Aquaculture

Marine spatial planning (MSP) is a process for gathering information on coastal and ocean activities and environments, providing recommendations for siting new ocean uses, creating a process for coordinating across all levels of government, and ensuring stakeholder input on new ocean uses in a comprehensive plan.

Aquaculture

Data from the following sources provides information related to aquaculture activities within the study area. Currently, these operations consist of shellfish aquaculture located primarily within the Willapa Bay and Grays Harbor estuaries. For more detail on aquaculture in the study area, please refer to Section 2.5 of the Marine Spatial Plan.

Major Data Sources

Information relevant to aquaculture in the study area was provided by:
- **Washington Department of Fish and Wildlife:** Aquaculture districts
- **Washington Department of Health**: Commercial shellfish growing areas, harvest sites, and water quality monitoring stations
- **Washington Department of Natural Resources**: Oyster reserves and oyster tracts
- **Washington Department of Ecology**: Seafood processors and location of marinas
- **US Army Corps of Engineers**: Location of ports
- **Industrial Economics and Cascade Economics**: Economic analyses of marine sectors including shellfish aquaculture

Products and Methods

Spatial data for harvest areas: Maps of commercial growing areas, harvest sites, and aquaculture districts were provided by the state agencies that regulate or manage aquaculture areas and operations.

Seafood processors: A list of seafood processors was compiled using two Department of Ecology (Ecology) databases. The Facility/Site Database and the water quality Permit and Reporting Information System (PARIS) contain publicly available information on facilities that hold state permits for industrial or stormwater discharges. Searches were performed to identify the location of facilities conducting operations related to various types of seafood processing.

Economics: Cascade Economics conducted an analysis of Washington's coastal economies, completed in 2015. This report provides economic profiles of several marine sectors including aquaculture. Analysis of the aquaculture industry was based in part on a report produced by Industrial Economics in 2014, which incorporated information including harvest and shellfish farm data from the Washington Department of Fish and Wildlife (WDFW) and licensing data from the Washington Department of Health. Cascade's analysis also includes results of a survey and interviews regarding coastal shellfish processing and distribution. The final report assesses the economic contributions of aquaculture and provides a qualitative analysis of the potential impacts of new coastal uses on the aquaculture industry.

Remaining Data Gaps and Challenges

Seafood processing: The state does not maintain a comprehensive spatial dataset of seafood processing facilities. The data described here identifies facilities involved in processing that have been issued more general stormwater or industrial discharge permits by Ecology. As a result, the records from these databases may not include all relevant facilities in the study area.

Tribal shellfish data: Data sources described here do not include tribal shellfish aquaculture activities.

Data used for economic studies: Some datasets used in economic studies, including information from WDFW regarding shellfish farm acreage and harvest volume, have known reporting limitations and are considered to some extent incomplete and inaccurate. This makes assessing the amount of aquaculture actively occurring in the study area difficult. For this and other reasons addressed in more detail in final reports, data on total harvest value is limited and potentially underrepresented. Additionally, some other datasets used in economic and sector analyses were only available at statewide or local scale, rather than at the county or planning area scale.

Offshore aquaculture suitability: General information is provided in the Marine Spatial Plan regarding conditions that tend to be suitable for various types of offshore aquaculture, including water depth and access to shore facilities. However, limited information is available on more specific attributes that pertain to detailed site suitability for offshore aquaculture. As a result, no detailed analysis has been done to identify where in the study area these types of activities might be proposed in the future.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.

Shipping

Marine spatial planning (MSP) is a process for gathering information on coastal and ocean activities and environments, providing recommendations for siting new ocean uses, creating a process for coordinating across all levels of government, and ensuring stakeholder input on new ocean uses in a comprehensive plan.

Shipping

Data from the following sources used in the Marine Spatial Plan provides information related to the transit of commercial waterborne cargo to, from, and through the study area, including navigational information relevant to the shipping industry. More information on marine transportation, navigation, and infrastructure is available in Section 2.7 of the Marine Spatial Plan.

Major Data Sources

Shipping data for the study area provided by:
- **Olympic Coast National Marine Sanctuary (OCNMS)**: Density of shipping vessel transits in the study area
- **BST Associates**: Vessel transit trends and forecasts for the Pacific Northwest
- **Cascade Economics**: Economic analyses of marine sectors including shipping

Navigational data relevant to shipping was acquired from:
- **National Oceanic and Atmospheric Administration**: Location of shipping lanes, Area to be Avoided (ATBA), buoys, beacons, and other aids to navigation
- **US Army Corps of Engineers**: Location of federal navigation channels and ports
- **National Waterways Network at the Bureau of Transportation Statistics**: Location of commercially navigable deep draft waterways
- **Washington Sea Grant**: Location of towboat lanes established by crab fishermen and tugboat and towboat industry in order to limit interactions between towing vessels and fishing gear.

