

2008 OLYMPIC COAST NATIONAL MARINE SANCTUARY CONDITION REPORT

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The document that follows is a copy of the DRAFT Olympic Coast National Marine Sanctuary Condition Report that was disseminated to four individuals who served as peer reviewers. In December 2004, the White House Office of Management and Budget (OMB) issued a Final Information Quality Bulletin for Peer Review (OMB Bulletin) establishing peer review standards that would enhance the quality and credibility of the federal government's scientific information. Among other information, these standards apply to Influential Scientific Information (ISI), which is information that can reasonably be determined to have a "clear and substantial impact on important public policies or private sector decisions." The Condition Reports are considered Influential Scientific Information. For this reason, these reports are subject to the review requirements of both the Information Quality Act and the OMB Bulletin guidelines. Therefore, following the completion of every report they are reviewed by a minimum of three individuals who are considered to be experts in the field, were not involved in the development of the report, and are not Office of National Marine Sanctuaries employees. Following the External Peer Review the comments and recommendations of the reviewers were considered by sanctuary staff and incorporated, as appropriate, into a final draft document. In some cases sanctuary staff reevaluated the status and trend ratings and when appropriate, the accompanying text in the document was edited to reflect the new ratings.

The comments and suggested edits that were received from the reviewers are embedded in the below draft. The final Olympic Coast NMS Condition Report may be downloaded from: <http://sanctuaries.noaa.gov/>.

Olympic Coast National Marine Sanctuary

Condition Report 2008

DRAFT

Comment [kb1]: Thank you for the opportunity to review the Olympic Coast NMS Condition Report. My comments will address a few general areas and then some specifics.

I found the report overall to be well researched and presented, and in particular, the environment, setting and natural resources of Olympic Coast NMS were very capably addressed from my perspective.

Comment [kb2]: Summarizing the status and trend of a complex, multispecies system such as the Olympic Coast National Marine Sanctuary is a difficult task, and the authors should be commended for their efforts. The report is reasonably well organized and thorough, and we generally agree with the OCNMS condition status findings. We do have a few comments/concerns on factual issues, inconsistencies and omissions, which are itemized below.

Comment [kb3]: Overall, I think that the OCNMS has done a good job following the format and providing well-justified statements about conditions in OCNMS given the often limited data available. The collective judgments that are presented in the ratings reflect internal and external expertise, although they are by design quite broad in lumping many activities or conditions into one rating. My primary concerns are with some details and with a few issues of consistency across the report. These matters, I believe, are easily addressed in the final Conditions Report. I raise some of these comments as questions where I am seeking review of existing information to ensure accuracy.

I am assuming that there will be further editing by a professional editor to deal with some awkward and run-on sentences. This document must communicate to the broad spectrum of interested parties in tribes, government agencies, and the general public.

Comment [kb4]: I have gone through the OCNMS Condition Report. Very impressive document. The treatment appears to be comprehensive, thorough and accurate as far as available resources will allow. I found no glaring oversights, misstatements or interpretations that I would substantially disagree with. The document does appear to offer an accurate overview of sanctuary resources, conditions, threats and actions taken or proposed. I commend you and your colleagues on a job well done. My only regret is that I do not have more time to spend reading the document in greater detail, but my work schedule with the California mapping project simply does not allow it at this time.

Comment [kb5]: a specific goal for submerged cultural resources assessment and then management is strongly recommended. This could include the preparation of a specific submerged cultural resources assessment, a detailed document similar to that prepared by the NPS and NOAA for Gulf of the Farallones NMS and its bordering NPS units, Golden Gate NRA and Point Reyes NS, in 1990. This report would detail the particulars and contexts for maritime activity in the region, vessel losses, and known encounters, impacts and archaeological activity related to submerged cultural resources at Olympic Coast NMS. An important part of this ...

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About this Report

This “condition report” provides a summary of resources in the National Oceanic and Atmospheric Administration’s Olympic Coast National Marine Sanctuary, pressures on those resources, current condition and trends, and management responses to the pressures that threaten the integrity of the marine environment. Specifically, the document includes information on the status and trends of water quality, habitat, living resources and maritime archaeological resources and the human activities that affect them. It presents responses to a set of questions posed to all sanctuaries (Appendix A). Resource status of the Olympic Coast sanctuary is rated on a scale from good to poor, and the timelines used for comparison vary from topic to topic. Trends in the status of resources are also reported, and are generally based on observed changes in status over the past five years, unless otherwise specified.

Sanctuary staff consulted with outside experts familiar with the resources and with knowledge of previous and current scientific investigations. Evaluations of status and trends are based on interpretation of quantitative and, when necessary, non-quantitative assessments, and the observations of scientists, managers and users. The ratings reflect the collective interpretation by sanctuary staff of the status of local issues of concern, based on their knowledge and perception of local problems, as rated and informed by outside experts. The final ratings were determined by sanctuary staff. Before public release, this report was peer reviewed to comply with the White House Office of Management and Budget’s peer review standards as outlined in the Final Information Quality Bulletin for Peer Review.

This is the first attempt to describe comprehensively the status, pressures and trends of resources at Olympic Coast National Marine Sanctuary. Additionally, the report helps identify gaps in current monitoring efforts, as well as causal factors that may require monitoring and potential remediation in the years to come. The data discussed will enable resource managers to not only acknowledge prior changes in resource status, but will provide guidance for future management as we face challenges imposed by such potential threats as oil spills, invasive species, commercial development, climate change, and underwater noise pollution.

Summary and Findings

Olympic Coast National Marine Sanctuary represents one of North America’s most productive marine ecosystems that lies adjacent to expansive stretches of spectacular undeveloped shoreline. The sanctuary encompasses a variety of habitat types from sand beaches and rocky intertidal shores, to nearshore kelp forests and uninhabited islands, to deep coral/sponge communities and submarine canyons. The sanctuary’s temperate location and complex physical environment maintain critical habitats for unique communities of organisms. Twenty-nine species of marine mammals and scores of seabird species enrich the system, while fishes occupy a myriad of niches from deep ocean canyons to the shallow tide pools. A long history of human interaction with the marine environment is a unique facet of the area’s legacy. Native American cultures have lived for millennia in an intimate relationship with the ocean, and beginning in the 16th century, European exploration and settlement made a significant impact on the Olympic Coast.

The overall resources protected by OCNMS appear to be in relatively good to fair condition. Water quality parameters in Olympic Coast sanctuary appear in good condition, which may reflect its isolation from major urban or industrial complexes. There are indications of habitat quality degradation of hard bottom and deep sea biogenic structures that is primarily a result of several decades of bottom contact fishing gear use; however, management decisions have been enacted recently to help reduce this pressure. Living resource conditions have followed trends similar to those of habitats with many seabird, marine mammal, and fish population structures significantly altered with respect to historical values. Some uncertainty surrounds our scientific understanding of fishery resources and current levels of exploitation with regards to new mandates for ecologically-based fisheries management that must address sustainability of not only targeted fisheries but marine ecosystem function. Beyond severe natural forces, the principal threats to maritime archaeological

Comment [kb6]: Try to avoid making sentences convey too much. Examples from the About this Report section are:

[p. iv “Olympic Coast National Marine Sanctuary represents one of North America’s most productive marine ecosystems that lies adjacent to [this compromises the inherent productivity by limiting the comparison to adjacency to undeveloped shorelines – but OCNMS is unique in this dimension.

The overall resources protected by OCNMS appear to be in “relatively” good to fair condition [A rating system is set up for these categories and it is not “relative”]

Avoid the use of “and” to create long run-on sentences, e.g., “Native American cultures have lived for millennia in an intimate relationship with the ocean [and beginning with the 16th C, European.... Full stop “relationship with the ocean.”

Comment [kb7]: the report could do more to promote transparency with regard to the precise way in which judgments on final status and trends were made using the 28 expert responses and participating OCNMS staff. Presumably all 28 experts did not provide a response for each and every of the 17 category questions, and consensus was probably not unanimous. Also, the OCNMS staff made the final judgment when compiling expert responses, and it is not at all clear whether final status and trend determinations were different from those of the experts. Perhaps a table showing questions, ratings, basis for judgment, etc. could include a column giving the number of expert respondents, level of agreement and indication of whether the final status determination made by OCNMS staff differed.

Comment [kb8]: “scores of seabird species” there are at least 5 score of seabirds according to later information [more than 100 Text box p. v... “Scores” gives an inaccurate assessment.

Comment [kb9]: “relatively good to fair” change to “good to fair” and drop relatively as that is not the metric.

Comment [kb10]: To what new legislation is the reference made with “regard[s] to new mandates for ecologically –based fisheries management ... that must address marine ecosystem function”? If the reference is to the MSA Reauthorization 2006, that legislation falls far short of a mandate. Clarify. My sense is that what is meant here is that the preferred management paradigm is shifting to a broader ecosystem approach based on the recommendations of the scientific literature. This does not yet constitute a “mandate”.

resources in the sanctuary comes from unauthorized salvage and contact by fishing gear. This condition report will serve as background and supporting material for the review of the Olympic Coast sanctuary's management plan which will enable us to better understand, protect and utilize the nation's marine environment.

Comment [kb11]: add "fiber optic cable laying" to threats to marine archeological resources – comes from tables.

National Marine Sanctuary System and System-Wide Monitoring

The National Marine Sanctuary System manages marine areas in both nearshore and open ocean waters that range in size from less than one to almost 140,000 square miles. Each area has its own concerns and requirements for environmental monitoring, but ecosystem structure and function in all these areas have similarities and are influenced by common factors that interact in comparable ways. Furthermore, the human influences that affect the structure and function of these sites are similar in a number of ways. For these reasons, in 2001 the program began to implement System-Wide Monitoring (SWiM). The monitoring framework (National Marine Sanctuary Program 2004) facilitates the development of effective, ecosystem-based monitoring programs that address management information needs using a design process that can be applied in a consistent way at multiple spatial scales and to multiple resource types. It identifies four primary components common among marine ecosystems: water, habitats, living resources and maritime archaeological resources.

Comment [kb12]: If it is going to be the practice in Condition Reports to always use metric and English units there is a lot of editing that needs to be done here. There are many, many inconsistencies where one is given but not the other. This has to be cleaned up.

Comment [kb13]: Similarly, I find the use of citations to be spotty and inconsistent. If citations are to be used as in a formal report, there is a fair amount of work needed to bring this Conditions Report up to snuff. The existing citations are well-done and make reference to key literature. However, large portions of the Conditions Report lack similar documentation.

By assuming that a common marine ecosystem framework can be applied to all places, the National Marine Sanctuary System developed a series of questions that are posed to every sanctuary and used as evaluation criteria to assess resource condition and trends. The questions, which are shown on pages vi and vii and explained in Appendix A, are derived from both a generalized ecosystem framework and from the National Marine Sanctuary System's mission. They are widely applicable across the system of areas managed by the sanctuary program and provide a tool with which the program can measure its progress toward maintaining and improving natural and archaeological resource quality throughout the system.

Similar reports summarizing resource status and trends will be prepared for each marine sanctuary approximately every five years and updated as new information allows. The information in this report is intended to help set the stage for the management plan review process. The report also helps sanctuary staff identify monitoring, characterization and research priorities to address gaps, day-to-day information needs and new threats.

TEXT BOX

Olympic Coast National Marine Sanctuary

- Designated as a national marine sanctuary in 1994.
- The sanctuary extends 135 miles along the Washington Coast from about Cape Flattery to the Copalis River. Fifty six of these miles are shared with Olympic National Park and include some of the last remaining wilderness coastline in the lower 48 states.
- 29 species of marine mammals and over 100 species of seabirds spend at least part of their lives in the sanctuary.
- Three national wildlife refuges, collectively called the Washington Island National Wildlife Refuges, are located within the sanctuary. These refuges are part of the WA Maritime National Wildlife Refuge Complex and protect over 600 named and unnamed offshore rocks, seaslacks and islands.
- The sanctuary has sustained human communities for at least 6,000 years.
- The sanctuary lies within the traditional fishing areas for four coastal Indian tribes, the Makah, Quileute, and Hoh Tribes and the Quinault Indian Nation.
- Over 150 documented shipwrecks have occurred within the area of the sanctuary.
- The seaward boundary of the sanctuary varies from about 25 to 45 miles offshore. This covers the continental shelf as well as parts of three major submarine canyons. Sanctuary waters include many types of crucial marine habitat including nearshore kelp beds, subtidal reefs, rocky and sandy intertidal zones, submarine canyons, rocky deep sea habitat, and plankton-rich upwelling zones, all of which support the sanctuary's rich biodiversity.

Comment [kb14]: Last bullet, third sentence: Given the specific meaning of "critical habitat" under the ESA and "essential habitat" under MSFCMA it is important for OCNMS to be clear in its meaning for these terms. "Critical" seems to be used interchangeably with "crucial" or other less defined conditions.

Olympic Coast National Marine Sanctuary Condition Summary Table

Good Good/Fair Fair Fair/Poor Poor Undetermined

- Trends: ▲ Conditions appear to be improving
 — Conditions do not appear to be changing
 ▼ Conditions appear to be declining
 ? Undetermined trend
 N/A Question not applicable

Comment [kb15]: Should marine debris be a line item in the table?

Comment [kb16]: Based on the instructions, I have not commented on the format or the design of the Draft Conditions Report although I do have ideas to share. Further, I understand that I am not expected to review Appendix A and the National Marine Sanctuary programs rationale for developing the approach applied here [I do observe that parts are a bit quixotic from my perspective].

The following table summarizes the "State of Sanctuary Resources" section of this report. The first two columns list 17 questions used to rate the condition and trends for qualities of water, habitat, living resources, and maritime archaeological resources. The Rating column consists of a color, indicating resource condition, and a symbol, indicating trend (see key for definitions). The Basis for Judgment column provides a short statement or list of criteria used to justify the rating. The Description of Findings column presents the statement that best characterizes resource status, and corresponds to the assigned color rating. The Description of Findings statements are customized for all possible ratings for each question. Please see the Appendix A for further clarification of the questions and the Description of Findings statements.

To explain what I mean about the "quixotic" nature of the Conditions report format let me state briefly that to accomplish full answers to each of the questions would require a lot of redundancy. In order to avoid redundancy, the Conditions Report authors have to parse out where to put the full explanations of particular impacts or activities. This results in a Report that seems incomplete with respect to the specific answers to the 17 questions, however, there is a complete answer to each scattered among the answers to the questions. This problem may be unique to OCNMS but I doubt it. My sense is that the format for the Conditions report gets in the way of coherent answers to key questions. As an example, I would note that I expected EFH to be described with respect to at least 5-7 questions but the only complete answer appears in the answer to one of the questions very late in the whole Report.

#	Questions/Resources	Rating	Basis for Judgment	Description of Findings	Sanctuary Response
WATER					
1	Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality?	?	Hypoxic conditions may be increasing in frequency and spatial extent in nearshore waters	Selected conditions may preclude full development of living resource assemblages and habitats, but are not likely to cause substantial or persistent declines.	Management focuses on oil spill and discharge preventative measures, including relocating ship traffic lanes offshore, tracking ships, enhancing spill response assets in the region, and reducing wastes discharged from ships; moored instruments track nearshore water quality; periodic shipboard surveys are conducted to investigate physical, chemical and biological linkages
2	What is the eutrophic condition of sanctuary waters and how is it changing?	—	No suspected human influence on HABs or eutrophication	Conditions do not appear to have the potential to negatively affect living resources or habitat quality.	
3	Do sanctuary waters pose risks to human health?	—	Naturally occurring HABs result in periodic shellfish closures	Selected conditions that have the potential to affect human health may exist but human impacts have not been reported.	
4	What are the levels of human activities that may influence water quality and how are they changing?	—	Threat of oil spills from vessels	Some potentially harmful activities exist, but they do not appear to have had a negative effect on water quality.	
HABITAT					
5	What is the abundance and distribution of major habitat types and how is it changing?	—	Reduction in habitat complexity by bottom-tending gear; short-term impacts from fishing gear and cable installation	Selected habitat loss or alteration has taken place, precluding full development of living resource assemblages, but it is unlikely to cause substantial or persistent degradation in living resources or water quality.	Sanctuary and partners map and characterize deep habitats and the extent of human impacts and convey information to fisheries managers; large areas have been closed to fishing that uses bottom trawl gear to protect sensitive habitats; negotiated reburial of exposed fiber optic cable; began marine debris removal efforts
6	What is the condition of biologically structured habitats and how is it changing?	?	Damage by bottom-tending gear in some deep biogenic habitats	Selected habitat loss or alteration may inhibit the development of living resources, and may cause measurable but not severe declines in living resources or water quality.	
7	What are the contaminant concentrations in sanctuary habitats and how are they changing?	—	Prior studies indicate low levels of contaminants	Contaminants do not appear to have the potential to negatively affect living resources or water quality.	
8	What are the levels of human activities that may influence habitat quality and how are they changing?	▲	Decrease in bottom trawling and presumably impacts to hard bottom habitats	Selected activities have resulted in measurable habitat impacts, but evidence suggests effects are localized, not widespread.	

Comment [kb17]: As part of the outreach work done for the Ocean Policy Workgroup (from which the Ocean Action Plan arose), we met with tribes on the outer coast. I believe it was the Quileute Tribe who told us that there was evidence of significant amount of lead weights (debris from sports fishing) lost on a bank identified as a bottom fish nursery. They were concerned about Pb contamination. Although it's anecdotal, it is possible that this is a more widespread issue worthy of future investigation.

Comment [kb18]: Why just hard bottom? I've done a lot of sidescan sonar work across the world and the softer seabed (ie sediments) hold the trawl scars from fishing for many, many years. I last surveyed the WA continental shelf in 1998 and I remember it being very scarred. I assume the habitats in these sedimented areas is also significantly impacted.

LIVING RESOURCES					
9	What is the status of biodiversity and how is it changing?	?	Ecosystem-level impacts caused by historical depletion of fish, high order predators, and keystone species	Selected biodiversity loss may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.	Sanctuary works with partners to monitor populations of seabirds and marine mammals, and to detect non-indigenous species and conducts regular intertidal monitoring; wide area closures by fisheries management authorities to allow populations to recover; working with Finavera and state, federal, and tribal representatives to develop monitoring plans for wave energy pilot project.
10	What is the status of environmentally sustainable fishing and how is it changing?	▲	Overexploitation of some groundfish species has led to wide area closures	Extraction may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.	
11	What is the status of non-indigenous species and how is it changing?	▼	Invasive <i>Sargassum</i> and tunicate distributions are expanding	Non-indigenous species exist, precluding full community development and function, but are unlikely to cause substantial or persistent degradation of ecosystem integrity.	
12	What is the status of key species and how is it changing?	?	Populations of Common Murres, sea otters, and numerous rockfish reduced from historic levels, with differing recovery rates	The reduced abundance of selected keystone species may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity, or selected key species are at reduced levels, but recovery is possible.	
13	What is the condition or health of key species and how is it changing?	?	Diseases detected in sea otters	The condition of selected key resources is not optimal, perhaps precluding full ecological function, but substantial or persistent declines are not expected.	
14	What are the levels of human activities that may influence living resource quality and how are they changing?	▲	Commercial and recreational fishing pressure has decreased	Selected activities have resulted in measurable living resource impacts, but evidence suggests effects are localized, not widespread.	
MARITIME ARCHAEOLOGICAL RESOURCES					
15	What is the integrity of known maritime archaeological resources and how is it changing?	?	Deepwater wrecks stable; shallow wrecks subject to environmental degradation; lack of monitoring to determine trend	The diminished condition of selected archaeological resources has reduced, to some extent, their historical, scientific, or educational value, and may affect the eligibility of some sites for listing in the National Register of Historic Places.	Need to conduct inventories and monitoring, and to assess possible impacts of sea level rise on coastal archaeological resources
16	Do known maritime archaeological resources pose an environmental hazard and how is this threat changing?	—	Historic wrecks did not carry substantial quantities of hazardous cargoes	Known maritime archaeological resources pose few or no environmental threats.	
17	What are the levels of human activities that may influence maritime archaeological resource quality and how are they changing?	?	Fishing activities, cable installations offshore, and unauthorized salvaging	Selected activities have resulted in measurable impacts to maritime archaeological resources, but evidence suggests effects are localized, not widespread.	

Comment [kb19]: It seems that the comments on Finavera would fall under question 8 rather than questions 9-14.

Comment [kb20]: Overexploitation of some groundfish species has led to wide area closures (add text following text—and now most overfished populations are increasing.

Comment [kb21]: There has been a very recently identified tunicate explosion in Puget Sound. I'm not sure if it's showing up in such high densities on the outer coast, but it might just be a matter of time... Most of these invasives seem to be attracted to unnatural structures, such as docks and floating and sunken vessels.

Site History and Resources

Overview

Designated in 1994, the sanctuary's mission is to protect the Olympic Coast's natural and cultural resources through responsible stewardship, to conduct and apply research to preserve the area's ecological integrity and maritime heritage, and to promote understanding through public outreach and education.

The Olympic Coast National Marine Sanctuary spans 3,310 square miles of marine waters off Washington State's rugged Olympic Peninsula coast (Figure 1). Extending seaward 25 to 45 miles (40 to 72 km), the sanctuary covers much of the continental shelf and the heads of three major submarine canyons, in places reaching a maximum depth of over 4,500 feet (1,400 meters). The sanctuary borders an undeveloped coastline, enhancing protection provided by the 56-mile-long (90 km) wilderness of the Olympic National Park's coastal strip, as well as more than 600 offshore islands and emergent rocks within the Washington Islands National Wildlife Refuges. Superimposed on a nutrient-rich upwelling zone with high primary productivity and comprising of a multitude of marine habitats, the sanctuary is home to numerous marine mammals and seabirds, diverse populations of kelp and other macroalgae, and diverse fish and invertebrate communities.



Figure 1. The Olympic Coast sanctuary is located off the western shore of Washington State, with a boundary that follows the international border at the north and approximates the 100 fathom (600 feet) depth contour. (Map: Olympic Coast sanctuary)

Geology

The Olympic Coast sanctuary is subject to tectonic forces caused by the combined movements of the large Pacific and North American Plates and the smaller Juan de Fuca Plate. The Juan de Fuca Plate and the Pacific Plate are spreading away from each other at a divergent plate boundary offshore, while the Juan de Fuca plate is being pressed toward and beneath the North American Plate (Figure 2). These forces are linked to a chain of volcanoes within the uplifted Cascade Range. The geologic activity in the area off the Olympic Coast sanctuary gives rise to potential hazards such as volcanic eruptions, earthquakes, and associated submarine landslides and tsunamis. Tsunamis, long-period sea waves produced by submarine earthquakes or volcanoes, occasionally strike the Washington coast. The Alaskan earthquake of 1964 produced a tsunami that reached a height of almost 13 ft (4m) on the Washington coast south of the sanctuary.

Comment [kb22]: Many sections start off with or later reference a statement of general effects of something, e.g., underwater noise, trawling, aquaculture from the literature, and then tend to extrapolate it uncritically to OCNMS. I would frankly prefer to focus first on what is known [could be little] in OCNMS and then bring in the inferences from other areas with appropriate qualifications.

Comment [kb23]: Where the maximum depth is known 4660 feet – don't use a "maximum depth of over 4,500 ft. Be specific.

Comment [kb24]: Be specific when describing designated Wilderness under the 1964 Wilderness Act and an otherwise "wild" coast. This is highly inconsistent in the document. Do a search on the word Wilderness and determine when it is being used to describe a formal Wilderness under the 1964 act vs. a small "w" wilderness referring to some sort of wild condition.

Comment [kb25]: I also noted that the proximity and interrelationship of Olympic Coast NMS with Olympic National Park was not addressed, and the NPS' archaeological activities, including its internal resources for the assessment of submerged cultural resources, was not mentioned. The potential for interagency collaboration exists. It is unclear if there was interaction with NPS in the preparation of this document. If not, it is recommended.

Deleted: ed of

Comment [kb26]: Check to be sure that the « international boundary » has actually been settled. My understanding that the Canada-US maritime boundary in the Strait of Juan de Fuca is agreed to 12 nm but not beyond.

Comment [kb27]: Place "volcanic eruptions" last in the order of potential hazards because it is the least likely.

Comment [kb28]: Cite, incomplete info for WA tsunami height at <http://wcatwc.arh.noaa.gov/64quake.htm>

http://vulcan.wr.usgs.gov/Volcanoes/JuanDeFucaRidge/description_juan_de_fuca.html
<http://walrus.wr.usgs.gov/tsunami/research1.html>
http://www.pnsn.org/HAZARDS/CASCADIA/cascadia_event.html

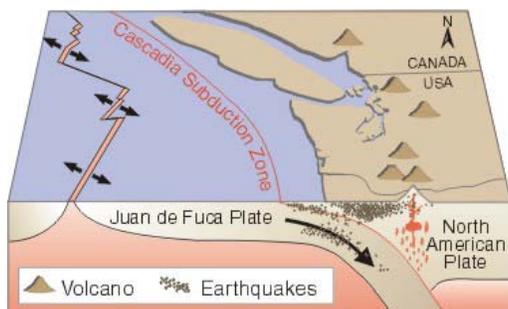


Figure 2. Subduction of the Juan de Fuca Plate under the North American Plate controls the distribution of earthquakes and volcanoes in the Pacific Northwest. (Diagram: USGS)

A continental shelf reaches out from Washington's coast from 8 to 40 miles (13 to 64 km), and provides a relatively shallow (600 feet or 180 meters depth or less) coastal environment within the sanctuary. Several submarine canyons cut into the continental shelf along the western boundary of the sanctuary, and the trough of the Juan de Fuca Canyon winds through the northern portion of the sanctuary towards the Strait of Juan de Fuca. In the northern portion of the sanctuary, the sediments on the shelf are largely glacial deposits from the Ice Age, and the shelf slope is steep and jagged. Modern sediments are carried west through the Strait of Juan de Fuca and north from the Columbia River. These materials are generally transported northward by year-round bottom currents and winter storms, and eventually accumulate on the shelf. The majority of the sanctuary seafloor, however, has not yet been adequately mapped or characterized, so a full understanding of sediments and habitat distribution remains elusive (Intelmann 2006).

Broad beaches, dunes, and ridges dominate the coastline from Cape Disappointment, on the north side of the Columbia River mouth, to the Hoh River. Wave action has eroded the shoreline through time and has formed steep cliffs at various places along the coast (Figure 3), and forested hills and sloping terraces are found near river mouths. Between Point Grenville and Cape Flattery, cliffs can rise abruptly 50 to 300 feet (15 to 90 m) above a wave-cut platform that is underwater except during extreme low tides. This wave-cut platform can be almost two miles (3 km) wide in some places. Small islands, sea stacks, and rocks dot the platform's surface.

http://olympiccoast.noaa.gov/living/physical_environment/geo/welcome.html
http://sanctuaries.noaa.gov/science/conservation/hm_olympic.html
http://sanctuaries.noaa.gov/science/conservation/hm_olympic.html

Comment [kb29]: Need to define continental shelf break at around 200 meters and use that number as the relatively shallow (660 feet or 200 meters of depth or less) Where does the 180 figure come from?



Figure 3. Eroded headlands, like this one at Point of Arches, exhibit the eternal dynamic of the sea's forces pounding against the shoreline.

Original Peoples and European Exploration

The Olympic Coast has sustained human communities for at least 6,000 years and possibly much longer. Native Americans villages were located at protected harbors and river mouths where people practiced ocean and river-dependent hunting, gathering, fishing and whaling activities (Figure 4). As they are today, Native Americans were among the top or apex predators in the marine ecosystem. Artifacts from one prehistoric site, the Ozette archaeological site near Cape Alava, provide a window into the daily life of that culture immediately before European contact. Clever tools made from natural materials developed from their intimate relationship with natural resources, and complex artwork and rich oral traditions demonstrate the sophistication of these Native American societies. Recent research on earlier sites confirms maritime-adapted cultural practices of offshore fishing and whaling dating at least 4,000 years before present. Today, the Makah, Quileute, and Hoh tribes and Quinault Indian Nation carry their heritage forward, balancing the very modern needs of their communities with long traditions, and manage natural resources like fisheries and forestry as co-equals as provided in their treaties with the United States government.

Comment [kb30]: Which of the Native American groups consider themselves tribes and which are Nations? Inconsistencies throughout the text. Sometimes reference is to tribes and other times to the same tribe as a Nation.

Comment [kb31]: "co-equals" is probably not the correct way to express "co-managers" based on sovereignty of Native American tribes under Treaties. Is tribes to be capitalized or not?

TEXT BOX: Coastal Tribes of the outer coast of Washington - (from south to north)

Quinault Indian Nation	The Quinault Indian Nation consists of the Quinault and Queets tribes and descendants of five other coastal tribes. The Quinault Indian Reservation, located in the southwest corner of the Olympic Peninsula, includes 37 kilometers (23 miles) of Pacific coastline and covers 84,271 hectares (208,150 acres) of forested land. http://209.206.175.157/
Hoh Indian Tribe	The Hoh Reservation consists of 179 hectares (443 acres) located 45 kilometers (28 miles) south of Forks at the mouth of the Hoh River. The reservation has about one mile of beach front between the mouth of the Hoh River and Ruby Beach. http://www.npaih.org/member_tribes/tribe/hoh_tribe/
Quileute Indian Tribe	Surrounded on three sides by The Olympic National Park, the Quileute Reservation is located on 451 hectares (1,115 acres) along the Pacific Ocean and on the south banks of the Quillayute River and includes the town of LaPush. http://www.quileutenation.org
Makah Nation	Located in the northwestern most corner of the contiguous US, the Makah Reservation consists of 11,007 hectares (27,200 acres) and is bounded by the Pacific Ocean and the Strait of Juan de Fuca. It includes the town of Neah Bay. Over 405 hectares (1,000 acres) of the land bordering the Pacific Ocean have been reserved as a Wilderness Area. The Makah are part of the Nootkan culture group, which includes two other tribes in British Columbia, Canada. http://www.makah.com/index.html http://www.npaih.org/member_tribes/tribe/makah_tribe1/



Figure 4. Human presence on the Olympic Coast predates historical records and attests to these cultures' long and intricate relationship with the marine environment. (Photo: Olympic Coast sanctuary)

In 1592, **Juan de Fuca**, a pilot on a Greek ship, reported visiting a Northwest Passage that emptied into the Pacific Ocean. For the next 200 years, Spain, England, France and Russia all sent explorers to confirm his report and lay claim to the region and its riches. De Fuca's visit was never confirmed, however his name was preserved on later English maps and the passage is now known as the Strait of Juan de Fuca (Figure 1).

