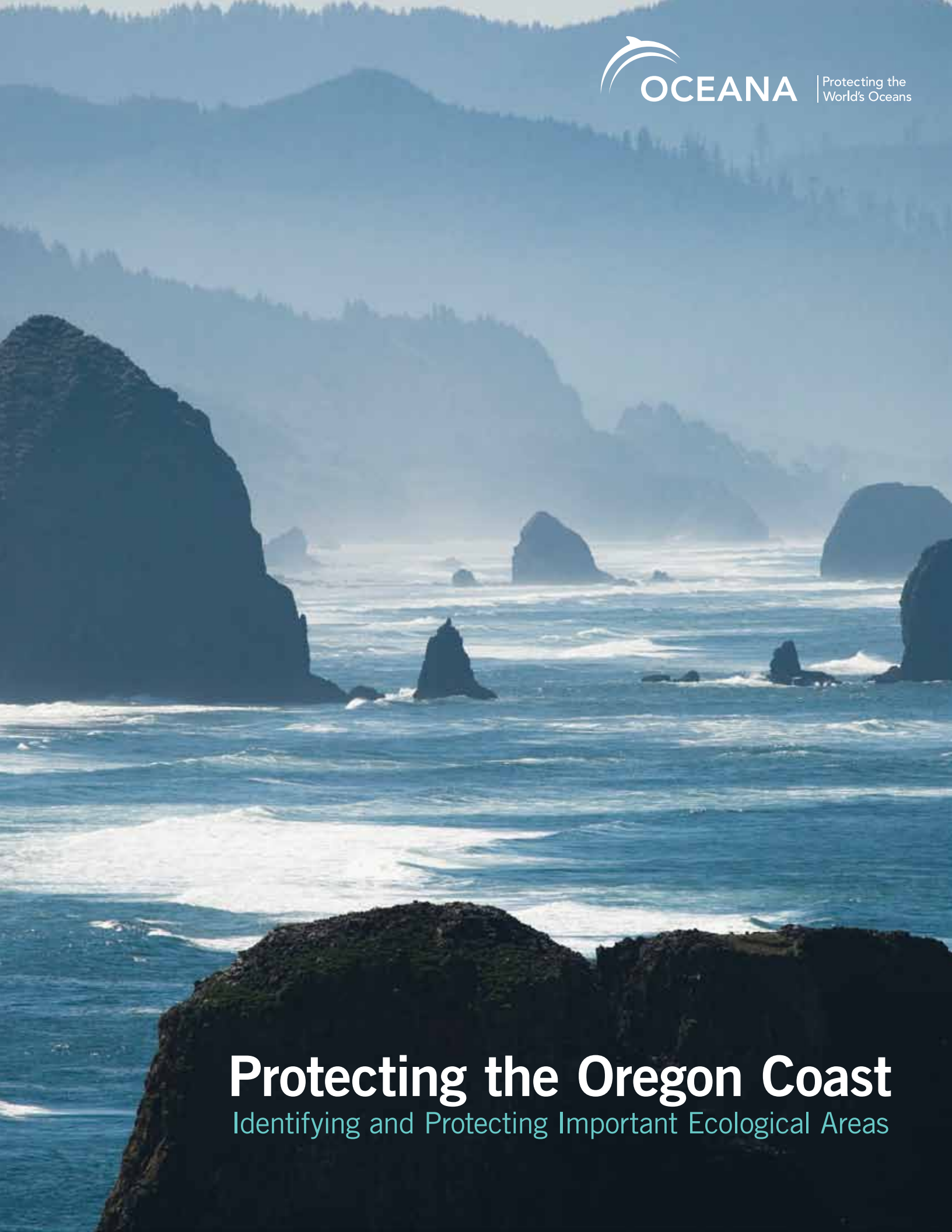
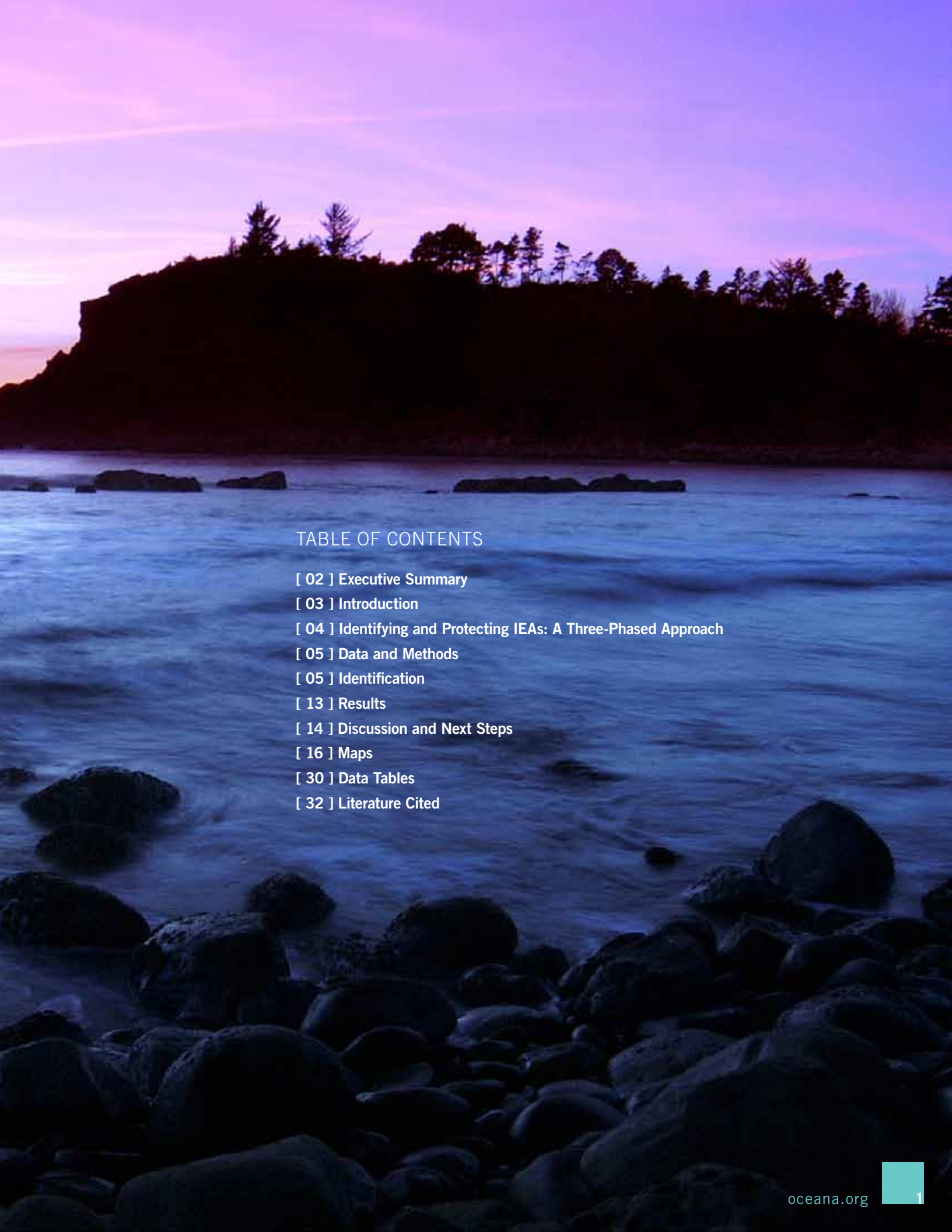


Protecting the Oregon Coast

Identifying and Protecting Important Ecological Areas

Cover: Looking south from Tillamook Head, Ecola State Park
Photo: Ben Nieves

Cape Arago, important ecological area in southern Oregon
Photo: Ben Nieves



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Three Arch Rocks, important ecological area
Photo: USFWS

EXECUTIVE SUMMARY

Home to gray whales, salmon, puffins, and life giving swarms of krill, the Pacific Ocean off Oregon is one of the richest temperate marine ecosystems in the world. Along Oregon's 360 mile stretch of coastline are 22 major estuaries, long sandy beaches, rocky headlands, more than 1,400 rocky outcrops and islands, and a phenomenal diversity of life.

Oregon's waters are a critical stop on the migratory route of more than 20,000 gray whales traveling between the Arctic and Baja California. Roughly 200 gray whales stay to feed off Oregon during the summer. Fourteen species of seabirds, making up over a million birds in total, nest and breed on the coastal rocks and cliffs. Below the surface are hundreds of species of fish such as salmon, rockfishes, and smelts, and invertebrates such as anemones, crabs and sea stars, that make the rocky reefs, kelp forests and deep ocean waters their home.

Yet like much of the world's oceans, Oregon's coastal and ocean ecosystems are facing increasing threats, including ocean warming, acidification, overfishing, pollution and development. Increasing human uses of our oceans and coasts have led to steep declines in fish and wildlife populations and habitat loss that threatens the long-term sustainability of biological resources. In order to have healthy coastal and ocean ecosystems and long-term, ecologically sustainable uses, we must move forward with an ecosystem-based approach that includes the identification and protection of Important Ecological Areas as part of comprehensive Marine Spatial Planning.

To that end, Oceana has identified 31 Important Ecological Areas (IEAs) off the Oregon coast, identified threats to those areas, and has worked with a diverse coalition to propose a network of marine protected areas and marine reserves. This report presents the scientific basis and Geographic Information System (GIS) analysis used to identify IEAs off the Oregon coast, the design of an ecologically significant network of marine reserves and protected areas, and the state policy framework shaping ongoing conservation planning.

"The identification of key marine and estuarine habitats (or 'important ecological areas') for the West Coast is a critical first step for future potential protection efforts relevant to the three states."

West Coast Governors' Agreement on Ocean Health, Action Plan (2008)

IMPORTANT ECOLOGICAL AREAS: AN INTRODUCTION

The state of Oregon has a long history of ocean planning, including the creation of key policies that recognize the importance of a healthy ocean ecosystem and long-term sustainable uses. The framework for the conservation of marine habitats and ecological functions exists in Statewide Planning Goal 19, adopted in 1976; the Oregon Ocean Resource Management Plan, developed in 1990; the Oregon Territorial Sea Plan, adopted in 1994; and the 2006 Oregon Nearshore Strategy (ODFW 2006). The 2006 West Coast Governors' Agreement on Ocean Health calls for protecting and restoring healthy ocean and coastal habitats, implementing ecosystem based management and expanding research and monitoring. In July 2009, Governor Kulongoski signed legislation that implements Oregon's first two pilot marine reserves and an adjacent protected area, and lays the groundwork for study, evaluation and possible designation of marine reserves in four other areas.

As the State of Oregon proceeds with building a network of marine protected areas and reserves; plans for future activities like offshore energy development; and evaluates existing uses like commercial and recreational fishing, dredge spoil dumping, shipping and undersea cables, what is needed is a comprehensive statewide Marine Spatial Planning approach to tie all of these activities together. It must be consistent with the State's ocean goals and policies, with a priority placed on maintaining and protecting a healthy ocean ecosystem. Such an approach to Marine Spatial Planning should begin with the identification and designation of IEAs. IEAs are geographically delineated areas which, either by themselves or in a network, have distinguishing ecological characteristics or contribute disproportionately to an ecosystem's health, including its functioning, structure, or resilience. A conservation approach to Marine Spatial Planning also includes an evaluation of existing and potential threats, implementation of appropriate conservation measures, research, monitoring and an adaptive management framework.

Using GIS tools, ecological criteria and a conservation planning approach, Oceana has identified and mapped 31 IEAs off the Oregon coast that warrant designation, monitoring and possible management measures. IEAs that are sensitive to human impacts may require special management relative to surrounding areas.

Threats to ocean health range from global warming, ocean acidification and other climate change related impacts, to development, over-exploitation, habitat destruction, pollution and cumulative and synergistic impacts. Fishing-related impacts in the Pacific Ocean off Oregon have been demonstrated by overfishing key groundfish populations, decreasing size and age structure of rockfish populations, shifts in ecological community structure and seafloor habitat impacts (Levin et al. 2006, Hixon and Tissot 2007, Hannah 2010). What is more, ocean warming and acidification will bring many new unexpected ecological changes such as shifts in species distributions, changes in food web ecology, and reduced growth, production and life span of some adult, juvenile

Sea stars and sea urchins adorn Oregon's rocky intertidal habitats
Photo: Nancy Sutton, NOAA

IDENTIFYING AND PROTECTING IEAS: A THREE-PHASED APPROACH

Phase I. **Identification**

1. Identify ecological features using the criteria below and in consideration of ecosystem-based management goals.
2. Gather and analyze datasets to determine the spatial distribution and intersection of ecological features as summarized by overlaying GIS maps.
3. Obtain peer review of preliminary datasets and GIS products by ecologists and by recognized local and traditional knowledge experts as available for accuracy and completeness.
4. Delineate approximate IEA boundaries based on features in datasets and knowledge of ecosystem function.
5. Identify immediate, potential, and long-term anthropogenic impacts and threats to IEAs.

