MSP Potential New Use Literature Summary:
Marine Product Extraction

What is Marine Product Extraction?

Marine product extraction (also sometimes called bioextraction) is the practice of harvesting marine plants and animals to develop non-food related goods. Examples include anti-viral, anti-cancer, and anti-tumor agents used in medical treatments, anti-inflammatories in cosmetics, chemicals used in biomedical and cell biology research, and fatty amino acids in nutritional supplements. New genome sequences have also been discovered within marine organisms.

Researchers, universities, government agencies, and private companies use **marine bioprospecting** to search for novel chemicals for human health products. SCUBA diving, manned submersible vehicles, and remotely operated vehicles are current methods for marine bioprospecting.

Several phases occur between initial discovery and commercial sales of a developed product. Initial chemical discovery and genome sequencing often require small amounts of the target organism. Testing, clinical trials, and commercial sales will require greater amounts of availability.

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The required quantities of the marine organism and target chemical can be obtained by a few different methods:

- **Wild harvest** has been used to collect the required amounts of chemical for product development and sales. Harvest sustainability is dependent upon the organism, method of harvest, and desired quantities.
- **Aquaculture** of marine organisms to produce desired chemicals can be land-based or in-the-sea. The success of aquaculture for product supply depends on the husbandry needs for the organism, as well as specific environmental controls that stimulate the organism to produce the desired chemical.
- **Biotechnology** is used within laboratories to synthetically replicate chemicals. There are examples of this, but the methods are often too complex and costly to be effective at creating the desired quantities.

Why Marine Product Extraction?

Marine organisms represent a vast pool of potential new discoveries that can advance human health products. For example, anti-viral compounds to treat HIV were discovered in marine sponges. The potential for discovery is also quite large, and is predicted to be about 300 to 500 times larger than terrestrial sources. Marine biotechnology is currently a multi-billion dollar industry.

Potential Benefits and Use Compatibilities

- **Marine protected areas** may be a way to protect marine genetic reserves and be sources of future discoveries.
- No information was found related to other existing use compatibilities.

Environmental Concerns

- **Over-harvest and habitat degradation** remain a key concern for marine product extraction. Impacts strongly depend upon the intensity and frequency of harvest, organism life history, and quantities required.
- **Sustainable harvest may be achieved** through conservation measures such as harvest feasibility studies, sustainable collection methods, and harvest limitations.

Potential Use Conflicts

- No information was found on conflicting uses.
- Spatial conflicts are difficult to forecast because they are dependent upon the organism harvested, the method, intensity, and frequency of harvest, and other factors.

Future Trends and Factors in Washington

Based on the literature, it does not seem likely that the Washington coast is a primary target for marine bioprospecting and marine product extraction. However, the Plan's study area has some high biodiversity and extreme environments including seamounts, deep sea corals, and hydrothermal vents. Organisms within these habitats are predicted have the greatest potential to contain undiscovered genome sequences and chemicals. Therefore, as technology continues to expand the depths of the ocean to be explored, it is possible that novel chemicals and DNA sequences could be discovered within Plan waters.

MSP Potential New Use Literature Summary:
Offshore Aquaculture

What is Offshore Aquaculture?

Aquaculture, the culture or growing of fish, shellfish, or other aquatic plants and animals, is an active industry in Washington. All of Washington's marine aquaculture currently occurs close to shore, within bays, estuaries, and Puget Sound-there is no offshore aquaculture in the state.

There is no standard definition for offshore aquaculture. Offshore aquaculture typically occurs in deep water and is generally exposed to one or several of the following: strong waves, storms, swells, and currents. Given the physical exposure of Washington's Pacific coast, offshore aquaculture is currently defined within the Marine Spatial Plan as **any new aquaculture operation outside of the coastal estuaries**.

Current and Emerging Offshore Technologies

Finfish aquaculture uses two general types of cage designs:

- Surface cages: This type sits at the surface of the water. Surface cages are often referred to as net pens, which are currently used in offshore aquaculture in Norway and Chile.
- Submersible cages: This type can partially or fully submerge underwater to avoid rough seas. Some have nets, while other designs have a rigid outer cage.

