

Overview of mariculture suitability along Oregon's coast: A spatial assessment

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Acknowledgments

This overview is a summary of the full report titled *Spatial Assessment of Mariculture Suitability Along Oregon's Coast*. Both products are the result of a multiyear project funded by The Chicago Community Foundation at the recommendation of Builders Vision, aimed at examining and creating mariculture opportunities in coastal Oregon communities and pursuing restorative aquaculture activities that can accompany mariculture operations. Builders Vision has been a driving force in supporting new mariculture operations, focusing on native species of seaweed and invertebrates on the West Coast.

From 2022 to 2026, Builders Vision supported five organizations in Oregon—collectively known as the Oregon Coastal Mariculture Collaborative (OCMC)—that include Ecotrust, the Oregon Aquaculture Association, the Oregon Kelp Alliance, Oregon Sea Grant, and The Nature Conservancy (TNC). The spatial assessment was developed by Geo Horizons, LLC, with advice from OCMC and TNC's Michael Schindel. TNC coordinated the assessment.

For more information

The full report associated with this overview, titled *Spatial Assessment of Mariculture Suitability Along Oregon's Coast* (Jossart et al., 2026), can be found at www.conservationsgateway.org/collections/oregon/spatial-assessment-of-mariculture-suitability-along-oregons-coast/.

Data are available for viewing and download via the Oregon Coastal Atlas (coastalatlas.net/MaricultureSuitability). The atlas is maintained by the Oregon Department of Land Conservation and Development.

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Acronyms

GIS	geographic information system
NOAA	National Oceanic and Atmospheric Administration
OCMC	Oregon Coastal Mariculture Collaborative
TNC	The Nature Conservancy

1. Executive summary

Mariculture has become a priority at global and local levels as population growth has increased demand for seafood products. At the same time, nearshore ecosystems are suffering from impacts affecting the critical services they provide. Sustainable mariculture can help restore estuaries and nearshore kelp beds while substantially delivering foods and livelihoods.

The Nature Conservancy's *Spatial Assessment of Mariculture Suitability Along Oregon's Coast* (Jossart et al., 2026), a longer, more technical companion to this overview, provides some essential first steps in locating seafood industries on the Oregon Coast. The assessment analyzed the specific habitat needs of nine native shellfish and seaweed species in both estuaries and coastal environments. Species included Olympia oysters, abalone, two species of mussels, sea urchins, dulse seaweed, bull kelp, sugar kelp, and ribbon/winged kelp, all cultivated in accordance with current and future best practices. Oregon currently has a limited mariculture industry focused on Pacific oyster production. A data-driven process developed in a geographic information system (GIS) framework identified priority locations for

cultivating each species. Data used in the assessment included both environmental and management variables needed for establishing mariculture farms.

Findings from Jossart et al. (2026) showed that an additional 1,485 ac in estuaries could be put into Olympia oyster production, as well as considerable capacity to raise tank-cultured sea urchins and dulse seaweed at three additional sites. In the coastal ocean, the assessment identified 78,526 ac of potential area suitable for bull kelp line cultivation, with many more acres suitable for other kelp species as well as mussel cultivation. Gold Beach ranked highest among coastal areas for potential mariculture, with Port Orford ranking second. Five estuaries were highly suitable for expanded mariculture operations: Tillamook, Netarts, Yaquina, Umpqua, and Coos Bay.

Overall, the assessment affirms that Oregon has great potential to develop new, successful mariculture operations. These efforts can be located near essential estuary and coastal habitats, such as kelp beds, and have the potential to play a key role in their restoration.

Figure 1. Dulse seaweed growing at the Hatfield Marine Science Center in Newport, OR.
Photo by Tiffany Woods, Oregon Sea Grant. CC BY-NC-SA 2.0.



