, snails, limpets, sea stars, urchins, brittle stars, nudibranchs, chitons, and worms. Free-swimming invertebrates, such as shrimps and drifting (planktonic) invertebrates also occur in tidepools or drift in with the tides. The algal and invertebrate communities in rocky intertidal areas often form distinct horizontal bands or zones of life according to the amount of time exposed to the air or covered by the tides.

The upper reaches of the supratidal and intertidal zones experience the greatest variation in moisture, exposure, and salinity, and are often highly dependent on strong wave action to bring in nutrients and life. Compared to other rocky shore areas, fewer species are found in the high intertidal and supratidal. These zones are typically characterized by vegetated rocks and boulders, along with isolated crevices and tidepools that hold water even during low tides. Greater abundance and diversity of life is associated with the lower intertidal areas. The distribution of organisms living in the mid-intertidal is generally limited at upper elevations by environmental stressors (such as high temperatures and desiccation) and at lower elevations by biological interactions (such as predation and competition). Organisms in the lowest parts of the rocky shore area experience almost continual tidal inundation, and must be able to withstand the mechanical and biological stresses associated with this high-energy environment.

The low intertidal serves as an important connection in the marine food web. Wave activity helps convert kelp and other organic debris into small fragments that are consumed by grazers and filter feeders and provide some nutrients to algal communities. Invertebrates and small fish provide a source of food for numerous bird species that forage along rocky shores.

Fishes using the rocky shore include species adapted to live in tidepools and subtidal species that move in and out of the intertidal area with the tides. Tidepool fishes include a variety of sculpins, gunnels, and pricklebacks, among others. Rockfish species, greenlings, and surfperch often move into the intertidal area during high tide to feed and take refuge from subtidal predators. The rocky shore area is especially important to juvenile life stages of these fishes. The rocks and islands associated with Oregon's rocky shores and the subtidal rocky reefs provide important seal and sea lion haulout and pupping areas, and support some of the largest seabird nesting colonies on the contiguous U.S. West Coast. Islands are another example of geoforms in the CMECS framework. Several seabird species that do not nest in colonies in Oregon do feed and take refuge here, including black oystercatchers, black turnstones, and surfbirds.

Rocky shores are linked to surrounding habitats by ocean currents and organism movements. Currents bring in planktonic organisms that help feed intertidal animals, and transport drifting larvae to and from intertidal environments. Currents also bring nutrients that feed the lush algal growth. Many organisms move in and out of intertidal habitats to feed or take refuge. Fish move in during high tides and terrestrial animals move in during low tides. Rocky intertidal areas are also linked to each other, primarily through transport of larvae by ocean currents. The proximity of intertidal habitat to other "upstream" or "downstream" habitats has dramatic effects on the types, abundance, and recruitment rates of communities and organisms.

Ecological linkages within and between rocky shore areas help to shape biological communities and contribute toward the biological abundance of this habitat type. The diversity of producers and consumers in the intertidal create complex food webs and interdependencies among organisms. This complexity of organism interrelationships makes the outcome of natural or human disturbance to rocky shore habitats difficult to predict or measure. For instance, while human foot traffic can result in inadvertent trampling of organisms, anthropogenic structures such as jetties provide a unique and valuable rocky shore habitat at the transition between estuaries and the marine environment.

Human Use

Exploring tide pools is a favorite activity for coastal residents and visitors. Photo Credit: Gregory Krutzikowsky

Human uses of rocky intertidal areas include fishing, invertebrate and algae harvest and collection, education, scientific research, sightseeing, and other recreational, economic, and social pursuits. Due to their accessibility and the fascinating array of marine life, rocky intertidal areas receive more public use than many other marine habitats. Visitation by school groups and others curious about marine life comprises the majority of public use. For many visitors, their first and sometimes only interaction with the wonders of marine life comes from tidepool visits. Visitation of rocky shore areas has generally been increasing over the past five decades.

Rocky shores are used extensively by researchers as a natural laboratory to increase understanding about general marine ecological principles. Currently, there are fifteen intertidal and subtidal sites along the Oregon coast that have special regulations limiting harvest or collection of organisms in order to enhance scientific research, as well as education and enjoyment benefits.

Detailed descriptions of types and amount of human use at individual rocky shore sites along Oregon's coast can be found in the *Oregon Rocky Shores Natural Resources Inventory* (ODFW 1994).

STRATEGY SPOTLIGHT: SEA STAR WASTING SYNDROME

Shot in Yellow Point, which is about a 30 minute drive south of Nanaimo on Vancouver Island, BC. Photo shows a sick purple ochre sea star which has dropped one of its arms, Photo Credit: Steve Rumrill, ODFW

The concept of a keystone species, one that affects its biological community assemblage, in both direct and indirect ways which are out of proportion to its biomass, is based on research done on the ochre sea star, *Pisaster ochraceus*, in the rocky intertidal zone (Paine 1969). Dr. Robert Paine's concept that a keystone species shapes it biological community continues to influence ecological theory and has been expanded from the rocky intertidal environment to most ecoregions on earth. The predatory ochre sea star selectively feeds on mussels effectively creating space and opportunities for many other species to live and thrive.

The ochre star is familiar to Oregonian tide pool visitors, divers and aquarium goers. The species ranges from Alaska to Baja, California. In June 2013, researchers monitoring tide pools along the Washington coast noticed great numbers of ochre stars dying through a process called sea star wasting syndrome. Sea star wasting syndrome is characterized by a set of symptoms that include appearance of external lesions, followed by tissue decay, fragmentation of the body and death. Sometimes an affected sea star looks deflated before other symptoms are visible. While these symptoms are typical of sea stars stranded high and dry out of their normal habitat, what is unusual in sea stars experiencing wasting syndrome is that they are found in normally suitable habitat often with many others of the same species that are also affected. Sea stars may die within a few days of the first symptoms appearing.

Outbreaks of sea star wasting syndrome occurred previously in the 1970s, 1980s and the 1990s. What is different this time is that the geographic area over which it is occurring and the numbers of sea stars affected appear to be unprecedented. After first being documented on the Washington coast, outbreaks in Canada's British Columbia, California, Washington's Puget Sound and Alaska were found. Not long afterward outbreaks in Oregon and Mexico were discovered. At the rocky intertidal sites along the Oregon coast monitored by Oregon State University researchers for many years, ochre sea star populations declined by 85 to 90 % in a matter of months. Sea star wasting syndrome is affecting a variety of other sea star species on the Pacific Coast including: mottled stars (*Evasterias troschelii*), leather stars (*Dermasterias imbricate*), six-armed stars (*Leptasterias*), sunflower stars (*Pycnapodia helianthoides*), rainbow stars (*Orthasterias koehleri*), giant pink stars (*Pisaster brevispinus*), giant stars (*Pisaster giganteus*), sun stars (*Solaster*), vermillian stars (*Mediaster aequalis*), and bat stars (*Patria miniata*).

The cause or causes of sea star wasting syndrome, the reasons for the outbreak, and the ecological consequences are not fully understood. Research is underway at universities around the nation. A number of factors that may be involved such as warmer than normal water temperatures, salinity, pH, water pollution, and the role of pathogens like the bacteria, viruses and protezoa are being investigated as well as combinations of these factors. One pathogen, a densovirus, has been identified as a likely agent of infection, but evidence that this pathogen has been present along the Pacific coast for over 70 years suggests that other factors are involved in this widespread outbreak of sea star wasting syndrome (Hewson et al. 2014). There is evidence that warmer water temperatures may be a factor that increased disease rates and mortality in ochre stars in some areas (Eisenlord et al. 2016), but in Oregon that did not appear to be the case (Menge et al. 2016).

The ecological effects of population declines of the keystone predator, the ochre star, are also under investigation. Long term studies of intertidal species and habitat along the Oregon coast allowed Menge et al. (2016) to document the dramatic declines in both density and biomass of adult ochre stars caused by sea star wasting syndrome, measure the immediate decline in their predation rates on mussels from its long term average, observe an unprecedented increase in recruitment of young ochre stars and provide ecological perspective on these events. Continued research and monitoring will be the key to understanding why these outbreaks occurred, what the ecological consequences will be, and if sea star populations will recover.

Photo Credit: Gregory Krutzikowsky

ESTUARIES

Estuaries are characterized by tidally-influenced waters that have a surface connection to the sea. The connection may be permanently open, restricted, or intermittently closed. Oregon's estuaries are part of the Coast Range ecoregion and are a critical interface between the terrestrial environment of coastal watersheds and the nearshore marine environment. Estuaries are designated as a Strategy Habitat in the Oregon Conservation Strategy and the riverine portions are discussed there. The Nearshore Strategy focuses on species and habitats where saline marine waters influence the ecological communities.

The estuarine system extends from the mouth of the estuary, defined by an imaginary line connecting the two most seaward portions of land, upstream to the head of tide where the average difference in water level caused by tides is 0.2 feet (0.06 m). Estuarine tidal basins are generally narrow and elongated throughout their upper riverine regions, and may be broad and shallow in the middle and lower regions before making the connection to the sea. These basins are typically drained and filled by a primary tidal channel that is connected to numerous secondary and tertiary channels, inlets, sloughs, and tidal creeks.

Physical Environment

Within the CMECS framework, the Oregon estuarine aquatic system is defined by geomorphology of the tidal basins and by the salinity regime of the brackish waters. The estuarine system is composed of several subsystems, including: (1) tidal riverine coastal; (2) tidal riverine coastal –diked (3) tidal riverine open water; (4) coastal; (5) coastal – diked; and (6) open water. Although the riverine subsystems greatly influence the lower portions of the estuaries, the species and habitats in the nearshore ecoregion all occur in the coastal and open water subsystems where the average salinity during the summer dry season / low freshwater flow period is greater than 0.5 practical salinity units.

Oregon's estuaries exhibit a wide variety of CMECS geoform components such as bays, beaches, berms, boulder fields, channels, coves, deltas, islands, lagoons, levees, marsh platforms, mega-ripples, rubble fields, shoals, shoreline, sloughs, spits, stacks, tidal creeks, tidal flats, and tidepools. The estuaries also contain a diverse variety of geoforms with biogenic origin such as burrows, bioturbation areas, and shell beds. Anthropogenic origin geoforms are widely represented in the Oregon estuaries and include aquaculture structures, boat launches, breakwaters and jetties, bridges, bulkheads and seawalls, dikes and levees, docks and piers, dredged channels, dredge deposit and fill areas, harbors and marinas, intakes and outfalls, pilings, rip-rap, and wharves.

Mapping efforts of Oregon's estuaries utilizing CMECS components is underway and an online tool for viewing estuary maps is available at: http://www.coastalatlas.net/estuarymaps/. This is a work in progress and data for various CMECS components is not yet complete. It is designed to help with planning efforts and is administered by the Oregon Coastal Management Program. An example of a geoform components map of Yaquina Bay shows a number of its geoforms for which data are available (Figure 6.9).

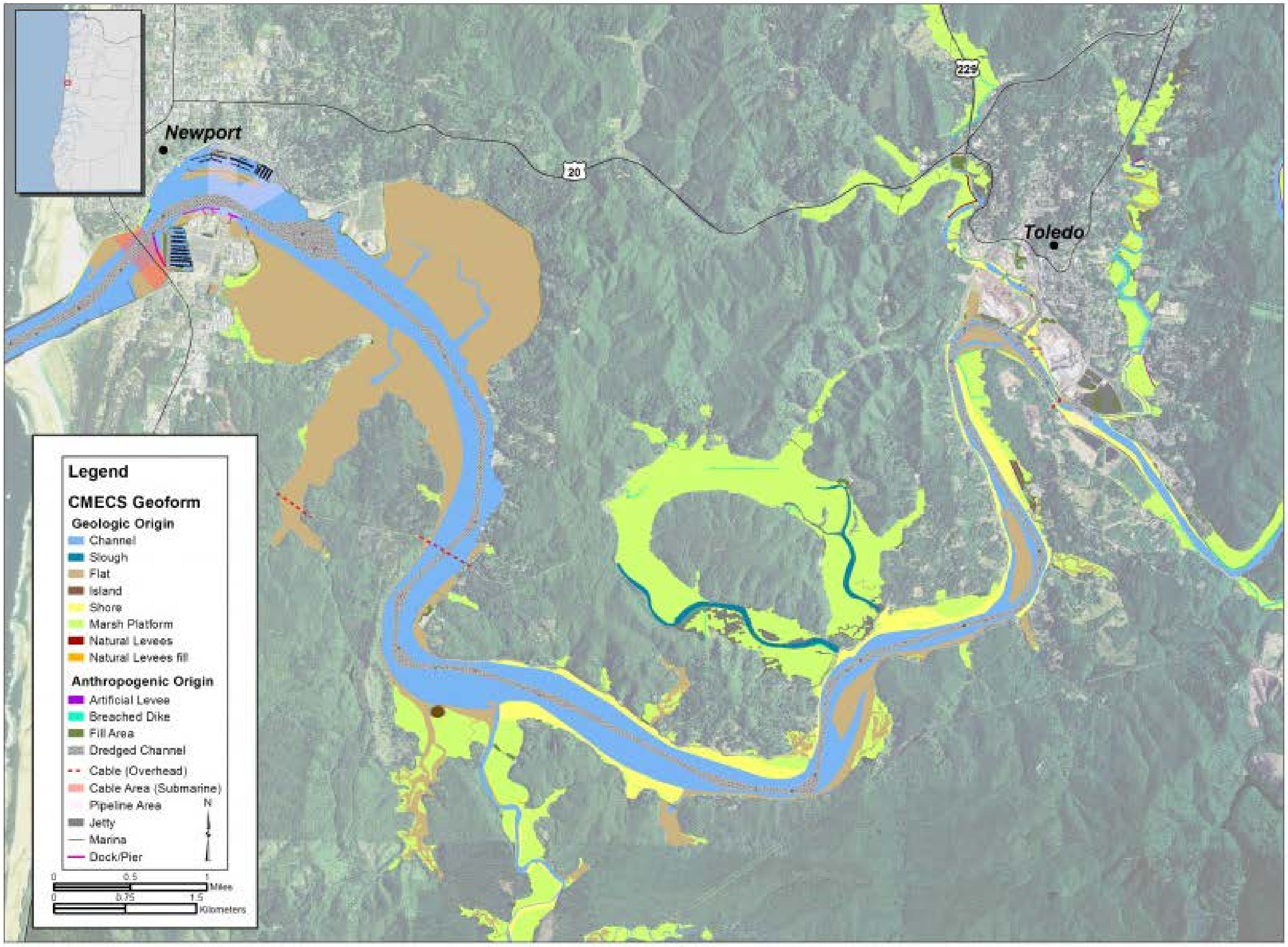


Figure 6.9. Map of Yaquina Bay depicting CMECS Geoform Components of geologic and anthropogenic origin.