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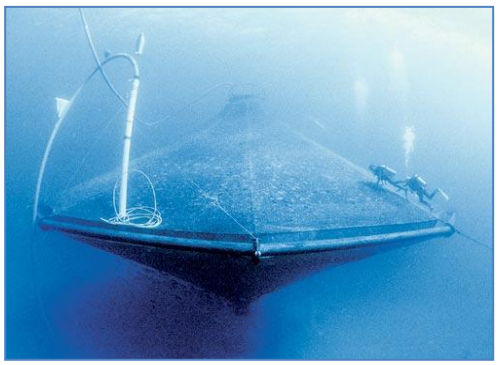


Shellfish aquaculture uses longlines moored to the seafloor. The shellfish are either directly attached to the lines or grown in net bags attached to the lines. Mussels and scallops are currently cultured offshore in many countries using this technique. Challenges for this technique include detachment of the shellfish from the lines in rough seas.

Marine plant aquaculture methods are similar to shellfish. Growing plants requires more sunlight and surface space compared to shellfish and finfish.

Why Offshore Aquaculture?

International food organizations have identified seafood as a promising option to provide a growing world population with high-quality protein. Coastal aquaculture is limited in space and site suitability, and wild capture fisheries will not be able to meet future seafood demand. Currently, all U.S. domestic aquaculture supplies only about 1.5% of American seafood demand. Several countries, including the U.S., are interested in increasing supplies of seafood protein to keep up with rising demand, and offshore aquaculture has been identified as a promising alternative.

Potential Benefits and Use Compatibilities

- Offshore aquaculture can minimize environmental impacts, improve seafood health, and reduce risk of disease when sited in **clean, well-flushed ocean waters** versus contaminated nearshore waters.
- Domestic aquaculture expansion can **increase seafood security** and decrease reliance on aquaculture products from other counties.
- Offshore aquaculture can **build off of existing aquaculture knowledge** and infrastructure and increase **jobs** in husbandry, cage supply, transportation, seafood processing, etc.
- Offshore sites can **decrease visual impacts** compared to coastal aquaculture.
- Shellfish culture could potentially be co-located with **marine renewable energy**.

Environmental Concerns

- **Food particles and feces accumulating on the seafloor** can change benthic chemistry and community composition. Well-flushed sites and avoidance of sensitive habitats is expected to minimize this impact.
- **Interactions between cages and wild fish, sharks, and mammals** have been discussed in the literature as a concern. Cages act as fish aggregation devices. Management practices are used to prevent injury and avoid interactions with mammals.
- **Chemical contaminants** such as antibiotics and anti-foulants are a concern, although their use has declined.
- **Water quality** is a low concern in deep, well-flushed sites.
- Several state and federal regulations are in place to prevent and minimize **disease transmission**.

Potential Use Conflicts

- Use conflicts listed in the literature include **commercial and recreational fisheries**, **recreational activities**, **shipping**, **military uses**, **cable installation**, **mining**, and **dredge disposal**. In particular, cages, longlines, and moorings create space and safety conflicts with navigation, fishing equipment, and SCUBA diving.

Other Concerns

- **Competition with commercial fisheries** may cause seafood prices to decline. The literature predicts that market competition between commercial fisheries and aquaculture will be a global phenomenon as aquaculture expands.

Future Trends and Factors in Washington

Washington has a strong foundation in aquaculture for offshore operations to build upon, and some have indicated offshore potential in the Pacific Northwest. The growing demand for seafood and the limited number of suitable nearshore sites are key drivers for exploring offshore aquaculture. However, the physical conditions off the Washington coast restrict the technology and cost feasibility of offshore aquaculture. Safe and consistent access to offshore sites and space conflicts are also currently key limitations.

MSP Potential Expanded Use Literature Summary:
Dredge Disposal in New Locations

What is Dredge Disposal?

