

Indicator 7: Shoreline armoring and beach loss (armored miles and trends). Oregon's beaches as we know them today have been in their proximate location for about the last 6000 years, when sea level stabilized after the last glacial period. During the relatively rapid rise in sea level, the coast retreated, and easily eroded dunes and marine terraces cut back more rapidly than the older, erosion-resistant rocks that form headlands today. These headlands divide the coast into a dozen separate pocket beach segments or "littoral cells". Each of these littoral cells is more or less isolated from the others, with relatively independent sources and sinks of beach sand.

Although large, infrequent earthquakes no doubt have dramatic physical impacts on Oregon's coastlines, the main physical processes that shape the coast today are large, storm-generated waves, high water levels, and strong nearshore currents that cut into and lower beaches, erode dunes, and undermine bluffs. Erosion at the base of bluffs in turn leads to slumping or major slides in geologically unstable areas. Erosion of dunes and bluffs and the redistribution of the eroded sand within littoral cells are natural processes that help maintain the physical integrity or size of beaches.

When the coast was sparsely populated, coastal erosion and landslides were viewed as natural events—something to be avoided when building on coastal lands. But as coastal lands were developed more extensively, particularly along ocean-front beaches, erosion and sliding were reclassified as "natural hazards"—something to be controlled in order to protect

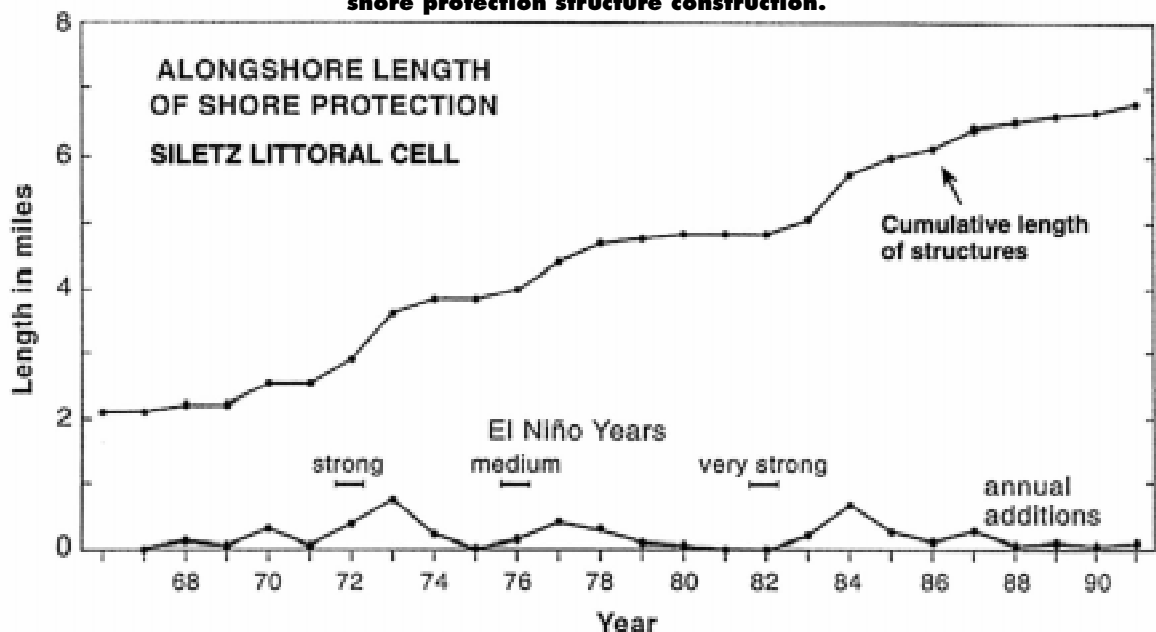
property. In recent times, that control has involved the construction of large rock walls called "riprap revetments" that extend along and out onto the public beach. Many miles of riprap revetments have been built along the Oregon coast in recent decades and the pace of new construction is steady and probably increasing (Good, 1994).