Biological Characteristics

Oregon's estuaries are dynamic and productive components of the nearshore coastal ecosystem. They harbor a rich diversity of species, habitats and ecological communities. This highly complex, productive habitat is critical for many fish and wildlife species, including salmon, crabs and other shellfish, juvenile marine fish, marine mammals and birds. Primary production in estuary habitats is among the highest of any on earth, meaning that both the visible and microscopic plants produce a tremendous amount of carbon material (from photosynthesis) that supports the base of the food web. Tidal marshes are particularly productive and produce plant material that, when it dies seasonally, is broken down by microscopic bacteria to serve as food for many organisms which in turn are eaten by larger ones as material is distributed throughout the estuary with the tides. Estuaries and eelgrass beds are habitat types that have been designated as a Habitat Area of Particular Concern under NOAA Fisheries' Essential Fish Habitat regulations for salmon and groundfish species. Efforts to maintain and restore estuaries will benefit many wildlife and commercially important species.

Many Strategy, Watch List, and other commonly associated species utilize Oregon's estuaries during parts of their life history (Table 6.3, Appendix E and F). For some, such the blue mud shrimp and Olympia oyster, the adult and reproductive stage is entirely in estuaries. Longfin smelt also spawn in estuaries. Native eelgrass is an important habitat forming species in estuaries. Native eelgrass and the habitat it provides is utilized by several Nearshore Strategy Species, for example: Black brant, Dungeness crab, black rockfish, copper rockfish and kelp greenling. Eelgrass is also an important spawning substrate for Pacific herring, an important forage fish species. Complex ecological communities occur in the different regions of Oregon bays and estuaries. Many invertebrates such as gaper clams, butter clams, native littleneck clams, softshell clams, and cockles live in the soft sediments along with polychaete worms, amphipods and burrowing shrimp. Other species, like barnacles, mussels, oysters, tunicates, and hydroids live attached to hard surfaces. More mobile species such as fishes, sea stars, birds and marine mammals utilize a wider variety of habitats. Starry flounder, English sole, sand sole, staghorn sculpins, and sturgeon are benthic feeders that utilize subtidal habitat to locate their prey. Salmonid species that utilize and move through estuaries include Chinook, coho, and chum salmon, steelhead and coastal cutthroat trout. Pelagic fishes like eulachon, topsmelt, Pacific herring, longfin smelt, surf smelt, northern anchovy, and Pacific sand lance also utilize Oregon estuaries. Estuaries provide important wintering habitat for waterfowl and migration feeding area stopovers for or a wide variety of shorebirds. The tidal channels, sand flats, and mudflats are also used regularly by raccoons and river otters.

The CMECS biotic components are determined by the dominant biota, defined as those with the greatest percent coverage. Although planktonic maps and maps of fauna associated with bottom substrate are possible, most mapping work in Oregon estuaries has focused on vegetation cover. An example of a biotic component map for Yaquina Bay (Figure 6.10) shows available CMECS biotic information along with more specific work that focused on eelgrasses. Gathering data to improve mapping the biotic components of Oregon's estuaries is a work in progress that is anticipated to be valuable for planning, management, research and monitoring purposes.

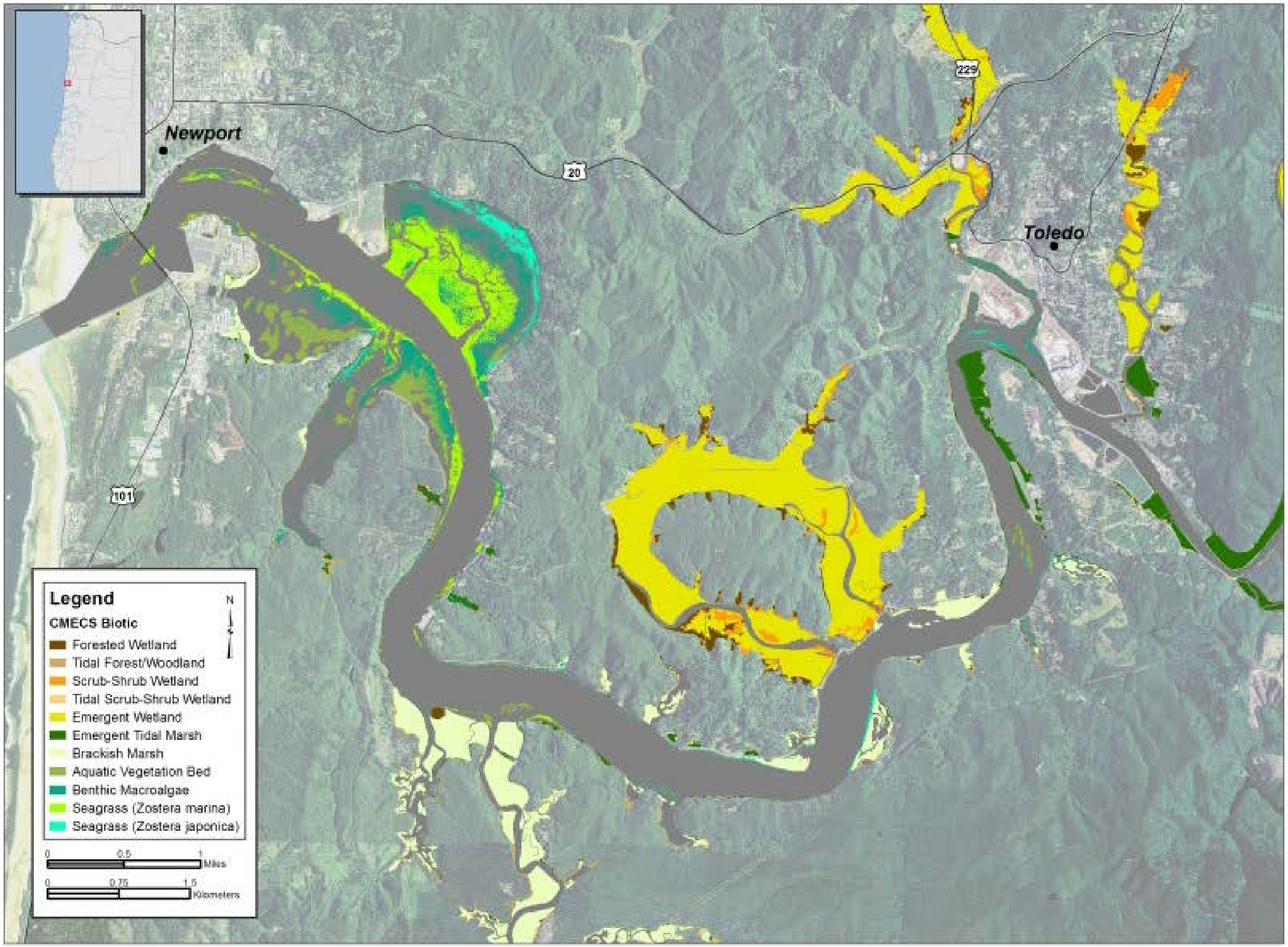


Figure 6.10. Map of Yaquina Bay with CMECS Biotic Components.

Human Use

Many estuaries have human communities on their shorelines and serve as ports and venues for recreational boating. Photo Credit: Gregory Krutzikowsky

Oregon has 22 major estuaries (Figure 6.11) and many other smaller estuaries along its coast. Many coastal cities developed around estuaries. People use estuaries for recreational and commercial harvest of fish and shellfish, navigation and shipping, ports for recreational and commercial vessels, shellfish aquaculture, hunting, sightseeing, bird watching, sailing, and other recreational and commercial activities. Portions of most of the larger estuaries have been altered through dredging, filling or diking. Many of the smaller estuaries remain in a more natural state. Twenty-two cities, seven counties, and thirteen port districts have planning or management responsibilities for Oregon's major estuaries and work with the Oregon Coastal Management Program and other state and federal agencies. Oregon utilizes a four level estuary classification system that defines the level of development permitted: natural; conservation; shallow draft development; and deep draft development. Natural estuaries are usually little developed for residential, commercial or industrial uses and include Sand Lake, Salmon River, Elk River and Pistol River. These estuaries do not have maintained jetties or channels. Conservation estuaries are within or adjacent to urban areas which have altered shorelines. These include the Necanicum River, Netarts Bay, Nestucca River, Siletz Bay, Alsea Bay and Winchuck River. Like natural estuaries maintained jetties and channels are absent. Shallow draft estuaries include Nehalem Bay, Tillamook Bay, Depoe Bay, Siuslaw River, Umpqua River, Coquille River, Rouge River, and Chetco River. These estuaries have maintained jetties and a main channel maintained by dredging to 22 feet (6.7 m) or less. Oregon's three deep draft estuaries, the Columbia River, Yaquina Bay and Coos Bay, are maintained by dredging to depths of 22 feet or deeper and have maintained jetties. This management classification system is designed to preserve the inherent diversity among Oregon's estuaries, and to guide the process of residential and industrial development in estuaries that have been altered and which can support further urbanization.

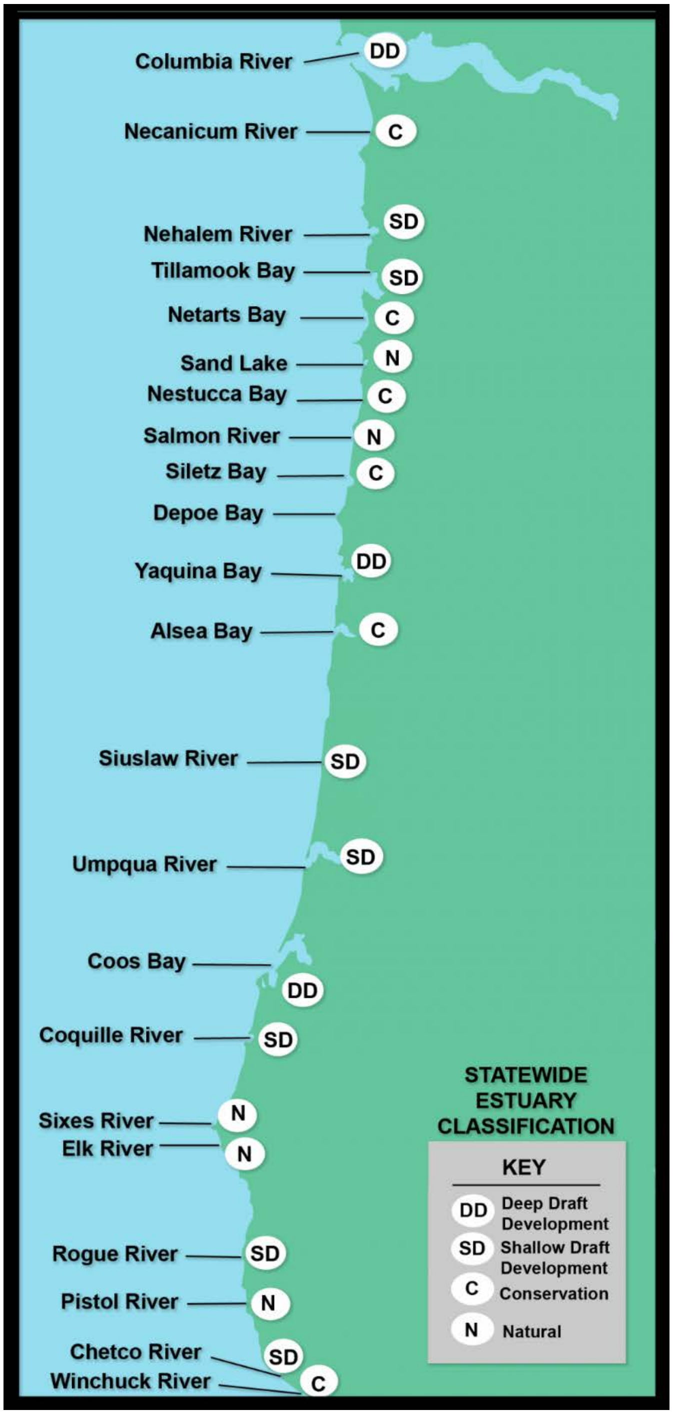
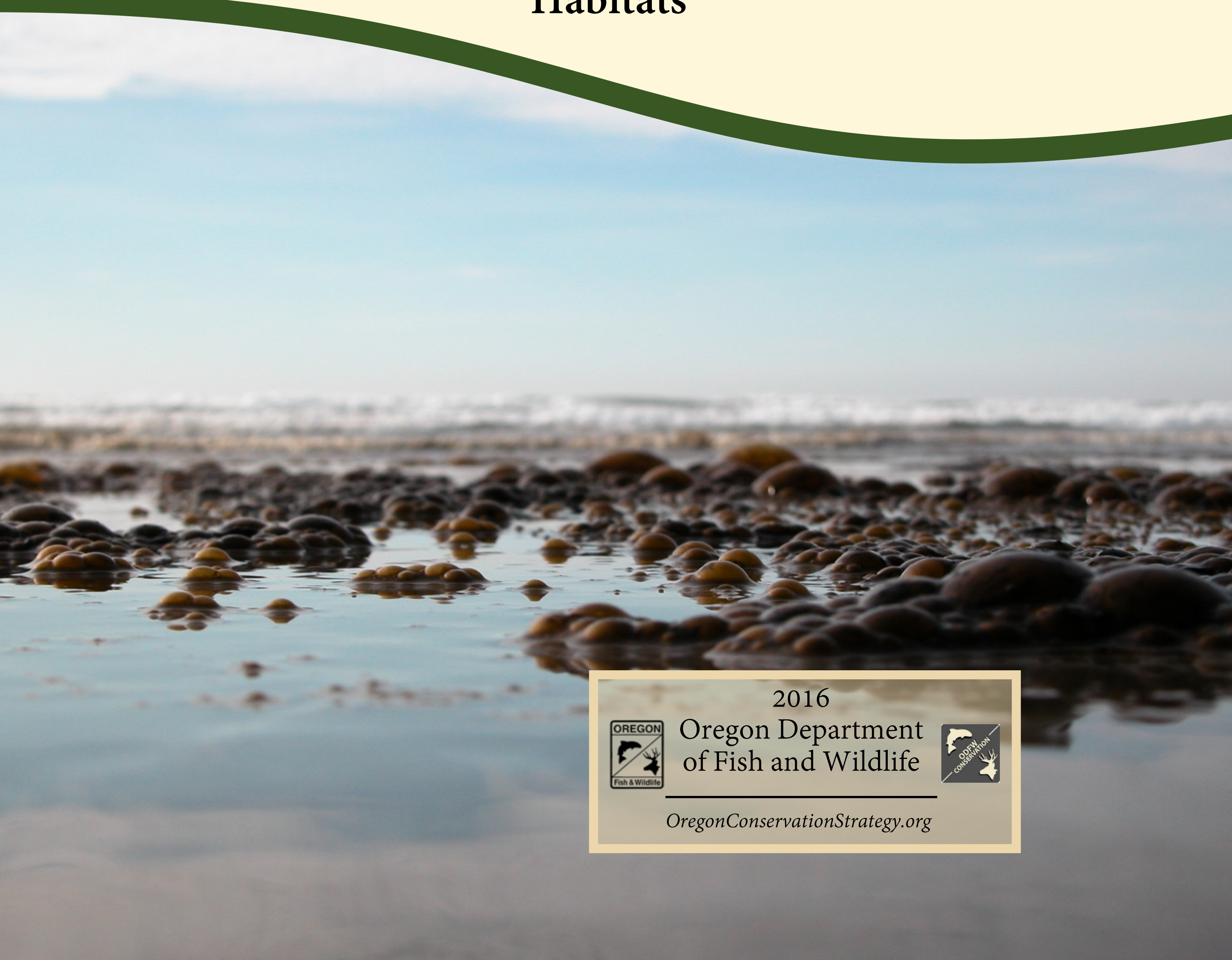