2. Benefits of mariculture

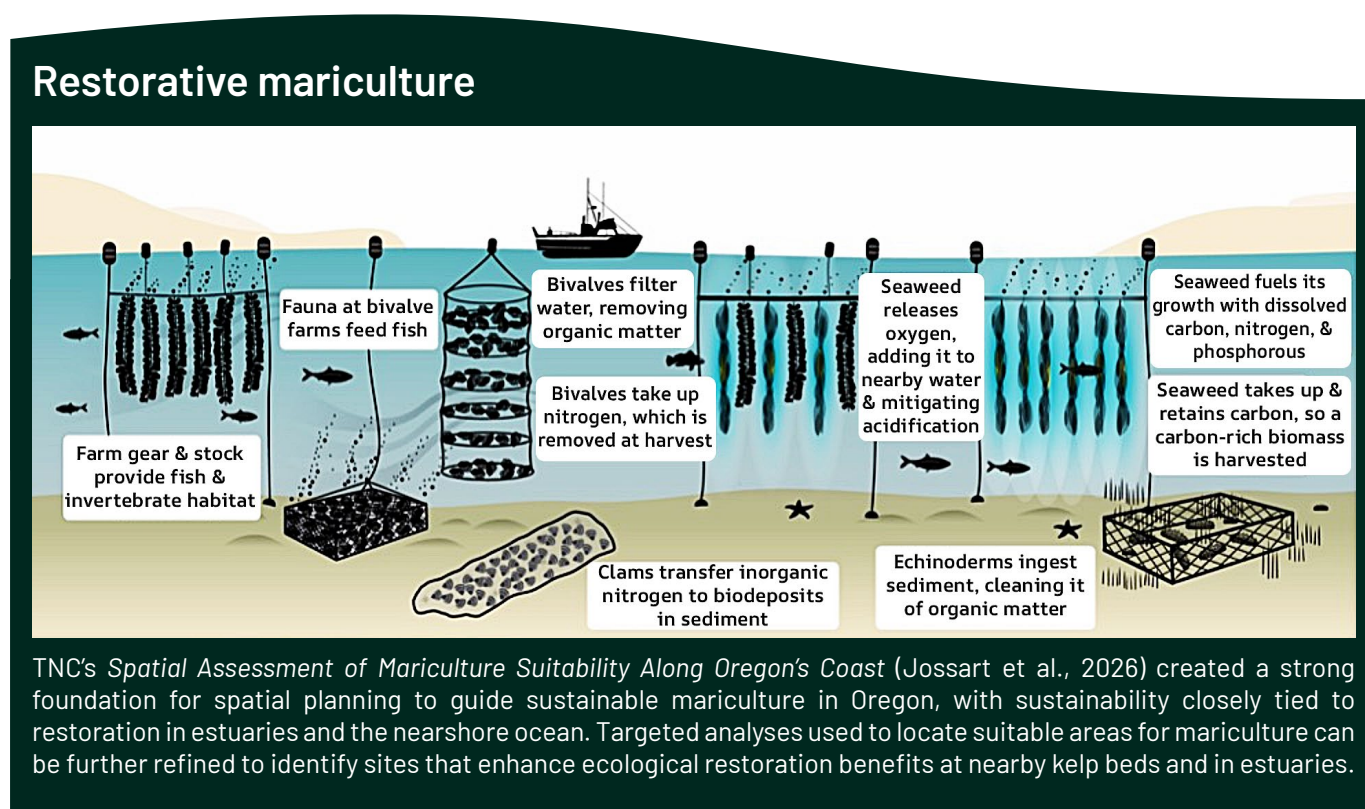
Theuerkauf et al. (2019) explained that coastal ecosystem resources, including seafood, are facing growing demands that coincide with population growth. *Mariculture* (i.e., sea-based aquaculture) is one of the fastest-growing sectors for food production, given increasing seafood consumption, wild harvests that fail to keep pace, and the limits on land-based agriculture. “Evidence increasingly indicates that aquaculture production of certain species groups, such as bivalve shellfish and seaweeds, has the potential to provide valuable ecosystem services that may allow aquaculture to serve as a tool to facilitate coastal ecosystem recovery [Gentry et al., 2019]” (Theuerkauf et al., 2019).

Habitats created by marine species, such as oyster reefs and kelp forests, generate essential benefits but suffer from overharvesting, pollution, and other human activities. Commercial mariculture could help these habitats and their broader ecosystems recover, particularly when public funds are unavaila-

ble to aid in restoration (Theuerkauf et al., 2019). Mariculture that pursues a combined focus on profitability and habitat restoration is known as *restorative mariculture* (Figure 2).

Sustainable growth of mariculture has increasingly emerged as a priority at global, national, and state levels (Considine et al., 2023; Ehrhart & Doerr, 2022; Food and Agriculture Organization of the United Nations, 2020; National Oceanic and Atmospheric Administration [NOAA], 2021). The development of mariculture—particularly shellfish and seaweed farming—offers a dual opportunity: (1) supporting the restoration and resilience of marine ecosystems and (2) driving economic growth by creating jobs, revitalizing working waterfronts, and expanding domestic seafood production and exports (NOAA, 2021; Theuerkauf et al., 2021). In Oregon, where approximately 90% of seafood is sourced from outside the state, mariculture presents a particularly compelling opportunity to enhance local seafood

Figure 2. The opportunity: Restorative aquaculture can actively benefit aquatic health. From Theuerkauf et al. (2021) and modified by The Nature Conservancy (TNC) Global Aquaculture Program 2025.



availability while fostering the restoration of productive estuary and nearshore habitats (Ehrhart & Doerr, 2022). A TNC study identified Oregon, Washington, and Vancouver, British Columbia, as the top marine ecoregions in North America, where seaweed aquaculture could be environmentally beneficial, socially acceptable, and economically viable (Theuerkauf et al., 2019).

Mariculture is increasingly recognized as a priority within the broader framework of blue economic growth (NOAA, 2021). Guiding this growth through responsible siting and management can minimize its potential impact and contribute to a more balanced and orderly development of mariculture operations (Lester et al., 2018).

Is there a role for Oregon in developing more mariculture operations that will support our coastal communities without impacting current marine-related activities or increasing threats to the ocean?

3. Oregon mariculture context

TNC's *Spatial Assessment of Mariculture Suitability Along Oregon's Coast* set out to answer the question above—to identify estuary and nearshore coastal ocean areas with the potential for future seaweed and shellfish mariculture. Hereafter, TNC's assessment will be referred to as the *Oregon mariculture spatial assessment*, or merely the *spatial assessment*. Both terms refer to the TNC work by Jossart et al. (2026). The spatial assessment helped guide siting decisions initially identified in the *Situation Analysis for Oregon's Emergent Seaweed Aquaculture Industry* (Considine et al., 2023). It used data analysis crafted in a geographic information system (GIS) platform to build a foundation for establishing a mariculture sector that is environmentally responsible, community-supported, and economically viable.

