

# The Context for an Ocean Plan

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*Rugged coastal mountains plunge to the sea at Ecola State Park, in the foreground, and loom just inland of the town of Cannon Beach and Haystack Rock, in the distance. (ODOT photo, 1968)*

# The Ocean Environment

## The Continental Margin Oregon's Marine Communities

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Oregon's ocean resources planning is set in the context of global ocean conditions and dynamics. The huge scale of ocean currents, particularly the North Pacific and Alaska gyres, connect vast oceanic and coastal areas into an interconnected, dynamic system.

In the search for a smaller, but still ecologically meaningful scale, oceanographers identify an area offshore from Cape Mendocino in northern California to Vancouver Island that shares similar species composition and oceanographic conditions. This system, called the northern California Current ecosystem, may be an appropriate unit for future regional planning and management.

For now, Oregon must focus its attention on an even smaller area which makes ecological, practical, and political sense for the state. Oregon's Ocean Plan highlights the entire continental margin off the coast of Oregon as Oregon's area of concern for ocean resources management.



*In many places along the Oregon coast, the forest is anchored in sandy sediments previously deposited on the ancient seafloor, then compacted and uplifted by the collision of continents. At the ocean's edge this sandstone gives way first to rocky rubble, then sand, and is returned to the sea. (Oregon Sea Grant photo)*

# Oregon Offshore Sediment Types

10 0 10 20 30 MILES

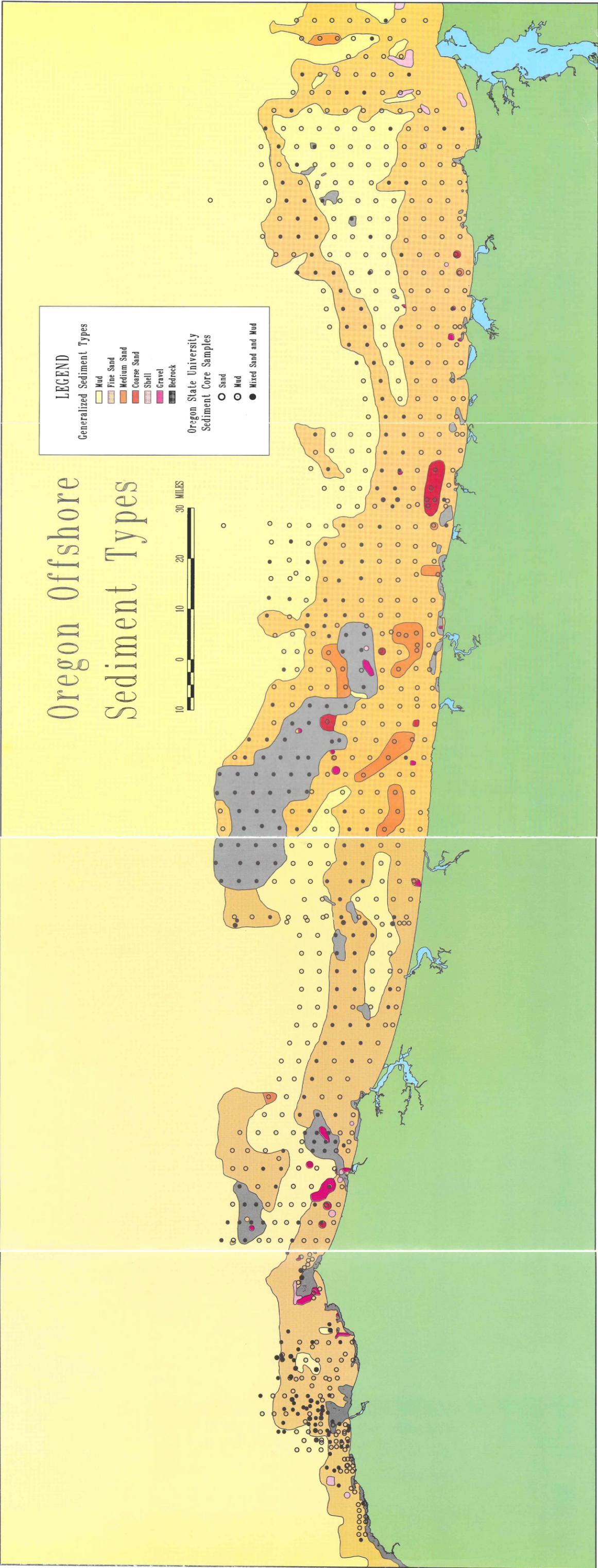
**LEGEND**

Generalized Sediment Types

- Mud
- Fine Sand
- Medium Sand
- Coarse Sand
- Shell
- Gravel
- Bedrock

Oregon State University  
Sediment Core Samples

- Sand
- Mud
- Mixed Sand and Mud



# The Continental Margin

Analysis of the physical and biological features of the Ocean Planning Area further focuses Oregon's ocean resources management setting on the continental margin for the following reasons:

- The continental margin is defined clearly by physical features.
- The continental margin supports distinct marine biological communities.
- The majority of human uses of ocean resources off the Oregon coast occur on the continental margin.
- Events which occur on the continental margin can directly affect the interests of the state of Oregon.

## Physical Features of the Continental Margin

### Topography

The continental margin is where the rocks of the continent meet the ocean floor. The major structural features of the continental margin are the continental shelf and the continental slope.

Oregon's continental shelf is a relatively flat, gently sloping terrace. The shelf is narrowest (10 miles) near Cape Blanco and widest (46 miles) off Florence and the central coast. The depth of the shelf at its outer edge where it merges with the steeper continental slope varies from about 450 to 550 feet (about 145 to 185 meters). The shelf is not entirely flat.

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*The map on the previous page shows the distribution of sediment types off Oregon, and the location and sediment composition of samples taken from the ocean floor over the past several decades.*

*Source: USGS and OSU*

Prominent submarine banks occur near the outer edge of the shelf. The four major banks are the Nehalem, Stonewall, Heceta, and Coquille. Submerged rocky outcrops are also found on the inner shelf, especially between Coos Bay and the Rogue River. Sea stacks and rocky islands thrust above the sea surface close to shore.

Oregon's continental slope is a narrow strip, from 12 miles wide at Cape Blanco to 60 miles wide off the Columbia River. From the outer edge of the continental shelf, the slope plunges to the deep sea bed about 1 1/2 miles below the surface. Gently sloping benches, low relief hills, and a few steep escarpments are found on the upper part of the slope.

Two prominent submarine canyons and numerous smaller submarine valleys breach the outer edge of the continental shelf and the upper slope. The Astoria Canyon cuts deeply into the outer shelf about 10 miles west of the Columbia River. The much smaller Rogue Canyon begins near the edge of the shelf offshore of the Rogue River. These submarine canyons and a number of smaller valleys are important avenues for moving sediment across the shelf and down to the deep ocean floor.

### Bottom Sediments

Sand and mud cover most of the continental margin. The movement and deposition of these sediments over the continental margin is controlled by river discharge; estuarine circulation patterns which can trap some of the sediment; coastal erosion; wave characteristics; ocean currents; density differences in the oceanic water column; benthic organisms burrowing in the sediment; and ocean dumping of material dredged from coastal harbors. In the winter, storms can stir the bottom sediments across all of the continental shelf.

### Ocean Currents

The movement of water over the continental margin off the Oregon coast is driven by the major Pacific Ocean currents. Local winds and weather create daily, seasonal, and yearly variations in the general circulation patterns.

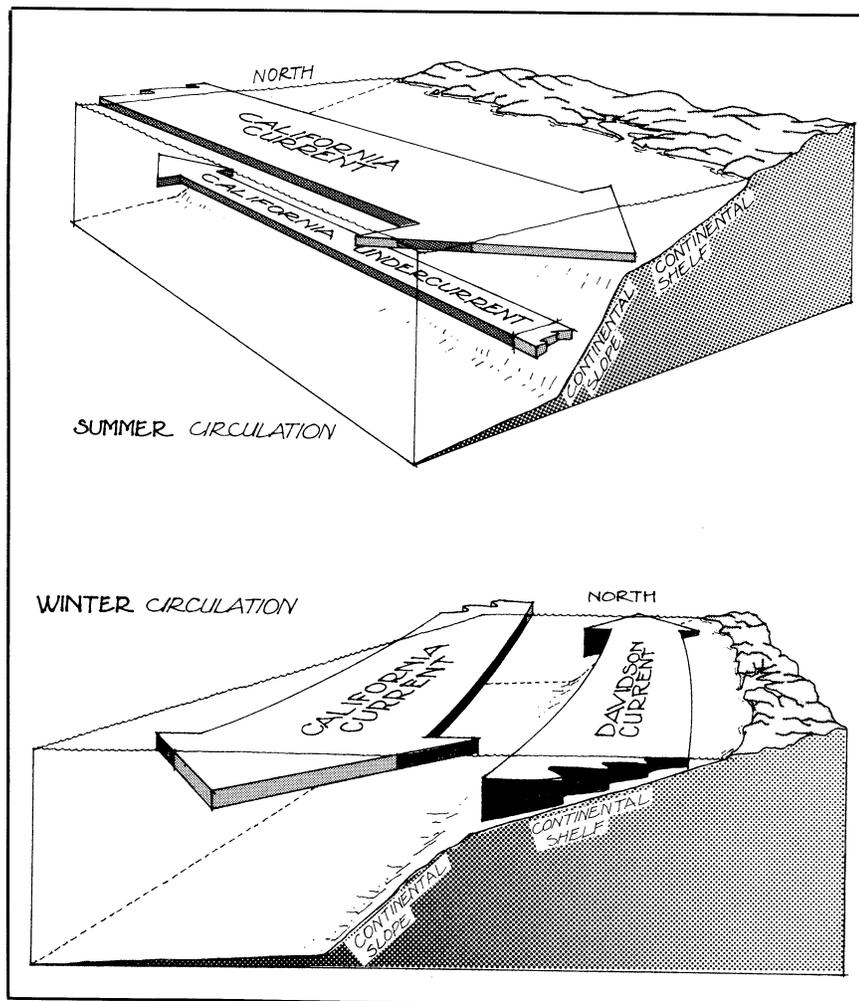
The North Pacific Current crosses the expanse of the Pacific Ocean from Japan to Canada where it encounters the continental margin near Vancouver Island. The North Pacific Current then splits into a northward flowing current carrying water into the Gulf of Alaska and a southward flowing current carrying water along the coast from Washington to California.