Figure 6.11. Oregon's 22 major estuaries are classified into four levels for development and planning purposes.


the OREGON NEARSHORE STRATEGY




Chapter 7: Factors Affecting Species and Habitats



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This PDF is a chapter of the Oregon Nearshore Strategy, the marine component of the official State Wildlife Action Plan for Oregon. The complete Oregon Conservation Strategy is available online at http://oregonconservationstrategy.org/. Since Conservation Strategy content will be updated periodically, please check the website to ensure that you are using the most current version of downloadable files.

Contact ODFW

For more information on the Oregon Nearshore Strategy or to provide comments, email ***Nearshore.Strategy@state.or.us*** *or write to Oregon Department of Fish and Wildlife, Marine Resources Program 2040 SE Marine Science Drive, Newport, OR 97365*

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Cover Photos

Banner: Copper Rockfish, © Janna Nichols; Red Sea Urchin, © Scott Groth; Black Oystercatcher, © Kelsey Adkisson; Steller Sea Lions, ODFW; Bull Kelp, © Janna Nichols; Wolf Eel, © Taylor Frierson

Feature image: Harmful algal bloom bubbles wash ashore, ODFW

Photo Credit: ODFW

FACTORS AFFECTING SPECIES AND HABITATS

As human populations and activities in and around Oregon nearshore waters increase, so too do the impacts on fish, wildlife and the habitats they utilize. The factors affecting species and their habitats are often intertwined, and anthropogenic impacts may be exacerbated by naturally occurring processes. This chapter identifies factors that could adversely affect key nearshore habitats and species, and possibly require management action. Cumulative impacts should be considered in addition to individual effects. The list of the factors affecting Strategy Species and their habitats initially developed for the original Nearshore Strategy has been revised here in light of new information from scientific literature and input from researchers, subject matter experts, and the public.

Over the last decade, new research has provided a better understanding of factors that may impact Oregon's nearshore environment. For example, ongoing research on the impacts of global climate change and ocean acidification to organisms and habitats in Oregon's nearshore waters is beginning to describe the far-reaching effects of these stressors (Figure 7.1). Impacts of the increase of atmospheric carbon dioxide and other greenhouse gasses on the marine environment include, but are not limited to, increasing ocean temperatures, sea level rise, changing circulation and weather patterns, and changes in ocean chemistry all of which may affect species and their habitats (Bindoff et al. 2007, Osgood 2008, Brierley and Kingsford 2009, Hixon et al. 2010, Mote et al. 2010, Hoegh-Guldberg and Bruno 2010, Rhein et al. 2013). There are new analyses that provide insight into the vulnerability of many species to overfishing (Essington et al. 2015, PFMC 2014), and to its effects on ecosystems. There is more information available about sustainable levels of harvest and fishing practices (Dick and McCall 2010, Essington et al. 2015). Additionally, new resource issues have arisen in the last ten years that could potentially affect species, habitats and biological communities. For example, the widespread emergence of sea star wasting syndrome along the west coast and the work on offshore renewable energy development have raised conservation concerns in Oregon since 2006. Table 7.1 and text briefly summarize the natural and anthropogenic factors that impact Strategy Species and their habitats, along with the potential sources of those factors.

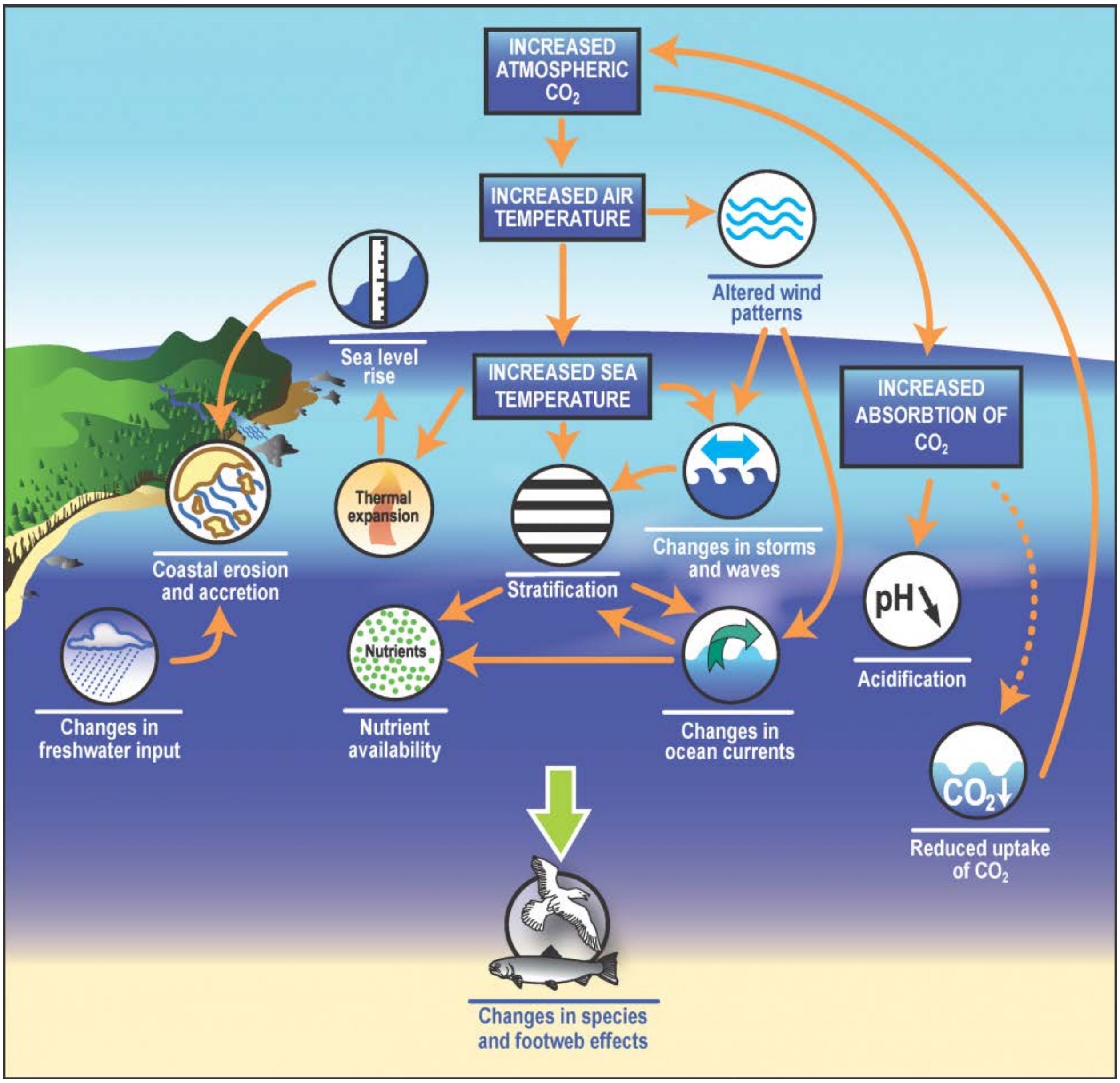

Figure 7.1. Diagram depicting the effects of increased atmospheric carbon dioxide on global oceans including Oregon's coastal and nearshore environments and the species living there.

Table 7.1. Factors Affecting Nearshore Strategy Species and Habitats

Natural Factors	**Potential Sources**
Alteration of oceanographic regimes	• El Niño • La Niña • Droughts (alters freshwater inflow) • Pacific Decadal Oscillation
Disease and biotoxins	• Harmful algal blooms • Sea star wasting syndrome
Loss / alteration of habitat	• Earthquakes / tsunamis / volcanic eruptions • Large storms • Droughts (alters freshwater inflow)
Water quality degradation	• Hypoxia events • Naturally occurring toxic compounds such as arsenic
Anthropogenic Factors	**Potential Sources**
Invasive species (including disease introduction)	• Aquaculture • Aquarium pet trade • Research facilities and public aquariums • Some fishing operations (e.g., herring roe which may entail importing kelp on which the roe can be deposited) • Transport of live animals and plants • Vessel operations / transportation / navigation • Ballast water
Loss / alteration of habitat and oceanographic regimes	• Agriculture and forestry practices • Altered freshwater inflow (created by dams upstream, etc.) • Artificial reefs • Aquaculture • Beach grooming • ***Climate change (global warming)*** o ***Increased air and water temperature*** o ***Changes in upwelling and ocean circulation patterns*** o ***Sea level rise*** o ***Altered river inputs*** o ***Larger storm events (coastal erosion)*** o ***Ocean acidification and hypoxia*** o ***Ocean stratification*** o ***Erosion*** • Beach nourishment

Table 7.1. Factors Affecting Nearshore Strategy Species and Habitats

	• Coastal and estuary development • Dredging and dredged material disposal • Diking • Fishing methods and gear (including derelict gear) • Fish processing waste (increased turbidity and surface plumes) • Harvest of habitat-forming organisms (e.g., kelp, mussels) • In water structures (e.g., jetties, seawalls) • Marine mining • Oil / gas exploration / development / production • Offshore renewable energy development • Overwater structures (e.g., mooring buoys, floating docks) • Point source discharge • Removal, resulting in loss, of keystone species • Submarine cable and pipeline installation • Trampling (on rocky intertidal) • Vessel operations / transportation / navigation • Water intake structures / discharge plumes • Wetland and aquatic fill
Noise pollution / noise disturbance	• Dredging • Oil / gas exploration / development / production • Offshore renewable energy development • Seismic studies • Submarine cable and pipeline installation • Vessel operations / transportation / navigation • Pile driving/sea wall construction
Oil spills	• Non-point source runoff from coastal areas (roads, parking lots, driveways, etc.) • Oil / gas exploration / development / production • Other spill sources (highways, trains) • Vessel operations / transportation / navigation • Offshore renewable energy development
Overexploitation	• Bycatch and incidental catch associated with commercial and recreational fishing, and scientific collection • Collection for scientific, educational, and public display • Commercial fishing / harvest • Poaching / illegal harvest • Recreational fishing / harvest

Table 7.1. Factors Affecting Nearshore Strategy Species and Habitats

Water quality degradation	*Non-point source pollution:*
	
	• Agricultural / nursery runoff
	• Changes in river temperature (land use practices)
	• ***Climate Change (global warming)***
	    o ***Changes in temperature (global warming)***
	    o ***Hypoxia events***
	    o ***Ocean acidification***
	• Fish processing waste
	• Land development
	    o Road building and maintenance
	    o Run off from faulty septic tanks
	    o Storm water runoff
	    o Urban / suburban development
	• Pesticides / fertilizers
	• Silviculture / timber harvest
	
	Point source pollution:
	
	• Aquaculture
	• Dredged material disposal
	• Dredging
	• Fish processing waste
	• Marine mining
	• Ocean dumping
	• Offshore renewable energy development
	• Oil / gas exploration / development / production
	• Sewage discharge
	• Submarine cable and pipeline installation
	• Vessel operations / transportation / navigation

Wildlife disturbance	• Aircraft • Boating (recreational and commercial) • Hiking / human presence / trampling • Light pollution • Noise pollution • Oil / gas exploration / development / production • Offshore renewable energy development Scientific research • Vehicles (driven on the beach) • Whale watching and other wildlife viewing

CLIMATE CHANGE AND OCEAN ACIDIFICATION

The Intergovernmental Panel on Climate Change found that the Earth's climate is warming as a result of increase in atmospheric carbon dioxide concentrations (IPPC 2007). Broader changes in the earth's climate will certainly influence the dynamics of the Oregon nearshore ocean. Additionally, the uptake of carbon dioxide changes the chemical equilibrium of seawater, resulting in ocean acidification (IPCC 2007). Impacts of climate change on the marine environment include increased ocean temperatures, sea level rise, changing oceanic circulation and weather patterns, ocean acidification and other changes to ocean chemistry. From 2013 to 2015, the West Coast Ocean Acidification and Hypoxia Science Panel, a group of scientists from California, Oregon, Washington, and British Columbia, convened to identify strategic data gaps, and develop research and management recommendations for state and federal decision-makers. During the last 10 years, ocean acidification has become a priority for decision-makers regionally and nationally, including commitments and policy attention by the Pacific Coast Collaborative, the West Coast Governor's Alliance on Ocean Health, the National Oceanographic and Atmospheric Administration, among others.