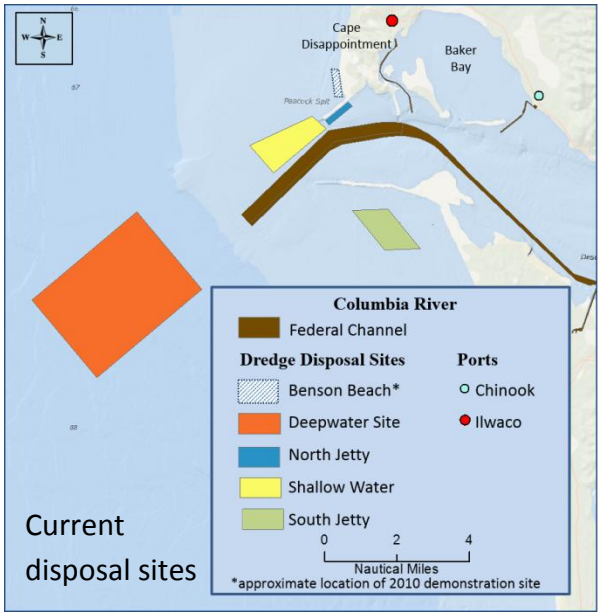
Navigation channels in Grays Harbor, the Mouth of the Columbia River, and other locations within the Plan area require frequent dredging to maintain vessel access to critical port infrastructure and services. In some locations, millions of cubic yards are dredged annually to keep navigation channels safe and accessible.

The majority of the dredged material is disposed of in-water at specific disposal sites. Current disposal types include:

- **Nearshore and on-shore beneficial use** sites keep sediment within the nearshore system, which can minimize erosion. These sites have boundaries, and sediment can accumulate on the seafloor. These sites are designed for the sediment to disperse over time.
- **Flow lane** sites are generally used for relatively small volumes of material. The material is placed in scour channels, and does not accumulate on the seafloor.
- **Deep water** sites are located offshore in federal waters. Sediment disposed at deep water sites is effectively removed from the nearshore system.

Current Dredge Disposal in Washington

- Grays Harbor: 5 active disposal locations (nearshore and onshore use)
- Mouth of the Columbia River (MCR): 4 active disposal locations (nearshore use and deepwater)
- Willapa Bay: Flow lanes
- La Push: 2 beneficial use sites



Current disposal sites

Why New Disposal Locations?

There are a few different reasons why new disposal sites may be created. At the MCR, current nearshore sites have limited capacity and accessibility, so the MCR regional sediment management team has recommended expanding the network of nearshore disposal sites to limit the use of existing disposal sites and increase beneficial use of sediment in the nearshore. In Willapa Bay, some ports are considering new flow lanes in locations where small dredges and volumes of material make the use of flow lanes more cost effective than established disposal sites. In other areas, agencies are recommending shifting some disposal locations in order to accommodate natural changes within scour channels.

Potential Benefits and Use Compatibilities

- Maximizing beneficial use of sediment can minimize erosion and provide benefits for:
  - Recreation and tourism
  - Coastal hazard protection

Environmental Concerns

- **Dungeness crab** are at risk of direct burial from dredge disposal. Current research is studying the mortality and behavior of crab at disposal sites to assess the extent of the risk. Mitigation measures may include thin-layer dispersal to minimize mortality.
- **Razor clams and other benthic invertebrates** are also at risk for direct burial. Studies suggest 100% razor clam survival in 12 cm or less of dredge disposal. Studies have indicated that benthic invertebrates such as polycheates and echinoderms will be impacted, but are expected to recover rapidly.
- **Marine fish, birds and mammals** are anticipated to have low impacts from dredge disposal. Not much information is known about these impacts.

Potential Use Conflicts

- The **Dungeness crab fishery** has concerns about disposal in shallow areas used heavily by fishermen. Conflicts include possible reductions of Dungeness crab catch, as well as loss of crab pots. Current mitigation measures include monitoring for crab “hot spots” and crab pots, and communicating with crab fishermen before disposal.
- **Navigational safety** can be put at risk if mounding of the disposal material is significant enough to amplify waves at the surface. The Mouth of the Columbia River Regional Sediment Management Plan recommends no more than 10% wave amplification above baseline conditions. The Army Corps of Engineers regularly monitors their sites for wave amplification from mounding.

Future Trends and Factors in Washington

- The **Mouth of the Columbia River** Regional Sediment Management Plan identified two potential new locations for dredge disposal. An onshore site at Benson Beach has been a demonstration project, but there are concerns about the safety and cost effectiveness of this site. A proposed North Head nearshore site is currently under consideration.
- Two sites at **Grays Harbor** may undergo small shifts in locations. The South Jetty site may be shifted slightly northward to accommodate the shifting scour channel. The Point Chehalis open water site may undergo a one-time northwestern shift in order to accommodate the additional material from the Grays Harbor channel deepening.
- Additional flow lanes in **Willapa Bay** may be established in the future for small port dredging.