The broad, shallow surface current which flows southward along the Oregon coast is called the California Current. During the summer, the California Current moves southward offshore of the continental margin at speeds of about 2.5 to 5 miles per day. During periods of strong northwest winds, this current may double its speed. A narrow, fast undercurrent moves northward deep below the surface along the continental slope at depths greater than 600 feet (200 meters). During the winter, the faster (6 to 12 miles per day) Davidson current flows northward at all depths over the continental margin pushing the California current further offshore.

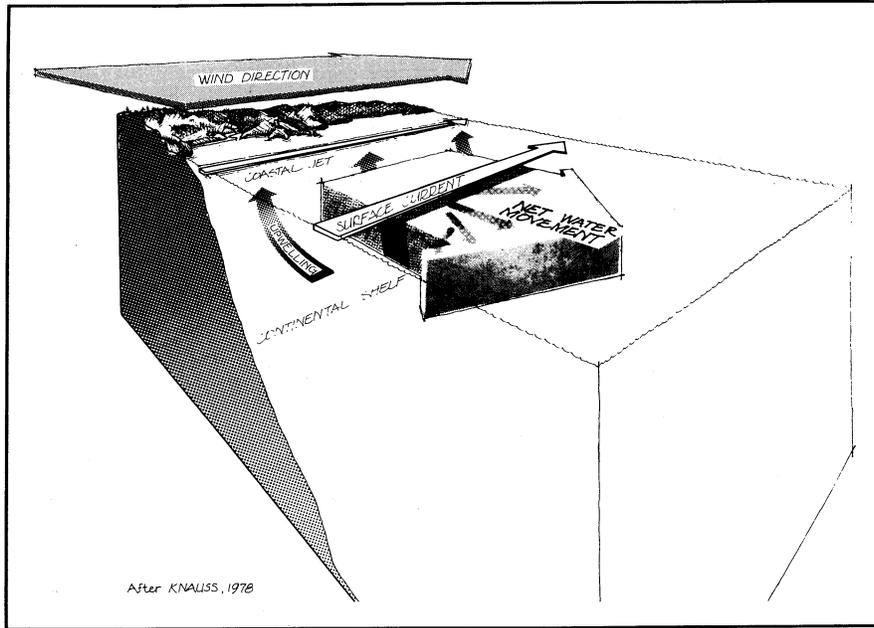
Although there are general seasonal patterns in surface currents, the high variability in winds off the Oregon coast results in a great deal of variability in these currents. Current fluctuations are the strongest near the shore and can change quickly and almost simultaneously over long stretches of the coast and throughout the entire water column over the shelf. These fluctuations in current patterns are nearly impossible to predict.

- **The Columbia River Plume**

The Columbia River also greatly influences ocean currents across the continental margin. The fresh river water mixes slowly with ocean surface waters and forms a large dilute lens or "plume" which extends southwesterly from Astoria. A strong, narrow current flows along the boundary between the lighter river water and the denser ocean water. On the inshore side of the plume, this current often enhances and strengthens the coastal jet. Changes in the winds will move this current either closer or



Seasonal ocean currents



Offshore water transport and upwelling

further away from the coast. South winds move this current offshore, while north winds move it closer to shore.

- **Summer Currents and Upwelling**

Summer is the season of upwelling, although upwelling can occur in any season if conditions are right. In the summer, winds are primarily from the north. Due to the earth's rotation and the topography of the continental shelf and shore, surface waters move west away from the shore. This offshore movement causes deep, cold, nutrient-rich waters to rise to the surface. This process is called *upwelling*. Although the most active upwelling is restricted to a narrow band approximately 6 to 15 miles from shore, the upwelling has a great influence on currents over the entire continental shelf.

Differences in the densities between the relatively heavy upwelled water and the lighter surface water set up a fast southward flowing current called a coastal jet. The core of the coastal jet is often as close as 10 to 20 miles from shore and can travel at speeds of 20 to 35 miles per day.

- **Winter Currents**

In the winter, winds are predominantly from the southwest. Surface waters across the continental margin move toward the shore during the winter. High runoff from coastal streams and the Columbia River dumps a lot of light fresh water along the coast during the winter. This sets up a northward flowing current along the coast which can reach very high speeds (1 1/2 to 2 miles per hour), especially during strong winter storms. Changing winds often interrupt the

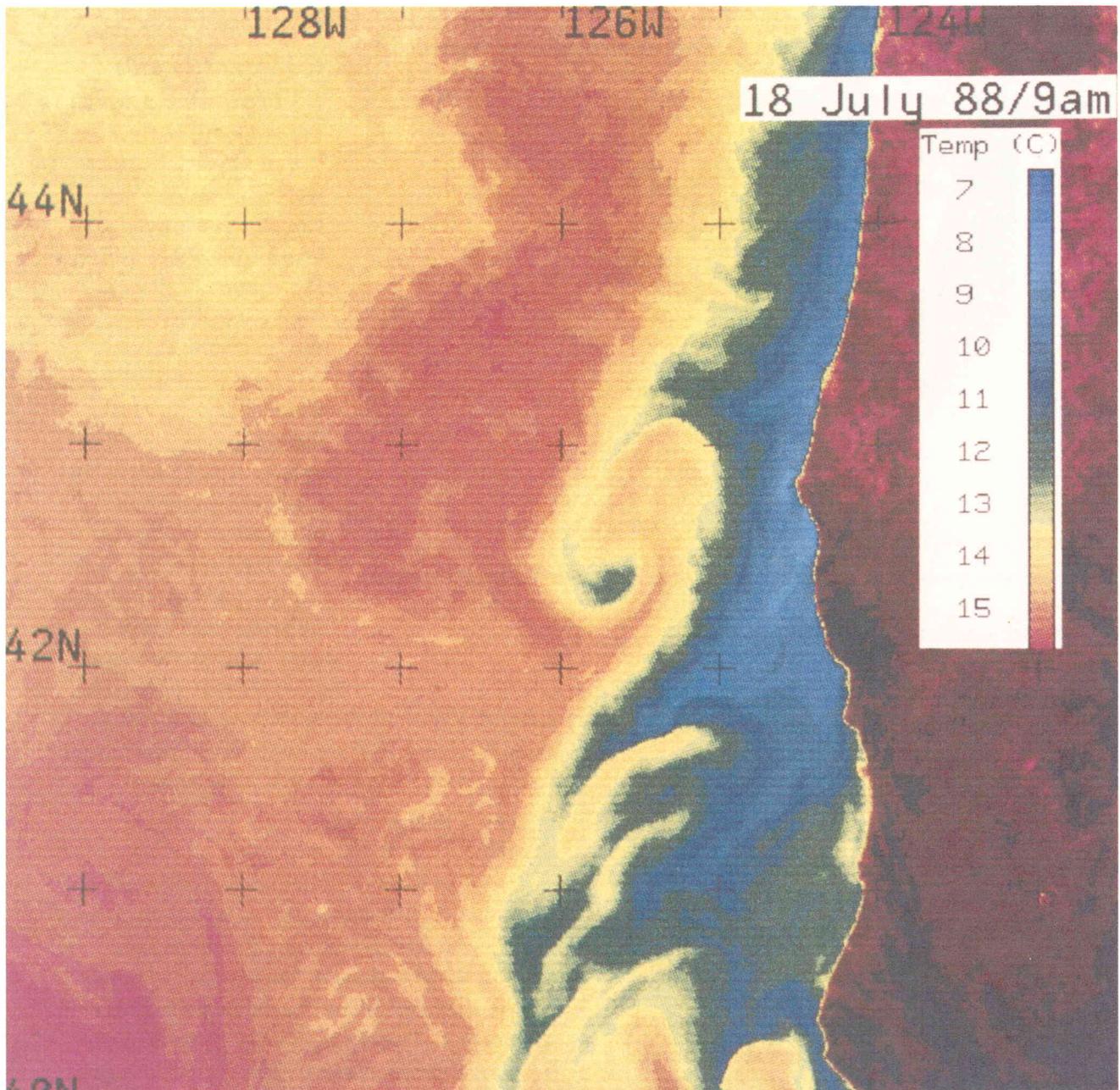
general winter current pattern and can move surface waters offshore and trigger coastal upwelling which can last for days or weeks.

- **Deep Water and Bottom Currents**

Deep water and bottom currents are poorly understood. In the summer, a deep counter current flows northward under the southward flowing surface current. This deep countercurrent is strongest along the shelf break and upper slope. The deep currents also vary with local topography. For example, eddies are common near the banks and the heads of submarine canyons.

- **Vulnerability to Spills and Contaminants**

The fast speeds, multiple directions, high variability and unpredictability of the currents over the continental margin make the entire continental shelf vulnerable to adverse effects from oil spills and other pollutants. An oil spill can move up or down the entire Oregon coast in the matter of a few weeks, and could come ashore from a spill anywhere over the continental margin in just a few days.



Satellite images reveal that ocean currents flowing near the coastline are as complex and dynamic as those of a mountain stream. Special cameras record the temperature of the ocean's surface waters, and the resulting images show ocean features that are both invisible to the naked eye and nearly impossible to measure using traditional sampling and measuring techniques. Scientists use such images to study how coastal promontories, like Cape Blanco and Cape Mendocino, and submarine features like Heceta Banks affect ocean currents.

This image covers the ocean and coast from Yaquina Bay, Oregon, to Cape Mendocino in California. It was taken in July, when strong northwest winds drive warmer surface waters (red areas) out to sea, thus allowing cold nutrient-rich waters (blue areas) to rise to the surface close to shore. The upwelling colder waters are pulled into complicated eddies and plumes by the warmer southward-flowing California Current.

