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A Wind Energy Area Siting Analysis for the Oregon Call Areas

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EXECUTIVE SUMMARY

This report provides background, methods, results, and next steps for the ecosystem-wide spatial suitability model developed to inform selection of Draft Wind Energy Areas in U.S. Federal waters. Spatial suitability models have long been applied to terrestrial and marine environments for the purpose of assessing the relative potential for development or conservation. The National Oceanographic and Atmospheric Administration's (NOAA) National Centers for Coastal and Ocean Science (NCCOS) and the Bureau of Ocean Energy Management (BOEM) used similar methods to complete suitability models for siting wind energy in the Gulf of Mexico and Draft Wind Energy Areas in the Central Atlantic.

To develop the Oregon suitability model, 30 geospatial data layers, developed by various government agencies, non-governmental organizations (NGOs), and academic institutions, were selected that represent major ocean characteristics for the Oregon Call Areas. Through an extensive one-year stakeholder outreach process that included data gathering, BOEM identified two Call Areas offshore the State of Oregon. These two areas are known as the Coos Bay Call Area (872,854 acres) and the Brookings Call Area (286,444 acres). Call Areas are areas identified by BOEM that appear to be suitable for offshore wind development. These two areas

include 167 whole OCS blocks[1] and 81 partial OCS blocks, and total approximately 1,159,298 acres (1,811 square miles) (Figure 1.2). Data were organized into categories (submodels) representing the major ocean sectors including national security, natural resources, wind, fishing, and industry and operations. All data layers were assigned scores of relative compatibility, allowing the calculation of an overall suitability score for each 10 acre grid cell of the study area. Using a cluster analysis, two potential Draft Wind Energy Areas (WEA) were identified representing the most suitable areas within the Call Areas.

The work presented here is the result of a Draft Wind Energy Area Siting Suitability model (Model) developed by expert marine spatial scientists, marine ecologists, project coordinators, policy analysts, and subject matter experts (SMEs) at both BOEM and NCCOS, and informed by extensive outreach efforts. Collectively, this team provided input during the model construction process, reviewed data layers, assigned weights, and informed the Model development and interpretation of results. These parties are referred to herein as the Oregon WEA Siting Team (Team).

BOEM selected two Draft WEAs as a result of the Modeling process. These two Draft WEAs encompass a total of 219,568 acres, an 81.06% reduction in size from the Call Areas.

[1] USA OCS Lease Blocks - Outer Continental Shelf (OCS) lease blocks serve as the legal definition for BOEM offshore boundary coordinates used to define small geographic areas within an Official Protraction Diagram (OPD) for leasing and administrative purposes.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIS	Automatic Identification System
AUV	Autonomous underwater vehicle
BIA	Biologically Important Area
BOEM	Bureau of Ocean Energy Management
CH	Critical habitat
CMECS	Coastal and Marine Ecological Classification Standard
DLCD	Department of Land Conservation and Development
DOD	Department of Defense
DPS	Distinct population segment
EFH	Essential fish habitat
EFHCA	Essential fish habitat conservation area
ESA	Endangered Species Act
HAPC	Habitat Areas of Particular Concern
ICPC	International Cable Protection Committee
IPHC	International Pacific Halibut Commission
LISA	Local Index of Spatial Association
MC	Marine Cadastre
MCDA	Multi-Criteria Decision Analysis
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Act
NCCOS	National Centers for Coastal and Ocean Science
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NWFSC	Northwest Fisheries Science Center
OCS	Outer Continental Shelf
ODFW	Oregon Department of Fish and Wildlife
PacFIN	Pacific Fisheries Information Network
PACPARS	Pacific Coast Port Access Route Study
ROV	Remotely operated vehicle
SME	Subject matter expert
SWFSC	Southwest Fisheries Science Center
USCG	United States Coast Guard
USGS	United States Geological Survey
VMS	Vessel Monitoring System
WCR	West Coast Region
WEA	Wind Energy Area

1 INTRODUCTION

The Oregon coast has substantial offshore wind resources, with some of the highest annual average wind speeds in the country (Figure 1.1). Therefore, the Pacific is one of several regions where wind energy development in offshore Federal waters is being considered to support the Biden-Harris Administration's goal of 30 gigawatts of offshore wind by 2030. In addition, Oregon Enrolled House Bill 2021 (HB 2021) requires the investor-owned utilities and electricity service suppliers in the State of Oregon to supply 100% greenhouse gas free electricity by 2040. Efforts to plan for and gather data to inform potential offshore wind energy leasing started well before these goals were established. In December 2010, Oregon's governor requested the establishment of a State-Federal task force to address the use of the ocean for renewable energy development. In response, in 2011, BOEM established a Task Force comprised of members from Federal, State, and local agencies, as well as federally recognized Tribes. The Task Force provides coordination and engagement with respect to BOEM's consideration of potential renewable energy activities on the Outer Continental Shelf (OCS) offshore Oregon, including issuing offshore wind leases.

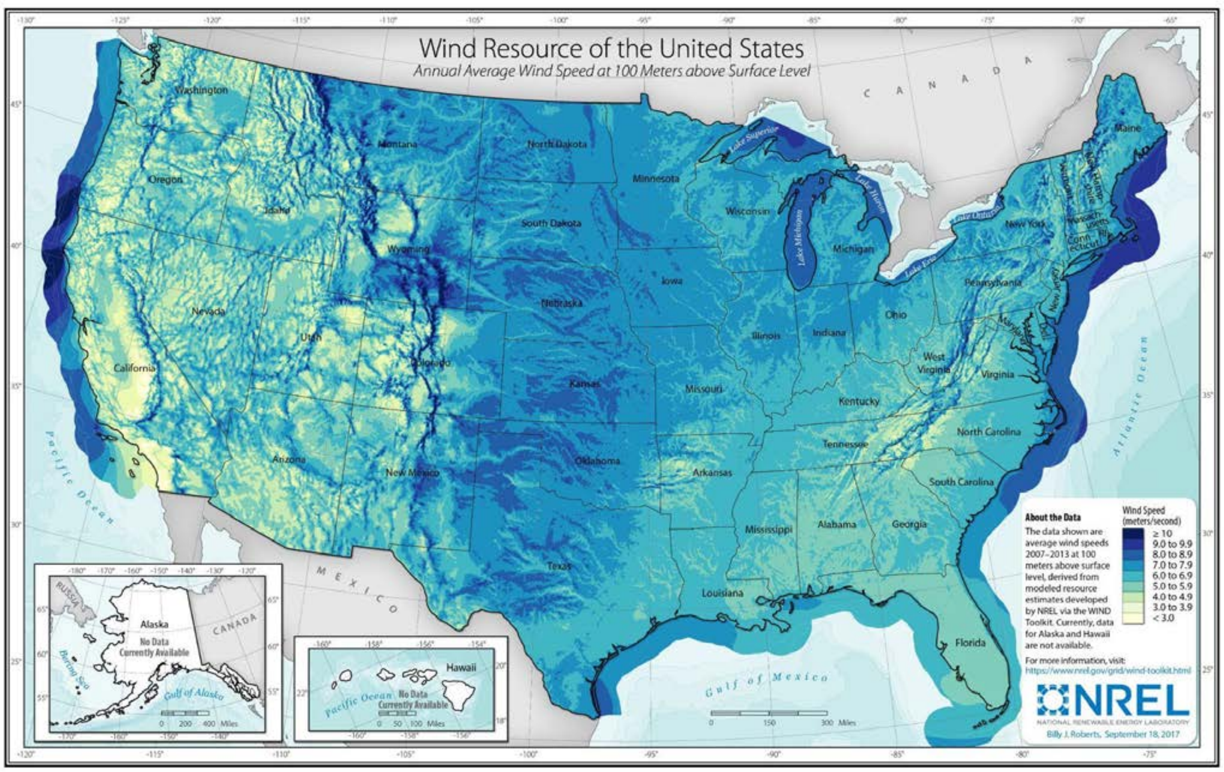

Figure 1.1. Annual average wind speed at 100 meters above surface level for the contiguous United States between 2007-2013 (NREL 2017).

In September 2019, BOEM and the State of Oregon (State) initiated a conversation with the Task Force regarding potential offshore wind planning off the coast of Oregon. At the June 2020 Task Force meeting, BOEM and the State, led by the Oregon Department of Land Conservation and Development (DLCD), made a commitment to move forward with offshore planning in Oregon and to conduct a planning process that would include a roughly 12-month effort of data gathering and meaningful public, stakeholder, and Tribal engagement. The DLCD, in partnership with BOEM, developed the Oregon Offshore Wind Mapping Tool (OROWindMap) within the West Coast Ocean Data Portal to provide public access to the best available data throughout the planning process.

Between October 2020 and December 2021, BOEM and the State held 6 webinars open to the public and 75 meetings with Tribes, elected officials, the commercial fishing community, mariners, the academic and research community, environmental groups, industry, labor unions, and the general public (BOEM and State 2022). BOEM published a Call for Information and Nominations (Call) in the *Federal Register* on April 27, 2022.

BOEM considered the following parameters in the development of the Call Areas: demand for renewable energy; suitability for offshore wind; maritime navigation; subsea cables; commercial fishing; wildlife and habitat; submerged landforms; viewshed; tribal considerations; and Department of Defense considerations. The Call included two Call Areas, Coos Bay and Brookings (Figure 1.2). The comment period for the Call ended on June 28, 2022. BOEM received 278 comments which are available at https://www.regulations.gov/document/BOEM-2022-0009-0001. BOEM received nominations from four companies all of which have been legally, technically, and financially qualified (Figure 1.3.). Nominations and maps are available at https://www.boem.gov/renewable-energy/state-activities/Oregon.

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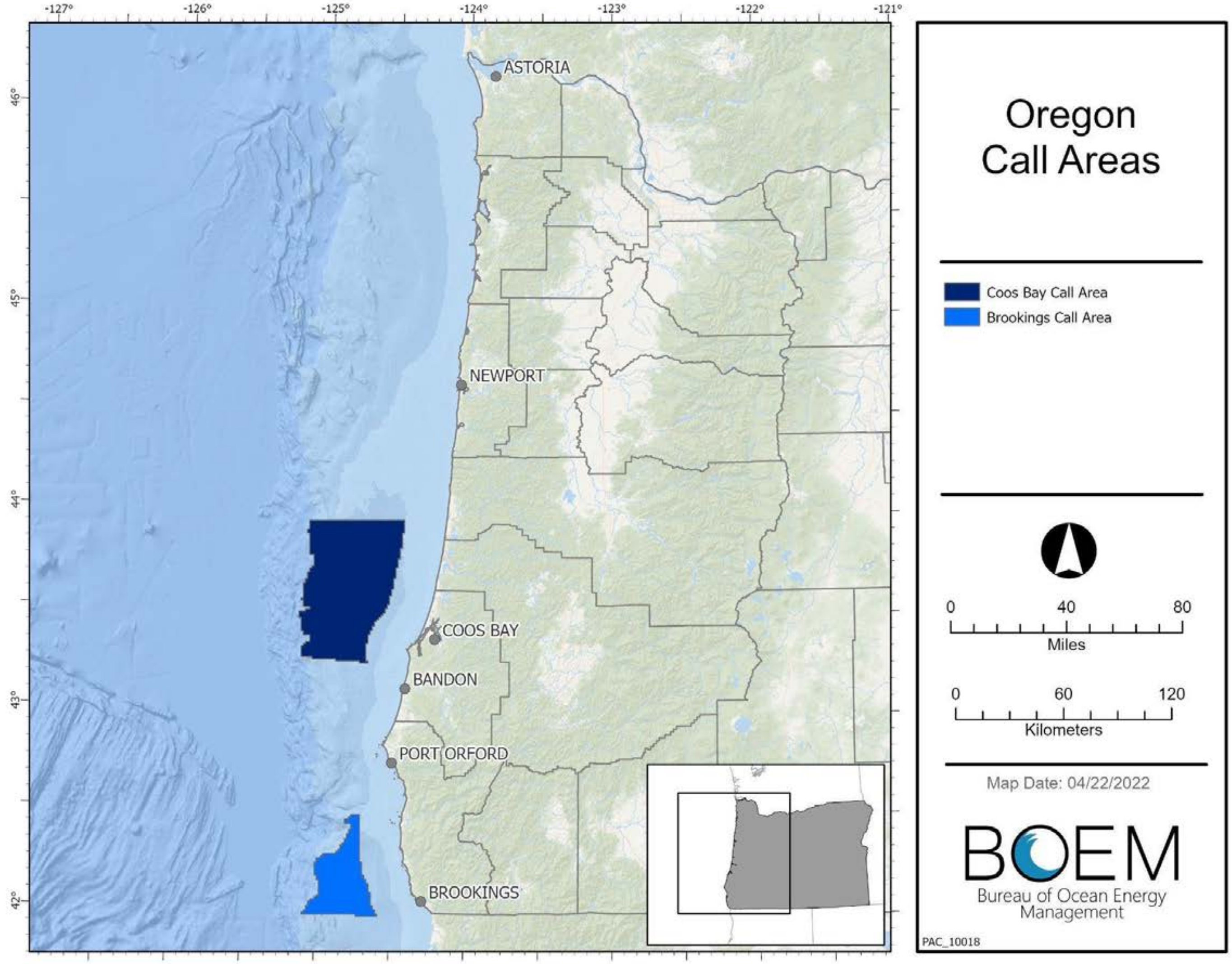

Figure 1.2. Oregon Call Areas. Dark blue indicates boundaries for the Coos Bay Call Area, while royal blue indicates boundaries for the Brookings Call Area.

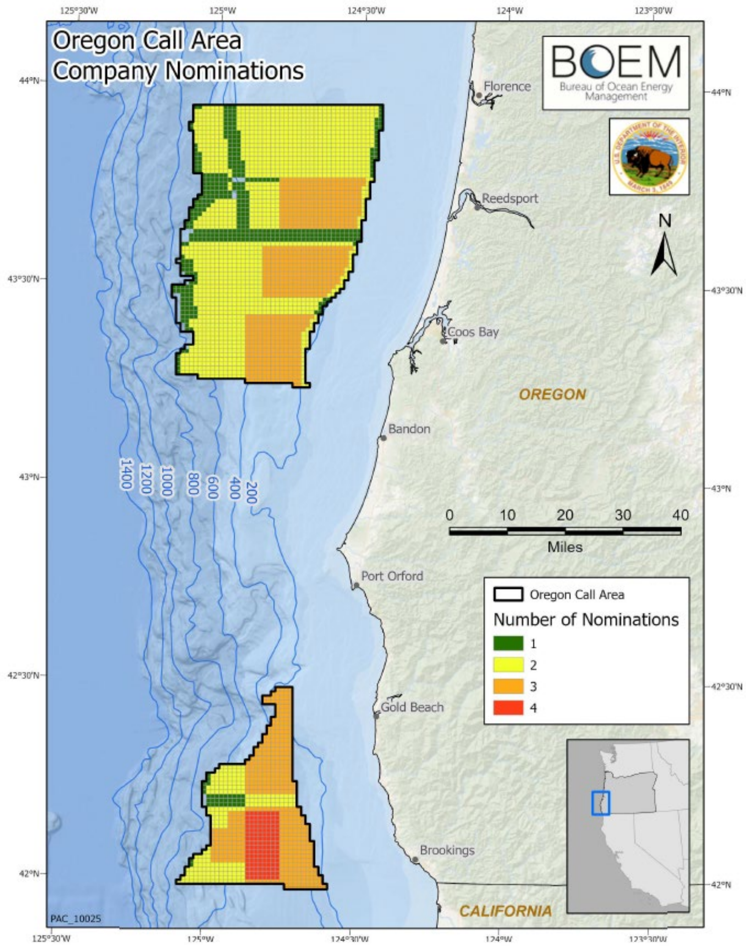

Figure 1.3. Oregon Call Areas Company Nominations.

For purposes of recommending Draft WEAs, BOEM considered the following non-exclusive list of information sources:

- Input from Tribal Nations,
- Input from Oregon State agencies,
- Input from Federal agencies,
- Comments from stakeholders and ocean users, including the maritime community, offshore wind developers, and the commercial fishing industry,
- Information from the Oregon Intergovernmental Renewable Energy Task Force,
- BOEM Data Gathering and Engagement Summary Report: Oregon Offshore Wind Energy Planning (BOEM and State 2020),
- Comments and nominations received on the Call,
- OROWindMap,
- State and local renewable energy goals, and
- Information on domestic and global offshore wind market and technological trends.

In addition, BOEM's recommendations reflect a final assessment of the Department of Defense (DOD) regarding compatibility of the proposed Draft WEAs.

During the public comment period for the Call, BOEM received ocean users' feedback to increase transparency in the Area Identification process and consider leveraging an existing ocean planning model that was previously used in NOAA's Aquaculture Opportunity Area Atlases as well as for the development of Wind Energy Areas in the Gulf of Mexico and Central Atlantic. In response, BOEM has modified the process to identify future offshore wind areas in a Notice to Stakeholders issued on September 16, 2021, which is available at https://www.boem.gov/newsroom/notes-stakeholders/boem-enhances-its-processes-identify-future-offshore-wind-energy-areas. This process is being used to support identification of Draft WEAs within the Oregon Call Areas. As part of this outlined process, BOEM, with support from NOAA's NCCOS, has conducted spatial analyses to identify the most suitable locations for Draft Wind Energy Areas. Methods and results of these spatial analyses are summarized below.

2 METHODS

A spatial modeling workflow for Draft WEAs was developed following the approach from Morris et al. 2021 and Riley et al. 2021 (Figure 2.1). The project requirements and area of interest were identified by BOEM through various engagement efforts. The goal of this study was to identify the most suitable areas for potential Draft WEAs in the Oregon Call Areas. The steps within the workflow are described below.

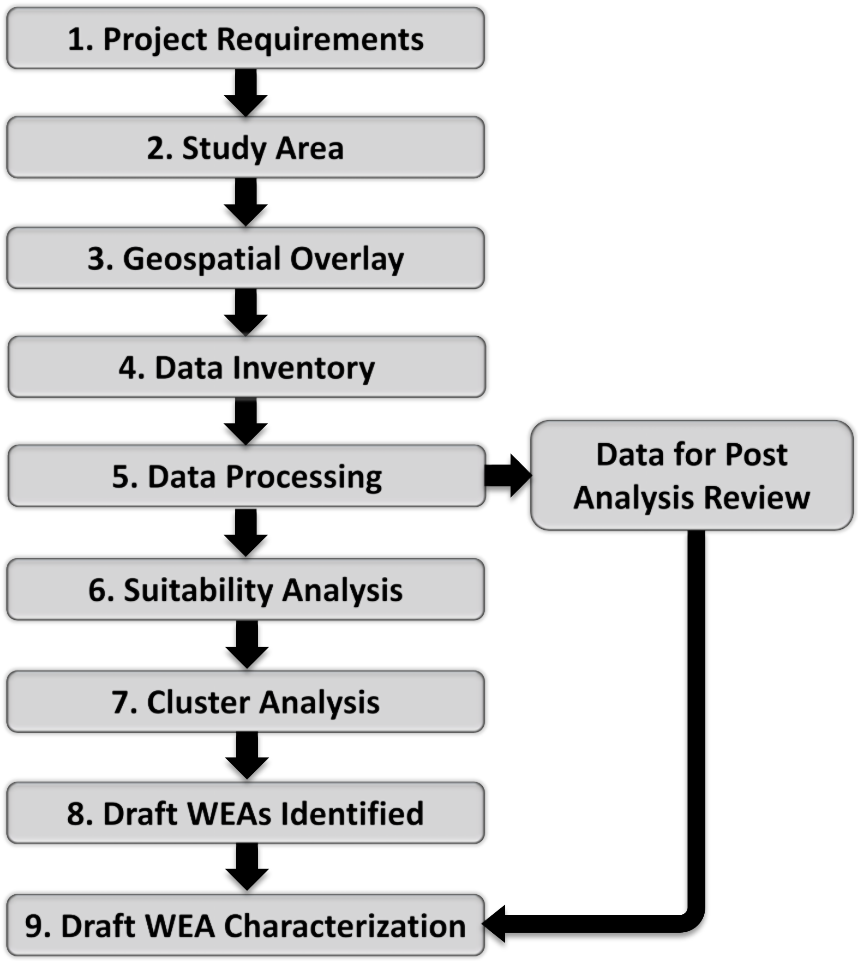

Figure 2.1. Workflow for Draft Wind Energy Areas spatial analysis for the Oregon Call Areas.