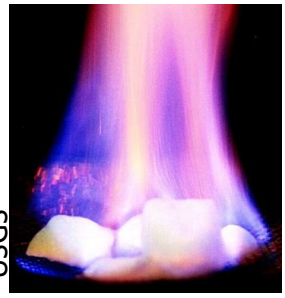
MSP Potential New Use Literature Summary:
Mining Gas Hydrates

What are Gas Hydrates?

Gas hydrates are a mixture of gas and water which, under low temperature and high pressures, forms a solid ice-like structure in marine sediments. Methane is the main type of gas in hydrates. When methane hydrates are exposed to warmer temperatures or lower pressures, the hydrates "dissociate" and release methane gas. Preliminary research suggests traditional oil and gas equipment and infrastructure can be successfully adapted to mine gas hydrates. Globally, no commercial methane mining activities currently exist, and no projects are proposed for offshore Washington.

Why Mine for Gas Hydrates?

Methane is a natural gas that can be used for energy production. Methane hydrates are estimated to be the world's largest source of organic carbon. The United States Congress identifed the potential for methane hydrates to help alleviate the projected shortfall of natural gas supplies, and has contributed substantial funding for researching gas hydrates.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Potential Benefits and Use Compatibilities

Recreational fisheries could benefit from fish aggregations around platforms.

Environmental Concerns

We expect many of the main environmental concerns to be similar to offshore oil and gas activities including: **noise** from seismic surveys, platform construction, and vessel operations; **water quality** impacts from hydrocarbons and chemicals; **air quality** impacts; **benthic habitat** disturbance; impacts to **marine mammals, birds, fish, and sea turtles**; and **hazards** from leaks, spills, and loss of well control.

Potential Use Conflicts

Commercial and recreational fisheries could be impacted through displacement, changes in fish location and behavior, and loss of fishing gear. **Tourism and recreation** could be affected by visual impacts to boating and sightseeing. **Shipwrecks and other archaeological** sites could also be impacted.

Future Trends and Factors in Washington

The Washington coastal margin has significant amounts of methane hydrates. However, the hydrates are generally widely dispersed and therefore not a high target for resource extraction. Current research efforts are focused on highly concentrated hydrate sites in the Gulf of Mexico and the Atlantic coastal margin.

MSP Potential New Use Literature Summary:
Mining Marine Sand and Gravel

What is Marine Sand and Gravel Mining?

Sand and gravel mining is the dredging of sand or gravel from the seafloor for use in beach nourishment, coastal hazard defense, and other uses such as upland construction. Suction dredges are used to extract the material, which is stored and transported by ship, barge, or pipeline to a beach or re-handling area.

Why Mine for Marine Sand and Gravel?

Sand and gravel are mined more than any other resource in the world, yet they are limited resources. Land development, decreasing land-based supplies, and climate change are shifting sand and gravel mining to marine waters. The U.S. East Coast has a high demand for offshore sand to renourish beaches and provide coastal defense against storms and climate change. Worldwide demand for sand and gravel is expected to increase.

Potential Benefits and Use Compatibilities

Mining used for beach nourishment and coastal protection projects may benefit **coastal communities and infrastructure** as well as beach **recreation and tourism** and **coastal habitats**.

Environmental Concerns

- **Benthic species and habitats** will be directly impacted by the dredge. Seafloor community recovery can take over 3-5 years, and community composition in dredge "pits" may change.
- **Bottom fish** could be affected if dredging occurs in their habitat.
- **Noise, vessels strikes, water quality,** and **ecosystem effects** are also concerns.

Potential Use Conflicts

Commercial and recreational fisheries could be impacted by: increased vessel traffic, restricted access to fishing grounds, gear loss, and changes to fish ecology. **Archaeological sites**, **marine renewable energy**, and **methane hydrate mining** are also not compatible with sand/gravel mining.

Future Trends and Factors in Washington

Washington's seafloor contains significant amounts of sand and gravel. Current local demand for sand and gravel is low, but decreasing land supplies, coastal population growth, increased storms, and sea level rise may increase future demand. Cost and logistics may limit the sand available from navigation dredging for beach projects, which may influence demand for offshore sand. To date, BOEM has not assessed Washington offshore lease blocks for sand and gravel mining for beach nourishment.