In 1778, the English explorer Captain James Cook sailed the coast. In 1788, another English sea captain, John Meares, was so impressed by Mount Olympus he named it after the mythical home of the Greek gods. "If that be not the home where dwell the Gods, it is beautiful enough to be, and I therefore call it Mount Olympus," he wrote. The name was made official 14 years later when Captain George Vancouver entered the name on his

Comment [kb32]: "Juan de Fuca" was the Spanish name of Greek pilot Apostolos Valerianos, who claimed a 1592 voyage to the area in a waterfront discussion with an English visitor. The voyage Valerianos was a participant in has not been historically documented, and aspects of his account, as related in Hakluyt, are fanciful. An earlier voyage claim, by Lorenzo Ferrer Maldonado, claimed passage through a strait in the region in 1588, passing from the Atlantic into the Pacific! In this context, Valerianos' account of sailing past a large rock pillar into a "broad inlet of sea, between 47 and 48 degrees of latitude" has been doubted by many, including Captain George Vancouver. Regardless of whether his account is apocryphal, the "legend" of Juan de Fuca and his straits inspired American maritime fur trader Captain Charles Barkley, the first known mariner to sail into the modern straits, to name them the Straits of Juan de Fuca in 1787.

In the aftermath of Barkley's voyage, Spanish and British explorers sailed into the region, entered the straits and charted them as well as adjacent waters such as Puget Sound, the Gulf of Georgia, and Burrard Inlet. George Vancouver's 1792-1794 voyages resulted in the first detailed maps of the area and its approaches and waters. Another comment in this regard is that while James Cook missed the straits and stayed well offshore in Washington waters, his landing on the shores of Vancouver Island resulted in Cook's bartering for sea otter pelts at Nootka. Their subsequent sale at high prices in China spurred a "rush" to the coast, and the resultant lucrative and extensive maritime fur trade of the late 18th and early 19th century. Hundreds of vessels, principally British and American, worked the coast and engaged in regular commerce with Native American groups, including those in the Olympic Coast NMS area.

The context for John Meares is somewhat confused in the report. He was also engaged in the maritime fur trade, and the seizure of his ship at Nootka, and his imprisonment caused a diplomatic incident that could have led to war between Britain and Spain. George Vancouver negotiated a treaty that included Spain's withdrawal from the region.

maps and referred to the whole range as the Olympic Mountains. Although the Spanish built the first European settlement near Neah Bay in 1792, Spanish influence was short-lived. The settlement was abandoned after only five months when Spain came under the threat of war from Great Britain.

http://olympiccoast.noaa.gov/living/history_and_culture/welcome.html
<http://www.americanparknetwork.com/parkinfo/ol/history/>

Commerce

Furs were the key to opening the northwest coast to European trade in the late 1700s, especially profitable sea otter pelts that were obtained from the Indians by English, Russian, Spanish and American fur traders. As the news spread of the great profits to be had in fur trading, sea otter populations dwindled and by the early 1900s, sea otters had been extirpated from the region (Figure 5).

http://olympiccoast.noaa.gov/living/history_and_culture/history/welcome.html



Figure 5. Sea otters were hunted nearly to extinction in the 18th and 19th centuries for their fur. Because of reintroduction efforts in the 1970s to the Pacific Northwest, they are making a comeback along the Olympic coast. (Photo: C. Edward Bowlby)

Through the latter part of the 1800s, pioneers moved into the Olympic Peninsula to farm, fish, and cut timber. Like Native Americans, most early settlers chose to settle along the coast. In 1851 Port Townsend became the first permanent American settlement on the Peninsula, providing a gateway for further settlements to the west (Figure 6). Port Angeles, with its harbor, lighthouse, military reservation, customs house, and strategic location on the Strait of Juan de Fuca, was designated by President Abraham Lincoln as a town site in 1862. Today, it is the Peninsula's largest town with a population of 18,400 (in 2000). Farther west, the town of Forks had European settlers as early as the 1860s. People were originally drawn to Forks for gold prospects but timber became the mainstay of the economy of Forks and other west end towns. Fishing continues to be an important commercial venture for coastal communities like Neah Bay and La Push.

<http://www.forks-wa-real-estate.com/history.htm>

Although the area attracted logging, farming and fishing interests, the rugged western coast and interior of the Peninsula retain significant roadless wilderness. Olympic National Park was established in 1938 and now includes nearly a million acres of mountain, forest, and coastline designated as wilderness. The coastal strip of

Comment [kb33]: Another aspect of the coast's history with implications for maritime cultural resources is the presence of Asian shipwrecks. Beginning in 1636, the Tokugawa Shogunate of Japan closed the country to foreigners and ordered Japanese ships constructed in a fashion that made extended ocean voyage extremely difficult. Nearly 1,000 Japanese vessels, between 1636 and 1858, disappeared, a large number of them seemingly caught in the kuroshio, or the "black current" that sweeps from Japan to the Northwest Coast of America. Native tradition, as well as 19th century accounts, suggest that a number of these vessels wrecked on or near the shores of British Columbia and Washington. One example particularly pertinent to Olympic Coast NMS is that of the Hojun-maru, an October 1832 departure from Toba for Edo (modern Tokyo). Caught in a typhoon and dismasted, the vessel drifted in the current for 14 months before wrecking the vicinity of Cape Flattery. Three survivors were enslaved by the Makah. Hudson's Bay Company fur traders learned of the captives, and on the orders of John McLoughlin, Chief Factor of the HBC and head of the HBC's Columbia Department at Fort Vancouver (on the Columbia River), Captain William Henry McNeill of the HBC vessel Llama bartered for the release of the three Japanese in 1834.

Comment [kb34]: The lumber trade on the Pacific Coast was a long-lived and very significant aspect of maritime trade along the coast now inside Olympic Coast NMS and contributed to a number of the shipwrecks in the sanctuary. Beginning in the 1850s and the establishment of sawmills on Puget Sound and environs, including the Olympic Peninsula, larger vessels, many of them veterans of the California Gold Rush commenced the trade. In the 1870s through the early 20th century, sailing and steam schooners built on the coast carried on an expanded and active trade.

Another aspect of coastal trade and its implications for submerged maritime cultural resources is that the environmental conditions of the sanctuary area and the fact that the sanctuary lies on the route that ALL coasting vessels coming up from California into the Puget Sound/British Columbia region - as well as lying to the south of the narrow entrance into the region (the Straits) taken by transpacific vessels, made this an active highway of maritime activity, and hence the type of vessels wrecked in the sanctuary could and do represent major trades and aspects of global as well as national and regional maritime activity, as well as ship types.

Comment [kb35]: note use of "extirpated" in text and "nearly to extinction" in the picture caption for Fig. 5. Can't be both.

....There seems to be some conflict in the text of the CR over whether or not sea otters were extirpated [eliminated entirely] from coastal WA or if they were "nearly" extirpated [caption of Fig. 5].

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Comment [kb36]: Fishing continues to be an important commercial [both commercial fishing and recreational fishing].....

the Park was added in 1953. The Olympic National Forest was designated 1897 as the Olympic Forest Reserve and now contains 88,265 acres (15% of the total national forest acreage) of designated wilderness.

<http://www.fs.fed.us/r6/olympic/faq/> <http://www.americanparknetwork.com/parkinfo/ol/history/>

Comment [kb37]: Link outdated? Reroutes to "oh ranger" site.



Figure 6. Most current day cities and towns around the Olympic Peninsula grew from Native American village sites.

Throughout the period of European settlement on the western Olympic Peninsula, the link between the land and the ocean has shaped history. Early canneries, logging operations and hotels reflected not just the economic opportunities offered by coastal resources, but the hardships imposed by the Olympic Coast's remoteness, such as lack of or limited road transport. Coast-wide trade linked the productive Olympic Peninsula with markets in California, Hawaii, Australia and beyond. In addition, the completion of railroad links across the Continental Divide in both Canada and the United States made the ports of Vancouver, Seattle, Everett, Tacoma and Victoria important sources of grain, timber, gold and other resources for the world's economy.

Comment [kb38]: The Peninsula's contribution to global trade probably overstates the proportion coming from OCNMS areas.

Comment [kb39]: The Port of Seattle was an established participant in the world economy due to its role in the lumber trade well before the construction of the railroad. The same holds true for the earlier maritime fur trade vessels.

http://olympiccoast.noaa.gov/living/history_and_culture/welcome.html

Today commerce on the Olympic coast still depends largely on commercial and recreational fishing, logging and tourism. In recent years, the local timber industry and the fishing industries have both been impacted by reduced harvests, and the local economy has struggled. Coastal communities continue to respond to a changing economy by developing innovative enterprises such as value-added wood product manufacturing (local manufacturing rather than export of raw timber) and accommodating the growth of tourism to diversify the economic base.

Water

The Washington outer coast is known for its rough seas and large waves - extreme wave heights ranging from 50 to 90 feet (15 to 27 m) have been recorded on and beyond the continental shelf. Winter storms travel across the fetch of the Pacific and the energy is magnified as they encounter the shallower continental shelf, where their force pounds the coast with the gathered intensity.

Comment [kb40]: In discussion of Water p. 7 and elsewhere, it is important to note the variability in these oceanographic and atmospheric conditions brought on by El Nino/La Nina and the PDO as these may have marked effects on marine communities on an interannual or decadal scale.

http://olympiccoast.noaa.gov/living/ocean_processes/waves_currents/welcome.html

Surface winds generated by atmospheric pressure systems are the main force driving ocean surface circulation off the Pacific Northwest. Spring and summer winds blow generally toward the south and push surface waters southward and offshore. This results in nearshore upwelling of cold, nutrient rich water to the surface (Figure 7). This influx of nutrients enhances plankton communities that are ultimately responsible for the region's productive fisheries. Downwelling tends to occur in the fall and winter months when the winds blow generally toward the north and surface water is forced shoreward. (Oregon Sea Grant 1997). Other physical features also play a role in these movements, however. Shelf platform width, river plumes, submarine canyons, banks, coastal promontories and offshore eddies influence the retention, magnitude, and timing of nutrient delivery to plankton, and may explain why primary productivity is higher along the Washington coast than the Oregon coast (Hickey and Banas 2003).

On a regional scale, the California Current transports cold subarctic water southward along the Washington coast, thereby directly influencing the local distribution of marine organisms. The California Current generally occurs from the continental shelf break to a distance of ~1000 km from shore and rides above the narrower California Undercurrent, which flows northward and is implicated in the transport of larvae and other plankton. The California Current and Undercurrent are strongest in the summer, while the seasonal, nearshore Davidson Current flows northward during winter months when the Columbia River plume is transported along the Washington coast. Another seasonal feature is the Juan de Fuca Eddy, which is ~50 km in diameter, persists in summertime, and entrains nutrient rich coldwater in a counterclockwise circulation pattern (see Figure WQS4).

Comment [kb41]: Find figure



Figure 7. Southward-blowing winds are associated with a net transport of surface waters away from the coastline, resulting in intermittent upwelling. (Image: Oregon Sea Grant)

Habitat

The Olympic Coast sanctuary contains a broad diversity of habitats including rocky shores, sandy beaches, kelp forests, sea stacks and islands, open ocean or pelagic habitats, the continental shelf seafloor and submarine canyons. Along the shoreline, tidepools are formed amid boulders and rocky outcrops that provide both temporary and permanent homes for an abundance of 'seaweeds' (e.g., macroalgae and seagrasses), invertebrate species such as sea stars, hermit crabs, and sea anemones, and intertidal fish. Rocky shores of the Olympic Coast have among the highest biodiversity of marine invertebrates and macroalgae of all eastern Pacific coastal sites from Central America to Alaska. Nestled between these rocky headlands are numerous sand-covered pocket beaches that host their unique array of intertidal invertebrates and fishes.

Comment [kb42]: need citation

Kelp forests form dense stands in nearshore waters, with individual plants reaching up to 20 m in length (Figure 8). The structure of this living habitat alters the physical forces (waves and currents) in the nearshore area and creates a protective environment for fish and invertebrates, from their holdfast base on the seafloor to their canopies at the surface. Sea otters often raft and rest in and near kelp canopies, while many species and ages of fish find protective habitat among the kelp forests.

Pinnacles (sea stacks) and islands along the coast also provide havens and resting sites for California and Steller sea lions, harbor and elephant seals, and thousands of nesting seabirds. High-relief submerged topographic features such as rock piles serve as fish aggregation areas.



Figure 8. Within the nearshore environment, kelp forests are vital habitat for many species of fish, invertebrates, seabirds and mammals.

A majority of the sanctuary lies over the continental shelf, extends from the nearshore to the shelf break at about the 200 meter contour. The shelf is composed primarily of soft sediment and glacial deposits of cobble, gravel and boulders, punctuated by rock outcrops, and is inhabited by creatures such as flatfish, rockfish, octopuses, brittle stars and sea pens that have adapted to the darkness, cold, and pressure of the seafloor. Sanctuary boundaries extend beyond the edge of the continental shelf and include portions of the Nitinat, Juan de Fuca, and Quinault submarine canyons (Figure 1). The Quinault canyon is the deepest, descending to 4,660 feet (1,420 m) at its deepest point within the sanctuary. Many creatures, such as corals, sponges, crinoids, rockfish, and shrimp, inhabit these areas of physical extremes. The canyons are also dynamic areas where massive submarine landslides can occur on the steep side walls, undetected by man, and canyon bottoms collect sediment deposited from above. They also serve as conduits for dense, cold, and nutrient-rich seawater that is pulled toward shore, where upwelling feeds surface productivity at the base of the food web.

Recent surveys conducted in offshore shelf and canyon habitats have confirmed the presence of hard-bottom substrates that harbor rich invertebrate assemblages, including deep water coral and sponges. Such fauna are commonly thought to be restricted to shallow tropical waters. However, an increasing number of studies around the world have recorded coral and sponge assemblages in deeper, cold-water habitats in both northern and southern latitudes. These living organisms with branching, upright structure are, in turn, habitat themselves for other invertebrates and fish (Whitmire and Clarke 2007). Habitat-forming corals and sponges provide hiding places, attachment sites, food sources, and breeding and nursery grounds in relatively inhospitable and otherwise featureless environments (Figure 9).

<http://olympiccoast.noaa.gov/living/habitats/welcome.html>

Comment [kb43]: Cite report(s) in below McArthur link

<http://sanctuaries.noaa.gov/science/conservation/mcarthur.html>



Figure 9. The red tree coral with darkblotched and sharpchin rockfish are colorful inhabitants of deep rocky areas. (Source: Olympic Coast sanctuary)

Living Resources

Twenty-nine species of marine mammals have been sighted in the Olympic Coast sanctuary, including seven species of endangered whales. Two species are frequent foragers in the sanctuary, the humpback whale and the killer whale (also called orca) (Figure 10). Gray whales, which were recently removed from the endangered species list, travel through the sanctuary on their annual migrations between breeding and calving grounds off the Baja Peninsula and summer feeding grounds in the northern Pacific. Sea otters, harbor and elephant seals, and Steller and California sea lions aggregate along the shore and haul out on land at many locations along the coast throughout the year.

http://olympiccoast.noaa.gov/living/marine_wildlife/welcome.html



Comment [kb44]: Are all the 7 whale species really designated as endangered under the ESA?

Figure 10. Most killer whales (or orca) in the sanctuary belong to resident groups that frequent northern Puget Sound and the Strait of Georgia. Occasionally, wide-ranging oceanic groups (transient orca and offshore orca) visit the region.

Seabirds are the most conspicuous members of the offshore fauna of the Olympic Coast. Sea stacks and islands provide critical nesting habitat for nineteen species of marine birds and marine associated raptors and shorebirds including seven alcid species (murre, puffin, murrelets etc.; Figure 11), three cormorant species, four gull and tern species, two storm-petrel species, two raptors and one shorebird, the Black Oystercatcher. Productive offshore waters attract large feeding aggregations of marine birds that breed in other regions of the world but travel great distances to “winter” in sanctuary waters. The Sooty Shearwater, for example, breeds off New Zealand and Chile in the austral summer and congregates along the Pacific coast in their non-breeding season. Black-footed and Laysan Albatross travel far from their breeding grounds in Hawaii and Japan to forage in the eastern Pacific. Nearer to shore, sand and gravel beaches furnish foraging areas for shorebirds, crows, gulls and a host of other birds and mammals. The coastline forms an important migratory pathway for millions of birds that pass through each year, guiding waterfowl, cranes, shorebirds, and raptors toward northern breeding areas during the spring and southward, as winter approaches.



Figure 11. The distinctive Tufted Puffin is a familiar seabird that nests in burrows on remote islands far from any mammalian predators.

Sanctuary waters are inhabited by diverse and abundant fish and invertebrate populations (Figure 12). Commercially important fish and shellfish include at least 30 species of rockfish (including thirteen state species of concern of which three are also federal species of concern), plus Pacific halibut, herring, Pacific cod, Pacific whiting, lingcod, sablefish, 15 or more species of flatfish, Dungeness crab, razor clams, and several species of shrimp. Five species of Pacific salmon (chinook, sockeye, pink, chum, and coho) occur along the outer coast of Washington and breed in the Olympic Peninsula’s rivers and streams. Three similar salmonid species found in freshwater systems (sea-run cutthroat trout, bull trout, and steelhead) spend portions of their lives in nearshore marine waters. Olympic Coast populations of Ozette sockeye and bull trout were added to the federal list of threatened species in 1999. Nearshore habitats of the sanctuary are important for salmon that spawn in adjacent streams. The sanctuary also encompasses the migration corridor of both juvenile and adult salmonids from California, Oregon, and British Columbia, and from other rivers in Washington. Sharks, albacore and yellowfin tuna, sardines, mackerel, anchovies and other migratory species also are found in the sanctuary seasonally. These fast-moving fishes are important resources for tribal and non-tribal fishers.

- Deleted: b
- Deleted: o
- Comment [kb45]: What convention is going to be used with seabird names? Some are capitalized and some aren't. My suggestion is to drop all capitals except where there is a person or place name.
- Deleted: s
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- Deleted: a

Comment [kb46]: Yellowfin tuna are not found in the sanctuary seasonally in the same manner as albacore, nor are they an important resource in this area for fishermen.



Figure 12. Nearly every surface in the rocky intertidal zone is used by something, and space is at a premium. Predatory ochre sea stars search for mussels among communities of green sea anemones and rockweed.

Intertidal habitats challenge inhabitants with extreme temperature, salinity, and oxygen fluctuations along with powerful physical forces such as sand scouring and wave action. Invertebrate communities in rocky intertidal zones are some of the richest on the west coast and include a wide diversity of sea stars, sea urchins, nudibranchs, chitons and polychaetes. Macroalgae or seaweeds are also extremely diverse in the region with an estimated 120 species thought to occur within the sanctuary rocky intertidal zone (Dethier 1988). Sandy intertidal areas host sand-dwelling invertebrates, and several notable fish species including starry flounder, staghorn sculpin, sand lance, sand sole, surfperch, and sanddab. Surf smelt spawn at high tide on sand-gravel beaches where surf action bathes and aerates the eggs. Rocky intertidal habitats hold another roster of residents: tidepool sculpins, gunnels, eelpouts, pricklebacks, cockcombs, and warbonnets, to name few.

In the deeper areas of the sanctuary (e.g., greater than 250 ft or 80 m) investigations have revealed stunning colonies of brightly colored, cold-water corals and sponges. These unique assemblages include soft corals such as gorgonian species, stony corals (e.g., *Lophelia sp.*), giant cup corals (e.g., *Desmophyllum sp.*) and at least 40 species of sponges (Brancato et al. 2007). The distribution of such deep-water communities, as well as their species richness and basic biology, are unknown but are currently under scientific investigation.

Maritime Archaeological Resources

Native and Prehistoric Maritime Heritage

The modern shoreline of the Olympic Peninsula contains dozens of late prehistoric archaeological sites that are rich in materials documenting the character of the maritime environment and the use of this environment by the region's native peoples. Nearshore coastal forests adjacent to the sanctuary contain mid-Holocene shorelines and older prehistoric archaeological sites. These older sites are rich in materials documenting the character of maritime paleo-environments, the history of environmental change, and the record of the use of these environments by the region's native peoples.

The earliest dated archaeological site on the Washington Coast occurs adjacent to the sanctuary on the Makah Indian Reservation, establishing human presence for the last 6,000 years. Although complex geological and climatic factors have changed the shoreline due to tectonic uplift and global sea level rise, it is evident that humans have occupied the coastal zone and adapted to changing habitats over time. The recent investigation of paleoshoreline sites on the Makah Reservation reveals high sea-stand village sites inland along the Sooes and Waatch river valleys, in some cases greater than ten meters above current sea level and miles from the current

Comment [kb47]: confirm spp taxonomy with coral specialist

Comment [kb48]: The amount of discussion in the report devoted to cultural resources seemed, however, to be less adequately addressed than natural resources. The overall impression was one of a lack of detailed information on the maritime cultural resources in Olympic Coast NMS other than the prehistoric and historic period Native American resources such as Ozette. The disparity in documentation and discussion suggests an inherently disproportionate level of attention to cultural resources.

The maritime cultural resources of Olympic Coast NMS include a large selection of historically documented shipwrecks and one of the more significant and unique maritime cultural landscapes in the United States that rest within federal jurisdiction. This area is popularly known as the "Shipwreck Coast," and the concentration of wrecks is material evidence of centuries of vessel losses at the entrance to a major inland maritime highway, the Inside Passage to Alaska, as well as two extensive waterways that hosted major ports, Burrard Inlet in Canada and Puget Sound in the United States - not to mention a wide variety of lesser but in their time historically significant and active ports such as Victoria, Port Townsend, Port Angeles and others. The 19th century lumber trade in particular introduced large numbers of vessels - in 1886, for example, more than 600 vessels entered and cleared Puget Sound by way of Cape Flattery.

As a result of these activities, there are 180 known and an unknown number of historic period shipwrecks that lie within sanctuary boundaries. A large number of unidentified vessels were noted as dismantled and adrift off Cape Flattery in 19th and early 20th century accounts of maritime traffic. This suggests that a substantial number of "unknowns" lie within the waters of Olympic Coast NMS. The report should therefore more explicitly stress that while a literature search has identified the 180 wrecks as potential resources within the sanctuary, only archaeological survey will locate and presumably identify wrecks not otherwise documented, and that such an initiative is a priority for CRM activities in the sanctuary.

The report should also address historic period aircraft losses, a subject assessed and documented by the Washington SHPO in conjunction with the US Navy's Naval Historical Center under the terms of a Legacy Grant.

ocean shore (Wessen 2003). These sites reveal complex interactions with marine resources of the period and yield important clues to large-scale ocean and climate regimes, marine wildlife and fish populations, habitat distribution and cultural patterns of marine resource use. Late Prehistoric cultural patterns are particularly well documented. The Makah Cultural and Research Center in Neah Bay houses a collection of artifacts from the Ozette archaeological site, a Makah village that was partially buried by a mudslide nearly 500 years ago and excavated in the 1970s. Items used for research and display include whaling, seal hunting, and fishing gear.

Other tangible records of prehistoric human occupation include petroglyphs, both above the intertidal zone and within it, and canoe runs, or channels cleared of boulders to facilitate landing of dugout watercraft. Research and preservation of coastal native languages, traditional cultural properties, traditional practices of song, dance and activities like whaling also enhances awareness in native and non-native peoples of the region's rich ocean-dependent heritage. The recent resurgence of the canoe culture in the annual "Tribal Journeys" celebration transfers knowledge and understanding of coastal culture to new generations.

<http://www.makah.com/mcrchome.htm>
http://sanctuaries.noaa.gov/maritime/expeditions/3000_expedition.html

Historic Maritime Heritage

The combination of fierce weather, isolated and rocky shores, and thriving ship commerce have, on many occasions, made the Olympic Coast a graveyard for ships. More than 180 shipwrecks have been documented in the vicinity of the Olympic Coast, yet only a few have been investigated by modern survey techniques (Figure 13). There are few recorded shipwrecks prior to the mid-nineteenth century and no verified wrecks during the eighteenth century. The number of vessel losses increased significantly as Puget Sound developed into an economic center and as Victoria, British Columbia, developed on the north side of the Strait of Juan de Fuca in the 19th century. Ship losses were predominantly weather-related, and included foundering, collisions, and groundings. Many ships simply disappeared, their last known location recorded by the lighthouse keeper at Tatoosh Island before they disappeared into watery oblivion (Figure 14).



Figure 13. Surveyed shipwrecks in the Olympic Coast sanctuary. (Map: Olympic Coast sanctuary)

Comment [kb49]: The section on known shipwrecks is unfortunately inadequate, and the link back to the NOAA shipwreck database is conducive to readers of a bound or printed document. As well, rather than a link, the known wrecks should have been summarized, not only by type of vessel, and period, but by context (i.e. maritime trade or activity). The context of the wrecks, especially given the history of the area, is very important.

Comment [kb50]: In the Text box p. v there are "more than 150 shipwrecks" here there are more than 180 shipwrecks. Which number is accurate for OCNMS designated area?



Figure 14. The wild coastline leading to the western entrance of the Strait of Juan de Fuca, the passageway for ships bound to major ports in the Pacific Northwest, is unforgiving to vessels who's bearings, visibility, or propulsion are compromised.

Historic structures on land, while technically outside of sanctuary boundaries, remain important tangible fragments of the past that inform of human values for the ocean. These include historic lighthouses at Tatoosh and Destruction islands, lifesaving station remnants at Waadah Island and LaPush, wartime defense sites at Cape Flattery and Anderson Point, and sites of coastal patrol cabins scattered along the Olympic Coast. Homesteads, resorts, graves, and memorials also reflect a human dimension to the coast now largely reclaimed by time, the forest, or the sea.

<http://channelislands.noaa.gov/shipwreck/ocnms.html>

Comment [kb51]: The report is also inadequate in regard to the cursory discussion of other maritime cultural resources. The lighthouses, life-saving stations, and shipwreck memorials (such as the memorial for the lost crew of the 1903 wreck of the Norwegian), are all part of a unique maritime cultural landscape that particularly pertains to the waters and coast of the Olympic Coast NMS as an active, and yet dangerous highway for maritime commerce. The documentation, preservation and interpretation of these resources individually is important, but just as significant is the interconnection of these resources. Actually listing the resources and providing a map of them would be important - as well, no illustrations of the maritime resources were provided.

Pressures on the Sanctuary

Human activities and natural processes both affect the condition of natural and archaeological resources in marine sanctuaries. This section describes the nature and extent of the most prominent human influences upon the Olympic Coast National Marine Sanctuary.

Commercial Development

With advances in technologies and changes in our society's needs come proposals for new projects, many of which could not have been anticipated at the time of the sanctuary's designation and are not addressed in the existing management plan. The design of these developments and their potential impacts must be carefully considered to assess their compatibility with the sanctuary's primary goal of resource protection.

Fiber Optic Telecommunications

In 1999-2000, a pair of trans-Pacific fiber optic telecommunication cables, the Pacific Crossing-1 system (PC-1), was laid across the northern portion of the Olympic Coast sanctuary en route from Mukilteo, WA to Japan. Submarine cable installation involves substantial seafloor disturbance as a plow cuts several feet into the substrate to bury and protect the cable and to avoid entanglement with anchors, fishing gear or organisms. Although successful cable burial was reported, surveys of the PC-1 cables in the sanctuary conducted in 2000 revealed that substantial portions of each cable were not buried at a sufficient depth to avoid risks, and in many places the cables were unburied and suspended above the seafloor. In this condition, the cables could be physically damaged by fishing trawl gear and require repairs that could repeatedly disturb seafloor communities. Additionally, where unburied and suspended, the cables pose a serious safety concern for fishers employed in bottom contact fisheries who could snag gear on an exposed cable, a risk that limits access of Native American tribal fishers to portions of their treaty-reserved fishing grounds. In light of these risks, the cable owners agreed to recover and re-lay the cables in the sanctuary, an effort that was completed in late summer 2006 (NOAA 2005, Tyco 2006)

http://sanctuaries.noaa.gov/library/national/pcl_ea.pdf

Proposed Ocean Wave Energy Project

The Makah Bay Offshore Wave Energy Pilot Project has been in development for several years and is currently undergoing environmental review and permitting approvals. In December 2007, this project was issued a conditional license by the Federal Energy Regulatory Commission; this is the first federal license for an ocean energy project in the U.S. This one megawatt demonstration project would test a novel technology and deliver power to the Clallam County Public Utility District's grid from a renewable, "green" energy source – ocean waves. As proposed, the project includes four interconnected, floating buoys tethered to the ocean floor with a complex anchoring system and a submarine electrical transmission cable laid across the seabed to the shore. Authorization from the sanctuary will be required, but the project proponent has not yet applied for a sanctuary permit.

The in-water portion of the project is within Olympic Coast sanctuary boundaries, and the shore-based facilities are on tribal land of the Makah Indian Nation. The development company, Finavera Renewables, has conducted preliminary site evaluation studies and is developing final designs and plans for the installations. Federal, state, and tribal representatives are working with Finavera to develop maintenance and monitoring plans to mitigate and assess potential environmental impacts of this new technology, including damage to seafloor habitats and threats to marine mammals and seabirds (FERC 2007).

Open-Ocean Aquaculture

Comment [kb52]: In the Commercial Development section p. 14+ it would seem more useful to start with existing commercial uses and then discuss proposed or potential commercial uses.