Fishermen also use satellite imagery to target fish catch, since many fish species congregate near the boundaries between cold and warm waters. (NOAA photo courtesy of Ted Strub, OSU)

# Oregon's Marine Communities

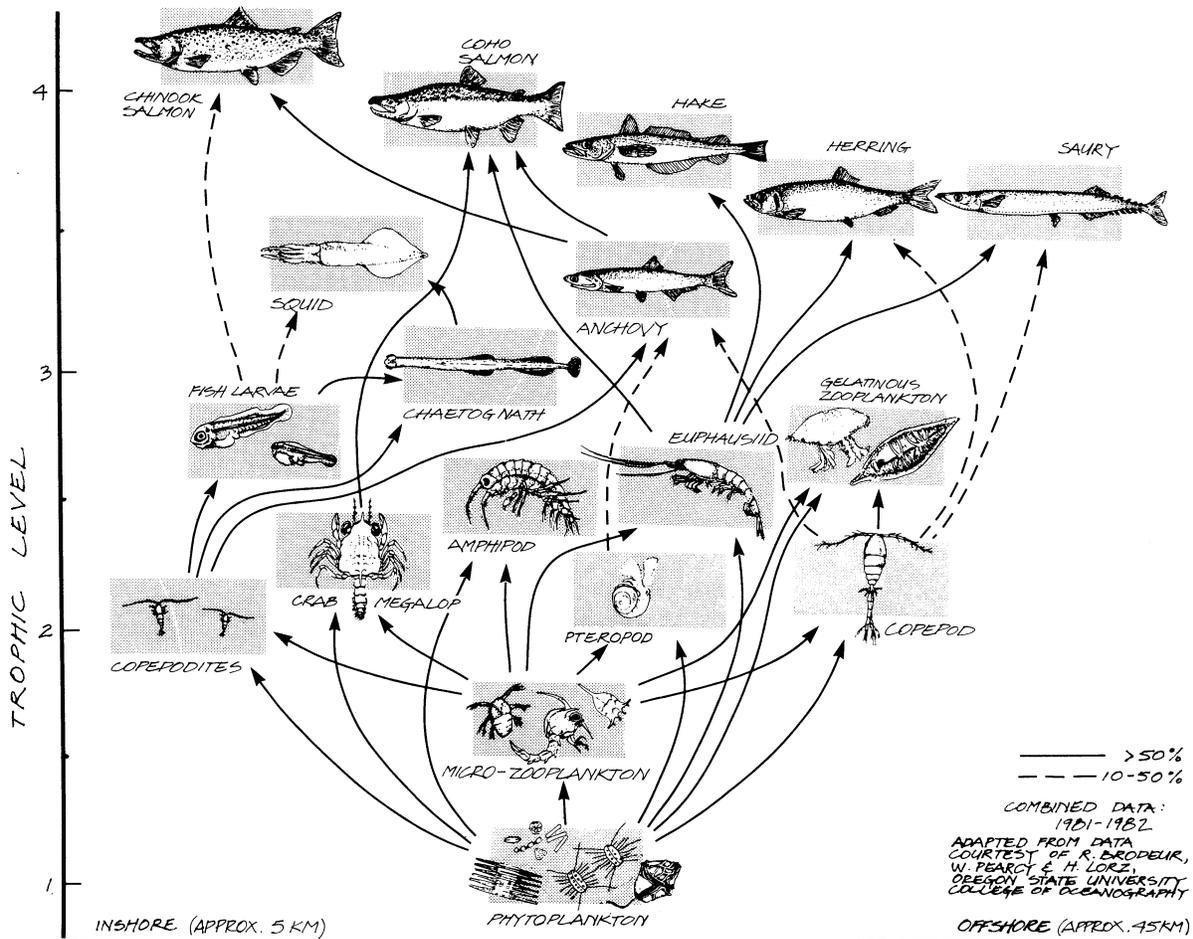
## High Biological Productivity

Oregon's continental margin is extremely rich and productive. The coastal upwelling brings cool, nutrient rich waters to the surface over the entire continental margin and stimulates plant growth. Phytoplankton, the microscopic plants of the ocean, thrive in the upwelled water. Primary production in the waters of the continental margin can be more than double the primary productivity of the open ocean. (Primary productivity is a biological measurement of the size of plant populations and the amount of food produced by these plants.) The seasonal occurrence of upwelling and pulses in upwelling events result in

seasonal peaks in primary production and in plankton "blooms" throughout the spring and summer.

During the summer the areas of maximum primary productivity are about 15 to 20 miles from shore. Sometimes the areas of highest productivity are concentrated very close to the shore. However, at other times, especially during periods of strong upwelling, these areas of high productivity are spread out across the shelf. Additionally, a lot of primary production occurs in the surf zone.

The large phytoplankton populations support large populations of microscopic animals called zooplankton, primarily copepods,



Typical marine food web off the Oregon coast

euphausiids, and larvae of fish and shellfish. The zooplankton are food for large populations of fish, birds, and mammals. The waters over the continental margin off Oregon are extremely rich and productive, as evidenced at least in part by the large fisheries industry dependent on these waters.

**An Ecotone - The Mixing of Several Biological Communities**

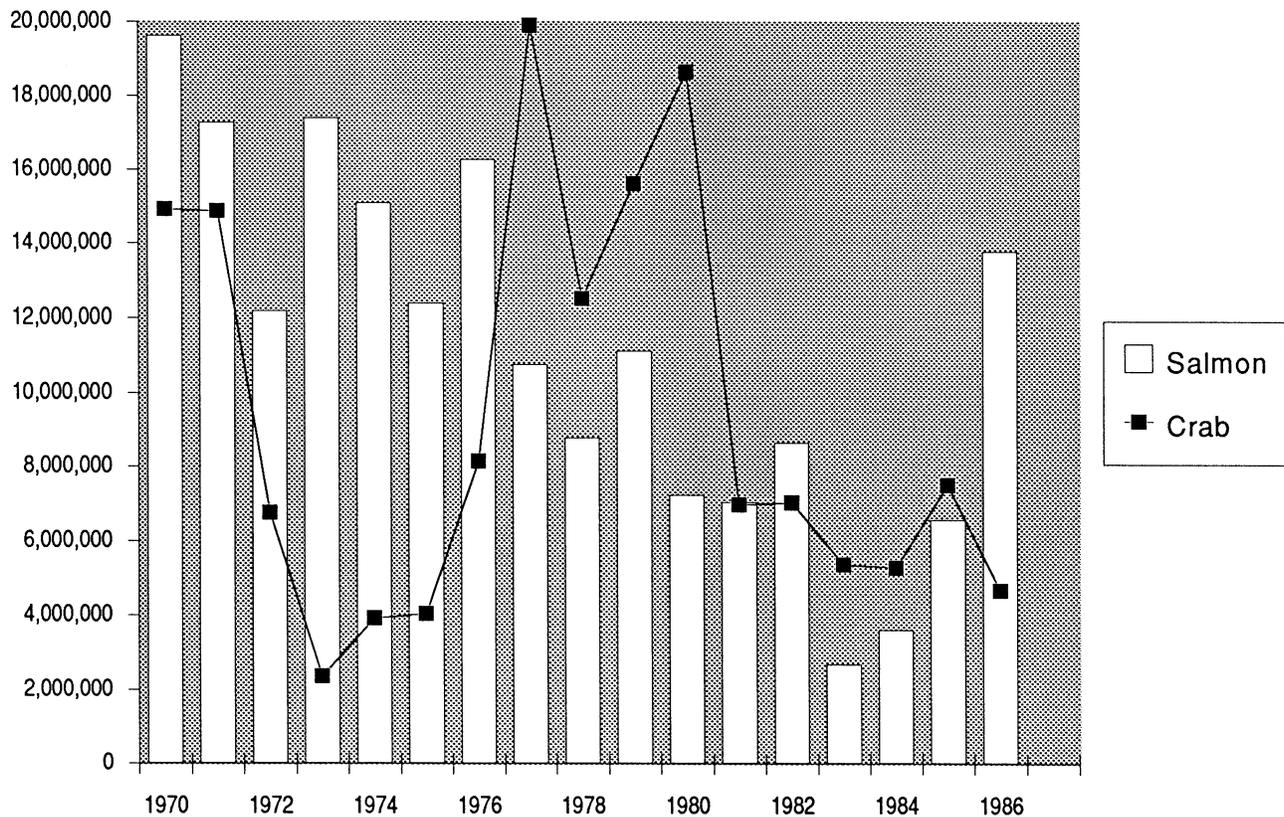
The waters of Oregon's continental margin are biologically important for other reasons too. This habitat forms what ecologists call an ecotone, a boundary area where different biological provinces overlap. In an ecotone, members of different communities are mixed together. The species found off Oregon are representative not only of a native community, but also of subarctic communities which are at the southern edge of their distribution and Califor-

nian communities which are at the northern edge of their distribution.

Populations of animals at the edge of their ranges tend to be smaller, more variable annually, and more sensitive to environmental changes than populations in the center or optimum part of their range.

Coho salmon off Oregon are an example of a species in an ecotone and at the edge of its range. In North America, coho salmon are found only in the cold, productive waters of the subarctic region. Abundance of coho is maximum at the center of its geographic range (i.e., offshore from British Columbia) and declines with changes in latitude towards the edges of its distribution. Average annual coho commercial catch data over the past 60 years demonstrate this distribution pattern. From year to year, the relative strengths of currents flowing

**Commercial Salmon and Crab Landings, 1970 - 1986**  
in pounds round weight



*History of two fisheries shows wide annual variability*

into the area off the Oregon coast from the northern subarctic and from the southern subtropical regions vary greatly. The environmental variability in water temperature and nutrient supply results in variability in biological productivity and in species composition of populations of zooplankton and fish. Migration routes of adult salmon and distribution patterns of the zooplankton on which they feed will also vary from year to year. And, offshore Oregon the average size of mature fish, fecundity, and survival of adult coho is generally less than in the middle of their range where such environmental fluctuations are not as likely.

### ***Highly Variable and Highly Vulnerable Communities***

One of the most characteristic and unique qualities of biological communities of the continental margin off Oregon is the extreme variability, both seasonally and yearly in planktonic and larval species and in fish stock. This high variability results in a high vulnerability to long-term, widespread, and adverse effects from human activities.

### ***Rich Fish Populations***

The productive continental margin supports large and diverse populations of fish, all of which are food to or feed on other creatures of the sea in a vast and complex food web. Some of these fish species are commercially important.