2.1 Study Area

On April 27, 2022, BOEM published a Call for Information and Nominations to assess commercial interest and obtain public input on potential wind energy leasing activities in Federal waters off the coast of Oregon. The Call Areas provided by BOEM were used as the study area boundaries. The Call Areas are located in Federal waters offshore the State of Oregon and comprise areas identified as Coos Bay and Brookings Call Areas. These two areas include 167 whole OCS blocks and 81 partial OCS blocks, and total approximately 1,159,298 acres (1,811 square miles) (Figure 1.2).

Coos Bay Call Area: The boundary of the Coos Bay Call Area begins 13.8 miles offshore Oregon and extends to about 57 miles offshore. The water depth ranges from 120 to 1,580 meters (394 to 5,184 feet). The area is about 50 miles in length from north to south and about 35 miles in width from east to west. The entire area is approximately 872,854 acres (1,364 square miles).

Brookings Call Area: The boundary of the Brookings Call Area begins 13.8 miles offshore Oregon and extends to about 46 miles offshore. The water depth ranges from about 120 to 1,530 meters (394 to 5,020 feet). The area is about 46 miles in length from north to south and about 22 miles in width from east to west. The entire area is approximately 286,444 acres (448 square miles).

2.2 Geospatial Overlay

Grids are an efficient means for mapping spatial variation and establishing a common framework for spatial models (Olea 1984; Dale 1998). A 10-acre hexagonal grid was overlaid to the study area, which resulted in 117,300 grid cells (Figure 2.2). A hexagon grid was used because it fits organic shapes and curves (e.g., pipelines, submarine cables, etc.) better than square grids, and it provides advantages for statistical analysis as all neighboring cells share a side and the distance from the center is the same distance to all neighboring cells (Birch et al. 2007; Sousa et al. 2006; Tsatcha et al. 2014; Domisch et al. 2019). The grid cell size was determined by a number of factors, including the extent of the analysis, minimum WEA size, processing time, and spatial resolution of data within the model (Hengl 2006). Grid resolution is a balancing act between the coarsest and finest data in the model. Hengl (2006) and Liang et al. (2004) both acknowledge that grid-cell size selection can be optimized, but at a certain point, increased resolutions only provide minor improvements. Moreover, there is no ideal grid cell or pixel size, but it is recommended to avoid using resolutions that do not comply with inherent properties of input datasets (Hengl 2006).

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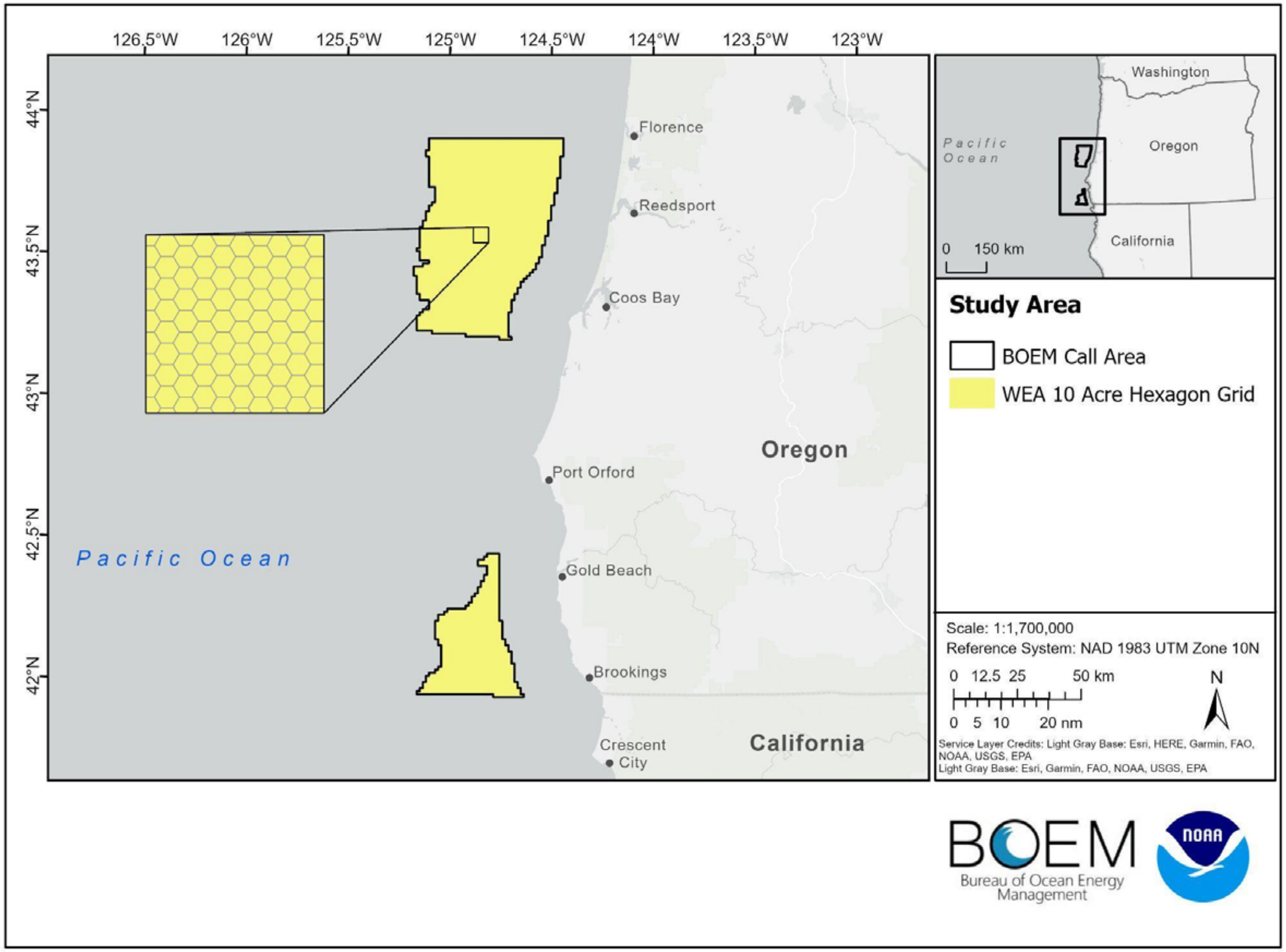

Figure 2.2. An example of the grid cells formulated for the Call Areas. Each cell is a 10-acre or 4.05-hectare hexagon.

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2.3 Data Inventory

2.3.1 Data Categorization

Geospatial analyses and ocean planning require the consideration of multiple, seemingly incompatible datasets that require substantial data collection and processing to properly understand and implement within ocean planning suitability models. Spatial suitability modeling is a type of Multi-Criteria Decision Analysis which provides the ability to calculate a relative suitability score for each grid cell in an area (Figure 2.3). Data categorization is needed to describe the relationship among the data input into the models and to organize information into appropriate submodels for relative suitability modeling. Data categorization was modified from the schema provided in Lightsom et al. (2015) as the intent of the categorical structure is for ocean planning. The structure intends to bring transparency and a consistent framework to the analysis of complex and dynamic ocean systems (Lightstom et al. 2015). The framework included herein ensures the work will include the necessary data for Wind Energy Area site suitability analysis, a specific type of ocean planning.

2.3.2 Data Acquisition

Collection and processing of spatial data is a key factor in model success because it is the basis for further calculations and analysis (Molina et al. 2013). An initial review was completed to determine the broad suite of data and categories needed to properly support this ocean planning process. A comprehensive, authoritative spatial data inventory was developed, including data layers relevant to national security, natural resources, industry and operations, fisheries, and wind logistics (e.g., wind speed, distance to port, or water depth). The data holdings were developed through engagement with non-governmental organizations and U.S. Federal and State agencies representing a diverse array of stakeholders and Tribal Nations. Many studies were leveraged through the Marine Cadastre (MC 2021) and OROWindMap, including datasets created for the BOEM Environmental Studies Program. Overall, over 400 data layers were acquired during data inventory.

Data were evaluated for completeness and best quality, and the most authoritative, up-to-date sources available were used. All data were projected, and calculations performed using the NAD 1983 UTM Zone 10N projection (WKID: 26910, Projection: Transverse Mercator, False Easting: 500000.0, False Northing: 0.0, Central Meridian: -123.0, Latitude of Origin: 0.0). Appendix A provides a list of data utilized for this spatial planning analysis.

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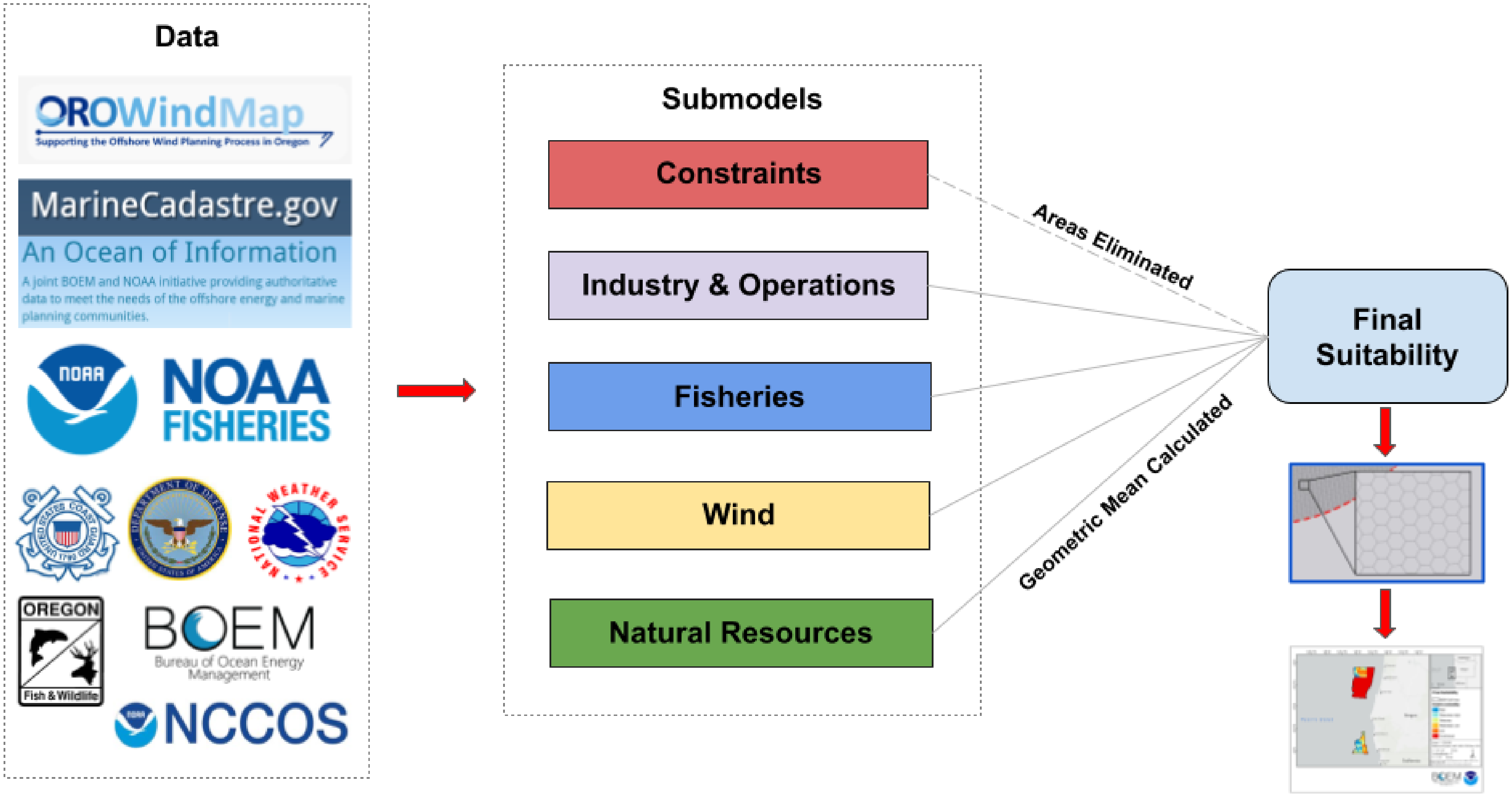

Figure 2.3. Example of a suitability model utilizing a submodel structure where data layers are grouped based on ocean use topics. Geospatial data were obtained from numerous State and Federal agencies, including but not limited to, those above to be included in the suitability analysis. A final suitability score is calculated for each grid cell within the Call Areas resulting in a final heat map displaying areas of low and high suitability for wind energy development.

2.4 Data Processing Steps

Many datasets required processing prior to use in the suitability model, subsequent cluster analysis, or for the option ranking model and characterization. Methods are provided for all data that required processing; many data were received in a ready-to-use format and processing notes can be found in metadata provided by the data originator. Setback distances (i.e., buffers) were applied using conservative professional judgment when an established setback requirement was not available from an authoritative source.

2.4.1 NMFS Protected Species Data Layer

For protected species in the region, a combined data layer providing the overall score for selected protected species was developed through collaboration with NOAA's National Marine Fisheries Service's (NMFS)[2] West Coast Region and the Northwest and Southwest Fisheries Science Centers (Appendix B). Protected species considered include those listed under the Endangered Species Act (ESA) and/or protected under the Marine Mammal Protection Act (MMPA). This combined data layer contains a subset of highly vulnerable protected species known to occur in the Call Areas exhibiting migratory, feeding, or resident behavior and for which adequate spatial data was available. Two species included are identified by NMFS as a Species in the Spotlight.[3] Other protected species, including some marine mammals, that were not included in this analysis can be found in Appendix B.

Scores were assigned to each species based on species' status, population size, and trend. The scores provided in Table 2.1 for MMPA stocks and ESA-listed species range from 0.1 (most vulnerable species, based on their biological status) to 0.9 (least vulnerable species) using best available data. This scoring approach was developed for each species/stock using factors that are more or less likely to affect the population's ability to withstand mortality, serious injury, or other impacts that could affect the species' ability to survive and recover (Farmer et al. 2022). This scoring approach was preferred given that this ocean planning process does not consider gear-specific wind planning or other secondary interactions with protected species.

[2] NCCOS is providing BOEM with technical assistance to support BOEM's spatial planning in relation to offshore wind projects. This support is being provided with funding resources from NCCOS and through reimbursable support from BOEM to NCCOS. NMFS is providing technical assistance to NCCOS regarding available science (i.e., data layers and modeling methods) for BOEM's consideration in their spatial modeling efforts. These efforts are supporting BOEM's ocean and coastal planning activities related to siting of call areas, Wind Energy Areas, and transmission cable routing. The information provided by NMFS to NCCOS is purely technical in nature and does not reflect or constitute an official agency policy, position, or action. Official NMFS positions related to spatial planning for offshore wind activity will be submitted by NMFS through written comments to BOEM during the planning and review processes for each activity.
[3] Species in the Spotlight are species NMFS identified as most at risk of extinction in the near future.

Table 2.1. Scoring system from Farmer et al. (2022) used for NMFS protected species. A small population equates to populations of 500 individuals or less (Franklin 1980). A strategic stock is defined by the Marine Mammal Protection Act as "…a marine mammal stock for which the level of direct human-caused mortality exceeds the potential biological removal level; which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA, or is designated as depleted under the MMPA."

Status	Trend	Score (0–1)
Endangered	Declining, small population or both	0.10
Endangered	Stable or unknown	0.20
Endangered	Increasing	0.30
Threatened	Declining or unknown	0.40
Threatened	Stable or increasing	0.50
MMPA Strategic	Declining or unknown	0.60
MMPA-listed	Small population or unknown/declining	0.70
MMPA-listed	Large population or stable/increasing	0.80
MMPA-listed	N/A (default score for MMPA-listed species in low-use areas)	0.90

Equation 2.1. Product method equation used by NMFS Protected Resources Division to calculate the final scoring layer for protected species considerations.

$$p = x_1 \bullet x_2 \bullet \ldots \bullet x_i$$

x_1 = variable 1
x_2 = variable 2
x_i = additional variables

A total of five data layers including leatherback sea turtle, Southern Resident killer whale, humpback whale Central America and Mexico Distinct Population Segments (DPS) (86 FR 21082), and blue whale were combined into a single data layer using the product method, which provides the highest weight to the lowest score (Equation 2.1). NMFS provided three scoring scenarios in their order of priority for BOEM's consideration for inclusion into the suitability model (Appendix B). Scenario 3 was used in the model because it did not include any constraints. A complete description of all scenarios can be found in Appendix B. Table 2.2 provides each species' status and trend, as well as the score used when creating the combined data layer for use within the relative suitability model. The combined data layer provides the highest resolution and contrast, allowing for meaningful comparisons between grid cells and attributing increasing levels of concern for areas with multiple overlapping protected species data layers.

Table 2.2. Score, status, and trend for ESA and MMPA-listed species known to occur within the Oregon Call Areas, and used to create the NMFS protected species combined data layer utilized in the suitability model.

Species Common Name	Status and Trend	Score (0–1)
Leatherback sea turtle	Endangered; Declining, small population	0.1
Southern Resident killer whale	Endangered; Declining, small population	0.1
Humpback whale - Central America DPS	Endangered; Increasing	0.3
Humpback whale - Mexico DPS	Threatened; Increasing	0.5
Blue whale	Endangered; Unknown	0.2

2.4.2 NMFS Habitat Data Layer

Using the best available scientific data sets, a combined habitat data layer was developed through collaboration with NMFS's West Coast Region and Northwest Fisheries Science Center to represent the suitability of the habitat in the Call Areas (Appendix C). Five habitat types were selected and ranked based on their relative potential sensitivity to offshore wind energy development. Overall, six data sets were chosen to be combined into a single data layer using the lowest method, providing the lowest score for each grid cell for the most sensitive habitats (Equation 2.2). NMFS provided two scoring scenarios in their order of priority for BOEM's consideration for inclusion into the suitability model (Appendix C). Scenario 2 was used in the model because it did not include any constraints. A complete description of all scenarios can be found in Appendix C. Table 2.3 provides the data layers, setbacks, and scores used when creating the combined data layer.

Equation 2.2. Lowest method equation used by NMFS to calculate the final scoring layer, where *x* represents scores for data layers within a given grid cell.

$$l = min(x_1, x_2, \ldots, x_i)$$

x_1 = variable 1
x_2 = variable 2
x_i = additional variables

Table 2.3. Data layers, setbacks, and scores used to create the NMFS habitat combined data layer.

Data set	Setback	Score (0–1)
Essential Fish Habitat Conservation Areas	500 m	0.01
Rocky Reef Groundfish Habitat Areas of Particular Concern - Mapped	500 m	0.01
Rocky Reef Groundfish Habitat Areas of Particular Concern - Probable	500 m	0.2
Deep-sea Coral Habitat Suitability (One or more coral taxa associated with hard substrate predicted to have high suitability)	500 m	Z Membership Function 0.0–1.0
Continental Shelf Break	10 km	0.6
Methane Bubble Streams	1 km	0.8

2.4.3 NMFS Scientific Surveys Data Layer

A combined scientific surveys data layer was developed through collaboration with NMFS's Northwest Fisheries Science Center and Southwest Fisheries Science Center to best represent NMFS scientific survey operations within the Call Areas (Appendix D). Four data layers were developed for geospatial representation of survey operations (footprints). These included two East-West sampling corridor data layers four nautical miles wide, a survey transect data layer two nautical miles wide, and a survey station data layer with a two nautical mile wide radius. These data layers were combined into a single composite data layer using the lowest method, providing the lowest score to the most sensitive survey operations.