Comment [kb53]: As a marine geologist and previous employee of the submarine telecom industry, I disagree with this statement, although you might perceive some bias and disregard this comment.

Seafloor ploughs are designed with a vertical share blade and an inclined, sharp, rotating cutting disc. The plough, as it advances, cuts a wedge of soil, similar in shape to a right-angled triangle. It lifts and holds the wedge, the cable is depressed into the trench, then the wedge is deposited back into the trench as the plough progresses forward. All that is seen on the seabed after the plough passes is a thin line showing progress of the share, and two shallow depressions (drag marks) either side associated with the front plough skids. It's actually a non-invasive method that does not leave an open trench.

ROV burial, on the other hand, does leave a trench, because it uses water jets to blow sediment out of the way around the already laid cable. The trench has to backfill naturally and this can take some time. It fills in much more rapidly in loose sand and quite slowly in firm to stiff clay. In clay, the trench created is straight sided and deep, whilst in the sand it is u-shaped and more shallow because sidewall sediment falls back into the trench immediately.

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Comment [kb54]: It's worth noting that these cables, different from telecom cables, are large diameter cables that generate a significant amount of heat. They have to be buried in the right type of sediment to allow heat dispersion (the sediment parameter is called 'thermal conductivity'), and it will be important to factor this into future project design.

Comment [kb55]: The nearshore section of the cable is planned to be bored. The proposal calls for the use of directional drilling to create a bore hole for the cable to avoid laying the cable over sensitive nearshore habitat.

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NOAA's Aquaculture Program is currently exploring possibilities for open-ocean or offshore aquaculture production in federal waters, which include all sanctuary waters more than three miles (5 km) off the Washington coast, a proposal that is controversial with some segments of the public with regard to pathogens, nutrient loading, and habitat and ecosystem impacts. To date, no projects have been proposed for open-ocean aquaculture in the sanctuary. Although sea conditions are dynamic and challenging in the sanctuary, technological developments in anchoring and structural design may make such development feasible in the sanctuary in the future. If projects are proposed for the sanctuary, it will be necessary for sanctuary staff to investigate potential environmental impacts and weigh these against sanctuary goals and mandates while making permitting decisions.

Comment [kb56]: Previously proposed draft legislation allowed for states to opt out to 12nm. Washington has not made a decision on that yet.

Comment [kb57]: I would say these are not the only concerns. The fishing industry has concerns. Also, although it's not the public, the state will have an interest in siting and environmental impact issues.

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Fishing

Commercial and recreational fishing are important components of the coastal economy and provide valuable food resources to the Northwest and beyond. Fishing occurs within the sanctuary, with commercial, tribal and recreational fishers as significant stakeholders in the health of the fisheries. However, some aspects of fishing practices and regulations are under scrutiny from co-managers for their potential negative impacts to habitat and to ecosystem functions.

Comment [kb58]: The discussion of impacts from fishing activities, including trawls, should specifically note that the majority of impacts to deepwater shipwrecks will be related to these activities. More discussion could occur with the local fishing community - the "anecdotal" comments about wrecks being impacted is common on the coast, and specific examples could be determined. This is particularly pertinent in the discussion on page 45 - deepwater wrecks are not relatively safe if deepwater trawling is taking place.

Comment [kb59]: Is the majority of seafood harvested in the PNW staying in this market (subsistence/commercial), or only a small percent?

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In recent years, National Marine Fisheries Service has implemented regulations on the West Coast to restore stocks of overfished species and to prevent physical damage to essential fish habitat. Research has documented damage to deep coral and sponge communities by bottom contact fishing gear around the world (Fossá et al. 2002, Morgan et al. 2005, Rogers 2004, Morgan et al. 2006). The distribution of existing and historic deep coral and sponge communities in the Olympic coast region is poorly known, as is the extent of impact to those areas (Brancato et al. 2007).

Rough waters and complex seabed features of the Olympic Coast sanctuary increase the potential for fishing gear entanglement and loss. Abandoned fishing gear can remain for decades, potentially entangling and killing species that encounter the gear. This phenomenon has been named "ghost fishing," where derelict gear continues to fish by attracting, trapping, and killing a wide variety of marine mammals, seabirds, invertebrates, such as shellfish, and fish. Dead organisms attract other feeding animals thus perpetuating the cycle of unintended mortality. A direct economic impact of ghost fishing is the reduction of fishery stocks otherwise available for commercial and recreational fishers. Accumulations of gear on critical spawning and rearing habitat can significantly impact fishery stocks. Derelict fishing gear also can threaten human safety, restrict other legitimate sanctuary uses, such as regulated fishing, anchoring and operation of vessels, and diminish the aesthetic qualities for activities such as scuba diving.

Comment [kb60]: In addition, there is the risk of localized heavy metals contamination caused by lost fishing weights.

Comment [kb61]: The discussion of ghost fishing gives the impression that we know there is a lot of such activity happening when in fact we lack good information on this phenomenon and its effect, if any, on living marine resource populations.

Comment [kb62]: the report identifies "ghost fishing" as a potential threat to OCNMS habitat and living resources. There is no citation associated with these statements. In addition, the report (on Page 55) then goes on to state that derelict fishing gear was not found to be a pervasive problem in the study area.

<http://olympiccoast.noaa.gov/protection/derelict/welcome.html>

Ballast Water and Invasive Species

Comment [kb63]: What do we know specifically about OCNMS and ballast water? What are the practices? Do such ships discharge offshore, inshore, in transit?

Millions of gallons of seawater are routinely carried around the world as ballast aboard oil tankers and other commercial vessels to increase stability. If ships empty their ballast tanks of water transported from other regions there is a risk of introducing non-native fish, invertebrates, and plants, many of which can alter ecosystems, sometimes in catastrophic ways. Washington State recently implemented regulations to minimize this risk, yet invasive species can also be introduced through hull fouling, smaller commercial and recreational vessels, aquaculture practices, release of captive animals and plants (e.g., aquarium specimens), floating marine debris or through range expansion.

Several established and emerging non-indigenous invaders, such as the invasive algae, *Sargassum muticum* and the European green crab, *Carcinus maenas*, threaten both critical habitat and important commercial species in the Pacific Northwest. There is widespread recognition that invasive species can affect fisheries, waterways,

Oil spills can have lethal and long-term sub-lethal effects on fish (e.g., behavioral changes, reproductive abnormalities) and can also contaminate fish targeted for human consumption. Some sectors of the fishing and shellfish industries could be shut down for years by an oil spill, causing long-term negative effects on the economy of local tribes and other coastal fishers. Nearshore habitats, critical for survival of juvenile fish, can also be severely impacted by oil spills that smother or poison kelp, sea grasses, and other marine plants. Oiling of intertidal areas can cause significant damage to invertebrates, with negative impacts that can linger for many years (Downs et al. 2002).

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The Washington coast endured the damages of several oil spills in recent times, including the 1988 *Nestucca* barge spill, which released 231,000 gallons of fuel oil into waters off Grays Harbor impacting many miles of coastline as far north as Canada, and the 1991 spill from the *Tenyo Maru*, where some 100,000 gallons of diesel fuel spread as far south as Oregon but most heavily impacted the Makah Indian Reservation and Olympic National Park wilderness coast. Although state and federal oil spill prevention and response policies are continually improving, the potential for severe environmental damage remains a strong concern.

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<http://www.olympiccoast.org/docs4posting/OCAonOilSpills.htm>

Increased Human Use

Long time residents as well as day-use visitors are drawn to the many recreational opportunities of the Olympic Coast, including sport fishing, kayaking, surfing, wildlife viewing, clamming, and beachcombing. Recreational use can sometimes cause unintended pressures to the coastal ecosystem. Motorized as well as non-motorized recreational boaters and sight-seeing pilots can inadvertently disturb wildlife, often with devastating consequences. Although human access to most seabird colonies is restricted by the U.S. Fish and Wildlife Service, WA Maritime Refuge Complex regulations (USFWS 2007), wildlife on the refuge islands is vulnerable to disturbance from low flying aircraft that do not comply with the 2000 foot elevation requirement established by the Olympic Coast sanctuary. Cliff-nesting seabirds can abandon their nests if frightened, leaving eggs and nestlings exposed to avian predators. Resting pinnipeds can abandon their haulout sites for the water when disturbed, often at a large energetic cost, especially to young animals. Beach users such as bird watchers, dog walkers, ATV users, and surfers can displace foraging migratory birds at important resting and staging areas. Popular intertidal areas show signs of trampling in localized patches.

Watershed alterations from increased land use such as timber harvesting may affect water quality by increasing sediment loads and nutrient runoff. Excessive sediment introduced to the nearshore environment can suffocate benthic marine life and reduce water clarity. Some persistent industrial chemicals, even those no longer in use in this country such as DDT, have found their way into marine food webs and can be detected in tissue samples of higher order predators (Brancato et al. 2006, Ross et al. 2000, Ross 2006). Some are carried from land to sea through watersheds, while others may be transported via air currents.

Garbage and lost fishing gear, particularly those constructed of non-biodegradable products like plastic, constitute what is collectively called marine debris. The amount of marine debris in open-ocean and coastal systems is on the rise. Impacts from marine debris include entanglement and drowning of animals, inadvertent ingestion of plastics by mammals, turtles and birds, transfer of diseases from land-based sources to marine wildlife, fowling of active fishing gear, and benthic habitat degradation. Garbage from land-based or ship-based sources can transfer diseases to wild populations.

Comment [kb66]: Discussion of garbage and lost fishing gear is largely speculative and the contributions to marine debris even more so. What can be said concretely about OCNMS?

Military Activities

Comment [kb67]: A map of the military operations areas would be useful here.

In or adjacent to the sanctuary the military has pre-established training areas that are part of the Northwest Training Range Complex (NWTRC). These training areas include two Warning Areas (W-237A and W-237B) and two Military Operation Areas (MOA Olympic A and B) that are designated training and operating areas for the Pacific Fleet air and surface forces. Military activities in these areas consist of subsurface, offshore surface, aerial training activities, and other military operations as discussed in the sanctuary's original environmental impact statement (EIS) (NOAA 1993). Military operations that are exempt from sanctuary regulations include:

- Hull integrity tests and other deep water tests;
- Live firing of guns, missiles, torpedoes, and chaff;
- Activities associated with the Quinault Range including the in-water testing of non-explosive torpedoes; and
- Anti-submarine warfare operations.

The Navy's Underwater Warfare Center (NUWC), Division Keyport operates and maintains the Quinault Underwater Tracking Range located in Navy Operations Area W-237A. This range is instrumented to track surface vessels, submarines, and various undersea vehicles. It is the policy of NUWC Division Keyport not to test in the presence of cetaceans. The Navy has proposed expansion of the Quinault Range's area more than 50-fold to support existing and future needs in manned and unmanned vehicle programs development. The proposed geographic expansion would include a surf-zone landing site.

Potential effects associated with Navy research, development, testing and evaluation (RDT&E) and fleet training activities are being evaluated via the NEPA process. The RDT&E activities are being evaluated under the Naval Sea Systems Command (NAVSEA) NUWC Keyport Range Complex Extension EIS/Overseas EIS. The Navy has proposed extending the Quinault Range site activities and geographic boundaries to support existing and future needs in manned and unmanned vehicle programs development. The Navy has no plan under this EIS to extend any permanent bottom mounted instrumentation by the proposed action. The extension would coincide with the existing W-237A Military Warning Area and one surf-zone access site. The Fleet training activities are being evaluated under the NWTRC EIS/OEIS. During scoping, the Sanctuary Advisory Council requested that this review consider a wide variety of issues, including: disturbance to birds, fish, and mammals from increased activity and noise; damage to seafloor habitats and wildlife from cables, anchors, targets, torpedoes, and/or unmanned undersea vehicles; accidental discharges of pollutants; interference with tribal fishing and subsistence harvest activities, and restrictions on the ability of sanctuary and affiliated scientists to conduct research.

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http://www-keyport.kpt.nuwc.navy.mil/EIS_Documents.htm

<http://www.nwtrangecomplexeis.com/EIS.aspx>

Underwater Noise Pollution

The level of noise pollution in the oceans has increased dramatically during the last 50 years. The primary source of low frequency ocean noise is commercial shipping (NRC 2003). Although impacts to wildlife in the Olympic Coast sanctuary have not been documented, underwater noise pollution in other locations has been linked to disturbance and injury. Many marine mammals respond to noise by altering their breathing rates, spending more time underwater before coming up for air, changing the depths or speeds of their dives, shielding their young, changing their vocalization content and durations, and swimming away from the affected area (Richardson et al. 1995). Acute sound intensities may cause marine mammals and other organisms to have temporary or permanent hearing loss. The disorientation and hearing loss may account for some cases in which ships collide with marine mammals that are apparently unaware of the approaching vessel. Most strikes occur in coastal waters on the continental shelf, where large marine mammals concentrate to feed. High levels of noise

could also affect predation efficiency for marine mammals that use sound to hunt or capture prey. Underwater noise has also been found to negatively affect social behaviors in fish because many species rely on vocalizations when courting potential mates, and most detect sound vibrations that can be used to localize food or avoid predators (Myrberg 1990). In extreme cases, extensive damage was reported to the sensory epithelia of fish ears with no subsequent repair or replacement of damaged sensory cells (McCauley et al. 2003).

Climate Change

Over the next century, climate change is projected to profoundly impact coastal and marine ecosystems on a global scale with anticipated effects on sea level, temperature, storm intensity and current patterns. At a regional scale, we can anticipate significant shifts in the species composition of ecological communities, rates of primary productivity, sea level rise, and wind-driven circulation patterns (Scavia et al. 2002). Rising seawater temperatures may give rise to increased algal blooms, major shifts in species distributions, local species extirpations, and increases in pathogenic diseases (Epstein et al. 1993, Harvell et al. 1999). A better understanding of ocean responses to global scale climatic changes is needed in order to improve interpretation of observable ecosystem fluctuations, such as temperature changes, hypoxic events, and ocean acidity that may or may not be directly coupled to climate change.

<http://www.climate.noaa.gov>

<http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewpnw.htm>

Comment [kb68]: Where did the "McCauley et al. 2003" take place?

Comment [kb69]: Check out the Climate Impacts Group website for more info on regional climate

DRAFT

State of Sanctuary Resources

This section provides summaries of the condition and trends within four resource areas: water, habitat, living resources, and maritime archaeological resources. Sanctuary staff and selected outside experts considered a series of questions about each resource area. The set of questions derive from the National Marine Sanctuary System's mission, and a system-wide monitoring framework (National Marine Sanctuary Program 2004) developed to ensure the timely flow of data and information to those responsible for managing and protecting resources in the ocean and coastal zone, and to those that use, depend on, and study the ecosystems encompassed by the sanctuaries. The questions are meant to set the limits of judgments so that responses can be confined to certain reporting categories that will later be compared among all sanctuary sites and combined. Appendix A (Rating Scheme for System-Wide Monitoring Questions) clarifies the questions and presents statements that were used to judge the status and assign a corresponding color code on a scale from "good" to "poor." These statements are customized for each question. In addition, symbols are used to indicate trends. Methods for consultation with experts and development of status and trends ratings are described in Appendix B.

This section of the report provides answers to the set of questions for the Olympic Coast sanctuary. Answers are supported by specific examples of data, investigations, monitoring and observations, and the basis for judgment is provided in the text and summarized in the table for each resource area. Where published or additional information exists, the reader is provided with appropriate references and web links.

Water Quality Status and Trends

Water quality within the sanctuary is largely representative of natural ocean conditions, with relatively minor influence from human activities at sea and on land. By conventional measures, marine water quality within the sanctuary is not notably compromised. There are very few point sources of pollution in the vicinity, such as sewage outfalls or industrial discharge sites, to degrade water conditions. To date, the sparse human population has limited the amounts of nonpoint source pollution – the harmful by-products of everyday activities, such as pathogens from failing septic systems, residues from domestic products, excess nutrients, petroleum combustion byproducts, or hydrocarbons from roads and highways – that might enter the oceanic food web. However, increased sediment loading in rivers from logging and associated road building activities has been a concern that presumably has diminished as regulations have been strengthened.

Although water quality within the sanctuary is currently good, the potential for contamination by petroleum products, pathogens and chemicals is a concern. Four of the five largest oil spills in Washington State history have occurred in or moved into the area now designated as the sanctuary. In the decade before sanctuary designation, two major oil spills released more than 325,000 gallons of petroleum products that impacted marine ecosystems and human communities on the outer Washington coast. Moreover, naturally occurring harmful algal blooms can elevate the risk of shellfish poisoning. Recently documented, widespread hypoxic conditions in nearshore areas off Oregon and part of the Washington coast appears to result from anomalous weather and oceanographic patterns.

The following information summarizes assessment by sanctuary staff and subject area experts of the status and trends pertaining to water quality.

Comment [kb70]: discuss role of EN/LN and PDO have as natural stressors – add climate change. Overall discussion is of a level of detail that I wish all the CR could cover.

Comment [kb71]: Although population density is low along most of the Sanctuary coast, upland development would also have an affect by increasing run off with sediment load in spot areas.

Comment [kb72]: On what time frame is this comment based? It sounds generic...

Comment [kb73]: You mention it later in the report, but it worth noting here that the state has made progress ways to prevent and respond to spills. Eg the Oil Spill Advisory Council and the Neah Bay tug.

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Water Quality Status & Trends

Good
Good/Fair
Fair
Fair/Poor
Poor
Undet.
 ▲ = Improving — = Not changing ▼ = Declining
 ? = Undetermined trend N/A = Question not applicable

Status	Rating	Basis for Judgment	Description of Findings
1	Stressors	Hypoxic conditions may be increasing in frequency and spatial extent in nearshore waters	Selected conditions may preclude full development of living resource assemblages and habitats, but are not likely to cause substantial or persistent declines.
2	Eutrophic Condition	No suspected human influence on HABs or eutrophication	Conditions do not appear to have the potential to negatively affect living resources or habitat quality
3	Human Health	Naturally occurring HABs result in periodic shellfish closures	Selected conditions that have the potential to affect human health may exist but human impacts have not been reported.
4	Human Activities	Threat of oil spills from vessels	Some potentially harmful activities exist, but they do not appear to have had a negative effect on water quality.

Comment [kb74]: Another general comment about the organization is this. Placing the rating boxes at the beginning of each section, e.g., Water p. 21, Habitat p. 27, Living p. 35 may make some sense in guiding the reader to what is concluded up front, however, I think that they really should serve as a wrap up for each section. The reader is given information in the text which then can inform his/her judgment later. Also, unless these are designated and numbered as "boxes" they should be treated as Tables in the text and given numbers. [Marine Archaeological is stuck in the middle of the section].

Comment [kb75]: The phrase "may preclude full development of LMRs" is hard to understand. Change or modify to communicate what is really meant.

Comment [kb76]: Add marine debris, including derelict fishing gear? WQ effect is from decaying caught animals and from heavy metals in fishing weights. Might be too minor to mention...

Comment [kb77]: Does raw sewage discharge from Victoria, BC have any impact on the Sanctuary?

1. Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality?

Whereas sanctuary waters are not degraded by persistent chemical contamination, periodic incursion of oxygen depleted water to continental shelf and nearshore waters has killed organisms in its pathway. Potential and early evidence of linkages between climate change and changing oceanic conditions with these hypoxic events, as well as local effects on toxic algae blooms, increasing water temperature and acidity, all lead to uncertainty about the trends in these stressors.

Oxygen serves a critical role in defining ocean habitats. Deep waters on the continental shelf normally have low oxygen concentrations, and resident organisms are adapted to oxygen levels that can be lethal to animals living in near surface and nearshore waters. Further depression of oxygen levels near the deep seafloor and movement of oxygen-depleted waters toward shore, however, can stress living communities. Hypoxia (low oxygen levels, or dissolved O₂ below 1.4 ml/L) is often associated with high nutrient loading from land-based sources, while off Washington's outer coast it is a function of wind-driven upwelling dynamics and ocean conditions that control the delivery of oxygen-poor, nutrient-rich deep water across the continental shelf (Grantham et al. 2004). Hypoxic conditions severe enough to cause widespread fish and invertebrate mortality were documented off the Washington and Oregon coasts in 2006. Figure 16 provides data from the sanctuary's monitoring station off Cape Elizabeth showing hypoxic conditions that persisted close to shore for more than two weeks in July 2006. Other invertebrate and fish mortality events have been observed along Washington's coast, for example in 2001 and 2002, but historic records and oxygen monitoring data are not available to definitively link previous mortality events to hypoxic conditions.

A major oceanographic feature off the eastern Pacific Coast, the oxygen minimum zone, is a layer of deep water along the upper continental slope extending to depths greater than 1000 meters where dissolved oxygen levels are persistently low (Deuser 1975). Analysis of a long term data set, the 50-year data record from the eastern subarctic Pacific, shows that deep waters beyond the continental shelf, although normally hypoxic, show trends of increased temperature and lower oxygen (Whitney 2006). As this occurs, deep waters transported across the

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Comment [kb78]: mg not ml

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continental shelf and upwelling toward shore may be increasingly depleted of oxygen and may cause more stress to living resources in the sanctuary.

Grantham et al. (2004) described the development of nearshore hypoxic conditions in the Pacific Northwest as “a novel emergence” that may represent a critical link between climate variability and ecosystem sensitivity to such changes. Although there is some historic evidence that hypoxic conditions have occurred along the Oregon and Washington coasts in the past (B. Hickey pers. comm.), a comprehensive set of historic data from Oregon’s shelf waters indicates that the severity, geographic extent, and duration of hypoxic conditions off Oregon have increased since 2000, and anoxic conditions (water completely devoid of oxygen) had never been recorded before the 2006 event (Chan et al. 2008).

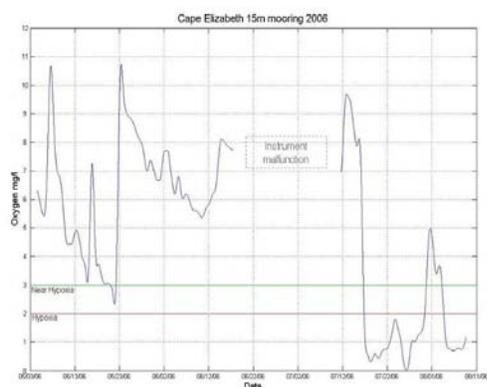
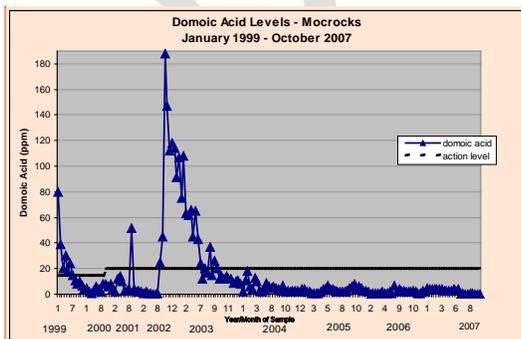


Figure 16. Oxygen data taken concurrently with the July 2006 fish kill first reported by Quinault Natural Resources Department. Oxygen was measured at 1m off the bottom from an OCNMS mooring station off Cape Elizabeth in 15m water depth.

Harmful algal bloom events (HABs) are common in sanctuary waters and can affect wildlife and marine ecosystems as well as human health. Figure 17 shows the presence and unpredictability of high domoic acid events at two beaches approximately 25 miles apart on the shores of the sanctuary (domoic acid is a toxin produced by one particular type of harmful algae). Some scientists suspect that HABs off the outer coast are increasing in frequency, but long-term records are not available for confirmation.



Comment [kb79]: I don't see the action level line

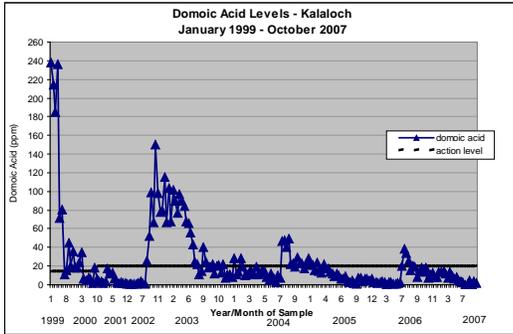


Figure 17. Domoic acid levels in razor clams from the Kalaloch and Mocrocks (near Moclips River) razor clam management areas where large recreational razor clam fisheries occur. Shellfish harvesting is closed when tissue levels exceed the action level. (data from WDFW)

Recent evidence of increasing seawater acidity (low pH), increases in water temperature, and shifts in oceanographic conditions have been attributed to anthropogenically influenced climate change (Wootton unpublished data, Grantham et al. 2004; Barth et al. 2007, Chan et al. 2008). Such cause and effect linkages, however, are uncertain and will require more data before they are fully accepted.

Existing levels of contaminants (metals, persistent organic pollutants, hydrocarbons, PCBs) are generally at low levels off the Olympic Coast. Measurements of chemical levels in water, sediment and biota in 2003 at 30 stations in OCNMS as part of the Environmental Monitoring and Assessment Program (EMAP) indicated reasonably good water quality throughout the sanctuary (Partridge 2007).

2. What is the eutrophic condition of sanctuary waters and how is it changing?

Human-caused eutrophication is not a concern in the sanctuary due to the absence of problematic sources of nutrients, such as population centers or significant municipal discharges in or near the sanctuary. In fact, sampling in 2003 indicated that conditions for primary production can be nutrient-limiting in summer months off the Washington coast (Partridge 2007). This would suggest that if nutrient supplies were to increase during that time of year, blooms could be triggered. Local inputs of nutrients are not expected to increase significantly, but because long-term datasets and sufficient instrumentation are lacking, there is not information to document a change or trend in nutrient concentrations in sanctuary waters.

The Juan de Fuca Eddy system is a naturally-occurring, seasonally intensified water circulation feature covering northern sanctuary waters (Figure 18). It covers a broad region beginning roughly 70 km west of Cape Flattery and contains elevated macronutrients levels. Nutrients in this system are derived primarily from upwelling of nutrient-rich deep waters from the California Undercurrent, combined with lesser contributions from the Strait of Juan de Fuca outflow (MacFadyen et al. 2008). The feature's retentive circulation patterns and nutrient supply promote high primary productivity within the eddy, and periodic advection of these water masses toward shore has been identified as a trigger for HABs in sanctuary waters (Foreman et al. 2007, MacFadyen et al. 2005). Consequently, HABs in the Olympic Coast sanctuary are currently considered natural phenomena that are not enhanced by anthropogenic inputs of nutrients or eutrophic conditions.

Comment [kb80]: What does this mean? It's not on the same scale as the NMS scale...? Is it equivalent to Good/Fair?

Comment [kb81]: This section doesn't clearly talk about natural trends. Any info?



Figure 18. The Juan de Fuca Eddy (also called the Big Eddy) is west of the Strait of Juan de Fuca and spans the international boundary between U.S. and Canadian waters.

3. Do sanctuary waters pose risks to human health and how are they changing?

The main risk to human health of sanctuary waters is through consumption of tainted shellfish. Levels of naturally-occurring biotoxins in excess of action levels to protect human health have been detected once or twice a year on average over the past 16 years, but the limited historical record does not allow for identification of a trend of increasing frequency.

Shellfish on the outer Washington coast is normally safe for human consumption, yet during HAB events, filter feeding organisms such as hard shelled clams and mussels can concentrate toxins produced by some species of plankton, rendering them toxic to consumers. Routine monitoring is conducted at selected locations by coastal tribes and Washington State, and shellfish harvest closures are enacted when concentrations exceed action levels for protection of human health. Rapid detection techniques are being sought to enhance the ability to monitor for toxins, but risk of human exposure remains because it can be difficult to reach all subsistence and recreational harvesters on this remote coast.

For centuries, consumers of bivalves in the Pacific Northwest have known about paralytic shellfish poisoning (PSP), which is caused by saxitoxins produced by dinoflagellates. In 1991, domoic acid, a neurotoxin produced by diatoms in the genus *Pseudo-nitzschia* and which causes amnesic shellfish poisoning (ASP), was first detected in clams on Washington's outer coast. High levels of either toxin have led to multiple restrictions of the popular recreational razor clam harvest and commercial harvest by local Indian tribes (Figure 17). For the shoreline adjacent to the sanctuary, Washington State Department of Health (WDOH) records since 1991 indicate 14 shellfish harvest closures based on ASP and nine closures based on PSP concerns. WDOH has received no reports of shellfish poisoning on the outer coast since 1991, although exposures (but no deaths) have been reported from other areas in Washington.

As discussed above, harmful algal blooms in OCNMS are naturally occurring phenomena. With more intensive monitoring in recent years, there is a perception that blooms have increased in frequency. However, there are insufficient data to confirm a trend because monitoring began only in the 1990s (Juan de Fuca Eddy Steering Committee 2004; Trainer 2005; Trainer and Suddeson 2005). If HABs are increasing in frequency, some factors that may contribute include increased advection of offshore waters shoreward as a result of reduced volume of the Columbia Plume (due to dams and water removals), altered wind and current patterns due to climate

Comment [kb82]: emphasize the lack of adequate monitoring data with respect to human health risk and the low likelihood of this being a problem

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Comment [kb83]: Page 22 says scientists believe there is an increasing trend...

change, misdiagnosis of shellfish poisoning in the past, and an inability to detect blooms historically (Juan de Fuca Eddy Steering Committee 2004; Hickey pers. comm.).

Limited bacterial monitoring in marine waters is conducted by WDOH with assistance from coastal tribes in order to assess human health risks in shellfish harvest areas (Washington State Department of Health 2008). In addition, Surfrider's Blue Water Task Force volunteers monitored five additional sites in the sanctuary during 2003-2005 (<http://www.surfrider.org/whatwedo3c.asp>). These data indicate there are no significant concerns regarding bacteria such as fecal coliform, *E. coli* and *Enterococcus* in the sanctuary waters.

4. What are the levels of human activities that may influence water quality and how are they changing?

The high volume of marine traffic, particularly through northern sanctuary waters, introduces the threat of catastrophic injury to marine resources from an oil spill. This threat is persistent but not changing significantly because vessel management procedures and preventative measures have been implemented, and vessel traffic volumes have been stable in recent years.