Populations of many fish species are concentrated over the entire continental margin. The distribution of fish is, of course, highly variable and different species are associated with specific sediment types. But, in general, fish populations tend to be highest in areas where there is a break or change in bottom topography, such as over the banks, along the shelf break, and at the heads of submarine valleys and canyons.

Trying to draw a boundary line or pinpoint a region in the Oregon Ocean Planning Area and say that fish are concentrated within that

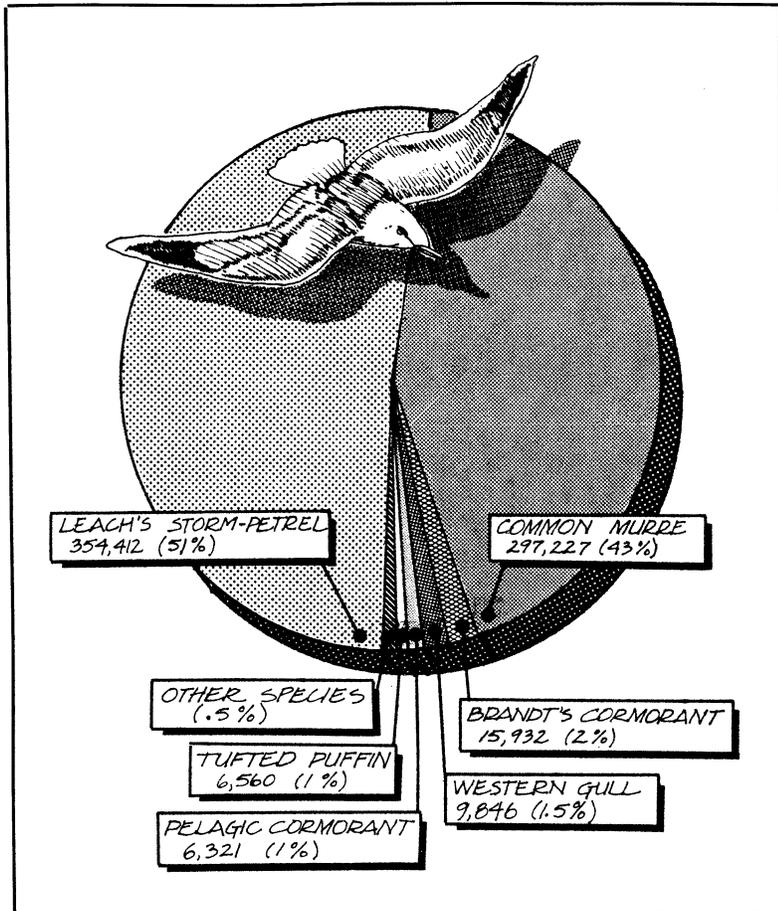
boundary or region is very difficult. Charts plotting the distribution of spawning areas and nursery grounds show different species using the nearshore waters, the offshore banks, the continental shelf break, and the continental slope. Other charts plotting the distribution of larvae, juveniles and adults show fish populations all across the continental margin.

The only boundary that does make ecological sense is the seaward edge of the continental margin. Although some species are found in the waters of the deep ocean and the continental margin, in general, the species composition of fish populations, the size of the populations, and the distribution of spawning areas of the continental margin are distinctly different from those of the deep open ocean.

### ***Huge Breeding and Feeding Bird Populations***

Large numbers of seabirds migrate along Oregon's continental margin. Multitudes of nesting seabirds along Oregon's coast depend on relatively undisturbed coastal nesting habitats and on the rich coastal waters for food for themselves and their young. Some bird species have very particular habitat and feeding requirements and are found only in certain areas. As examples, the northern fulmar and the sooty shearwater are found primarily along the mid and outer shelf and the shelf break. The California and western gull are nearshore and coastal birds which are rarely found seaward of the shelf break. Some seabirds such as the tufted puffin nest in burrows dug in the dirt atop offshore rocks and islands and travel daily to the rich feeding grounds near the edge of the continental shelf to capture fish to bring back to the fledglings in their nests.

Biologists believe that many of today's seabird populations are just remnants of much larger seabird populations common in the times before intense human use and development of the coast. A number of seabird species have been formally listed as sensitive,



Populations of breeding seabirds and proportion of the total seabird population of each species.

threatened, or endangered by the state and federal governments.

### Diverse Marine Mammal Populations

The continental margin is important habitat to a wide variety of migrating and resident marine mammals. Gray whales migrate along the Oregon coast within a few miles of shore from November through June. A year round population of adult killer whales is found over the shelf. Several species of seals and sea lions use the offshore rocks and islands as pupping and haul out areas. Northern fur seals migrate along the shelf edge from its wintering grounds in southern California to its breeding grounds in the Pribilof Islands.

Marine mammals of the offshore rocks and islands depend on the waters of the continental margin as feeding areas. For example, northern sea lions leave their rookery areas near Cape Arago and the Rogue Reef and travel as far as 20 to 25 miles offshore to forage for food. California sea lions, harbor porpoises, and harbor seals not only feed in river mouths and estuaries, but they also forage across the continental margin out to the shelf break.

The map following this page shows the location of the most sensitive marine species habitats along the Oregon coast. Sites on the map include bird colonies that serve as breeding sites, pinniped haulout locations, and known threatened or endangered species locations.

Source: ODFW and USFWS

# Sensitive Species Locations

- Breeding Bird Colonies
- ◆ Pinniped Haulout Sites
- ◐ Endangered Species



# The Human Environment

## The Counties

## The Coastal Economy

## Ocean Users and Uses

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**M**any Oregonians have chosen the coast as their home. They live in small towns like Langlois, Yachats, and Gearhart; in the larger cities of Astoria, Newport, and Coos Bay; in retirement or second home developments like Little Whale Cove and Salishan; and in relatively remote areas where neighbors are few.

The coast is many things to many people: the family home for many generations; a place to earn a living from the rich natural resources, such as timber, fish and shellfish; a retreat from the populated cities and hectic urban living; a place to play, to walk on the beaches, to fly kites, to hike, to race dune buggies, to canoe and kayak, to angle from a small boat or the shore; a place to study the natural phenomena of the forests and the sea: an environment to stimulate human imagination and explore individual creative capacities; and, basically, a place to live, do business, and raise a family.

The population of Oregon's coast lives in five coastal counties and the coastal parts of two large, mostly inland counties. These counties, from north to south, are Clatsop, Tillamook, Lincoln, Lane, Douglas, Coos, and

Curry. The 1987 estimated coastal population totaled about 190,000 persons or approximately 24 persons per square mile. The largest metropolitan area along Oregon's coast is the Coos Bay area where the neighboring cities of Coos Bay and North Bend have a combined total population of about 24,000. Coastal Oregon has thirty-three cities and approximately 40% of the coastal population resides in cities with populations over 2500. The total population of coastal Oregon is roughly 7% of the state's population.

Oregon coastal communities are experiencing significant changes in their population and their economies. Many of these changes are a function of the overall national demographic trend toward an older population. Oregon, and especially the coast, has a relatively large percentage of elder citizens. Many retired people

have moved into coastal areas because these communities are so "liveable" and provide retreats from urban or industrial areas. Young

adults have left coastal areas to seek educational and job opportunities elsewhere. Both of these trends are likely to continue.



Nye Beach in the city of Newport is typical of the close relationship of Oregon's coastal communities with the ocean. Jumpoff Joe, a landslide area from ocean erosion, is located in the center of the photo. Rising sea level is projected to accelerate erosion along the cliff edge. Cities will need to plan for this geologic eventuality. (ODOT photo, 1978)

# The Counties

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## Clatsop County

- **Population: 33,100**
- **Principal Industries: Fishing, Lumber, Agriculture, and Recreation**

Clatsop County was named for the Clatsop Indians, one of the many Chinook tribes living in Oregon. Fort Clatsop, Lewis and Clark's winter headquarters in 1805, is now a national memorial and is located near the mouth of the Columbia.

Astoria, the county seat, was the first American city to be settled in the West. Astoria was established as a fur trading post in 1811. The first U.S. Post Office west of the Rocky Mountains was also established in Astoria in 1847.

## Tillamook County

- **Population: 21,400**
- **Principle Industries: Agriculture, Lumber, Fishing, and Recreation**

Dairy farms dominate Tillamook County's fertile valleys. The county is the home of the world-famous Tillamook cheese. Logging and lumbering are also again becoming economically important due to the reforestation and regrowth of most of the huge "Tillamook Burn" area.

Tillamook County offers ocean and stream fishing, charter and dory boats, clamming, crabbing, beachcombing and hiking. The county's oceanfront is famous for its scenic grandeur.

## Lincoln County

- **Population: 38,800**
- **Principle Industries: Lumber, Fishing, Agriculture, and Recreation**

Newport is Oregon's oceanography research center with OSU's Mark O. Hatfield Marine Science Center which also provides facilities for the National Oceanic and Atmospheric Administration, Environmental Protec-

tion Agency, U.S. Fish and Wildlife Service, and the Oregon Department of Fish and Wildlife. Newport, a major fishing port, is also the Dungeness crab capitol of the world. Lincoln City, formed by the consolidation of five small towns, is an oceanside community with numerous tourist-oriented attractions and resorts. Lincoln City is also a popular retirement community.

Sport fishing is popular and productive along the coast of Lincoln County, from the Siletz River and Bay to Yachats River. Sizeable charter and commercial fishing fleets operate out of Depoe Bay and Newport. Mild winters and cool summers help to produce an abundance of horticultural specialities.