NMFS provided two scoring scenarios in their order of priority for BOEM's consideration for inclusion into the suitability model (Appendix D). Scenario 2 was used in the model because it did not include any constraints. A complete description of all scenarios can be found in Appendix D. Table 2.4 displays the data layers, setbacks, and scores used in the development of the combined data layer. Scientific surveys conducted by NMFS that are not well suited to fixed stations or transects, and/or include broad geographic coverage across and outside of the entire geographic extent of the Call Areas, were not included.

Table 2.4. Data layers, setbacks, and scores used to create the NMFS scientific surveys combined data layer.

Data set	Setback	Score (0–1)
East-West Sampling Corridors	2 nm	0.01
Additional East-West Sampling Corridors	2 nm	0.5
Survey Stations	2 nm	0.5
Survey Transects	1 nm	0.5

2.4.4 NMFS & ODFW Fisheries Data Layer

Through collaboration with NMFS West Coast Region and Northwest Fisheries Science Center and the Oregon Department of Fish and Wildlife, a novel combined fisheries data layer was developed for select commercial and recreational fisheries for use in the relative suitability model (Appendix E). Nine fisheries were identified for inclusion into the model including groundfish bottom trawl, at-sea hake mid-water trawl, shoreside hake mid-water trawl, pink shrimp trawl, groundfish fixed gear pot, groundfish longline, commercial albacore, charter albacore, and Dungeness crab pot fisheries. Other fisheries were considered for inclusion, but time constraints and the availability of spatial data prevented inclusion in the model. Data layers were created by combining effort and revenue data into a single 'ranked importance' value for grid cells in the Call Areas for each fishery (for specific methods, see Appendix E). Both effort and revenue data were included in each, except for charter albacore and groundfish bottom trawl, which only used effort data.

Overall, nine fisheries data layers were combined into a single composite data layer for the Fisheries submodel (Table 2.5). The geometric mean across all nine fisheries was calculated and used as the initial suitability score for each grid cell, which provides equal weighting among fisheries. Additional considerations were made for the four trawl fisheries that operate within the Call Areas. These fisheries have little flexibility in where they fish due to their operational logistics and target species' site fidelity. To represent the space that trawl fisheries need to reasonably operate, NMFS and the Oregon Department of Fish and Wildlife (ODFW) identified grid cells contained within the top 75%, 60%, and 50% of the ranked importance values across these four fisheries. Spatial polygons of these areas and five scoring scenarios, in their order of priority, were provided to BOEM for consideration (Appendix E). Scenario 4 was used in the model because it was the most conservative scenario that did not include constraints, and suitability scores of 0.001 replaced the geometric mean in grid cells within the top 75% of the trawl fisheries' ranked importance values. Areas outside of the trawl fisheries polygon retained the suitability score calculated across all nine fisheries.

Table 2.5. Data layers and scores used to create the combined Fisheries data layer provided by NMFS and ODFW.

Fisheries	Score (0–1)
At-sea hake mid-water trawl	Ranked Importance
Shoreside hake mid-water trawl	Ranked Importance
Groundfish bottom trawl	Ranked Importance
Groundfish pot gear	Ranked Importance
Groundfish longline gear	Ranked Importance
Pink shrimp trawl	Ranked Importance
Dungeness crab	Ranked Importance
Commercial troll/hook-and-line albacore	Ranked Importance
Charter vessel albacore troll/hook-and-line	Ranked Importance

2.4.5 Marine Bird Combined Data Layer

A novel marine bird combined data layer was developed through collaboration with NCCOS, BOEM, and U.S. Geological Survey (USGS) (Appendix F). Utilizing existing modeled relative density data for marine birds in Pacific OCS waters (Leirness et al. 2021), a combined spatial distribution data layer of marine bird density was created for the region. Each species was assigned a vulnerability rating based on its sensitivity to offshore wind development within the Call Areas (Adams et al. 2017; Kelsey et al. 2018). Using a weighted vulnerability metric, a final combined data layer was created for use in the relative suitability model.

2.5 Suitability Analysis

A gridded relative suitability analysis, commonly used in a Multi-Criteria Decision Analysis (MCDA), was performed to identify the grid cells with the highest suitability (Mahdy and Bahaj 2018; Deveci et al. 2020; Abdel-Basset et al. 2021; Abramic et al.2021; Vinhoza and Schaeffer 2021) for Draft WEA development in the Call Areas. Spatial data layers included in the suitability analysis identify space-use conflicts and environmental constraints such as active national security areas, maritime navigation, ocean industries, and natural resource management. We utilized a submodel structure to capture ocean use and conservation concerns including industry and operations, natural resources, fisheries, and wind logistics. Data layers with no compatibility with wind energy development (e.g., Department of Defense exclusion areas) were captured in the list of incompatible constraints and removed from further analysis due to known incompatibility with wind energy (Figure 2.4). This submodel structure ensures that each submodel is given equal weight in the final suitability model regardless of how many data layers are present in each submodel.

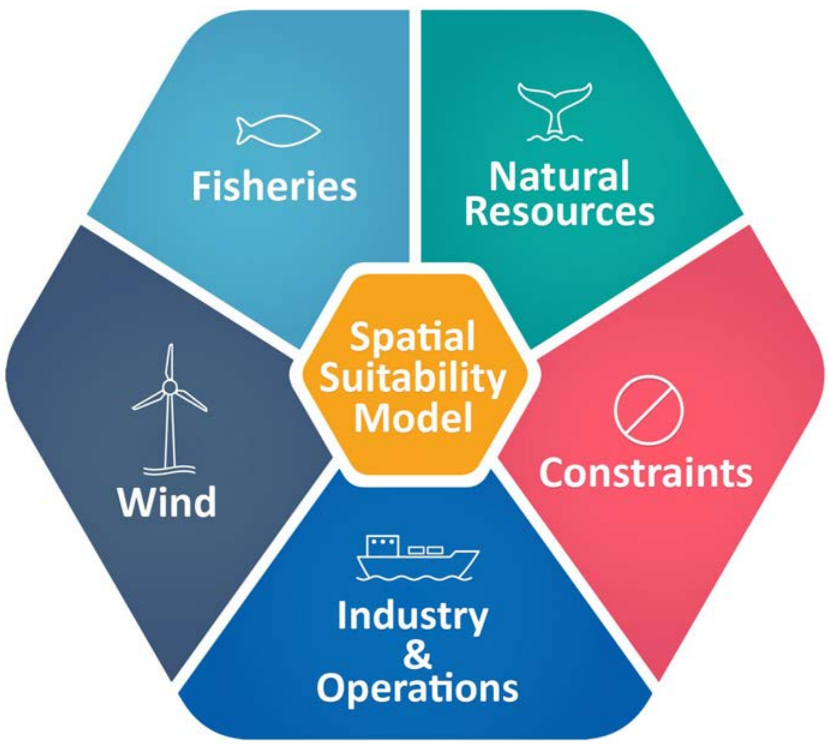

Figure 2.4. Overview of the Oregon Draft WEA suitability model design and the submodel components. The constraints submodel includes all data layers with a score of 0.

2.5.1 Scoring Categorical Data

Categorical datasets (i.e., in which data are distinct and separate groups) were evaluated to determine if a constraining feature was present or absent in each grid cell. If a feature was absent, a score of 1 was given indicating suitability with wind energy development, otherwise a score ranging from 0 to 1 was assigned (0 = unsuitable with wind energy; 1 = being more suitable with wind energy).

After all data were gathered and integrated into the greater data inventory, certain data layers required setbacks from the discrete/categorical layer. If a setback was established, the data layer score was also applied to the setback. Setbacks were also established based on governance, policy, and regulations, and taking the most conservative setback distance (i.e., buffer) to avoid interactions with other ocean activities.

2.5.2 Scoring Numerical Data

Numerical data (i.e., continuous data that can represent any value within a given range) were reclassified to a 0 to 1 scale using a linear function or fuzzy logic membership functions (Vincenzi et al. 2006; Vafaie et al. 2015; Theuerkauf et al. 2019; Landuci et al. 2020). Fuzzy membership functions are similar to a linear or non-linear functional approach, however, use of fuzzy logic membership functions accounts for additional uncertainty when assigning scores to the data (Kapetsky and Aguilar-Manjarrez 2013). The function used for each numerical dataset was chosen based on the data and known interactions or compatibility with wind energy. The range of the numerical datasets (i.e., the minimum and maximum values) were used as the inputs for creating the function and were modified to ensure no output value would equal 0. No 0 values were allowed because no observed value in any numerical dataset used was known to be completely incompatible with wind energy infrastructure.

Fisheries, marine bird, and habitat suitability datasets were reclassified using the Z-shaped membership function from the Scikit-Fuzzy (Version 0.4.2) Python library, where the higher the observed value (e.g., fishing importance) the lower the compatibility with wind energy, and thus the lower the suitability score (Warner et al. 2019; Equation 2.3; Figure 2.5). Other numerical datasets, such as the levelized cost of energy, used a standard linear function because of high certainty that the lower the cost of energy, the more suitable a WEA is regarding logistics and cost (Abdel-Basset et al. 2021).

Categorical and numerical data used in scoring for the relative suitability analysis are in Table 2.6.

Equation 2.3. The Z-shaped membership function from the Scikit-Fuzzy (Version 0.4.0) Python library used to rescale numerical data to a 0 to 1 range, with input values modified to ensure no 0 values in the output (Warner et al. 2019). Equation of Z-shaped membership function is based on the MathWorks documentation examples (MathWorks 2021).

$$zmf(x;\ a,b)\begin{cases} 1, & x \leq a \\ 1-2\left(\frac{x-a}{b-a}\right)^2, & a \leq x \leq \frac{a+b}{2} \\ 2\left(\frac{x-b}{b-a}\right)^2, & \frac{a+b}{2} \leq x \leq b \\ 0, & x \geq b \end{cases}$$

x = Input value to be rescaled
a = Function begins falling from 1 (Minimum values of data set)
b = Function attains 0 (Maximum value adjusted to ensure no 0 values in output)

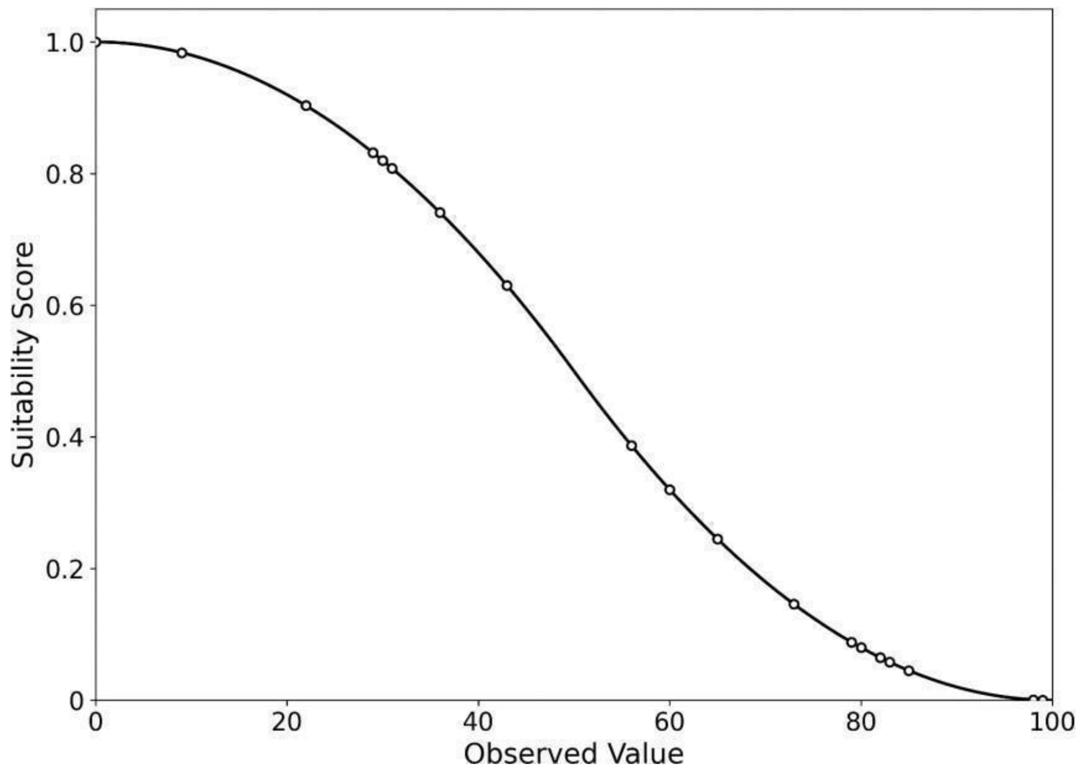

Figure 2.5. Example of hypothetical Z-shaped membership function, with the minimum observed value being 0 and the maximum observed value being 99. However, the total range of the function goes to 99.0001, as 0.0001 was added to 99 when creating the function to ensure no observed values would be rescaled to 0. For example, the points on the line indicate the intersection of an observed value (e.g., fishing importance) and the corresponding score to which it would be rescaled from the function.

Table 2.6. Data layers and scoring within each submodel for the relative suitability analysis. Scores closer to 0 are less suitable for wind energy development, while scores closer to 1 are more suitable. A dash denotes when a dataset did not have a setback applied.

Data Set	Setback Distance	Score (0–1)
Constraints Submodel		
Department of Defense (DOD) - Exclusion Area	-	0
Pacific Coast Port Access Route Study (PACPARS)	-	0
Industry and Operations Submodel		
Submarine Cables	0–500 m	0.6
	501–1,000 m	0.8
NMFS Scientific Surveys Combined Layer	-	NMFS Scores
Natural Resources Submodel		
NMFS Protected Species Combined Layer	-	NMFS Scores
NMFS Habitat Combined Layer	-	NMFS Scores
Marine Bird Combined Layer	-	Z Membership Function 0.01–1.0
Fisheries Submodel		
NMFS & ODFW Fisheries Combined Layer	-	NMFS & ODFW Scores
Wind Submodel		
Levelized Cost of Energy for 2027	-	Linear Function 0.8–1.0 (Lower cost is better)

2.6 Calculation of Final Score

Each data layer was scored on a 0 to 1 scale, with scores approaching 0 representing low suitability and 1 representing high suitability relative to the other grid cells for wind energy. All constraints data layers were deemed unsuitable for wind energy, and not considered further in the analysis. Next, a final suitability score was calculated for each submodel by taking the geometric mean of all scores within each grid cell. The geometric mean of all submodels was used to calculate a final overall suitability score. The geometric mean (Equation 2.4) was chosen because it grants equal importance to each variable and provides a non-biased weighting of each submodel as they interact with each other (Bovee 1986; Longdill et al. 2008; Silva et al. 2011; Muñoz-Mas et al. 2012). Furthermore, all data layers and submodels had equal weight within the suitability model.

Equation 2.4. Geometric mean equation implemented for final suitability model scoring, after 0 values (constraints submodel) were removed.

$$g = \sqrt[n]{x_1 \cdot x_2 \cdot \ldots \cdot x_i}$$

$n =$ number of variables
$x_1 =$ variable 1
$x_2 =$ variable 2
$x_i =$ additional variables

2.6.1 Local Index of Spatial Association

A Local Index of Spatial Association (LISA) analysis, which identifies statistically significant clusters and outliers, was performed on the final relative suitability modeling results (Anselin 1995). All cells with a score of 0 were not included in the cluster analysis, as these areas are unsuitable for wind energy and were not considered further. This included all cells that overlapped with the DOD exclusion area, and the PACPARS proposed fairway zone. The ArcGIS Pro Cluster and Outlier Analysis tool was used to implement the LISA analysis (Esri 2021a). The fixed distance spatial conceptualization used within this analysis allows the identification of localized clusters. The function inputs consisted of an 8,400-m search distance and 9,999 iterations with row standardization and a false discovery rate correction applied. The search distance was chosen as it is representative of a wind facility site of 55,000 acres. The false discovery rate mitigates issues associated with spatial dependency and multiple testing by estimating how many false positives may occur and adjusting the p-value calculation accordingly (Caldas de Castro and Singer 2006; Esri 2021b). Analysis results identified statistically significant clusters at a 95% confidence interval ($p \leq 0.05$) of the highest suitable scores (i.e., High-High clusters).

2.6.2 Data Included in the Suitability Model and Cluster Analysis

All data layers utilized in the suitability model were considered authoritative from Federal or State agencies. Before selection for use in modeling, data were evaluated for spatial accuracy and temporal and spatial completeness to ensure quality control. Data that did not meet these specifications, or did not overlap with the Call Areas, were not included in the model. However, some data in the characterization inventory were included to provide supplementary information for the purposes of putting the Call Areas and Draft WEAs in a larger context.

2.6.3 Suitability Modeling Approach, Assumptions, and Limitations

Models, in general, can optimize planning choices and improve the decision-making process by avoiding common biases and offering objective results with limited subjectivity (i.e., equally-weighted approach). However, assumptions must be made within a modeling framework. For instance, we assume multiple overlapping activities in the same space results in greater conflict and less suitable with wind energy, which may not necessarily be the case depending on the activities.

Spatial data were used within a GIS-framework to develop workflows with a series of interconnected steps (Stelzenmüller et al. 2012; 2017). A flexible, integrated GIS-based suitability model was implemented to consider complex interactions (i.e., equally weighted relative suitability model in an ocean environment) while also aiming for long-term sustainability (Perez et al. 2003; Cho et al. 2012; Pinarbasi et al. 2017, 2019; Stelzenmüller et al. 2017) (Figure 2.6). An attempt was made to minimize bias among submodels and data layers through the implemented equally weighted approach. Models have some limitations (e.g., statistical assumptions, best-available data, modeling approach). For example, the scoring of categorical and numerical data; the reporting of statistic used, variability in data temporal and spatial coverage, p-value for LISA cluster and outlier analysis, and variables in the suitability and precision siting model; and the consideration of model error, used in the relative suitability spatial workflow approach, could, if approached differently, impact or change the final Draft WEA options reported. Other limitations include spatial and horizontal resolution of model data, the accuracy and precision of model data, and available time and data availability (See NMFS disclaimer in Appendix B through E). Further, we consistently tried to choose the most conservative approach for scoring assignments and other judgments to ensure a high level of accuracy for wind energy compatibility within the constraints of the data and model.