Products and Methods

Shipping activity maps: OCNMS compiled and processed spatial data on shipping activity. This information represents the location and density (vessels per square mile) of ship traffic passing through the study area in 2013 and 2014.

Types of ships and their movement through the study area were identified by analyzing satellite-derived automatic identification system (AIS or SAIS) data from *exactEarth.com*. AIS is a tracking system used to identify and locate vessels; the Coast Guard requires that AIS systems be carried by large commercial ships in the United States, though they are also used by some smaller and/or private vessels. OCNMS sorted reported vessel positions into six categories, which include both shipping data (cargo, tanker, and tug & tow vessels) and data on other types of vessels (recreational, military, and passenger ships), and mapped traffic density using ArcGIS software. The resulting maps show where AIS data indicates that each category of vessel traffic is occurring at a low, moderate, or high intensity in the study area.

Vessel trends and forecasts: In 2014, BST Associates compiled a report for use in the MSP process on the current state of the shipping sector and calculated projections for future shipping activity in the Pacific Northwest. Projections of future vessel traffic are based on data including past trends in cargo volume and value, transit routes, previous export and import studies, and forecasts for trade patterns in the northwest and abroad. This report also assesses the potential for offshore energy development to affect marine shipping.

Economics: Using the information compiled by BST Associates as well as other recent studies, Cascade Economics conducted an analysis of Washington's coastal economies, completed in 2015. This report describes economic profiles of several marine sectors including commercial shipping. It assesses economic impacts associated with shipping, discusses areas of risk and vulnerability in the sector, and summarizes potential impacts of new coastal uses on commercial shipping. Economic models were produced for five counties in Washington with heavily coastal use-dependent economies, as well as for the entire state.
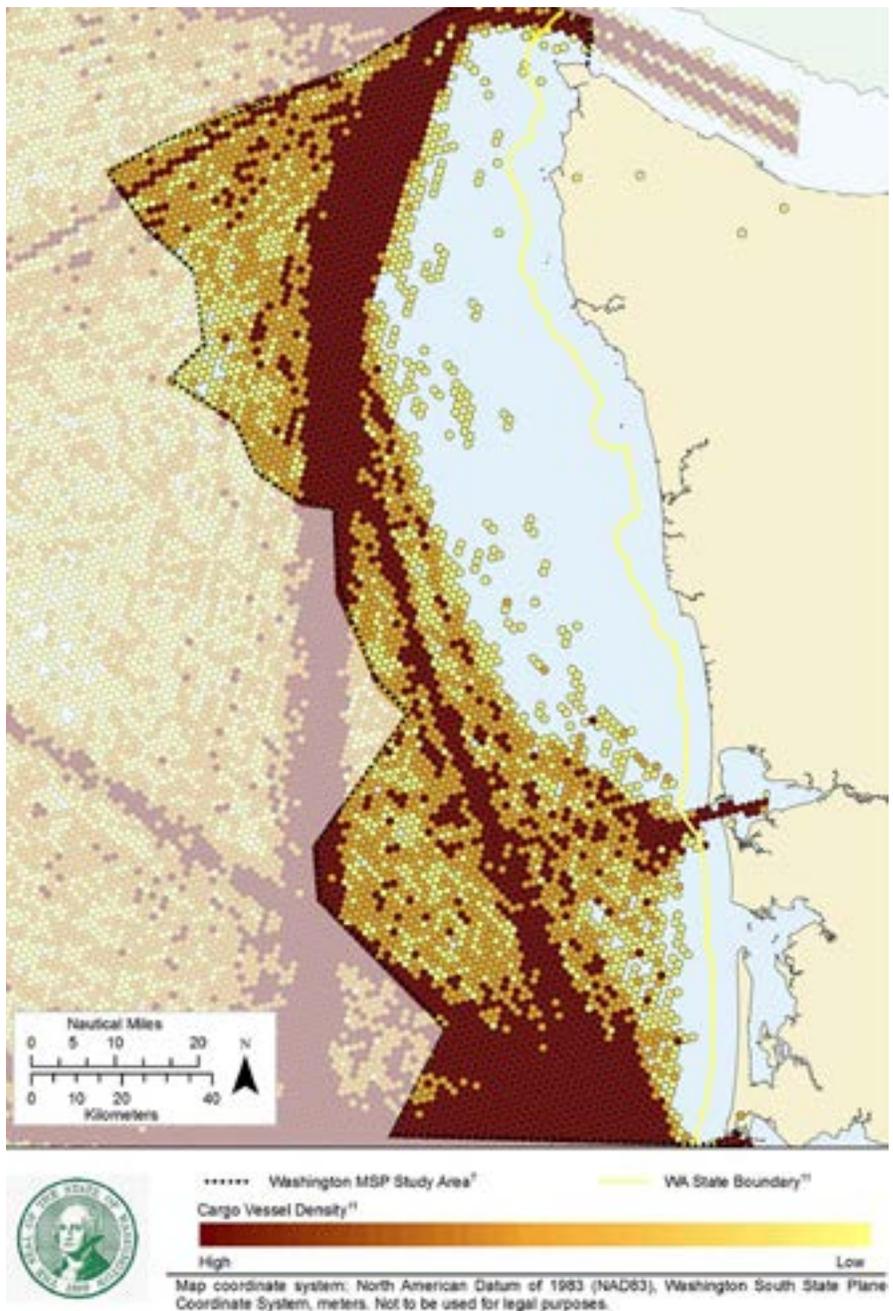
Ports: Available sources for port data use different methods and criteria to identify port locations. Additional datasets and stakeholder feedback were used to supplement the Army Corps of Engineers port information for some uses.