3.1. Oysters

Commercial mariculture in Oregon state waters currently occurs in six estuaries—Tillamook Bay, Netarts Bay, Yaquina Bay, Umpqua Estuary, Coos Bay, and the Coquille Estuary (Figure 3). These estuaries support a mariculture industry dominated by oyster farming (Ehrhart & Doerr, 2022). Farmers employ a

range of gear types—including bottom culture, trays, stakes, longlines, racks, rafts, and floating bags—tailored to each estuary's salinity, sediment, and growing conditions. Production primarily involves three species:

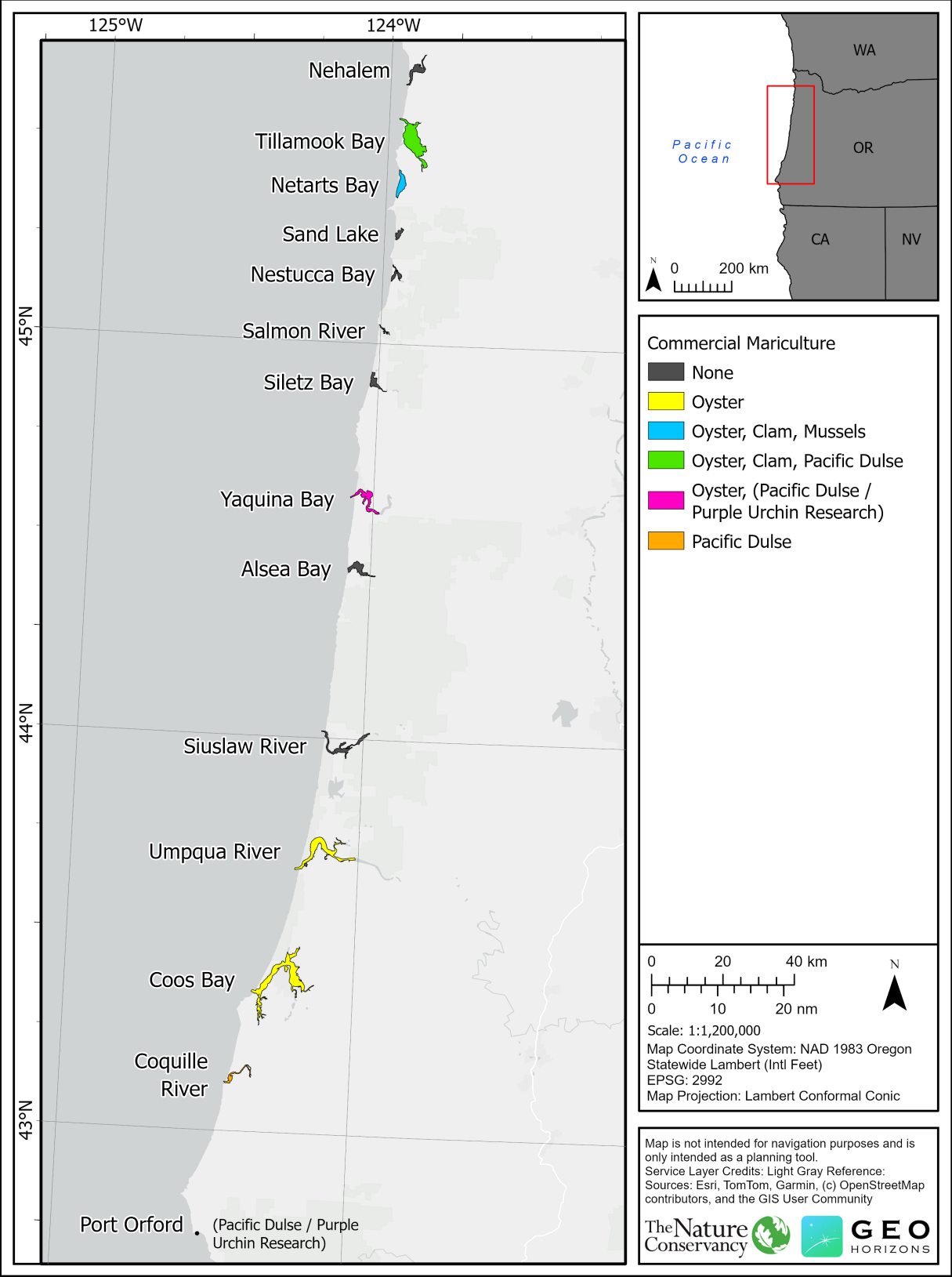
- **Pacific oyster** — By far the most widely farmed species statewide and the cornerstone of Oregon's shellfish aquaculture industry. The Pacific oyster dominates commercial leases due to its rapid growth and high salinity tolerance (Barton et al., 2012; Ehrhart & Doerr, 2022).
- **Kumamoto oyster** — Cultivated in smaller quantities, with its slower growth and deep-cupped shell valued for premium half-shell markets.
- **Olympia oyster** — Oregon's only native oyster species. Once commercially harvested, it is now the focus of restoration efforts due to major population declines. A small incidental harvest occurs in Yaquina Bay in conjunction with the cultivation of Pacific oysters.