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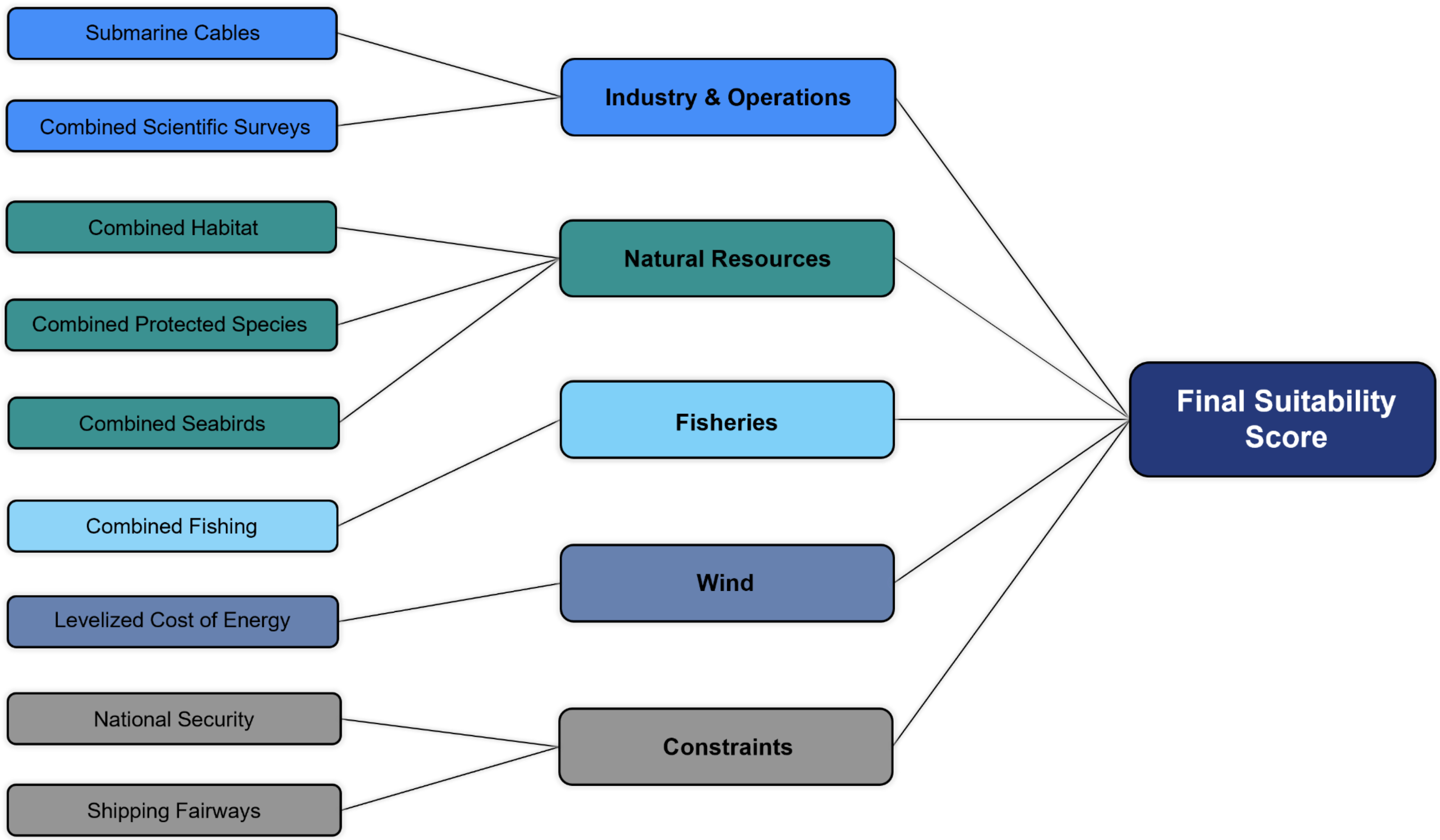

Figure 2.6. A generalized approach to a Multi-Criteria Decision Analysis suitability model for Oregon Draft Wind Energy Areas with equally weighted data layers and submodels in the final suitability model.

2.7 Draft Wind Energy Area Identification

BOEM determined the minimum viable size of a WEA to be 55,000 acres, and Draft WEAs were identified using the High-High clusters in conjunction with defined rules with the goal of identifying at least two suitable Draft WEAs (>55,000 acres). The High-High clusters were overlaid with the lease block aliquots. The aliquots are 1/16th the size of a lease block (1 lease block = 16 aliquots). Aliquots that overlapped the High-High clusters were selected and extracted, for a total of 617 aliquots, and any additional aliquots containing suitability scores less than the 95% confidence interval ($p > 0.05$) were included in an area if it was completely encircled by high scoring aliquots. The aliquots were grouped together based on location to make up the two Draft WEAs. This methodology does allow for some conflicting interactions to be located within the final areas (submarine cables, surveys, etc.), which are noted in the results and with the discussion of avoidance or mitigation to follow.

2.8 Characterization of Draft Wind Energy Areas

An in-depth look at each of the identified Draft WEAs was performed both visually and by examining metrics and summary statistics of data layers for evaluation and comparison. All data layers from the modeling were examined with the Draft WEAs, including a selection of data layers used in the development of combined data layer composites. In addition, some data layers were not used for suitability modeling, but are still important in the final decision-making process. Therefore, additional data layers not included in the modeling process are examined in the characterization of the Draft WEAs (Table 2.7).

Table 2.7. Data included for spatial modeling characterization of Draft WEAs which were not used in suitability modeling.

Data Set	Setback	Score (0–1)
• ESA-designated Critical Habitat • Biologically Important Areas for Cetaceans	• All Fishing • Whiting Mothership/Catcher Processor • Whiting Shoreside • Bottom Trawl • Dungeness Crab • Pink Shrimp • Salmon Troll	• NCEI Coastal Relief Model • Annual Average Wind Speed • Principal Ports

3 RESULTS

3.1 Submodels

3.1.1 Constraints

This section presents a summary of the constraints that are likely to limit wind energy development either because of national security or high level of conflict with other ocean industries. National security assets are relatively extensive throughout many portions of U.S. Federal waters with uses varying over time and space. The DOD assessed compatibility of wind energy operations in the Call Areas with their activities, and a DOD exclusion area was included as a constraint (Appendix H; Figure 3.1). It is important to note that the total area removed may not sum to 100% because of overlapping constraints. The total constraints in the submodel overlapped with 57.59% of the Call Areas (Figure 3.3 and Table 3.1).

Table 3.1*.* Constraints submodel data layers included in the relative suitability analysis and the percent overlap. Each dataset in the constraints submodel was scored 0 for complete avoidance.

Data Layer	Score	Percent Area Constrained
Department of Defense - Exclusion Area	0	49.27%
Pacific Coast Port Access Route Study (PACPARS)	0	18.10%
	All Constraints	57.59%

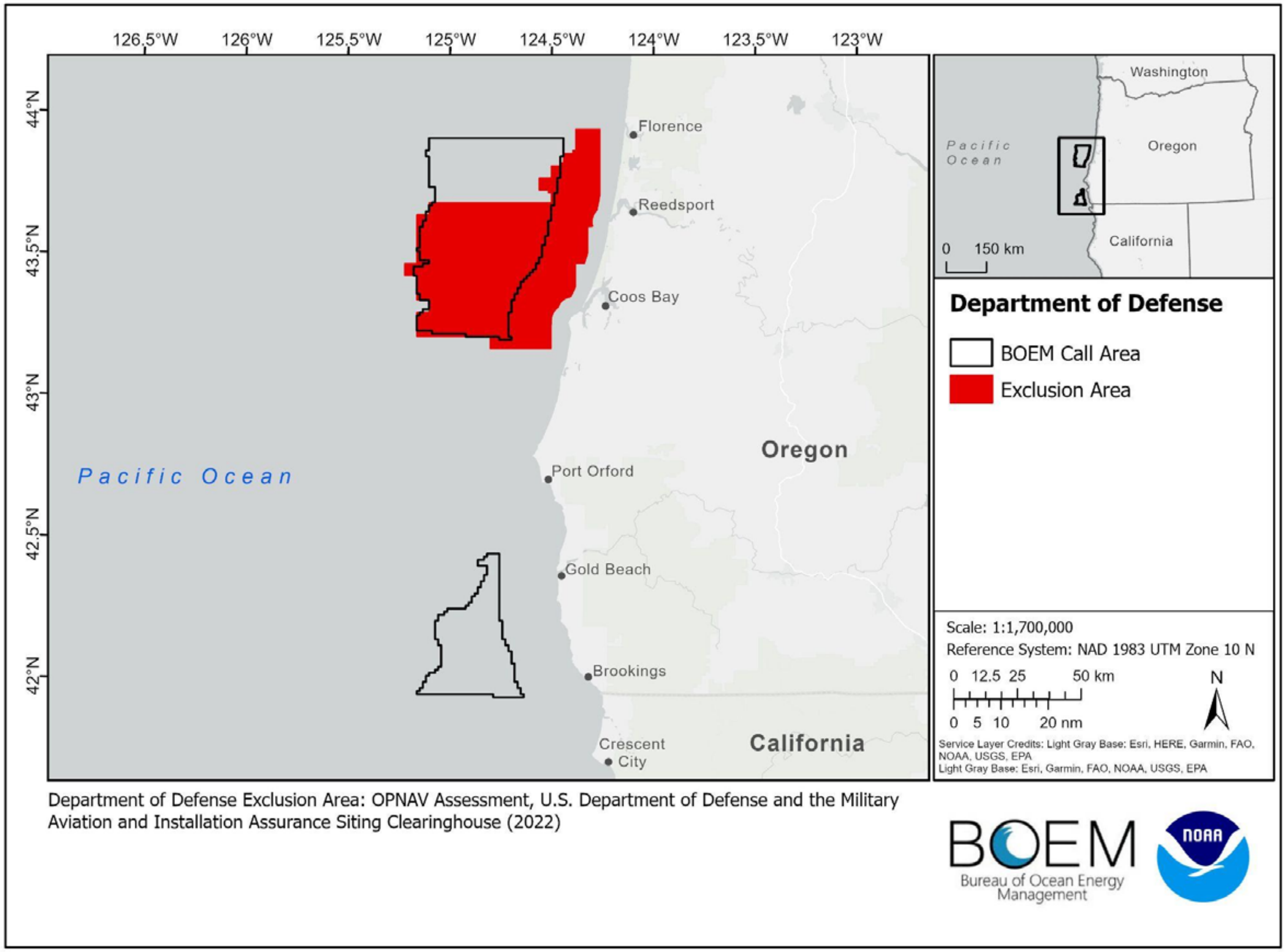

Figure 3.1. Department of Defense exclusion area for the Call Areas implemented within the constraints submodel for relative suitability analysis.

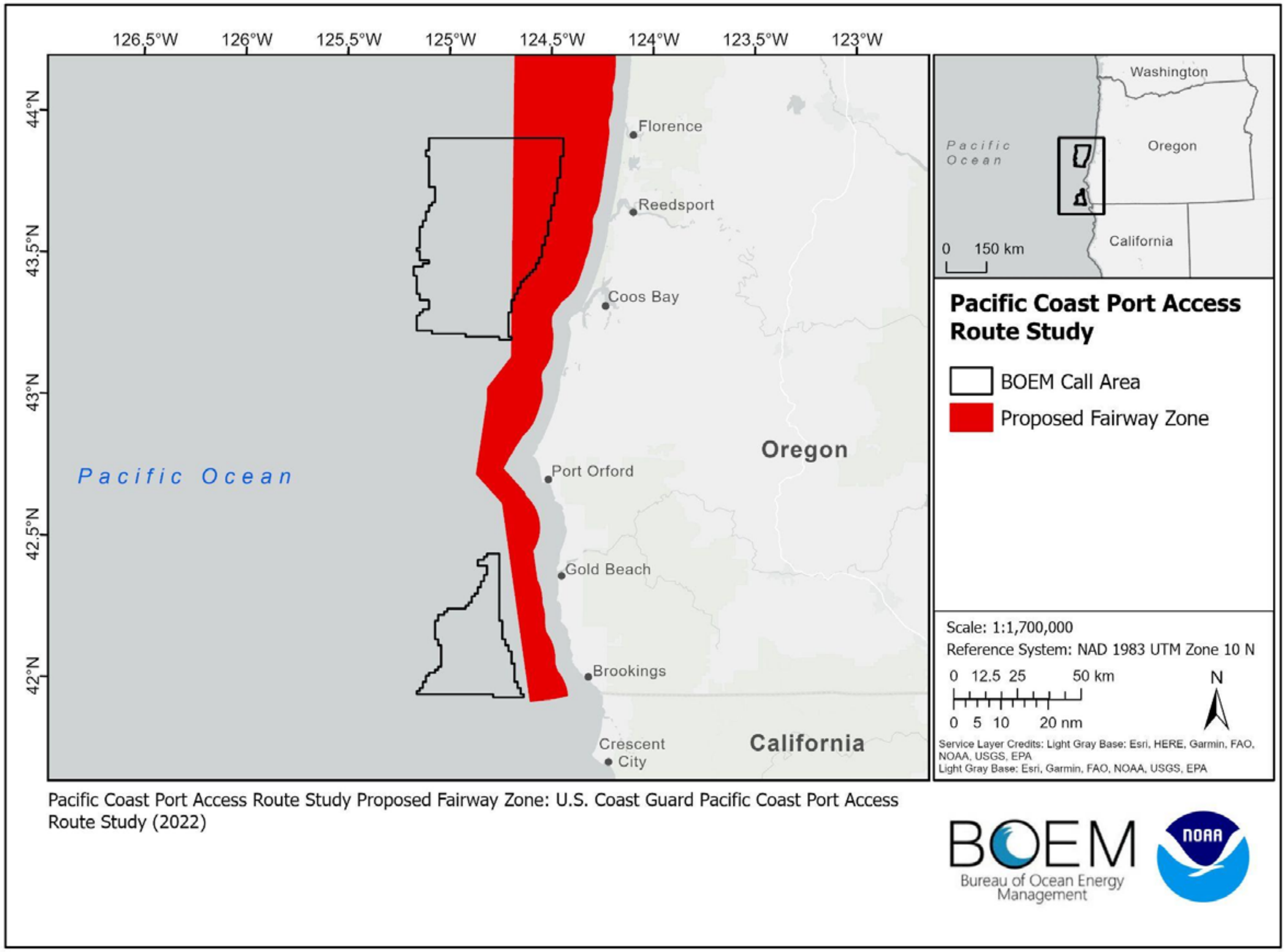

Figure 3.2. U.S. Coast Guard proposed fairway zone for the Call Areas implemented within the constraints submodel for relative suitability analysis.

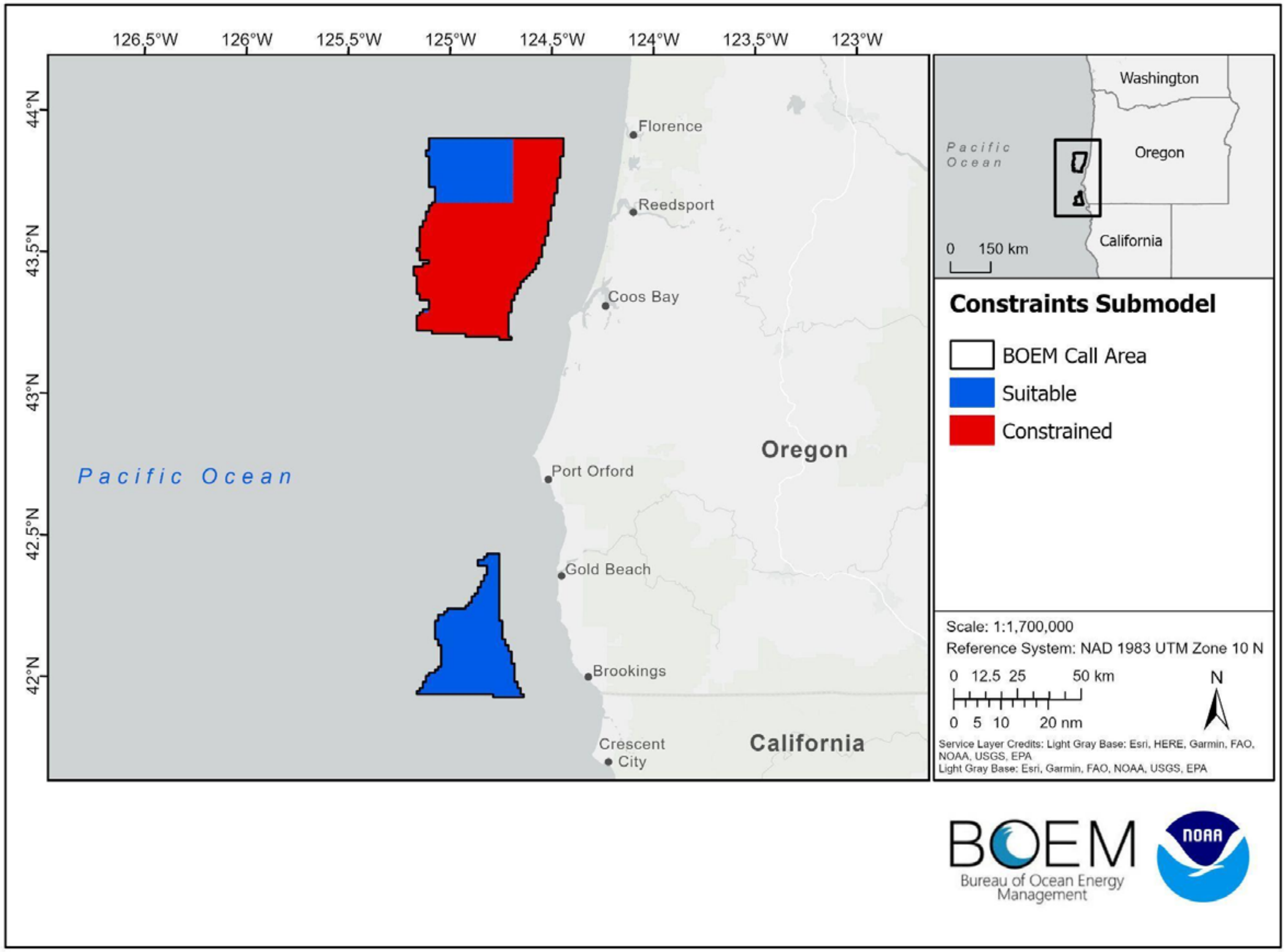

Figure 3.3. Constraints submodel relative suitability for the Call Areas. Red color indicates those areas constrained by ocean activity, while blue areas are considered suitable.

3.1.2 Industry and Operations

Navigational constraints for vessel traffic were evaluated for the suitability model and included shipping fairways and Automatic Identification System (AIS) data. The U.S. Coast Guard (USCG) has been conducting a Pacific Coast Port Access Route Study, PACPARS (USCG 2022), along the western seaboard to determine if routing measures to shipping fairways should be established and/or modified. The USCG provided a draft shipping safety fairway data layer to be included in the suitability analysis. This data layer was assigned a score of 0 and moved to the constraints submodel for complete avoidance (Figure 3.2). Additional industry activity in and around the Call Areas was spatially examined (Table 3.2).

3.1.2.1 Operations

Scientific surveys in the region were considered, and six survey footprints overlap with the Call Areas. Overall, four data layers were developed and combined to be used in the suitability model as a single NMFS scientific surveys layer. Eight 4-nm wide survey corridors were given a lower score than areas with less survey activity (Figure 3.4).

3.1.2.2 Industry

Submarine cables in the region were taken into consideration and the majority were mitigated during the development of the Call Areas early in BOEM’s planning process. No overlap of submarine cables is present within the Brookings Call Area, and minimal overlap remains in the Coos Bay Call Area (Figure 3.5). A 500 and 1,000 m setback were added due to potential interactions with the industry (ICPC 2023).

Suitability results for the industry and operations submodel are presented in Figure 3.6.

Table 3.2. Industry and operations submodel data layers included in the relative suitability analysis and the score assigned to each dataset.