Oregon Parks and Recreation Department, the state agency that regulates shoreline armoring and other beach construction, has issued nearly 500 permits since 1967, when the Oregon Beach Law established the regulatory program to protect public access and prevent private encroachment on public beaches. Data on shoreline armoring is not available for the entire coast, but a case study of the Siletz littoral cell in north Lincoln County found that at the present rate of armoring, the entire cell would be hardened by 2030 (Figure 3.2-6; Good, 1994).

Strengths, threats, and information needs

The deteriorating condition of a number of marine fish stocks is cause for concern about the overall health of Oregon's marine ecosystem. Coastal coho salmon and some stocks of steelhead and sea run cutthroat trout are listed as threatened under the Endangered Species Act. The health of these stocks is affected by natural variability in ocean conditions, as well as a host of other factors—fishing pressure, mortality at dams, poor habitat conditions in estuaries and watersheds, and more. Although not a reflection of marine ecosystem health, the condition of these stocks nevertheless affects the ability of

Figure 3.2-6. Cumulative and year-to-year length of shore protection structures constructed in the Siletz littoral cell (<1967-1991), showing periodic El Niños and post-El Niño surges of shore protection structure construction.



(Good, 1994)

the marine ecosystem to provide the goods and services people expect. For other species, such as rockfish, declines are most likely due to overfishing as well as underestimates of population size and reproduction rates. The most significant risk to condition of fish stocks is our very limited understanding of the complex interactions of natural and human-caused changes in stock health. Furthermore, we understand very little about species and habitat associations and needs, and recruitment and rearing requirements of species and species complexes.

Federal law mandates that the regional fishery management councils that manage fisheries in federal waters to manage for the maximum sustained yield as reduced by relevant social, economic or ecological factors. Attempting to determine a maximum sustainable yield in a dynamic and changing ocean environment with an inadequate research base is a continuing problem. In practice, many stocks around the nation have declined as a result of overfishing. In part this resulted from ecological ignorance, in part from ineffective management measures, and in part from intense political pressure from fishers and others who have a financial interest in maintaining harvest levels. Recent management measures have turned attention to the recovery of West Coast salmon stocks (particularly coho salmon) and rebuilding of several groundfish stocks. These measures will require careful monitoring and evaluation for perhaps a decade or more—at least long enough to allow salmon habitat to recover, and to permit the rebuilding of slow growing rockfish species. Sustainable fisheries, and the economic benefits they provide to fishermen and to coastal communities, are dependent on healthy stocks of fish and the ecosystems that produce them. However, moving toward sustainability is a socially and economically painful process, as shown by the present “crisis” in the groundfish industry.

Additional research on fish stocks and impacts of fishing gear is needed to achieve sustainable fisheries, including (1) increased data collection on species for which stock assessments have not been conducted due to lack of data; (2) habitat-specific distribution and associations of all rockfish and other groundfish species; (3) life history characteristics and basic biology of all the commercial groundfish species to obtain better understanding of the ecology of these diverse communities; (4) sources and sinks for groundfish larvae and spatial patterns of recruitment to allow scientists to evaluate the potential of marine reserves as management tools; (5) studies on food and habitat requirements of all life history stages of the principal groundfish species to allow us to shift from single species to ecosystem management; (6) data on the impacts of bottom trawls and other mobile fishing gear on benthic invertebrate communities; (7) studies of the physical damage done by bottom trawls on different types of bottom habitat;

(8) other biological and chemical impacts of bottom trawls on habitat.

The dramatic resurgence in marine pinniped numbers and expansion of the range of some species since implementation of the 1972 Marine Mammal Protection Act and protection of offshore rock and island breeding habitat suggest that strong management measures have clearly offset the effects of natural variability and human-caused stressors—oil spills, marine debris, other pollution, and direct harassment. Increased numbers and expanded ranges (e.g., the northern elephant seal) also testify to the abundance of food sources and the overall health of the nearshore marine ecosystem.