Phase II. **IEA Designation and Protective Management Measures**

6. Formulate management measures to mitigate threats and maintain biological and ecological functions.
7. Work with other stakeholders, managers, tribes, enforcement officers, scientists, and resource users to develop regulations that most cost-effectively implement these management measures.
8. Evaluate conservation and management measures based on the extent to which they meet ecosystem objectives and identify needs and opportunities for increasing connectivity.

Phase III. **Monitoring, Evaluation and Adaptive Management**

9. Conduct sufficient monitoring to detect environmental changes that may alter the ability of IEAs and management measures to meet conservation and management goals.
10. Periodically consider changes to boundaries and/or management measures based on monitoring results.

Photo: NOAA

Steller sea lions at Rogue Reef
Photo: USFWS

and larval fishes and invertebrates (Cochrane et al. 2009, Royal Society 2005, Harrould-Kolieb and Savitz 2009).

Protecting IEAs will help buffer and reduce existing and future impacts by ensuring relatively intact marine habitats and a coastal and nearshore marine ecosystem that is more resilient to coming changes in the ocean environment. Ecosystem resilience (Hollings 1973) describes the capacity of an ecosystem to cope with disturbances, such as climate change, ocean acidification, pollution and overfishing, without shifting into a qualitatively different state. A resilient ecosystem has the capacity to withstand impacts and, if damaged, to rebuild itself. If resilience is lost or reduced, disturbances can trigger sudden and dramatic change and loss of the structural integrity of the system (Hollings 1973).

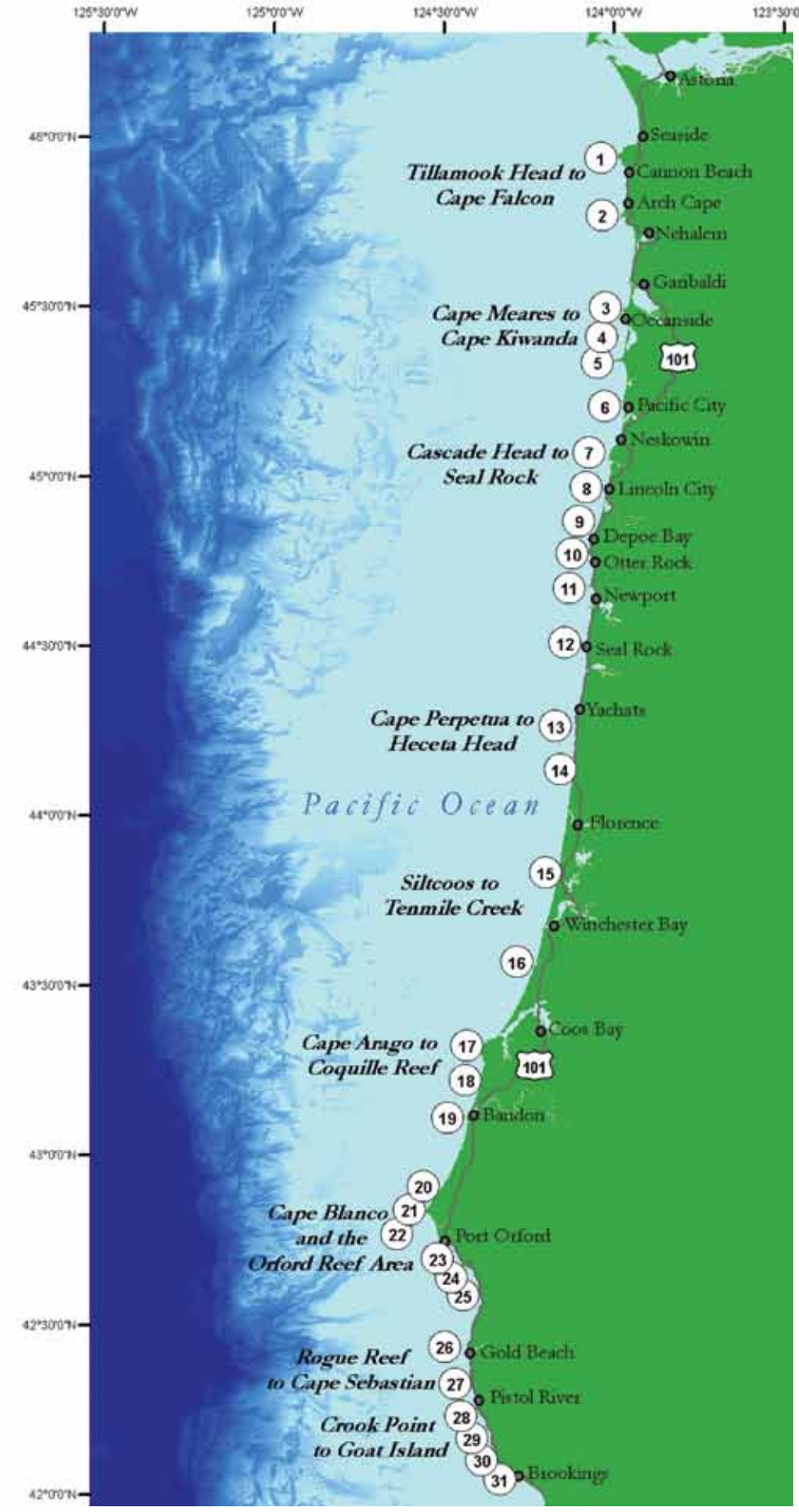
DATA AND METHODS

Oceana's methods include a conservation planning approach for identifying and protecting ocean areas based on unique and important ecological features. This approach includes gathering and analyzing data on ecological features meeting respective criteria; identifying IEAs based on features and functions; identifying immediate and long-term threats; and describing management measures, a monitoring program, and a system for evaluation and adaptive management. In coming years, as new data becomes available or with new analytical approaches to identifying IEAs, it may be necessary to make adjustments to IEA boundaries.

IDENTIFICATION

In phase one, ecological features were identified based on criteria including: significance of habitat to maintaining ecosystem structure, biological diversity, representative species assemblages, importance to life history stages of marine organisms (areas used for breeding, feeding, spawning, nurseries, resting or haulout), vulnerability to adverse effects, rarity and critical habitat for threatened and endangered species.

Ecological features and available spatial data in each respective biogeographical region meeting these criteria were identified (Table 1). The two bioregions off the



Tillamook Head to Cape Falcon
1. Tillamook Head
2. Cape Falcon

Cape Meares to Cape Kiwanda
3. Cape Meares
4. Three Arch Rocks
5. Cape Lookout
6. Cape Kiwanda

Cascade Head to Seal Rock
7. Cascade Head
8. Nelscott and Siletz Reefs
9. Boiler Bay and Boiler Ridge Reef
10. Cape Foulweather to Otter Rock
11. Yaquinea Head
12. Seal Rock

Cape Perpetua to Heceta Head
13. Cape Perpetua
14. Heceta Head

Siltcoos to Tenmile Creek
15. Siltcoos and Tahkenitch
16. The Umpqua to Ten Mile Creek

Cape Arago to Coquille Reef
17. Cape Arago
18. Seven Devils/Five Mile Point
19. Coquille Reef

Cape Blanco and The Orford Reef Area
20. Blacklock Point
21. Blanco Reef
22. Orford Reef
23. Redfish Rocks
24. Humbug Mountain
25. Sister's Rocks

Rogue Reef to Cape Sebastian
26. Rogue Reef
27. Cape Sebastian

Crook Point to Goat Island
28. Crook Point and Mack Reef
29. Whalehead
30. Cape Ferrelo
31. Goat Island

OCEANA

0 20 40 80
miles

TABLE 1: Ecological feature datasets used for Important Ecological Area analysis. Most GIS data available at pacoos.coas.oregonstate.edu

FEATURE	DATA SOURCE
Hard substrates/rocky reefs	Version 3, Surficial Geologic Habitat, Washington and Oregon continental margins, Active Tectonics and Seafloor Mapping Lab, College of Oceanic and Atmospheric Sciences, Oregon State University, 2008
Oregon canopy kelp	Oregon Department of Fish and Wildlife, Coastwide Survey, 1990
Coral and sponge	NOAA, Alaska Fisheries Science Center slope and shelf trawl surveys, 1977 to 2001, and Northwest Fisheries Science Center slope and shelf trawl surveys, 2001 to 2003
Pinniped rookeries and haulouts	Oregon Department of Fish and Wildlife, 2008
Steller sea lion critical habitat	National Marine Fisheries Service, 2008
Oregon seabird colony locations	U.S. Fish and Wildlife Service, 2008
10 meter bathymetry	Pacific Coast Groundfish Essential Fish Habitat Project. Consolidated GIS Data. Volume I: Physical and Biological Habitat. NOAA, 2005
Estuaries and coastal marshes	Pacific Coast Groundfish Essential Fish Habitat Project. Consolidated GIS Data. Volume I: Physical and Biological Habitat. NOAA, 2005
Seagrasses	Pacific Coast Groundfish Essential Fish Habitat Project. Consolidated GIS Data. Volume I: Physical and Biological Habitat. NOAA, 2005
Eastern North Pacific gray whale observations	OBIS-SEAMAP, 1986-2004
Rocky Intertidal	Shoreline Classified by Environmental Sensitivity to Spilled Oil (ESI), NOAA, 1996
Snowy Plover Critical Habitat	U.S. Fish and Wildlife Service, 2005
Marbled Murrelet Critical Habitat	U.S. Fish and Wildlife Service, 1996

Oregon coast extend from the Columbia River to Cape Blanco and from Cape Blanco to Cape Mendocino in northern California (STAC 2008). The Columbia River and Cape Blanco are significant barriers affecting currents and the movement of various marine organisms (STAC 2008). Next, IEAs were identified by mapping and analyzing these datasets using GIS software (ESRI 2009), reviewing scientific and management reports and consulting with local experts. Methods for analyzing geographic data included building layers of physical and biological spatial data allowing for graphic visualization of the extent of spatial overlap of habitats and species, and measurement and evaluation of the extent or numeric value of individual features and species, where available.

Description of Ecological Features and Data Sets

The ecological importance of rocky reef habitat, canopy kelp habitat and rocky shore habitat as well as the species associated with them is described in the Oregon Nearshore Strategy (ODFW 2006). Rocky reef habitat and canopy kelp habitat are designated Habitat Areas of Particular Concern (HAPC) by the National Marine Fisheries Service (NMFS) for their importance as Essential Fish Habitat and their rarity, sensitivity and/or vulnerability (NMFS 2005). Canopy kelp and rocky reef habitats provide nurseries, feeding grounds and/or shelter to a variety of fish species, seabirds and marine mammals. These HAPC designations have no associated management measures but agency consultation with NMFS is required before permitting activities that may harm them. Rocky reef data will be updated when the results of ongoing multi-beam seafloor mapping are made publicly available.

Corals and sponges recorded inside Oregon state waters are mostly Pennatulaceans (sea whips and sea pens, a

Heceta Head
Photo: Ben Nieves

type of octocoral) identified from NMFS trawl surveys. Octocorals such as Stylatula spp. reach 30-50cm in height and they are slow growing, long-lived species. Cold water corals, vase sponges, and reef forming sponges act as biogenic habitat for a variety of species including arrowtooth flounder, big skate, lingcod and many types of rockfish (NMFS 2005, Lumsden et al. 2007).

Estuaries and seagrasses provide critical ecological functions as nursery grounds for juvenile fish and invertebrates. Some commercially important species such as Dungeness crabs and Pacific herring use seagrass beds. In 2005 the Pacific Fishery Management Council designated estuaries and seagrasses as HAPC for their significance as Essential Fish Habitat (NMFS 2005).

Four species of pinnipeds frequent Oregon's rocky islands and protected shores for breeding and/or resting. These include California sea lions (haulout only), Pacific harbor seals, Steller sea lions, and the northernmost breeding colony of Northern elephant seals at Shell Island off Cape Arago. Critical habitat for the Endangered Species Act-listed Steller sea lion (threatened) is located at Orford Reef and Rogue Reef (Figures 9 and 10).

Over one million seabirds, including 14 different species, nest on offshore rocks and cliff faces along the Oregon coast (Naughton et al. 2007). Many seabirds live their lives entirely at sea except during the important breeding season when offshore rocks and remote cliffs are used for breeding, laying and incubating eggs, feeding and rearing chicks (Manuwal and Carter 2001). In addition to nesting seabirds, critical habitat for the ESA-listed snowy plover and breeding locations for other shorebirds such as black oystercatcher were included in this analysis. Critical habitat for the ESA-listed marbled murrelet was also identified. These seabirds nest in old growth forests and feed off the Oregon coast on krill and forage fish such as Pacific sand lance, herring, anchovy and smelts.