Data Layer	**Score**
NMFS Scientific Surveys Combined Layer	Scored provided by NMFS
Submarine Cables	0–500 m = 0.6 501–1,000 m = 0.8

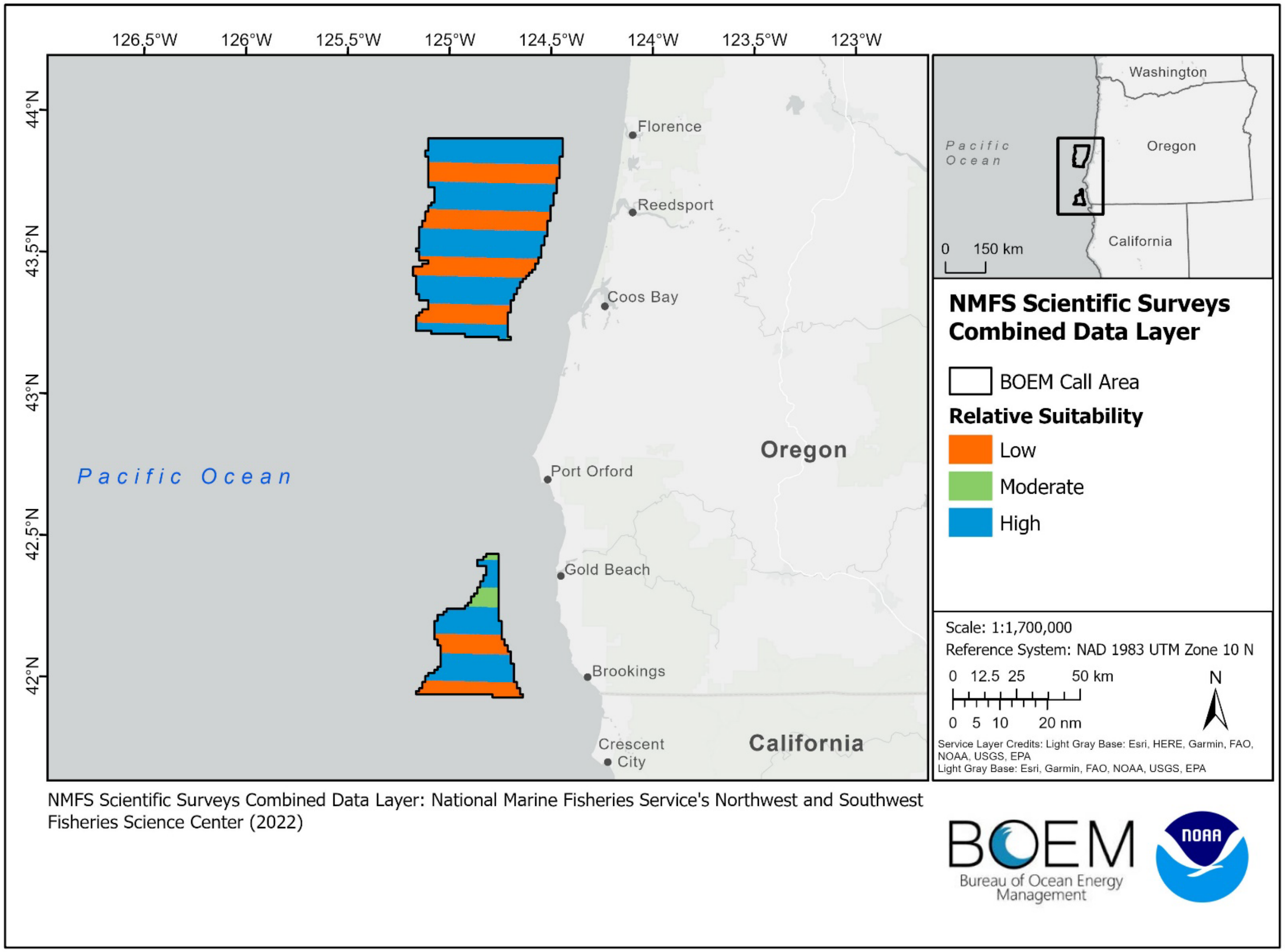

Figure 3.4. NMFS scientific surveys combined layer for the Call Areas implemented within the industry and operations submodel for relative suitability analysis. The color orange represents areas of relatively lower suitability, while the color blue indicates areas of relatively higher suitability.

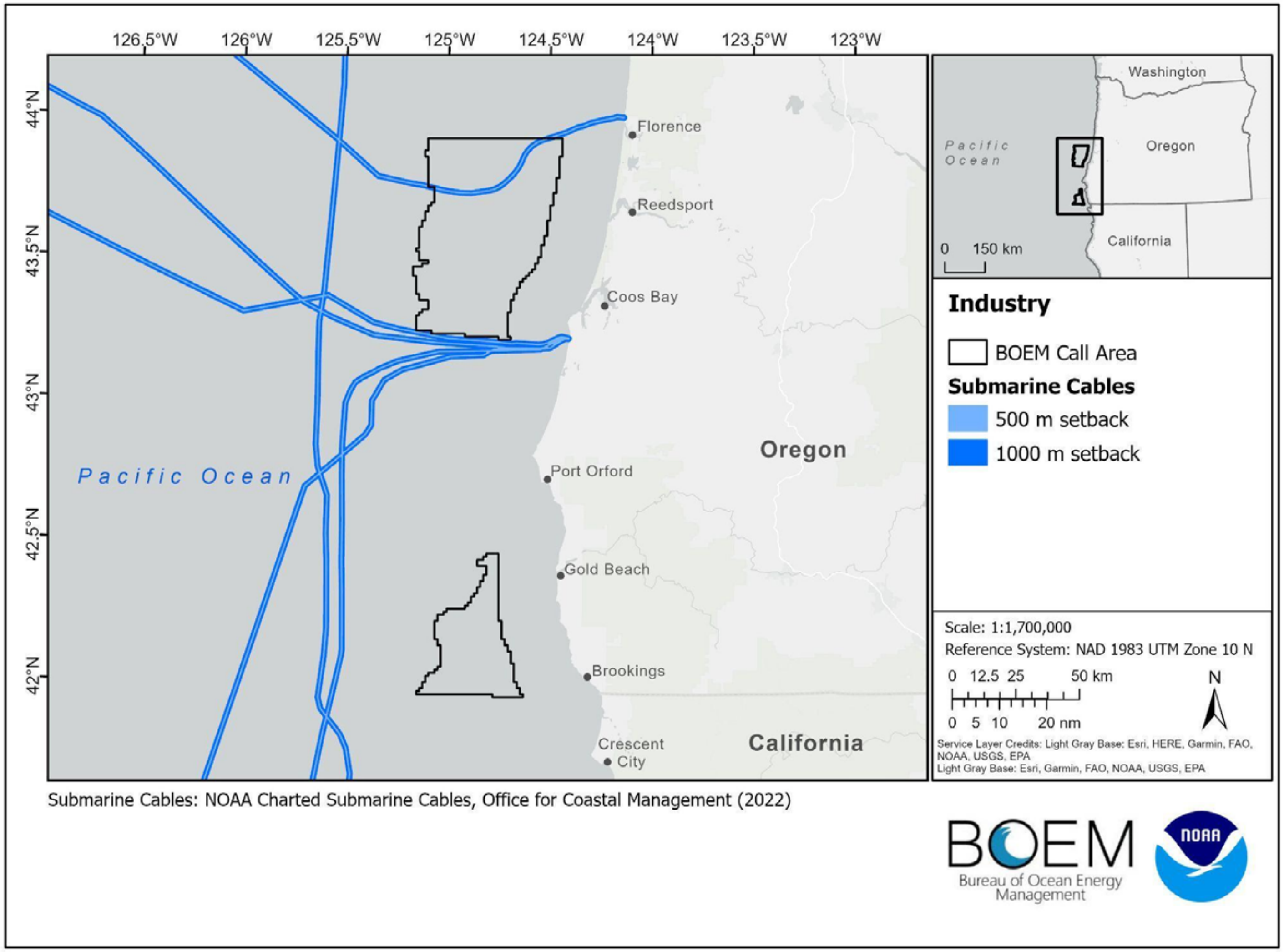

Figure 3.5. Submarine cable considerations for the Call Areas implemented within the industry and operations submodel for relative suitability analysis.

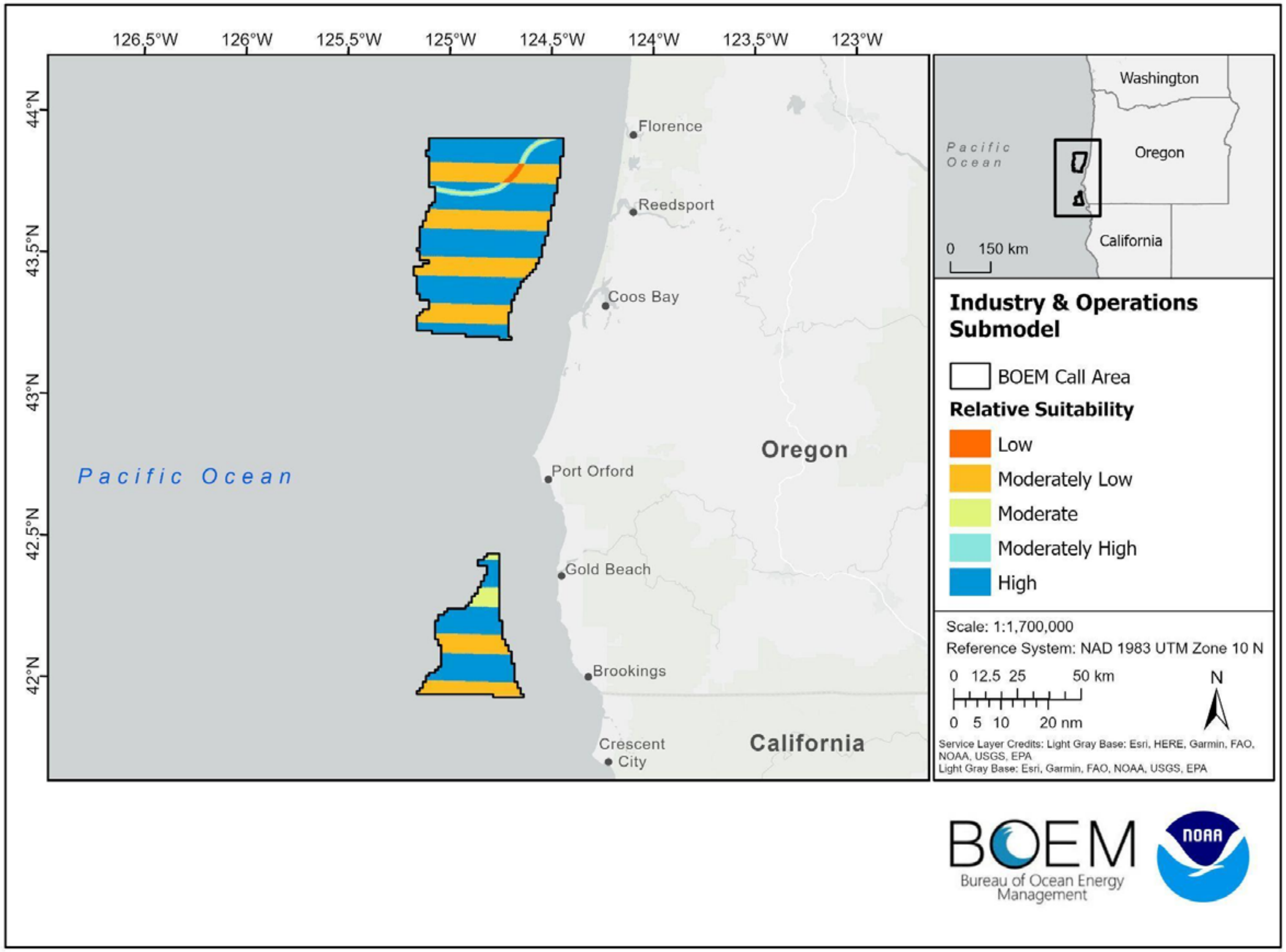

Figure 3.6. Industry and operations submodel utilized in the relative suitability model. The color orange represents areas of relatively lower suitability, while the color blue indicates areas of relatively higher suitability.

3.1.3 Natural Resources

Natural resources in and around the Call Areas were assessed to determine biologically important and sensitive habitats, and designated protected areas that may be incompatible with wind energy (Table 3.3).

3.1.3.1 Protected Species Considerations

A total of five protected species data layers were combined and used in the suitability model as a single NMFS protected species layer. The final composite layer covered the entire Call Areas and the interactions for each species varied (Figure 3.7). The east and north portions of both Call Areas, along with the southern portion of Brookings, had the lowest relative suitability. The southwest portion of Coos Bay and the north portion of Brookings had the highest relative suitability.

3.1.3.2 Habitat Considerations

A number of interactions with habitat were considered and mitigated during the development of the Call Areas early in BOEM's planning process. Both Call Areas were developed with minimal overlap with essential fish habitat conservation areas. Both Call Areas had overlap with hardbottom, the 10 km setback from the shelf break, methane seeps, and deep-sea coral habitat (Figure 3.8). The Coos Bay Call Area had more overlap with hardbottom and the 10 km setback from the shelf break. The Brookings Call Area had more overlap with deep-sea coral habitat.

3.1.3.3 Marine Bird Considerations

Understanding bird spatial distributions and densities at sea is necessary to minimize impacts of offshore wind development. Therefore, a total of 30 individual species and 12 taxonomic groups were combined and used in the suitability model as a single composite layer representing marine bird importance. The data layers were also weighted with marine bird vulnerability metrics. The final composite completely covered the Call Areas (Figure 3.9). The eastern sides of the Call Areas have the highest bird importance values, while lower values are seen further offshore toward the western sides.

The overall suitability results for the natural resources submodel are presented in Figure 3.10

Table 3.3. Natural resources submodel data layers included in the relative suitability analysis and the score assigned to each dataset.

Data Layer	Score
NMFS Protected Species Combined Layer	Scored provided by NMFS
NMFS Habitat Combined Layer	Scored provided by NMFS
Marine Bird Combined Layer	Z Membership Function 0.01–1.0

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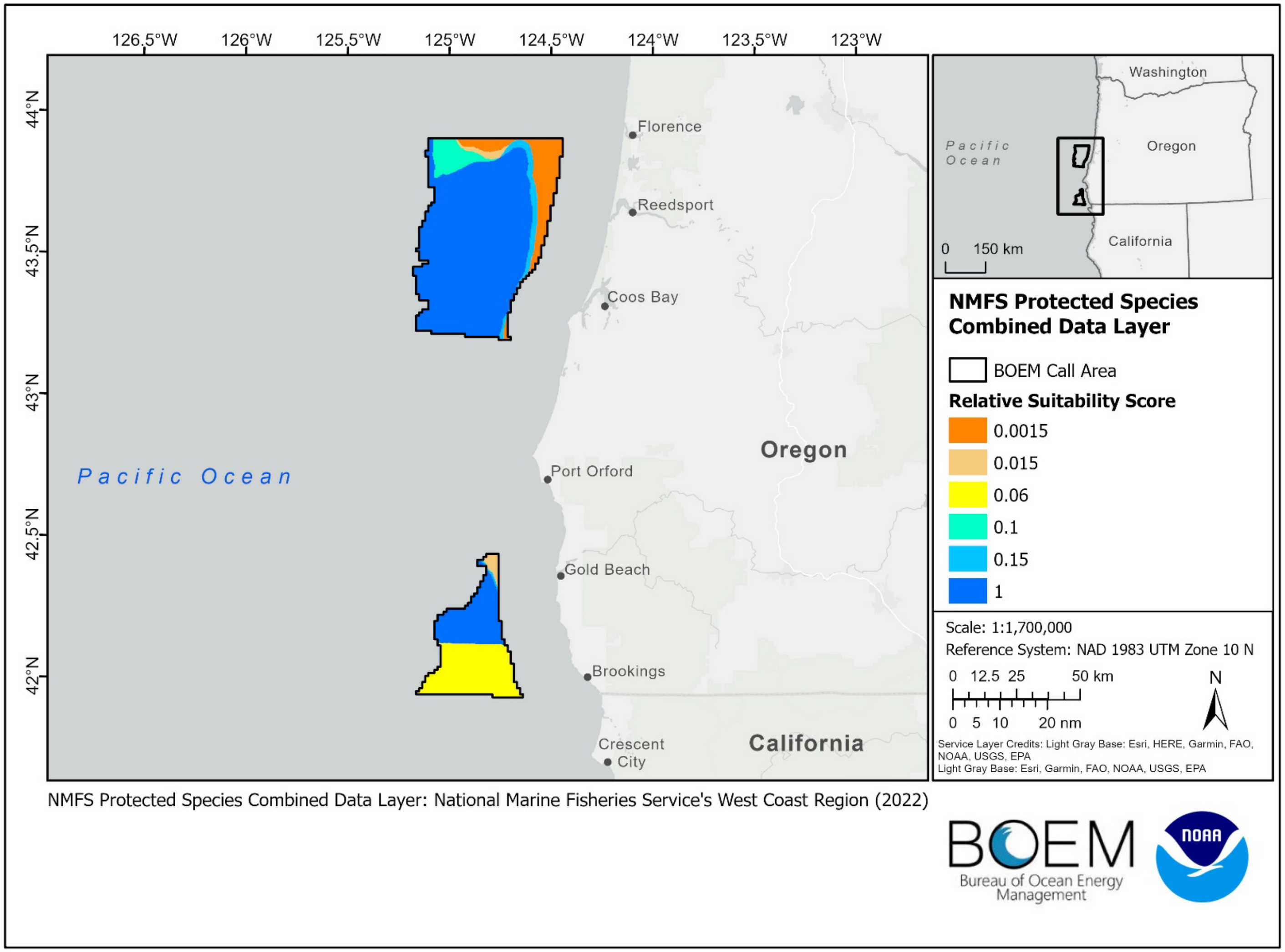

Figure 3.7. NMFS protected species combined data layer (five species layers) implemented within the natural resources submodel for relative suitability analysis. The color orange represents areas of relatively lower suitability, while the color blue indicates areas of relatively higher suitability.

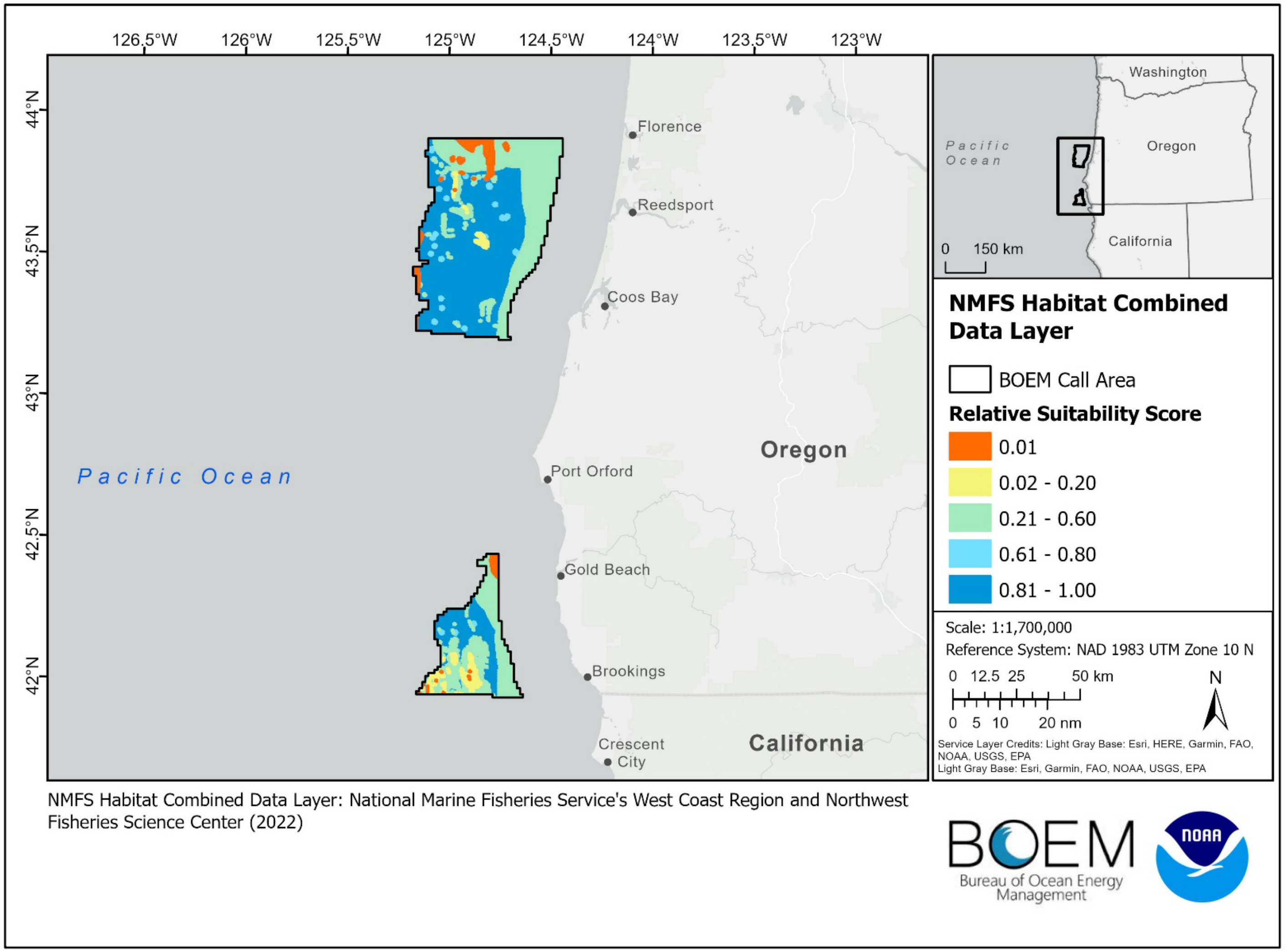

Figure 3.8. NMFS habitat combined data layer implemented within the natural resources submodel for relative suitability analysis. The color orange represents areas of relatively lower suitability, while the color blue indicates areas of relatively higher suitability.