3.2. Seaweed and sea urchins

Beyond oysters, Oregon hosts two commercial Pacific dulse seaweed operations in Garibaldi and Bandon, situated in land-based tanks supplied with tidal seawater (Considine et al., 2023). Dulse is cultivated for human consumption and specialty applications and is used experimentally to feed purple sea urchins in co-culture systems that generate marketable *uni*, sea urchin roe that is a delicacy often served with sushi. The cultivated sea urchins have been removed from former kelp beds that were decimated by the urchin population explosion in recent years.

No in-water seaweed farms operate in Oregon's marine waters, yet the state's coastal ecosystems are noted as a top North American region for restorative aquaculture due to favorable environmental, social, and economic conditions (Theuerkauf et al., 2019). Exploring the feasibility of cultivating native kelps, such as bull kelp and sugar kelp, was a primary goal of the Oregon mariculture spatial assessment. Native kelps are well suited to Oregon's high-energy coastal environment and could enhance kelp bed restoration, thus supporting biodiversity conservation and carbon sequestration in these critical habitats (O'Shea et al., 2019; Theuerkauf et al., 2021).

Figure 3. Overview of commercial mariculture in Oregon based on the Commercial Shellfish Plats 2021 (Oregon Department of Agriculture, 2021) and known commercial and research tank-based operations for Pacific dulse and purple sea urchins. From Jossart et al. (2026).



4. Spatial assessment approach

4.1. Project goals

The Oregon Coastal Mariculture Collaborative (OCMC)—a partnership among Ecotrust, the Oregon Aquaculture Association, the Oregon Kelp Alliance, Oregon Sea Grant, and TNC—has been working collectively to advance responsibly sited, restorative mariculture along Oregon’s coast. OCMC supports the expansion of native shellfish and seaweed in ways that strengthen ecological, cultural, and economic outcomes. The Oregon mariculture spatial assessment has provided a robust evaluation of mariculture opportunities by accounting for current and competing estuary and ocean uses, as well as a broad spectrum of environmental conditions necessary for the successful siting, operation, and cultivation of new mariculture ventures.

4.2. Study area

The study area for the spatial assessment (Figure 4) consisted of 897,492 ac of Oregon’s coastal ocean waters, including estuarine waters (93,880 ac). Due to the different gear types used, logistical considerations, data availability, and species tolerances that exist between coastal ocean and estuarine waters, two subareas (Estuary and Coastal) were developed within the study area for subsequent analyses.

4.3. Candidate shellfish and seaweed species selection

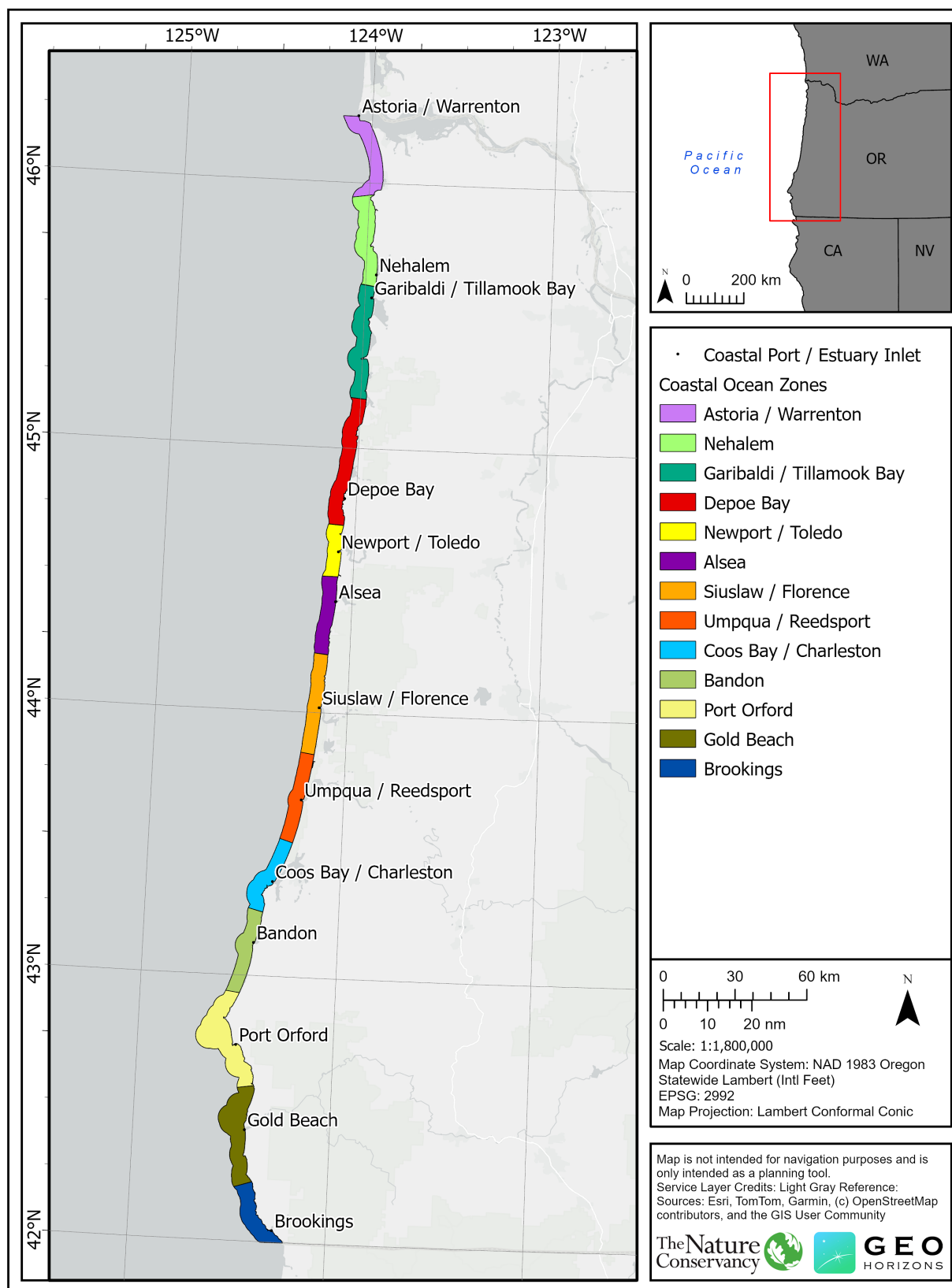
Priority native shellfish and seaweed species were identified for spatial analyses (Table 1). These included species currently cultivated in Oregon waters or considered for future cultivation. Non-native species, such as the Pacific oyster, were excluded from further analysis with the understanding that they will continue to play a role in the mariculture industry in Oregon. Given the high uncertainty and data limitations within estuarine environments, a species-specific kelp model was not feasible. Instead, a generalized “kelp species” model was developed using environmental tolerances for multiple kelps.