Rocky intertidal habitats are characterized by abundant and diverse biological communities including algae and marine plants, invertebrates, fish, marine mammals and seabirds (ODFW 2006). Oregon hosts approximately 82 miles of rocky intertidal habitat interspersed throughout the State's 360 miles of coastline. The physical characteristics of rocky shores include cliff faces, rocky platforms and boulder fields (ODFW 2006).

Over thirty species of marine mammals, seabirds, sea turtles and fish stocks that use Oregon's marine waters are listed as threatened or endangered under the federal Endangered Species Act (ODFW 2010).

Finally, the Oregon coast is part of the Eastern North Pacific gray whale migratory route between Baja California and the Arctic. Each year roughly 200 gray whales do not continue to the Arctic but stay and feed off the Oregon coast. Locations of gray whale sightings are included in figures 1-11, but sightings were not used to identify specific IEAs as it is unclear whether or not there are any specific preferred gray whale routes or feeding areas from these data alone.

Identifying Threats to IEAs

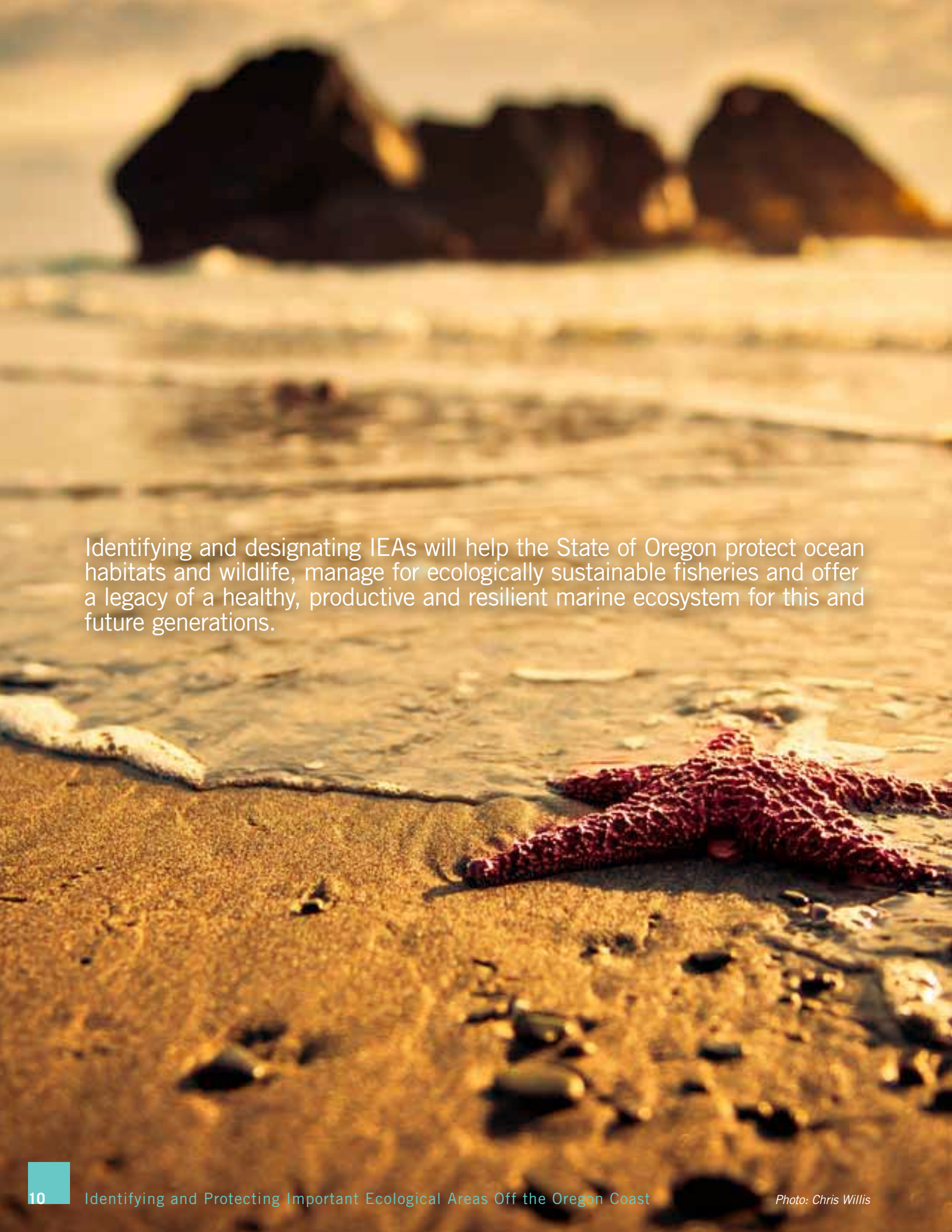
Threats to ocean health range from global warming and associated impacts including ocean acidification and dead zones, to over-exploitation, coastal and ocean development, habitat destruction, pollution, and other impacts. Heavy impacts on the continental shelf off Oregon and Washington occur from multiple stressors including acidification, fishing and pollution (Halpern et al. 2009).

In January 2000, following intensive fishing pressure, a risky fishery management strategy and highly uncertain scientific advice, the West Coast groundfish fishery was declared a commercial fishery disaster, as seven species of groundfish were overfished (NOAA 2000, Darm 2001). Canary and yelloweye rockfish, both found in the Oregon Territorial Sea, are not likely to rebuild to sustainable levels until approximately 2027 and 2087 respectively (Stewart 2009 and Stewart 2009b). Essential habitat for juvenile bocaccio rockfish extends throughout the Oregon Territorial Sea (NMFS 2005) and ODFW has listed this overfished species on its Nearshore Strategy as a strategy species in need of management attention (ODFW 2006). In 2009, petrale sole were determined to be overfished, and this species is found throughout Oregon state waters (Haltuch and Hicks 2009, NOAA 2005). What is more, managers have stock assessments for only 13 of 51 nearshore "watch list" and strategy fish species (ODFW 2006 and PFMC 2007 and 2005 stock assessments). Little or no information is available on the status of other fish populations, which raises concerns about the ability to successfully manage unassessed populations.

Discarded trash and fishing gear line an Oregon beach
Photo: NOAA

Over thirty species of marine mammals, seabirds, sea turtles and fish stocks that use Oregon's marine waters are listed as threatened or endangered under the federal Endangered Species Act (ODFW 2010). Other signs of depletion and stress include declines of forage fish such as Pacific eulachon (smelt) and Pacific herring, a Pacific whiting population at an all time low (Stewart and Hamel 2010), and seabird dieoffs associated with starvation (USFWS 2005). NMFS recently listed Pacific eulachon as threatened under the ESA, citing climate change, habitat alteration and fisheries impacts as causes for the species' decline (NMFS 2010). Further, all marine waters within the Oregon Territorial Sea and out to 110 meters depth in federally managed waters, plus some estuaries along the Oregon coast, are now designated as critical habitat for the threatened Southern Distinct Population Segment of the North American Green Sturgeon (NMFS 2009, Figure 14).

To assess spatially identifiable threats in the Oregon nearshore ecosystem, bottom trawl and potential wave



Identifying and designating IEAs will help the State of Oregon protect ocean habitats and wildlife, manage for ecologically sustainable fisheries and offer a legacy of a healthy, productive and resilient marine ecosystem for this and future generations.

Photo: Chris Willis

energy sites were analyzed in the study area in relation to IEAs. Bottom trawl gear impacts seafloor habitats across a wide range of substrates, reducing habitat complexity, altering seafloor communities and reducing productivity (NRC 2002, Auster and Langton 1999, Hixon and Tissot 2007). Bottom trawling indirectly alters community structure and ecosystem processes (NRC 2002, Hannah et al. 2010). Wave energy facilities have potential impacts including striking or entangling marine wildlife, electromagnetic field effects, noise and toxic impacts associated with paints and other chemicals (Cada et al. 2007, Boehlert et al. 2008).

Groundfish trawl paths using set and haul points provided by the Pacific States Marine Fisheries Commission/ Pacific Coast Fisheries Information Network and the Oregon Department of Fish and Wildlife were aggregated into three combined years and buffered to show general trawl areas in state waters. Proposals for offshore energy development sites include Coos Bay Ocean Powers Technology (OPT) Wave Park, Douglas County Project (Douglas County), Principle Power Offshore Wind Project (offshore wind, in partnership with TIDE) and Reedsport OPT (PFMC 2009). Others such as the Newport OPT Wave Park, Oregon Coastal Wave Energy Project (Tillamook Coastal Development Entity (TIDE)), and Florence Wave Park were identified, but preliminary federal permits are no longer active. The Reedsport OPT may be the first to install wave energy buoys, possibly in 2010.

In addition to bottom trawl and wave energy facilities, we have mapped other existing uses including undersea cables, dredge disposal sites, sewer outfalls and barge/ tug lanes (Figures 1-11). Some of these activities may have low level impacts or contribute to cumulative impacts. In any case, they are spatially defined human uses of the Oregon Territorial Sea. Spatial data on other uses such as recreational fishing and other commercial fisheries (non-groundfish trawl) were not available for analysis. Collection and incorporation of these data would be greatly beneficial to Marine Spatial Planning processes and there are efforts underway now to do this (Oregon Coastal Caucus 2009).

TABLE 2: Human Uses and Activities, GIS datasets

FEATURE	DESCRIPTION	DATA SOURCE
Proposed Offshore Energy Sites	Preliminarily Permitted Areas for offshore wave/wind energy development	Federal Energy Regulatory Commission, 2008
Dredge Spoil Disposal Areas	Ocean dredged material disposal sites along the Oregon coast.	Army Corps of Engineers, 2008
Undersea Cables	Underwater fiber optic cables off the Oregon Coast	Oregon Fishermen's Cable Committee, 2005
Sewer Outfalls	Point locations of facilities with permits to discharge pollutants into Oregon coastal waters and watersheds.	Oregon Department of Environmental Quality, 2008
Barge and Tug Lanes	Barge/tug tow lane areas as agreed by tow boat operators and Northwest crab fishermen to prevent tug and crab gear conflicts.	Sea Grant, 2007
Bottom Trawling, 2003-2005	Aggregated groundfish bottom trawling between 2003-2005, state waters only	ODFW 2003, PacFIN 2007
Oregon State Parks	Oregon State Parks, Recreation Areas, Natural Areas, etc.	Oregon Parks and Recreation Department, 2008
Oregon Territorial Sea	Three nautical mile state jurisdiction	Oregon Ocean-Coastal Management Program - Department of Land Conservation and Development, 2008

Sunset off the Oregon Coast
Photo: Ben Nieves

Protecting IEAs off the Oregon Coast

Oceana worked with Our Ocean, a coalition of environmental organizations, scientists, businesses and coastal community members, to develop proposals for a network of marine protected areas and reserves (no take areas) designed to protect Oregon's IEAs and the overall health and resilience of the coastal and nearshore marine ecosystems. In September 2008, this Our Ocean coalition submitted eight proposals in response to a statewide call for marine reserve nominations as described in Governor Kulongoski's Executive Order 08-07. Governor Kulongoski's Ocean Policy Advisory Council (OPAC) stated that the overall purpose of a network of marine reserves in Oregon's Territorial Sea is to, "provide an additional tool to help protect, sustain, or restore the nearshore marine ecosystem, its habitats, and species for the values they represent to present and future generations" (OPAC 2008). OPAC defined the following goal:

> Protect and sustain a system of fewer than ten marine reserves in Oregon's Territorial Sea to conserve marine habitats and biodiversity; provide a framework for scientific research and effectiveness monitoring; and avoid significant adverse social and economic impacts on ocean users and coastal communities. A system is a collection of individual sites that are representative of marine habitats and that are ecologically significant when taken as a whole. (OPAC 2008)

Our Ocean coalition designed and submitted to the State eight marine protected area and marine reserve proposals based on the identification of Oregon's IEAs; the overall purpose, goals and objectives defined by OPAC; the governor's executive order; and the size and spacing guidelines developed by the OPAC Scientific Technical Advisory Committee (STAC) (STAC 2008).

The STAC marine reserve size and spacing report is an essential piece to the design of the conservation proposal as it provides the scientific basis for achieving an ecologically significant network of marine reserves (STAC 2008). The report provides guidelines for the size, shape and spacing of marine reserves and networks necessary for meeting objectives for protecting species diversity,

protecting marine habitats, and to enhance ecosystem resilience. These recommendations included marine reserves distributed along the full Oregon coast in each biogeographic region, spaced no more than 50-100 km apart, with individual sites having a minimum alongshore distance of 5-10 km, but preferably 10-20 km in length (STAC 2008).

The boundaries of the proposals submitted by Our Ocean were designed to reflect the identified ecological features, meet minimum and preferably optimum size guidelines recommended by the STAC, meet the requirements of the executive order, and ease enforcement. Figure 12 shows the statewide proposal of the eight Our Ocean areas plus the area submitted by Port Orford Ocean Resource Team that the Our Ocean coalition supported.