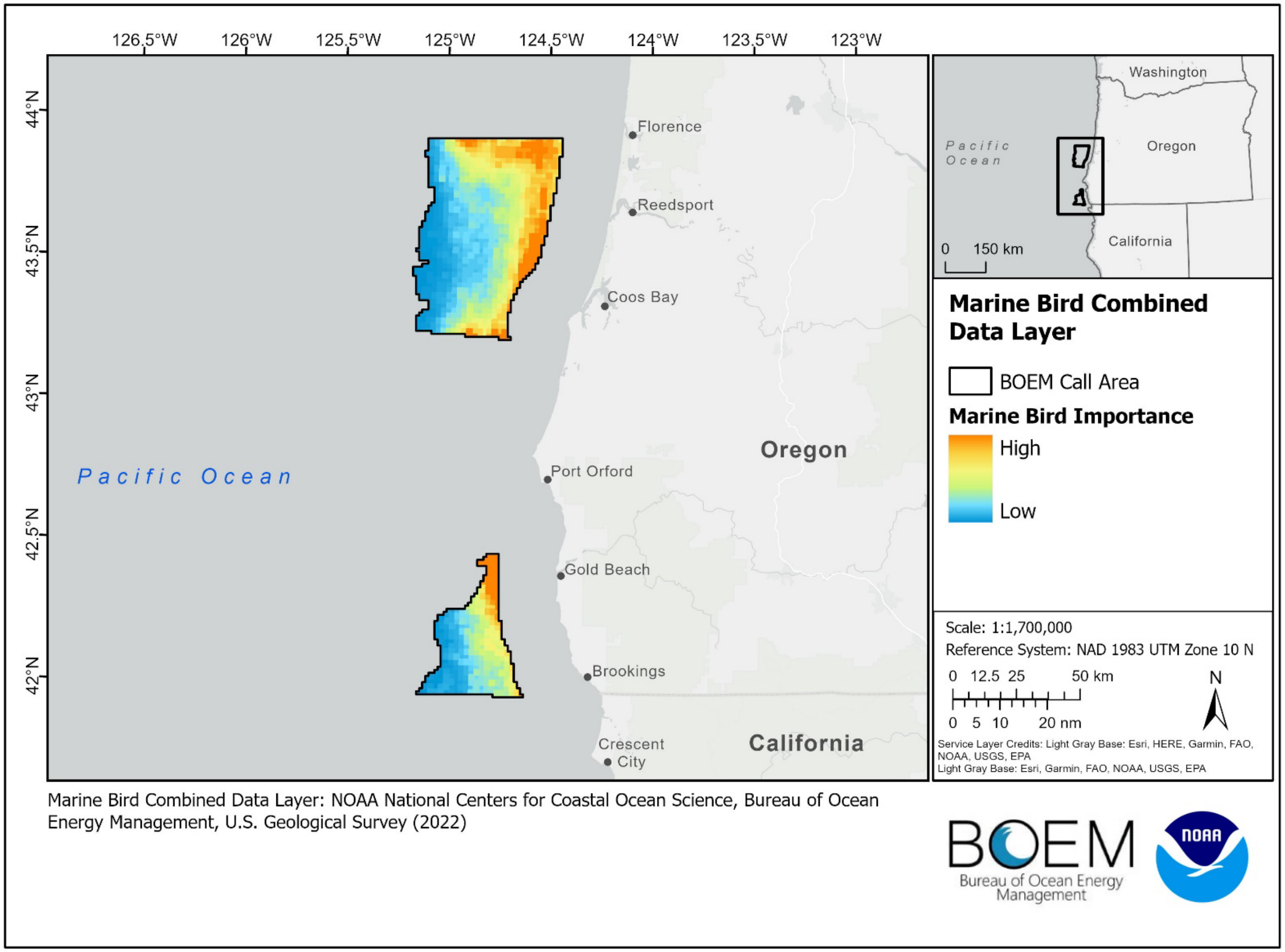

Figure 3.9. Marine bird combined data layer implemented within the natural resources submodel for relative suitability analysis. The color orange represents areas of higher bird importance relative to the Call Areas, while the color blue indicates areas of lower bird importance.

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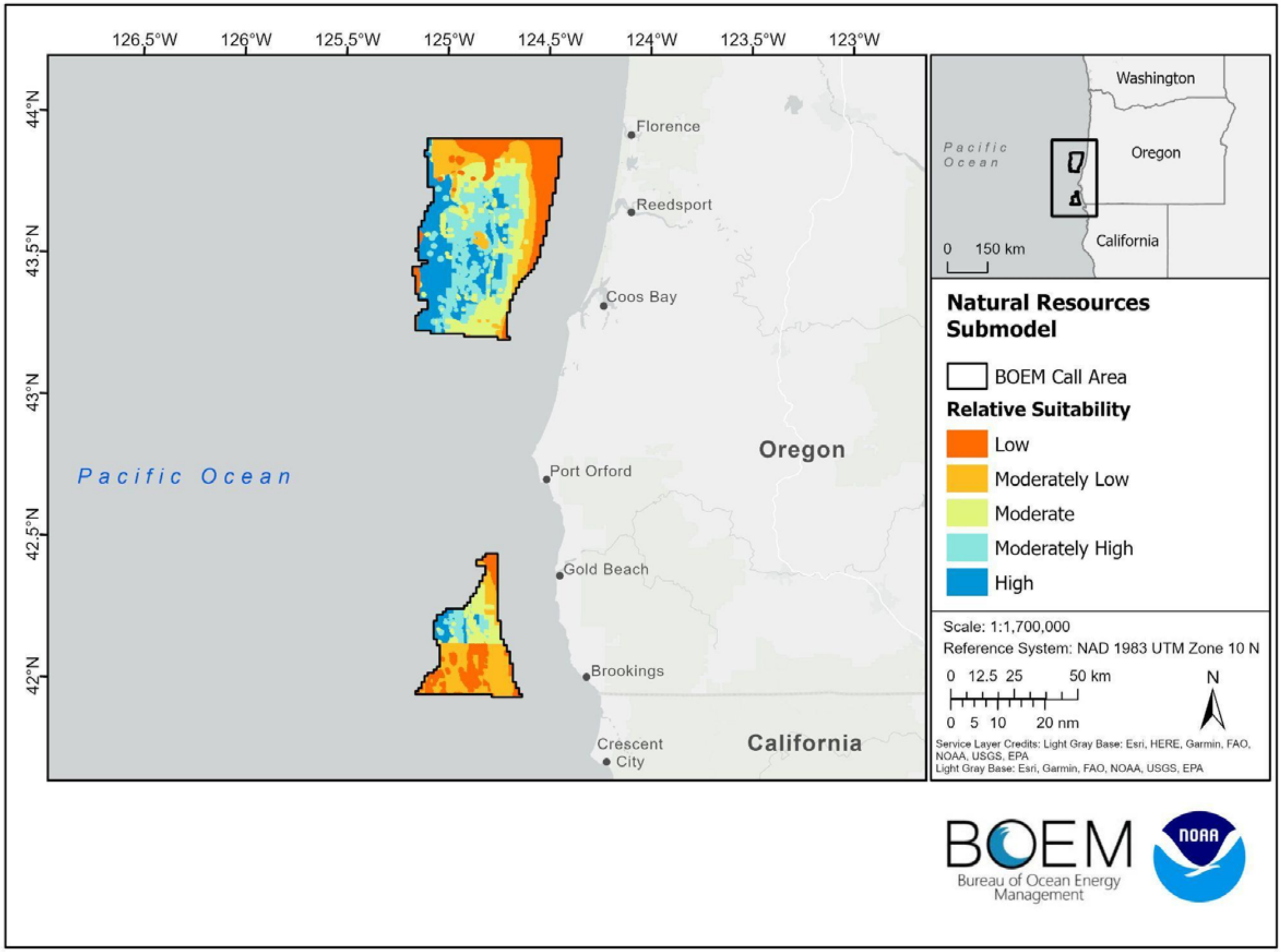

Figure 3.10. Natural resources submodel utilized in the relative suitability model. The color orange represents areas of relatively lower suitability, while the color blue indicates areas of relatively higher suitability.

3.1.4 Fisheries

Several commercial and recreational fisheries datasets were considered for inclusion in the fisheries submodel (Table 3.4). Overall, a total of nine fisheries were selected and used in the suitability model as a single NMFS & ODFW fisheries layer (Figure 3.11). The Coos Bay Call Area had the highest overlap with the lowest suitability scores for trawling fisheries, and the majority of the fisheries interactions for the Brookings Call Area can be seen toward the eastern side.

The overall suitability results for the fisheries submodel are presented in Figure 3.12.

Table 3.4*.* Fisheries submodel data layers included in the relative suitability analysis and the score assigned to each dataset.

Data Layer	Score
NMFS & ODFW Fisheries Combined Layer	Scored provided by NMFS & ODFW

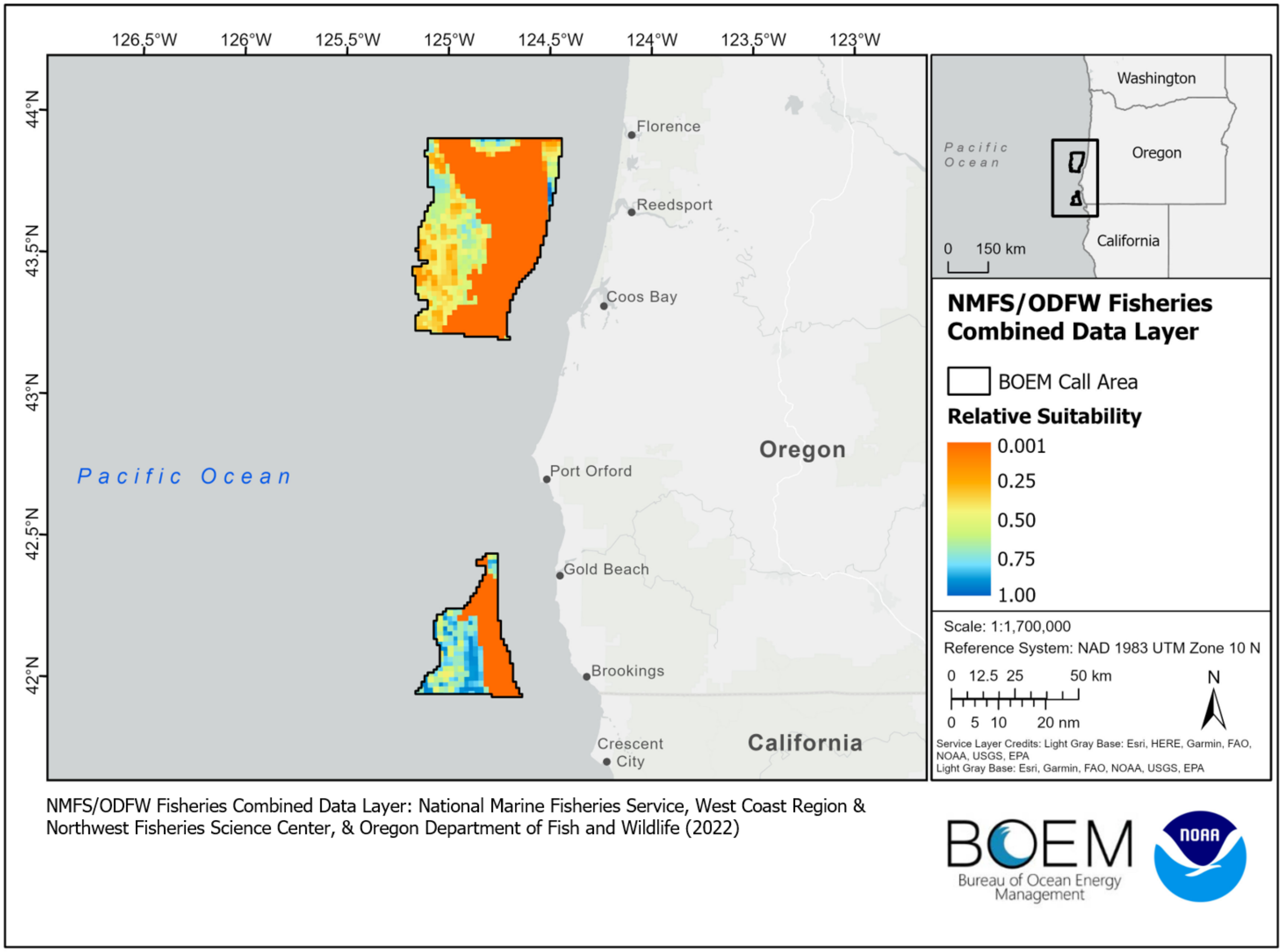

Figure 3.11. NMFS & ODFW combined data layer implemented within the relative suitability analysis.

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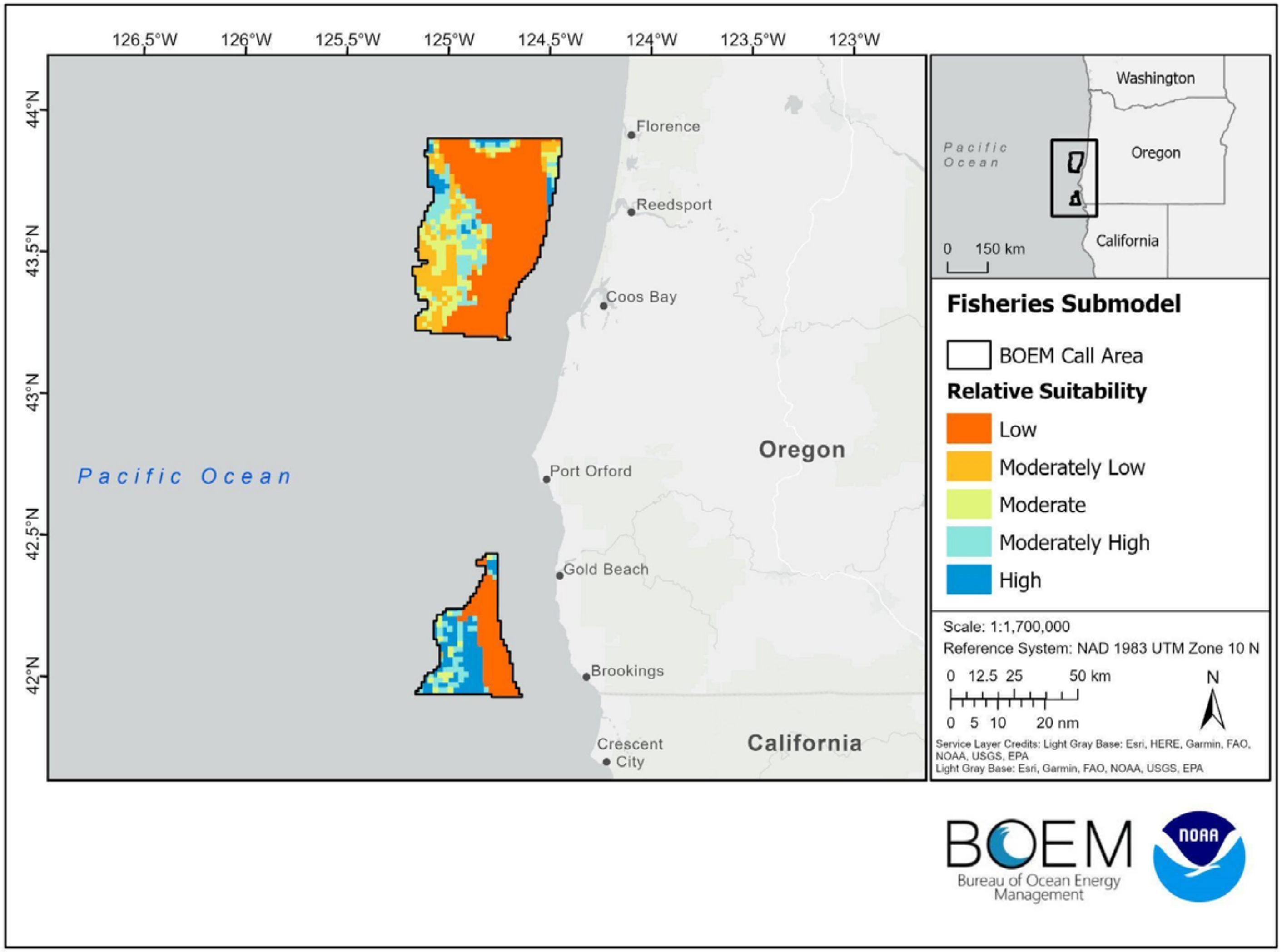

Figure 3.12. Fisheries submodel utilized in the relative suitability model. The fisheries submodel only included one data layer, the NMFS & ODFW combined fisheries data layer. The color orange represents areas of relatively lower suitability, while the color blue indicates areas of relatively higher suitability.

3.1.5 Wind

The closer to shore a WEA is located, the less fuel and travel time required and the lower cost of running transmission lines. Being closer to principal ports should aid in use of available port infrastructure needed for the deployment and installation of wind facilities. In terms of wind speed, Oregon has some of the best wind resources in the country, and the high annual average wind speeds and their consistency lead to an assumption of consistent and continuous operation. A levelized cost of energy model developed by the National Renewable Energy Laboratory (NREL) was used to represent these factors in dollars per megawatt for the year 2027 (Musial et al.2021; Figure 3.13). The overall levelized cost of energy is relatively higher in the northern portion of the Coos Bay Call Area.

The overall suitability results for the wind submodel are presented in Figure 3.14.

Table 3.5*.* Wind submodel data layers included in the relative suitability analysis and the score assigned to each dataset.