Commonly used cultivation gear associated with shellfish and seaweed mariculture was considered in the analysis. Gear categories included subtidal gear (floating or submerged cultivation systems deployed below the water surface), tank culture (land-based mariculture operations using tanks), rope or raft culture (floating rafts with vertically suspended ropes or lines), horizontal line culture systems, and planted-on-bottom approaches, in which seaweed are affixed to natural or artificial substrates and allowed to grow in situ for commercial cultivation or restoration purposes.

Table 1. Mariculture species and gear included in the spatial analysis. From Jossart et al. (2026).

Study area	Species	Gear
Estuary	Olympia oyster (<i>Ostrea lurida</i>)	Subtidal gear
Estuary	Purple sea urchin (<i>Strongylocentrotus purpuratus</i>)	Tank culture
Estuary	Pacific blue mussel (<i>Mytilus trossulus</i>)	Line culture
Estuary	Pacific dulse (<i>Devaleraea mollis</i> ; syn. <i>Palmaria mollis</i>)	Tank culture
Estuary	Kelp species	Line culture
Coastal	Red abalone or flat abalone (<i>Haliotis rufescens</i> or <i>H. walallensis</i>)	Tank culture
Coastal	Pacific blue mussel (<i>M. trossulus</i>)	Line culture
Coastal	California mussel (<i>Mytilus californianus</i>)	Line culture
Coastal	Bull kelp (<i>Nereocystis luetkeana</i>)	Line culture
Coastal	Bull kelp (<i>N. luetkeana</i>)	Planted on bottom
Coastal	Sugar kelp (<i>Saccharina latissima</i>)	Line culture
Coastal	Ribbon/winged kelp (<i>Alaria marginata</i>)	Line culture
Coastal	Giant kelp (<i>Macrocystis pyrifera</i> ; syn. <i>M. integrifolia</i>)	Line culture

Figure 4. Coastal zones and estuary subareas. Note that coastal zones extend along the coastline and are named for the nearby port. From Jossart et al. (2026).



4.4. Assessment methods

The findings from the Oregon mariculture spatial assessment were derived from a comprehensive data-driven analysis that stepped through the following approach (also illustrated in Figure 5):

1. An Exclusion Model identified and removed areas known to be incompatible with mariculture.
2. An Opportunity Model assessed the ability of priority species to be cultivated.
3. A Suitability Model identified optimal locations termed *highly suitable areas* for priority species based on five variables: Biophysical, Logistics, Industry, Natural and Cultural Resources, and Mariculture/Fisheries.
4. A Ranking Model prioritized the top sites for shellfish and seaweed mariculture in coastal and estuary areas.

The Ranking Model began with the highly suitable areas, which were the outcomes from the Suitability Model, and then factored in many of the variables used in the Suitability Model.

Once the analysis was completed, the assessment's researchers interpreted the results to develop recommendations for future shellfish and seaweed mariculture operations along Oregon's coast. A geo-database of data layers and analytical models is available at Oregon Coastal Atlas (coastalatlas.net/MaricultureSuitability). The atlas is maintained by the Oregon Department of Land Conservation and Development.