The potential for a large-volume oil spill is generally considered the greatest threat to the sanctuary's water quality – a low probability but high impact threat. The northern area of the Olympic Coast sanctuary lies at the western Strait of Juan de Fuca, the major passage for the incoming and outgoing shipping traffic that lead to the Pacific Northwest's major ports - Seattle, Tacoma and Vancouver, British Columbia. Large commercial vessels, including oil tankers and freighters with large fuel capacity, transit through and near the sanctuary daily, creating a persistent and elevated risk of accidental and catastrophic release of toxic products. An estimated 1.5 billion gallons of oil are transported through the area each year. Tanker and container traffic occurs daily through all seasons and weather, with about 5,500 freighters and 1,400 tankers transiting the Strait of Juan de Fuca in 2006. (Figure 19) These numbers have increased over the past few decades but have been stable since about 2000.

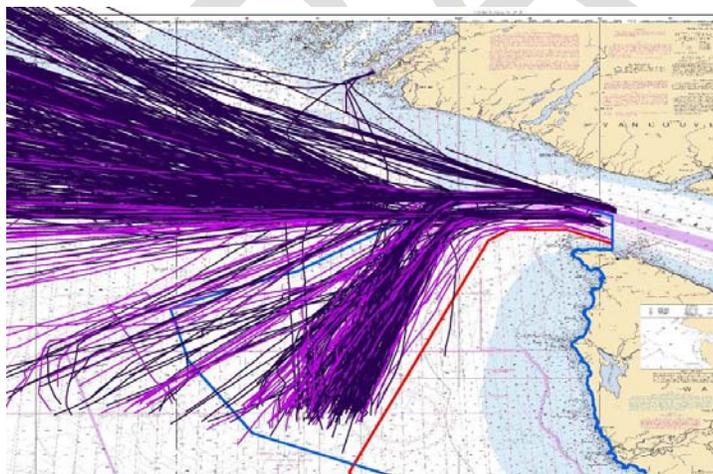


Figure 19. Track lines from large commercial vessels transiting the western Strait of Juan de Fuca in June 2007. Purple lines are tanker traffic. Darker lines are freighter traffic. The light blue line is the Olympic Coast National Marine Sanctuary boundary and the red line marks the Area-To-Be-Avoided.

Comment [kb84]: Increased likelihood of loss of power and the need to drop anchor under emergencies to control the ship. This also would cause habitat damage. Note the Neah Bay tug, which is only funded through June 2009 at this point. The need for the tug was noted in at least two state reports—the Oil Spill Advisory report and the Ocean Policy Work Group's Ocean Action Plan.

Comment [kb85]: Are vessel discharges an issue for OCNMS?

Comment [kb86]: In discussion of trawl track impacts – aren't there some data from an NRC report for the nation that includes WA? What do the maps in NRC 2002 show? How does OCNMS stack up in terms of trawl intensity? Are there NMFS data?

In the previous century, weak environmental regulations allowed logging and road building practices to damage freshwater habitats and systems in the Pacific Northwest. Rivers and creeks in logged watersheds discharging into marine waters of the outer Washington coast carried elevated burdens of suspended materials that increased turbidity of nearshore marine waters. Although definitive documentation is not available, these conditions may have inhibited growth of macroalgae in areas near river mouths (Devinny and Volse 1978; Dayton et al. 1992; Norse 1994). Logging remains a major industry on the Olympic Peninsula, although harvest levels have declined in the past two decades and improved regulatory oversight of logging practices presumably has reduced inputs of fine particulates into freshwater systems flowing into the sanctuary.

Comment [kb87]: riparian?

Coastal development adjacent to the sanctuary is sparse, with a few small population centers on tribal reservation lands and growing residential development along the southern shores of the sanctuary. State and county development regulations should minimize impacts of the growing coastal populations on marine water quality.

Comment [kb88]: Knowing the vaguaries of the Shoreline Management Act and how it implemented locally (Shoreline Master Programs under SMA), I think this is a very hopeful statement. Local governments are authorizing high rise buildings very close to shore, for example. I would say this is a real future threat, or else the report should state that it is a very real potential future threat unless controlled by local regulations.

Habitat Status and Trends

Marine habitats of the Olympic Coast sanctuary extend from the intertidal, which is accessible daily during low tides, to the depths of submarine canyons that are only seen by humans via submarines, sensors, or lenses on remotely or autonomously operated vehicles. The sanctuary covers a large area, with physical and biological complexity to its habitats. Exploration and habitat mapping involves carefully planned and costly surveys from large vessels using sophisticated technology. Thus far, the sanctuary has detailed habitat mapping completed for about 25% of its seafloor, while information on remaining areas lacks resolution and specificity (Figure 20). As a result, generalizations about the Olympic Coast sanctuary's habitats are difficult to make. The following discussion focuses on available information wherever possible, but also includes speculative analysis based on habitats from similar areas and impacts to these habitats documented at other locations.

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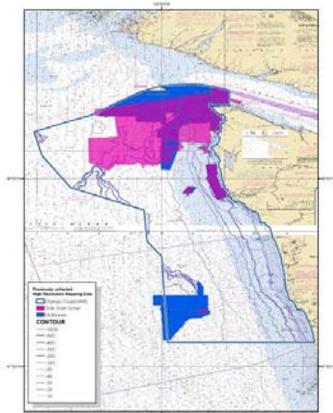


Figure 20. Areas where high resolution seafloor habitat mapping has been completed by NOAA in Olympic Coast sanctuary.

Olympic Coast sanctuary's habitats, similar to its waters, are relatively uncontaminated by chemicals introduced by human activities. Intertidal and nearshore habitats are not considered substantially altered or degraded. Underwater noise pollution and marine debris do compromise habitat quality, but their impacts in the Olympic Coast sanctuary are not well documented. The most significant concern relates to several decades of intensive

Comment [kb89]: There is potential for localised areas of contamination from the more recently sunken vessels—eg PAHs, PCBs, TBTs, heavy metals. Also potential for contamination from lost fishing gear—eg Pb in weights.

efforts by fisheries using bottom contact gear. At locations where biologically structured habitats existed on the sanctuary's seafloor, it is likely they have been altered by fishing practices, except perhaps in the roughest of terrain that fishermen avoided. Recovery of biologically structured habitats is expected to occur very slowly, even in the absence of future pressures.

The following information provides an assessment by sanctuary staff and subject area experts of the status and trends pertaining to the current state of marine habitat.

Habitat Status & Trends

Good
Good/Fair
Fair
Fair/Poor
Poor
Undet.
 ▲ = Improving — = Not changing ▼ = Declining
 ? = Undetermined trend N/A = Question not applicable

Status	Rating	Basis for Judgment	Description of Findings
5 Abundance/Distribution	—	Reduction in habitat complexity by bottom-tending gear; short-term impacts from fishing gear and cable installation	Selected habitat loss or alteration has taken place, precluding full development of living resource assemblages, but it is unlikely to cause substantial or persistent degradation in living resources or water quality.
6 Structure	?	Damage by bottom-tending gear in some deep biogenic habitats	Selected habitat loss or alteration may inhibit the development of living resources, and may cause measurable but not severe declines in living resources or water quality.
7 Contaminants	—	Prior studies indicate low levels of contaminants	Contaminants do not appear to have the potential to negatively affect living resources or water quality.
8 Human Impacts	▲	Decrease in bottom trawling and presumably impacts to hard bottom habitats	Selected activities have resulted in measurable habitat impacts, but evidence suggests effects are localized, not widespread.

5. What are the abundance and distribution of major habitat types and how are they changing?

This question focuses on changes to the type and physical composition of marine habitats, whereas Question 6 focuses on biologically structured habitats. Past or ongoing modification of habitat types (e.g., conversion of coastal marsh into upland) from extensive physical disturbance or alterations to physical forces is not a concern in the Olympic Coast sanctuary. Some reduction to the physical complexity of deep seafloor habitats, however, has resulted from extensive bottom trawling activity over the past half century. Recent fishery management measures have limited bottom trawl effort in areas where the seafloor is most susceptible to physical alteration, so future alteration of habitat from this activity is likely to be minimal as long as trawl area closures remain in effect.

With limited exceptions, nearshore and intertidal habitats in the sanctuary are remarkably undisturbed by human use and development that has modified habitats in more urbanized areas, such as shoreline armoring, wetlands alteration, dredging, and land-based construction. The remote location, low levels of human habitation, protections provided by the wilderness designation of Olympic National Park's coast, and restricted access to tribal reservations have allowed these coastal habitats to persist largely intact. At the few locations where shoreline armoring has been employed or where human visitation has focused on intertidal areas for food

Comment [kb90]: When I read this section I asked the question 'how much is the reduction?'. Later on I noted that it was a 90% reduction from 1950s levels. Might be worth stating this here too.

Comment [kb91]: See previous comment about impacts to soft bottoms too. Also, see comment above about stating the 90% decrease.

Comment [kb92]: Check to see whether or not the Russian trawl activity [p. 28] was strictly bottom fishing during the 1960s and 1970s. My understanding is that it was largely directed at Pacific whiting [hake] which is often a mesopelagic fishery. It is important to note the PFMC's coastwide closure of trawl fisheries in the deeper shelf waters and shelf break as part of its rebuilding plan for rockfish [p. 29] and closure of the really deep waters offshore of that to protect benthic deepwater habitats. These measures are alluded to but not formally recognized as part of the reduction in bottom trawl fishing effort. [Sorry I do not have access to references to these specific actions at this time. I see that they are discussed in somewhat more detail in conjunction with Figure 25. This illustrates my concern expressed above about the format of the report either creating holes in the discussions or creating redundancies in the responses when questions are answered completely as stand alone items]. Note that the plot of density of trawl fishing by statistical area does not indicate that the whole area received an equal amount of that effort; rather it is most likely concentrated in target zones. Something worth checking on is whether or not the data used to construct these trawl intensity plots distinguish between bottom trawling and mesopelagic trawling for species like Pacific whiting. I do not know the detail here but it could be important in actually defining conditions.

I am trying to remember where I saw them, but I recall seek very recent plots that compared and contrasted location of fishing effort prior to rockfish trawl closures and after. Having these plots would be highly beneficial to the reader of the condition report to understand the significance of the changes made to reduce fishing effort and thereby justifying the ratings in the CR. This plot could show the 2000 prohibition on bottom trawls in state waters noted [p 29]. In Fig. 23 which is very hard to read, by the way, there might be an overlay of showing the areas closed to trawling under recent management measures.

While I understand why OCNMS uses the National MPA inventory of marine managed areas to come to the rating of the trawl closure areas as "temporary" this designation is going to be in place for a very long time given the goals of rebuilding long-lived rockfish stocks. At the least, the reader needs to be tipped off on why the rating is "temporary" in OCNMS perspectives. Maybe make a connection the Inventory classification of "marine managed area"

Finally, while I do not purport to be an expert in these areas, I think the very widespread fishing pattern for Atlantic species described by Auster and Langton is not necessarily a guide for OCNMS fisheries as the west coast fisheries were much more highly directed toward specific species and habitats...

collection and recreation, there do not appear to be dramatic or widespread impacts (Erickson and Wulfschleger 1998; Erickson 2005).

Data on habitats of the deeper waters of the sanctuary are limited. Only 25 percent of the sanctuary has been characterized through use of modern, high resolution acoustic and imaging methods (Intelmann 2006; Bowlby et al. 2008). Low resolution surveys have revealed a generally wide and featureless continental shelf in the southern portion of the sanctuary dominated by soft substrates with areas of rock outcrop and spires, and the Quinault Canyon. High resolution mapping may reveal more complex features along the shelf than presently indicated. The northern portion of the sanctuary is dominated by the Juan de Fuca Canyon and trough, complex, glacially carved features containing a mixture of soft sediments, with significant cobble and boulder patches and scattered large glacial erratics deposited during ice retreat. Most of the trough, the shallower extensions of the canyon closer to the Strait of Juan de Fuca, has been mapped using high resolution methods. Comprehensive surveys with both multibeam and side scan techniques have not been completed for the Nitinat, Juan de Fuca, and Quinault canyons.

The most significant physical alteration of sanctuary habitats, besides the forces of nature, is likely to have resulted from commercial fishing with bottom trawl gear. Known physical impacts of bottom trawl gear on seafloor habitats from similar areas, in combination with historic fishing patterns in the sanctuary, are evidence that such habitat alterations have likely occurred. Bottom trawl gear is known to reduce complexity and alter the physical structure of seafloor habitats (NRC 2002). Bottom trawling can smooth sedimentary bedforms, such as sand waves, reduce bottom roughness, alter the size distribution of surficial features, impact biogenic structures, and roll and move boulders on the seafloor (Auster et al. 1996; Auster and Langton 1999; Norse and Watling 1999; Thrush and Dayton 2002). Moreover, monitoring by the sanctuary has shown that acute and localized seafloor impacts from submarine cable installations result in short term habitat disturbance in soft sediments and more persistent physical disturbance in hard substrates. Cable trenching, however, covers a very small portion of the sanctuary seafloor. Monitoring by the sanctuary has also revealed rolled and displaced boulders as a result of cable trenching and bottom contact commercial fishing gear. Dredging, another fishing technique that causes acute physical disruption of the seafloor, has not been widely employed in the sanctuary.

National Marine Fisheries Service statistics indicate that the northern waters of the sanctuary were one of the most intensively fished bottom trawl areas along the West Coast of the U.S. in the later half of the 1900's (Shoji 1999). Groundfish landings in Washington, the majority of which were from bottom trawlers, averaged 30 to 40 million pounds annually from the mid-1950's through about 1980. To put this into perspective, non-tribal bottom trawl landings into Washington have averaged about 7 million pounds per year in recent years (2004-06), which represents a decline of about 80% since that earlier time period. The number of vessels participating in the fishery shows similar trends. About 100 trawl vessels landed and sold groundfish on the Washington coast (excluding Puget Sound) between the late 1970's and early 1990's (Shoji 1999). As a result of a federal buyback program in 2003 and attrition in the fishery, in some cases, as a direct result of increasing fishing restrictions, the number of non-tribal trawl vessels landing into Washington has declined to less than 10 vessels per year, which represents about a 90% decrease from historical participation levels. Another statistic relevant to potential habitat impact is trawl effort. The total hours of trawler fishing effort on the outer coast averaged about 10,000 hours per year between 1989 and 1997 (Shoji 1999), yet a subsequent decline in the amount of trawl hours has also occurred as the number of vessels has decreased coupled with a general reduction in trawl trip limits for target species. While Washington bottom trawl fishermen typically used moderate sized vessels (e.g., <100 feet length), there was an especially high impact fishery practiced in deeper waters for more than two decades. Beginning in 1966, a large Soviet fleet of factory trawlers began fishing off the U.S. coasts of California, Oregon and Washington. Vessels were large stern ramp trawlers exceeding 250 feet in length using large gear that fished mostly on the continental shelf and upper slope at depths ranging from about 300 to 720 feet deep. Their efforts continued until 1991 when all commercial fishing by foreign vessels was excluded from waters within 200 miles of shore of the U.S.

Comment [kb93]: I wondered whether it was worth adding the potential for offshore energy and offshore aquaculture impacts in this section... If we assume that project review and permitting would involve adequate siting criteria, then maybe it's moot.

Comment [kb94]: There was a geophysical survey conducted in 2001 for a Canadian company called 360networks, which covered the San Juan canyon. The cable was never installed because the 360networks filed Chapter 11. The survey was undertaken by Alcatel Submarine Networks and included swathe bathy, side scan sonar, sub bottom profiling and gravity coring to 2000m. Not that you'd necessarily want to state this in the report, but it might be worth trying to acquire the data...

Comment [kb95]: Page 29 says WDFW banned bottom trawling in state waters. Assume this was just to 3nm and that trawling still occurs outside that? It's unclear to me in how this is written...

Although the manner in which data were collected in the past makes it difficult to map precisely the level of bottom trawl effort by area, there clearly has been significant interaction between the fishery and the sanctuary seafloor for several decades. Although bottom trawl effort in different areas has changed over time, analysis of WDFW commercial trawl logbooks between 1989 and 1997 indicates that trawling occurred widely throughout the sanctuary during this period (Figure 21). Moreover, large footrope gear (i.e., footrope that is greater than 8 inches in diameter) that allows trawlers to access rockier areas by bouncing the bottom of the trawl net over larger obstructions without tearing nets, was not restricted until 2000 West Coast-wide (PFMC 2005). In recent years, fishery management measures that restrict footrope gear size and limit areas open to trawlers have focused trawl effort more toward soft seafloor substrates where gear impacts on the physical habitat are less of a concern. Off of Washington, WDFW has had a five-inch footrope restriction on non-tribal trawling in state waters (i.e., shoreward of 3 miles) since 1996; WDFW then followed up with a complete prohibition on bottom trawl gear in state waters in 2000. Although detailed information on historic and current conditions in the sanctuary's deep seafloor habitats is limited, the degree and extent of alteration to the physical complexity of these habitats resulting from past bottom trawling activity are concerns based on evidence from other locations, both in the Pacific and Atlantic (Auster and Langton 1999; NRC 2002; Thrush and Davton 2002). The most significant threat, however, is the impact of these damages to the distribution and abundance of biologically structured habitats of the sanctuary's seafloor. (see Question 6).

Deleted: There is greater concern, however, for damage to biologically structured habitats of the sanctuary's seafloor

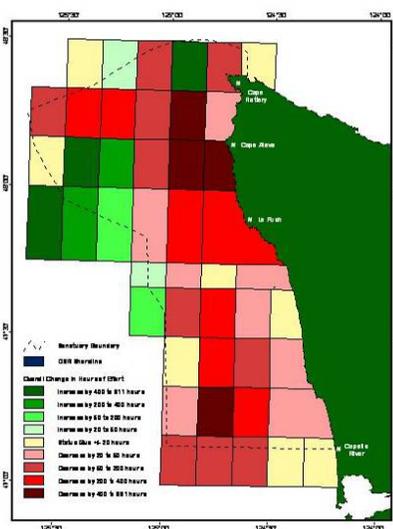


Figure 21. Composite map of overall change in bottom trawl effort by WDFW block area over 1989-1997 (Shoji 1999)

6. What is the condition of biologically structured habitats and how is it changing?

Intertidal and nearshore habitats structured by living or once-living organisms are intact and thriving in the Olympic Coast sanctuary. Of concern are biogenic habitats in deeper areas of the sanctuary that are presumed to have been degraded by extensive practice of bottom trawl and longline fisheries. The trend is undetermined because these habitats may not recover quickly or may never re-establish to their original composition, and recovery can occur only where bottom contact gear is prohibited.

Comment [kb96]: Does the OCNMS have a categorization of biologically structured habitats? By inference it seems that the descriptions focus on benthic surface habitats usually on hard bottoms or intertidal area and there is not mention of biologically structured soft seabed habitats if such exist in OCNMS.

If I recall correctly the Paine and Levin work cited also noted El Nino/La Nina implications in the periodicity of impacts. Is that worth noting? [p. 30] I applaud the efforts to utilize local and traditional knowledge in the Conditions document as that can be an invaluable source of long-term change recognition. It does seem that the single cited observation could be brought more closely up-to-date than 1994, however.

There may be a source of kelp canopy area missing. Dave Jamieson from WDNr did a survey of existing information in the mid 1980s if I recall correctly. His data from earlier work was spotty but it might be worthwhile trying to connect his information to Fig. 22. [This is just a tip. I realize that the Conditions Report does not use all known data.]

Last paragraph on p. 30 seems to fit better following the next to last paragraph on p. 29 thus keeping the deep water trawl impact information together.

Biologically structured habitats in rocky intertidal areas include macroalgae and invertebrate communities (e.g., mussel beds) that provide micro habitats for many species of invertebrates and fish. Monitoring conducted by Olympic National Park since 1989 indicates that these habitats are healthy and do not appear to be changing substantially in response to human influences. Large-scale disturbances related primarily to extreme winter weather cause periodic damage to mussel beds (Paine and Levin 1981). Coastal ecologists have begun to design studies to better detect changes that may result from effects of global climate change, such as sea level rise, reduced pH, increasing temperatures, and changes in storm frequency and magnitude. Local trends in these parameters are uncertain, however, and no definitive results are yet published.

In nearshore areas, canopy kelp beds form a productive, physically complex, and protected habitat with a rich biological community association of fish, invertebrates, and sea otters. The first historical record for Washington kelp occurred in 1912 (Rigg 1915) as part of the war effort to assess potential sources of potash. Annual monitoring and quantification of the floating kelp canopy has been conducted since 1989 by Washington Department of Natural Resources and in collaboration with the sanctuary since 1995. Although the canopy changes each year, these kelp beds are generally considered stable. In fact, the area covered by floating kelp has been increasing along the outer coast and western portion of the Strait of Juan de Fuca (Figure 22; Berry et al. 2005; http://www1.dnr.wa.gov/htdocs/aqr/nshr/pdf/floating_kelpbed.pdf). This increase may be due in part to a growing population of sea otters and subsequent decline in grazing sea urchins or may be influenced by changes in oceanographic conditions. In contrast, extensive logging of the Olympic Peninsula, an area of very high rainfall, has in the past markedly increased sediment loads in rivers. Long-term residents along the coast have noted a reduction in kelp beds near river mouths, which may have been associated with siltation of nearshore habitat and reduced light penetration (Chris Morganroth III, personal communication in Norse 1994).

Comment [kb97]: Can you provide a time frame context?

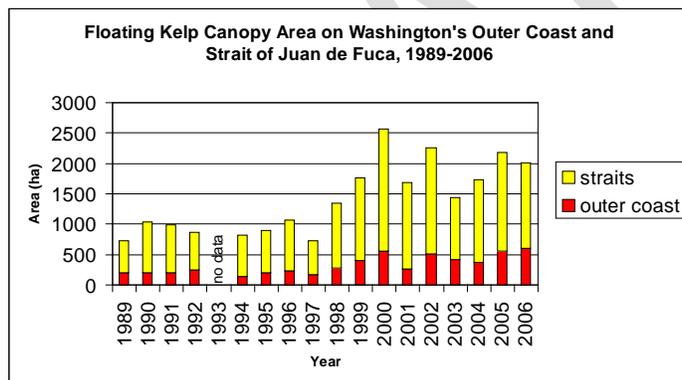


Figure 22. Annual floating kelp canopy area since 1989 along the Washington Coast and the Strait of Juan de Fuca. (data from WDNR)

Some deep water corals found off the Pacific Coast are designated as "structure forming" because they provide vertical structure above the sea floor that serves as habitat for other invertebrate and fish species (Whitmire and Clarke 2007). Other emergent epifauna, such as sponges, hydroids, and bryozoans also provide living habitat for invertebrates and fishes. These organisms are vulnerable to damage from bottom contact fishing gear, and because many have slow growth and recruitment rates, damage can be long-lasting (Auster and Langton 1999; Norse and Watling 1999; NRC 2002; Thrush and Dayton 2002). Information on the historic distribution and condition of habitat-forming corals in the sanctuary is extremely limited, based on observations compiled from NMFS trawl surveys from which identification of invertebrates was very limited particularly prior to 1980 (Whitmire and Clarke 2007) and occasional observations by west coast research institutions (Etnoyer and

Morgan 2003). These data augmented by video surveys conducted more recently by the sanctuary in limited areas indicate the presence of several habitat-forming species. The paucity of data is indicated by the first discovery in 2004 of *Lophelia pertusa* in the sanctuary (Hyland et al. 2005), a species with high potential as a biogenic habitat producer (Whitmire and Clarke 2007). Surveys conducted since then have documented additional living and dead colonies of *L. pertusa* and several other species of corals and sponges in the sanctuary (Brancato et al. 2007). Analysis of seafloor habitat data used for essential fish habitat (EFH) designation indicates that approximately 6% of the sanctuary is hard substrate with potential to host biologically structured habitat (Figure 23). Of this, 29% lies within the Olympic 2 EFH conservation area (see Figure 34). Recent surveys by OCNMS have documented corals and other biologically structured habitat in other areas, which indicates this analysis may underestimate the historic and/or current distribution of biologically structured habitat.

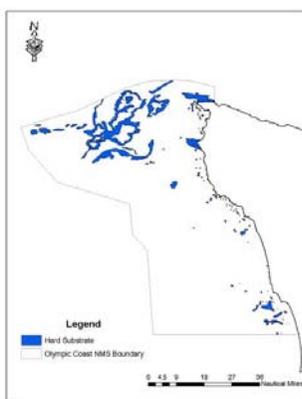


Figure 23. Potential historic distribution of biologically structured habitat associated with hard substrate in Olympic Coast sanctuary (data from Curt Whitmire, NOAA)

Of all fishing gear types used in the region, bottom trawls have the highest severity ranking (in terms of severity and extent of damage) for potential impacts to deep corals (Morgan and Chuendpagdee 2003). A single pass of a bottom trawl was shown to have significant impacts on corals in Alaska (Krieger 2001). Bottom trawls are followed in severity ranking by bottom longlines. Longline gear can travel significant distances over the seafloor, particularly during retrieval, snaring or undercutting emergent structures (Whitmire and Clarke 2007). Several recent management measures implemented through the Pacific Fisheries Management Council, such as footrope size restrictions, essential fish habitat designations, vessel buy back programs, and rockfish conservation area trawl closures, will reduce ongoing impacts to such habitats.

The condition of the sanctuary's biologically structured habitats prior to modern fishing activities may never be known. However, we do know that bottom trawl and longline fisheries have been widely practiced in the sanctuary for many decades, likely over all but the roughest of seafloor habitats. We also know that the sanctuary waters contain hard bottom habitats that can support biogenic structures that are susceptible to damages from these activities. Consequently, we believe it is reasonable to assume that where trawl and longline fisheries have occurred on deep sea biogenic habitats, it is likely they have been degraded and may not quickly recover. Intensive survey effort will be required to determine the extent of detectable damage, and the rate of recovery can only be determined within areas where these practices are no longer allowed.

Comment [kb98]: I agree that the EFH discussion belongs here as well as earlier. However, it is reserved for fuller discussion until around Fig. 34 [p 40]. Reference forward to figures is not good form as all figures referenced should appear in that order. Again this is a frustrating artifact of the CR structure.

Comment [kb99]: It may be helpful to the reader to separate the discussion of longline and trawl gear impacts and the description of how recent management measures affect each. I am uncertain whether the trawl management actions to reduce trawl effort in certain areas also results in lower longline impacts. Is there gear switching taking place that would tend to increase the longline impacts [which are usually considerably less than bottom trawling]?

Comment [kb100]: But only inside 3nm?

Comment [kb101]: Approximate age of coral communities known to estimate the order of magnitude of the recovery period?

7. What are the contaminant concentrations in sanctuary habitats and how are they changing?

Sediment contamination levels in the Olympic Coast National Marine Sanctuary are generally low and do not appear to be increasing. In 30 sediment samples taken in 2003 as part of the West Coast Environmental Monitoring and Assessment Program (EMAP), there were no PCBs, DDT, or other chlorinated pesticides detected (Partridge 2007). Polycyclic aromatic hydrocarbons (PAHs; in oils and byproducts of petroleum combustion) and metals were found in the sediment throughout the sanctuary, but no concentrations exceeded Washington State sediment quality standards (Washington State Department of Ecology 1995). At one location, a sediment quality guideline predictive of toxicity called the Effects Range-Low (ERL) was exceeded for silver, and at four locations the ERL was exceeded for chromium. The ERL is a concentration correlated with a low likelihood of toxicity to biological organisms (Long et al. 1995, O'Connor 2004). Anthropogenic sources for these metals are not known. Given the low level of human development along the shoreline, these conditions are not likely to change in the near future.

Concentrations of contaminants in tissues can provide an integrated measure of bioavailability of compounds that are present at low or variable levels in the marine system. Chemical concentrations were recently measured in a variety of invertebrates and sea otters for a study of sea otter health (Brancato et al. 2006) and for NOAA's Status and Trends, Mussel Watch Program. Contaminant concentrations were found to be low in all organisms, with very few exceptions.

Two potentially significant sources of chemical contaminants in the sanctuary include petroleum releases and atmospheric deposition. Physical evidence, such as tar balls on beaches and oil sheens on water, are occasionally noted in the sanctuary, but persistent and widespread contamination from petroleum has not been documented outside of major oil spills, the most recent of which occurred in 1991. Atmospheric sources of contaminants, however, are a growing regional concern associated with rapid industrialization of SE Asia (Wilkening et al. 2000), but the most significant impacts are anticipated in terrestrial systems.

8. What are the levels of human activities that may influence habitat quality and how are they changing?

Bottom tending fishing gear has been employed widely throughout the sanctuary for many decades. Where this has occurred, biologically structured habitat that may have existed is likely to have been degraded. Recent fisheries management measures have reduced the potential for further impacts to these habitats by reducing fishing effort and restricting areas where bottom trawling is practiced by non-tribal commercial fishers. Strengthened regulation of land use in watersheds and shoreline areas and management of visitor use in intertidal areas have improved protection of intertidal and nearshore habitats. As a result, it is expected that impacts to sanctuary habitats are decreasing, in general.

The primary activity affecting the deep water habitats of the sanctuary is bottom contact fisheries. As noted under Question 5, the bottom trawl effort has significantly declined as compared to historical levels. Also, the area subject to commercial trawling has been significantly reduced in the sanctuary through designation of permanent closures of groundfish essential fish habitat and the creation of Rockfish Conservation Areas where trawlers are excluded for the next several decades while key overfished rockfish stocks rebuild, and well as attrition of the fleet resulting in a reduction in bottom trawl effort. (see Figure 25). Requirements for use of small footrope gear also limits trawling to areas of low "roughness" which tend to be seafloor substrates, such as sand, mud, and gravel, where habitat is less degraded by bottom contact gear. If these area and gear restrictions remain in place over time, biogenic structures may improve, though with their low reproductive rates and patchy distribution of source material, recovery may take decades (Etnoyer and Morgan 2003; Morgan et al. 2005; Whitmire and Clarke 2007).