Due to the complexity of the ocean and the relative scarcity of studies at varying scales, the specific impacts of climate change and ocean acidification to Oregon's nearshore environment are not entirely clear but there are indications (Mote et al. 2010, Hixon et al. 2010). In order to provide insight into potential impacts of climate change and ocean acidification, as well as guide future management efforts, ODFW developed a policy analysis of climate change factors that are known to or are anticipated to impact nearshore resources, for the 2012 Strategy update. This analysis is laid out in a technical supplement designed for use by resource managers and decision makers, as well as in a series of fact sheets highlighting impacts in Nearshore Strategy habitats (ODFW 2012a, 2012b, 2012c, 2012d). The technical supplement and fact sheets are included as appendices in this updated edition of the Nearshore Strategy (see appendices A through D).

WATER QUALITY DEGRADATION

Poor water quality can stem from both natural and anthropogenic sources, and has far-reaching and direct impacts on nearshore species and their habitats. Natural sources include harmful algal blooms that produce toxins and sediments from storm runoff that increase turbidity. Anthropogenic point source and non-point source pollution can substantially alter marine and estuarine water quality. Urban runoff and storm water discharge are the leading sources of pollution in coastal waters in the United States, according to the Environmental Protection Agency's 2012 Coastal Condition Report (EPA 2012). These discharges can include pesticides, heavy metals, sediments, trash, nutrients, bacteria, petroleum products, and sewage overflow. Beach closures, due to health risks from pollution discharges, are a concern in Oregon with increasing coastal development and population growth. Atmospheric carbon dioxide absorbed by ocean waters has resulted in more acidic ocean waters in Oregon (Feely et al. 2008). All of these factors may differentially impact nearshore species and their habitats, and may have more severe cumulative effects when they occur together.

ALTERATION OR LOSS OF HABITAT

All of the habitats found in nearshore environments are vulnerable to habitat alteration or loss, and resulting impacts on species that use these areas during spawning, rearing, breeding, feeding, shelter, and other life stages. Factors that can degrade habitats result from both natural and anthropogenic causes. Examples include coastal development and associated construction, shoreline armoring, and alteration of hydrologic regimes; dredging and dredged material disposal; aquaculture; and global climate change. Effects can be direct or indirect, of varying intensity and duration, and multiple factors may interact to produce significant cumulative impacts.

Surf smelt and Pacific sand lance offer an example of species affected by alteration of sandy intertidal habitats. These forage fish species spawn on beaches in the intertidal zone. Anthropogenic beach modifications reduce the number of offspring produced by surf smelt and also may affect Pacific sand lance spawning and winter rearing habitat (Rice 2006, Krueger et al. 2010). Estuarine habitats have been altered or lost due to human development activities, such as dredging, filling, diking, hydrologic modifications, and urbanization. Salt marshes and other tidal wetland types have been diked, drained, and converted to pasture, resulting in substantial habitat alteration or loss. Industrial and residential development, new pilings, docks, or bridge structures, and aquaculture practices that reduce eelgrass beds and disturb winter waterfowl are also associated with habitat alteration or loss. Estuarine development closer to the ocean can impact habitats, as well. For example, building and maintaining jetties, piers, breakwaters, marinas and navigation channels including disposal of dredge materials can alter the habitat and impact Oregon Nearshore Strategy Species.

Derelict fishing gear includes nets, lines, pots, or other commercial or recreational fishing debris that is abandoned or lost and left unattended in the marine environment. Derelict fishing gear may disturb rocky reef and soft-bottom subtidal habitats. In addition, derelict gear poses a hazard in the neritic zone as well, where it may continue to catch and wound or kill fish, shellfish, birds, and marine mammals that become entangled. An estimated 10,000 crab pots are lost and become derelict annually (ODFW 2014). Collaborative projects between ODFW and the fishing industry to remove derelict gear in 2009 and 2010 recovered more than 3,100 crab pots and associated buoy lines off the Oregon coast with the majority of them still in usable condition. Marine organisms recovered in these pots were returned to the sea including over 6,000 legal sized Dungeness crab. These efforts have continued and there is now a permit program for vessels to voluntarily collect derelict crab pots each year once the crabbing season is over. In 2014, almost 650 pots were recovered. Loss of other gear types is less well documented.

As the earth warms with global climate change the main reservoir for heat energy is the ocean. Oregon's coastal surface waters (< ~650 feet or 200 meters) have warmed an average of 0.5º F (0.3º C) per decade over this time period and are predicted to increase by approximately an additional 2.2 º F (1.2º C) by the mid-21st century (Mote et al. 2010). Warming ocean temperatures appear to be causing a northward shift in the distribution of fish and other mobile animals, likely associated with species-specific temperature requirements (McKinnell et al. 2010, Perry et al. 2005). Poleward movement of marine fishes may actually increase species richness at temperate latitudes. Species exhibiting these shifts or range expansions tend to be smaller, which will change the energy flow through the food web and alter the dynamics of the ecosystem. Poleward population shifts may also be linked to temperature-associated food source availability. Some fish species exhibit enhanced growth and survival when cool water zooplankton is available because this food base provides greater biomass and higher energy content.

ALTERATION OF OCEANOGRAPHIC REGIMES

Nearshore ecosystems depend on dynamic oceanographic processes such as currents, upwelling, freshwater input and sediment transport. Alteration of oceanographic regimes can stem from both anthropogenic stressors (e.g., climate change or altered flow regimes from dams), or from natural factors (e.g., El Niño and the Pacific Decadal Oscillation).

Coastal upwelling, driven by spring and summer northerly winds, provides the nutrients that make Oregon's ocean environment so productive. Part of the reason Oregon's nearshore ecosystem is productive is the particular pattern of upwelling that starts in early spring and then occurs intermittently through the spring and summer (Menge and Menge 2013). There is growing evidence that, over time, upwelling will increase in intensity, be less intermittent, and start later in the year due primarily to changes in wind patterns resulting from global climate change (Bakun 1990, Barth et al. 2007, Iles et al. 2012, Sydeman et al. 2014). These shifts in the upwelling pattern will change the ecosystem off of Oregon, but the exact nature and severity of the changes is not yet known. Water temperature is a key factor in determining the strength of mixing in the nearshore, with higher temperatures inhibiting mixing because stratified layers of warm surface waters mix less easily with colder, deeper water. As the climate warms, the upper ocean will almost certainly be more stratified on average. The thermocline (the relatively distinct layer of steep temperature gradient) is 32 – 65 feet (10 – 20 meters) deeper off Oregon in the early 21st century, compared with the middle of the 20th century (Huyer et al. 2007). Stronger stratification will make ocean mixing due to wind patterns less effective at bringing nutrients to the surface, thereby reducing primary productivity (Hoegh-Guldberg and Bruno 2010).

The Oregon coast has a complex shoreline consisting of beaches, estuaries, and rocky shores, along with manmade structures such as jetties. Jetties, breakwaters, and other structures built out into the water from shore can alter the depth and shape of nearby sand bottoms and can alter localized oceanographic characteristics such as patterns of currents and sediment transport. In Oregon, jetties exceed 19.5 miles in total length, with about nine miles of structure extending out into the ocean beyond the high tide line (ODFW 1994). Shoreline stabilization structures, such as riprap and seawalls, have been constructed in many developed areas along the Oregon coast to protect coastal property from erosion due to wave action. These structures can block or alter the natural littoral drift of sand along the coast and can deprive some beaches of sand, while in other areas increase the deposition of sand (Brown and McLachlan 1990).

Alteration of the hydrologic regime in upper freshwater systems can have downstream effects on estuarine and nearshore environments. Dams located on rivers may serve as sources of hydropower, act as reservoirs for water storage, or be used for flood control. Dams can change the amount and timing of freshwater influx into estuaries and the nearshore ocean. This may result in an alteration of river plume fronts within the marine environment, including changes in the direction of flow of the river plume, availability of nutrients and sediment being brought into the marine system, and changes in water chemistry composition from suppressed mixing of fresh and saltwater. These alterations can in turn affect the species that are dependent on river plume microhabitats, and alter species composition within the area.

Hypoxic (low oxygen) events have occurred frequently off the central Oregon coast in the past decade. In 2002, a particularly strong hypoxic event resulted in kills of crab and fishes in the nearshore environment. Retrospective analyses suggest that these dense, cold, low-oxygen waters are transported from the Gulf of Alaska southward along the shelf break, where they can then be drawn up onto the continental shelf by the upwelling conditions that characterize the Oregon coast during the summer. During 2002, this hypoxic water transport coincided with a subsequent period of calmer winds that led to stratification of the coastal waters, limited water mixing and exacerbated the hypoxic event leading to the observed fish kills (Grantham et al., 2004). Hypoxic events in coastal waters were also been observed in 2004 and 2005. In 2006, anoxic conditions were first documented in Oregon's nearshore waters and after examining five decades of available records, scientists concluded that these types of hypoxic and anoxic conditions on the inner continental shelf off Oregon were not evident before 2000 and may be a result of climate change and related changing ocean chemistry (Chan et al., 2008).

OVEREXPLOITATION

State and federal management of Oregon's fisheries adheres to strict mandates for sustainability, using the best available information and employing a precautionary approach when data are sparse or uncertainty is high. Because of this, Oregon is recognized as a leader in fishery monitoring and management. Despite many successes, unsustainable overexploitation via excessive harvest, bycatch or collection continues to be a concern for some nearshore species and habitats. This includes harvest of nearshore resources for human consumption or use, incidental bycatch in fisheries, and illegal poaching along with collection for scientific research, aquarium display or educational purposes. Overexploitation affects targeted or bycatch species populations directly, and it indirectly affects nearshore species through alteration of food webs and community dynamics.

An example is the removal of large predators from neritic waters. Large predators are often key in determining the depth distribution and aggregation of prey. Their removal can result in changes in the foraging behaviors and success of a whole suite of other predators in the system (Dayton et al. 2002). Furthermore, many nearshore rocky reef species are vulnerable to overexploitation due to the cumulative effects of low productivity and infrequent recruitment, compounded by incidental bycatch in non-targeted fisheries (e.g., yelloweye rockfish).

NOISE POLLUTION

Noise caused by vessel operations, sonar, offshore energy development or production, dredging, construction, and seismic studies may disturb marine mammal and fish populations in nearshore and estuarine habitats. Acoustic disturbances may stress, displace, or even damage individuals in the affected area. Marine mammals rely heavily on sound to communicate and navigate the oceans. Numerous studies have demonstrated behavioral changes of marine mammals responding to exposure of anthropogenic activities (Nowacek et al. 2007). These responses have ranged from subtle short-term behavioral changes, to longer-term population level impacts (Richardson et al. 1995, Lusseau 2003, Consantine et al. 2004). Cetaceans are particularly vulnerable to noise disturbance, particularly harbor porpoise (Tougaard et al. 2012), along with gray whales (Malme et al. 1983).

Most fish species have hearing capability, but specific studies on hearing have only been conducted on a very small fraction of species, and there are very few studies on the effects of anthropogenic noise on fish. Thomsen, et al. (2006), Hastings and Popper (2005), Popper and Hastings (2009), and Popper et al. (2014) reviewed peer-review and grey literature on the effects of noise on fish, and Popper, et al. (2014) have proposed sound exposure guidelines for fish. Noise can affect fish behavior, communication and, in extreme cases, cause direct tissue damage resulting in immediate or delayed mortality (Thomsen, et al.

2006; Hastings and Popper 2005; Popper and Hastings 2009; Popper et al. 2014). Behavioral avoidance of noise can alter fish migration and schooling which can impact foraging, predator avoidance, or reproductive success.

OIL SPILLS

Oil spills can have devastating effects on nearshore fish, wildlife and habitats. Sources of oil spills may include tanker accidents, unintended spillage from the cleaning of oil tanks at sea, and runoff from upland sources such as roads. The water-soluble components of various types of crude oils and refined petroleum products contain compounds that are toxic to many types of marine plants and animals. Feathers of marine birds exposed to oil lose their water repellant qualities and the birds may ingest oil which poisons them. Marine birds that feed intertidally in sandy beach habitat or in the surf-zone are especially vulnerable to oiling, which can lead to death (Brown and McLachlan 1990; Clark 2001). In addition, large amounts of stranded oil may smother and kill marine organisms.

All of the habitats found in Oregon's waters are vulnerable to oil spills. The type of oil spilled, how weathered the oil or petroleum product is when it reaches the shore, characteristics of the substrate, and level of exposure to wave energy are all factors that contribute to the degree of damage to shoreline habitats and associated organisms.

Offshore, water-soluble fractions of crude oil and refined petroleum products can cause immediate toxic effects on all life stages of marine organisms near the water's surface. Plankton occurring in the top layers of the water column are assumed to be particularly at risk since they would be exposed to the highest concentrations of the water soluble compounds leaching out of the spilled oil. Alterations in phytoplankton production caused by an oil spill can result in indirect effects on microfauna and macrofauna that are dependent on the quantity and quality of phytoplankton primary productivity. Alterations to phytoplankton productivity appear to only last for short periods of time and have greater effects on oceanic than coastal species (Brown and McLachlan 1990; Clark 2001, González et al. 2009).