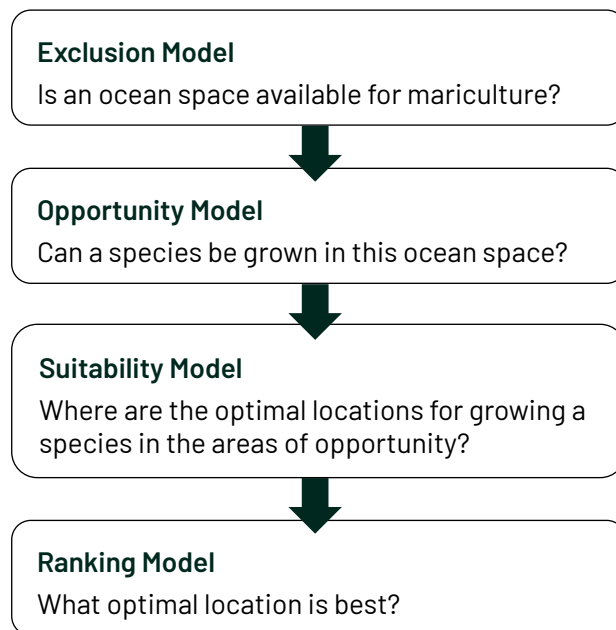
5. Spatial assessment findings

The spatial assessment confirmed that many Oregon sites have incredible potential for expanded mariculture in estuaries and in ocean subareas. These opportunities include expanded Olympia oyster farming in estuaries, kelp production in many sites along the southern coast, and mussels on raft culture in both subareas.

5.1. Estuary subarea

Estuaries were analyzed for new in-water mariculture opportunities focused on seaweed, Olympia oysters, and mussels. Olympia oyster mariculture

Figure 5. Definition of model types used in this spatial analysis. From Jossart et al. (2026).



using subtidal gear exhibited the largest extent of highly suitable area among the species-gear combinations evaluated, totaling 1,485 ac. The greatest concentration of highly suitable acres was identified in Coos Bay and the Umpqua River estuary, followed by Yaquina and Tillamook Bay. Cultivation of Pacific blue mussels could potentially be farmed on 1,133 ac, and co-culture of mussels and kelp seaweed could occur on 519 ac. Kelp alone has the potential to be farmed on 521 ac in estuaries.

The analysis for purple sea urchin mariculture using tank culture (e.g., Figure 7) identified 503 ac of highly suitable area, with the largest areas located in Yaquina Bay, Coos Bay, and the Umpqua River estuary. Tank-cultured dulse seaweed suitability in estuaries largely mirrored the sites found suitable for sea urchin culture.

5.2. Coastal subarea

A total of 158,220 ac of the subarea were identified as highly suitable for kelp production, with 78,526 ac specifically suitable for bull kelp operations using line culture and 13,649 ac for planted bull kelp cultivation. The greatest extent of kelp potential occurred along the southern Oregon Coast, with Gold

Figure 6. Workers harvesting in Yaquina Bay at Oregon Oyster Farms Inc. An example of raft culture. [Photo](#) by Lynn Ketchum, [Oregon Sea Grant](#). CC BY-NC-SA 2.0.



Beach, Port Orford, Brookings, and Bandon showing high suitability. Sugar kelp, ribbon/winged kelp, and giant kelp added more suitable acres to those identified solely for bull kelp along the southern coast. Lower ocean salinity attributed to the Columbia River plume contributed to the limited suitability for kelp mariculture along Oregon's northern coast.

Highly suitable coastal sites for mussel mariculture were extensive, totaling 146,602 ac, with southern coastal sites being most suitable. Abalone tank cultivation was shown to be suitable on 3,708 coastal acres, predominantly near Gold Beach, Yaquina, Nehalem, Alsea, and Port Orford. The co-culture of seaweed and mussels was shown to have 55,827 ac of highly suitable area available for potential development.

5.3. Overall mariculture ranking

In the Coastal subarea, Gold Beach ranked highest for mariculture overall, regardless of species or gear type. This finding was driven by Gold Beach having the greatest extent of highly suitable area for mari-

culture operations and the second-highest suitability ranking among seaweed species for the Biophysical variable. These factors ensured Gold Beach's top ranking despite its relatively higher interactions per the model's Fisheries variable. Port Orford ranked second, characterized by a large amount of highly suitable area and lower interactions with fisheries, though with comparatively lower Biophysical suitability for seaweed cultivation.

The three lowest-ranked coastal sites—Newport/ Toledo, Nehalem, and Astoria/Warrenton—were characterized by limited extents of highly suitable area, less favorable Biophysical suitability, and higher levels of interaction with fisheries. It is important to note that classifications of high or low interactions with commercial or recreational fisheries, determined by the spatial assessment's Fisheries variable, reflect average conditions across each coastal site and do not imply uniform interaction throughout the entire site. Site-specific evaluation would be required to fully assess potential interactions between proposed mariculture operations and existing fisheries within any given coastal site.

Figure 7. Bandon dulse and urchin tank culture. Photo courtesy of Ecotrust.



Of the 15 estuaries evaluated within the Estuary sub-area, only five were identified with highly suitable areas: Tillamook, Netarts, Yaquina, Umpqua, and Coos Bay. Overall, the Logistics scores of all five estuaries were similar, and the Biophysical scores were similar, other than Netarts, which had a perfect Biophysical score of 1.0. Therefore, the largest driver of the overall ranking was the highly suitable area and the presence of enterprise zones that support industry development in ports. Coos Bay and the Umpqua River have the greatest amounts of suitable area and have established enterprise zones. Tillamook Bay and Yaquina Bay ranked the lowest, with less highly suitable area than the other estuaries and with large acreages dominated by eelgrass that were excluded in the Exclusion Analysis.