RESULTS

IEA Identification

Oceana identified 31 coastal and marine areas in the Oregon Territorial Sea as IEAs. The IEA maps are presented in Figures 1-11 and a matrix of the areas, existing human uses and activities, and existing and proposed conservation areas are presented in Tables 3-4. Oregon's 22 major estuaries and 17 minor estuaries were identified and highlighted when adjacent to the coastal and marine IEAs. All sites contain multiple ecological features.

Some proposed wave energy sites directly overlap IEAs such as Three Arch Rocks and Cape Falcon, an area under evaluation for a marine reserve designation. Bottom trawling also occurs within some of the identified areas as well as other spatially defined uses and activities (Figures 1-11 and Tables 3-4).

Tables 3 and 4 show where IEAs overlap with existing protected areas such as the U.S. Fish and Wildlife Service (USFWS) Oregon Coast National Wildlife Refuge Complex, including Oregon Islands, Three Arch Rocks and Cape Meares. Also identified are sites designated in the Oregon Territorial Sea Plan as Marine Gardens, Habitat Refuge and Research Reserves (OPAC 1994). These are primarily intertidal protected areas, with different management objectives and various uses, including fishing. The Whale Cove Habitat Refuge is the exception where the harvest of fish and invertebrates is not allowed.

In the initial stage of identifying IEAs, it is unnecessary to define specific spatial boundaries. Figures 1-11 depict the general area of the identified IEAs for graphical representation, within polygons that were used for spatial analysis. It is in the process of designating IEAs or designing management measures for marine protected areas that specific boundaries are identified.

China Rockfish
Photo: Steve Fisher, NOAA

IEA Protection

The State of Oregon and OPAC received 20 marine reserve and marine protected area proposals from the public that all revolved around nine areas. These nine areas included 23 of the IEAs identified in this analysis. Some IEAs were not nominated for protection, like Seal Rock and Rogue Reef, due to their proximity to major ports, to avoid social and economic impacts and to stay within the limits specified in the governor's Executive Order 08-07. The marine protected areas in the Our Ocean coalition proposal would allow all uses except bottom trawling, offshore development and the commercial harvest of forage species. The coalition supported an additional proposal for a marine reserve and no trawl zone around the Orford and Blanco Reef

areas submitted by the Port Orford Ocean Resource Team (POORT). When taken as a whole, these nine areas constituted an ecologically significant network designed to conserve the marine habitats and biodiversity that make up Oregon's IEAs (Figure 12). Of the eight proposals submitted by the Our Ocean coalition, seven were found by the State to have either high or medium-high ecological value (OPAC 2008b). Independent scientific review including the Oregon Chapter of the American Fisheries Society, academic scientists and others found all areas to be of ecological importance, including the proposed network as a whole (Hixon 2008).

In November 2008, a majority of OPAC recommended that six sites move forward for designation or further evaluation. OPAC recommended two "pilot" sites: a marine reserve and adjacent protected area at Redfish Rocks and a marine reserve at Otter Rock. OPAC's recommendation included further evaluation of the Cape Falcon, Cascade Head and Cape Perpetua Areas (including Heceta Head) and development of a proposal in the Cape Arago – Seven Devils area. In June 2009 the Oregon legislature passed HB 3013a that implements the OPAC recommendations and defines a process for moving forward with the development of management plans and evaluation. The two pilot marine reserves total 0.3% of the Oregon Territorial Sea, the three marine reserve areas identified for further evaluation total 6.5% of the Territorial Sea and the sixth site at the Cape Arago-Seven Devils area is undefined (Figure 13).

DISCUSSION AND NEXT STEPS

Identifying IEAs is an imperative first step to a comprehensive conservation planning approach. This analysis of physical, biological and social datasets demonstrates that it is possible to identify specific ecological areas that warrant spatial management and monitoring using existing public data and information. This approach can meet multiple ecological, social and economic objectives.

IEAs may require additional management measures up to and including marine protected areas and marine reserves, depending on specific management objectives such as biodiversity conservation, recovery of depleted stocks, or habitat protection (Lubchenco et al. 2003, NRC 2000, OPAC 2008). For Oregon, marine reserve objectives

Bull Kelp at Crook Point/Mack Reef Area
Photo: USFWS

Pacific White-sided Dolphins
Photo: NOAA

should be consistent with Oregon's existing ocean management goals and policies, the Governors' Agreement on Ocean Health and the OPAC marine reserve policy recommendations. In light of the Governor's commitment to a network of fewer than 10 marine reserves and to provide for the conservation of marine habitats, biodiversity and the long-term health of Oregon's marine ecosystem, it is necessary to include other designations for Oregon's IEAs not receiving reserve status, such as marine protected areas or habitat refuges. The successful implementation of an ecologically significant network of reserves and protected areas must also include application of the STAC size and spacing guidelines.

Phase 3 of the IEA approach includes development and implementation of a monitoring program. Monitoring in the context of IEAs generally refers to the process of collecting information about state variables (i.e. abundance, size, temperature) over time for the purpose of detecting change (Gerber et al. 2005). Monitoring these changes is important to understand the extent to which management measures are working and therefore provide guidance for changes to regulations in an adaptive management context. Additionally, monitoring can also help distinguish secular environmental changes from those caused by specific activities, thus helping improve future designs. At this time there is not a comprehensive monitoring plan in place but one should be developed and implemented over the next couple of years. A comprehensive monitoring program would include all of the identified IEAs, not just those receiving marine reserve designation.

While this IEA analysis was first applied to the design of marine protected area and reserve proposals used in the Oregon marine reserve process, the identification and ultimate designation of IEAs will be a valuable tool to advance comprehensive Marine Spatial Planning. As the State of Oregon makes difficult decisions about conserving marine resources and habitats, providing for sustainable uses and permitting new activities, such as offshore development projects, it is essential to first identify and designate IEAs. Identifying and designating IEAs will help the State of Oregon protect ocean habitats and wildlife, manage for ecologically sustainable fisheries and offer a legacy of a healthy, productive and resilient marine ecosystem for this and future generations.

Figure 1: Important Ecological Areas and Human Activities–Tillamook Head, June 2010.

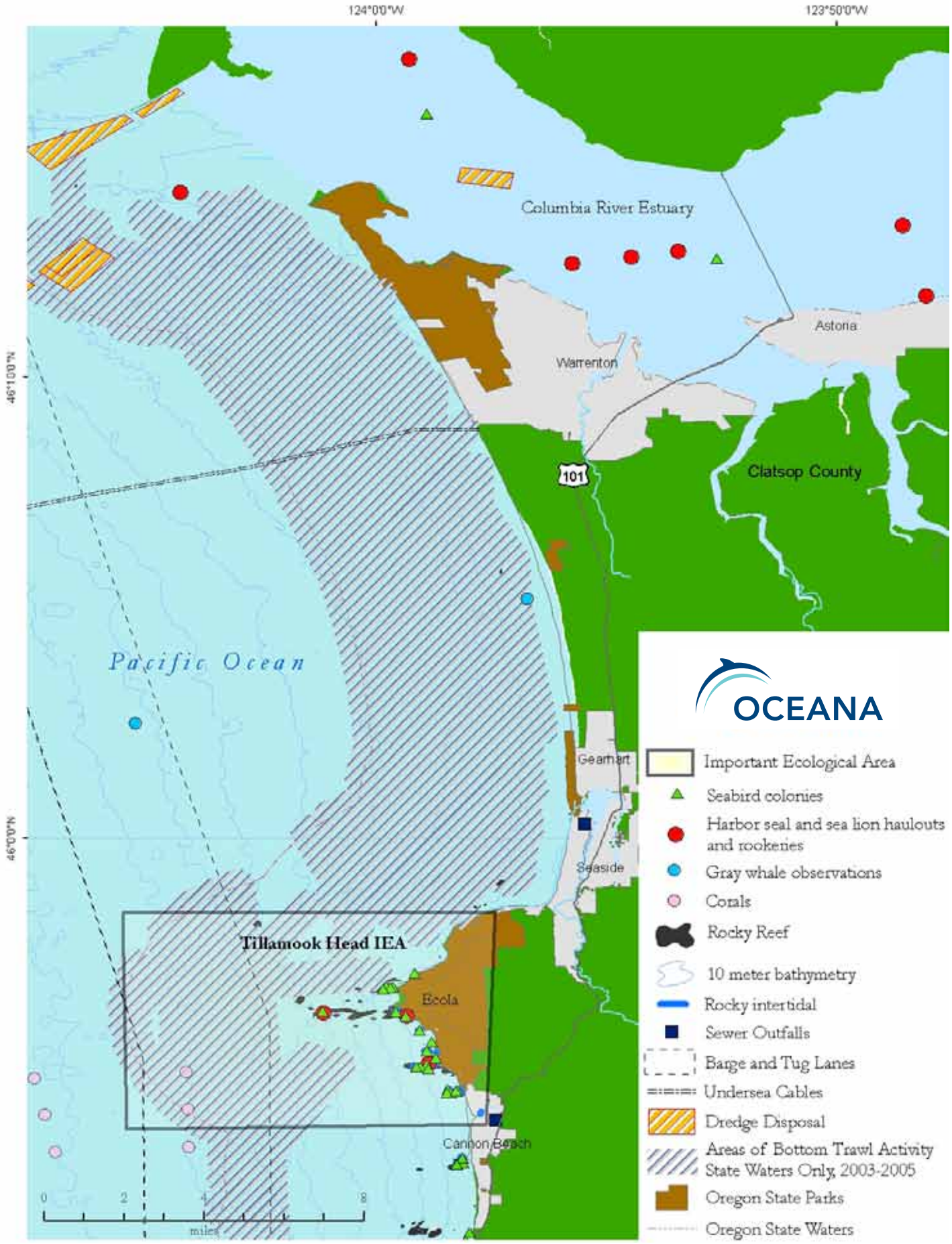


Figure 2: Important Ecological Areas and Human Activities–Cape Falcon to Three Arch Rocks, June 2010.

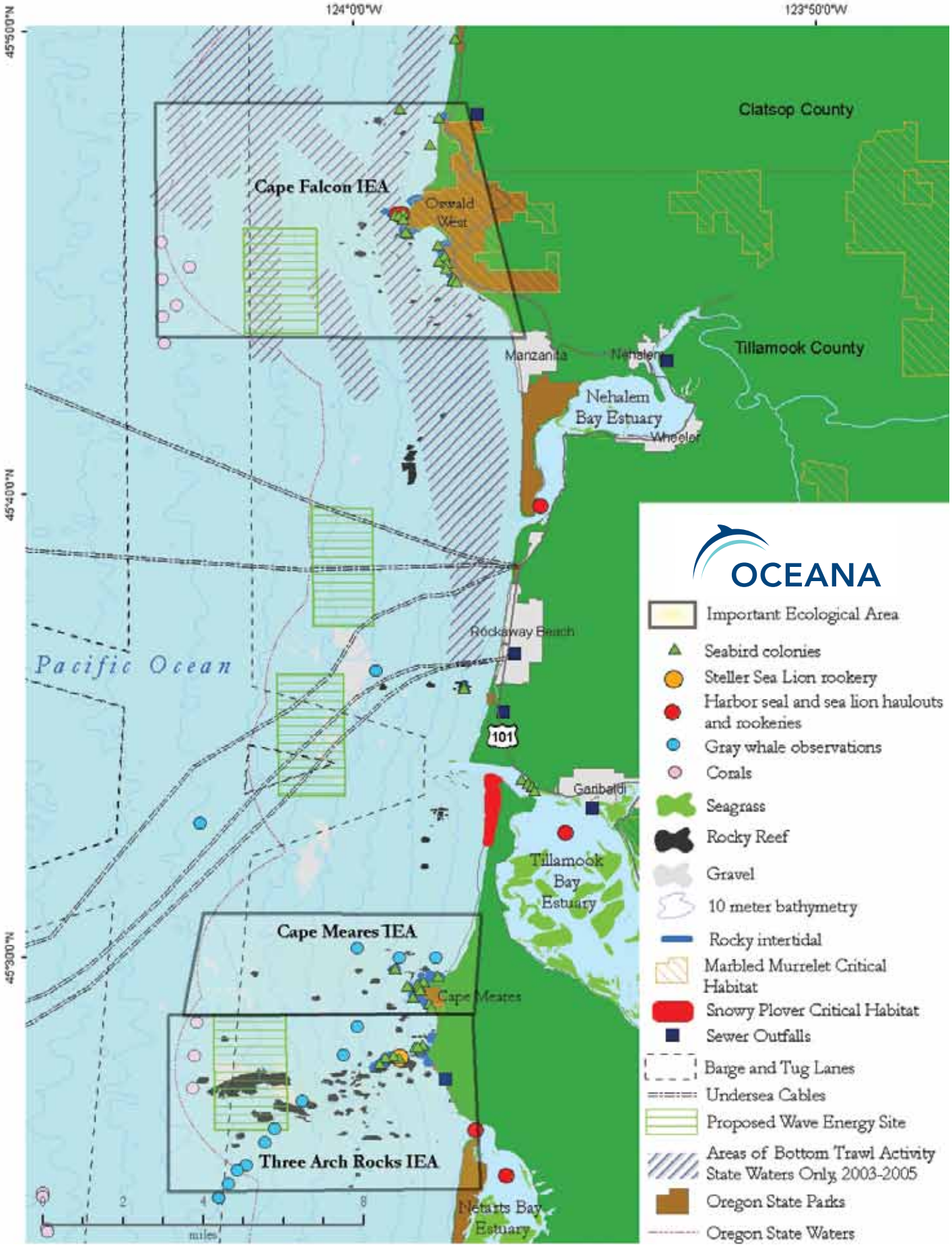


Figure 3: Important Ecological Areas and Human Activities–Cape Lookout to Cascade Head, June 2010.