Data Layer	Score
Levelized Cost of Energy for 2027	Linear Function (0.8–1.0)

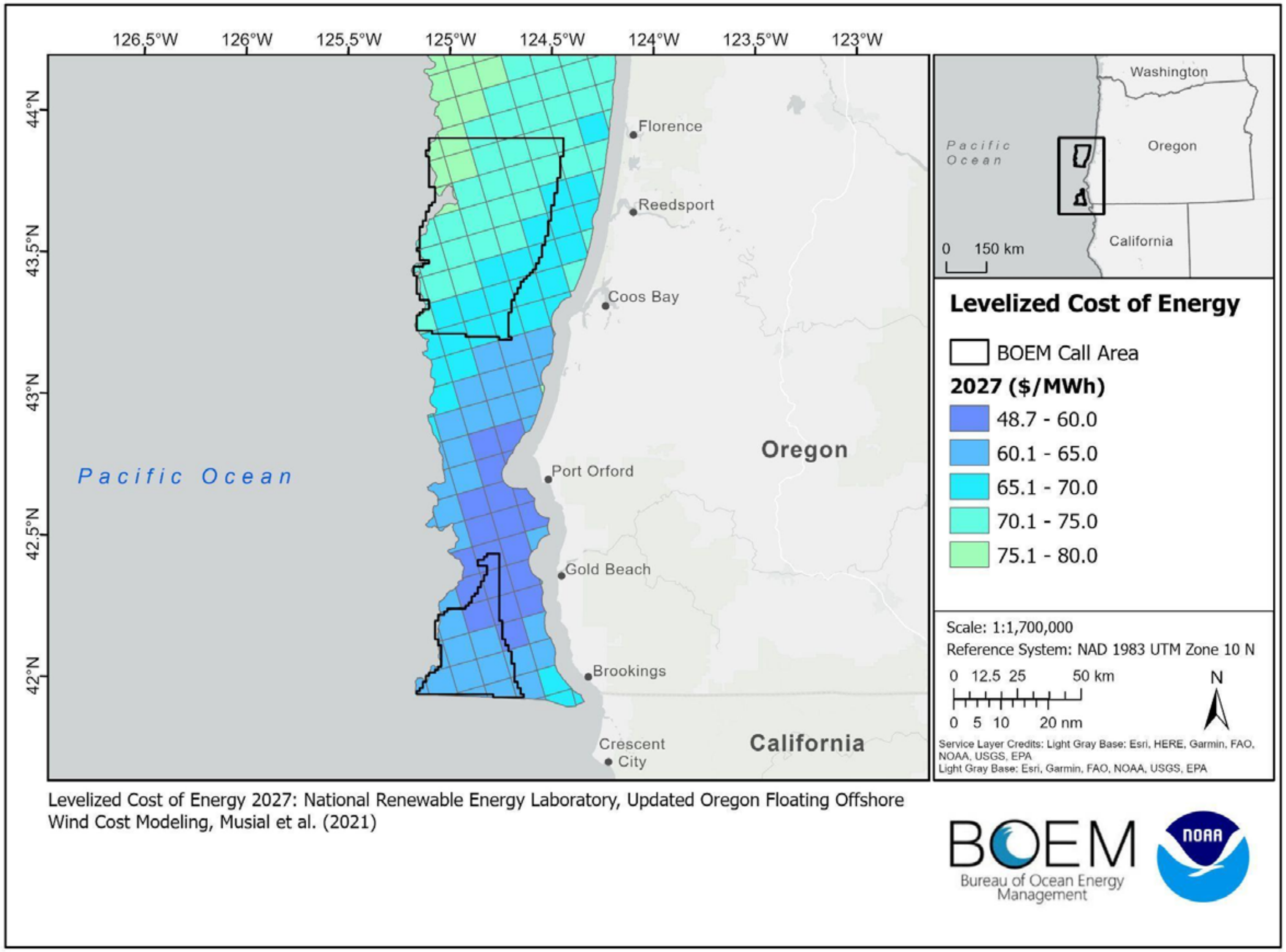

Figure 3.13. Levelized cost of energy in 2027 for the Call Areas implemented within the wind submodel for relative suitability analysis. The lower the levelized cost of energy (dollars per megawatt hour), the more suitable for wind energy development.

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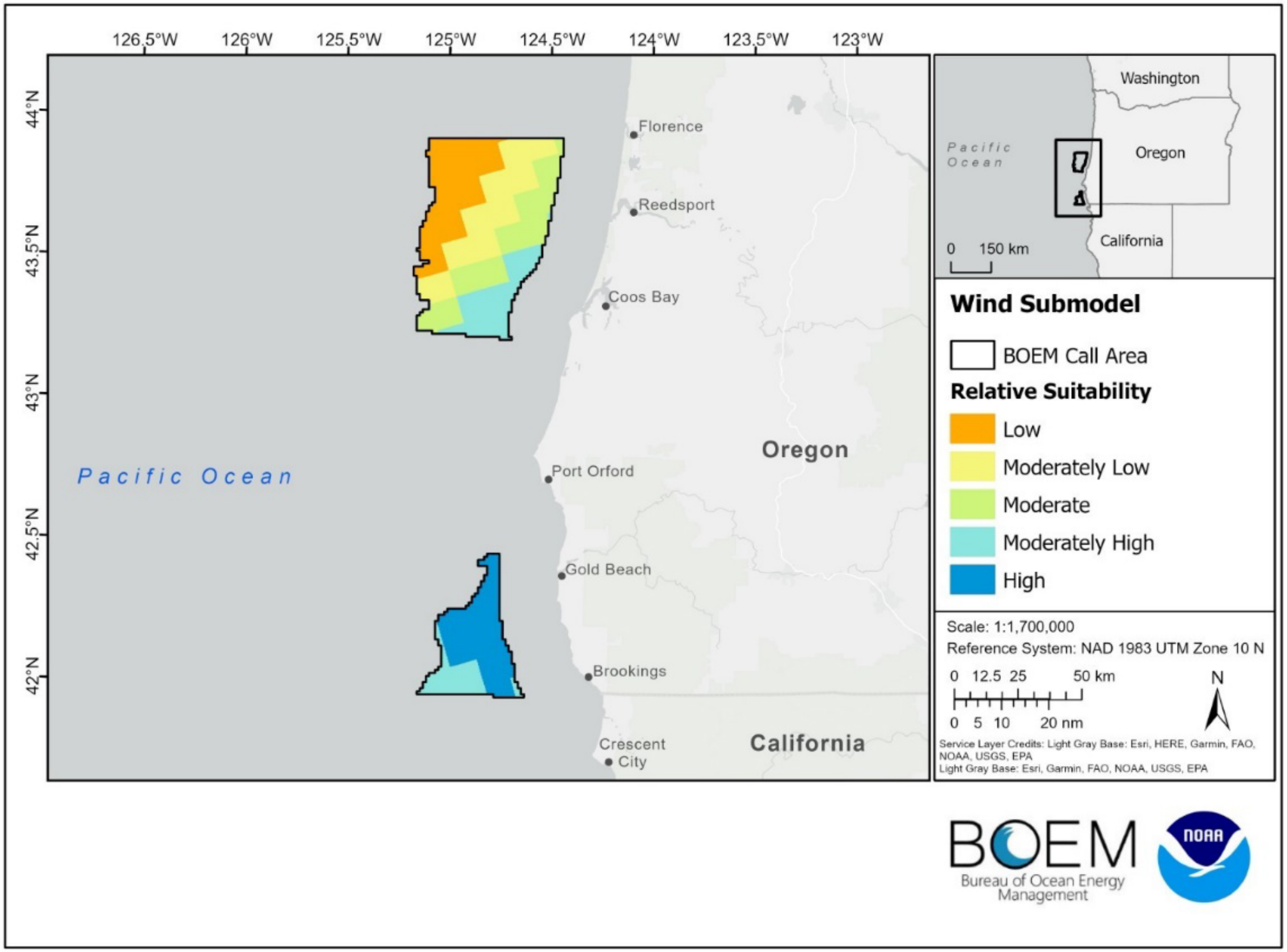

Figure 3.14. Wind submodel utilized in the suitability model. The wind submodel only included one data layer, the levelized cost of energy for 2027 data layer. The color green represents areas of relatively moderate suitability, while blue indicates areas relatively higher in suitability.

3.2 Final Suitability

The final suitability results for all submodels are presented in Figure 3.15. Several suitable areas were found in each of the Coos Bay and Brookings Call Areas. It is important to note that these suitability results are reflective of the planning objective to identify Draft Wind Energy Areas. In the Oregon region, different wind energy opportunities may exist under different planning objectives or at different scales than considered here.

3.3 Cluster Analysis and Draft Wind Energy Areas

The cluster analysis identified 208,650 acres of High-High clusters, which are groups of cells with high values that are statistically significant from other cells (Figure 3.16). Aliquots that overlapped with a High-High cluster were selected, and areas less than 55,000 acres were removed, resulting in a total of 617 aliquots being selected. Additional aliquots were included that were fully encircled by the selected aliquots, including four aliquots in Draft WEA A totaling 1,420 acres, and two aliquots in Draft WEA B totaling 710 acres. Overall, two Draft WEAs were identified, one (A) in Coos Bay at 61,204 acres and the second (B) in Brookings at 158,364 acres (Figure 3.17).

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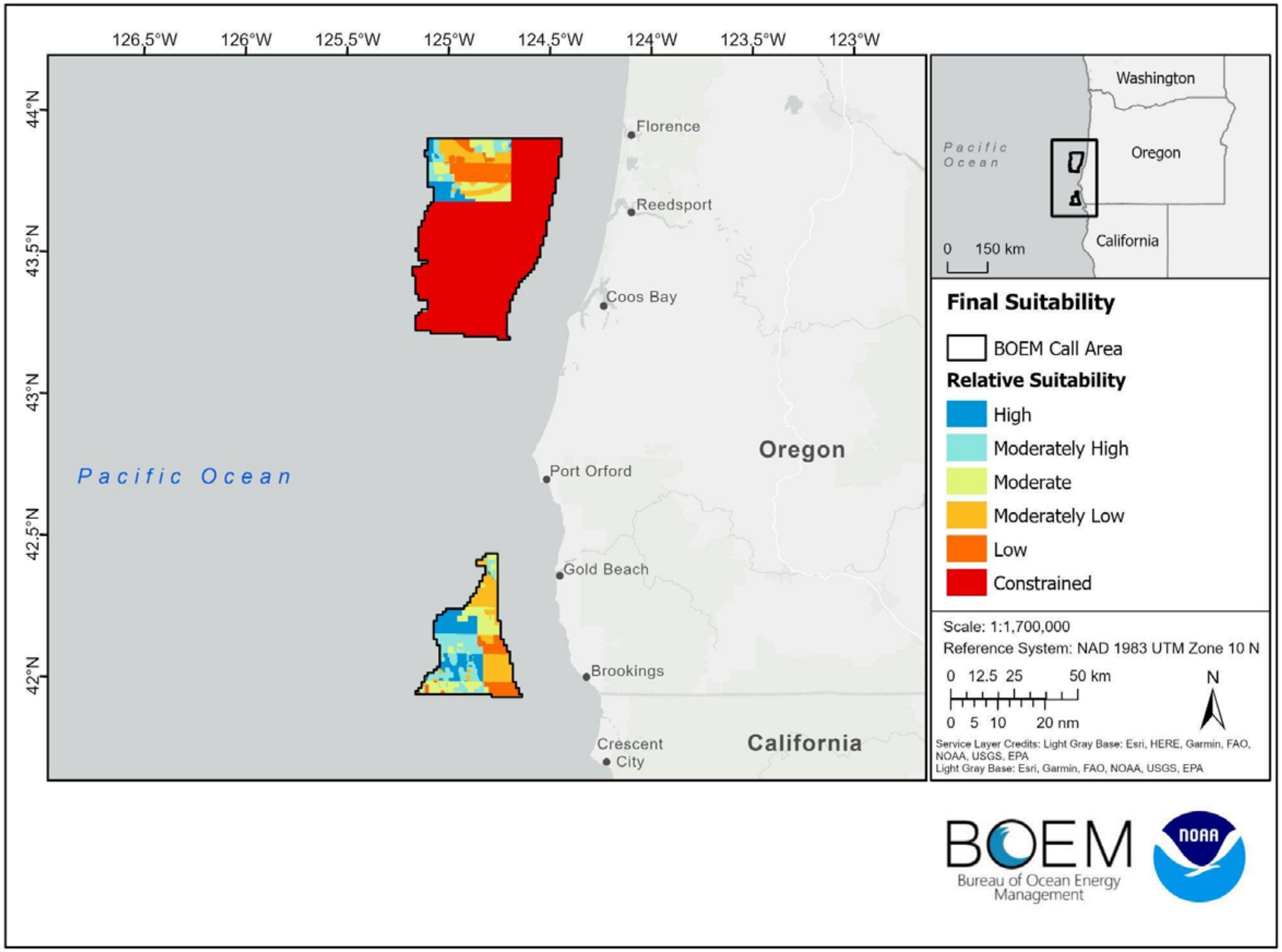

Figure 3.15. Final suitability modeling results for the Call Areas. Red color indicates constraints with a score of 0, and blue color indicates areas of highest suitability.

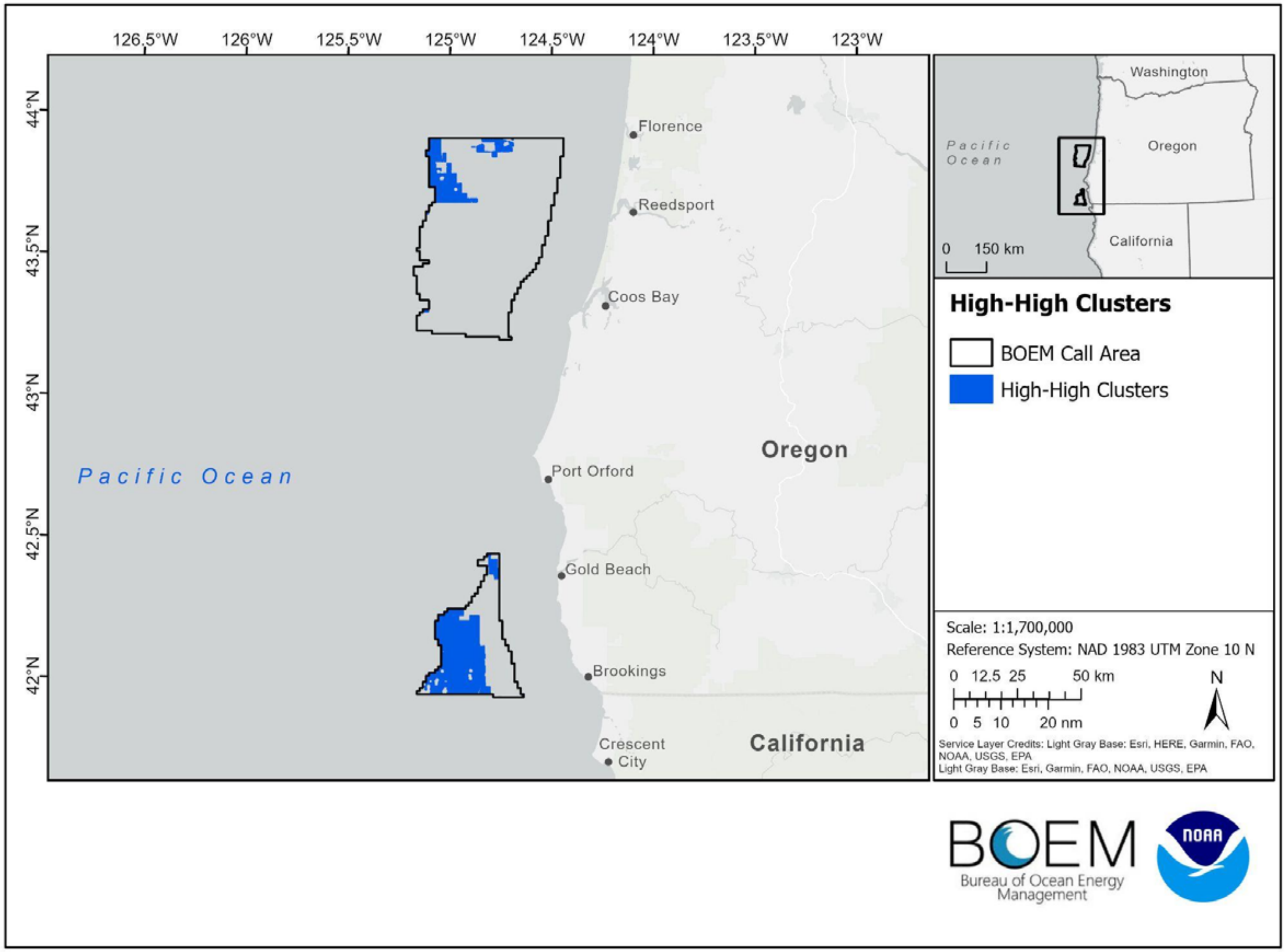

Figure 3.16. Cluster analysis of the Call Areas at the 95% Confidence Interval (p ≤ 0.05). These areas represent clusters of grid cells with the highest suitability (i.e., High-High clusters).

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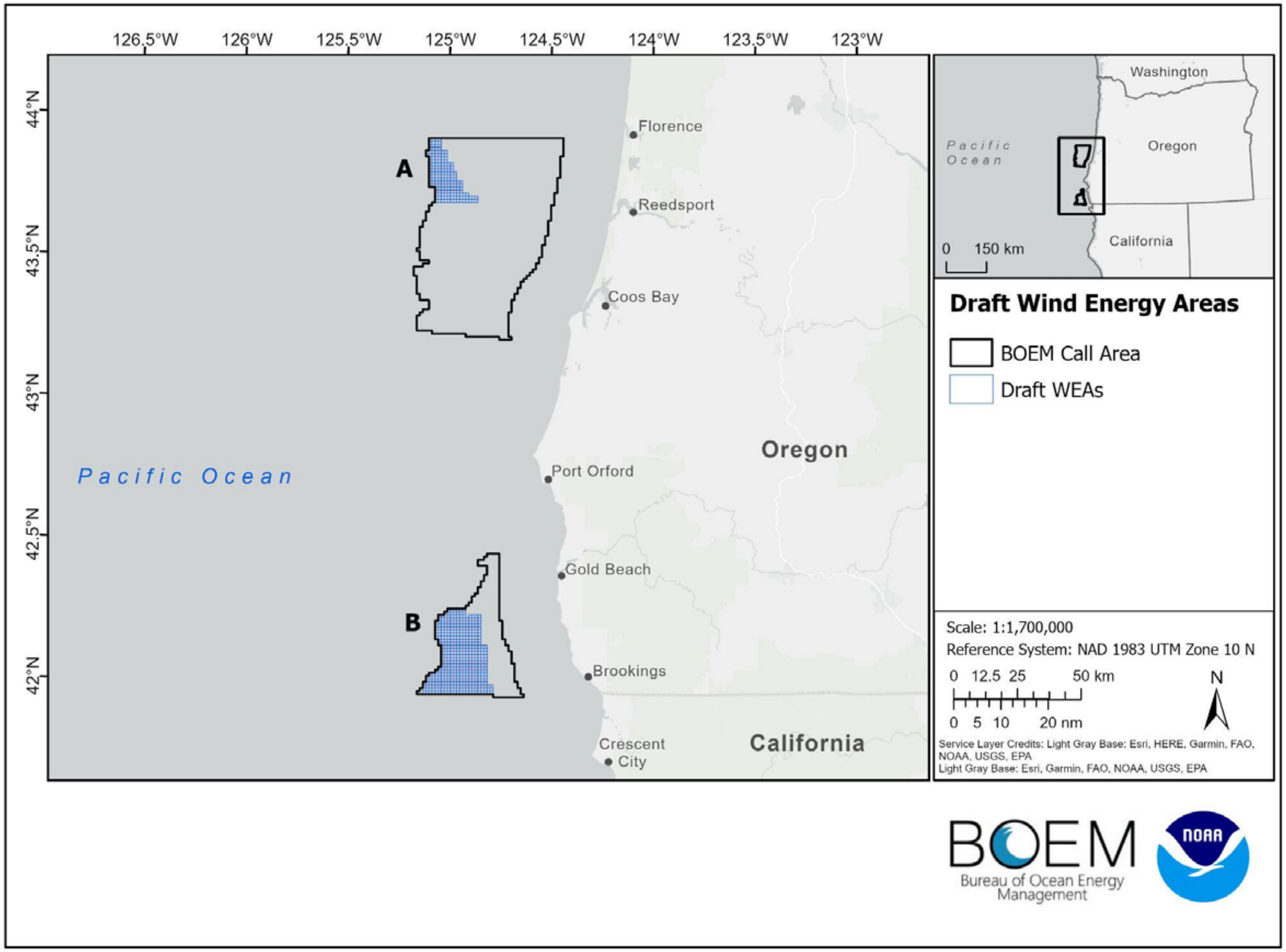

Figure 3.17. Map of Draft WEAs determined by selecting aliquots that overlapped High-High cluster areas. Areas that resulted in fewer than 55,000 acres were removed from further consideration. Overall, 617 aliquots were selected, totaling 219,568 acres. Draft WEA A located in Coos Bay is 61,204 acres, and Draft WEA B located in Brookings is 158,364 acres.