6. A deeper dive into suitability

6.1. Olympia oyster mariculture

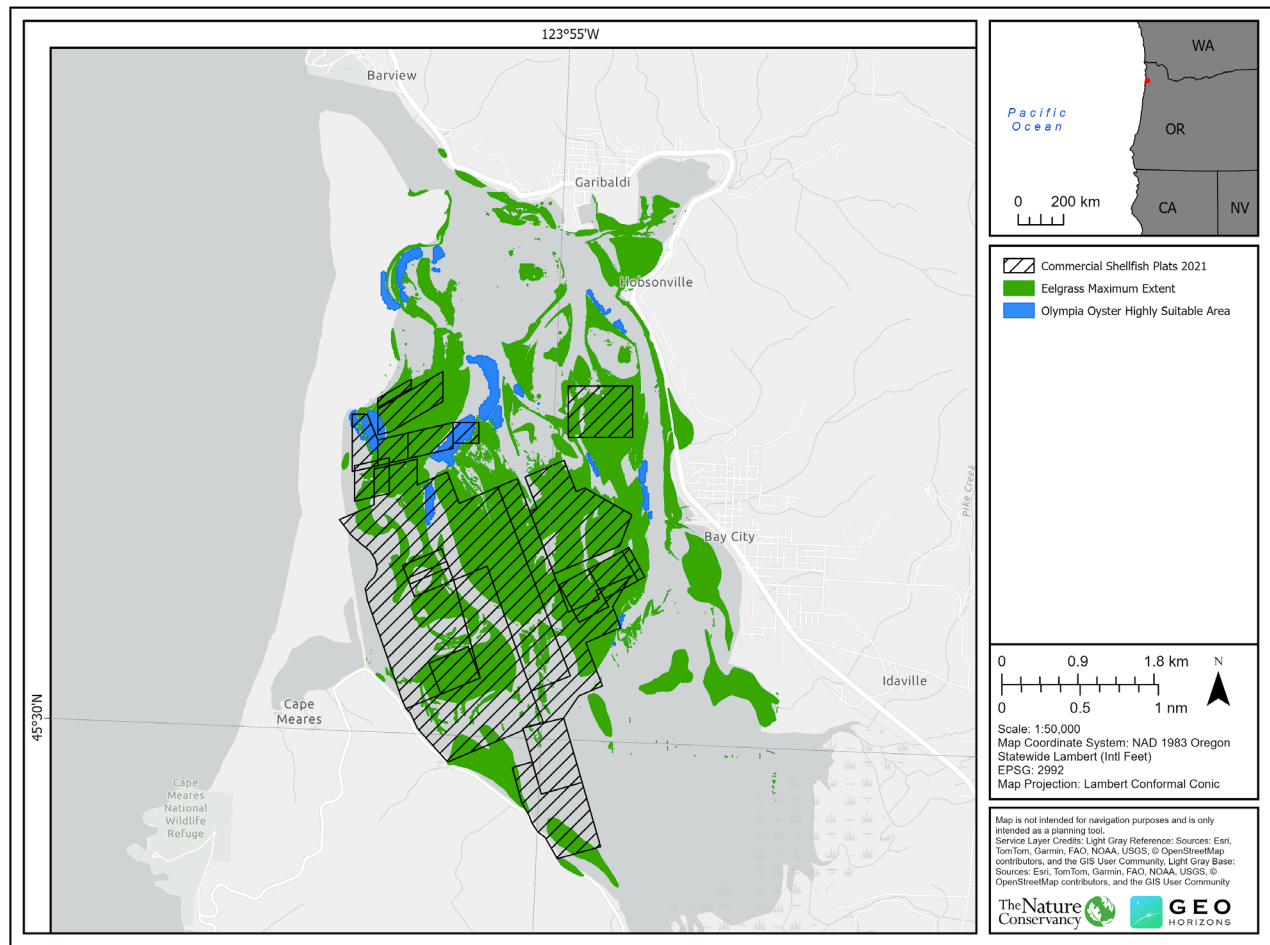
Olympia oyster mariculture (e.g., Figure 8) provides a window into the results for mariculture opportunities in estuaries. Most highly suitable areas identified by TNC's spatial assessment occur in estuaries

where Olympia oysters are already present, although much of the modeled highly suitable area was found to lie outside existing shellfish plats. This pattern suggests there is potential room for expansion, with the caveat that limitations in the available data may be influencing results.

Figure 8. Olympia oysters on cultch shell, Netarts Bay. Photo by TNC.



Figure 9. Eelgrass, current shellfish plats, and Olympia oyster highly suitable area overlap in Tillamook Bay. From Jossart et al. (2026).



An additional consideration of future Olympia oyster cultivation is that it may conflict with existing oyster leases and eelgrass habitats. Tillamook Bay offers a good example of this conflict, with eelgrass covering vast acreages in the bay (Figures 9 and 10).

6.2. Purple sea urchin – tank culture

The spatial assessment results suggest that there is substantial potential to expand the mariculture of purple sea urchins into additional sites; however, significant uncertainty remains, particularly related to the availability and cost of land-based infrastructure. Highly suitable areas for purple sea urchin mariculture (e.g., Figure 11) were present in four estuaries, with only one—Tillamook Bay—currently supporting an active tank-based operation, for dulse seaweed production. Bandon, located in the Coquille

River estuary, currently hosts a purple sea urchin and dulse operation, but the model did not identify it as highly suitable due to limited supporting infrastructure, including the absence of nearby seafood processing facilities and cold storage.