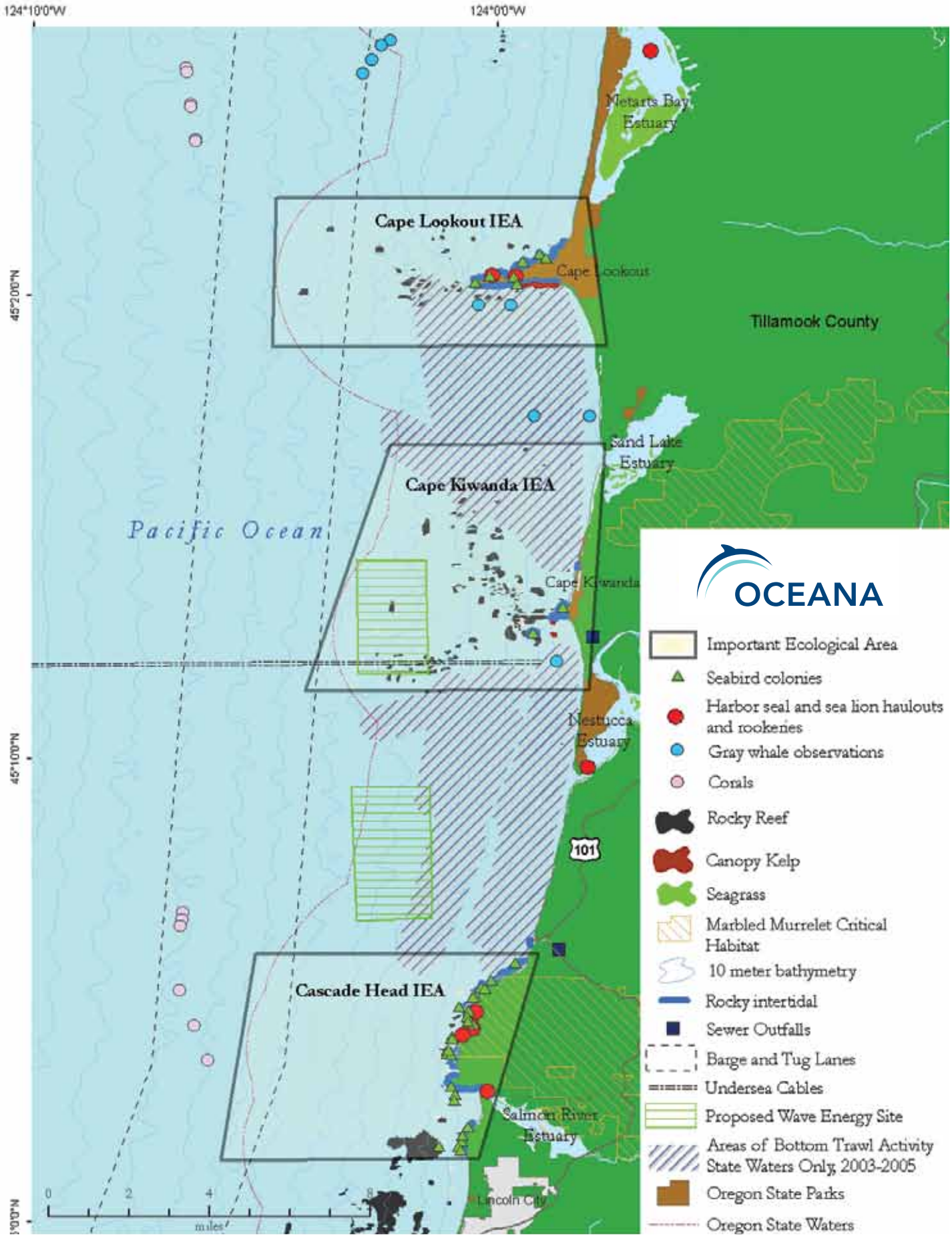


Figure 4: Important Ecological Areas and Human Activities–Siletz Reef to Yaquina Head, June 2010.

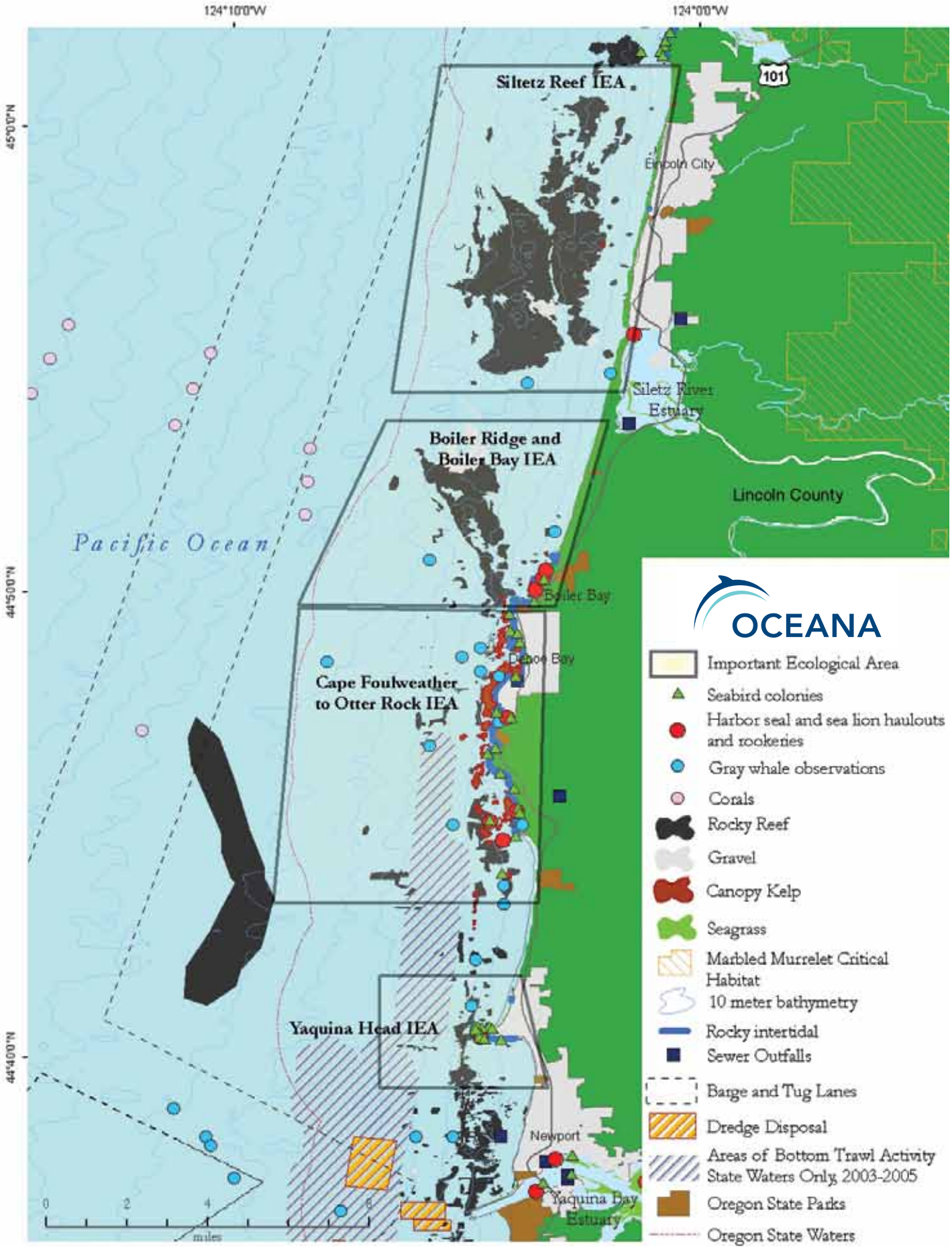


Figure 5: Important Ecological Areas and Human Activities–Seal Rock to Cape Perpetua, June 2010.

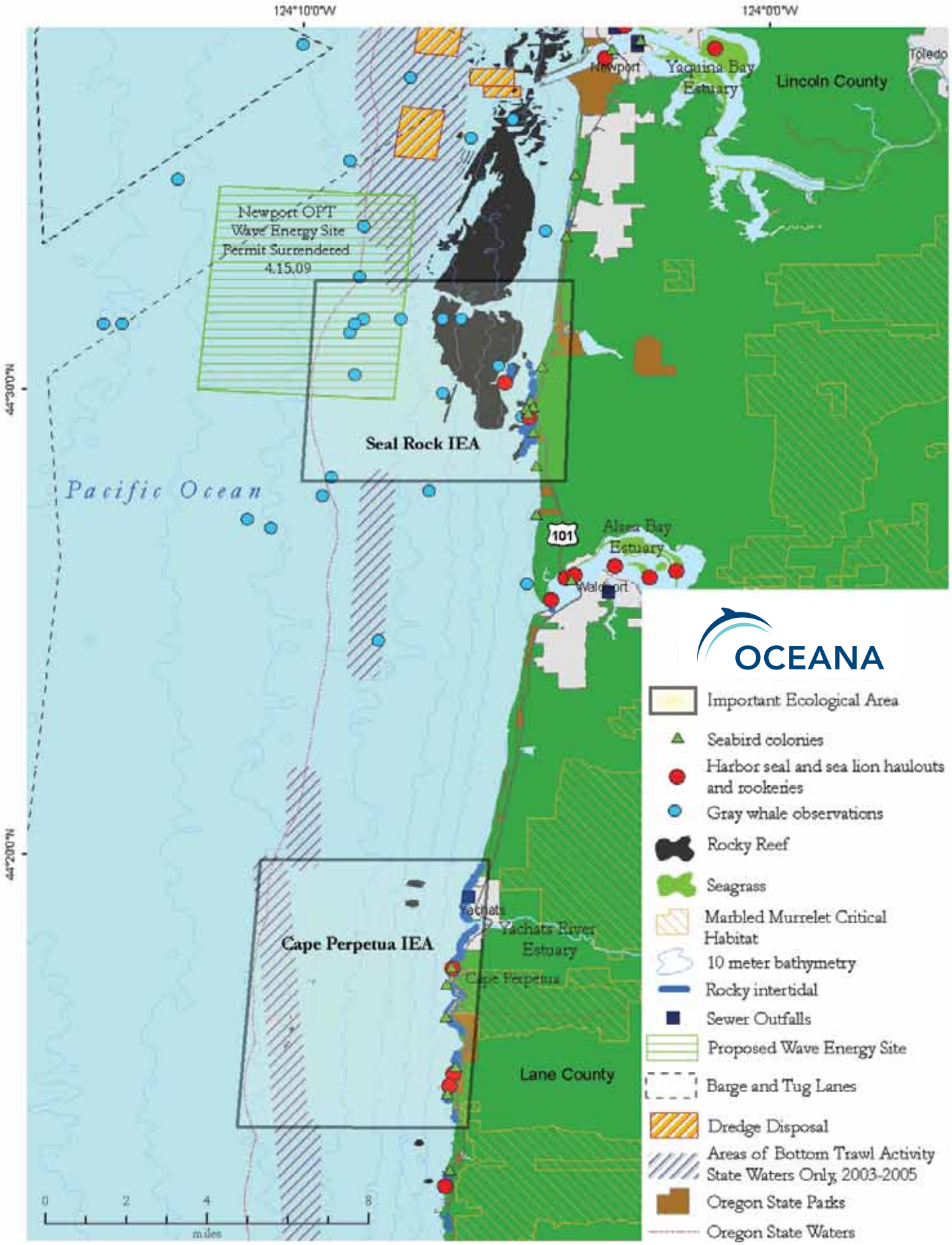


Figure 6: Important Ecological Areas and Human Activities–Heceta Head to Tahkenitch Creek, June 2010.