Kelp beds are vulnerable to exposure to crude oil and refined petroleum products, because the floating oil is more likely to have an impact on plants and animals on the water's surface than those residing deeper in the water column. Studies in Washington State found that weathered diesel fuel was the most toxic to bull kelp (*Nereocystis luetkeana*). The study also found unweathered intermediate fuel oil, unweathered diesel fuel, weathered intermediate fuel oil, unweathered crude oil, and weathered crude oil have decreasing amounts of toxicity, respectively (O'Clair and Lindstrom 2000).

INVASIVE SPECIES

Globalization has increased the rate at which non-native species are introduced to new habitats where they can be invasive. Non-native and invasive species are a concern for Oregon's estuaries and nearshore waters. Non-native species arrive in a variety of ways including aquaria releases, aquaculture escapes, intentional introduction, hitch hiking on boats or recreational equipment, seafood packing and disposal, and perhaps most importantly, ballast water. Ship ballast water is known to carry viable organisms from one body of water to another and it is estimated that over two-thirds of recent species introductions in marine and coastal areas are likely due to this ship-borne vector. International shipping (including its ballast water component), followed by aquaculture, have been identified as the two greatest sources of introductions of marine and estuarine invasive species worldwide (Molnar et al. 2008).

Non-native species can adversely affect native species by various means including competing for food and space, spreading diseases new to the area, producing toxins. Detecting the first arriving individuals of non-native species may be the “key” to managing invasions because they can be the most readily eradicated or contained. This highlights the importance of prevention and monitoring programs. Invasions are more complicated to respond to over time as populations expand.

One well-documented invasion in Oregon is the Griffen’s isopod (*Orthione griffenis*), native to Asia and likely introduced via ship ballast water during the 1980’s. This parasitic isopod can draw enough blood from the blue mud shrimp (*Upogebia pugettensis*) to prevent it from reproducing. The introduction of this parasite has been linked to substantial population declines of blue mud shrimp in many Pacific Northwest estuaries (Griffen 2009, Dumbauld et al. 2011, Chapman et al. 2012).

Another well-documented invasion is the European green crab (*Carcinus maenas*), native to the northeast Atlantic and Baltic Sea coasts, which was first seen in San Francisco Bay in 1989. Pelagic *Carcinus* larvae can survive for up to 80 days in coastal waters and then return to adjacent bays and estuaries to settle. The expansion of *Carcinus* from San Francisco Bay likely occurred on coastal currents south to Monterey Bay and northward to Humboldt Bay, California. The spread to Coos Bay, and Yaquina Bay, Oregon, Willapa Bay and Grays Harbor, Washington, and the west coast of Vancouver Island occurred following the strong El Niño of 1997/1998. The expansion of *Carcinus* up the east coast of the U.S. to Maine occurred over an approximately 120 year period, culminating in the collapse of the soft-shell clam industry in Maine. *Carcinus* could possibly threaten Dungeness crab, oyster and clam fisheries and aquaculture operations in the Pacific Northwest.

Larvae of the European green crab and the Asian Griffen’s isopod have relatively long pelagic phases that survive only in the ocean. The recently introduced purple varnish clam *Nuttallia obscurata* has spread down the coast via planktonic dispersal. Coastal ocean conditions are thus critical determinants of biological invasions of estuaries, but the processes and possible management strategies for limiting ocean dispersal of invasive species are unknown.

Estuaries are especially susceptible to adverse impacts from invasive plants and animals. Invasive plants can alter water circulation and sediment patterns. For example, common cordgrass , which has been documented in two Oregon estuaries and is well-established in Washington and California, reduces mud flat habitats, disrupts nutrient flows, displaces native plants and animals, and traps sediments, which changes the beach profile and water circulation. Three other cordgrass species have invaded the Pacific coast and could potentially pose a threat to estuaries.

During the 2012 Nearshore Strategy updates, ODFW staff first worked with experts to identify non-native species and potentially invasive species known to occur in the nearshore ocean and estuaries of Oregon, California, and Washington. This information is updated in the 2015 revision. More than 200 non-native species have been identified in Oregon marine and estuarine waters, of which 14 were classified as invasive (see Appendix G).

WILDLIFE DISTURBANCE

Rocky shores, sandy beaches, estuarine areas and adjacent terrestrial habitats are important to marine birds, shorebirds, pinnipeds, and other wildlife species as foraging areas, nesting places, and haulout sites. Human presence can disturb wildlife using these important areas. Adverse effects stemming from wildlife disturbances may include short-term or permanent abandonment of eggs or young by adults, changes in foraging or other behaviors, and greater susceptibility to predators. Human presence resulting in wildlife disturbances may be from activities such as walking/hiking, wildlife viewing, boating (motorized and man-powered), aircraft flying in the vicinity, educational excursions, or scientific research.

HARMFUL ALGAL BLOOMS

Harmful algal blooms in marine waters can kill fish, marine mammals and birds, and threaten human health when resulting toxins are concentrated in shellfish and other species consumed as food. Harmful algal blooms have been increasing worldwide (Gilbert et al. 2005) and this increased frequency and intensity has been linked to climate change. Two primary forms of toxic effects are linked to harmful algal blooms in Oregon marine waters: paralytic shellfish poisoning and domoic acid poisoning (Lewitus et al. 2012). Both toxins can affect marine birds and mammals as well as humans. Paralytic shellfish poisoning has been linked to a suite of toxins produced by blooms of phytoplankton diatoms belonging to the genus *Alexandrium*. Several species of diatoms in the genus *Pseudo-nitzschia* produce domoic acid, which causes amnesiac shellfish poisoning in humans. These diatoms and the toxins they produce are concentrated by organisms that feed on them directly. Numerous species including razor clams, mussels, Pacific littleneck clams, geoduck and manila clams, Pacific oysters, Dungeness and rock crabs, Pacific sardines, Pacific anchovies, and market squid are reported to be bioaccumulators of toxins. In addition, thousands of marine birds were killed off Oregon and Washington in 2009 by a temporary bloom of a dinoflagellate which produces a surfactant-like foam that destroys the water resistant coating of their feathers.

DISEASE

In 2013, an outbreak of Sea-Star Wasting Syndrome was discovered along the west coast, which led to rapid degeneration, mortality and disappearance of many sea stars in Oregon's nearshore waters. Similar outbreaks have occurred intermittently during the last four decades, although never before at the magnitude of the most recent outbreak. The ochre star (*Pisaster ochraceus*) and the sunflower star (*Pycnopodia helianthoides*), are two of the many species susceptible to Sea-Star Wasting Syndrome. Because both of these species are keystone predators, there are likely to be changes to the lower trophic levels, although the degree is still unknown. Currently, the cause of the disease is unclear, but there appears to be a link to a Densovirus (Hewson et al. 2014). Further research and monitoring is needed to better understand the causes and potential effects.

More information on diseases that are of management concern to nearshore species, including those affecting marine mammals, birds, fish and invertebrates is presented in the Oregon Conservation Strategy along with diseases affecting terrestrial and freshwater species.

SENSITIVITY TO ADVERSE EFFECTS FROM NATURAL AND ANTHROPOGENIC FACTORS

The extent and severity of adverse effects will depend on specific events, environmental conditions, species presence, co-occurring factors, etc. Some of the factors described in this section are small-scale, localized, and/or short-term, with potential adverse impacts limited in geographic and temporal scope. Others may have much more widespread effects. Table 7.2 presents the most likely sensitivities of each Strategy Species to the major categories of anthropogenic and natural factors.

Table 7.2. Sensitivity matrix for Strategy Species and Factors

	Sensitivity To									
	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Big skate *Raja binoculata*			x	x			x			
Black brant *Branta bernicla nigricans*		x			x		x			
Black oystercatcher *Haematopus bachmani*		x			x	x	x			
Black rockfish *Sebastes melanops*			x							
Blue mud shrimp *Upogebia pugettensis*		x				x				
Blue rockfish *Sebastes mystinus*			x							
Brown rockfish *Sebastes auriculatus*			x							

Table 7.2. Sensitivity matrix for Strategy Species and Factors

	Sensitivity To									
	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Bull kelp *Nereocystis luetkeana*	x	x	x		x				x	
Cabezon *Scorpaenichthys marmoratus*			x							
California brown pelican *Pelecanus occidentalis* californicus		x	x		x		x		x	
California mussel *Mytilus californianus*	x	x			x		x	x	x	
Canary rockfish *Sebastes pinniger*			x							
Caspian tern *Hydroprogne caspia*		x					x			
China rockfish *Sebastes nebulosus*			x							
Chinook salmon *Oncorhynchus tshawytscha*	x	x	x						x	
Chum salmon *Oncorhynchus keta*	x	x	x						x	

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Sensitivity To

	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Coastal cutthroat trout *Oncorhynchus clarki clarki*	x	x	x						x	
Coho salmon *Oncorhynchus kisutch*	x	x	x						x	
Copper rockfish *Sebastes caurinus*			x							
Deacon rockfish *Sebastes diaconus*			x							
Dungeness crab *Cancer magister*	x					x			x	
Eulachon *Thaleichthys pacificus*		x	x						x	
Flat abalone *Haliotis walallensis*	x	x	x		x	x		x	x	
Fork-tailed storm petrel *Oceanodroma furcata*		x			x	x	x			
Grass rockfish *Sebastes rastrelliger*			x							
Gray whale *Eschrichtius robustus*		x	x	x			x			

Table 7.2. Sensitivity matrix for Strategy Species and Factors

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	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Green sturgeon *Acipenser medirostris*		x	x			x				
Harbor porpoise *Phocoena phocoena*			x	x			x			
Kelp greenling *Hexagrammos decagrammus*			x							
Lingcod *Ophiodon elongatus*			x							
Leach's storm petrel *Oceanodroma leucorhoa*		x			x	x	x			
Longfin smelt *Spirinchus thaleicthys*		x					x			
Marbled murrelet *Brachyramphus marmoratus*		x		x					x	
Native eelgrass *Zostera marina*	x	x							x	
Native littleneck clam *Leukoma staminea*		x	x			x				
Northern anchovy *Engraulis mordax*		x				x			x	

Table 7.2. Sensitivity matrix for Strategy Species and Factors

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Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Northern elephant seal *Mirounga angustirostris*			x				x			
Ochre sea star *Pisaster ochraceus*		x			x		x			x
Olympia oyster *Ostrea lurida*	x	x	x					x		
Pacific giant octopus *Enteroctopus dofleini*			x							
Pacific harbor seal *Phoca vitulina*							x			
Pacific herring *Clupea pallasii*		x				x	x			
Pacific lamprey *Entosphenus tridentatus*	x	x								
Pacific sand lance *Ammodytes hexapterus*		x							x	
Pile perch *Rhacochilus vacca*			x							
Purple sea urchin *Strongylocentrotus purpuratus*		x	x		x		x		x	

Table 7.2. Sensitivity matrix for Strategy Species and Factors

	Sensitivity To									
	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Quillback rockfish *Sebastes maliger*			x							
Razor clam *Siliqua patula*	x		x			x		x	x	x
Red abalone *Haliotis rufescens*	x	x	x		x	x		x	x	
Red sea urchin *Mesocentrotus franciscanus*		x	x		x				x	
Redtail surfperch *Amphistichus rhodoterus*			x			x				
Rock greenling *Hexagrammos lagocephalus*			x							
Rock sandpiper *Calidris ptilocnemis*		x			x					
Rock scallop *Hinnites giganteus*			x							
Sea palm *Postelsia palmaeformis*		x	x							
Shiner perch *Cymatogaster aggregata*			x							

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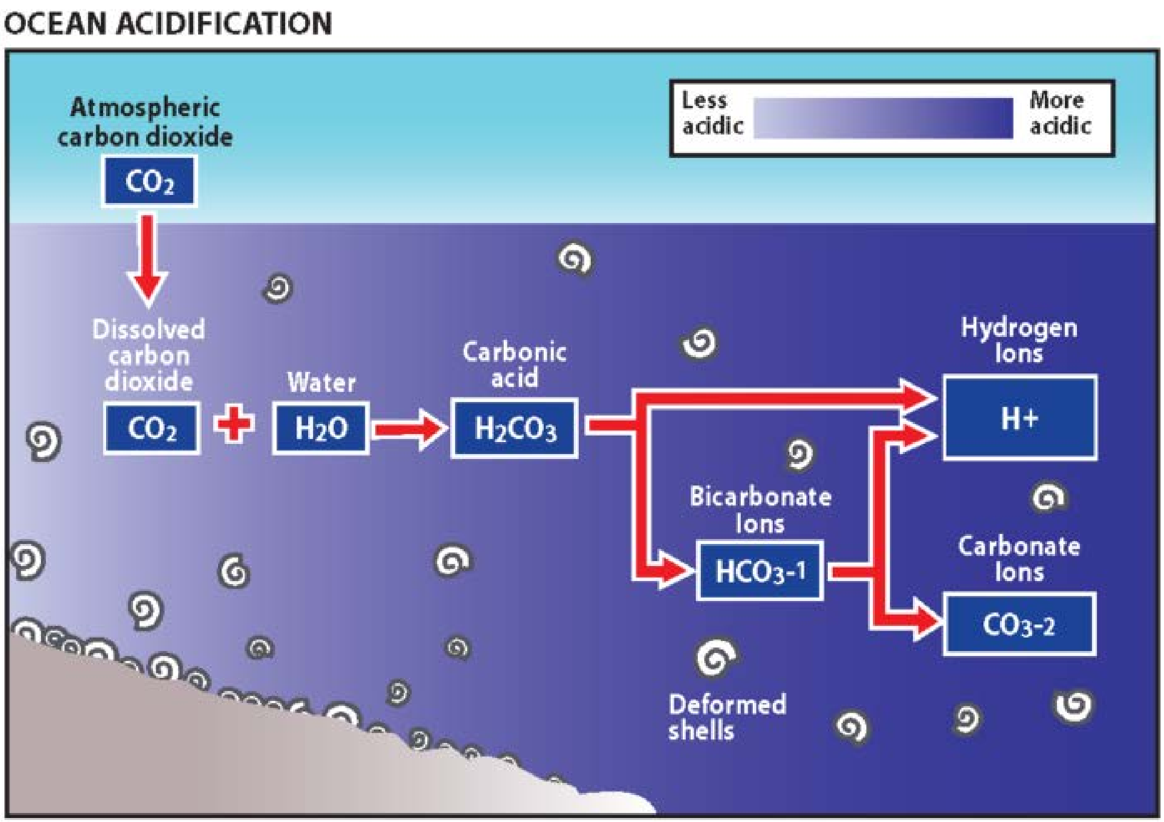
	Sensitivity To									
	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Southern Resident Killer Whale *Orcinus orca*				x			x			
Spiny dogfish *Squalus acanthias*			x				x			
Starry flounder *Platichthys stellatus*			x							
Steller sea lion *Eumetopias jubatus*			x				x			
Striped perch *Embiota lateralis*			x							
Sunflower star *Pycnopodia helianthoides*		x							x	x
Surf grass *Phyllospadix spp.*		x			x				x	
Surf smelt *Hypomesus pretiosus*		x							x	
Tiger rockfish *Sebastes nigrocinctus*			x							
Topsmelt *Atherinops affinis*		x				x			x	