6.3. Bull kelp – line culture

Bull kelp is the most likely initial target species for coastal seaweed mariculture in Oregon. It could contribute to the needed restoration of kelp beds that are dominated by bull kelp in Southern Oregon, and current pilot projects show bull kelp mariculture to be viable off Port Orford.

The Oregon mariculture spatial assessment identified highly suitable areas across the six southernmost coastal ocean areas, driven primarily by more favorable biophysical conditions for bull kelp mari-

Is mariculture compatible with eelgrass?

Eelgrass is a submerged aquatic plant that is essential fish habitat in estuaries. It provides food and shelter for many marine species and can be susceptible to disturbance from boating, dredging, and other activities common in bays and estuaries. Some people say that mariculture benefits eelgrass, while others say it can harm it.

Figure 10. Eelgrass and mariculture compatibility.



Figure 11. Sea urchins and dulse. Bandon seaweed facility. Photo by Lynn Ketchum, Oregon Sea Grant. CC BY-NC-SA 2.0.



Figure 12. Bull kelp cultivation. Hog Island Oyster Company. Humboldt Bay, CA. Photo courtesy of GreenWave.

culture (Figure 12). Port Orford ranked highest overall, due to its relatively large extent of highly suitable area with minimal interaction with fisheries. Other kelp species considered in the assessment have different biophysical requirements that may allow them to thrive along the northern Oregon Coast, as well as along the southern coast.

6.4. Kelp cultivation in estuaries

Sugar kelp may be well suited for cultivation in Oregon estuaries with its tolerance for lower salinities and its tendency to grow closer to the surface. In contrast, bull kelp and giant kelp typically require higher salinities, greater depths, and different culture configurations. During winter months, Oregon estuaries experience increased freshwater input and reduced salinities, conditions that may limit the feasibility of many kelp species. Sugar kelp grown in higher-salinity zones of estuaries may tolerate episodic reductions in salinity and could benefit from increased light availability associated with near-surface growth, particularly during periods of elevated turbidity.

Bull kelp may still be a potential candidate for estuarine line culture in specific situations, given its May-to-November growing season, which largely avoids winter freshwater pulses. While estuarine kelp line culture shows potential, substantially higher-resolution spatial and temporal data, along with site-specific monitoring, would be required before pursuing this approach as a feasible commercial option.

6.5. Growing seaweed and shellfish in co-culture operations

The co-culturing of seaweed and shellfish is often described as an ideal situation for mariculture operations. It can deliver multiple products for market from the same farm operation and produce multiple ecosystem restoration benefits. Co-culture operations can be co-located on structures that support oysters and seaweed line culture while providing a workforce with year-round work, as products have different production timelines.

Bandon ranked the highest of all coastal sites for co-culture due to more acres available and relatively

lower interactions with commercial and recreational fisheries, as indicated by the Fisheries variable. The other top-ranked coastal sites (Port Orford, Gold Beach, Umpqua, Alsea, and Siuslaw) had relatively similar combined scores for highly suitable area but differing scores for Industry, Biophysical, and Fisheries factors. For example, Gold Beach had the most area available but a less favorable Fisheries score, while Alsea did not have much area available but had the best Fisheries score. The lowest-ranked coastal sites were the three northernmost sites in the state due to their smaller available areas and lower scores for Biophysical conditions.

Beyond the coastal sites, only three estuaries—Coos Bay, Umpqua River, and Tillamook Bay—had highly suitable areas for kelp line culture, which could be co-located with oyster or mussel mariculture. All estuaries had similar Logistics and Biophysical scores, which made the amount of highly suitable area the primary driver of the ranking for co-culture opportunities within estuaries.

7. Conclusions

TNC's *Spatial Assessment of Mariculture Suitability Along Oregon's Coast* (Jossart et al., 2026) provides a baseline assessment of mariculture opportunities in Oregon's estuary and coastal waters, identifying areas suitable for specific species and gear types. The spatial assessment yielded some surprising results for the southern coast, particularly Gold Beach,

which was found to have the greatest coastal mariculture suitability. Another surprise was that multiple sites had strong potential for the tank culture of abalone, sea urchins, and dulse. Included were new sites, the Nehalem and Alsea estuaries, that currently have no mariculture farms operating within them. The assessment also identified strong potential for mariculture expansion into mussels, sea urchins, abalone, and several species of kelp, all of which are experiencing increased market interest both locally and beyond.

Using a spatial modeling framework—from broad compatibility screening (Exclusion Model) to the identification of highly suitable sites (Suitability and Ranking Models)—the spatial assessment established a robust basis for estimating mariculture development potential in Oregon. It relied on best available, high-resolution, quality-controlled datasets, strengthening Oregon's spatial planning capacity and supporting long-term, sustainable development of the mariculture sector. Farm-specific siting factors were clearly defined in the assessment, enabling a transparent determination of where and to what extent mariculture development would be most appropriate in Oregon's coastal waters.

The future of mariculture will be bright along the Oregon Coast as coastal communities and residents seek new ways of farming the abundance of the sea.

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