Remaining Data Gaps and Challenges

Vessel transit and tonnage data for economic analysis: Vessel transit information is readily available for international trade and the domestic transportation of petroleum products. However, available data on the tonnage of domestic non-petroleum products being transported is more limited.

Potential impacts of new uses: Information on how shipping conditions could be impacted by potential new uses remains limited, including potential economic impacts.

Cargo Vessel Density

Nautical Miles
0   5   10   20

0   10   20   40
Kilometers

•••••• Washington MSP Study Area††   WA State Boundary††
Cargo Vessel Density††

High   Low

Map coordinate system: North American Datum of 1983 (NAD83), Washington South State Plane Coordinate System, meters. Not to be used for legal purposes.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.

Fisheries

Marine spatial planning (MSP) is a process for gathering information on coastal and ocean activities and environments, providing recommendations for siting new ocean uses, creating a process for coordinating across all levels of government, and ensuring stakeholder input on new ocean uses in a comprehensive plan.

Recreational and Commercial Fisheries

The following sources provide information related to commercial and recreational fishing activity within the study area. For a description of the fisheries occurring in and their importance to the communities of the MSP study area, please refer to Chapter 2.4 of the Marine Spatial Plan. More details about the fisheries maps will also be provided in a separate report, still in progress.

Major Data Sources

Maps for the following non-tribal fisheries were created by the **Washington Department of Fish and Wildlife (WDFW)** using logbook data, industry interviews, and other information:

- **Commercial fisheries**: Albacore Tuna, Dungeness Crab, Sablefish fixed gear, groundfish bottom trawl, Pacific Whiting, Pink Shrimp, salmon troll, and Pacific Sardine
- **Recreational fisheries**: Salmon, Pacific Halibut, bottomfish, Lingcod, and Albacore Tuna

Additional relevant information was acquired from:

- **Washington Department of Health**: Location of recreational shellfish beaches
- **National Park Service**: Location of hardshell clam beaches in Olympic National Park
- **Industrial Economics** and **Cascade Economics**: Economic analyses of marine sectors including tribal and non-tribal fisheries, based on catch and effort statistics from WDFW and the National Oceanographic and Atmospheric Administration (NOAA), permit records, and other sources
- **NOAA Fisheries**: Location of combined Usual and Accustomed areas for the four coastal treaty tribes
- **Washington Sea Grant**: Location of towboat lanes established by crab fishermen and the tugboat and towboat industry in order to limit interactions between towing vessels and fishing gear.

Products and Methods

Maps of fishing activity: Fisheries use maps were developed by WDFW to summarize available information on areas of high importance to fisheries as required by RCW 43.372.040(6)(c). The primary purpose of producing the maps was to identify the footprint, or general areas within which fishing occurs, for each fishery. The secondary goal was to provide an assessment of the level of activity within each fishery's footprint using relative intensity rankings.

Maps were based on (a) fishery logbook data that records the location of fishing activity at varying spatial resolutions; (b) the professional expertise and judgment of fishery managers and participants; or (c) a combination of the two. Specifically, WDFW used one of the following three approaches depending on the information available for each fishery:

1. **Maps based on fishery-dependent data and percentile rankings**: Each 1-square mile hexagon in the study area was evaluated and ranked based on fishing effort (i.e., number of sets or tows) using a quantile approach. The hexagons ranked as "High" were in the top 25% of hexagons, "Medium" the middle 50%, and "Low" the bottom 25%.
2. **Maps based on logbook data with criteria-based intensity definitions**: In some fisheries, there was not enough contrast in the logbook data or the fishery itself to apply the percentile ranking approach (for example, in the Sardine fishery, roughly 40% of hexagons had only one set). In these cases, each hexagon was evaluated based on available effort data and other criteria associated with high activity in that particular fishery, such as depth or distance from shore.
3. **Maps based on interviews with fishery participants and managers**: Some fisheries have no logbook or observer data that can be used to evaluate effort level. In these cases, WDFW consulted with fishery participants and managers to determine intensity levels and footprints of select fisheries.