Table 7.2. Sensitivity matrix for Strategy Species and Factors

	Sensitivity To									
	Anthropogenic Factors							*Natural Factors*		
Strategy Species	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Overexploitation	Noise pollution / Noise disturbance	Oil spills	Invasive species	Wildlife disturbance	Water quality degradation	Loss / alteration of habitat and oceanographic regimes	Disease
Tufted puffin *Fratercula cirrhata*		x			x		x		x	
Vermilion rockfish *Sebastes miniatus*			x							
Western river lamprey *Lampreta ayressii*		x							x	
Western snowy plover *Charadrius alexandrines nivosus*		x					x		x	
White sturgeon *Acipenser transmontanus*		x	x			x				
Wolf-eel *Anarrhichthys ocellatus*			x							
Yelloweye rockfish *Sebastes ruberrimus*			x							
Yellowtail rockfish *Sebastes flavidus*			x							

STRATEGY SPOTLIGHT: OCEAN ACIDIFICATION



Gases from earth's atmosphere are absorbed in ocean waters. The amount of carbon dioxide in the earth's atmosphere has increased substantially since the industrial age that began roughly 150 years ago. Dubbed the "evil twin" of global climate change, ocean acidification results from carbon dioxide added to earth's atmosphere being absorbed by ocean waters. Roughly a third of the carbon dioxide added to earth's atmosphere from human causes has been absorbed by ocean waters. The capacity of the ocean to absorb and be a "sink" for atmospheric carbon dioxide will decrease in the 21st century. Although ocean acidification and climate change are often lumped together, they are by no means the same thing. This ocean "sink" has slowed the accumulation of carbon dioxide in our atmosphere and its effects on earth's climate, but the result is a change in the chemical balance of seawater that is unique to the ocean environment. More information about the potential effects of both global climate change and ocean acidification on Oregon's nearshore species and habitats can be found in the 2012 supplements to the Oregon Nearshore Strategy (see Appendices A-D).

Carbon dioxide dissolved in seawater is a component of an equilibrium chemical reaction. The balance shifts to create more carbonic acid as the amount of dissolved carbon dioxide increases. More acidic seawater decreases the availability of the carbonate ion building blocks that are necessary for marine organisms to form their skeletons and shells (see diagram). Deep ocean waters naturally have lower carbonite ion availability and are more acidic. Spring and summer upwelling that brings deep nutrient rich waters to Oregon's nearshore waters also brings more corrosive acidic waters. Exposure to more acidic water has been shown to inhibit shell formation, reduce individual size and population abundance, and to cause behavioral changes that affect survival in marine organisms. California mussels, gooseneck barnacles, pelagic marine snails called pteropods that are food for salmon, hermit crabs and marine fishes are among the organisms for which these effects have been documented. A new study conducted at NOAA's Northwest Fishery Science Center found that ocean acidification may slow development and reduce survival of Dungeness crab larvae.

The video Ocean Acidification – Changing Waters on the Oregon Coast provides information on the causes of ocean acidification, its effects on marine life in our coastal waters and why Oregon is at the forefront of these changes taking place in our oceans.

The major findings and recommendations of the West Coast Ocean Acidification and Hypoxia Science Panel, released in April 2016, provide additional information and steps that can be taken to address this issue.


the OREGON NEARSHORE STRATEGY




Chapter 8: Nearshore Research and Monitoring

2016
Oregon Department of Fish and Wildlife

OregonConservationStrategy.org

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This PDF is a chapter of the Oregon Nearshore Strategy, the marine component of the official State Wildlife Action Plan for Oregon. The complete Oregon Conservation Strategy is available online at http://oregonconservationstrategy.org/. Since Conservation Strategy content will be updated periodically, please check the website to ensure that you are using the most current version of downloadable files.

Contact ODFW

*For more information on the Oregon Nearshore Strategy or to provide comments, email **Nearshore.Strategy@state.or.us** or write to Oregon Department of Fish and Wildlife, Marine Resources Program 2040 SE Marine Science Drive, Newport, OR 97365*

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Feature Image: Video lander being deployed on an ODFW research cruise, ODFW

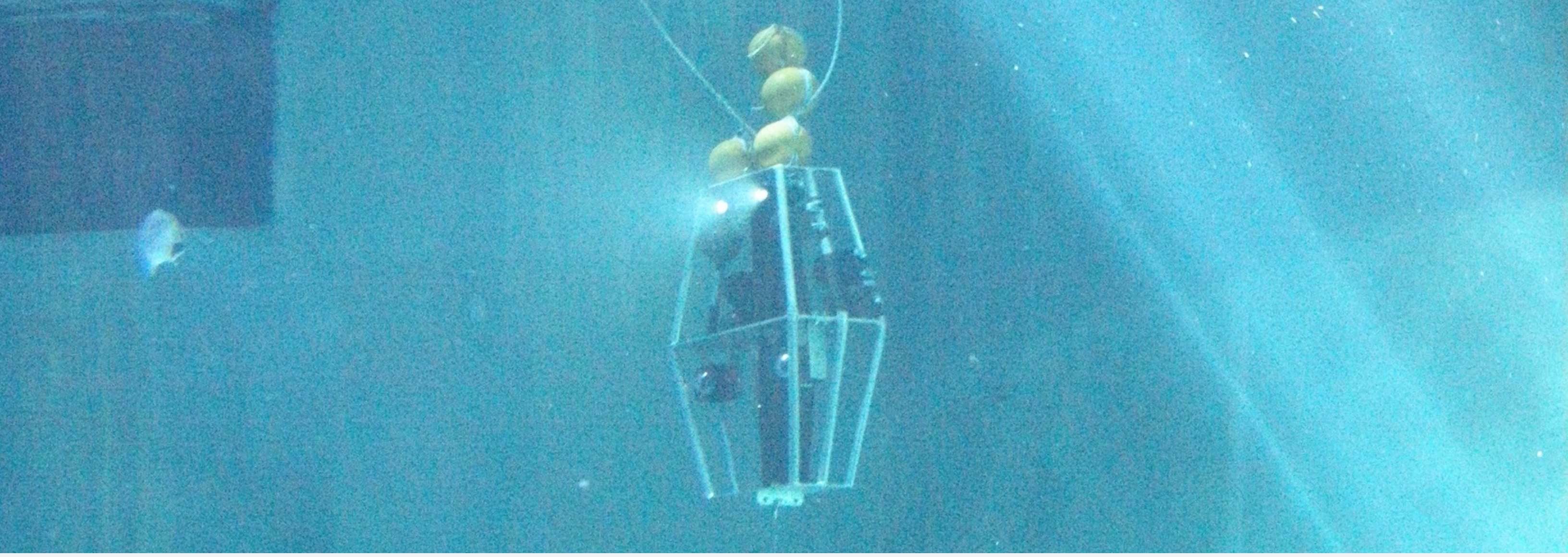

Photo Credit: ODFW

NEARSHORE RESEARCH AND MONITORING

Despite tremendous advances over the last decade in understanding Oregon's nearshore species and habitats, as well as advances in ODFW's program capacity to conduct nearshore research and monitoring (ODFW 2012e), there is still a need to enhance and augment existing nearshore programs. Nearshore resources are still poorly understood, relative to the state's other natural resources. Yet, the demands for information and data for conservation and management purposes continue to grow. Biological, physical, and socioeconomic data collected from research and monitoring efforts are central to effective wildlife conservation and management programs, and provide the information needed for effective outreach and education. The conservation values of a well-informed public help drive policy and management decisions that ensure a heathy ecosystem.

ODFW's current marine research and monitoring program capacity is diverse, and obtains data on a range of both ecological and fishery questions. The broad suite of research and monitoring projects currently conducted by ODFW help support management decisions and also provide a better understanding of the nearshore environment's inhabitants and their habitats. This chapter includes information on existing ODFW research and monitoring efforts (to provide context) and some detail on additional research and monitoring needs. This chapter provides a foundation for many of the Recommendations.

EXISTING ODFW RESEARCH AND MONITORING CAPACITY

The list below highlights existing ODFW research and monitoring efforts, along with specific project goals and outcomes.

Shellfish and Estuary Habitat

ODFW staff conducting research on estuary shellfish resources. Photo Credit: ODFW.

The Shellfish Program conducts research, monitoring and management of marine and estuarine shellfish species, along with the habitats these species utilize. This includes surveys for multiple species of sport and commercially harvested shellfish including, bay clams, Dungeness crab, red rock crab, red sea urchins and razor clams. The shellfish program conducts shoreline creel surveys to monitor the levels of sport harvest. Data from these creel surveys are coupled with counts of the sport harvesters to develop estimates of the overall effort expended by the recreational shellfishers. The ODFW shellfish program also collects measurements of the biological characteristics of the clams and crab. Information generated by the monitoring work is used to gauge the level of seasonal harvest activity and periodically evaluate the need for any modifications of the shellfish harvest regulations. The Shellfish and Estuarine Assessment of Coastal Oregon (SEACOR) project conducts clam population assessments and estuarine habitat studies throughout estuaries along the Oregon coast. Data collected through this project is used to better manage the commercial and recreational clam fisheries, along with informing shellfish stock assessments and tracking estuarine habitat changes. Since its inception in 2008, the SEACOR project has collected data from six major estuaries, with the goal of assessing every major estuary and bay along the Oregon coast. SEACOR has also digitized historical habitat survey information as a component of developing predictive capabilities for shellfish resources within Oregon estuaries.

Marine Habitat

This remotely operated vehicle (ROV) is a tool ODFW uses to survey the ocean bottom and its inhabitants. Photo Credit: ODFW.

The Marine Habitat Project conducts numerous ecological research projects focused on marine species-habitat relationships. This work helps provide a scientific understanding of the nearshore ecosystem for both fishery and non-fishery species. This project conducted some of the first detailed mapping efforts for Oregon's nearshore habitat using advanced sonar technologies. This effort has since been expanded by Oregon State University and others, which has resulted in mapping of approximately half of the Oregon Territorial Sea. This spatial data represents a dramatic improvement in the knowledge of seafloor habitats in the nearshore and will have significant applications to resource management. Additionally, the marine habitat project has been instrumental in documenting and monitoring the ecological consequences of nearshore hypoxic zones off of Oregon. This project has also led research efforts on aerial surveys of kelp forests, trawl impacts on soft bottom habitats and annual monitoring of rocky reef biological communities.

Marine Mammals – Pinnipeds

Stellar sea lion being tagged by ODFW to track its movements. Photo Credit: ODFW.

The ODFW provides regional leadership on research and monitoring of seals and sea lions. Ongoing ODFW population monitoring has documented the recovery of seals and sea lions in Oregon since the passage of the federal Marine Mammal Protection Act in the 1970s. The Marine Mammal Program has conducted research on the population status and reproductive output of Oregon's Steller sea lion population, contributing to the recent de-listing of this species from the federal Endangered Species Act. The program has conducted important studies on the food habits and foraging behavior of seals and sea lions and how their predation impacts to fish species of conservation concern such as ESA-listed salmon and steelhead, white sturgeon and Pacific lamprey.

Marine Reserves Ecological and Human Dimensions

ODFW conducts research and monitoring in marine reserves. Photo Credit: ODFW.

In 2012, Oregon completed designation of five marine reserve sites, which are areas in coastal waters dedicated to conservation and scientific research. The ODFW Marine Reserves Program has begun an ongoing monitoring effort designed to understand the effects of marine reserves on the marine environment and on people. This information will be used to evaluate marine reserves as a management tool in the future. There are two research projects within the marine reserves program: ecological research and human dimensions scientific research. The ecological monitoring project is focused on habitat characterization, oceanography, species that exist at each marine reserve site, and determining whether or not prohibiting extractive activities changes the environment over time. Marine reserve human dimensions monitoring is focused on determining social, cultural and economic changes for ocean users and communities that result from marine reserves implementation. In addition to providing insight on the specific effects of marine reserves, the monitoring effort is proving to be a vital resource in augmenting the general understanding of Oregon's nearshore environment, coastal economy and ocean users.

Fishery Sustainability Research

Results from an ODFW study of the black rockfish population off Newport was used in federal stock assessments. Photo Credit: ODFW.