## Lane County

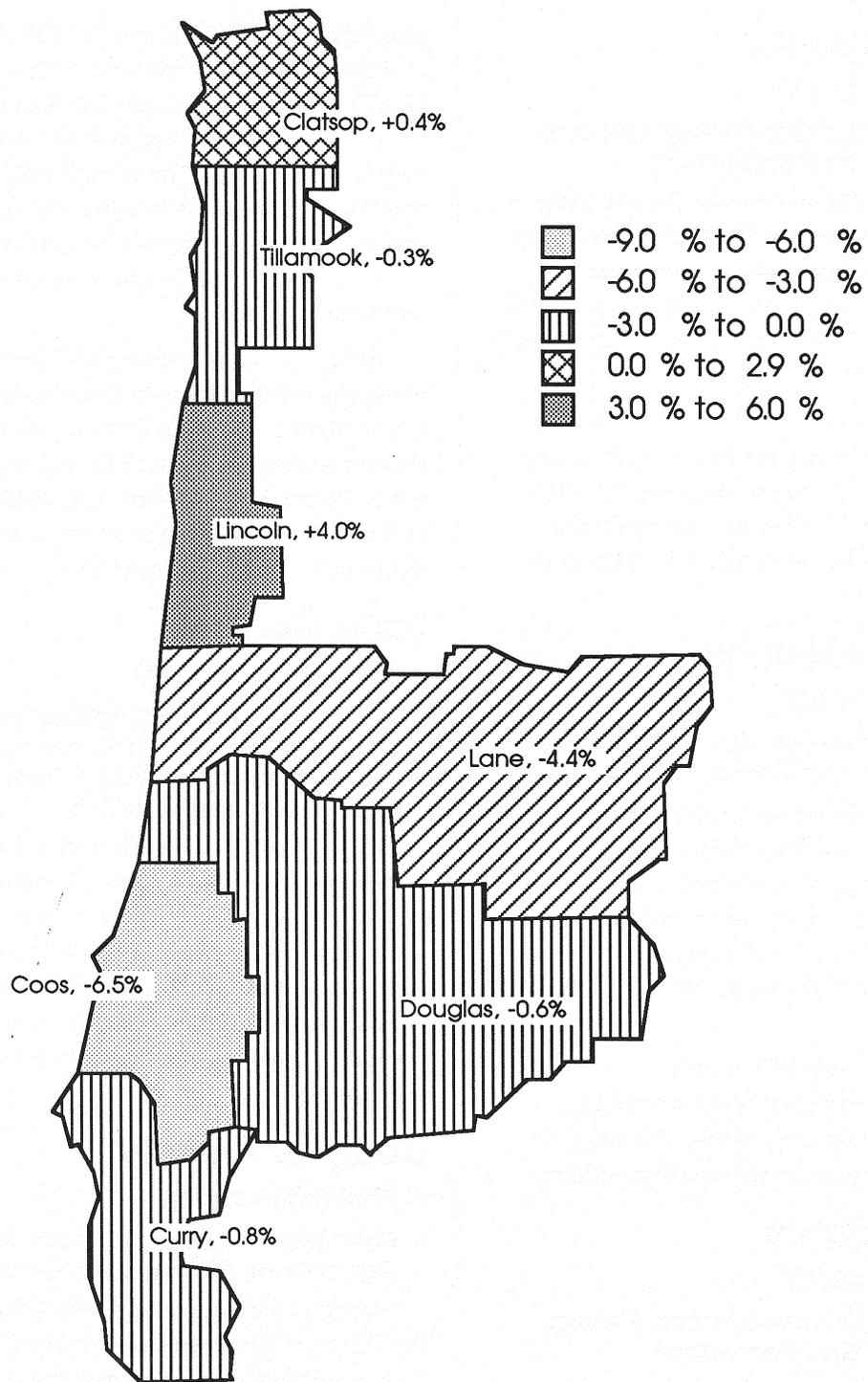
- **Population: 273,700**
- **Principle Industries: Agriculture, Education, Fishing, Food Processing, Logging, Manufacturing of Wood Products, Recreation, and Tourism**

Only a relatively small part of Lane County is located in the coastal zone. Eugene, Oregon's second largest city, occupies the population focus of the county in the Willamette Valley. Florence, at the mouth of the Suislaw River, is the only coastal city in Lane County. Most of the land in coastal Lane County is part of the Suislaw National Forest.

## Douglas County

- **Population 92,150**
- **Principle Industries: Lumber, Mining, Agriculture, Fishing, and Recreation**

Douglas County extends from the coast up the Umpqua River drainage to the Cascades. Only a relatively small part of the county is actually in the coastal zone. Almost all of the coastline of Douglas County is in the Oregon Dunes National Recreation Area. Reedsport, Gardiner, and Winchester Bay, all located near



Percent change in coastal county populations from 1980 - 86

the mouth of the Umpqua River, are the center of population and activity in coastal Douglas County.

## Coos County

- **Population: 61,000**
- **Principle Industries: Lumber, Fishing, Agriculture, Shipping, and Recreation**

The name "Coos" is derived from the native Coos Indian word which may translate to "lake" or "place of pines." Although trappers had been in the area a quarter of a century earlier, the first permanent settlement in present Coos County was made at Empire City, now part of Coos Bay, by members of the Coos Bay Company in 1853.

Forest products, tourism and fishing dominate economic activity in Coos County. Boating, dairy farming, myrtlewood manufacturing, ship repair, module fabrication and agriculture specialty products, including cranberries, also play an important role. The International Port of Coos Bay, considered the best natural harbor between Puget Sound and San

Francisco, is the world's largest forest products shipping port.

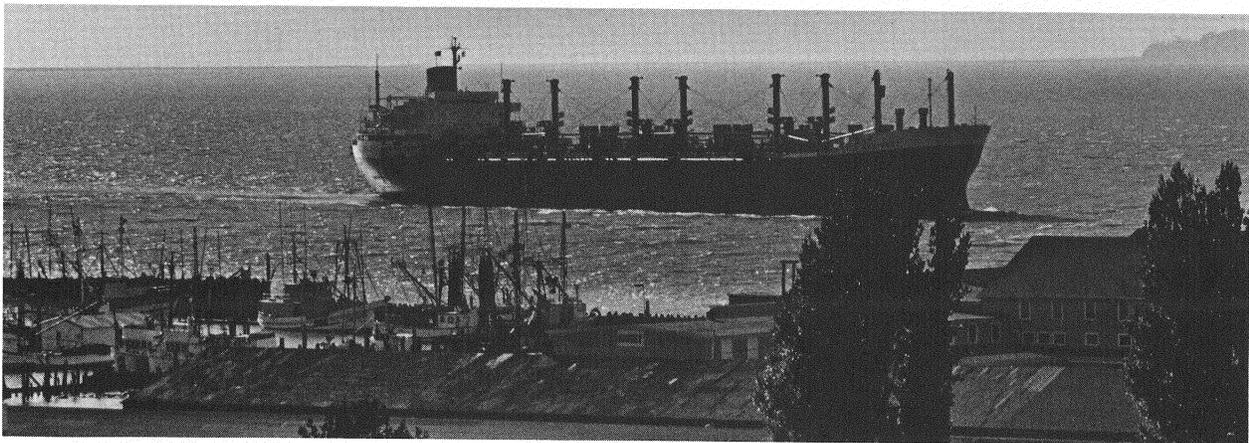
## Curry County

- **Population: 17,100**
- **Principle Industries: Lumber, Agriculture, Commercial and Sport Fishing, Recreation, and Tourism**

The county contains valuable standing timber and also offers spectacular coast scenery and recreational attractions, such as beachcombing, clamming, and crabbing; excellent fishing (freshwater and saltwater); river scenic boat trips; and coast, river and mountain hiking trails. The Port of Brookings is considered one of the safest harbors along the coast for ocean recreational fishing.

Agriculture in Curry County includes raising sheep and cattle, dairy farming, and raising cranberries, blueberries, and horticultural nursery stock.

(The source of most of the preceding material is the *Oregon Blue Book, 1989-1990.*)



A large freighter glides into the Columbia River estuary at Astoria. The Columbia River, along with Coos Bay, is a major international port on the Oregon coast. (Oregon Sea Grant)



*Seafood processing, often small scale and labor intensive, is an economic mainstay of several coastal ports. This part of the industry depends on a continuous supply of fresh fish from the ocean. (Oregon Sea Grant)*

# The Coastal Economy

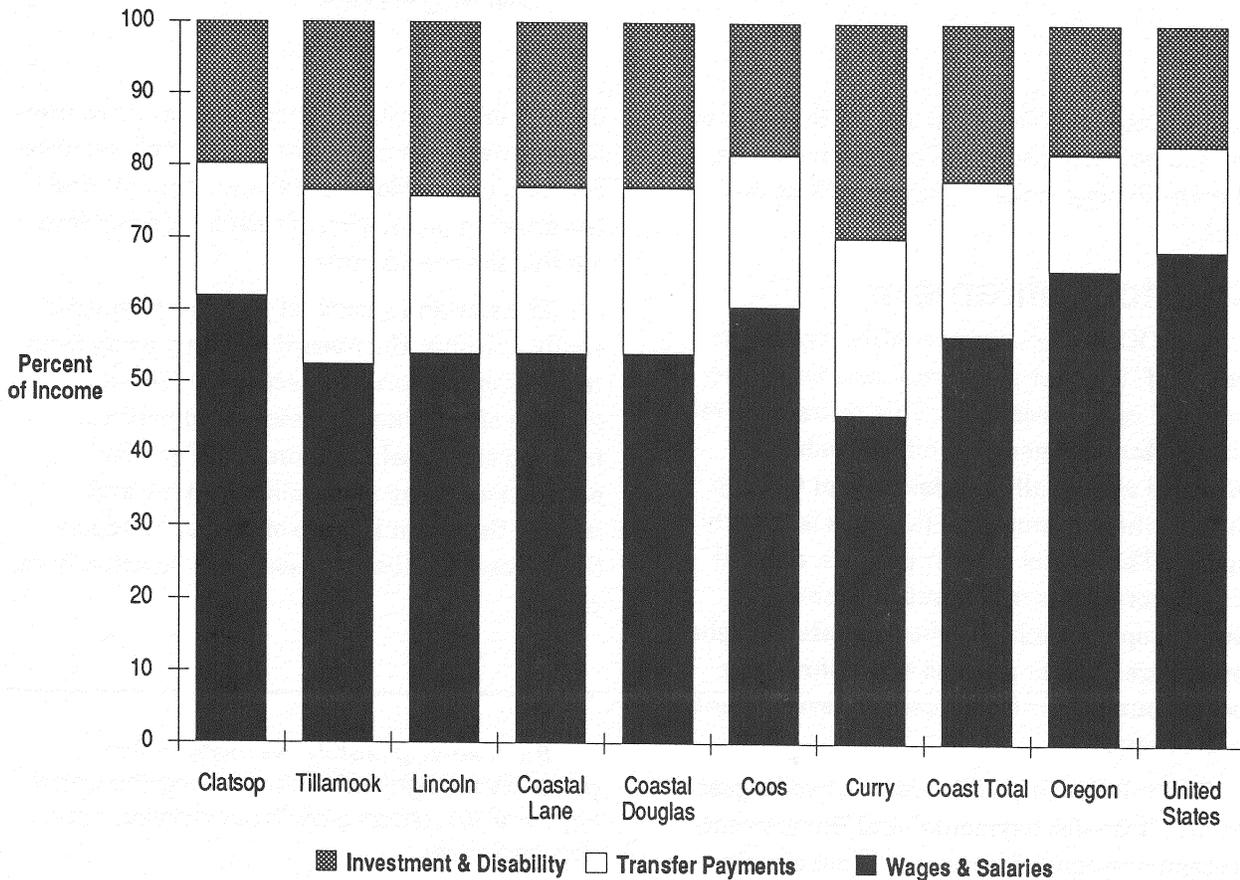
## Personal Income

Coastal Oregon has experienced generally low overall economic growth and amplified swings in employment during national recessions. The demographic "aging" of the coastal population combined with the coast's reliance on natural resource-based industries that are subject to dramatic supply and demand changes have caused per capita personal incomes of coastal residents to lag behind averages for the rest of Oregon and the U.S.