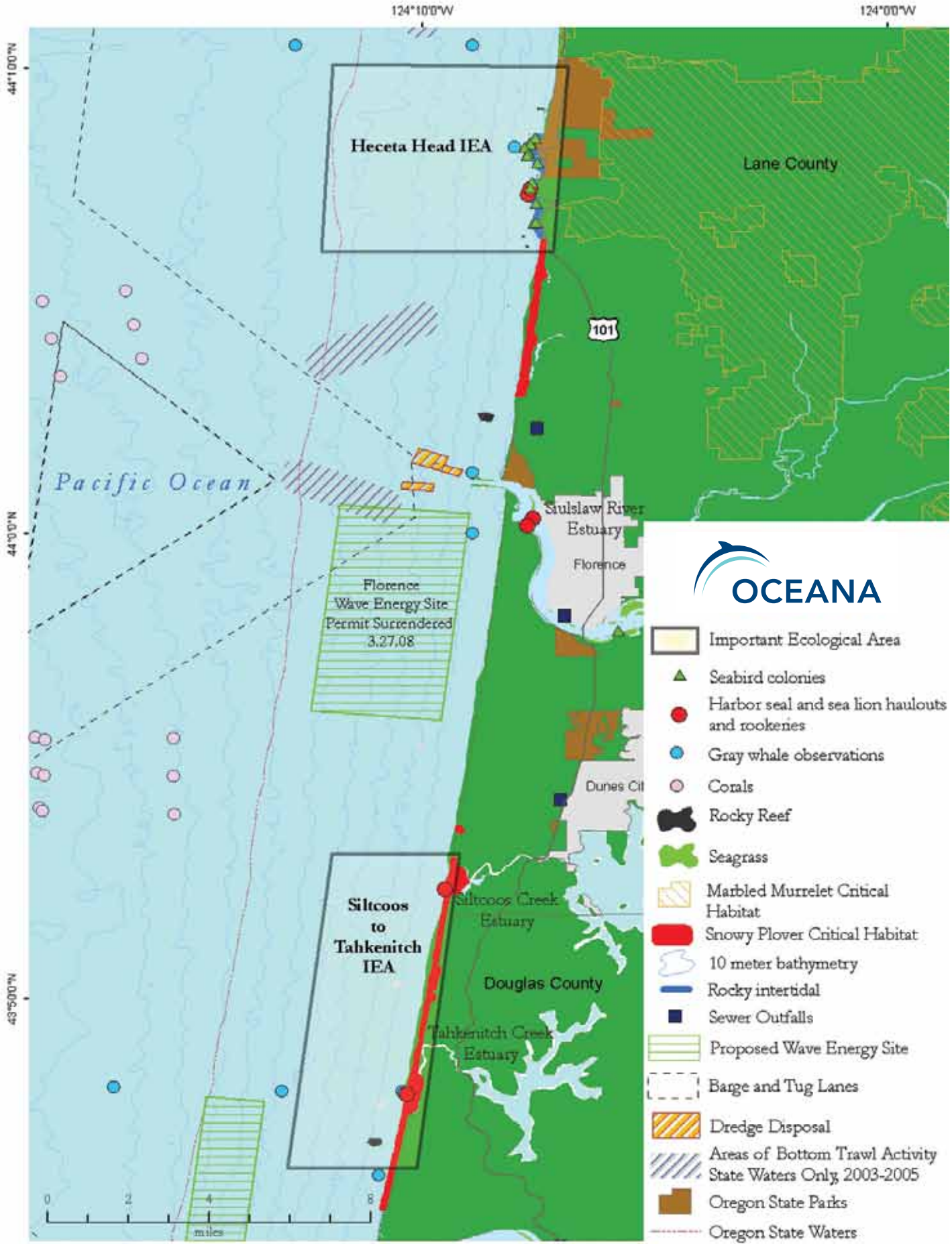


Figure 7: Important Ecological Areas and Human Activities–Umpqua to Cape Arago, June 2010.

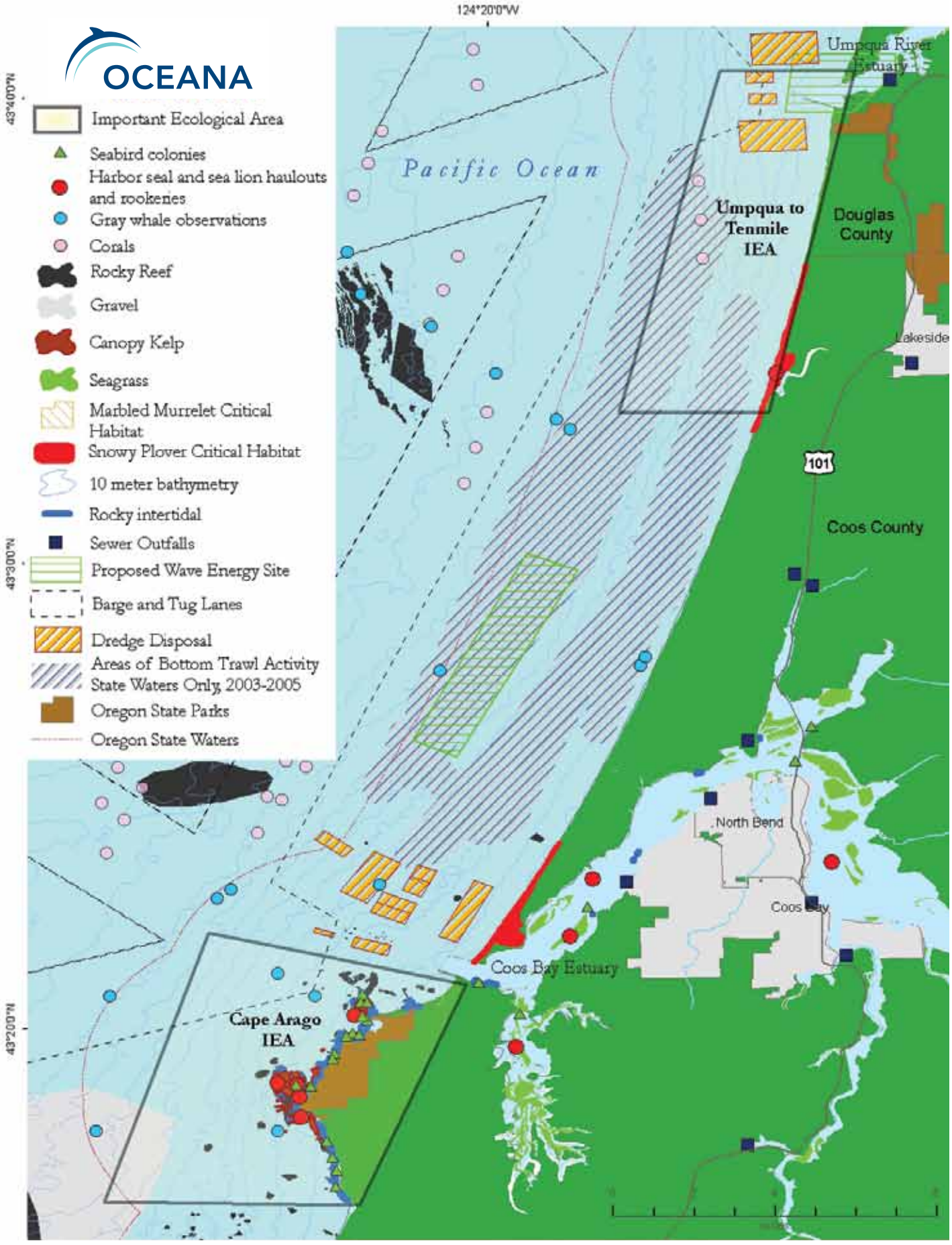


Figure 8: Important Ecological Areas and Human Activities–Cape Arago to Coquille, June 2010.

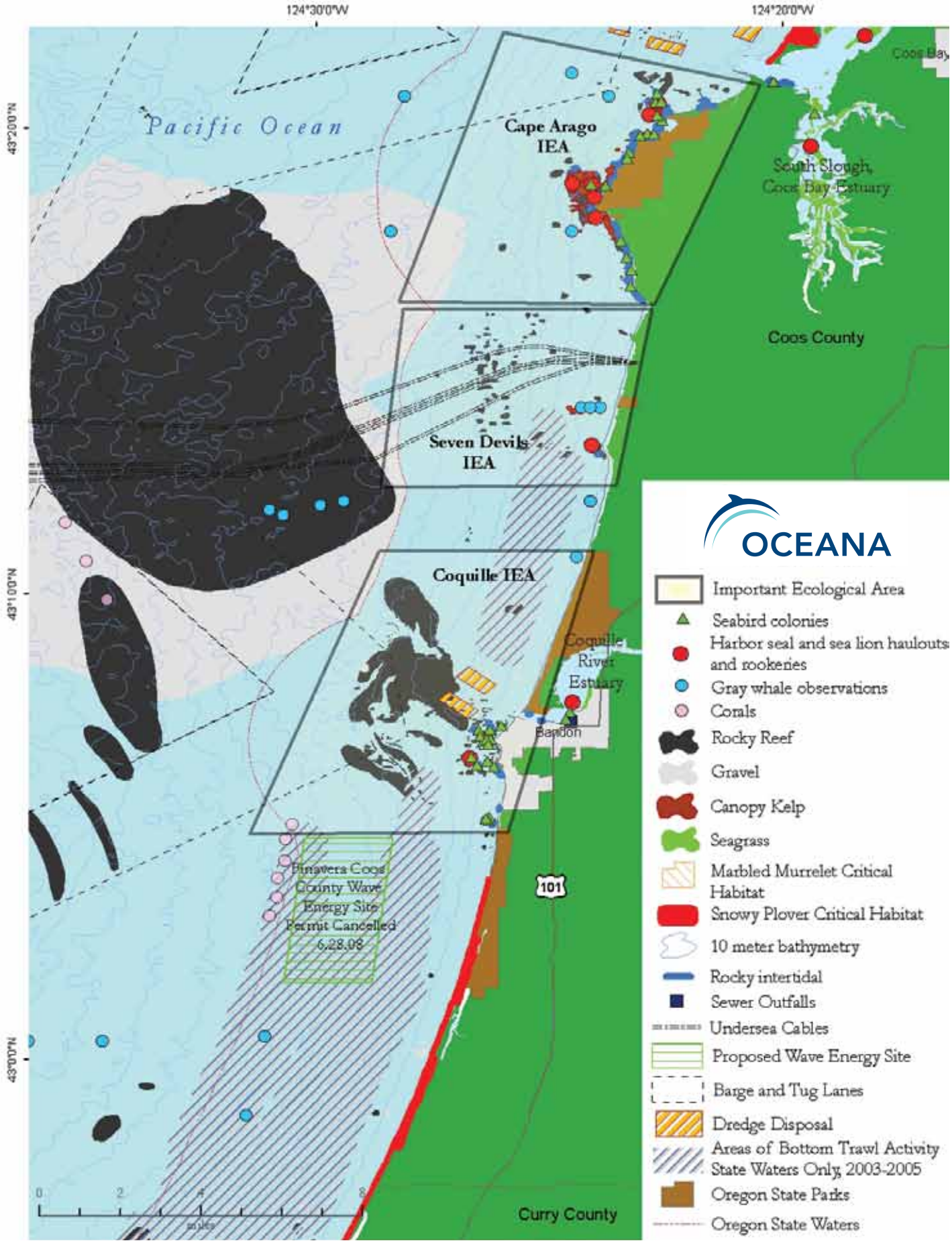


Figure 9: Important Ecological Areas and Human Activities–Blacklock Point to Humbug Mountain, June 2010.