Fishery-related research supports fishery management and assessment of fish stock health. Over the past decade, this program's research has led the way towards understanding and reducing bycatch. One notable example is with the pink shrimp fishery and the reduction of eulachon bycatch (listed as a threatened species under the federal Endangered Species Act). This work was instrumental both in allowing the continuation of this important fishery while addressing conservation concerns for eulachon, and in contributing toward certification of the Oregon pink shrimp fishery by the Marine Stewardship Council as a sustainable fishery. Additionally, this program conducted extensive research to understand the effects of barotrauma on rockfish and how to reduce barotrauma-related mortality in rockfish. The research resulted in the development and acceptance of rockfish descender devices. Fishery managers use the survival rates to improve estimates of fishing impacts on sensitive species such as yelloweye rockfish. These improved estimates meant increased fishing opportunity for anglers, while still addressing the conservation concerns for the sensitive species.

Fishery managers require information on the population status of harvested species in order to make well-informed management decisions. While the federal government conducts stock assessments on federally managed species, including many ocean fishery species included in the Strategy Species list, there remain a number of state-managed species for which there is incomplete knowledge of population status. ODFW's fishery-related research program develops species life history information such as population age composition and age of female fish maturity for poorly-understood species, including both federally and state managed species. Federal stock assessment scientists use this information to improve their understanding of population status. The fishery-related research program is currently testing visual survey tools to directly assess the population of nearshore rocky reef fish species, which are not well represented in federally-sponsored species surveys. These studies will help ODFW develop more consistent, accurate and sustainable harvest recommendations.

Fishery Monitoring

ODFW staff sample sport fishing catch. Photo Credit: ODFW.

Fishery monitoring and sampling are integral in generating data and information to meet the needs of resource managers and ensuring sustainable fisheries. Approximately 40 percent of the ODFW Marine Resource Program's budget is devoted to a sophisticated sampling program that monitors both commercial and sport fisheries along the Oregon coast. These programs collect information on groundfish, halibut, salmon and albacore tuna fisheries, including catch composition and biological data. Fishery data processing and quality control are also a significant component of the fishery monitoring program. The information collected via this program is used to monitor progress toward quotas, to inform stock assessments, and to assist in the development of management recommendations for the best use of Oregon's fishery resources.

RESEARCH AND MONITORING NEEDS

The subsequent section highlights significant data gaps for the nearshore ecosystem and gives examples of research needed to fill these gaps. While not comprehensive, these examples – if addressed and the data gaps filled – would provide a much deeper understanding of nearshore ecosystem function and status.

General information needs include: baseline data on the distribution and abundance of nearshore species and habitats, data on inter-species and species-habitat associations to understand the nuances of nearshore ecosystem function, and issue-specific data on the effects human activities on nearshore resources.

In particular, the effects of climate change and ocean acidification on species and their habitats need to be understood and considered in conservation decisions. Universities, government agencies and private entities have begun developing programs to observe and monitor the symptoms of climate change. Future needs include designing further studies that can identify and quantify the impacts of those symptoms on species, habitats, and ecosystem function; to explore what changes in nearshore resource distribution, abundance, and interactions we can expect with changing climate patterns anticipated in years to come.

Species Data

Information on the presence, abundance, and location of some nearshore species and biological communities is needed. While we have an understanding of the types of species present in the nearshore area and have limited abundance information on some, we lack the following important information for many species:

- invertebrate and fish community structure of nearshore reefs, and variation in communities among reefs
- identification of indicator species that can be tracked to monitor the health of the system and impacts of climate change
- absolute abundance measures or fishery-independent relative abundance measures for key managed species, and/or indicators of changes in abundance (important for fished species such as nearshore rockfish, cabezon, and greenling, etc.)
- movements undertaken by nearshore species

Specific types of research that can help fill these data gaps include:

- surveys for marine fish, invertebrates, and algae, which are independent of fisheries and at coastwide or other appropriate scales
- periodic and consistent long-term monitoring of organisms at selected indicator sites, such as the ecosystem monitoring currently conducted in marine reserves and nearby comparison areas by ODFW’s Marine Reserves Program, and the selection of specific sites and organisms most likely to demonstrate impacts of climate change

- developing and testing abundance measures or population trend indicators for selected species and monitoring those species over time

Habitat Data

Habitat data include structure and composition of the seafloor, estuary bottoms, and rocky and sandy shore substrates; oceanographic patterns and process (see Oceanographic Data below); and biological communities present (see Species Data above). Our knowledge of nearshore subtidal habitat is improving. We now have considerably more detailed seafloor maps for roughly half of Oregon's Territorial Sea than we had a decade ago; however, almost half remains to be mapped in detail. Researchers have only begun to understand which characteristics of habitats are most important in addressing the needs of particular species or communities. Types of research that can help fill these data gaps include:

- examining the relationships between species/communities and habitats to determine the most important habitat features to survey
- large-scale, coastwide survey of seafloor structure and composition employing modern ocean survey methodologies
- detailed surveys of selected areas to support studies of species-habitat relationships (see recommendation 7)

Oceanographic Data

Marine organisms are intimately tied to the physical/chemical properties and movements of the ocean waters in which they live. In order to understand the nearshore system we need more information on:

- large and small scale processes determining local water properties
- water movement and circulation patterns on large and small scales of time and space
- natural variation in oceanographic conditions over short and long time scales
- models with proven predictive ability on short and long time scales
- how local Oregon ocean conditions are tied to global ocean and climate conditions, and how global processes such as climate change and ocean acidification are likely to affect local conditions in Oregon's nearshore waters

Researchers at universities and other research institutions continue to make significant progress toward understanding nearshore oceanographic patterns and ecological processes in the waters off Oregon. Continuation of this research is essential to gaining a better understanding of the nearshore ecosystem.

Ecosystem Data

This includes the data types described above, stitched together to provide an understanding of the interactions and dependencies among species and the relationships between species and their habitats, to provide insight into the functioning of the nearshore ecosystem. This is a growing field and still data-poor; information needed to improve this understanding includes:

- habitat characteristics that determine community structure

- relationships among species, habitats, and oceanographic variables
- how ocean currents affect larval transport and consequently the genetic structure of populations
- connectivity and relationship between estuary and ocean populations
- factors affecting primary and secondary production
- factors affecting reproduction, recruitment, and natural mortality
- food web relationships and predator-prey dynamics
- natural variability of these and other factors
- climate change impacts on species and habitats related to:
    - sea level rise effects
    - warming ocean temperatures
    - altered weather patterns
    - changes in circulation patterns
    - changes in species range distribution related to temperature or food requirements
    - upwelling and nutrient availability for primary production
    - changes in food web dynamics
- ocean acidification and hypoxia
- effects of introduced non-native and invasive species

Most of these represent large scientific questions that cannot be addressed with individual research projects. Understanding these variables has, and will continue, to occur incrementally over time. The best way to ensure progress is to continue building Oregon's research infrastructure and increasing the emphasis on nearshore research. Recent ecosystem modeling efforts have provided insights but still need data both to make predictions and to validate the accuracy of those predictions.

Human Dimensions

Human presence and activities are integral parts of Oregon's nearshore ecosystem. Human dimensions – or socioeconomic – information can be used to understand how coastal communities, economies, and nearshore resources are interrelated and might be affected by various management actions. Basic economic data concerning commercial fisheries are developed regularly; however, there is less information on recreational fisheries, natural resource contributions to the tourist industry, and the economic consequences of management actions. These and other studies are needed to ensure managers address human dimensions factors in decision-making.

Human Development & Impacts

Several existing and emerging human uses of the nearshore environment will require special studies to understand their effects on nearshore resources and to develop appropriate management measures. Existing human development uses of the nearshore include maritime infrastructure, shoreline armoring, dredging and dredge material disposal, and other marine and/or estuarine construction projects. Examples of possible emerging uses include wave and wind energy development, methane hydrate mining, marine algae harvest, and aquaculture. There has been considerable interest in renewable energy projects off the Oregon coast over the last decade, with an interest in finding solutions to our nation's energy needs. While the benefit of efficient alternative energy is clear, more research and monitoring (once projects are built) is needed to understand the potential and/or realized impacts of such development. Ballast water from shipping, aquaculture and recreational boating have contributed to the introduction of non-native and invasive species to Oregon's nearshore. Once established in Oregon, these species are difficult to remove, so prevention of introductions is a preferable approach. An important data need is how best to effectively prevent or mitigate the effects of such species introductions.

CONCLUSION

As demonstrated above, there are considerably more data gaps than can be filled by any one group or organization. Research and monitoring must be prioritized to address the most pressing needs first. It also is important to develop conservation, research and monitoring partnerships with the commercial and recreational fishing industries, other state and federal agencies, universities, and appropriate non-governmental organizations to maximize the effectiveness and efficiency of the work. ODFW continues to work with partners to address conservation, research and monitoring needs for Nearshore Strategy Species (see Table 5.1).

the OREGON NEARSHORE STRATEGY






Chapter 9: Nearshore Recommendations

2016
Oregon Department of Fish and Wildlife

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Recommended Citation

Oregon Nearshore Strategy. 2016. Oregon Department of Fish and Wildlife, Salem, Oregon.

Cover Photos

Photo Credit: ODFW

NEARSHORE RECOMMENDATIONS

The core of the Nearshore Strategy is the following set of recommendations, intended to facilitate voluntary, collaborative actions to improve understanding and stewardship of Oregon's nearshore resources. These recommendations reflect input received from ODFW staff, outside experts who served as technical advisors and reviewers, and members of the public. Twelve recommendations are outlined below, categorized into three main themes: Education and Outreach, Research and Monitoring, and Management and Policy. Each recommendation was chosen because it addresses priority nearshore issues that are in need of immediate or timely attention, is feasible, has received public support, and is beyond the capability of any single institution to achieve. The recommendations rely on partners to differing degrees, and are intended to help guide collaboration rather than act as an action plan for ODFW alone.

The description of each recommendation includes:

Recommendation: A brief statement of the recommended action.

Rationale: Conservation and/or management need(s) addressed by this recommended action, and strategies to achieve results. Recommendations are based on the known and/or potential factors affecting nearshore resources and resource sensitivity, as identified by public input, scientific information, technical advisors, and ODFW staff.

Potential Partners: Who should—or could—be involved? A general list (not necessarily comprehensive) of potential partners for collaboration on implementation.

CATEGORY: EDUCATION AND OUTREACH

A well-informed public helps drive policy and management decisions that support a heathy ecosystem and the many benefits it offers. The following recommendations are designed to enhance public awareness of nearshore species and habitats, and foster public engagement in nearshore conservation issues.

(1) General Public, Stakeholder and Advisory Group Engagement

Recommendation: Develop and expand creative avenues to engage a diverse array of stakeholders, including the broader general public, on nearshore resource issues. Explore technologies that support alternative methods of communication and participation, in addition to continuing to support traditional paths such as issue-specific advisory groups.

Rationale: Input from informed and engaged partners is essential to successfully developing and implementing research, management/policy, and outreach on all natural resource issues. The exchange of information between ODFW and stakeholders improves understanding and support on both sides, and aligns management with public priorities. Advisory committees can provide focused, in-depth engagement in selected aspects of nearshore management and research. In addition, there is a growing need to augment traditional methods of public input to reach an increasingly dispersed and diverse population of stakeholders interested in nearshore issues. ODFW has begun using new options for engaging the public and exchanging information—for example, opportunities for online participation in public meetings, and online surveys—and these have shown promise as effective tools for enhancing traditional methods.

Potential Partners: ODFW, existing advisory bodies, the general public, sport and commercial fishing interests, non-governmental organizations, tribes, Oregon Sea Grant, and various other communities of interested parties with a broad and diverse representation.

(2) Nearshore Resources Outreach Information, Access and Awareness

Recommendation: Broaden outreach materials and information available electronically, to deepen public appreciation of Oregon's nearshore environment. Increase the quantity, quality, and timeliness of information available on ODFW's website on nearshore fisheries, regulations, conservation and ecosystem management.

Rationale: Oregon's nearshore is one of the richest ecological systems in the world, home to thousands of species in a multitude of habitat types. While there is much to learn about this incredible ecoregion, there is a wealth of existing information that could be used more effectively to fuel public interest in natural resource issues, and stewardship of those resources. Populating educational exhibits, websites, social media, and other media outlets with information about Oregon's nearshore will deepen Oregonian's connection to the outdoors and to wildlife. Photographs, video, and stories, provided through a variety of sources and outlets will engage the public in the short-term, and build partnership and stewardship in the long-term.

Potential Partners: State and federal natural resource agencies, universities, Oregon Sea Grant, public aquaria and museums, non-governmental organizations, tribes, and others.

(3) Communications Partnerships

Recommendation: Develop and expand existing partnerships for communication, education, and outreach on nearshore topics and issues. Work with partners to develop new mechanisms for information development and dissemination and through partnerships reach new audiences.

Rationale: Conservation and management actions are better trusted and publically supported when they are developed with stakeholders who understand nearshore issues. Partnering with groups that have a rich history of developing science-based education and outreach programs, effectively and efficiently amplifies the quality and scope of nearshore resources communication, and builds relationships and capacity outside of ODFW on nearshore resource issues. Through these partnerships, Oregon's understanding of nearshore issues – and clarity on what members of the public can do to contribute to a healthy nearshore ecosystem – would facilitate a renewed spirit of engagement and commitment to nearshore resource stewardship.

Potential Partners: State and federal natural resource agencies, universities, Oregon Sea Grant, public aquaria and museums, non-governmental organizations, tribes, and others.

CATEGORY: RESEARCH AND MONITORING

Expanded research and monitoring activities are required to generate data and information to meet the needs of resource managers. This is especially true in the nearshore area where human activity is intense and information on many species and their habitats is sparse. The Nearshore Research and Monitoring section lists some key data elements and examples of projects that would help support resource management. The following recommendations address research and monitoring program priorities for collaborative, multi-institutional issues. The broad objectives in this category are far beyond the capability of any one institution to fully achieve and therefore require partnerships to realize meaningful results.