Coastal residents depend on economic activity in six basic categories: commercial fishing; commercial agriculture; lumber and wood products; tourism; passive income from investments and transfer payments, such as Social

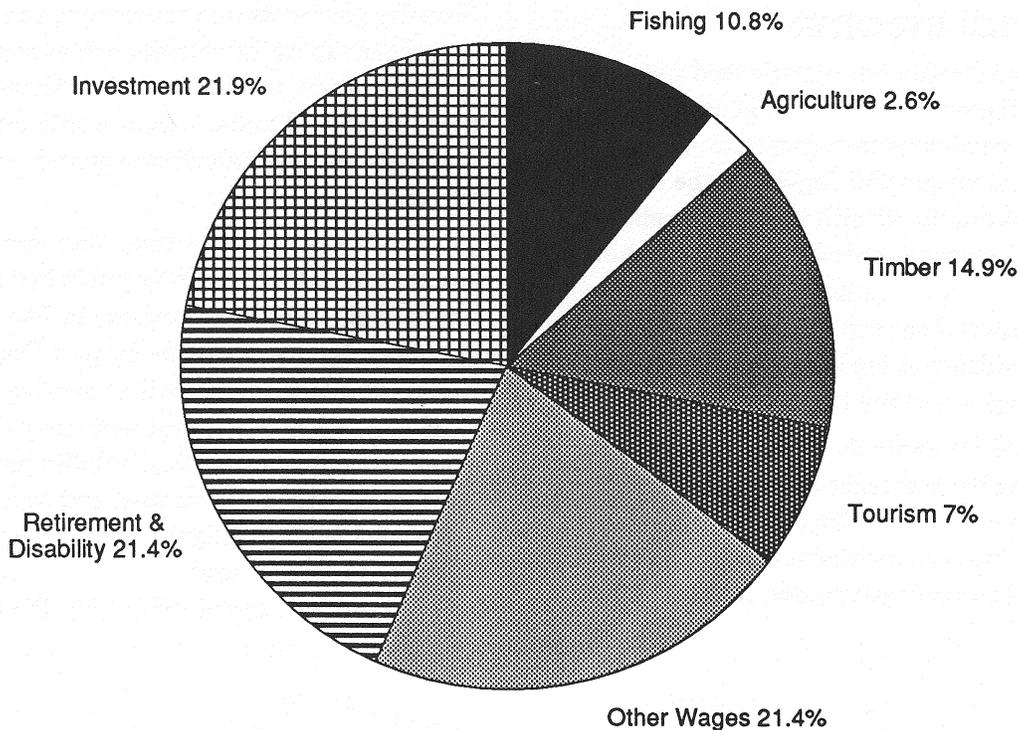
Security payments and retirement pensions; and other export industries such as water transportation, marine cargo handling, paper and paperboard mills, boat and ship building, and state and federal education and research facilities.

The Oregon Coastal Zone Management Association (OCZMA) recently published an analysis of the coastal economy in *The Economic Landscape of the Oregon Coast*. The results of this study show that passive income from such sources as social security payments, other retirement benefits, disability payments, interest and dividend income, and rents are becoming increasingly significant as the average age of the coastal population increases. Of the natural resource based industries, the timber



Sources of personal income in 1987 in coastal counties, Oregon, and the U.S. (Source: OCZMA)

Personal income sources in Oregon's coastal communities in 1987. (Source: OCZMA)



industry accounts for about 15% of the total estimated personal income of coastal residents, whereas fishing makes up about 11% of the total.

## Coastal Retirement

The OCZMA economic profile reveals the growth of "transfer payments" as a major sector of the coastal economy. This retirement-related sector is larger than either timber or fishing in almost all counties (except Clatsop County where commercial fisheries is slightly higher). This influx of older persons, coupled with historic patterns of "out-migration" of young people after high school, creates a higher percentage of older persons and a shrinking pool of young labor for industrial development on the coast.

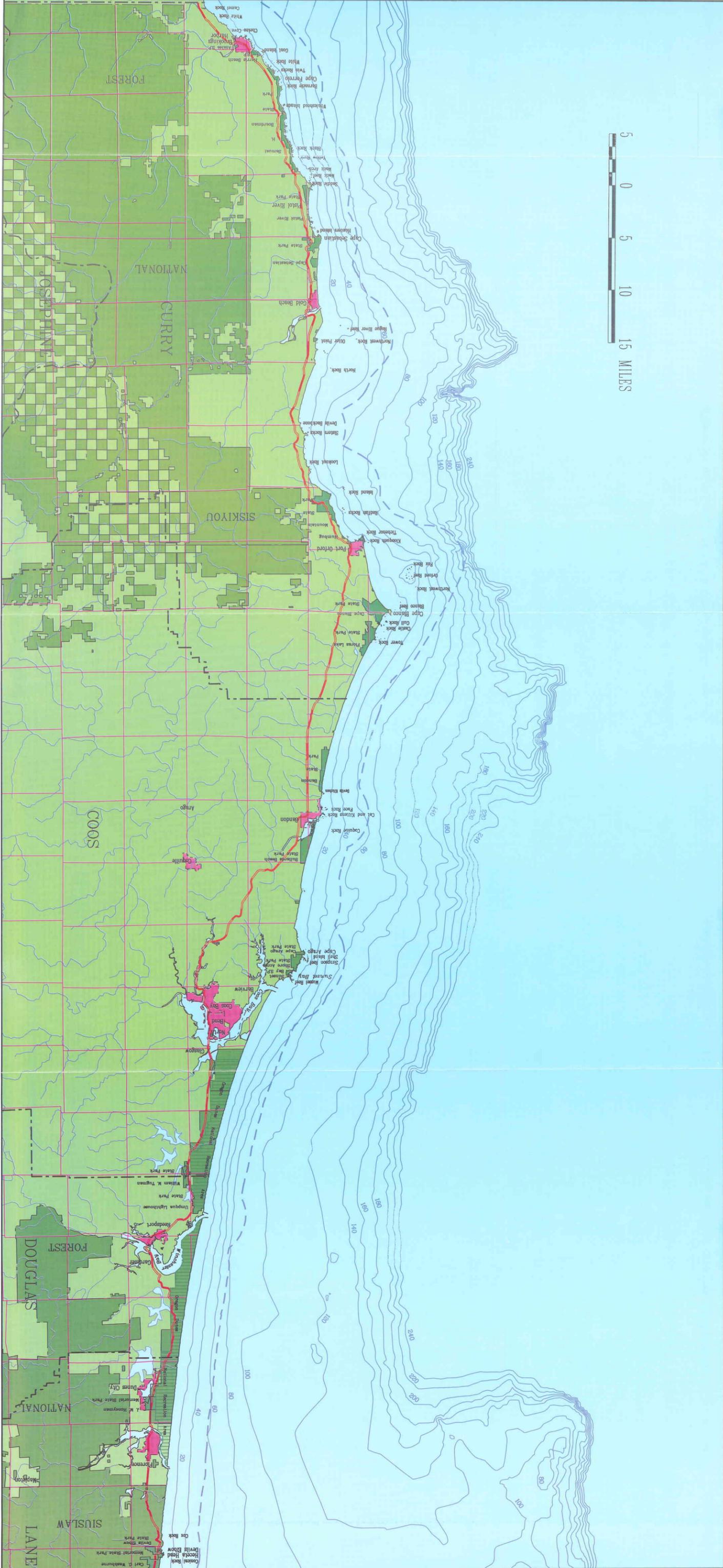
The relationship of the coast's two largest sectors, "transfer payments" and "investments" to ocean and coastal resources is not clearly

defined or understood. There is a strong connection between the attraction of Oregon's relatively clean, uncrowded coastal environment and the growing population of retired persons from outside the coastal area.

The size and growth of transfer payments spells a shift in the coastal economy away from reliance on resource extraction and gives a glimpse of the changing social and political makeup of coastal communities. For this population, many with political savvy and money, the ocean is more of a visual and aesthetic resource than a resource to be actively exploited.

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The following plot shows many of the generally recognized features along the coast: Highway 101, urban growth boundaries, counties, and so on.



5 0 5 10 15 MILES



5 0 5 10 15 MILES

### **Ocean Resources**

The direct economic role of ocean resources varies from community to community. In 1987, commercial fishing, a major social component of the coast, provided 10.9 percent of the total coastal personal income. Yet for that same year in Lincoln County, fishing contributed 16.4 percent (\$80.9 million) and in Clatsop County 20.5 Percent (\$94.2 million) of the total personal income, both well above average. On the other hand, in Curry County, commercial fishing contributed about 4.7 percent (\$10.4 million), slightly less than tourism at 5 percent (\$11.0 million). None of these figures reflect the economics of ocean recreational fisheries which are not specifically addressed by recent available studies.