Oregon’s kelp forests are a dynamic and ecologically important site-based marine resource located on submerged rocks and reefs administered under the Oregon Territorial Sea Plan (1994). The kelp beds are subject to the requirements of Oregon Statewide Planning Goal 19 (ORS 197.180), and consequently, bull kelp forests and their associated subtidal marine habitats and communities must be managed for the sustained yield of renewable resources. Oregon’s marine and coastal resource managers currently lack sufficient scientific information to characterize annual variability in the location and spatial extent of kelp forests, and to understand the functional role served by kelp forests in the dynamics of nearshore marine fish, mammals, and invertebrate communities. Additional descriptive information and results from controlled field experiments are needed to assist the next generation of coastal resource managers with sound decisions. Examples of needed research include (1) annual aerial and water-based surveys of the location, spatial extent, plant density, and overall biomass of representative kelp forests in southern and central Oregon, (2) comprehensive descriptions of habitat use of kelp forests by communities of seabirds, shorebirds, marine mammals, fish, and invertebrates, (3) empirical studies to gain increased understanding of the dynamics and interactions among members of plant and animal communities that inhabit kelp beds, and (4) annual estimates and future predictions of commercial and recreational use of kelp forests and their associated nearshore subtidal rocky reefs .

Oregon’s marine protected areas have not substantially changed in size or degree of protection in recent years. With increasing human population, coastal development, and recreation use of marine environments, more protection may be needed, particularly for unprotected nearshore reef ecosystems threatened by overfishing, habitat alteration, oil spills, and dredged material disposal. Difficulties in establishing protected areas in the ocean result from the dynamic, fluid, nature of the habitat and the hesitancy to unnecessarily restrict take of exploitable species, although protection of spawning and nursery areas might actually increase overall take. Political acceptance of increased protection is also a major issue.

The seven Marine Garden designations for sensitive rocky intertidal areas provide some protection to these habitats. However, extensive tourist visitation can damage fragile tidepool organisms and some sites are in danger of being loved to death. Pollution from outside the gardens is also a threat, as demonstrated by the wreck of the *New Carissa* in winter 1999.

Oregon's rocky islands are protected as part of the National Wildlife Refuge system. Protection, however, only extends down to the mean high water line. A 500-foot buffer zone around the rocks and islands is closed during summer to protect breeding birds and stellar sea lions, affording some protection to subtidal habitat and species as well.

Analysis of limited data on historical trends in the appearance of saxitoxin and domoic acid in estuarine shellfish, seems to follow the earlier appearance of the toxins in mussels or razor clams on the open exposed coast adjacent to the mouths of the estuaries. Given the current state of knowledge regarding the sources and population dynamics of the harmful algal bloom species responsible for Amnesiac Shellfish Poisoning (ASP) and Paralytic Shellfish Poisoning (PSP), it is difficult to assess the future risks to estuarine shellfish from these sources. Algae or plankton producing saxitoxin (toxin in PSP) are known to form resting stages which, in other regions of the world, serve as "seed stocks" to initiate toxic blooms. In Oregon there is no data on where these seed stocks may be located. Enhanced spatial and temporal shellfish monitoring would greatly enhance the ability to assess risks and threats.

Construction of revetments and seawalls along ocean beaches can have a number of adverse effects, blocking public access to or along the beach and worsening erosion on unprotected adjacent property. In the long term, however, it is the gradual cutting off of natural sand replenishment processes that may be the most significant effect these structures have on Oregon beaches (Good 1994). Shoreline areas most at risk are the north and central Oregon coast areas from Cannon Beach to Yachats. These are areas where beachfront lands are mostly in private ownership, where erosion has been most severe in recent decades, and where relative sea level has been on the rise during most of the 20th century. Global sea level rise is expected to accelerate as the 21st century wears on, moving the high water line ever landward. These factors, combined with diminished sand supply associated with shoreline armoring, threaten the health and physical integrity of one of Oregon's important natural resources—its ocean beaches.