(4) Ecosystem Response to Climate Change

Recommendation: Develop and implement research and monitoring efforts to understand, track, and work toward predicting effects of climate change and increased carbon dioxide on Oregon's nearshore species and ecosystems. Focus research toward species and ecosystems most at risk, and foster collaboration between scientists and managers to optimize research outcomes for use in management.

Rationale: Oregon's ocean is already experiencing effects of climate change and increased carbon dioxide, including ocean acidification, hypoxia, other changes in water chemistry, warming ocean temperature, and changes in upwelling and other characteristics of the nearshore ocean and estuaries. These changes will continue to grow and intensify in the future. Oregon's upwelling ecosystem is experiencing many of these changes sooner and in greater magnitude than other parts of the nation, increasing the urgency for collecting the needed information and formulating the necessary management response. This is a global problem that requires rigorous scientific information to solve, and partnership between scientists inside and outside of agencies to both understand the phenomena and try to mitigate its effects. Desired outcomes are to increase ecosystem and community resilience and sustainability of Oregon's nearshore resource.

Potential Partners: State and federal natural resource agencies, universities, local governments, non-governmental organizations, shellfish and fishing interests, tribes and others.

(5) Ecosystem Characterization – Species and Habitats

Recommendation: Continue and expand research and monitoring efforts on nearshore species and habitats. Gather scientific information on the abundance and distribution of species and habitats, the interactions among species and between species and their physical environment, and changes in those resources and interactions over time. The Strategy Species and Nearshore Research and Monitoring needs provide guidance for setting research and monitoring priorities.

Rationale: Management of nearshore resources is most effective when based on a sound scientific understanding of the nearshore ecosystem. While there has been a great deal of research on Oregon's nearshore ocean and natural resources, there remain significant data gaps that, once filled, will reduce uncertainty in resource management. ODFW gathers information on nearshore fish, invertebrates, marine mammals and habitats. In addition, ODFW monitors changes in marine reserves and nearby comparison areas, providing a unique opportunity to examine changes that occur to nearshore species in areas closed to fishing compared with similar areas where fishing occurs. These ODFW programs, along with numerous efforts undertaken by universities, resource agencies, and other partners need to be continued and expanding to produce information necessary to meet resource management challenges.

Potential Partners: State and federal natural resource agencies, universities, non-governmental organizations, fishing interests, tribes, and the general public.

(6) Fishery Independent Surveys

Recommendation: Develop methods for surveying fishery species in the nearshore environment with the goal of collecting fish and shellfish abundance data useful in assessing the status of harvested fish and shellfish stocks. Once methods are developed, conduct periodic fishery-independent surveys in the nearshore environment to produce data useful in stock assessments and develop long-term datasets that can indicate trends in abundance over time.

Rationale: The status of fishery stocks needs to be assessed periodically to ensure that fishery managers set appropriate catch limits and to provide sustainable harvest into the future. Stock assessments are often based on a combination of data collected from fishery landings and fishery-independent surveys of fish populations. Fishery-independent data are crucial to fine-tune and ground truth stock assessment models, helping to ensure assessment results most accurately reflect real-world fish abundance. These more accurate results allow managers and fishermen to have more certainty with management decisions, and reduce the risk of deviating from conservation targets.

There are currently no fishery-independent surveys for most fish species caught in the nearshore. Many of these species are caught on nearshore rocky reefs, an environment that presents challenges to conventional fish survey methodology (e.g., trawl surveys). Methods need to be developed for conducting fish surveys in nearshore rocky reef areas that will produce consistent and reliable results useful in assessing stocks. Surveys then need to be conducted on a periodic basis and continued over a long time period to be most useful in supporting stock assessments. The initial focus should be on nearshore rocky reef fish species, including black, blue, deacon, China, copper, quillback, and other rockfish species, as well as kelp greenling and cabezon.

Potential Partners: Fishery managers, stock assessment scientists, commercial and sport fishing interests, non-governmental organizations and university scientists.

(7) Nearshore Species Stock Assessments

Recommendation: Improve stock assessments and/or stock status indicators for priority data-limited nearshore fish and shellfish species to improve confidence in population estimates and management strategies. Develop and improve data collection programs needed to support nearshore species stock assessments including developing fishery-independent surveys (see Recommendation 6), and evaluating and improving existing fishery monitoring programs that record fishery catch/landings, estimate fishery effort, and collect biological data on landed catch.

Rationale: There is limited information about nearshore fish and shellfish populations available for use in population assessments. Data and monitoring have not been adequate to confidently assess stock status on many nearshore species, and there is currently no mechanism for indicating a population decline for many species. Developing stock assessment and/or indicator strategies, along with collecting the data necessary to implement the strategies, is essential to maintain confidence in management decisions and ensure sustainable harvest.

Potential Partners: ODFW, NOAA stock assessment scientists, other state and federal fishery resource agencies, university scientists, and the fishing industry.

(8) Human Dimensions Research and Monitoring

Recommendation: Conduct and support studies of social and economic patterns and trends as they relate to nearshore resources, human use of the resources, and effects of resource management actions on individuals, user groups, or communities. Potential topics include coastal community demographic trends, economic and social contributions of industries that depend on nearshore resources directly (e.g., fishing) or indirectly (e.g., tourism), and the impacts of regulatory and other management changes. In some cases, new methods will need to be developed to study these topics and develop data useful for resource management.

Rationale: Human dimensions information is central to understanding the context of natural resource issues and how people, coastal communities, economies, and nearshore resources are interrelated and might be affected by various management actions. The social and economic benefits and consequences of resource management actions need to be an integral part of the resource management process. For example, ODFW's marine reserves program is developing human dimensions information about Oregon's coastal communities to provide information needed to evaluate marine reserves as a management tool and to increase our general understanding Oregon's coastal communities and user groups.

Potential Partners: State and federal natural resource agencies, university scientists, non-governmental organizations, the fishing industry, tribes, and the general public.

(9) Marine Mammals-Fisheries Interactions

Recommendation: Continue and expand efforts to gather necessary information to manage resource conflicts between pinnipeds and fish resources in Oregon's nearshore ocean, estuaries, and rivers. Information needed includes ongoing monitoring of pinniped population abundance, research on feeding habits and foraging behavior, research on predation impacts to fish populations, and evaluation of conflicts with fisheries.

Rationale: Pinnipeds in the Pacific Northwest, under the protection of the federal Marine Mammal Protection Act of 1972, have enjoyed a marked recovery of their populations. The substantial increase in the number of pinnipeds along the coast and in the lower Columbia River has resulted in widespread negative impacts to fish species of conservation concern such as ESA-listed salmon and steelhead, white sturgeon and Pacific lamprey, as well as conflicts with sport and commercial fisheries. As an example, the U.S. stock of California sea lions has experienced a successful recovery over the past 30 years, increasing from perhaps 50,000 animals at the time of protection to approximately 300,000 today. While a conservation success story, their increase has resulted in increased resource conflicts throughout their range. Similarly, the eastern stock of Steller sea lions has also experienced a successful recovery over the past 30 years and was recently delisted under the Endangered Species Act. In order to address conflicts created by large and increasing pinniped populations, it is essential to monitor pinniped populations, examine food habits, foraging behavior, and predation effects on fish populations, and evaluate conflicts with fisheries.

Potential Partners: ODFW, National Oceanic and Atmospheric Administration, the Washington Department of Fish and Wildlife, U.S. Army Corps of Engineers, sport and commercial fishing interests, tribes, port districts, and other local government entities.

CATEGORY: MANAGEMENT AND POLICY

Good governance for natural resources is built from a transparent management framework, trust from stakeholders, and sound science. Resource sustainability and resilience to a changing environment is improved with good management, good policy, and good governance. The recommendations in this category address priority nearshore issues and species using a variety of non-regulatory tools.

(10) Management Response to Climate Change

Recommendation: Promote use of climate change information in management decision-making and policy development in statewide, regional and global arenas. Build climate resilience and climate change adaptation into decision-making to maximize the long-term benefits of today's public investment in natural resource management.

Rationale: Our understanding of climate change continues to broaden and deepen, as we discover the multitude of climate change symptoms and explore predictions of future impacts. Symptoms include those that have been in the public awareness for decades (e.g. warming temperatures) as well as newly identified phenomenon such as ocean acidification, which was first recognized in 2003. Many (or arguably most) natural resource management tools do not explicitly incorporate climate change information; at best, management tools include methods for addressing scientific uncertainty (e.g.

harvest quota estimates), which may indirectly account for some degree of climate change uncertainty, but not all of it. Decisions made today on natural resource issues – made in a vacuum relative to climate change adaptation information – likely will not stand the test of time. Poor decisions today, assuming a static environment, will likely lead to destabilization of businesses, and economies that rely on resource availability for harvest, tourism or other purposes.

Potential Partners: State and federal natural resource agencies, university scientists, non-governmental organizations, and the fishing industry.

(11) Marine Fishery Management Plans

Recommendation: Build the information/datasets and stakeholder support for state marine fishery management plans for appropriate nearshore Strategy Species and Watch List Species.

Rationale: Transparent documentation of management strategies can lead to increased public engagement in management (particularly increased public input) and improved information for decision-making processes. Both lead to greater public confidence that Oregon's natural resources are healthy and well-managed. To facilitate transparency and improve information in decision-making, ODFW has developed the Marine Fishery Management Plan Framework (2015) – an approach to developing Fishery Management Plans (FMPs) for nearshore and other marine species, developed under the umbrella of the Native Fish Conservation Policy. The goal of the Framework is to create a common understanding of what can and/or should be part of state FMPs, and lay out a publically transparent road map for how to develop marine FMPs. The real heart of the Framework is in the building of individual FMPs, each of which will be adopted by the Fish and Wildlife Commission. Building each individual FMP will be time and labor-intensive, both for agency staff and for the public, whose input will be necessary for the FMPs to be rigorous and effective.

Potential Partners: State and federal natural resource agencies, sport and commercial fishing interests, non-governmental organizations, university scientists, tribes, and the general public.

(12) Marine Planning

Recommendation: Participate in marine planning processes to ensure Oregon's interests in marine natural resource conservation and use are fully represented in marine policy. Develop marine natural resource spatial information and incorporate it into marine planning processes to ensure they use the best available science to formulate plans concerning Oregon's marine resources and uses.

Rationale: Growing demand for ocean resources and competing use of ocean space has increased the need to move beyond single-sector management and plan for ocean uses more holistically. Marine planning processes require comprehensive spatial information on location, abundance and distribution of marine resources and resource uses. Spatial data that meet these needs have not been developed for many marine resources, and require collaborative efforts and funding to ensure full development. Marine planning efforts engage multiple users, governments, and management agencies to ensure continued sustainability of ocean resources, while providing for a diverse array of uses and public priorities. Alongside many collaborators and partners, ODFW participated in the state's development of part 5 of the Territorial Sea Plan, which outlines state policy on renewable ocean energy siting in the nearshore and characterizes the more suitable areas for this development to occur. Several marine planning processes affecting Oregon are currently underway at the federal level. While these are in federal waters, they still affect Oregon's nearshore marine resources and Oregon's ocean users. ODFW will continue to play a key role in providing natural resource information to support these processes, as well as ensuring Oregon's nearshore resources and ocean user groups are represented in policy decisions. ODFW will also play an ongoing role in plan implementation and keeping marine resource data sets current, and relevant, as new information becomes available.

Potential Partners: State and federal natural resource agencies, sport and commercial fishing interests, local, state, regional, and federal governments, community groups, non-governmental organizations, tribes, and the general public.


the OREGON NEARSHORE STRATEGY




Chapter 10: Nearshore Conclusions

2016
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Feature Image: Kelp and nearshore island, ODFW

Photo Credit: © Gregory Krutzikowsky

NEARSHORE CONCLUSIONS

LOOKING TO THE FUTURE

The ultimate goal of the Nearshore Strategy is to help guide actions that will conserve ecological functions and nearshore resources that provide long-term ecological, economic, and social benefits for current and future generation of Oregonians. Each of the recommendations in the Nearshore Strategy includes details on tasks, partners, timing, and funding for implementation of the suggested action(s). Although the range of potential actions has been substantially narrowed to the 12 recommendations presented in the Nearshore Strategy, there are still too many to undertake simultaneously. Priorities will be established based on urgency, importance, and links to other ongoing or scheduled activities. Furthermore, ODFW does not have the capacity to address all of the recommendations, so initiatives by and partnerships with other entities will be essential.

Some actions, such as marine planning, ongoing engagement of public stakeholders, and a variety of research and monitoring efforts are already underway. Additional implementation of the recommendations will begin immediately following final approval of this initial Strategy. Input from both internal and external sources is critical in prioritizing and guiding implementation of the recommendations and monitoring programs to track their success.

State Wildlife Grant (SWG) funding is anticipated to be available for future Nearshore Strategy actions, but may be limited in duration. Some recommendations or parts thereof will be implemented regardless of SWG funding, based on priorities and current levels of other funding sources. Increased funding is essential for successful implementation of all Nearshore Strategy recommendations. Obtaining additional funding to augment implementation of the Nearshore Strategy will be a priority for all interested parties.

REVIEW OF THE NEARSHORE STRATEGY

ODFW staff will report annually to the Oregon Fish & Wildlife Commission on Strategy status, relevance to current nearshore resource issues and priorities, and implementation of its recommendations. It will provide a means of assessing implementation progress and effectiveness on an ongoing basis, and adapting to changing conditions. Public input on current resource issues will be continually taken under consideration to adjust priorities.

One of the eight required elements of the SWG program is to include procedures to review and update the State Wildlife Action Plan at least every ten years. ODFW will lead a full and comprehensive review of the Oregon Conservation Strategy and Oregon Nearshore Strategy and engage stakeholders and representatives of other state and federal agencies and tribes within that time period. The documents will be updated for consistency with current resource issues, state policies, scientific information, and public interest. On completion of the formal review, an updated version of the Nearshore Strategy that meets all eight required elements and includes an explanation of all modifications made will be presented to the Oregon Fish and Wildlife Commission and the U.S. Fish and Wildlife Service no later than October 1, 2025.


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