Because the intensity rankings are relative to the activity within a fishery, they cannot be used to compare intensity between fisheries. For example, a "high" intensity area in a smaller fishery may equate to less overall activity than a "low" or "medium" from a larger fishery.

Seafood processors: A list of seafood processors was compiled using two Department of Ecology (Ecology) databases. The Facility/Site Database and the water quality Permit and Reporting Information System (PARIS) contain publically available information on facilities that hold state permits for industrial or stormwater discharges. Searches were performed to identify the location of facilities conducting operations related to various types of seafood processing.

Economics: Industrial Economics provided a sector analysis for non-tribal commercial and recreational fishing in Washington, which gives an overview of the current status of these sectors and significant issues facing them. Cascade Economics conducted an analysis that provides economic profiles of Washington's tribal and non-tribal coastal communities and several marine sectors including fisheries and associated industries. The authors used landing and survey data from WDFW and NOAA, as well information on international markets, environmental conditions, and more to assess current trends and the potential for impacts on fishing sectors from future new uses. Additional sources of economic information are referenced in Chapter 2.4 of the Marine Spatial Plan.

Remaining Data Gaps and Challenges

Uncertainty in fishing maps: Information on the location and intensity of fishing activity should be recognized as uncertain. In general, identifying the footprint of a fishery is a simpler task than accurately ranking intensity of use. Intensity information is particularly uncertain, especially at a fine spatial resolution.

Uncertainty arises from the quality of the data and from the nature of fisheries themselves. Logbook records are not available for every fishery. When available, records may be subject to inaccurate reporting, reported at an imprecise spatial resolution, available for only a few years, or associated with other uncertainties. Fisheries

are also inherently variable. The location and amount of fishing effort each year will vary in response to changes in regulations, economic conditions, the marine environment, and other factors. The areas of highest importance to a fishery should be expected to vary from year to year and may shift over time. While the footprints are thought to reflect areas of fishing with reasonable accuracy, they too may vary.

Assessing potential conflict: WDFW emphasizes that while the maps provide valuable information about where fishing occurs, on their own they cannot be used to assess the impact or conflict that would occur from new uses in these areas. Relative intensity rankings do not equate to the amount of impact (such as economic loss) that a new use could have on a fishery. Conflict in an area identified as "low" intensity could still cause significant adverse impacts to a fishery and fishing communities. Similarly, development in a "high" intensity area could be of a type that is compatible with certain fishing methods and create no significant adverse impact. Assessment of conflict and impact would require careful study and examination of all available information on a case-by-case basis.

Tribal fisheries: While information on tribal fishing activity and its economic value is provided both in the Cascade Economics study and the Marine Spatial Plan, spatial data regarding tribal fishing intensity was not available nor included in these fisheries maps. Section 2.4 provides an overview of tribal fishing activities.

Seafood processing: The state does not maintain a comprehensive spatial dataset of seafood processing facilities. The data described here identifies facilities involved in processing that have been issued more general stormwater or industrial discharge permits by Ecology. As a result, the records from these databases may not include all relevant facilities in the study area. Additionally, the Cascade Economics report addresses the economic impacts of seafood processing but does not include secondary processing operations or non-local distribution or retailing.

Economic data: In some cases the data used in economic analysis had confidentiality restrictions. Some datasets were also only available at a scale that can be difficult to apply to the planning area, specific communities, or segments of the commercial or recreational fishing sectors.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.

Species and Habitats

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Species and Habitats

The Marine Spatial Plan provides information about the physical, biological, chemical, and geological characteristics of the study area. Some information was acquired from existing programs or studies, while other data was collected or analyzed specifically for MSP purposes. This document provides a summary of some key data sources, but more information on the many ecological data sources consulted is provided in Sections 2.1, 3.1, and 3.2 of the Marine Spatial Plan.