Other ocean related industry is concentrated in a few major ports. In 1987, the marine transportation and cargo sector contributed less than 2 percent of the total personal income but 4.5 percent (\$34 million) in Coos County. Boat building in Coos Bay provides about 1 percent of Coos county's personal income, while boatbuilding at Reedsport

provides about 2.6 percent of Douglas county's personal income.

The economic contribution of recreational activities related to the ocean is difficult to quantify because there is no clearly defined "industry" to measure. The OCZMA study focused on portions of selected industries that are directly affected by visitor expenditures: hotels and lodging places, amusement and recreation services, eating and drinking places, retail sales and automobile service stations that are directly affected by tourist's expenditures. Overall, tourism is estimated to contribute approximately 7 percent to the total personal income of the Oregon coast. How much of this is directly related to ocean and coastal resources is simply impossible to determine. In some communities, such as Depoe Bay and Brookings, recreational ocean fishing contributes significant income to the community, especially during salmon season. Whale watching trips, especially from Newport and Depoe Bay, are a growing segment of off-season trips for charter boat operators.



*Fishing vessels represent the personal investment of individual fishermen in the future of Oregon's fisheries industry. (Oregon Sea Grant)*



*These boats tied up a Newport are a small part of Oregon's commercial fishing fleet, which numbers about 2000 vessels. (Oregon Sea Grant)*

## Ocean Users and Uses

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Oregonians depend on the ecologically and economically valuable resources of the ocean. Human uses of the ocean are concentrated on the resources of the continental margin. These resources can be listed and categorized, but Oregonians know that they are ecologically interconnected and interdependent and that these resources are highly valuable to human economies and highly vulnerable to disruption by human activities.

### **Commercial and Recreational Fishing**

Commercial fishing was one of Oregon's first industries. In the mid-1800's, Scandinavian and French immigrants fished for salmon in the lower Columbia River. Using horses and their own human strength, these people worked gill nets, beach seines and fish wheels to reap an abundant harvest which was processed and packed in nearby plants. With the new invention of gasoline engines, adventurous fishermen ventured "across the bar" at the mouth of the Columbia and began to fish the resources of the ocean.

The rich harvest of the oceans and rivers played an important role in the development of the Oregon economy and the establishment of various cities and ports all up and down the coast.

Today, Oregon fishermen catch fish almost everywhere. Some fishermen may work relatively close to shore taking day trips to near-shore reefs. Others will stay out for several days and fish the rich resources at the edge of the continental shelf. Still others participate in the distant water fisheries of the central Pacific. Even so, Oregon fishermen tend to concentrate their efforts on the rich fishery resources of the continental margin. About 95 percent of the value of the fisheries and the total pounds landed in Oregon is from fish and shellfish harvested from the continental margin.

Fishermen form a diverse community. They fish a wide variety of species including salmon, cod, rockfish, snapper, sablefish, sole, flounder, halibut, tuna, shrimp, crab, whiting, sea urchins and squid. Some of them are independent businessmen who own one or more vessels. Others work as crew members. Some work with foreign companies in joint fishing ventures.

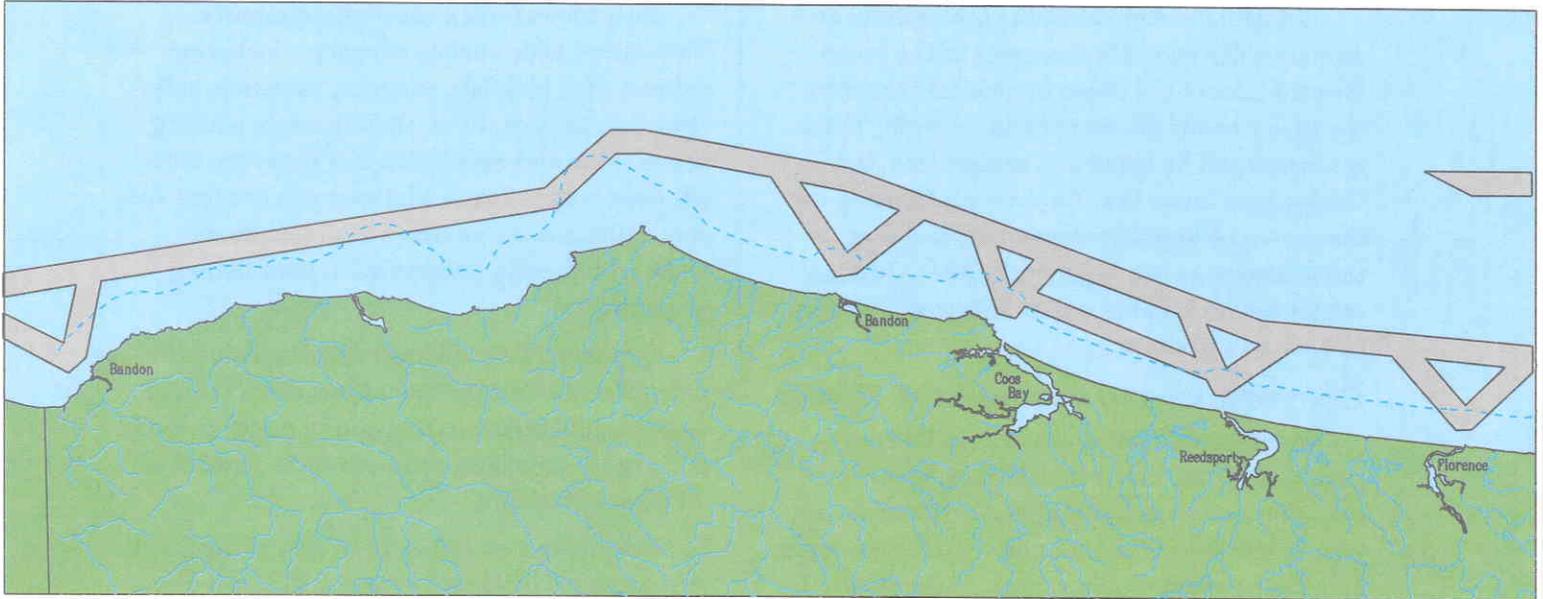
Commercial fishing contributes about 10 percent of the total personal income of coastal counties and communities and in major fishing ports may contribute as much as 25 percent of all personal income.

Fishing is also a cherished way of life for many coastal residents whether they are directly involved in the fishing industry or not.

### **Navigation and Transportation**

Oregonians have long used the beaches and the nearshore waters to get from one place to another along the coast and to transport goods to and from markets. In the years before the coastal highway was completed, coastal residents drove their carts and carriages and later their automobiles along the highway of the beach. For many years, coastal traders using barges and small ships have carried goods to communities up and down the entire west coast. Captains of fishing vessels and merchant ships sought refuge in the natural harbors where communities were also developing. Today coastal pilots meet large oceangoing vessels several miles at sea and guide them to safety in these harbors.

The deep water ports of the lower Columbia River (including Portland), Coos Bay, and Newport are part of a complex network of inland and oceanic transportation systems serving millions of people worldwide. People in coastal ports like Coos Bay often host regular crewmen from the Soviet Union, Japan, Korea, the Philippines and Hong Kong.



*The plot on these pages shows the location of towboat lanes off Oregon. Lane locations are published by the OSU Sea Grant Extension Service, and are used by towboat operators and fishermen to*

Oregonians have strong economic ties to major nations around the Pacific Rim and the world. Huge vessels regularly leave Oregon loaded with wood products such as chips, logs, and lumber and with grain for foreign trade. Large quantities of imported commodities also enter the U.S. through Oregon's ports. These imports include automobiles, chemicals, metal products, clothing, shoes, and machinery.

Numerous smaller, shallow draft coastal ports support the commercial and recreational fishing industry, pleasure boaters, and domestic coastal trade.

Much of the domestic trade between the Pacific coast states is carried by shallow draft barges. Barge captains generally follow the 60 fathom (360 feet or 120 meter) contour, four to five miles offshore.

Each day, several supertankers full of North Slope crude oil, travel southward from Valdez, Alaska, to refineries in California and the Gulf of Mexico states. Tanker captains

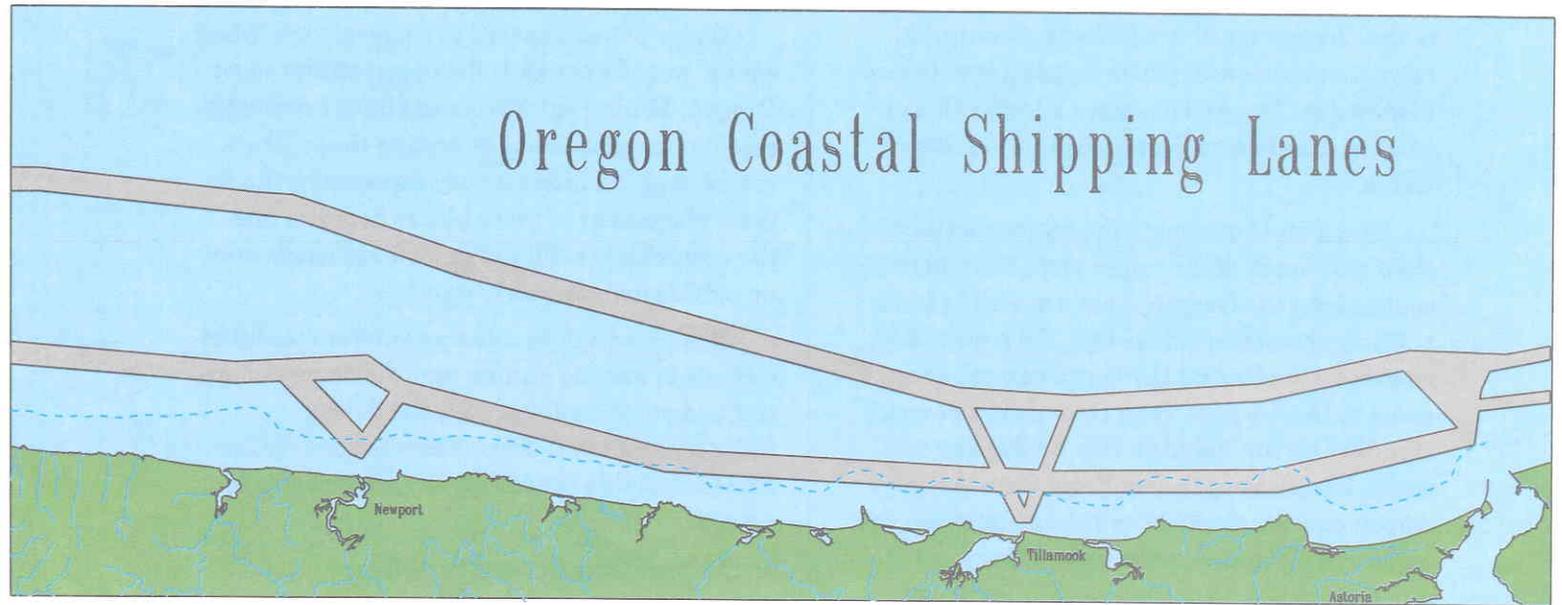
generally chart a straight line course which slices diagonally across the Oregon ocean planning area from about 150 miles at sea off Astoria to about 50 miles at sea off Cape Blanco.