The sanctuary's boundaries include intertidal areas of Olympic National Park where habitat quality can be affected by harvesting and trampling by visitors. Park visitation rates have been relatively stable over the past

Comment [kb102]: Is there an OCNMS categorization of contaminants? Brief statement at the start of this section would help reader track organization of what follows.

Comment [kb103]: This project was aimed at characterizing a statewide baseline condition and was not aimed to identify local conditions. It's possible there are localized contaminated areas, eg the previous comment about anecdotal evidence of lots of lost fishing weights on a bank used as a fish stock nursery area. There could be both sed and tissue contams there.

Comment [kb104]: I am a bit puzzled by the statement "Anthropogenic sources for these metals are not known." As noted much later in the CR, there have been various proposals for mining mineral sands from the Olympic Coast. It is quite possible that these are naturally high concentrations which really supports the conclusion that they are unlikely to change in the future.

When there is a statement contaminant levels being low in all organisms, "with very few exceptions" makes the reader immediately wonder what the exceptions are. They could be noted here and discussed later.

Similarly, under the discussion of fishing impacts influencing habitat quality, there is mention of the non-tribal fisheries impacts. It would seem that information on measures or approaches followed by tribal co-managers could be added following in the spirit of the Intergovernmental Agreement among the tribes, state of Washington on OCNMS.

Comment [kb105]: The 2003 EMAP project, also did fish tissue. Might it be worth summarizing these data? Valerie Partridge at 360 407-7217 could help wit this.

Comment [kb106]: Does this keep pace with increasing overall population creating an overall higher stress?

Comment [kb107]: Citations for my comment earlier on coral recovery rate.

decade, but the shoreline remains a popular destination, with most visits focused near the few access points where roads or trails approach the coast. Shoreline harvesting by non-tribal visitors is not common, yet evidence of destructive harvest practices can be seen, particularly at easily accessible locations. An exception is the popular razor clam harvest at Kalaloch and Mocrocks beaches, an activity that does not damage the high energy, sandy beaches where razor clams live. Localized areas of habitat damage have been caused by fish bait harvesting (Erickson and Wullschleger 1998) but regulations have been implemented to minimize this activity. The Park plans to implement harvest closure on approximately 30% of the shoreline, which will further reduce the minimal pressure experienced at selected mixed gravel/cobble and rocky intertidal habitats (ONP 2008). Trampling and intertidal exploration may degrade intertidal habitats in some areas, but substantial impacts have not been documented (Erickson 2005).

Comment [kb108]: What are the “destructive harvest practices” seen in shoreline areas and how prevalent are they?

Marine debris may be an increasing problem for the sanctuary, as has been demonstrated elsewhere. For example, the Ocean Conservancy’s monitoring program documents more than a 5% increase in debris per year in the US from 1999 through 2005 (Ocean Conservancy 2007). Wildlife impacts from floating marine debris, such as entanglement and ingestion, have been documented in other areas and are assumed to occur off the Washington coast. Recent cleanup efforts on the Olympic Coast have removed significant quantities of marine debris from beaches, an estimated 24 tons in 2007 during a 2-day clean up event, yet debris is continuously deposited on the shores. The decline in nearshore fishing effort and increasing expense of fishing gear might reduce abandonment of fishing gear in the sanctuary. Surveys in limited portions of the sanctuary have revealed few derelict nets in nearshore areas near Cape Flattery, but abandoned crab pots remain a problem and in deeper areas abandoned longline gear and netting has been noted that likely will remain for many years because removal methods are not cost effective.

Comment [kb109]: Sentence beginning.. “Surveys in limited portions...” tries to convey too much information. Needs some editing.

Land use in upland areas also has the potential to negatively impact nearshore habitats. Chief among these activities has been timber harvest in upland areas, with consequent alteration of water runoff and sediment transport regimes in rivers and nearshore areas. Road building and maintenance, runoff from roads, and the development and maintenance of recreational facilities (e.g., campgrounds) and coastal residences all have potential to degrade nearshore habitats and water quality. Coastal development is increasing along the southern shore of the sanctuary, but stronger regulation of forestry and construction practices is expected to minimize impacts to marine areas.

Comment [kb110]: How much is known about the relative impact of the road building associated with logging vs. the impacts of the logging activity itself? My cursory reading in this area cites side cast logging road construction and subsequent failure on steep slope as the leading cause of sediment contaminants in area rivers.

The US Navy has historically trained and operated off the Washington coast, as described in the sanctuary’s original EIS (NOAA 1993). The Navy’s research and testing activities involving non-weaponized technologies have been evaluated for effects of existing activities and the associated environment and are being re-evaluated under the NAVSEA NUWC Keyport Range Complex Extension EIS/OEIS. In addition, the Fleet training activities are being evaluated under the NWTRC EIS/OEIS. The Navy has proposed significant expansion in area and extent of operations in the sanctuary. Although only non-weaponized technologies would be tested, an increase in Naval activity or areas of operation, if not properly controlled, could have potential to disturb the seabed, introduce pollutants associated with weapons, and produce sound energy that could negatively alter the acoustic environment within the sanctuary.

Comment [kb111]: The references to “stronger regulation of forestry and construction practices” are too vague. What are the measures being taken and who is taking them?

http://www-keyport.kpt.nuwc.navy.mil/EIS_Documents.htm
<http://www.nwtrangecomplexeis.com/EIS.aspx>

Comment [kb112]: the discussion of “significant expansion of area and extent of operations” is truncated. What are the specific proposals and what might be their impacts? Please translate the acronyms. Explain the process for evaluating this and the role of the OCNMS and tribes in these processes.

Underwater noise can act as pollution to acoustically oriented organisms, such as some whale and fish species, and degrade the underwater habitat. The main source of anthropogenic noise within sanctuary waters is vessel traffic, with some contribution from military activities. The establishment of the Area to be Avoided (ATBA) and high level of compliance by the commercial shipping industry suggests that the risk of pollution and acoustic impacts associated with shipping are reduced in the southern and nearshore portions of the sanctuary where vessel traffic is directed offshore. In northern sanctuary waters, convergence of Pacific Rim shipping routes into the western Strait of Juan de Fuca, vessel traffic lanes, and ATBA boundaries all concentrate large vessels (see

Comment [kb113]: Does OCNMS or any other entity have actual monitoring of levels of sound on an ongoing basis in this area? I have seen east coast studies which have been able to utilize declassified Navy data for gaining an understanding of this issue [was it in Stellwagen Bank right whale studies or other avoidance studies?].

Figures 19 and 30) in an area where marine mammal density is relatively high (Calambokidis et al. 2004). Stable levels of shipping traffic in the northern sanctuary over the past five years suggest that noise from ships may remain relatively constant in the near future.

Living Resources Status and Trends

The living resources of the sanctuary are composed of a wide array of species organized into several ecological communities including intertidal, nearshore, pelagic, and benthic. Community structure is shaped by species-species interactions, such as competition or predation, and physical factors, such as disturbance, upwelling or temperature. Connections between communities are complex when considering species can move between habitats at various stages of their life history or even on a daily basis while foraging or seeking shelter. There are knowledge gaps in the dynamics of ecological communities, and these are areas of active and proposed scientific investigation.

Given the complexity of community types and the diversity within each, not all communities or species are discussed in detail. Rather there is a greater focus on selected living resources where a better understanding of function and dynamics exists. Also, there is a greater emphasis on those species that serve as proxy for the health of overall community function.

The following information provides an assessment by sanctuary staff and subject area experts of the status and trends of living resources.

Comment [kb114]: There seems to be an emphasis on all species which have declined. For a CR shouldn't there be mention of species that have maintained their abundance or increased in abundance as well? These are indications of state as well and may be quite significant in terms of understanding management approach, e.g., Pacific halibut, coastal salmon/steelhead and or trend in ecosystem processes.

Comment [kb115]: There are several quantitative data available that do not appear to have been directly included in the analysis of state of the fish and invertebrate resources. These include: WDFW annual surveys of clam resources, and the WDFW submersible surveys of rocky habitats (Jagiello et al. 2003). In addition, a request from the Sanctuary for area specific analyses of the NOAA Fisheries NWFS survey data should be considered for the future. (see comment at the end of review)

Living Resources Status & Trends

Good
Good/Fair
Fair
Fair/Poor
Poor
Undet.

▲ = Improving — = Not changing ▼ = Declining
 ? = Undetermined trend N/A = Question not applicable

Status	Rating	Basis for Judgment	Description of Findings	
9	Biodiversity	?	Ecosystem-level impacts caused by historical depletion of fish, high order predators, and keystone species	Selected biodiversity loss may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.
10	Sustainable Fishing	▲	Overexploitation of some groundfish species has led to wide area closures	Extraction may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.
11	Invasive Species	▼	Invasive <i>Sargassum</i> and tunicate distributions are expanding	Non-indigenous species exist, precluding full community development and function, but are unlikely to cause substantial or persistent degradation of ecosystem integrity.
12	Key Species Status	?	Populations of Common Murres, sea otters, and numerous rockfish reduced from historic levels, with differing recovery rates	The reduced abundance of selected keystone species may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity; or selected key species are at reduced levels, but recovery is possible.
13	Key Species Condition	?	Diseases detected in sea otters	The condition of selected key resources is not optimal, perhaps precluding full ecological function, but substantial or persistent declines are not expected.
14	Human Activities	▲	Commercial and recreational fishing pressure has decreased	Selected activities have resulted in measurable living resource impacts, but evidence suggests effects are localized, not widespread.

Comment [kb116]: add "...to rebuild fish stocks" to the basis for judgment.

9. What is the status of biodiversity and how is it changing?

Biodiversity is variation of life at all levels of biological organization, and also commonly encompasses diversity within a species (genetic diversity) and among species (species diversity), and comparative diversity among ecosystems (ecosystem diversity). While thorough historic or current inventories are not available to fully measure biodiversity and trends in the sanctuary, there are numerous species in the sanctuary that have experienced population declines in recent decades, which indicates compromised biodiversity in the system. Incremental improvement in our understanding of ecosystem processes and intensified regulatory oversight have led to anticipated reductions in some impacts, and some depleted marine mammal populations have increased in numbers. Nevertheless, the decline of seabird populations and limited information about deep sea organisms lead to an undetermined overall trend for biodiversity.

Deleted: a

The sanctuary's rocky intertidal community is biologically rich with at least 300 documented species (Suchanek 1979, Dethier 1988), and new species are continuing to be discovered (deRivera et al. 2005). Long-term monitoring conducted by Olympic National Park, partnering with the sanctuary, shows relatively stable trends in biodiversity (Dethier 1995, ONP unpublished data).

Comment [kb117]: This statement seems inadequately justified, since the referenced report (Dethier) is over ten years old and other data is unpublished and not presented/described in this report.

Less is known about the historic or current conditions of sub-tidal, open water and deep-sea communities. A historical perspective suggests that many of the large mammal, high-order predators, and keystone species no longer functioned in maintaining community structure when their stocks were depleted by commercial whaling, hunting, and fishing (Roman and Palumbi 2003, Springer et al. 2003, Alter et al. 2007), although this topic remains controversial (Trites et al. 2007, Wade et al. 2007). For example, the loss of sea otters in kelp forest ecosystems, like those in the sanctuary, can cause cascading trophic impacts to the kelp itself and significant changes in biodiversity of that habitat due to the loss of predation pressure on herbivorous invertebrates such as the sea urchin (Estes et al. 1989, Estes and Duggins 1995, Kvitek et al. 1998). More recently, harbor seal numbers were severely reduced during the first half of the 20th century in Washington State by a state-financed population control program (Jeffries et al. 2003). Harbor seal and sea otter populations have rebounded to the point where some people are concerned that the Marine Mammal Protection Act's effective removal of humans as predators on marine mammals is causing an imbalance in the system. Impacts of such dramatic population changes on trophic webs, although not well understood, are likely to have occurred, yet such impacts and recovery from them are difficult to estimate in the absence of historical information.

Although species richness (number of species in a community) may be relatively intact as evidenced by few documented local vertebrate species extinctions, species evenness (the relative abundance of each species within a community) has undergone documented changes. Severe decreases in abundance of a species can impact ecosystem function. Changes in species evenness are exemplified by declining numbers of several locally breeding seabirds including the Common Murre, Tufted Puffin, Marbled Murrelet, Cassin's Auklet and Brandt's Cormorant. Populations of these species are considered declining in the area, and all are Washington State species of concern. The Marbled Murrelet is also federally threatened, and the Tufted Puffin is a federal species of concern. Four species of rockfish found in the sanctuary have been classified as overfished by the National Marine Fisheries Service (NMFS 2006). Nineteen fish species found within the sanctuary are identified as Washington State species of concern, of which eight also have some degree of federal status. Eleven marine mammals, three sea turtles and nine species of marine birds found in the sanctuary are on either federal or state species of concern lists across their range (Washington Department of Fish and Wildlife 2008). These are specific examples of the declining indices of biodiversity within the sanctuary.

Biodiversity within deep water communities off the Washington coast is poorly understood given the logistical challenges of conducting research in this habitat. Due to technological advances in undersea research, censusing and evaluation of ecological integrity of deep-sea communities has only recently begun (Etnoyer and Morgan 2003, Morgan et al. 2006, Brancato et al. 2007, Lumsden et al. 2007). There are indications that deep water sponge and coral communities in the sanctuary have been impacted before many aspects of their basic biology and ecology have been ascertained (Brancato et al. 2007). Overall, there is much that is not known about the species richness and evenness of several important communities within the sanctuary. The importance of biodiversity of ocean ecosystems cannot be discounted when considering it plays an important role in recovery of systems from perturbations (Worm et al. 2006).

10. What is the status of environmentally sustainable fishing and how is it changing?

Environmentally sustainable fishing protects the fish and the environment in which they live while allowing responsible use of the species that come from that environment. It is designed to protect the integrity of ecosystem structure, productivity, function and biodiversity, including habitat and associated dependent and ecologically related biological communities.

The major commercial fisheries that occur in the sanctuary target groundfish (bottom trawl and longline), Pacific halibut, Dungeness crab, pink shrimp, sardines, and salmon. In addition, there are significant recreational fisheries that occur in the sanctuary that target salmon, groundfish, and halibut. In general, professional fisheries managers appear optimistic that sustainable fisheries off the outer coast of Washington are possible under new

Comment [kb118]: EMAP 2003 did infauna richness and diversity

Comment [kb119]: NMFS trawl surveys provide data on the diversity of fish and invertebrate populations. Although it is true to say that deep water communities are poorly understood, several papers describe important species assemblages (Gabriel and Tyler 1980, Rogers and Pikitch 1992, Weinberg 1994, Tolimieri and Levin 2006) and survey data documents their presence or absence within the Sanctuary.

Gabriel, W. L., and A. V. Tyler. 1980. Preliminary analysis of Pacific coast demersal fish assemblages. *Marine Fisheries Review* 42:83-88.

Rogers, J. B., and E. K. Pikitch. 1992. Numerical definition of groundfish assemblages caught off the coasts of Oregon and Washington using commercial fishing strategies. *Canadian Journal of Fisheries and Aquatic Sciences* 49:2648-2656.

Rogers, J. B., and E. K. Pikitch. 1992. Numerical definition of groundfish assemblages caught off the coasts of Oregon and Washington using commercial fishing strategies. *Canadian Journal of Fisheries and Aquatic Sciences* 49:2648-2656.

Tolimieri, N., and P. S. Levin. 2006. Assemblage structure of eastern Pacific groundfishes on the U.S. continental slope in relation to physical and environmental variables. *Transactions of the American Fisheries Society* 135:317-332.

Comment [kb120]: Is it important in this CR to know whether or not WA waters are more productive for rockfish than OR?

management regimes following historical stock declines. Because this is the first condition report completed for Olympic Coast sanctuary and acknowledging the potentially long lag period between fishery actions and observable ecosystem level repercussions, this report examines this question from a long term perspective, looking back one or more decades.

For several decades, commercial and recreational fisheries have extracted significant biomass from waters now encompassed by the Olympic Coast sanctuary, **in part** by methods that are known to reduce complexity and damage living structures of seafloor habitats. Management actions, such as reduction of fish stocks to less than 50% of the unfished biomass, have potential to alter ecosystems. Meanwhile, scientists are just beginning to understand fundamental elements of ecosystem function - the distribution and community composition of seafloor habitats, the distribution of and habitat requirements for different life stages of important commercial species, the significance of diverse age structures in sustaining fishery resources, and many other factors that influence community development and function. Recent fishery management measures implemented to reduce fishing effort, monitor and minimize bycatch, and reduce impacts to habitat appear to have assisted initial recovery of some overfished groundfish stocks and provide evidence for an improving trend.

The complexity of the groundfish stocks makes it difficult to make generalized statements about the sustainability of groundfish fisheries off Washington. Over 90 species of groundfish are managed under the PFMC's Groundfish Fishery Management Plan, including over 60 species of rockfish. Beginning in the 1970's, improved understanding of life history characteristics led fisheries scientists to conclude that many of these species were incapable of sustaining high intensity fishing pressure using modern fishing methods (PFMC 2008a). In recent years, West Coast groundfish stocks and fisheries were in crisis with steep declines in commercial ex-vessel value, overcapitalization, and several groundfish stocks depleted by a combination of fishing and natural factors (NMFS 2002). There are increasing concerns that our limited ability to forecast groundfish production from single species investigations is missing important natural and fishery-induced changes in the ecosystem and will not be able to forecast truly sustainable harvest policies (NMFS 2002).

Some groundfish species have been depleted in the past and have recovered quickly (e.g., English sole, Pacific whiting, and lingcod), while others are rebuilding more slowly (e.g., Pacific ocean perch or POP) (PFMC 2008a). **For depleted species, rebuilding programs are in place, with anticipated stock recovery period ranging from about 10 to 80 years for different species. All species considered depleted are on track to be rebuilt by their respective schedules, which take into account their different life histories. Most groundfish populations are below 50% of their estimated unfished or original biomass (Figure 24). Of the 22 species of groundfish that occur in the sanctuary and are managed at the species level, 13 species have stocks that are considered healthy, 3 species are in a precautionary status (<40% of unexploited spawning biomass), and 5 are depleted (<25% of unexploited spawning biomass; canary, yelloweye, widow, and darkblotched rockfish, and POP) (PFMC 2008a). The remaining groundfish species are managed in groupings or stock complexes because individually they comprise a small part of the landed catch and insufficient information exists to develop adequate stock assessments.**

Comment [kb121]: Note that the West Coast groundfish were managed as a multispecies complex from the start and this did not lead to a sustainable result. Thus, the answer now is not to move to a more holistic approach only but to combine the signals for single species assessments about weak, or stocks targeted for rebuilding, and a look at the broader context. This is a combination approach.

Comment [kb122]: The report states that "For depleted species, rebuilding programs are in place, with anticipated recovery period ranging from 10 to 80 years". Technically that is not correct for all the species under PFMC rebuilding plans. Widow rockfish is scheduled to be rebuilt in 2009, while Pacific Ocean perch will very likely be rebuilt in 2011. This also calls into question the trend rating for question 12 on Page 35, as many groundfish species are showing increasing trends since reaching their depleted levels in the late 1990s.

Comment [kb123]: "5 species are depleted (<25% of unexploited spawning biomass..." is incorrect for a 2008 PMFC reference; the canary resource was at 32% in 2007, and the widow resource was at 36% in 2006.

Comment [kb124]: It is inaccurate to suggest that, for species currently managed as groups or stock complexes, insufficient information exists to develop adequate stock assessments. In fact, NMFS is adding new species during each assessment cycle and there is a large quantity of assessment-quality data for west coast groundfish species that has not yet been evaluated via formal stock assessments but could be in the near future.

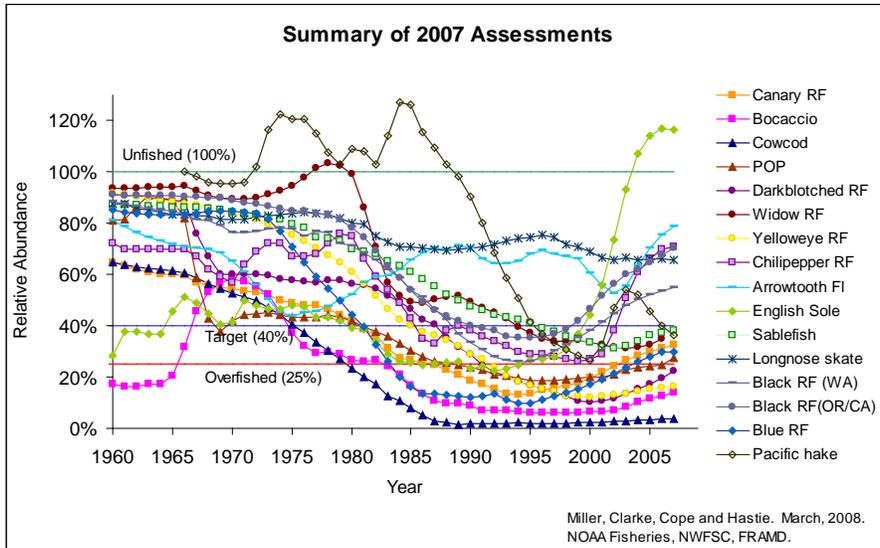


Figure 24. Historic trends in groundfish abundance off the West Coast (from NMFS/FRAM)

The Olympic Coast sanctuary lies within the California Current marine ecosystem, which contains a complex web of pelagic and demersal fish resources, marine mammals, birds, invertebrate resources and elements of the food chain that support these more visible and economically valuable resources. This ecosystem undergoes significant climate fluctuations that last from a couple of years to several decades, and these cycles can both increase and mask the human impacts. For example, computer model simulations of the Northern California Current ecosystem (including OCNMS) support the general assertion of a significant shift in the mid-1970's from a cold regime with high zooplankton productivity to a warmer regime with lower productivity and declining fish stocks (Field et al. 2001). There are some indications that the biomass off Washington of several rockfish species is high (per unit area) compared to Oregon and California, and this information has been taken into account for the management of some stocks (e.g., black rockfish). For many species, however, adequate survey data have not been collected and/or analyzed in a manner that allows a scientifically defensible determination that other groundfish stocks off Washington are more abundant than those off Oregon and California. Additional discussion of groundfish stocks is provided under Question 12.

<http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm#07>

Fisheries for crab and shrimp off the outer coast of Washington experience catch fluctuations but appear to be sustainable. The commercial Dungeness crab fishery has over 200 Washington coastal commercial Dungeness crab license holders. Dungeness crab landing data back to 1950 shows a large fluctuation in harvest, ranging from a low of 2.5 million pounds in 1981 to a high of 25 million pounds in 2004-2005, averaging at 9.5 million pounds. This large fluctuation in landings is likely due to varying ocean conditions including water temperature, food availability, and ocean currents (<http://wdfw.wa.gov/fish/shellfish/crabreg/comcrab/coast/index.htm>). A fishery for pink shrimp off Washington peaked in 1988 with landings just over 18 million pounds and about 100 vessels involved. Within a few years, a dramatic decline in local abundance drove many fishers out of the fishery. Since 2000, the Washington coastal fishery has been stable, with landings of seven to eight million pounds annually and about 25 fishers participating. Management of the fishery is passive, with no stock

Comment [kb125]: Can similar summaries of other relevant stocks be added, e.g., Pacific halibut, Coastal salmon/steelhead, crabs/shrimp (estimated biomass).

Comment [kb126]: The report uses a figure showing the summary of 2007 assessments in support of discussion on page 37 concerning status of groundfish species. Many, if not all, of the species illustrated in this figure are based on coastwide assessments and therefore have less relevance to status-trends conclusions specific to the OCNMS. Further, the report states that "adequate survey data has not been collected and/or analyzed in a manner that allows a scientifically defensible determination that other groundfish stocks off Washington are more abundant than those off Oregon and California". The NWFSC has conducted a fishery resource survey off the slope since 1999 and both self and slope since 2003. Many species caught in the survey both off Washington and further south off Oregon could be quantitatively analyzed to address this question. However we were asked for input as experts on specific questions and not for specific quantitative analyses of that area. These analyses could be conducted in the future if there were resources and more importantly the time to conduct them. If we had known that the time frame for this report would, in the end, be so long we probably could have managed to complete analyses of survey information that were specific to the sanctuary area. In addition, the original request for expert opinion was on a fairly short time frame and the questions were so general that it was difficult to assess if and how a more detailed analysis would be useful. It may be useful to look at the survey data that can be accessed via <http://pacoos.coas.oregonstate.edu/> to view data that are more area specific.

Comment [kb127]: Statement that data is lacking "...that allows a scientifically defensible determination..." of relative abundance off Washington vs. Oregon and California is incorrect. There are several assessments, yellowtail rockfish (Wallace and Lai 2005), lingcod (Jagiello and Wallace 2005), and black rockfish (Wallace et al. 2008) that delineate a separate stock in Washington waters. In addition, the NMFS trawl surveys have several strata that match closely the extent of the Sanctuary, and quantitative estimates of density and abundance are provided in technical memoranda which could be used to evaluate diversity, status of key species and trend in the last 30 years.

Jagiello, T. H., and F. R. Wallace. 2005. Assessment of lingcod (*Ophiodon elongatus*) for the Pacific Fishery Management Council in 2005.

Wallace, J. R., and H.-L. Lai. 2005. Status of the yellowtail rockfish in 2004.

Wallace, F. R., Y. W. Cheng, and T.-S. Tsou. 2008. Status of the black rockfish resource north of Cape Falcon, Oregon to the U.S.-Canadian border in 2006. in Stock assessment and Fishery Evaluation. Pacific Fisheries Management Council. Portland, OR. 119 p.

assessment or mandatory logbook program in place. Most fishing occurs off the central and southern coast of Washington (<http://wdfw.wa.gov/fish/shelfish/shrimp/comm/index.html>).

Chinook and coho salmon are the main salmon species managed by PFMC off Washington's outer coast. In odd-numbered years, fisheries are also conducted near the Canadian border for pink salmon, which are primarily of Fraser River origin. Managing ocean salmon fisheries is an extremely complex task, due in large part to the wide oceanic distribution of the salmon and difficulty in estimating the size of salmon populations. Salmon numbers can vary widely from year to year, and returns can differ significantly from model estimates. In the past decade, landings from the ocean troll fishery off Washington (excluding the area south of Willapa Bay) varied 5 fold for chinook and 9 fold for coho between low and high catch years, but no clear trends in landings are evident (PFMC 2008b). Salmon at all life history stages are affected by a wide variety of natural and human-caused factors in the ocean and on land, including ocean and climatic conditions, habitat degradation and loss, and predators (including humans). Other challenges to a sustainable salmon fishery off the Washington coast include judging the effects of different regional fisheries on salmon stocks; recovering salmon under the Endangered Species Act; dividing the harvest fairly; impacts from salmon aquaculture, competition between wild and hatchery salmon, and restoring freshwater habitat (PFMC 2008b).

<http://www.pcouncil.org/salmon/salback.html>

The past decade has seen a paradigm shift in the management of fisheries from assessments of target stocks to a more holistic consideration of sustaining marine ecosystems as well as fishing yields (NMFS 1999; Pikitch et al. 2004; Fluharty 2005; Tudela and Short 2005; Babcock et al. 2005). Fishery managers are now beginning to define and employ this practice (Zabel et al. 2003; Marasco et al. 2007; PSMFC 2005). The ecosystem-based fisheries management approach requires managers to consider all biotic interactions of predators, competitors and prey at all life history stages; the effects of physical factors such as climate and weather on fisheries biology and ecology; the complex interactions between fishes and their habitat; and the effects of fishing on fish stocks and their habitat (NMFS 1999).

Ecosystem-based fisheries management is designed to forge a healthy *long-term* relationship within and between ecosystems, economies, and societies (NMFS 1999; Gaichas 2008). Management of ecologically or environmentally sustainable fisheries includes consideration of measures such as the elimination of overfishing, minimizing habitat damage and loss, and insuring that the total of all biomass removed by all fisheries in an ecosystem does not exceed a total amount of system productivity (Pikitch et al. 2004). Such management goals also include maintaining populations of target species to conserve their natural role in maintaining ecosystem function while enabling sustainable reproduction rates; eliminating the use of fishing gear that creates a high level of bycatch or incidental contact with non-target species; and restricting removals from critical feeding, breeding and spawning grounds to protect marine ecosystems (NMFS 2006).

Fisheries management policies enacted on the West Coast and within the Olympic Coast sanctuary have been progressive steps to incorporate ecosystem-based fishery management concepts and improve trends toward restoring historical population levels. A variety of recent fishery management actions off the Washington coast, such as trawl footrope gear restrictions, low rise nets that reduce bycatch, monitoring of bycatch, protection of essential fish habitat (NMFS 2006), implementation of stock rebuilding plans, and establishment of temporary area closures (Rockfish Conservation Areas) to promote recovery of species under rebuilding plans, have provided early indications that depleted stocks can recover and these fisheries can be sustainably practiced (Figure 25).

Comment [kb128]: The conclusion that "most fishing occurs off the central and southern coast of WA seems at odds with the data shown in Figure 21. How to reconcile?"

Comment [kb129]: Does the Pikitch reference really state that the "total amount of biomass removed by all fisheries in an ecosystem does not exceed a total amount of system productivity"? My recollection is that the discussion was about the relative amount of biomass removed was to be maintained at a level considerably less than the productivity of each stock and cumulatively of that assemblage of stocks within an ecosystem. The goal of fisheries is not to remove the total production. ... surplus production...

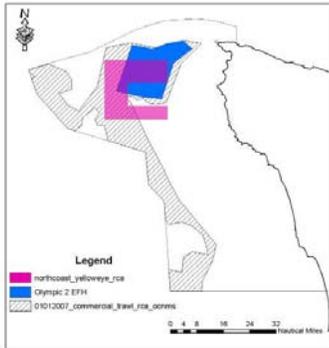


Figure 25. Bottom trawl fisheries are prohibited from areas designated as essential fish habitat and Rockfish Conservation Areas.