Major Data Sources

The **Washington Department of Fish and Wildlife** performed an analysis of Ecologically Important Areas for:

- **Birds**: Snowy Plover, Streaked Horned Lark, Black-footed Albatross, Northern Fulmar, Sooty Shearwater, Common Murre, Tufted Puffin, Pink Footed Shearwater, Marbled Murrelet, seabird colonies, and nearshore seabird encounters
- **Marine Mammals**: Seal and sea lion haulouts, Dall's Porpoise, Gray Whale, Harbor Porpoise, Harbor Seal, Humpback Whale, sea otters, and Steller Sea Lion
- **Fish and Invertebrates**: Razor clams, Dungeness Crab, Darkblotched Rockfish, Dover Sole, Greenspotted Rockfish, Longspine Thornyhead, Pacific Ocean Perch, Petrale Sole, Sablefish, Shortspine Thornyhead, Yelloweye Rockfish, Pacific Whiting, Pink Shrimp, deep sea coral, and forage fish spawning areas
- **Habitats**: Rocky reefs and kelp

Additional information relevant to the ecology of the study area was provided by:

- **Washington Department of Natural Resources**: Maps of shoreline biology and habitat including kelp, seagrass, and salt marshes

- **Washington Department of Fish and Wildlife (WDFW)**: Forage fish survey results and the location of seabird colonies, marine mammal haulouts, and Northern Sea Otter concentration areas
- **NOAA's National Centers for Coastal Ocean Science (NCCOS)**: Predictive models showing expected relative abundance for eight species of birds and six species of marine mammals
- **National Oceanic and Atmospheric Administration (NOAA)**: Maps of **critical** and **essential habitat** for several fish species and information supporting the evaluation and selection of **ecosystem indicators** for the study area

Selected Products and Methods

Ecologically Important Areas (EIA): The WDFW compiled maps that aimed to identify regions of relatively greater ecological importance in the study area, as represented by available data on the distribution of selected species and habitats. Input data for this analysis varied widely in format and scope, but included information from fisheries records, fish and wildlife surveys, and predictive models. Data was acquired both from WDFW projects and monitoring programs, and from various external federal, state, and academic sources. Estuaries were not included in analysis owing to data availability and resolution issues, but the Marine Spatial Plan recognizes that they are known to be of high ecological importance. For each species and habitat, WDFW used a quantile approach to assign a relative importance score to each 1-square mile hexagon within the planning area. These scores allowed analysts to compare results across species and to combine multiple data layers into "hotspot" maps. Hotspots show areas that are expected to be relatively more important to a greater number of species or groups. Please see Section 3.2 of the Marine Spatial Plan for more information about the methods and results of the EIA analyses.

Relative Abundance Models for Mammals and Birds: NCCOS synthesized data from 11 existing survey programs and a wide variety of ecological datasets. The results of this analysis were a series of statistical models and maps showing areas where relatively higher abundances of each species would be expected, based on field observations and relevant environmental predictor variables. Model outputs were incorporated into the EIA analysis described above. Please see Section 3.1 of the Marine Spatial Plan for more detail on the source data and models.

Ecosystem Indicators: With input from a wide range of scientists, NOAA's Northwest Fisheries Science Center (NWFSC) developed a conceptual model for describing key ecological components of the study area and identified a list of potential ecological indicators to support Marine Spatial Planning in Washington. This project described physical drivers, habitats, human pressures, and biological factors that are important to characterizing ecology in the study area. Based on this information, a review of scientific information on indicators, initial input from scientists and managers on criteria, and other sources, NWFSC developed an initial list of potential indicators that may provide measures of the health and status of Washington's coastal waters. NWFSC also produced a status and trends report for these potential ecological indicators where data was available to report on those indicators.

REMAINING DATA GAPS AND CHALLENGES

Ecologically Important Areas and Relative Abundance Models: Because of the complexity of the analyses conducted by WDFW and NCCOS and the number and diversity of datasets used to represent different species and habitats, there are various limitations and uncertainties associated with their data and results. The EIA maps provide a way to summarize available data on some key biological aspects of the study area, and show broad trends in species and habitat distribution throughout the region. However, these maps cannot fully account for other important factors such as ecological interactions or differences in ecological hotspots over different seasons and time scales. For both analyses, each input dataset is also associated with its own challenges depending on data coverage and collection methods, and insufficient data was available to include some important species, including some which are endangered or threatened. All analysis outputs must be carefully assessed alongside other available information, including the evaluations of uncertainty provided by both studies. Please see Sections 3.1 and 3.2 of the Marine Spatial Plan for further discussion of NCCOS and EIA data gaps and limitations.

Ecological Indicators: The work by NWFSC provides a starting point for identifying helpful and scientifically-sound ecological indicators. The indicators suggested in the final report are only an initial list, which still must be further assessed and refined into a shorter list to maximize their usefulness.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.

Oceanography

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Oceanography

The Marine Spatial Plan provides information about the physical, biological, chemical, and geological characteristics of the study area. Some information was acquired from existing programs or studies, while other data was collected or analyzed specifically for MSP purposes. This document provides a summary of key data sources, but more information on the many ecological data sources consulted is provided in Sections 2.1, 3.1, and 3.2 of the Marine Spatial Plan.