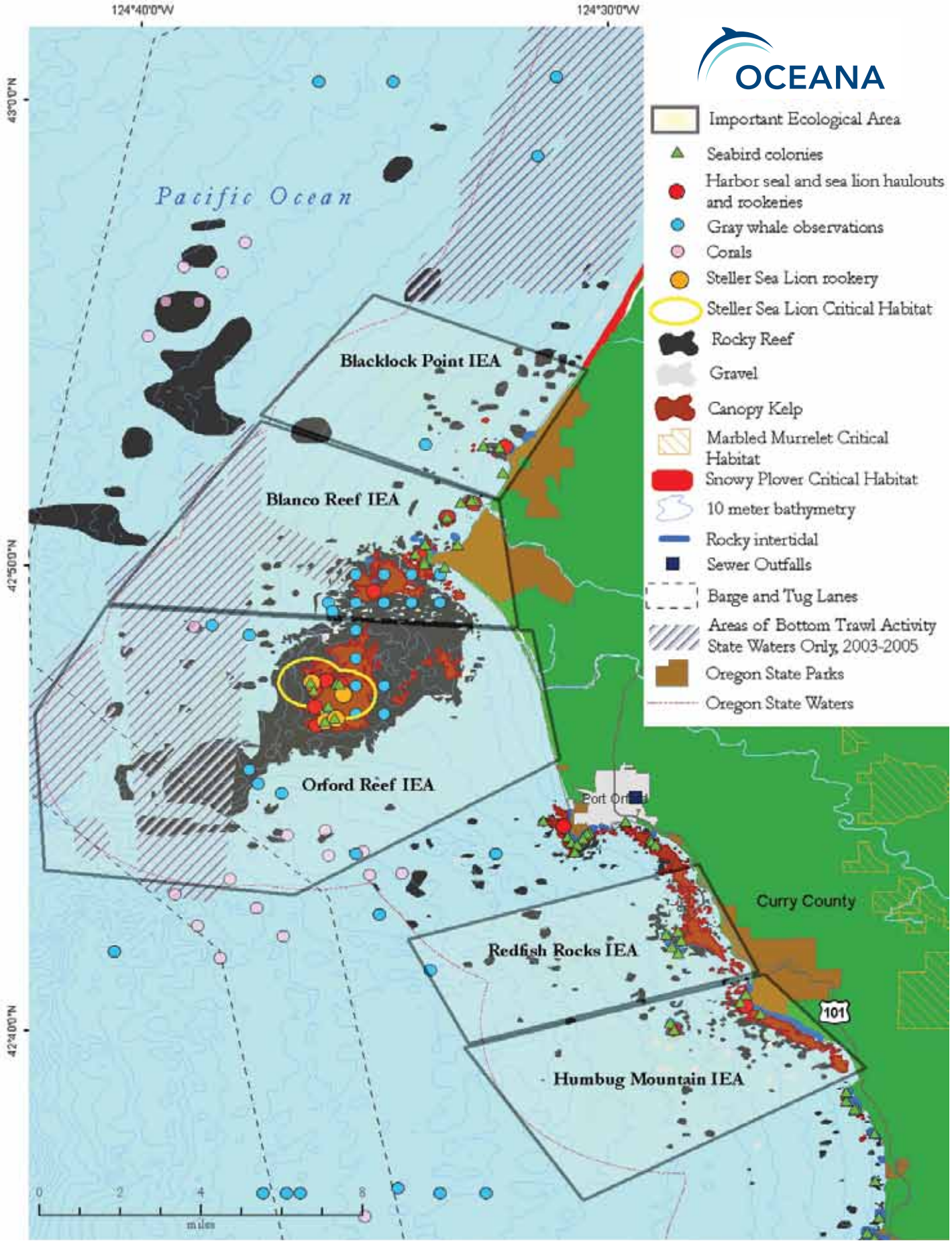


Figure 10: Important Ecological Areas and Human Activities–Sister's Rocks to Mack Reef, June 2010.

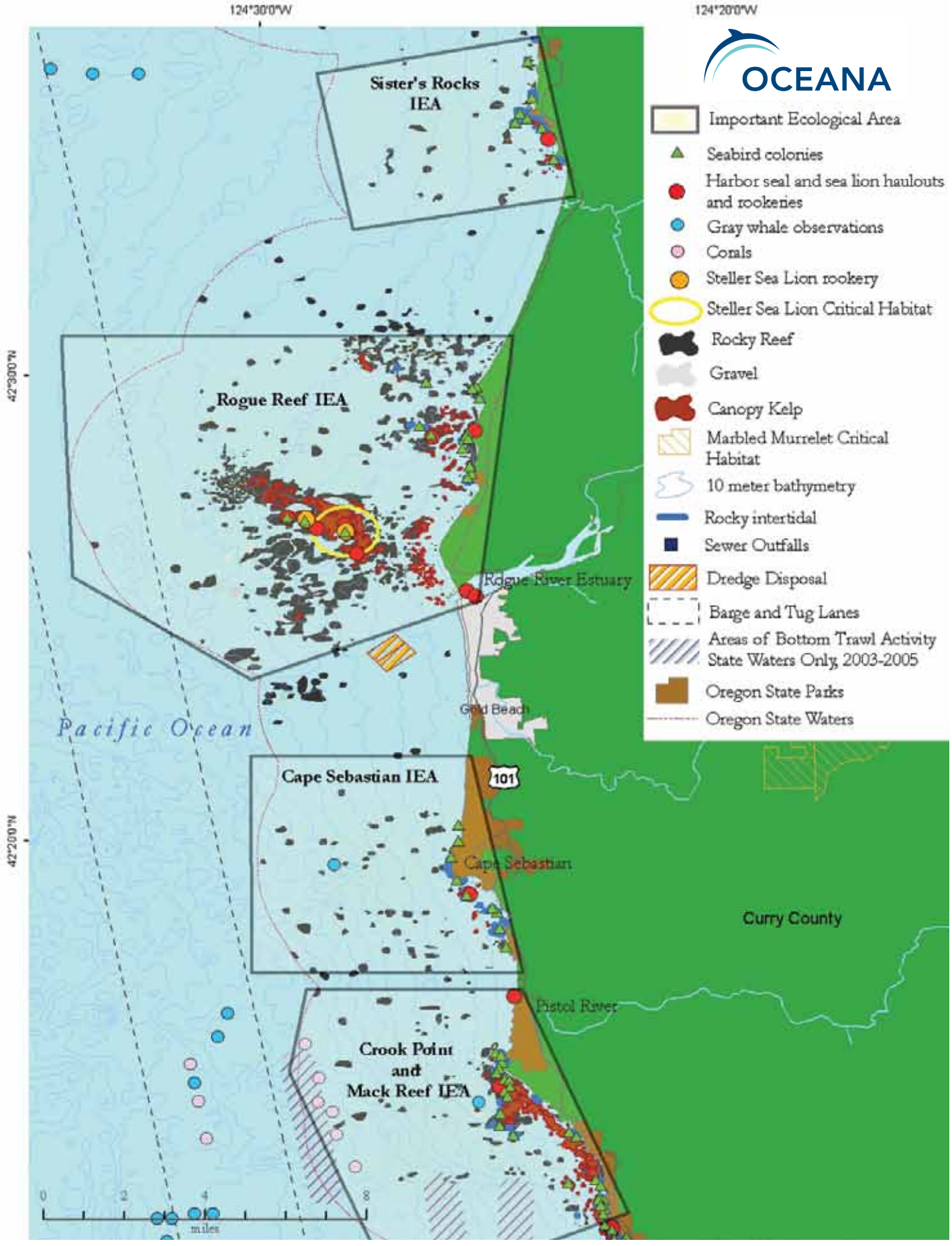


Figure 11: Important Ecological Areas and Human Activities–Cape Sebastian to Goat Island, June 2010.

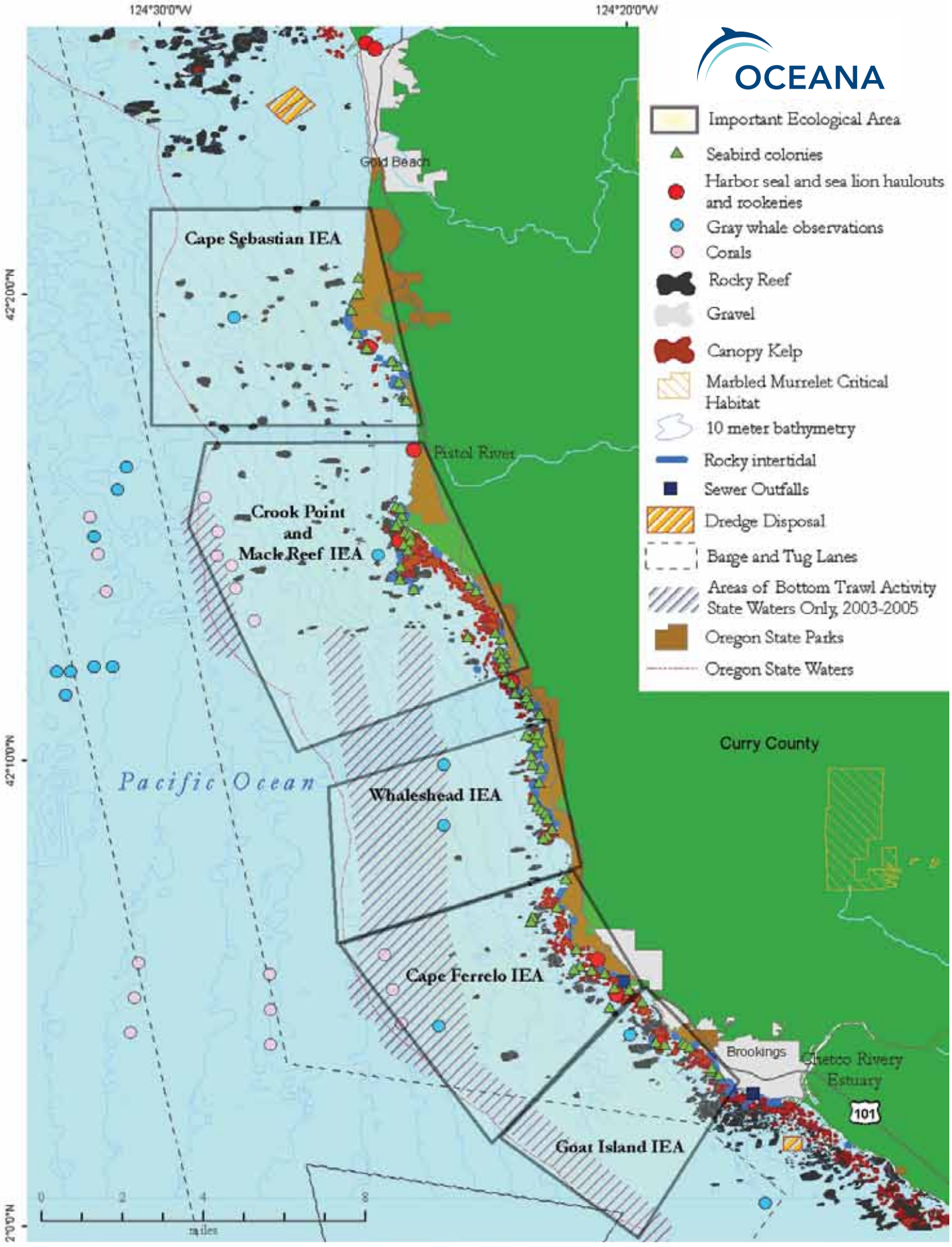


Figure 12: Proposed network of marine protected areas and marine reserves submitted to the State of Oregon, September 2008 by the Our Ocean coalition. Also showing the Port Orford Ocean Resource Team propoal.

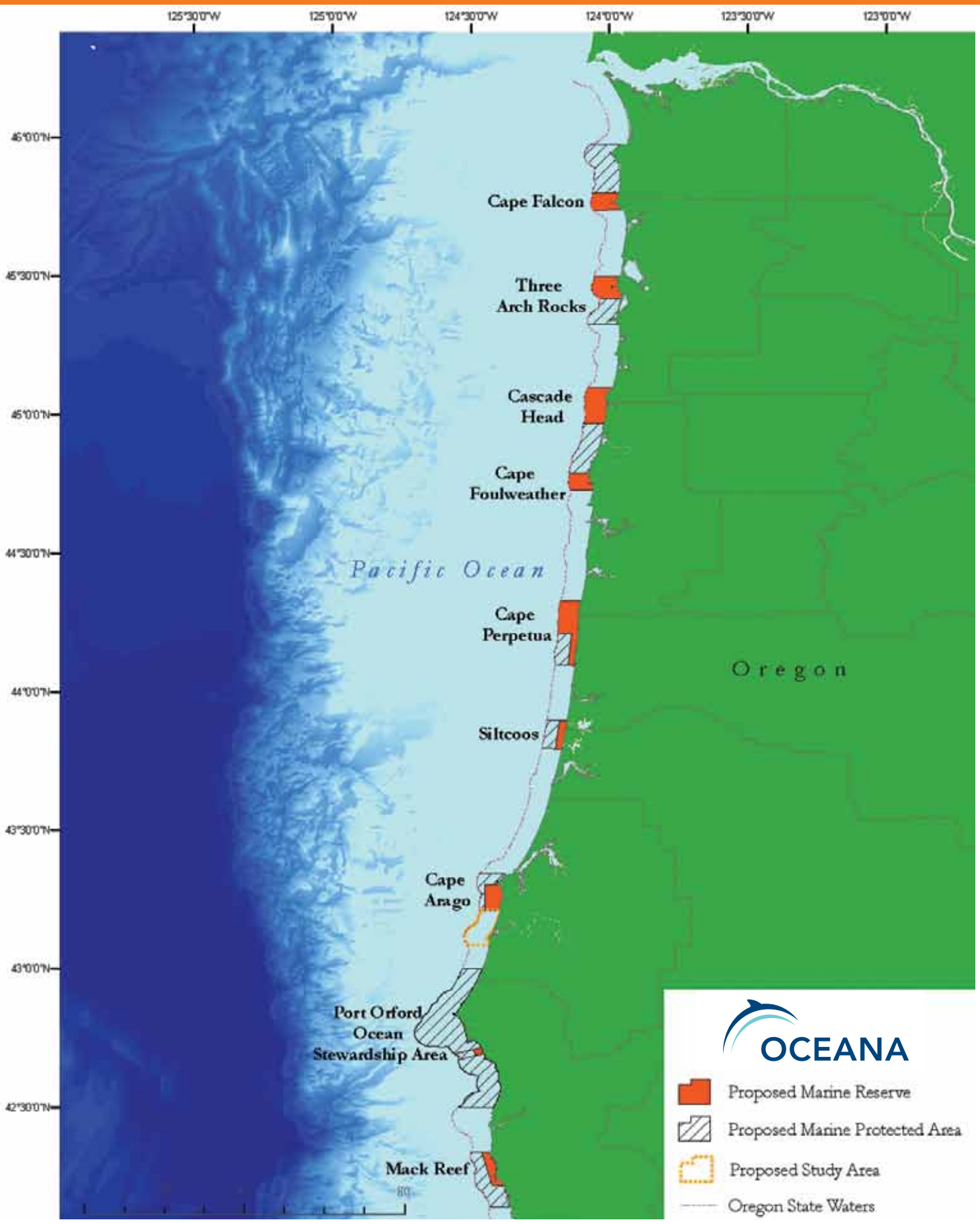


Figure 13: Oregon marine reserve pilot projects, areas for further evaluation and proposal as defined in House Bill 3013