11. What is the status of non-indigenous species and how is it changing?

Relatively few exotic or non-indigenous species (NIS) have been reported in the sanctuary and, of those, only a few are invasive and therefore threatening to community structure and function. Observations by coastal ecologists from ONP and OCNMS of increased amounts of the invasive brown algae *Sargassum muticum*, the documented range expansion of invasive ascidians (tunicates or sea squirts) (deRivera et al. 2005), and the encroachment of the invasive green crab to areas both south and north of the sanctuary all suggest that negative impacts from non-indigenous species are likely to increase in the future.

The sanctuary's Rapid Assessment intertidal surveys from 2001 and 2002 identified nine non-indigenous invertebrate species (two polychaetes, one amphipod, one bryozoan, four bivalves and one ascidian) and one algal species. A 2005 study of non-indigenous species along the West Coast in marine protected areas using settling plates located on buoys offshore found four NIS (one crustacean and three ascidians) inhabiting OCNMS (deRivera et al. 2005).

Ports as well as marinas have higher numbers of invasive species due to transport by vessels (deRivera et al. 2005). There are no major ports located within sanctuary waters, and the few marinas that exist are relatively small, which may slow the number and severity of species invasions. However, shipping traffic through the sanctuary may provide a vector for NIS via transport on hulls and discharge of ballast water. To minimize this risk, Washington State recently strengthened regulations covering ballast water exchange. Ships traveling from outside the Exclusive Economic Zone (EEZ) must exchange ballast water no closer than 200 nautical miles (nm) off shore while ships considered U.S. coastal traffic, including Canadian waters, must exchange ballast water no closer than 50 nm off shore. http://groups.ucanr.org/Ballast_Outreach/Laws_and_Regulations/Washington_State.htm Even with regulations in place, there is a need for basic understanding of the spatial and temporal patterns of invasions (deRivera et al. 2005).

12. What is the status of key species and how is it changing?

Key species (i.e., keystone species, indicator species, sensitive species, and those targeted for special protection) within the sanctuary are numerous, and all cannot be covered here. Emphasis is placed on examples from various primary habitats of the sanctuary – seabirds for nearshore and pelagic habitats, sea otters for

Comment [kb130]: Like the earlier comment on “Wilderness” when discussing designated Wilderness areas, Essential Fish Habitat should be capitalized to indicate specific measures under the MSFCMA rather than some general understanding of what is “essential”. Should be done throughout the CR. [Check title fig. 25] While commenting on such details == species designated under the ESA should be listed as Threatened or Endangered to reflect the similar concern about specific designations.

Deleted: Economic

Deleted: on

Comment [kb131]: Be careful when defining “key” species and “keystone species.” They are not interchangeable. Please define what is meant in terms of the thesis/ report. Which are the keystone species -- what fits into other categories and why? This suggestion is primarily definitional. How does OCNMS define the examples used as “proxy” species and how were they chosen [p. 34]. Note, this is not a quibble about which species are selected but about imprecise use of these terms in the CR generally. Finally, when we reach p. 42, these same species are referenced as “indicator species.” Each of these terms is undefined and all seem to be used interchangeably.

nearshore habitat, and rockfish for deep seabed habitats. In this response, status refers primarily to population numbers, as opposed to condition or health of the populations as addressed under Question 13. Several species of seabirds that breed and feed in the sanctuary, several species of cetaceans that forage in or visit sanctuary waters, and a few groundfish species that inhabit the sanctuary are reduced in numbers in comparison to historical levels. In many cases, their recovery is uncertain and linked to dynamic and poorly understood ecosystem level processes.

Seabirds are relatively numerous, conspicuous, and forage across multiple habitat types and trophic levels. For these reasons they are often considered indicators of ocean conditions, and the status of their populations provide insight into ecosystem health (Parrish and Zador 2003, Piatt et al. 2007). Many feed on forage fish, a critical link in the food chain, but one that is difficult to quantify by direct observation. Five marine birds that breed in the sanctuary are on federal and/or state species of concern lists: Common Murre, Marbled Murrelet, Tufted Puffin, Cassin's Auklet, and Brandt's Cormorant. Trends and common concerns among these seabirds are long-term declines in their population sizes (Wahl and Tweit 2000, Wahl et al. 2005, Raphael 2006); vulnerability to human disturbances such as oil spills, habitat disruption and fisheries bycatch (Piatt et al. 2002, Raphael 2006); and susceptibility to natural disturbances such as ENSO events (Wooster and Fluharty 1985, Wilson 1991, Piatt et al. 2002, Wahl et al. 2005). Some population levels do appear to be stabilizing at values lower than historical levels; however, a longer time series is needed to determine a trend (Lance and Pearson 2008).

Comment [kb132]: It would be more appropriate to reference the specific chapter on seabirds which contains the information cited here than to Wooster and Fluharty 1985 generally.

A closer examination of the Common Murre population provides insight into some factors affecting the status of all seabirds on the Washington coast. The murre population declined dramatically in 1982 and 1983, coinciding with a severe ENSO and has not recovered to pre-1983 levels since that time (Warheit and Thompson 2004). Aside from other ENSO events, it has been suggested that the population has not recovered due to a combination of oil spills, disturbance at breeding colonies (e.g., historic Naval bombing practices), and gillnet mortality (Warheit and Thompson 2004). Two oil spill events have occurred in recent times on the Washington coast, one in 1988 (the *Nestucca*) and the other 1991 (the *Tenyo Maru*). In both spills, Common Murres were a significant proportion of the bird mortality (74% and 73% respectively) of the birds recovered (Parrish personal communication). There were 9,275 Common Murre mortalities documented from the *Nestucca* spill (Parrish personal communication), from which total mortality was estimated at 30,000 murres off the outer coast of Washington (Manuwal et al. 2001). During the *Tenyo Maru* spill 3,157 Common Murres mortalities were documented, suggesting that a potentially sizable proportion of the total Washington state Common Murre population may have been killed by the *Tenyo Maru* oil spill (The *Tenyo Maru* Oil Spill Natural Resource Trustees 2000). Although the sanctuary's Common Murre population showed signs of recovery through the 1990s, its population size is greatly diminished relative to pre-spill numbers and modest declines have been found in recent years (Manuwal et al. 2001). At the breeding colony on Tatoosh Island, Common Murre populations have also been affected by influx of avian predators including Bald Eagles, Peregrine Falcons and nest depredating Glaucous-winged Gulls (Parrish et al. 2001). The multiple stressors affecting the sluggish recovery of Common Murres may be indicative of the challenges facing the long-term recovery of other seabirds.

Comment [kb133]: How many gallons? Was quoted earlier in the report

Comment [kb134]: Discussion of Tatoosh Is recent breeding failures refers to several causes but are "oil spill" really recent?

The sea otter is often considered a keystone species because of the strong top-down influence they have on the nearshore kelp ecosystem. Sea otters are of high interest because sea otters were extirpated from Washington State by commercial pelt hunters by 1911 and were reintroduced in 1969 and 1970 (Lance et al. 2004). This population has been counted annually since 1989 and has shown increases the past few years, with a peak of 1,121 animals in 2008 (Jameson and Jeffries 2008). However, the sea otter population remains vulnerable to catastrophic events (e.g., oil spills), and the population rate of increase has been slower than expected. The population is still considered to be below the estimated carrying capacity based on historical and regional habitat use which includes rocky, sandy, and mixed substrates (Laidre et al. 2002; Lance et al. 2004). However, habitat loss in estuaries such as Grays Harbor could reduce the actual carrying capacity, and it remains to be seen if the projected rocky habitat density (7.1 otters per km of shoreline) will be attained along the Olympic shoreline. The sea otter remains a federal species of concern and an endangered species within Washington State. The sea

otter population remains vulnerable because of its small size, limited genetic diversity, existing exposure to pathogens, and risks from spills (see Question 13).

Indicator species of the deep sea environs are not clearly defined due to limited information about this remote region of the ocean. Very little is known about the status of deep sea coral and sponge communities (Brancato et al. 2007; Whitmire and Clarke 2007). Rockfish assemblages are a key vertebrate guild that could serve as a proxy for the condition of deep sea communities. Unfortunately, the status of discrete fish stocks relevant to Washington State is not well defined independently from the west coast assessment effort because data are not readily available for assessment authors to make that determination for many species. In general, PFMC has indicated its support for regional management of stocks, where it is appropriate and when there are data to support such a management structure. Stock assessment authors are asked to review and evaluate all available data to determine whether a regional management approach would be recommended for the stock being assessed. In some cases, however, even when adequate data are available to support more discrete management, PFMC has chosen to continue to manage those stocks on a coast-wide basis. Groundfish fisheries are also discussed under Question 10.

Comment [kb135]: here it is noted that more discrete data are available for management, there is a comment that indicates the PMFC chooses to ignore these data. This requires a bit of an expansion. Why does PMFC make this choice? I suspect that it has to do with very pragmatic weighting of costs and benefits of implementing single species measures in an area specific manner. The current wording makes it sound like the Council is simply being bull-headed. There is likely more to this story.

13. What is the condition or health of key species and how is it changing?

As indicated above in Question 12, the sanctuary selected certain seabirds, sea otters, and rockfish as key species or indicators of ecosystem health. The condition or health of each is discussed below. Exposure to pathogens that have killed sea otters in California, bioaccumulation of organic pollutants in high order predators, modification of natural population structure through harvest, and uncertainty about altered oceanographic conditions associated with climate change all contribute to degradation of ecosystem integrity. Long term implications of these conditions are uncertain.

Most wildlife populations in the Olympic Coast sanctuary are relatively healthy and unburdened by contaminants, pathogens or related maladies. There are, however, notable exceptions. The sea otter population has been shown to carry several potentially lethal pathogens. In a study where tissue samples were collected from 30 live sea otters, 80% of the otters tested positive for the distemper viral complex *Morbillivirus* and 60% tested positive for the protozoan *Toxoplasma gondii* (Brancato et al. 2006). No direct negative health effects in the Washington population have yet been documented from these pathogens; however, *Toxoplasma* has been a cause of mortality in California sea otters (Miller et al. 2004). In addition, there was a positive correlation between chemical contaminants such as PCBs and pathogen levels with the latter used as a proxy for immunosuppression (Brancato et al. 2006). Furthermore, PCB levels were correlated with a significant reduction of vitamin A stores in the liver, yet overall tissue concentrations of assayed contaminants were relatively low in Washington sea otters (Brancato et al. 2006). Fat soluble contaminants are generally considered to biomagnify or increase in concentration when moving up the food web (Cockcroft et al. 1989). Top predators in the region, such as killer whales, have been shown to carry high contaminant loads (e.g., PCBs and PBDEs) in their blubber (Ross et al. 2000; Ross 2006) though the population effects of such high contaminant loads are unknown.

Comment [kb136]: bioaccumulate may be a better word choice.

Sea otter populations were regionally extirpated in the early 1900's and 59 individuals reintroduced to the area in 1969 and 1970. Consequently, there is reduced genetic variation in the Washington coast sea otter population when compared with ancient sea otter remains, as determined by analysis of DNA sequences (Larson et al. 2002). Reduced genetic variability is generally considered to impart deleterious effects such as reduced fecundity, higher juvenile mortality and reduced capacity to combat environmental stressors (Ralls et al. 1983, Lance et al. 2004). Sea otter populations should be closely monitored for such adverse effects, and to determine when the population crosses the Strait, potentially breeding with the population around Vancouver Island, BC, which could increase genetic variability. At the moment the condition or health of sea otters is stable but bears watching.

Age structure, an important measure of population integrity, has been affected by extractive activities. Some rockfish populations have been shown to have reduced numbers of larger, older fish, a factor that could affect their recovery rate (PFMC 2008a). There is a positive relationship between fecundity and age in long-lived Pacific rockfish such as the genus *Sebastes* (Eldridge and Jarvis 1995). Furthermore, larvae of larger, older rockfish are considered of better condition in terms of higher growth rates and ability to withstand starvation (Berkeley et al. 2004). Removals of older individuals from long-lived species also can have broader ecological impacts (Heppell et al. 2005). However, in most cases, the status of the larger, older fish within the population is unknown (i.e., it has not been determined whether the older fish are simply not available because they have been removed from the population, or are not available to the data source - e.g., the fishery or survey used as the index of abundance in the assessment).

Age structure and mortality rates are also in question in some bird populations on the coast. Common Murres on Tatoosh Island have had documented breeding failures during recent years, partially attributed to observed heavy predation by raptors and gulls, oil spills, but also possibly due to low food supply during critical breeding periods (Parrish et al. 2001, Warheit and Thompson 2003). Because they are long lived, an occasional year of poor productivity may not impact the population significantly, but multiple years or successive years of failure would likely have future impacts on the population. Baseline mortality rates for Common Murres and other seabirds are currently being examined through the Coastal Observation and Seabird Survey Team (COASST) program, a comprehensive coast-wide program initiated in 1999 to document beach-cast bird trends over time (Hass and Parrish 2000). Recent demographic studies of Marbled Murrelets in the region have indicated that they have had low nesting success in recent years (Raphael and Bloxton 2008) which may inhibit their recovery or at least slow the rate of recovery.

www.coasst.org

14. What are the levels of human activities that may influence living resource quality and how are they changing?

Fishing has in the past and today continues to affect sanctuary habitats and biota in a number of ways. For several decades, bottom contact fishing gear used by commercial fishers damaged seafloor habitat widely in the sanctuary and altered benthic communities by removing biogenic structures and/or disturbing infauna. As discussed above, recent fishery management actions have significantly reduced, although not completely eliminated, the potential for further habitat damage. Yet because the distribution of deep-sea coral and sponge communities has never been quantified or sufficiently mapped within the sanctuary, it is difficult to determine the extent of overlap between existing biogenic communities and current fishing activity. From the ecosystem perspective, there remain concerns that industrial fishing targets larger, older fish, which alters age structure and can reduce the breeding potential of long-lived species such as certain rockfish species (NRC 2006). Moreover, past overfishing has caused dramatic reduction in some fish stocks (see Figure 24). Recent closure of large portions of the sanctuary to fishing techniques that target species most vulnerable to overfishing is expected to mitigate past impacts to both seafloor habitats and ecosystem integrity, and indicates the potential for recovery.

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Comment [kb137]: On what timescale?

Oil spills remain the most serious threat to local populations of marine organisms. Although no major spills have occurred within the sanctuary since the *Tenyo Maru* spill in 1991, some populations, such as the Common Murre, have not yet recovered. The establishment of the Area to be Avoided has helped to keep oil barges, tankers, and other large commercial vessels away from the most biologically sensitive areas and the rescue tug stationed at Neah Bay has averted several hazardous situations. However, because of the high shipping traffic using the Strait of Juan de Fuca, combined with the challenging seas of the eastern North Pacific, the sanctuary still remains at risk from a catastrophic spill.

Maritime Archaeological Resources Status and Trends

The Olympic Coast sanctuary has a rich maritime heritage where lives, languages, communities and even cultures are shaped constantly by the sea. The Makah, Quileute, Hoh and Quinault peoples traditionally lived at the water's edge, thriving on the richness of the ocean - fish, shellfish, seabirds and marine mammals. Waters of the sanctuary were highways that linked Native peoples all along the coast as they traveled by canoe while mastering currents, weather and tides. The rugged Olympic Coast can be treacherous, especially during winter storms when high winds and strong currents can push ships dangerously close to the rocky islands, reefs and shoreline. Over 180 ships have been wrecked or lost at sea in sanctuary waters in the years from 1808 to 1972 (Figure 26). The following discussion addresses issues facing these sanctuary resources with respect to their integrity and condition, potential hazards they pose, and ways in which human activities may impact their integrity.



Figure 26. Olympic Coast National Marine Sanctuary is the graveyard for many shipwrecks. Human error, treacherous weather, dangerous reefs and headlands and ship's navigational or operational failures still contribute to this place's hazardous reputation among mariners. This anchor is nearly all that remains of the bark Austria, grounded at Cape Alava in 1887. (Photo: Olympic Coast sanctuary)

The following information provides an assessment by sanctuary staff and subject area experts of the status and trends pertaining to the current state of the sanctuary's maritime archaeological resources:

Comment [kb138]: add "marine plants" to the richness of the ocean supporting native peoples.

Comment [kb139]: Someone must comb the CR for all references to the number of ships sunk off the coast of WA. I have seen "more than 150" 180 along the WA coast. 180 in the Sanctuary waters. There should be consistent and clear accounting for the sunken ship numbers.

Comment [kb140]: Has to be older than 50 yrs to be considered by fed and state law... are there additional NMS rules that designate younger wrecks as an archaeological resource? The state Derelict Vessel Removal Program would likely consider sunken newer vessels a significant hazard because of fuel in degrading tanks, leaching of heavy metals, PCBs, TBTs and localized habitat coverage.

Maritime Archaeological Resources Status & Trends

Good
Good/Fair
Fair
Fair/Poor
Poor
Undet.
 ▲ = Improving — = Not changing ▼ = Declining
 ? = Undetermined trend N/A = Question not applicable

Status	Rating	Basis for Judgment	Description of Findings
15	Integrity	Deepwater wrecks stable; shallow wrecks subject to environmental degradation; lack of monitoring to determine trend	The diminished condition of selected archaeological resources has reduced, to some extent, their historical, scientific, or educational value, and may affect the eligibility of some sites for listing in the National Register of Historic Places.
16	Threat to Environment	Historic wrecks did not carry substantial quantities of hazardous cargoes	Known maritime archaeological resources pose few or no environmental threats.
17	Human Activities	Unauthorized salvaging nearshore, fishing activities and cable installations offshore	Selected activities have resulted in measurable impacts to maritime archaeological resources, but evidence suggests effects are localized, not widespread.

Comment [kb141]: The newer sunken vessels would pose significant threats as they decompose. Fuel in degrading tanks, heavy metals/TBTs in hull paints, PCBs in wiring/potting compounds/mineral oils to name just a few. Admittedly the threat is localized.

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15. What is the integrity of maritime archaeological resources and how is it changing?

In general, maritime archaeological resources are not being managed in accordance with the National Historic Preservation Act (NHPA) due to limited funding, and efforts to locate and assess maritime archaeological resources have been extremely limited.

While the Olympic Coast has been the focus of human communities for thousands of years and has figured prominently in Pacific Northwest maritime history, there is no agency-sponsored inventory of submerged maritime archaeological resources in the offshore environment in the sanctuary. The sanctuary's inventory contains information of approximately 180 known vessel losses, and limited efforts to locate specific wrecks have located only a few wrecks.

Due to limited survey effort, few deepwater shipwrecks are known. Of these, only the WWII submarine *Bugarra* has received any survey attention. Archaeological resources in deep offshore waters are generally in a more stable environment because such environments tend to be calmer and have fewer physical and biological processes accelerating ship degradation compared to nearshore sites. Historical and recent bottom trawling is one probable impact to offshore maritime archaeological resources that has potentially damaged submerged historic resources. Because the majority of wreck locations are unknown, the impacts from historical and recent trawling are unknown. Anecdotal reports have indicated damage from fishing gear or fishing practices such as entanglement and snagging. The development of underwater technologies now affords the public the opportunity to locate and visit deep-water archaeological resources in the offshore environment. As with divers visiting accessible nearshore archaeological sites, the diving community must be educated on the regulations in place in order to protect these non-renewable resources. In the absence of a robust cultural resources education program, the maritime resources may be subject to vandalism, looting or damage.

Comment [kb142]: Check spelling: USS *Bugara*

Shallow shipwrecks are subject to severe environmental degradation resulting from natural processes such as ocean surge, north Pacific storms, strong currents and sea level rise (Figure 27). The *General Meigs* and the

Austria are two wrecks that are heavily impacted from natural destruction. However, there is no monitoring of changing conditions taking place.

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Figure 27. Wreck of the Lamut, a Russian merchant ship lost in 1943 near Quillayute Needles.

There have already been significant studies of both the late prehistoric and older archaeological sites, but much remains to be learned. To date, most of the effort has focused upon the more recent sites but knowledge of the sites associated with mid-Holocene shorelines is relatively limited. Although some collaborative monitoring of prehistoric sites is currently being conducted by Olympic National Park, the sanctuary and Makah Tribal Historic Preservation Officers (THPO), it is minimal and informal. However, data from other parts of the northwest coast suggest that there may be several different types of prehistoric archaeological resources in the sanctuary.

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Features such as late prehistoric fish traps and canoe runs are known to be present near the sanctuary and examples of either, or both, may be present within it. There is also the possibility that very ancient archaeological sites could be present on inundated Pleistocene and/or Early Holocene shorelines in the sanctuary. Given the absence of direct evidence, it is not possible to address the conditions of such resources (if they are present).

However, data from other parts of the northwest coast suggest that such resources are likely to be relatively durable but, like the case with the shipwrecks, prehistoric archaeological resources could be adversely affected by wave energy (particularly those in the intertidal zone and shorelines), commercial fishing activities and/or recreational divers. Prehistoric archaeological sites in the intertidal zone and shorelines are also subject to looting and other human disturbance, but little monitoring, education or enforcement takes place.

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There is considerable variation in the integrity of the known archaeological resources near the sanctuary. Nearly all of the late prehistoric sites associated with the modern shoreline are actively eroding. Data exist that document the loss of cultural deposits due to shoreline erosion, and it can be anticipated that rising sea levels will accelerate the rate of this loss. There has also been a significant loss of cultural deposits due to development in and near modern shoreline communities. As can be expected, development is less of a factor in the Olympic National Park. Also, although relatively limited, there has been some damage to cultural deposits along the modern shoreline due to vandalism. Finally, while knowledge of the integrity of the older mid-Holocene sites is more limited, the situation with these sites may be somewhat better. Since these sites are mostly located in nearshore forest settings, they are not being impacted by shoreline erosion. To the extent that historic impacts have damaged these sites, it has been from mechanisms such as logging and the construction of logging roads. Finally, given that these sites tend to be located in relatively remote places and are difficult to detect, there are no known cases of damage due to vandalism.

16. Do maritime archaeological resources pose an environmental hazard and how is this threat changing?

The sanctuary's inventory of known maritime archaeological resources suggests that the potential of shipwrecks in the sanctuary to pose an environmental hazard to sanctuary resources is minimal. Therefore, the situation is considered to be good and not changing.

The historic ship wrecks (at least 50 years old) in the sanctuary include both merchant and military vessels that sank during wartime, as well as older peacetime sinkings and groundings. However, for the purposes of wreck removal, salvage, and pollution response, most of the vessels in question would be post 1910 when Navy and commercial vessels began to shift from coal to oil bunkers (Dahl 2001). It is likely that earlier wrecks are no longer intact and did not carry substantial quantities of hazardous cargoes, or fuel oil as cargo.

Given the above criteria that constitute "historic wrecks" with potential to pose an environmental hazard, the sanctuary has 12 vessels in this category. [OCNMS Shipwreck Database](#)

Of these 12 vessels, only one, the *General Miegs*, has been identified as a source of oil leakage into the environment (Clark et al. 1975). However, no monitoring is currently taking place. There are occasional reports of mystery spills (oil sheen reported on the water from an unknown source). This can be an indication of a release from a wreck; however, this is not frequent or consistent enough to give a strong indication of a release from a submerged wreck. It is more likely that this is the result of an illegal discharge of oily ballast or other accidental and unreported release from a vessel (Helton 2003).

Comment [kb143]: See previous comment on Page 45 about localized sources of contamination

17. What are the levels of human activities that may influence maritime archaeological resource quality and how are they changing?

Human activities in the sanctuary have impacted maritime archaeological resources, but a general lack of assessment makes the trend undetermined. This is based on unauthorized salvaging that is taking place in the intertidal zone of the sanctuary and fishing activities and cable installations that are occurring in the offshore zone of the sanctuary.

Prehistoric sites in the intertidal zone and shorelines are subject to erosion – wave action and storm events uncover new materials every year. As resources are unearthed, they are subject to the threat of looting and vandalism. There is little monitoring, enforcement and education taking place to offset this threat.

Historical and recent bottom trawling can potentially impact maritime archaeological resources in the offshore zone of the sanctuary. Incidental damage to resources may occur from impact from bottom contact fishing gear (trawl, longlines, etc.), anchoring, and derelict fishing gear. However, because the majority of wreck locations are unknown, the impacts from historical and recent trawling are unknown. Recent closures of large areas of the sanctuary to bottom trawling will reduce these threats. The creation of new or larger areas restricting bottom contact gear may indirectly protect historical resources.

Also threatening resources in the offshore zone is the trenching of submerged communication cables. As has been mentioned, the installation and subsequent re-installation of an underwater cable in the sanctuary negatively impacts benthic habitat in the immediate vicinity of the cable, but the impacts are localized along the length of the cable. Maritime archaeological resources can be damaged if they are in the vicinity of the cable trenching.

Comment [kb144]: Disagree. Surveys would identify and avoid these things. No plough or ROV operation could survive hitting something like this, so surveys are spec'd to identify them for avoidance. Additionally, the width of impact of the cable and the installation operation is very narrow.

Other human activities affecting archaeological resources in the sanctuary include:

- With more sophisticated diving technology becoming available (rebreathers, affordable sidescan sonar, etc.), and the allure of treasure or artifacts, some treasure hunters are moving to deeper waters. Any vessel or site could be considered in danger of damage from scavenging or vandalism, but those known in local histories as carrying valuables, such as the steamer *Pacific*, should be located and evaluated soon. The threat of looting or vandalism increases as erosion and human use/access rates increase.
- Human use disturbance due to management activities (placement of wilderness privies) or lack of mitigating measures (use of informal social trails or campsites) potentially impact land-based sites that were once coastal. This threat is decreasing due to improved interagency consultation.
- Mineral extraction activities (such as oil or gas drilling, or submarine gravel mining). Intertidal maritime cultural resources could be imperiled by beach mining activities (gravel, sand, gold, etc.) as have been proposed in the past (State of Washington 2006). Significant timber cutting or inland mining has the potential to reduce watershed water quality and increase erosion to river and stream mouths, altering or imperiling intertidal and near-shore resources.
- The possibility of installation of offshore power generation facilities.

There is a lack of assessment, monitoring and enforcement on maritime archaeological resources in the sanctuary. However, the situation for archaeological resources on lands immediately adjacent to the sanctuary is somewhat better understood. Sites in these areas are relatively more accessible therefore monitoring is accomplished with more ease. These sites represent a variety of different conditions and are influenced by varying combinations of both natural processes and human activities. As such, some are much more threatened than others. The human activities threatening archaeological sites near the sanctuary are mostly related to development and terrestrial resource extraction (principally logging). Presumably, both types of activities will continue in nearshore areas for the foreseeable future. Shoreline erosion is also a serious threat to the survival of many archaeological sites and this effect will become more severe if sea levels rise continues to occur in the coming decades (Pendleton et al. 2004).

Comment [kb145]: The wreck of SS Pacific is mentioned - this particular shipwreck is the focus of an active effort by Odyssey Marine and other treasure hunting firms to locate it and salvage it, and this specific type of threat as well as Pacific's context should be more explicitly discussed. The wreck is an early example of a coastal steamer, a veteran of two gold rushes, and one of the greatest maritime disasters in the coast with tragic consequences that impacted both the US and Canada.

Comment [kb146]: wilderness or Wilderness privies?

Comment [kb147]: Confused if this is cited as an activity that is currently taking place, or could take place in the future if Sanctuary protections are reduced or removed?

Comment [kb148]: How might this directly impact archeological resources?

Comment [kb149]: And also offshore aquaculture. Would need good siting criteria and appropriate surveys to reduce the risk of aquaculture and energy projects.

Response to Pressures

The national marine sanctuary program has a mandate to maintain biological communities and protect and restore native habitats, populations, and ecological processes within its boundaries while allowing compatible uses. A sanctuary management plan establishes research, monitoring and resource protection priorities and programs to address key threats or pressures. In addition to guidance provided through the management plan, sanctuary regulations specific to each site establish a range of activities that are prohibited or are authorized through a sanctuary permit if it can be demonstrated that the activity supports a sanctuary management objective and it will not substantially injure sanctuary resources. Olympic Coast sanctuary staff have worked with others in the program to review concerns and develop consistent policies associated with activities common to multiple sanctuaries, such as submarine cable installation, alternative energy development, and anchoring of research buoys.

In addition to sanctuary authorities, other federal, state, and tribal authorities, regulations, and policies govern the conduct of specific activities within the sanctuary. The nature of overlapping jurisdictions and authorities requires coordination and collaboration between resource managers to achieve marine conservation objectives. The sanctuary Superintendent must balance the diverse interests of citizens, organizations and partner agencies and make informed decisions that protect resources without unfairly hurting sanctuary users and stakeholders. To better understand those interests and enlist help from those we serve, the sanctuary Superintendent meets regularly with an Advisory Council that is comprised of representatives of Indian tribes, state and local governments, other federal agencies, industry, conservation organizations and citizens. In 2007, the coastal treaty Indian tribes, State of Washington and the Olympic Coast sanctuary established an Intergovernmental Policy Council to provide a forum for the tribal, state and federal governments to coordinate activities within the sanctuary.

This section describes current responses and research and resource protection initiatives addressing selected pressures. Current responses are based on implementation of the 1994 sanctuary management plan and regulations, as well as specific programs to address threats which have emerged since the 1994 management plan. Strategies to address prioritized threats or pressures will be further evaluated and adapted during the management plan review process, scheduled to begin in September 2008.