Major Data Sources

Information relevant to seafloor mapping and other oceanographic data was provided by:

- **NOAA's National Centers for Coastal Ocean Science (NCCOS)**: An evaluation of available seafloor mapping data and identification of priorities for future mapping projects
- **The Nature Conservancy**: Models and data describing benthic substrate and bathymetry
- **Olympic Coast National Marine Sanctuary and Oregon State University**: Seafloor mapping data and a seafloor atlas for Washington's outer coast
- **Washington Department of Ecology and the US Geological Survey**: Shallow water bathymetric, sediment, and topographic surveys
- **National Oceanic and Atmospheric Administration (NOAA)**: The location of dominant coastal geology features
- **The University of Washington**: Oceanographic data relevant to primary productivity, oxygen levels, and other physical and chemical properties of the study area

Selected Products and Methods

Seafloor Data Prioritization: NCCOS conducted an evaluation of available seafloor data and led a participatory process designed to identify priorities for future seafloor mapping efforts. This effort included two workshops with representatives from federal and state agencies and coastal tribes, where participants provided their perspective on the potential for future mapping efforts to assist with fulfilling their management and planning goals. The process resulted in the creation of an interactive data viewer and prioritization tool, and the collaborative identification of several areas most frequently selected by participants as a high priority.

Synthesis of Seafloor Data: The Olympic Coast National Marine Sanctuary collaborated with the Active Tectonics and Seafloor Mapping Lab at Oregon State University to compile and standardize existing seafloor mapping survey data. This involved synthesizing sidescan and multibeam sonar data collected between 2000 and 2013, and producing an online Seafloor Atlas.

Shallow Water Surveys: The Washington Department of Ecology's Coastal Monitoring and Analysis Program (CMAP) conducted surveys of shallow coastal areas along Washington's coast. CMAP collected data using multibeam bathymetric, single beam bathymetric, and topographic LiDAR surveys. CMAP also collected data on beach profiles and geomorphology, and collaborated on the installation of a network of geodetic controls to support the ongoing study of shoreline characteristics. Partners for these projects included the U.S. Geological Survey, Oregon State University, the Quinault and Quileute Indian Nations, and the National Park Service.

Synthesis of Water Property Data: Oceanographers at the University of Washington compiled maps of the study area describing properties including temperature, salinity, water currents, chlorophyll content, and oxygen content. These maps and other final products were based on data collected by the University over several decades. Researchers synthesized existing data and models, and converted them to formats compatible with other information being used in the MSP process. Seasonal variability in this ocean observation data was also considered and incorporated into the maps.

Remaining Data Gaps and Challenges

Seafloor Mapping: Collecting bathymetric and other seafloor data is often logistically challenging and costly. In some cases, modeling approaches can provide indications of where certain seafloor features or sediment types are likely to be located based on various environmental factors and known features. However, the usefulness of this kind of data can be limited without studies that can ground-truth models using mapping technology in the field.

The seafloor data prioritization process led by NCCOS identified areas that may prove particularly valuable for both MSP and other ongoing efforts to understand the physical characteristics of Washington's coastal and marine waters. These locations do not represent the only oceanographic and bathymetric data gaps in the study area. They give an indication of areas that have shared management priorities for filling data gaps and, therefore, where future mapping efforts could maximize their benefit for multiple purposes and groups.
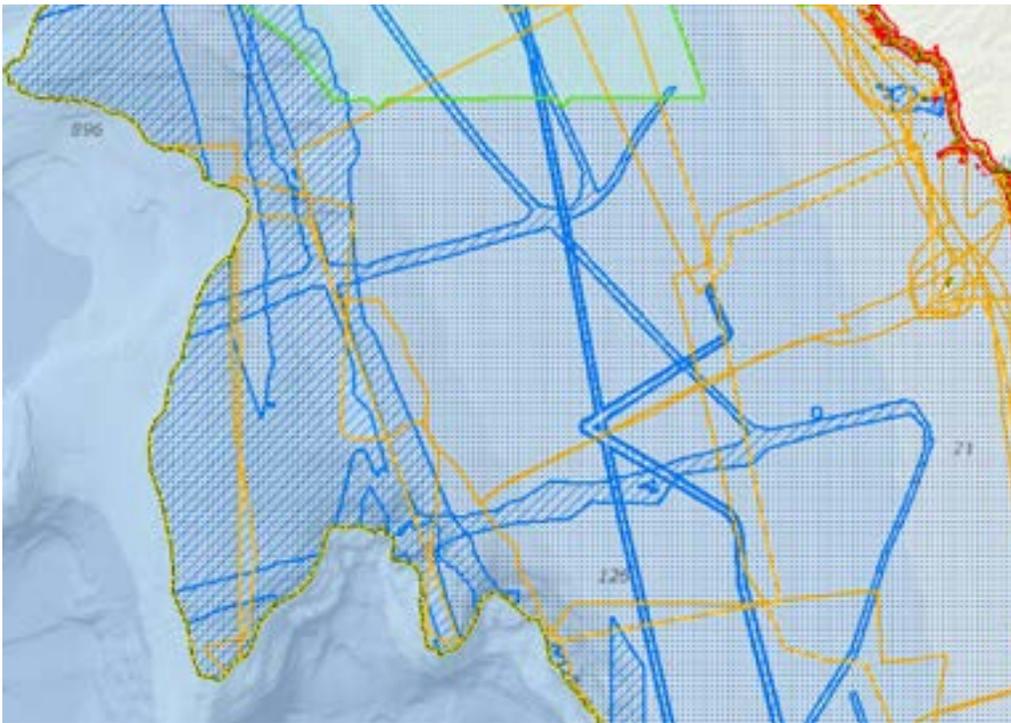
Example of seafloor mapping inventory data available on the Washington State Spatial Prioritization Tool, created by NOAA.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.