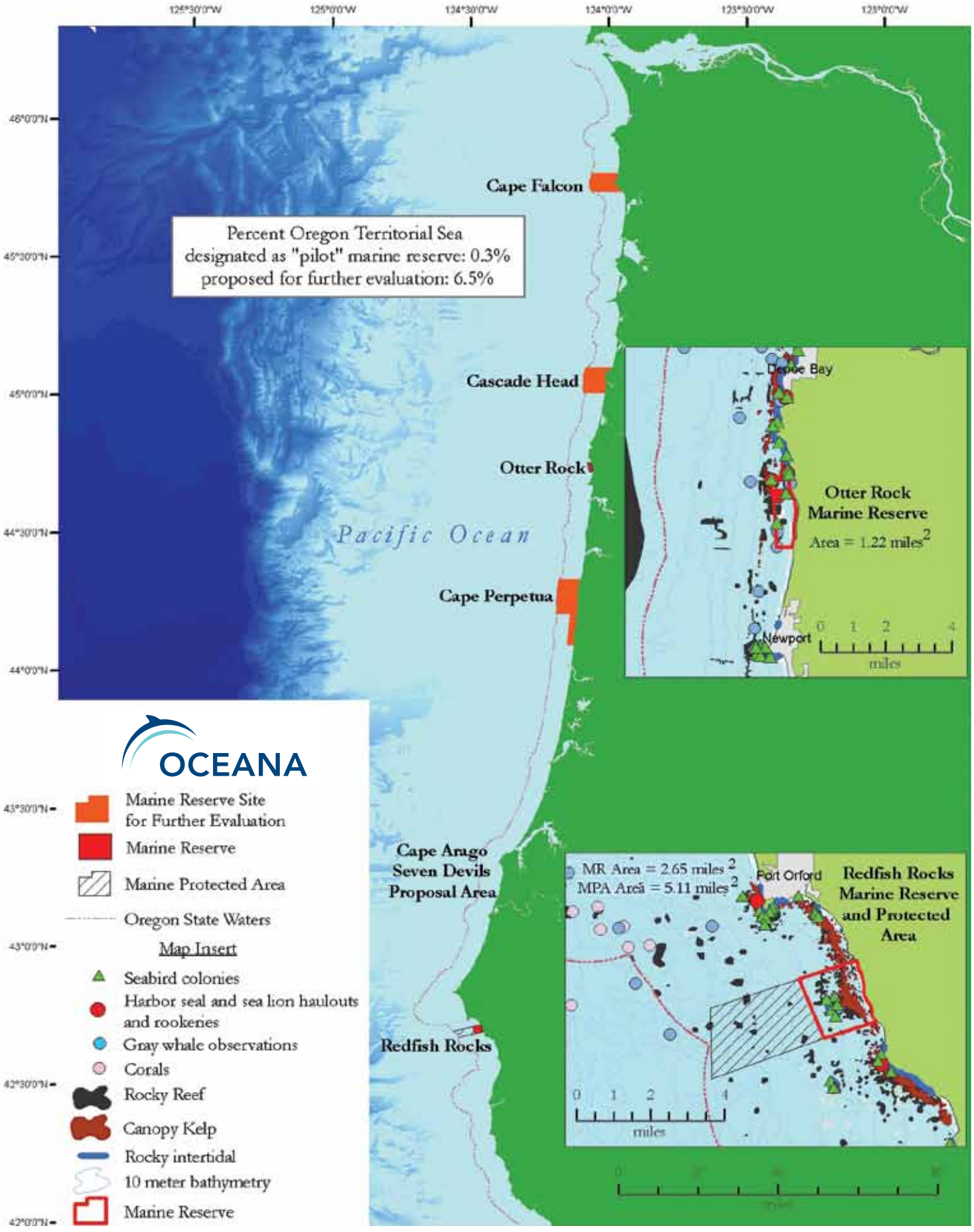


Figure 14: Critical Habitat for Threatened and Endangered Fish Species

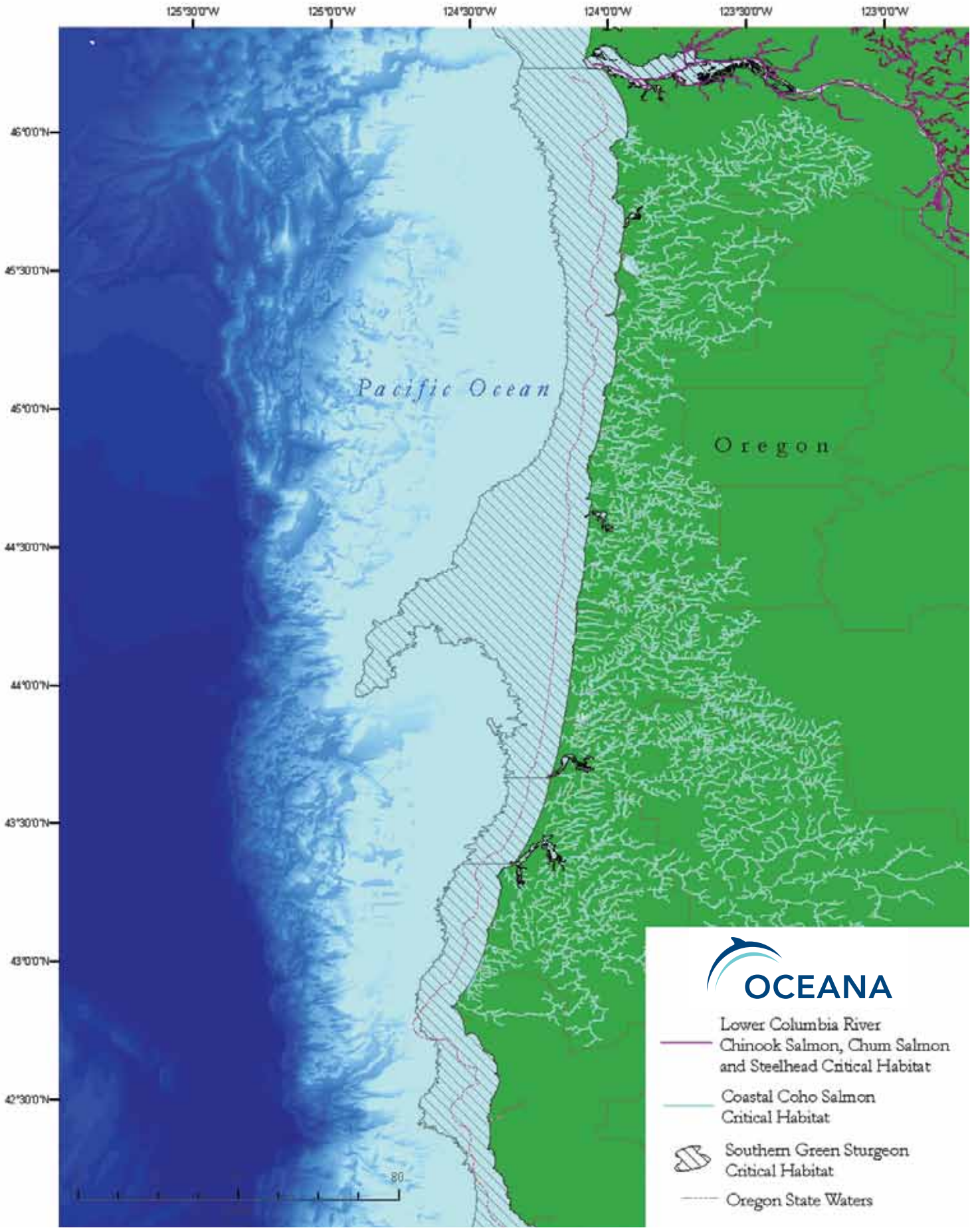


Table 3: Elements of Important Ecological Areas

	Ecological Features								Spatially Defined Human Uses					Proposed Conservation Areas		Existing Conservation Areas		
Important Ecological Area	Rocky Intertidal	Seabird Colonies	Pinniped Haulout/Rookery	Rocky Reef	Canopy Kelp	Endanggered/Threatened Species Critical Habiatt	Corals and Sponges	Adjacent Estuary	Bottom Trawl 03-05	Undersea Cable	Dredge Disposal	Sewer Outfall	Proposed Wave Energy	Marine Reserve	Marine Protected Area	Rocky Shore/Intertidal/ Subtidal Designation	USFWS Refuge	Adjacent Terrestial Protected Area
Tillamook Head		23	PV, ZC, EJ			GS												State Park (SP)
Cape Falcon		20	PV			MM, GS												SP
Cape Meares		10				MM, GS	u											USFWS
Three Arch Rocks		9	EJ, PV			EJ, GS												
Cape Lookout		7	PV			GS	u											SP
Cape Kiwanda		2				GS	u											SP
Cascade Head		28	PV, EJ, ZC			MM, GS	u											USFS, TNC
Nelscott and Siletz Reef		0	PV			GS	u											
Boiler Bay and Boiler Ridge Reef		3	PV			GS	u											SP
Cape Foulweather to Otter Rock		18	PV			GS	u											SP
Yaquina Head		12	PV			GS	u											BLM, SP
Seal Rock		7	EJ, PV			GS	u											SP
Cape Perpetua		6	PV			MM, GS	u											USFS, SP
Heceta Head		13	EJ, ZC			MM, WSP, GS	u											USFS, SP
Siltcoos and Tahkenitch			PV			WSP, GS	u											USFS
Umpqua and Tenmile Creek			PV			WSP, GS												USFS, SP
Cape Arago		19	EJ, ZC, MA, PV			GS	u							Proposal in Development				SP
Seven Devils / Five Mile Point			PV			GS	u											SP
Coquille Reef		16	PV			GS												USFWS, SP

	Ecological Features								Spatially Defined Human Uses					Proposed Conservation Areas		Existing Conservation Areas		
Important Ecological Area	Rocky Intertidal	Seabird Colonies	Pinniped Haulout/Rookery	Rocky Reef	Canopy Kelp	Endanggered/Threatened Species Critical Habiatt	Corals and Sponges	Adjacent Estuary	Bottom Trawl 03-05	Undersea Cable	Dredge Disposal	Sewer Outfall	Proposed Wave Energy	Marine Reserve	Marine Protected Area	Rocky Shore/Intertidal/ Subtidal Designation	USFWS Refuge	Adjacent Terrestial Protected Area
Blacklock Point		4	PV			GS	u											State Park (SP)
Blanco Reef		10	PV, EJ			GS	u											SP
Orford Reef		8	EJ, ZC, PV			EJ, GS												
Redfish Rocks		5				GS	u											SP
Humbug Mountain		5	PV			GS	u											SP
Sister's Rocks		8	PV			GS	u											SP
Rogue Reef		17	EJ, ZC, PV			EJ, GS	u											SP
Cape Sebastian		9	PV			GS	u											SP
Crook Point and Mack Reef		25	EJ, ZC, PV			GS												USFWS, SP
Whaleshead		18	PV			GS	u											SP
Cape Ferrelo		12	PV			GS												SP
Goat Island		9	PV			GS	u											SP

Table Key

Rocky Intertidal (mi)		Pinniped		Rocky Reef $(mi)^2$		Canopy Kelp (acres)		Species Critical Habitat		Other					
	0<1.6	PV	Harbor Seal		0<1.39		5<35	EJ	Steller Sea Lion	u	Unknown		Pilot Marine Reserve		Marine Garden
	1.6-3.4	ZC	California Sea Lion		1.39-5.06		36-390	MM	Marine Mammal		Absence		Further Evaluation		Research Reserve
	3.41-5.6	EJ	Steller Sea Lion		5.07-9.5		391-822	WSP	Western Snowy Plover		Presence	*	MR site at Otter Rock only		Multiple Site Designations
	>5.6	MA	N. Elephant Seal		>9.5		>822	GS	Green Sturgeon						Habitat Refuge

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Three Arch Rocks
Photo: Alfred Essa

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