### ***Waste and Dredged Material Disposal***

Worldwide, the ocean has become the final dumping place for many of the wastes of human society, including municipal and industrial waste, dredged material, and marine and terrestrial litter. Oregon's coastal communities and industries, like others around the world, use the ocean to dispose of waste and unwanted material. Some of the sources of the waste, such as municipal sewage treatment plants and harbor dredging projects, are deliberate societal choices. Whereas, others are the result of carelessness or ignorance.

Six municipal wastewater treatment works and three pulp and paper mills currently discharge directly into Oregon's coastal ocean. At current levels, the pollutants from these out-

## Oregon Coastal Shipping Lanes



avoid conflicts. Since the process of agreeing on lane locations and publishing the results began, conflicts and fishing gear losses—which were not uncommon—have become practically nonexistent.

falls are relatively small and seem to be dispersed quickly.

Oregon's coastal ocean is also used for the disposal of dredged material. The need to keep channels in harbors open for vessels requires maintenance dredging. Growth of ports can require new dredging. Everyone who uses products transported over the ocean or who eats fish from the ocean contributes to the need to dredge. The Corps of Engineer's discharges from 7 to 11 million cubic meters of sediment from coastal harbors and rivers at about twenty authorized dredged material disposal sites on the continental shelf. These sites are generally located near river mouths in water depths ranging from 50 to 185 feet. The dredged material that is currently being dumped on Oregon's continental margin is clean, uncontaminated sand.

Discharges from rivers transport a variety of pollutants from many sources into the coastal waters. Many of these may be untraceable

to specific sources and may, in fact, be unidentifiable. No one and yet everyone is responsible.

### **Marine Litter**

Marine litter fouls Oregon's continental margin. People litter. They unthinkingly throw beer bottles, plastic packaging, and garbage overboard. They leave the leftover trash from a beach picnic on the shore. They throw cigarette butts in the sand.

Plastics and other trash, which end up in coastal waters and on the bottom, kill marine organisms. Although no scientific studies have been done on the origin and amounts of marine litter on Oregon's shoreline and across the continental margin, beach cleanup projects report that the great majority of the litter found is from boats, that significant amounts of litter is found near campgrounds and picnic sites, that about 60% of all items found are plastic, and that the amount of litter deposited by tides the day after a beach cleanup is often equal to the amount picked up by the cleanup effort.

### **Recreation and Aesthetics**

Oregon's coast has been termed a national treasure. People from all over the world come to the Oregon coast to admire its beauty, to relax, to experience nature, to play, and to find inspiration. Oregonians place a high value on pristine beaches, rocky headlands, and scenic vistas.

The waters of almost the entire continental shelf and much of the upper slope from north to south along the Oregon coast are visible from publicly accessible viewpoints. On a clear day, a person standing on the beach can see about 6 miles to the horizon. On a clear day, a person standing on the Yaquina Bay Bridge can see about 16 miles out to sea; From Cape Arago, a person can see about 17 miles up and down the coast and out to sea; from Cape Blanco, 19 miles; from Sea Lion Caves, 24 miles; from Otter Crest Lookout, 28 miles; from Neahkahnie Mountain Lookout, 32 miles; from Cape Sebastian, 35 miles, from Cape Perpetua Lookout, 37 miles; and from Cascade Head, 45 miles.

Degradation of the aesthetic resources of the coast could greatly alter the quality of the Oregon coast and could negatively affect the coastal experience and the economies which are dependent on tourism and recreation.

### **Possible Future Uses**

Oregonians and visitors to the Oregon coast worry that future development of ocean resources will adversely affect the way of life on the coast.

#### **• Marine Minerals Mining**

The federal government and a few companies have been interested in the mineral resources of Oregon's continental shelf. Currently no mining is occurring on the continental margin, but economically recoverable deposits may be present.

Developers may be attracted to offshore gravel deposits as onshore sources are depleted or demand increases. The gravel deposits off

Oregon are small and localized, but they lie in relatively shallow water where miners using dredges could recover the gravel.

Major placer deposits of mineral-rich "black sands" may lie beneath the ocean off the coast Oregon. Mining entrepreneurs have been interested in the possibility of mining these "black sands" and the interest may increase in the future. The extent of these placer deposits and the economic viability of marine minerals mining off Oregon are poorly known.

The potential for adverse environmental effects from marine mining and the degree of spatial and other conflicts with the fishing industry and other ocean users are poorly understood at this time. But, Oregonians are concerned.

#### **• Oil and Gas Development**

Although Oregon's offshore geology has not been fully explored, geologists who have interpreted existing information postulate that oil and gas deposits may be present in three sedimentary basins which extend across the continental shelf and upper slope. Existing technology and the economics of oil and gas development would probably limit oil and gas activities to the continental shelf and upper slope. The federal government and the oil and gas industry are very interested in knowing the magnitude of oil and gas resources off the Oregon coast.

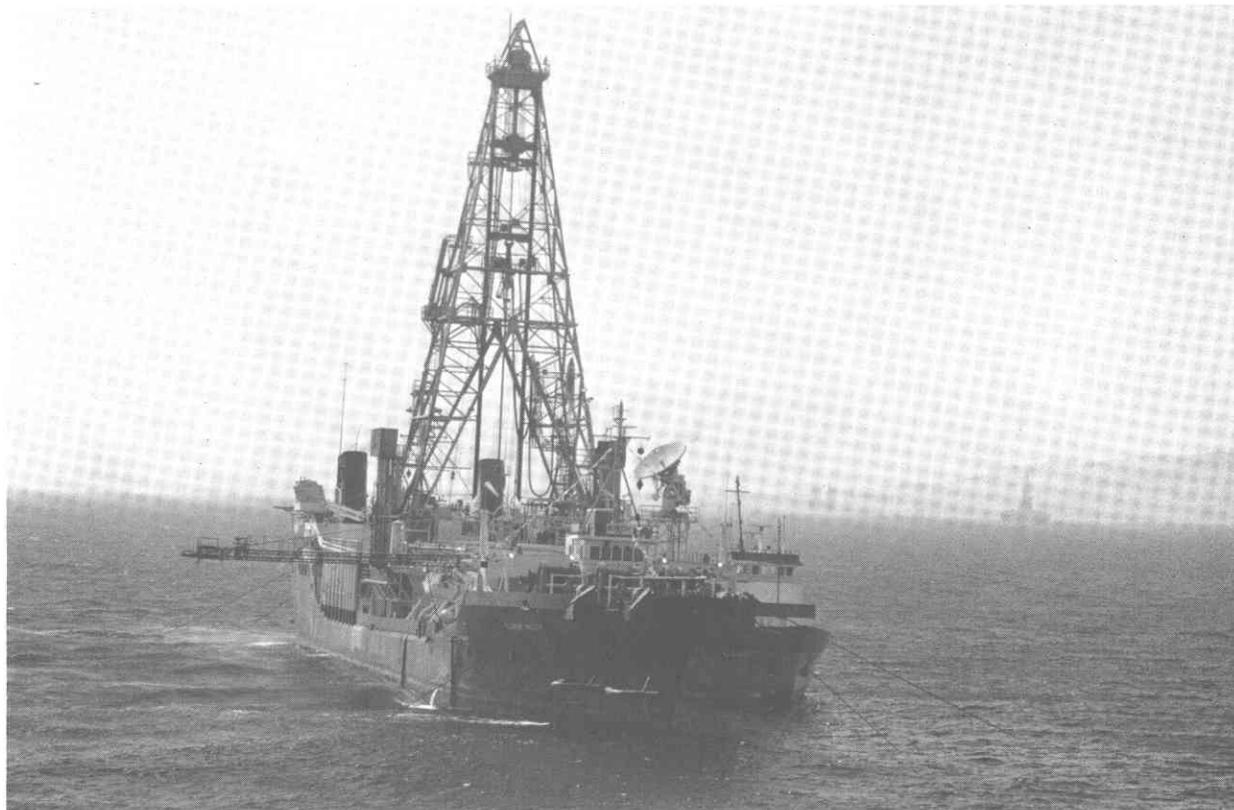
Environmental risks of oil and gas development and potential use conflicts with the fisheries industry, as well as the aesthetic impacts of oil and gas development are of great concern to Oregonians. Geographically, these concerns are focused on the entire continental margin.

#### **• Other Uses**

Looking to the future, other potential users of Oregon's coastal ocean could include people growing oceanic plants and animals in large scale mariculture operations, kelp or other marine algae harvesters, people who want to in-

stall or have installed artificial reefs which would attract fish and to serve as a fishing or SCUBA diving site, and new recreational users such as people exploring reefs in private recreational submersibles or jet skiers or sail board-

ders hosting marathons along the coast. Oregonians will probably have many interesting and difficult ocean resource use choices in the future.



*If offshore oil and gas exploration were ever permitted off Oregon, drill ships such as this one operating in the Santa Barbara Channel, may be used. The ship is anchored into position, drill pipe is lowered from the tower through a hole in the ship's bottom, and the hole is drilled into the seafloor. (DLCD photo)*