Recreation and Tourism

Marine spatial planning (MSP) is a process for gathering information on coastal and ocean activities and environments, providing recommendations for siting new ocean uses, creating a process for coordinating across all levels of government, and ensuring stakeholder input on new ocean uses in a comprehensive plan.

Recreation and Tourism

Data from the following sources provides information related to recreational and tourism activities within the MSP study area. This information is described in more detail in Chapter 2.6 of the MSP. Note that recreational fishing data is described in the fisheries data summary and Chapter 2.4.

Major Data Sources

A study by the Surfrider Foundation on ocean and coastal recreation in Washington provided data describing:
- The economic impacts of recreational activities on Washington's coast
- The geographic distribution and intensity of recreational uses in four categories:
  ◦ Diving activities: SCUBA diving and free diving/snorkeling
  ◦ Shore-based activities: Beachcombing, beach going, beach driving, biking & hiking, camping, hang gliding & parasailing, horseback riding, sea-life collecting & harvesting, tide pooling
  ◦ Surface water activities: Boating & sailing, kayaking, kiteboarding, skimboarding, surfing, windsurfing, swimming & body surfing
  ◦ Wildlife viewing and sightseeing activities: Photography, sightseeing, scenic drives, and wildlife viewing from boats or shore

Additional data were provided by:
- **Industrial Economics and Cascade Economics**: Economic analyses of marine sectors including tourism and recreation
- **Washington Department of Ecology**: Public shoreline access locations
- National Park Service: Location of Olympic National Park boundaries

- **Washington Department of Natural Resources**: Location of Seashore Conservation Areas
- **National Oceanic and Atmospheric Administration**: Location of Olympic Coast National Marine Sanctuary boundaries and spatial data on recreational vessel transit
- **US Fish and Wildlife Service**: Location of National Wildlife Refuges
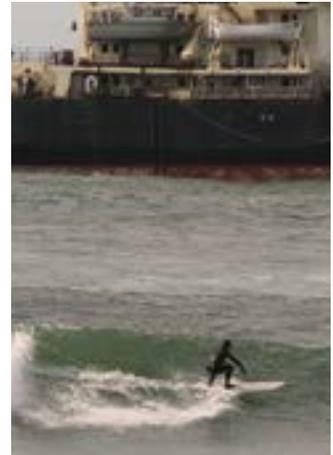
Products and Methods

Recreation data: To provide baseline data on the extent, intensity, and economic impacts of recreation and tourism in coastal Washington, the Surfrider Foundation, in collaboration with Point 97, conducted an online survey that asked respondents to map locations where they had participated in recreational activities within the study area, and to provide information on expenditures associated with trips to coastal Washington. Two sampling approaches were used, the first of which acquired data from a random sample representing all Washington residents. The second approach was an opt-in survey that allowed anyone to participate, with the goal of reaching a more targeted group of coastal users. This method helped provide a complete picture of activities occurring in the study area, including some activities which are important to the region and its economy but have a smaller number of users that may not have been represented using only statewide random sampling.

Spatial and statistical analyses were used to display activity results as "heat maps" showing areas of highest intensity for individual uses and groups of uses. Surfrider also provided a map showing overall use intensity based on the results, and a final report describing important trends, popular uses, and estimations of the economic value of recreation and tourism to the coast.

Economics: The sector analysis by Industrial Economics provides an overview of other available information on recreation and tourism in Washington State and the study area. Cascade Economics also conducted an analysis of Washington's coastal economies, using Surfrider's results as well as other economic data and studies. Cascade's final report assesses the importance of these sectors to three regions, individual communities, and the state as a whole, and discussed likely impacts to tourism and recreation from potential new uses.