WATER QUALITY

Water Quality Monitoring

The sanctuary strives to understand, maintain, and improve water quality within the sanctuary (Figure 28) and regulations prohibit discharges into sanctuary waters. Since 2000, nearshore oceanographic moorings have been deployed to measure water temperature and, as funding has allowed, the program has been expanded to cover a greater area and include additional sensors to measure salinity, dissolved oxygen, currents, plankton density, and other standard environmental parameters (Figure 29). Information from these moorings, as well as data collected from periodic surveys from NOAA vessels, will lead to a better understanding of the links between the physical, chemical, and biological processes in productive nearshore waters and the connections with offshore and deeper waters. In turn, these data are useful to federal, tribal, university, and state-sponsored studies of harmful algal blooms, helping to assess potential threats to human health, and to that of birds and other marine mammals. These data are also used to correlate with intertidal invertebrate and algae studies, assist in oil spill response, and improve our understanding of hypoxic conditions that have been measured off the Washington and Oregon coasts in recent years. In an effort to establish baseline levels of persistent organic pollutants (industrial contaminants that remain for decades and can accumulate in organisms) in the ecosystem, the sanctuary has led and collaborated on several projects to measure contaminant levels in sediments, invertebrates, and sea otters, against which future data can be compared.

Comment [kb150]: Do a word search on "comprise" and "compose". They are used interchangeably and largely incorrectly the Advisory Council is "composed" of.



Figure 28. Water quality data is collected by lowering equipment into the ocean to sample a water column profile from the bottom to the surface. This rosette is a series of instruments on a metal frame, that measure temperature, pressure, salinity, oxygen content, algae content, and other factors, and chambers to collect water samples at pre-determined depths. (Photo: Olympic Coast sanctuary)



Figure 29. Remote sensors on fixed moorings collect information on physical and biological properties of sanctuary waters at thirteen locations that were selected to capture variability in nearshore ocean processes.

Vessel Discharges

Sewage and graywater discharges from large vessels (300 gross registered tons or more), including cruise ships and container ships are a concern in state and sanctuary waters. In 2004 a Memorandum of Understanding between Washington State, the Port of Seattle, and the cruise ship industry included an agreement to avoid dumping of biosolids (sewage sludge or solids from wastewater treatment systems) inside 12 nautical miles from shore. In 2007, this agreement was expanded to avoid such discharge in all sanctuary waters. According to Port of Seattle statistics, approximately 150 cruise ship trips between Seattle and Alaska occurred in 2007, and each week-long trip generated about 28,000 gallons of sewage sludge. Cruise ships transiting the Olympic Coast sanctuary are not prohibited from discharging minimally treated sewage, graywater, and blackwater in accordance with state and federal law. Consequently, the rapidly expanding cruise ship industry in the Pacific Northwest may have growing potential to impact sanctuary waters if not properly managed.

http://www.ecy.wa.gov/programs/wq/wastewater/cruise_mou/MOU%203rd%20Amendment%205-25-07%20final.pdf

Area to Be Avoided Monitoring and Compliance

A catastrophic discharge of oil from a maritime accident poses the single greatest risk to the sanctuary. The Olympic Coast sanctuary worked with the U.S. Coast Guard and the International Maritime Organization to establish an Area to be Avoided (ATBA) as a buffer and provide greater response time for assistance to foundering vessels along this rocky and environmentally sensitive coast (Figure 30). All ships transiting the area and carrying cargoes of oil or hazardous materials, and all ships 1,600 gross tons and larger, are requested to avoid this area. In addition, sanctuary staff participated in multi-party discussions that led to modifications to the vessel traffic lanes at the western entrance to the Strait of Juan de Fuca in an effort to increase the safety of commercial vessel transits through this busy area.

Since 1998 the sanctuary has been obtaining monthly vessel position files from the Canadian Coast Guard's radar site on Vancouver Island (Galasso 2000). This information is displayed as tracklines on a geographic information system. The data also includes vessel attributes that allows spatial and temporal analysis of behavior and trends, based on vessel characteristics. The Marine Exchange of Seattle has also been providing the sanctuary with data from the Automated Identification System to augment vessel transit monitoring. The sanctuary uses this information to create monthly transit plots of non-complying vessels, which are used as part of an outreach effort to the marine industry. Letters are sent out under signature of the sanctuary Superintendent and the Coast Guard Captain of the Port to non-complying vessels observed within the ATBA. The response by the maritime industry has been very favorable, with an approximated compliance rate of 98.8% in 2007.

<http://olympiccoast.noaa.gov/protection/atba/welcome.html>

Comment [kb151]: It seems to me that this fuller discussion of the ATBA should be moved up to an earlier question section where the reader could benefit from knowing the details. This does not obviate discussion here but the information is important and represents a singular accomplishment of the OCNMS management within the last decade.

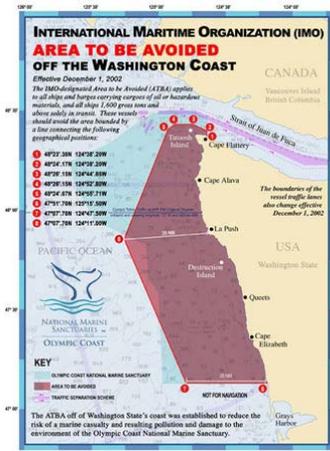


Figure 30. Map of the Olympic Coast sanctuary (in blue) and Area to be Avoided (in red). (Flyer: NOAA Olympic Coast National Marine Sanctuary)

Oil Spill Prevention

The sanctuary works closely with the U.S. Coast Guard, Washington Department of Ecology, Makah Office of Marine Safety and other organizations on oil spill response and preparedness by participating in oil spill drills, supporting a rescue tug stationed in Neah Bay, participating in discussions of alternative response technologies, prioritizing allocation of oil spill restoration funds, and reviewing proposed legislation, regulations, and documentation. Starting in 1999, Washington State has funded a seasonal rescue tug stationed at Neah Bay to quickly respond to vessels that may need assistance. As of February 2008, the tug has escorted, stood by or assisted 40 ships that were disabled or had reduced maneuvering or propulsion capability while fishing or transporting oil and other cargo through the sanctuary and along the Strait of Juan de Fuca.

The sanctuary also has developed a site-specific Sanctuaries Hazardous Incident Emergency Logistics Database System (SHIELDS), which is designed to aid in spill response by providing a comprehensive reference and resource data tool.

TEXT BOX

Comment [kb152]: Funding for this tug was supported by the work of the Oil Spill Advisory Council and the Ocean Policy Work Group. The funding for the tug (\$400,000 for the 07-09 biennium) comes from the Aquatic Lands Enhancement Account, or ALEA, which is funded by Washington State Department of Natural Resources' management on state owned aquatic lands. Current funding ends on June 30th 2009 and new funds would be required to continue this.

Washington State Department of Ecology – Spill Response Rescue Tug at Neah Bay, WA

- Since 1999, a standby rescue tug has been stationed seasonally, generally October through March, in Neah Bay.
- The rescue tug has responded to 40 incidents of vessels in distress on the outer coast and the western Strait of Juan de Fuca.
- Reasons for tug responses include reduced or lost propulsion and/or steerage, drift groundings, powered groundings, collisions, broken tow wires, fires, explosions and structural failures.
- During the winter of 2007-8, the rescue tug was called out in response to six vessels in distress.
- Because of the high volume of shipping traffic, the remoteness of the outer coast and difficulty with implementing effective on-water response to a spill, and the potential devastating effects of an oil spill on tribal and federally protected shores, advocates have strongly advocated for permanent, year-round funding for a rescue tug in Neah Bay.
- In March 2008, the Washington State Legislature for the first time approved funding for year-round rescue tug contract services anticipated to extend through June 2009.
- Federal legislation requiring the shipping industry to pay for year-round, standby rescue tug service at Neah Bay has been introduced by Senator Maria Cantwell.

HABITAT

Habitat Mapping

The sanctuary does not directly manage fisheries within sanctuary waters; however, sanctuary research informs fisheries management entities, particularly on habitats within sanctuary boundaries. Starting in 2000, the sanctuary embarked on a project to characterize seafloor habitats within the sanctuary, using advanced acoustic and optical technologies to create digital images, and verifying those images using remotely operated vehicles and drop-cameras (Figure 31). The imagery helps to characterize the types, distribution, and abundance of seafloor habitats, and groundtruthing helps to verify classification results, as well as to provide new habitat information. Furthering this research was a key recommendation of Washington's Ocean Action Plan (The Office of the Governor 2006) and is a priority for the Intergovernmental Policy Council. These efforts can support crucial management issues, such as protecting critical habitats, identifying areas of undisturbed deep-sea coral and sponge communities, or examining fishing regulations to aid in the recovery of declining fish populations.

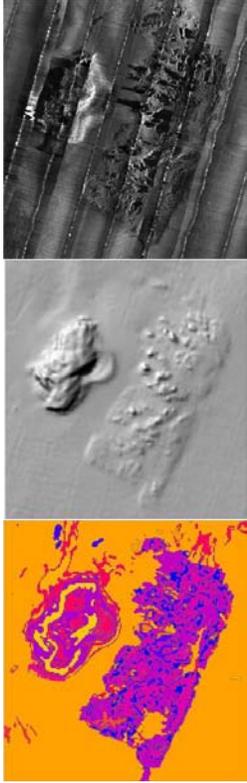


Figure 31. Using texture analysis algorithms, information from side scan sonar imagery (top plate) and multibeam bathymetry (middle plate) are combined to create classified habitat images (bottom plate). (Image: Olympic Coast sanctuary)

Deep Sea Coral Research and Conservation

In 2004 and 2006, sanctuary staff, in partnership with the National Centers of Coastal Ocean Science conducted side-scan and video surveys of offshore habitats. The focus of this initiative was to document the presence of hard-bottom habitats in deep-water areas of the sanctuary and video survey any associated living communities. Hard substrates often harbor diverse assemblages of invertebrates and fish, including corals, sponges, and other extremely slow-growing fauna that are particularly sensitive to human disturbances. Several species of corals and sponges were documented at 14 of the 15 sites surveyed in 2006; sites located both inside and outside of the protective EFH Conservation Area (Olympic 2). Numerous gorgonians, two stony coral species (*Lophelia pertusa* and *Desmophyllum dianthus*) and small patches of the reef building sponge (*Farrea occa*) were found (Figure 32). Some anthropogenic disturbance to these seafloor communities was also documented. Future explorations will continue to improve our understanding of deep coral and sponge habitat, its distribution and ecosystem functions, and potential pressures to that system (Brancato et al. 2007).

<http://sanctuaries.noaa.gov/science/conservation/bowlby.html>

<http://coastalscience.noaa.gov/>

<http://www.nmfs.noaa.gov/>



Figure 32. Stony coral *Lophelia pertusa*, characteristic of deepwater coral assemblages in the North Atlantic but less documented in the Pacific, was recently found in the Olympic Coast sanctuary at several locations.

Derelict Fishing Gear and Marine Debris

In 2005, the sanctuary was awarded funds from NOAA's Marine Debris Program for a pilot project to identify and remove derelict fishing gear in the northern part of the sanctuary, as well as to develop safe operating protocols for gear removal operations while working in the open ocean environment (Figure 33). This pilot project was a partnership with the Makah Tribe with a goal to build capacity in an affected community to conduct future derelict gear removal projects. Fishery managers and fishermen were interviewed, multiple target areas were surveyed by sonar and divers, and three abandoned fishing nets and several crab pots were located and recovered. In general, derelict fishing gear was not found to be a pervasive problem in the study area.

<http://response.restoration.noaa.gov/>



Figure 33. Derelict gear is removed from the ocean floor. This net contained numerous dead animals including seabirds, fish, harbor seals, harbor porpoise, and a California sea lion. (Photo: Olympic Coast sanctuary)

Comment [kb153]: The conclusions about fishing nets and lost crab gear seems to be different where "ghost fishing" is discussed in an earlier section of the report. One gets the impression earlier that these impacts are pervasive. The picture in Figure 33 documenting the content of mammals and birds raises another set of issues. It would be well to have some text explaining OCNMS conclusions about the overall effect of lost gear on Sanctuary organisms.

Another grant the sanctuary received from NOAA's Marine Debris program in 2007 supported collaborative development of a long-term strategy to remove accumulated marine debris from the outer coast of Washington State, beaches adjacent to the sanctuary and beyond. State and federal agency representatives joined with Native American tribes and non-government organizations to outline a strategy that addresses both the remote, wilderness shores of Olympic National Park and tribal reservations and the more accessible areas where beach driving facilitates removal of marine debris. Partner agencies formed a new organization, Washington Clean Coast Alliance, to coordinate public outreach, volunteer coordination, and event planning, as a successor to the private citizen (deceased) who was largely responsible for cleanup efforts dating back to 2000. The Alliance's first event in April 2008 was a great success, scheduled to coincide with Earth Day. More than 1,100 volunteers joined the effort and enjoyed the beach while removing nearly 23 tons of debris.

Fiber Optic Cable Permit Compliance and Monitoring

In 2006, the Pacific Crossing responded to sanctuary and tribal concerns over improper burial of the Pacific Crossing PC-1 fiber optic submarine telecommunication cables by reinstalling the cable through the sanctuary. The goal of this effort was to minimize risks of interactions with fishing gear, reduce cable damage, and to minimize ongoing impacts to seafloor habitats. Sanctuary regulations generally prohibit seafloor disturbances. Post-installation assessment revealed improved cable burial, yet the cable remained unburied and suspended in limited areas, which confirms the difficulty of cable burial where the seafloor has boulders, compacted subsurface deposits, and bedrock (Tyco 2006). Under conditions in their sanctuary permit, Pacific Crossing will mitigate risks at these areas through directed outreach to bottom trawl fishers to make them aware of cable locations and burial state and reducing interactions with fishing activities. The sanctuary has also implemented a monitoring program that has provided important information on the rate of seafloor habitat recovery following disturbance associated with cable installation, and to which will support inform future decision-making on similar proposals.

LIVING RESOURCES

Groundfish Protection/Designation of Essential Fish Habitat

Recent significant conservation actions that have taken place within the sanctuary include the establishment of conservation areas to protect groundfish habitat and to minimize the bycatch of overfished species. The Pacific Fishery Management Commission (PFMC) and NOAA's National Marine Fisheries Service (NMFS) designated multiple areas along the west coast as essential fish habitat areas with specific fishing restrictions. There were five EFH areas adopted off the coast of Washington that are closed to non-tribal bottom trawl fishing. One unit, the Olympic 2 EFH area closure, is located within the boundary of the sanctuary (Figure 34) and is closed to all types of non-tribal bottom trawl fishing gear but not all types of bottom contact gear, such as longline gear. Olympic 2 EFH covers 7% of the sanctuary area. The EFH measures also included a prohibition of bottom trawl activity deeper than 700 fathoms West Coast-wide. The EFH areas were implemented through amendment 19 to the Pacific Coast Groundfish Fisheries Management Plan and went into effect in 2006. In addition, Rockfish Conservation Areas (RCAs), are temporary large-scale closed areas that extend along the entire length of the U.S. West Coast that are expected to be in place until key overfished rockfish species recover (i.e., 80 or more years). The RCA boundaries approximate particular depth contours that can change during the year and are designed to minimize opportunities for vessels to incidentally take overfished rockfish by eliminating fishing in areas where and when those overfished species are likely to co-occur with more healthy stocks of groundfish. In general, within the sanctuary waters, the non-tribal trawl RCA extends from 75 fathoms to 150 fathoms year-round; this RCA may become more restrictive (i.e., extend to 200 fathoms on the seaward boundary, or in to the shore for the shoreward boundary) throughout the fishing year as additional measures are required to avoid overharvest. The non-tribal non-trawl RCA (i.e., the RCA for gears other than trawl) is closed from the shore seaward to 100 fathoms year-round. This RCA boundary typically does not change during the season. In addition, there are specific area closures within the sanctuary that are permanent in nature and pertain to specific fisheries—there is a large commercial non-trawl RCA (commonly referred to as “tabletop”), a large recreational RCA (“C-shaped” area), and a smaller RCA that applies to the salmon troll fishery (commonly called

Comment [kb154]: There is really good information in the Groundfish Protect/ section here that really should be included in the discussions of fisheries and management measures above. The reader cannot be expected to synthesize across all of the different sections of the report where some aspect of fisheries is parsed out. The CR report structure does not lend itself to being reader friendly. The CR report authors could assist by front loading the critical details into earlier sections and cross referencing where that may not be feasible.

the "sharkfin"). It will be important to monitor the EFH and RCAs to detect changes in physical habitat and groundfish populations.

<http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/>

<http://www.nwr.noaa.gov/Groundfish%2DHalibut/Groundfish%2DFishery%2DManagement/Groundfish%2DClosed%2DAreas/>

<http://www.pcouncil.org/groundfish/gffmp/gfa19.html>

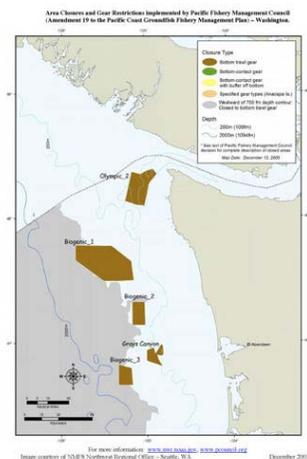


Figure 34. EFH area closures to protect Pacific Coast groundfish habitat - Washington. Only Olympic 2 lies within the Olympic Coast sanctuary boundaries

Intertidal Habitats

In response to growing concerns about impacts of increased visitation to the shores, sanctuary and Olympic National Park staff cooperated in an effort to examine the threats and opportunities to protect intertidal resources along the Olympic Coast. Science experts and citizen representatives outlined activities that are potentially degrading to intertidal areas and disturbing to wildlife, and identified a set of ecologically significant habitats and range of potential management actions, including possible establishment of no-harvest areas, or intertidal reserves. These sites would provide long-term protection of the federally owned shores as human use increases. Intertidal reserves covering roughly 30% of the park's shore were incorporated into the park's Final General Management Plan released in March 2008 and will be subject to existing tribal treaty use of such zones.

<http://parkplanning.nps.gov/projectHome.cfm?parkId=329&projectId=10233>

Sea Otter Health Study

In 2001 and 2002, the sanctuary joined with the U.S. Fish and Wildlife Service and U.S. Geological Service to conduct focused research on the health of sea otters off Washington State (Brancato et al. 2006). This study was a response to suspicions that increased disease susceptibility resulting from contaminant-induced immunosuppression may be responsible for decline of the California sea otter population, where infectious disease and cardiac disease have been significant mortality factors. With range expansion possible to the south along the Washington coast and east into the Strait of Juan de Fuca, the Washington sea otter population is facing new or additional risks due to increased anthropogenic influences and a different ecosystem. Unlike other marine mammals that migrate extensively, sea otters provide an unusual opportunity to study a mid- to high-

trophic level marine consumer inhabiting highly industrial to extremely remote habitats throughout its occurrence in the Northeast Pacific. Because both the sea otters and their principle prey are relatively sedentary, their contaminant burdens should reflect localized contamination. In 2001 and 2002, 32 sea otters were captured, of which 28 were implanted with transmitters to track their movements and liver and blood samples were collected to evaluate contaminant and pathogen exposure. The results indicate low levels of contaminants in general, but high levels of exposure to morbillivirus and *Toxoplasma*, the latter of which has been a significant cause of mortality in Southern sea otters in California.

Wildlife Disturbance

To protect seabirds, migratory waterfowl, endangered species, and marine mammals from disturbance and harassment, a sanctuary regulation prohibits flights of motorized aircraft at less than 2,000 feet within 1 nautical mile of national wildlife refuge islands or the shore, with exceptions for tribal timber operations on reservation lands. To improve familiarity and compliance with this regulation in the recreational pilot community, the sanctuary implemented an outreach program that focused on small aircraft at regional air strips. Sanctuary representatives have attended regional air shows to meet local pilots, talk about the sanctuary's resource protection concerns, and distribute fliers and posters that explain the regulation and its purpose.

Invasive Species Mitigation and Monitoring

As mentioned above, Washington State has implemented regulations to minimize the risk of invasive species introductions that require all vessels 300 gross tons or more travelling from foreign ports to exchange of ballast water in the open ocean or to treat the ballast water before discharge to state waters, and to submit ballast water reports. In addition, ships considered U.S. coastal traffic, including Canadian waters, must exchange ballast water no closer than 50 nm off shore. The Marine Exchange of Puget Sound reports very high compliance rates with these requirements.

The sanctuary has sponsored two seasons of Rapid Assessment (2001 and 2002) of intertidal areas, bringing together a team of taxonomic experts to survey for and identify non-indigenous species (NIS) as well as inventory native species. Those surveys documented 10 non-indigenous invertebrate and algal species and, in a joint study with the Smithsonian Environmental Research Center in 2003, two invasive ascidians and one invasive barnacle were also documented (deRivera et al. 2005). A third Rapid Assessment to cover additional areas of the coastline will be conducted when funding is available. Rigorous monitoring and early detection of NIS are important tools in minimizing the harmful effects of non-native invaders.

The Olympic National Park and sanctuary staff also conduct long-term intertidal monitoring of both sandy and rocky habitats in order to inventory invertebrates and identify trends in populations. This monitoring program, though not specifically designed to address non-indigenous species, serves as an early warning detection program for non-native species that may become invasive (rapidly reproducing, aggressive and/or highly competitive with native species) within the region.

The sanctuary also partners with the Washington State Department of Fish and Wildlife and the Makah Tribe in monitoring for the invasive European green crab at sites in Neah Bay and Makah Bay. This non-native crab competes with native species for habitat and food and has proved quite destructive in other areas of the country. To date, no European green crabs have been detected along the sanctuary coast or in Neah Bay, although green crabs have been found just south of the sanctuary boundary in Willapa Bay and also north of the sanctuary along Vancouver Island, BC, Canada.

Military Activities

The Navy is currently developing two EIS/OEIS documents proposed federal actions, one to extend the Quinault Underwater Training Range (OUTR) and another to provide for current, emerging, and future Fleet training activities in the Northwest Training Range Complex. These multi-year assessments will include opportunities for public input and comment, and are expected to be completed in 2009. Sanctuary staff will be active participants

Comment [kb155]: Also worth referencing Washington's Invasive Species Council and Aquatic Nuisance Species Committee. See previous comment and links provided on Page 16

in the environmental assessment process to evaluate potential impacts to sanctuary resources and develop appropriate protection measures. The proposed extension of the QUTR site could involve the continued testing of non-weaponized equipment in and near the sanctuary.

http://www-keyport.kpt.nuwc.navy.mil/EIS_Documents.htm

<http://www.nwtrangecomplexeis.com/EIS.aspx>

MARITIME HERITAGE

Coastal archaeological resources may be negatively impacted by rising sea levels and environmental forces. Under the National Historic Preservation Act, federal agencies are required to inventory and assess resources to determine what, if any, management actions could be taken in an effort to preserve critical sites and material. While programmatic funding has been limited, the sanctuary has participated in individual projects, using small grant funding and staff time as available. Examples of shipwreck studies include NMSP nationally-funded shipwreck surveys of Destruction Island, Quillayute Needles, La Push and Cape Flattery vicinities and intertidal surveys of the wreck *Austria* conducted with community members and graduate students. Examples involving prehistoric resources include a surface survey of Tatoosh Island, conducted by the Makah THPO (with sanctuary staff assistance), test pit excavation led by Makah THPO on paleoshoreline sites on the Makah Reservation (including one excavation funded by a NMSP Maritime Heritage Program minigrant), and periodic visual assessments of known prehistoric sites undertaken cooperatively with the Makah THPO and archeologists from Olympic National Park. In addition to these activities, sanctuary staff frequently consults with partner organizations as incidents or specific threats arise.

CLIMATE CHANGE

Changing climatic conditions can not be managed at the level of the sanctuary. However, the sanctuary can assist in documenting the direct effects of climatic changes, by recording through time oceanographic properties such as water temperature and dissolved oxygen levels. Using remote moorings the sanctuary records ocean conditions continuously for the duration of the field season and, with improved equipment and mooring apparatus, could extend monitoring efforts throughout the year. These data can be shared with other researchers, such as fisheries biologists, to better understand the effects of ocean conditions on these economically important resources. The sanctuary also indirectly assesses responses to climate change in living resources through long-term monitoring of marine birds and mammals, intertidal organisms and invasive species. Associations between ocean conditions, possibly driven by climate change, and the presence of harmful algal blooms or hypoxic conditions are explored through both sanctuary programs and collaborative efforts that include Olympic Region Harmful Algal Bloom consortium (ORHAB), Ecology and Oceanography of Harmful Algal Blooms (ECOHAB), and Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO).

Coastal archaeological resources may be negatively impacted by rising sea levels. These resources, most on national park and Indian reservation lands, should be inventoried and assessed in order to help managers interpret what, if any, management actions could be taken in an effort to preserve critical sites and material. The sanctuary recognizes this need and will continue to facilitate and conduct these inventories.

Concluding Remarks

This report is the first attempt to describe the relationship between human pressures and the status and trends of natural resources within Olympic Coast National Marine Sanctuary (OCNMS). By doing so, this condition report helps to identify the pressures and their impacts on marine ecosystems that may warrant monitoring and remediation in the years to come. Overall, the resources protected by OCNMS appear to be in relatively good to fair condition. Of the 17 resources or questions identified, 3 appear to be in good condition, 6 appear to be in good/fair condition, and 8 appear to be in fair condition. None of the resources identified ~~was~~ listed in either fair/poor or poor condition.

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OCNMS has a history of collaborative scientific research among Federal, Tribal and State agencies, as well as academic and non-government organizations, with studies designed to develop an improved understanding of the ecosystem to inform management and protect the sanctuary's natural resources. In recent years, research conducted at OCNMS has become focused less on simple characterization and more on oceanographic processes, biogeographic distribution, and sources and fates of individual organisms and their contributions to the ecosystem as a whole. It is important to understand the factors that help to structure the resources of the sanctuary, and how uses of its resources may affect their health, viability and longevity. The information presented in this report enables managers to look back and consider past changes in the status of the resources, and provides guidance for continued resource management as future challenges are presented. This is especially important since OCNMS will soon begin a process to review its management plan, which will enable us to better understand, protect and utilize the nation's marine environment.

Acknowledgements

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The report benefited significantly from a preliminary review, and we are grateful for comments received on a draft of the report provided by members of the Scientific and Statistical Support Committee, Habitat Committee, and Groundfish Advisory Panel of the Pacific Fisheries Management Council, and the OCNMS Advisory Council.

Our grateful thanks are also extended to the reviewers of this document *Name Peer reviewers and affiliation*

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Additional Resources

American Park Network, History of Olympic National Park:
<http://www.americanparknetwork.com/parkinfo/ol/history/>

Big Eddy International Marine Ecosystem Initiative: <http://www.bigeddy.net/>

Channel Islands National Marine Sanctuary, Bridging Our Past Through Shipwrecks:
<http://channelislands.noaa.gov/shipwreck/shiphome.html>

Coastal Observation and Seabird Survey Team: <http://www.coasst.org/>

Ecology and Oceanography of Harmful Algal Blooms: <http://www.ecohabpnw.org/>

Intergovernmental Policy Council: http://sanctuaries.noaa.gov/news/features/0107_octribes.html

Makah Cultural and Research Center: <http://www.makah.com/mcrchome.htm>

Makah Tribe: <http://www.makah.com/>

Marine Conservation Biology Institute: <http://www.mcbi.org/>

Marine Protected Areas of the United States: <http://www.mpa.gov/>

NOAA's Climate Program Office: <http://www.climate.noaa.gov/>

NOAA's National Center Centers for Coastal Ocean Science: <http://coastalscience.noaa.gov/>

NOAA's National Marine Fisheries Service: <http://www.nmfs.noaa.gov/>

NOAA's National Marine Fisheries Service Northwest Regional Office: <http://www.nwr.noaa.gov/>

NOAA's National Marine Sanctuary Program: <http://sanctuaries.noaa.gov/>

NOAA's Ocean Explorer: <http://www.oceanexplorer.noaa.gov/>

NOAA's Office of Ocean Exploration and Research: <http://explore.noaa.gov/>

NOAA's Office of Response and Restoration: <http://response.restoration.noaa.gov/>

Northwest Association of Networked Ocean Observing Systems: <http://www.nanoos.org/>

Northwest Indian Fisheries Commission: <http://www.nwifc.wa.gov/>

Northwest Straits Commission: <http://www.nwstraits.org/>

Ocean Futures Society: <http://www.oceanfutures.org/>

Olympic Coast Alliance: <http://www.olympiccoast.org/>

Olympic Coast National Marine Sanctuary: <http://olympiccoast.noaa.gov/>

Olympic National Park: <http://www.nps.gov/olym/>

Olympic Region Harmful Algal Bloom: <http://www.orhab.org/index.html>

Oregon State University: Oceanic and Atmospheric Sciences: <http://www.coas.oregonstate.edu/>

Pacific Fishery Management Council: <http://www.pcouncil.org/>

Pacific Northwest Seismic Network: <http://www.pnsn.org/>

Partnership for Interdisciplinary Studies of Coastal Oceans: <http://www.piscoweb.org/>

Quileute Tribe: <http://www.quileutetribe.org/>

U.S. Fish & Wildlife Service: Pacific Region: <http://www.fws.gov/pacific/>

U.S. Geological Survey, Cascades Volcano Observatory: <http://vulcan.wr.usgs.gov/>

U.S. Geological Survey, Tsunamis and Earthquake Research: <http://walrus.wr.usgs.gov/tsunami/>

U.S. Geological Survey: <http://www.usgs.gov/>

Washington Department of Fish and Wildlife: <http://wdfw.wa.gov/home.htm>

Washington Invasive Species Coalition: <http://www.invasivespeciescoalition.org/>

Washington Maritime National Wildlife Refuge Complex:
http://www.fws.gov/pacific/refuges/field/WA_maritime.htm

Washington Sea Grant Program: <http://www.wsg.washington.edu/>

Washington State Department of Ecology: <http://www.ecy.wa.gov/>

Washington State Department of Ecology: <http://www.ecy.wa.gov/>

Washington State Department of Natural Resources: <http://www.dnr.wa.gov/>

Washington State Ocean Policy Work Group: <http://courses.washington.edu/oceangov/OPWG.html>

Appendix A: Rating Scheme for System-Wide Monitoring Questions

The purpose of this appendix is to clarify the 17 questions and possible responses used to report the condition of sanctuary resources in "Condition Reports" for all national marine sanctuaries. Individual staff and partners utilized this guidance, as well as their own informed and detailed understanding of the site to make judgments about the status and trends of sanctuary resources.