Policy statements in the Oregon Beach Law and Oregon's land use program would seem to provide for public beach resources and promote avoidance of natural hazards along adjacent uplands. In practice, however, local comprehensive plans do not really advance hazard avoidance. Instead, development

decisions directly or indirectly promote shoreline armoring by allowing variances to setback requirements that put buildings and infrastructure in harms way (CNHPWG 1994).

Projections and conclusions

- Some groundfish stocks are likely to continue at depressed levels unless strict management controls continue to be applied. Recovery of these long-lived species may take a decade or more of reduced fishing pressure and habitat protection. As a result, the segment of the industry dependent on groundfish is in an economic crisis with little hope of quick recovery.
- Although only limited data exist on the impact of fishing on bottom habitat, high levels of fishing effort with bottom trawls and other fishing gear may be adversely affecting the productivity of the habitat that supports bottom fishes. If so, the carrying capacity of the habitat may be degraded and rebuilding stocks to previous levels may not be feasible or may take much longer than expected.
- Recent weather patterns may be signaling a major decadal climatic shift toward wetter, cooler conditions, and ocean conditions that are more favorable to salmon survival. If so, coho stocks may recover to 1970s levels, allowing resumed fishing. However, unless there is a significant improvement in the health of spawning and rearing habitat, the strength of stock recovery may be weak. This will place coho stocks at even greater risk of extinction when the next unfavorable climatic shift occurs.
- Increased commercial and recreational fishing pressure on nearshore subtidal rocky reef areas for rockfish, lingcod, greenling is primarily the result of the collapse and subsequent closure of the coho salmon fishery. Increased fishing pressure on these nearshore reef species is likely to continue, reducing the size and age structure of these populations and placing them at risk.
- Oregon's nearshore reefs are also sites for expansion of emerging commercial resource uses, including kelp harvest, the live-fish fishery, expansion of the open-access hook-and-line fishery, and the in-situ propagation and enhancement of sea urchins, abalone, and other mariculture species.
- Nearshore reef areas are also a popular destination for recreational boaters, and the kelp forests and rocky subtidal habitats face increased and diversified use by recreational and commercial SCUBA divers.
- Marine mammal populations will stay healthy, barring unforeseen problems with stocks or food availability. Species and habitat protection measures over the past three decades have been very effective.
- Data on the recurrence and severity of harmful algal blooms is inconclusive, but the potential risks to human

health associated with poisonous shellfish toxins warrant monitoring of this indicator to better assess their threat.

- Assuming that present oceanfront development and shoreline armoring practices persist, beachfront property along privately owned shorelines will be increasingly armored as the 21st century wears on. As episodes of erosion increase in frequency and severity, and affect more property, pressure will mount to lift the prohibition on armoring for post-1977 development. As armoring gradually shuts off natural sand replenishment processes, some beaches will gradually narrow and cease to function as viable recreational resources.

What data are available and how complete are they?

A wide variety of data sources were used in preparing this marine ecosystem health status report, as reflected in the reference section and citations in Table 1 and the text. Confidence in the data for some indicators is high (e.g., marine mammals, fish landings, some stock assessments). For other indicators (e.g., shoreline armoring, kelp, harmful algal blooms), confidence was moderate to low, owing to limited data from geographic case studies or incomplete time series. There are no Oregon-specific data on the impacts on bottom habitat by mobile fishing gear; however, high-confidence data on bottom trawl starts does provide a partial basis for designing needed research. Despite limited data, this latter issue is so important that it warrants indicator status. In all cases, the interpretation of data with respect to marine ecosystem health is based in part on the professional judgment of those scientists who contributed to or reviewed the report. Specific caveats about data quality and interpretation are included in context.

There may be better indicators than those used here for monitoring marine ecosystem health and sorting out natural versus human-caused change. Thus, this report should be viewed as a beginning effort to characterize ecosystem health and suggest causal factors for observed trends. It also presents a challenge the marine science and resource management community—we must identify the best possible indicators of marine ecosystem health, improve monitoring programs to track these indicators, and use the findings to improve decision-making processes and marine resource management.

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