Recreational vessel transit: The Olympic Coast National Marine Sanctuary (OCNMS) mapped recreational vessel traffic using similar data and methods to those described for other shipping layers (please see shipping data summary). Recreational vessel data includes personal craft like sailboats, motorboats, and small personal fishing vessels when they are using the study area for purposes other than fishing.

Remaining Data Gaps and Challenges

Recreational activity and vessel mapping: For the recreation study, over 17,000 data points were entered by respondents using an online mapping application. All points were included in the final analysis because, even if a few individual points were associated with minor user input errors, they provide valuable information about overall trip expenditures and the total numbers of users participating in each activity.

Vessel density analyses by OCNMS were primarily based on Automated Identification System data, which is not available for all small vessels. OCNMS consulted multiple sources to identify and track recreational ship transits in the study area, but some small vessels may not be represented in this data.

Economics: As noted in Cascade's report, the full economic impacts of some expenditures by out-of-state visitors (and thus the related employment and labor implications) are difficult to accurately assess and are not included in their analysis. Surfrider results only include expenditure and activity information for Washington State residents, and additional surveys would be necessary to provide comparable information for those visitors coming to the area from out of state.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.

Renewable Energy

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Renewable Energy

Data from the following sources provides information relevant to potential future offshore wind, wave, and tidal energy development within the MSP study area. Data was collected about existing infrastructure relevant to renewable energy facilities, as well as the technical suitability of Washington's marine waters for energy production. For more information on renewable energy, please refer to Section 2.10.1 of the MSP.

Major Data Sources

Information about renewable energy potential in the study area was provided by:

- **Pacific Northwest National Laboratory (PNNL)**: Technical suitability analysis for renewable ocean energy
- **Olympic Natural Resources Center**: Line of sight analysis for offshore facilities
- **Industrial Economics and Cascade Economics**: Economic analyses of marine sectors including renewable energy

Data on existing infrastructure relevant to offshore energy facilities was provided by:

- **US Army Corps of Engineers**: Location of ports
- **Bonneville Power Administration**: Location of transmission lines and substations
- **National Oceanic and Atmospheric Administration**: Location of submarine cables

Products and Methods

Technical suitability analysis: The Department of Energy's PNNL modeled offshore energy suitability off the coast of Washington for three types of wind technology, four types of wave technology, and one type of tidal energy technology. Suitability was determined based on factors including available energy resources, distance to shore support and electrical transmission infrastructure, water depth, and bottom sediment type. Results were calculated and mapped in ArcGIS. For this analysis, PNNL acquired technical specifications for renewable energy devices from industry advisors and the U.S. Department of Energy's Marine and Hydrokinetic Technology Database. Various federal, state, and academic sources provided spatial datasets describing existing conditions in the study area. A full list of data sources is available in the final project report on the MSP website.

Viewsheds: The Olympic Natural Resources Center provided a map showing the predicted visibility of offshore structures from land. Sight line distances were calculated and displayed in ArcGIS using a formula describing sight distance in terms of structure height, viewer height, and atmospheric conditions. Three potential facility heights were based on typical wind and wave structures, and three observer heights were based on viewing from the shoreline or a multistory onshore structure.

Economics: A sector analysis by Industrial Economics summarizes the potential economic implications of planning, constructing, and operating wind, tidal, and wave energy facilities off the coast of Washington. The authors describe the current status of the sector and predict future trends based on sources including the PNNL suitability analysis, other suitability studies in the US, expert interviews, and information on past research and development projects for marine renewable energy in Washington. Additionally, Cascade Economics conducted an analysis of Washington's coastal economies. This

report summarizes potential impacts of offshore renewable energy development on existing uses including fishing, aquaculture, recreation, and shipping.

Remaining Data Gaps and Challenges

Technical suitability: The final report provided by PNNL cites known uncertainty issues related to substrate information and data collected in shallow water, such as wave resource data. Additionally, it is unclear how rapidly renewable energy technology may advance in coming years, but changes in technology will affect assessments of the technical suitability of the study area for both pilot- and full-scale development.

Economics and market influences: PNNL's analysis focused only on technical requirements for development and did not incorporate detailed information related to the cost of planning, installing, or operating offshore energy facilities.

Marine renewable energy development is still a relatively new sector and has not occurred in the study area to date. So while economic data related to the renewable energy industry is available for other locations and at broader scales, Cascade Economics' report notes that quantitative information specific to the study area is limited. There are also unknowns related to some of the broader market and energy policy influences that could affect where renewable energy projects may actually be of interest to developers in the future.

For more detailed information on the planning process in Washington, specific data, or projects, or to use the interactive spatial data viewer, please visit the MSP website at *www.msp.wa.gov.* Links are also provided to some project reports or data sources.