The questions derive from the National Marine Sanctuary Program mission, and a system-wide monitoring framework (National Marine Sanctuary Program, 2004) developed to ensure the timely flow of data and information to those responsible for managing and protecting resources in the ocean and coastal zone, and to those that use, depend on, and study the ecosystems encompassed by the sanctuaries. They are being used to guide staff and partners at each of the 14 sites in the sanctuary system in the development of this first periodic sanctuary condition report. The questions are meant to set the limits of judgments so that responses can be confined to certain reporting categories that will later be compared among all sites, and combined. Evaluations of status and trends may be based on interpretation of quantitative and, when necessary, non-quantitative assessments and observations of scientists, managers and users.

Following a brief discussion about each question, statements are presented that were used to judge the status and assign a corresponding color code. These statements are customized for each question. In addition, the following options are available for all questions: "N/A" - the question does not apply; and "Undet." - resource status is undetermined.

Symbols used to indicate trends are the same for all questions: "▲" - conditions appear to be improving; "▬" - conditions do not appear to be changing; "▼" - conditions appear to be declining; and "?" - trend is undetermined.

Question 1 (Water/Stressors): Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality and how are they changing?

This is meant to capture shifts in condition arising from certain changing physical processes and anthropogenic inputs. Factors resulting in regionally accelerated rates of change in water temperature, salinity, dissolved oxygen, or water clarity, could all be judged to reduce water quality. Localized changes in circulation or sedimentation resulting, for example, from coastal construction or dredge spoil disposal, can affect light penetration, salinity regimes, oxygen levels, productivity, waste transport, and other factors that influence habitat and living resource quality. Human inputs, generally in the form of contaminants from point or non-point sources, including fertilizers, pesticides, hydrocarbons, heavy metals, and sewage, are common causes of environmental degradation, often in combination rather than alone. Certain biotoxins, such as domoic acid, may be of particular interest to specific sanctuaries. When present in the water column, any of these contaminants can affect marine life by direct contact or ingestion, or through bioaccumulation via the food chain.

[Note: Over time, accumulation in sediments can sequester and concentrate contaminants. Their effects may manifest only when the sediments are resuspended during storm or other energetic events. In such cases, reports of status should be made under Question 7 – Habitat contaminants.]

Good	Conditions do not appear to have the potential to negatively affect living resources or habitat quality.
Good/Fair	Selected conditions may preclude full development of living resource assemblages and habitats, but are not likely to cause substantial or persistent declines.

- Fair** Selected conditions may inhibit the development of assemblages, and may cause measurable but not severe declines in living resources and habitats.
- Fair/Poor** Selected conditions have caused or are likely to cause severe declines in some but not all living resources and habitats.
- Poor** Selected conditions have caused or are likely to cause severe declines in most if not all, living resources and habitats.

Question 2 (Water/Eutrophic Condition): What is the eutrophic condition of sanctuary waters and how is it changing?

Nutrient enrichment often leads to planktonic and/or benthic algae blooms. Some affect benthic communities directly through space competition. Overgrowth and other competitive interactions (e.g., accumulation of algal-sediment mats) often lead to shifts in dominance in the benthic assemblage. Disease incidence and frequency can also be affected by algae competition and the resulting chemistry along competitive boundaries. Blooms can also affect water column conditions, including light penetration and plankton availability, which can alter pelagic food webs. Harmful algal blooms often affect resources, as biotoxins are released into the water and air, and oxygen can be depleted.

- Good** Conditions do not appear to have the potential to negatively affect living resources or habitat quality.
- Good/Fair** Selected conditions may preclude full development of living resource assemblages and habitats, but are not likely to cause substantial or persistent declines.
- Fair** Selected conditions may inhibit the development of assemblages, and may cause measurable but not severe declines in living resources and habitats.
- Fair/Poor** Selected conditions have caused or are likely to cause severe declines in some but not all living resources and habitats.
- Poor** Selected conditions have caused or are likely to cause severe declines in most if not all living resources and habitats.

Question 3 (Water/Human Health): Do sanctuary waters pose risks to human health and how are they changing?

Human health concerns are generally aroused by evidence of contamination (usually bacterial or chemical) in bathing waters or fish intended for consumption. They also emerge when harmful algal blooms are reported or when cases of respiratory distress or other disorders attributable to harmful algal blooms increase dramatically. Any of these conditions should be considered in the course of judging the risk to humans posed by waters in a marine sanctuary.

Some sites may have access to specific information on beach and shellfish conditions. In particular, beaches may be closed when criteria for safe water body contact are exceeded, or shellfish harvesting may be prohibited when contaminant loads or infection rates exceed certain levels. These conditions can be evaluated in the context of the descriptions below.

- Good** Conditions do not appear to have the potential to negatively affect human health.
- Good/Fair** Selected conditions that have the potential to affect human health may exist but human impacts have not been reported.
- Fair** Selected conditions have resulted in isolated human impacts, but evidence does not justify widespread or persistent concern.
- Fair/Poor** Selected conditions have caused or are likely to cause severe impacts, but cases to date have not suggested a pervasive problem.

Poor Selected conditions warrant widespread concern and action, as large-scale, persistent, and/or repeated severe impacts are likely or have occurred.

Question 4 (Water/Human Activities): What are the levels of human activities that may influence water quality and how are they changing?

Among the human activities in or near sanctuaries that affect water quality are those involving direct discharges (transiting vessels, visiting vessels, onshore and offshore industrial facilities, public wastewater facilities), those that contribute contaminants to stream, river, and water control discharges (agriculture, runoff from impermeable surfaces through storm drains, conversion of land use), and those releasing airborne chemicals that subsequently deposit via particulates at sea (vessels, land-based traffic, power plants, manufacturing facilities, refineries). In addition, dredging and trawling can cause resuspension of contaminants in sediments.

Good Few or no activities occur that are likely to negatively affect water quality.

Good/Fair Some potentially harmful activities exist, but they do not appear to have had a negative effect on water quality.

Fair Selected activities have resulted in measurable resource impacts, but evidence suggests effects are localized, not widespread.

Fair/Poor Selected activities have caused or are likely to cause severe impacts, and cases to date suggest a pervasive problem.

Poor Selected activities warrant widespread concern and action, as large-scale, persistent, and/or repeated severe impacts have occurred or are likely to occur.

Question 5 (Habitat/Abundance/Distribution): What are the abundance and distribution of major habitat types and how are they changing?

Habitat loss is of paramount concern when it comes to protecting marine and terrestrial ecosystems. Of greatest concern to sanctuaries are changes caused, either directly or indirectly, by human activities. The loss of shoreline is recognized as a problem indirectly caused by human activities. Habitats with submerged aquatic vegetation are often altered by changes in water conditions in estuaries, bays, and nearshore waters. Intertidal zones can be affected for long periods by spills or by chronic pollutant exposure. Beaches and haul-out areas can be littered with dangerous marine debris, as can the water column or benthic habitats. Sandy subtidal areas and hardbottoms are frequently disturbed or destroyed by trawling. Even rocky areas several hundred meters deep are increasingly affected by certain types of trawls, bottom longlines, and fish traps. Groundings, anchors, and divers damage submerged reefs. Cables and pipelines disturb corridors across numerous habitat types and can be destructive if they become mobile. Shellfish dredging removes, alters, and fragments habitats.

The result of these activities is the gradual reduction of the extent and quality of marine habitats. Losses can often be quantified through visual surveys and to some extent using high-resolution mapping. This question asks about the quality of habitats compared to those that would be expected without human impacts. The status depends on comparison to a baseline that existed in the past - one toward which restoration efforts might aim.

Good Habitats are in pristine or near-pristine condition and are unlikely to preclude full community development.

Good/Fair Selected habitat loss or alteration has taken place, precluding full development of living resource assemblages, but it is unlikely to cause substantial or persistent degradation in living resources or water quality.

Fair Selected habitat loss or alteration may inhibit the development of assemblages, and may cause measurable but not severe declines in living resources or water quality.

- Fair/Poor** Selected habitat loss or alteration has caused or is likely to cause severe declines in some but not all living resources or water quality.
- Poor** Selected habitat loss or alteration has caused or is likely to cause severe declines in most if not all living resources or water quality.

Question 6 (Habitat/Structure): What is the condition of biologically-structured habitats and how is it changing?

Many organisms depend on the integrity of their habitats and that integrity is largely determined by the condition of particular living organisms. Coral reefs may be the best known examples of such biologically-structured habitats. Not only is the substrate itself biogenic, but the diverse assemblages residing within and on the reefs depend on and interact with each other in tightly linked food webs. They also depend on each other for the recycling of wastes, hygiene, and the maintenance of water quality, among other requirements.

Kelp beds may not be biogenic habitats to the extent of coral reefs, but kelp provides essential habitat for assemblages that would not reside or function together without it. There are other communities of organisms that are also similarly co-dependent, such as hard-bottom communities, which may be structured by bivalves, octocorals, coralline algae, or other groups that generate essential habitat for other species. Intertidal assemblages structured by mussels, barnacles, and algae are another example, seagrass beds another. This question is intended to address these types of places, where organisms form structures (habitats) on which other organisms depend.

- Good** Habitats are in pristine or near-pristine condition and are unlikely to preclude full community development.
- Good/Fair** Selected habitat loss or alteration has taken place, precluding full development of living resources, but it is unlikely to cause substantial or persistent degradation in living resources or water quality.
- Fair** Selected habitat loss or alteration may inhibit the development of living resources, and may cause measurable but not severe declines in living resources or water quality.
- Fair/Poor** Selected habitat loss or alteration has caused or is likely to cause severe declines in some but not all living resources or water quality.
- Poor** Selected habitat loss or alteration has caused or is likely to cause severe declines in most if not all living resources or water quality.

Question 7 (Habitat/Contaminants): What are the contaminant concentrations in sanctuary habitats and how are they changing?

This question addresses the need to understand the risk posed by contaminants within benthic formations, such as soft sediments, hard bottoms, or biogenic organisms. In the first two cases, the contaminants can become available when released via disturbance. They can also pass upwards through the food chain after being ingested by bottom dwelling prey species. The contaminants of concern generally include pesticides, hydrocarbons, and heavy metals, but the specific concerns of individual sanctuaries may differ substantially.

- Good** Contaminants do not appear to have the potential to negatively affect living resources or water quality.
- Good/Fair** Selected contaminants may preclude full development of living resource assemblages, but are not likely to cause substantial or persistent degradation.
- Fair** Selected contaminants may inhibit the development of assemblages, and may cause measurable but not severe declines in living resources or water quality.
- Fair/Poor** Selected contaminants have caused or are likely to cause severe declines in some but not all living

resources or water quality.

Poor

Selected contaminants have caused or are likely to cause severe declines in most if not all living resources or water quality.

Question 8 (Habitat/Human Activities): What are the levels of human activities that may influence habitat quality and how are they changing?

Human activities that degrade habitat quality do so by affecting structural (geological), biological, oceanographic, acoustic, or chemical characteristics. Structural impacts include removal or mechanical alteration, including various fishing techniques (trawls, traps, dredges, longlines, and even hook-and-line in some habitats), dredging channels and harbors and dumping spoil, vessel groundings, anchoring, laying pipelines and cables, installing offshore structures, discharging drill cuttings, dragging tow cables, and placing artificial reefs. Removal or alteration of critical biological components of habitats can occur along with several of the above activities, most notably trawling, groundings, and cable drags. Marine debris, particularly in large quantities (e.g., lost gill nets and other types of fishing gear), can affect both biological and structural habitat components. Changes in water circulation often occur when channels are dredged, fill is added, coastal areas are reinforced, or other construction takes place. These activities affect habitat by changing food delivery, waste removal, water quality (e.g., salinity, clarity and sedimentation), recruitment patterns, and a host of other factors. Acoustic impacts can occur to water column habitats and organisms from acute and chronic sources of anthropogenic noise (e.g., shipping, boating, construction). Chemical alterations most commonly occur following spills and can have both acute and chronic impacts.

Good

Few or no activities occur that are likely to negatively affect habitat quality.

Good/Fair

Some potentially harmful activities exist, but they do not appear to have had a negative effect on habitat quality.

Fair

Selected activities have resulted in measurable habitat impacts, but evidence suggests effects are localized, not widespread.

Fair/Poor

Selected activities have caused or are likely to cause severe impacts, and cases to date suggest a pervasive problem.

Poor

Selected activities warrant widespread concern and action, as large-scale, persistent, and/or repeated severe impacts have occurred or are likely to occur.

Question 9 (Living Resources/Biodiversity): What is the status of biodiversity and how is it changing?

This is intended to elicit thought and assessment of the condition of living resources based on expected biodiversity levels and the interactions between species. Intact ecosystems require that all parts not only exist, but that they function together, resulting in natural symbioses, competition, and predator-prey relationships. Community integrity, resistance and resilience all depend on these relationships. Abundance, relative abundance, trophic structure, richness, H' diversity, evenness, and other measures are often used to assess these attributes.

Good

Biodiversity appears to reflect pristine or near-pristine conditions and promotes ecosystem integrity (full community development and function).

Good/Fair

Selected biodiversity loss has taken place, precluding full community development and function, but it is unlikely to cause substantial or persistent degradation of ecosystem integrity.

Fair

Selected biodiversity loss may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.

Fair/Poor

Selected biodiversity loss has caused or is likely to cause severe declines in some but not all

ecosystem components and reduce ecosystem integrity.

Poor Selected biodiversity loss has caused or is likely to cause severe declines in ecosystem integrity.

Question 10 (Living Resources/Extracted Species): What is the status of environmentally sustainable fishing and how is it changing?

Commercial and recreational harvesting are highly selective activities, for which fishers and collectors target a limited number of species, and often remove high proportions of populations. In addition to removing significant amounts of biomass from the ecosystem, reducing its availability to other consumers, these activities tend to disrupt specific and often critical food web links. When too much extraction occurs (i.e. ecologically unsustainable harvesting), trophic cascades ensue, resulting in changes in the abundance of non-targeted species as well. It also reduces the ability of the targeted species to replenish populations at a rate that supports continued ecosystem integrity.

It is essential to understand whether removals are occurring at ecologically sustainable levels. Knowing extraction levels and determining the impacts of removal are both ways that help gain this understanding. Measures for target species of abundance, catch amounts or rates (e.g., catch per unit effort), trophic structure, and changes in non-target species abundance are all generally used to assess these conditions.

Other issues related to this question include whether fishers are using gear that is compatible with the habitats being fished and whether that gear minimizes by-catch and incidental take of marine mammals. For example, bottom-tending gear often destroys or alters both benthic structure and non-targeted animal and plant communities. "Ghost fishing" occurs when lost traps continue to capture organisms. Lost or active nets, as well as lines used to mark and tend traps and other fishing gear, can entangle marine mammals. Any of these could be considered indications of environmentally unsustainable fishing techniques.

- Good** Extraction does not appear to affect ecosystem integrity (full community development and function).
- Good/Fair** Extraction takes place, precluding full community development and function, but it is unlikely to cause substantial or persistent degradation of ecosystem integrity.
- Fair** Extraction may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.
- Fair/Poor** Extraction has caused or is likely to cause severe declines in some but not all ecosystem components and reduce ecosystem integrity.
- Poor** Extraction has caused or is likely to cause severe declines in ecosystem integrity.

Question 11 (Living Resources/Invasive Species): What is the status of non-indigenous species and how is it changing?

Non-indigenous species are generally considered problematic, and candidates for rapid response, if found, soon after invasion. For those that become established, their impacts can sometimes be assessed by quantifying changes in the affected native species. This question allows sanctuaries to report on the threat posed by non-indigenous species. In some cases, the presence of a species alone constitutes a significant threat (certain invasive algae). In other cases, impacts have been measured, and may or may not significantly affect ecosystem integrity.

- Good** Non-indigenous species are not suspected or do not appear to affect ecosystem integrity (full community development and function).
- Good/Fair** Non-indigenous species exist, precluding full community development and function, but are unlikely to cause substantial or persistent degradation of ecosystem integrity.

- Fair** Non-indigenous species may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity.
- Fair/Poor** Non-indigenous species have caused or are likely to cause severe declines in some but not all ecosystem components and reduce ecosystem integrity.
- Poor** Non-indigenous species have caused or are likely to cause severe declines in ecosystem integrity.

Question 12 (Living Resources/Key Species): What is the status of key species and how is it changing?

Certain species can be defined as “key” within a marine sanctuary. Some might be keystone species, that is, species on which the persistence of a large number of other species in the ecosystem depends - the pillar of community stability. Their functional contribution to ecosystem function is disproportionate to their numerical abundance or biomass and their impact is therefore important at the community or ecosystem level. Their removal initiates changes in ecosystem structure and sometimes the disappearance of or dramatic increase in the abundance of dependent species. Keystone species may include certain habitat modifiers, predators, herbivores, and those involved in critical symbiotic relationships (e.g. cleaning or co-habiting species).

Other key species may include those that are indicators of ecosystem condition or change (e.g., particularly sensitive species), those targeted for special protection efforts, or charismatic species that are identified with certain areas or ecosystems. These may or may not meet the definition of keystone, but do require assessments of status and trends.

- Good** Key and keystone species appear to reflect pristine or near-pristine conditions and may promote ecosystem integrity (full community development and function).
- Good/Fair** Selected key or keystone species are at reduced levels, perhaps precluding full community development and function, but substantial or persistent declines are not expected.
- Fair** The reduced abundance of selected keystone species may inhibit full community development and function, and may cause measurable but not severe degradation of ecosystem integrity; or selected key species are at reduced levels, but recovery is possible.
- Fair/Poor** The reduced abundance of selected keystone species has caused or is likely to cause severe declines in some but not all ecosystem components, and reduce ecosystem integrity; or selected key species are at substantially reduced levels, and prospects for recovery are uncertain.
- Poor** The reduced abundance of selected keystone species has caused or is likely to cause severe declines in ecosystem integrity; or selected key species are at severely reduced levels, and recovery is unlikely.

Question 13 (Living Resources/Health of Key Species): What is the condition or health of key species and how is it changing?

For those species considered essential to ecosystem integrity, measures of their condition can be important to determining the likelihood that they will persist and continue to provide vital ecosystem functions. Measures of condition may include growth rates, fecundity, recruitment, age-specific survival, tissue contaminant levels, pathologies (disease incidence tumors, deformities), the presence and abundance of critical symbionts, or parasite loads. Similar measures of condition may also be appropriate for other key species (indicator, protected, or charismatic species). In contrast to the question about keystone species (#12 above), the impact of changes in the abundance or condition of key species is more likely to be observed at the population or individual level, and less likely to result in ecosystem or community effects.

- Good** The condition of key resources appears to reflect pristine or near-pristine conditions.
- Good/Fair** The condition of selected key resources is not optimal, perhaps precluding full ecological function, but

substantial or persistent declines are not expected.

Fair

The diminished condition of selected key resources may cause a measurable but not severe reduction in ecological function, but recovery is possible.

Fair/Poor

The comparatively poor condition of selected key resources makes prospects for recovery uncertain.

Poor

The poor condition of selected key resources makes recovery unlikely.

Question 14 (Living Resources/Human Activities): What are the levels of human activities that may influence living resource quality and how are they changing?

Human activities that degrade living resource quality do so by causing a loss or reduction of one or more species, by disrupting critical life stages, by impairing various physiological processes, or by promoting the introduction of non-indigenous species or pathogens. (Note: Activities that impact habitat and water quality may also affect living resources. These activities are dealt with in Questions 4 and 8, and many are repeated here as they also have direct effect on living resources).

Fishing and collecting are the primary means of removing resources. Bottom trawling, seine-fishing, and the collection of ornamental species for the aquarium trade are all common examples, some being more selective than others. Chronic mortality can be caused by marine debris derived from commercial or recreational vessel traffic, lost fishing gear, and excess visitation, resulting in the gradual loss of some species.

Critical life stages can be affected in various ways. Mortality to adult stages is often caused by trawling and other fishing techniques, cable drags, dumping spoil or drill cuttings, vessel groundings, or persistent anchoring. Contamination of areas by acute or chronic spills, discharges by vessels, or municipal and industrial facilities can make them unsuitable for recruitment; the same activities can make nursery habitats unsuitable. Although coastal armoring and construction can increase the availability of surfaces suitable for the recruitment and growth of hard bottom species, the activity may disrupt recruitment patterns for other species (e.g., intertidal soft bottom animals) and habitat may be lost.

Spills, discharges, and contaminants released from sediments (e.g., by dredging and dumping) can all cause physiological impairment and tissue contamination. Such activities can affect all life stages by reducing fecundity, increasing larval, juvenile, and adult mortality, reducing disease resistance, and increasing susceptibility to predation. Bioaccumulation allows some contaminants to move upward through the food chain, disproportionately affecting certain species.

Activities that promote introductions include bilge discharges and ballast water exchange, commercial shipping and vessel transportation. Releases of aquarium fish can also lead to species introductions.

Good

Few or no activities occur that are likely to negatively affect living resource quality.

Good/Fair

Some potentially harmful activities exist, but they do not appear to have had a negative effect on living resource quality.

Fair

Selected activities have resulted in measurable living resource impacts, but evidence suggests effects are localized, not widespread.

Fair/Poor

Selected activities have caused or are likely to cause severe impacts, and cases to date suggest a pervasive problem.

Poor

Selected activities warrant widespread concern and action, as large-scale, persistent, and/or repeated severe impacts have occurred or are likely to occur.

Question 15 (Maritime Archaeological Resources/Integrity): What is the integrity of known maritime archaeological resources and how is it changing?

The condition of archaeological resources in a marine sanctuary significantly affects their value for science and education, as well as the resource's eligibility for listing in the National Register of Historic Places. Assessments of archaeological sites include evaluation of the apparent levels of site integrity, which are based on levels of previous human disturbance and the level of natural deterioration. The historical, scientific and educational values of sites are also evaluated, and are substantially determined and affected by site condition.

Good	Known archaeological resources appear to reflect little or no unexpected disturbance.
Good/Fair	Selected archaeological resources exhibit indications of disturbance, but there appears to have been little or no reduction in historical, scientific, or educational value.
Fair	The diminished condition of selected archaeological resources has reduced, to some extent, their historical, scientific, or educational value, and may affect the eligibility of some sites for listing in the National Register of Historic Places.
Fair/Poor	The diminished condition of selected archaeological resources has substantially reduced their historical, scientific, or educational value, and is likely to affect their eligibility for listing in the National Register of Historic Places.
Poor	The degraded condition of known archaeological resources in general makes them ineffective in terms of historical, scientific, or educational value, and precludes their listing in the National Register of Historic Places.

Question 16 (Maritime Archaeological Resources/Threat to Environment): Do known maritime archaeological resources pose an environmental hazard and how is this threat changing?

The sinking of a ship potentially introduces hazardous materials into the marine environment. This danger is true for historic shipwrecks as well. The issue is complicated by the fact that shipwrecks older than 50 years may be considered historical resources and must, by federal mandate, be protected. Many historic shipwrecks, particularly early to mid-20th century, still have the potential to retain oil and fuel in tanks and bunkers. As shipwrecks age and deteriorate, the potential for release of these materials into the environment increases.

Good	Known maritime archaeological resources pose few or no environmental threats.
Good/Fair	Selected maritime archaeological resources may pose isolated or limited environmental threats, but substantial or persistent impacts are not expected.
Fair	Selected maritime archaeological resources may cause measurable, but not severe, impacts to certain sanctuary resources or areas, but recovery is possible.
Fair/Poor	Selected maritime archaeological resources pose substantial threats to certain sanctuary resources or areas, and prospects for recovery are uncertain.
Poor	Selected maritime archaeological resources pose serious threats to sanctuary resources, and recovery is unlikely.

Question 17 (Maritime Archaeological Resources/Human Activities): What are the levels of human activities that may influence maritime archaeological resource quality and how are they changing?

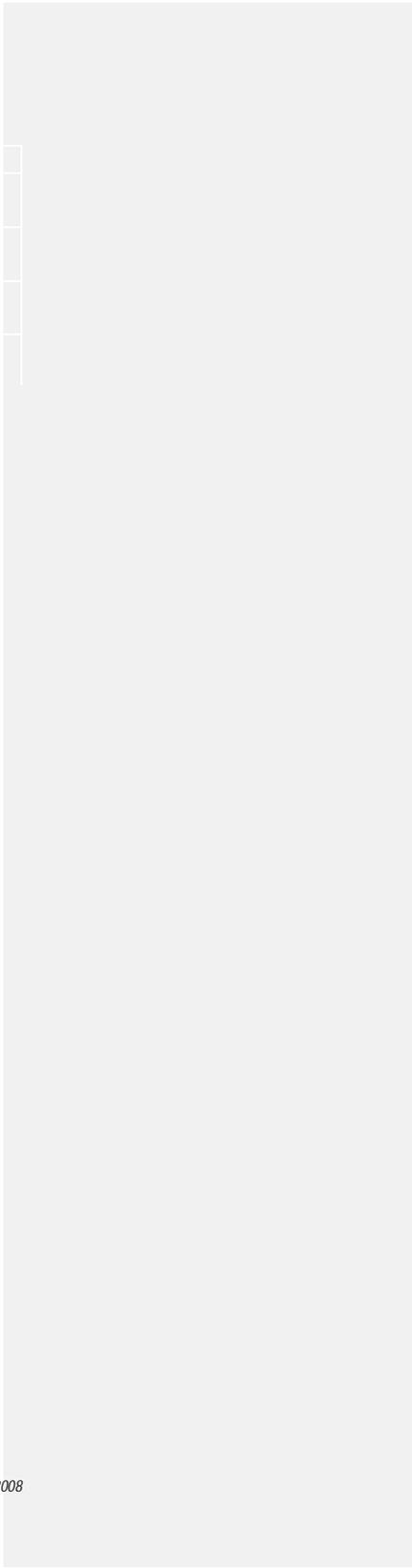
Some human maritime activities threaten the physical integrity of submerged archaeological resources. Archaeological site integrity is compromised when elements are moved, removed, or otherwise damaged. Threats come from looting by divers, inadvertent damage by scuba diving visitors, improperly conducted archaeology that does not fully document site disturbance, anchoring, groundings, and commercial and recreational fishing activities, among others.

Good	Few or no activities occur that are likely to negatively affect maritime archaeological resource
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	integrity.
Good/Fair	Some potentially relevant activities exist, but they do not appear to have had a negative effect on maritime archaeological resource integrity.
Fair	Selected activities have resulted in measurable impacts to maritime archaeological resources, but evidence suggests effects are localized, not widespread.
Fair/Poor	Selected activities have caused or are likely to cause severe impacts, and cases to date suggest a pervasive problem.
Poor	Selected activities warrant widespread concern and action, as large-scale, persistent, and/or repeated severe impacts have occurred or are likely to occur.



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Appendix B: Consultation with Experts and Document Review

In order to address the 17 questions relating to the status and trends of sanctuary resources, sanctuary staff selected and consulted outside experts familiar with water quality, living resources, habitat, and maritime archaeological resources. Experts represented various affiliations including WA State Departments of Archaeology and Historic Preservation, Ecology, Fish and Wildlife, and Natural Resources; Quinault Indian Nation; Hoh Tribe; Quileute Tribe; Makah Tribe; Coastal Maritime Archaeology Resources; Natural Resource Consultants, Inc.; Wessen & Associates, Inc.; NOAA – Fisheries and Office of National Marine Sanctuaries; Northwest Indian Fisheries Commission; Olympic National Park; University of Chicago – Department of Ecology and Evolution; U.S. Fish and Wildlife Service; and University of Washington – School of Oceanography and Applied Physics Laboratory. Expert opinion was solicited through one-on-one contact via phone calls and/or emails. Background material was provided to the experts in order to develop a consistent understanding of the project and the questions. Experts were asked to utilize the Appendix that accompanies every report (Rating Scheme for System-Wide Monitoring Questions; see Appendix A) to guide their responses. The Appendix clarifies the set of questions and presents statements that are used to judge the status and assign a corresponding color code on a scale from “good” to “poor.” These statements are customized for each question. A total of 80 experts were contacted, of which 28 responded during the initial request for response to questions.

Responses for each question were compiled and reviewed by sanctuary staff. Staff from the Office of National Marine Sanctuaries experienced with developing Condition Reports assisted in reviewing the responses and provided guidance in developing the State section of the report. Each response and the associated data and literature that were provided by the experts were carefully reviewed, and final status and trend ratings were assigned by consensus of the participating sanctuary staff. Appropriate “basis of judgment” text was also developed for the report.

Following completion of a preliminary draft report, the document was distributed to the original set of experts as well as others for review, including Olympic Coast National Marine Sanctuary’s Advisory Council, Pacific Fishery Management Council (PFMC) advisory committees (Scientific and Statistical Committee, Habitat Committee, and Groundfish Advisory Panel), and tribal and state co-managers through the Intergovernmental Policy Council. These bodies were asked to review the technical merits of the resource ratings and accompanying text as well as point out any omissions or factual errors. The comments and recommendations of 10 invited reviewers as well as the PFMC committees were received, considered by sanctuary staff, and incorporated, as appropriate, into a final draft document.

A draft final report was then sent to four individuals who served as peer reviewers. In December 2004, the White House Office of Management and Budget (OMB) issued a Final Information Quality Bulletin for Peer Review (OMB Bulletin) establishing peer review standards that would enhance the quality and credibility of the federal government’s scientific information. Among other information, these standards apply to Influential Scientific Information (ISI), which is information that can reasonably be determined to have a “clear and substantial impact on important public policies or private sector decisions.” The Condition Reports are considered Influential Scientific Information. For this reason, these reports are subject to the review requirements of both the Information Quality Act and the OMB Bulletin guidelines. Therefore, following the completion of every report they are reviewed by a minimum of three individuals who are considered to be experts in the field, were not involved in the development of the report, and are not Office of National Marine Sanctuaries employees.