3.4 Characterization of Draft WEAs

The two Draft WEAs are characterized below. The characterizations provide option specific details regarding the geographic location, natural resources, industry and operations, fisheries, and wind logistics.

3.4.1 Draft WEA A Characterization

Draft WEA A is located on the northwest side of the Coos Bay Call Area. The 61,204-acre site is located offshore approximately 40.68 miles northwest of the Port of Coos Bay, Oregon (Figure 3.18). The mean water depth across the entire option is 1,178 m, with a maximum depth of 1,414 m and a minimum depth of 635 m (Table 3.6; Figure 3.19).

Table 3.6. Characterization summary for Draft Wind Energy Area A.

Logistics	**Value**
Size (acres)	61,204
Distance to Port (miles)	40.68
Distance to Shore (miles)	32.29; Umpqua River
Depth (m) (minimum, maximum, mean)	min = 635, max = 1,414, mean = 1,178
Annual Average Wind Speed (mph)	19.01
Levelized Cost of Energy for 2027 ($/MWh)	76.73
Constraints	
Department of Defense - Exclusion Area	Along southern edge of option
Natural Resources	
NMFS Protected Species Combined Layer - Species overlap **Bolded species are designated as Endangered under the Endangered Species Act (ESA) and have declining or unknown/stable populations. These species received the lowest scores (0.1 or 0.2) in the combined layer.*	**Leatherback sea turtle**
NMFS Habitat Combined Layer - Habitat overlap	Rocky reef groundfish HAPC - mapped Deep-sea corals Continental shelf break setback Methane bubble streams
Industry and Operations	
NMFS Scientific Surveys Combined Layer - Survey overlap	1 East-West sampling corridor
Submarine Cables	1 cable
Fisheries	
NMFS & ODFW Fisheries Combined Layer - Fisheries overlap	Groundfish Longline Groundfish Bottom Trawl Groundfish Pot Gear At-sea Hake Albacore Charter Albacore Commercial

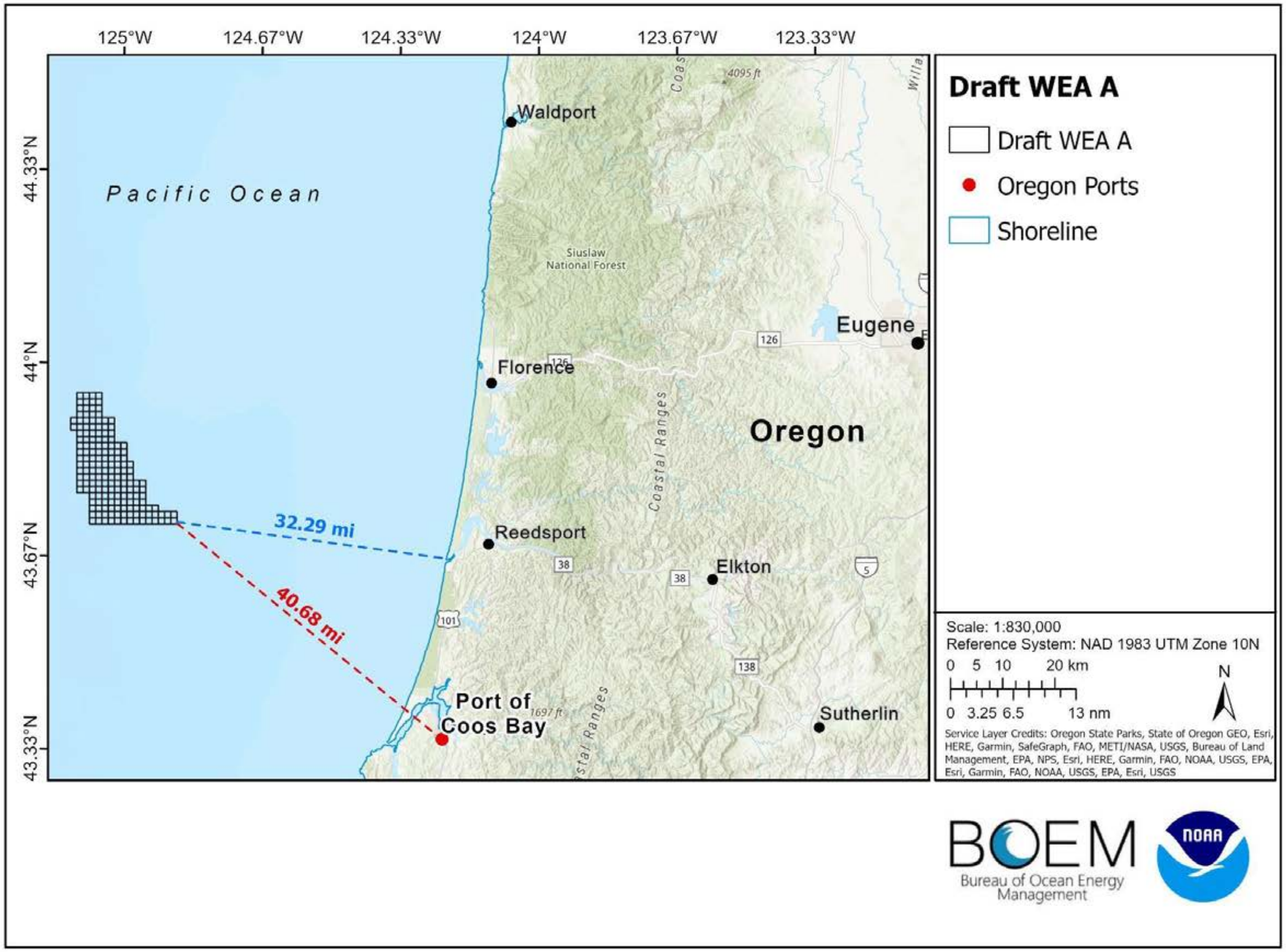

Figure 3.18. Draft WEA A and distance to shore and the Port of Coos Bay, Oregon.

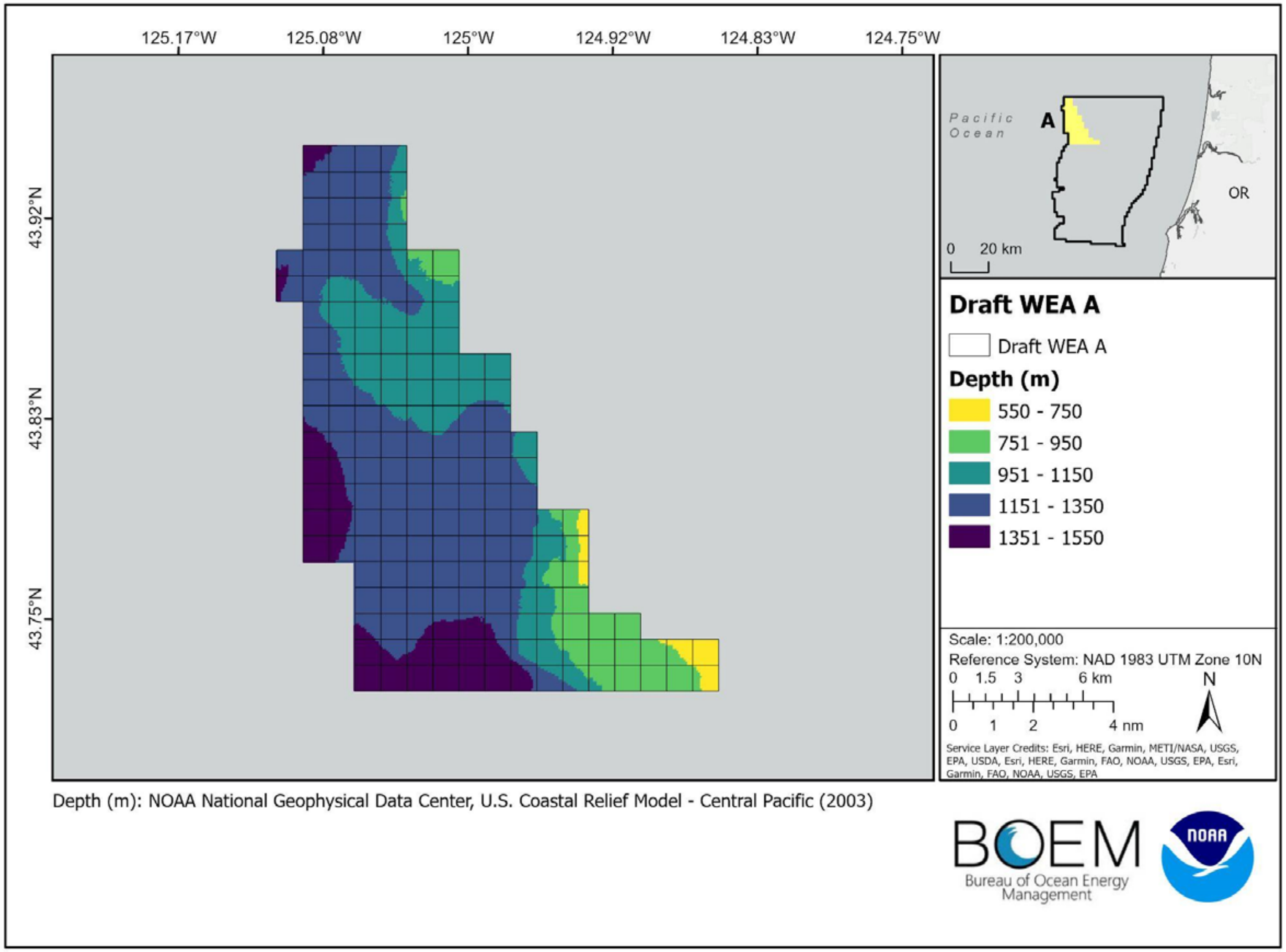

Figure 3.19. Map depicting depth in meters across Draft WEA A.

3.4.2 Draft WEA B Characterization

Draft WEA B is located on the western side of the Brookings Call Area. The 158,364-acre site is located offshore approximately 23.57 miles west of the Port of Brookings Harbor, Oregon (Figure 3.20). The mean water depth across the entire option is 928 m, with a maximum depth of 1531 m and a minimum depth of 567 m (Table 3.7; Figure 3.21).

Table 3.7. Characterization summary for Draft Wind Energy Area B.

Logistics	**Value**
Size (acres)	158,364
Distance to Port (miles)	23.57
Distance to Shore (miles)	18.61; Crook Point
Depth (m) (minimum, maximum, mean)	min = 567, max = 1531, mean = 928
Annual Average Wind Speed (mph)	23.49
Levelized Cost of Energy for 2027 ($/MWh)	61.51
Natural Resources	
NMFS Protected Species Combined Layer - Species overlap **Bolded species are designated as Endangered under the Endangered Species Act (ESA) and have declining or unknown/stable populations. These species received the lowest scores (0.1 - 0.3) in the combined layer.*	**Humpback whale - Central Atlantic DPS** Humpback whale - Mexico DPS **Blue whale**
NMFS Habitat Combined Layer - Habitat overlap	Essential Fish Habitat Conservation Areas Deep-sea corals Methane bubble streams
Industry and Operations	
NMFS Scientific Surveys Combined Layer - Survey overlap	2 East-West sampling corridors 1 survey transect 4 survey stations
Fisheries	
NMFS & ODFW Fisheries Combined Layer - Fisheries overlap	Groundfish Longline Groundfish Bottom Trawl Groundfish Pot Gear At-sea Hake Albacore Charter Albacore Commercial

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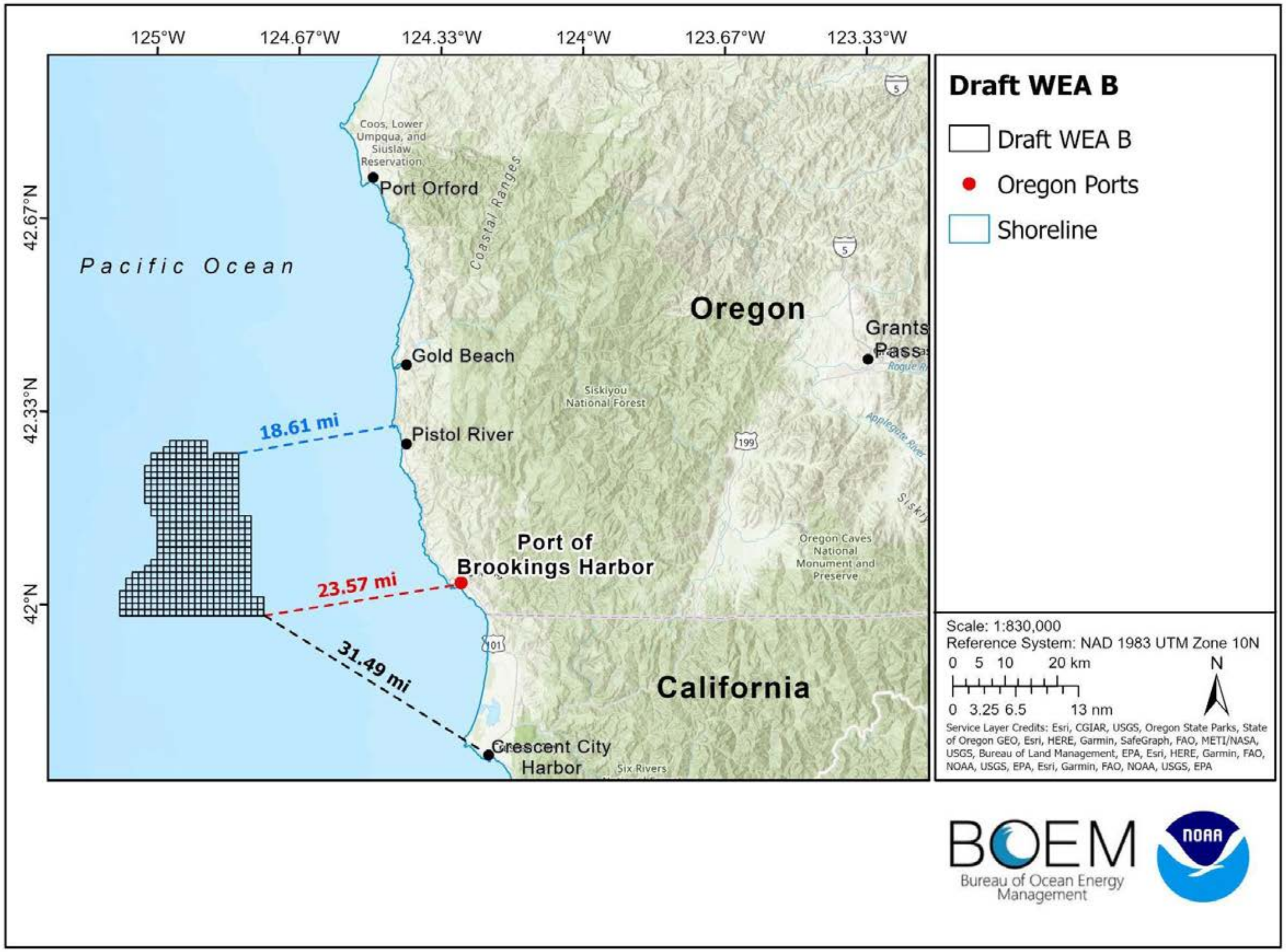

Figure 3.20. Draft WEA B and distance to shore, Crescent City Harbor, California, and the Port of Brookings Harbor, Oregon.

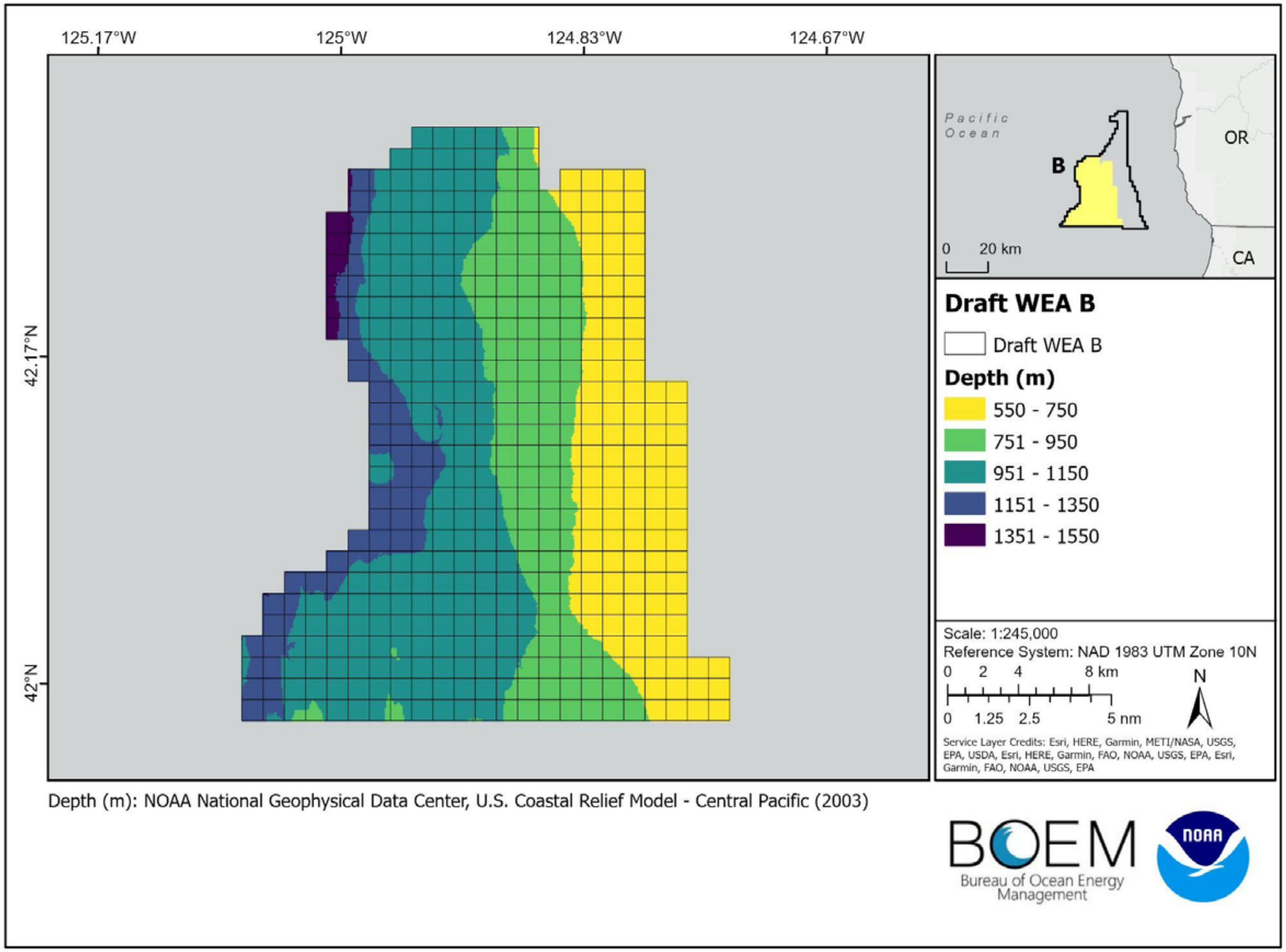

Figure 3.21. Map depicting depth in meters across Draft WEA B.

3.5 Model Performance and Other Considerations

A review of data layers overlaid with the identified Draft WEAs provides some information on how well the model performed. Each data layer within the suitability analysis was examined with the Draft WEAs. Additional data layers not used in the suitability model were examined in relation to the identified Draft WEA options to further provide information for decision makers such as relation to nomination areas of competitive interest (Figure 3.22–3.65).

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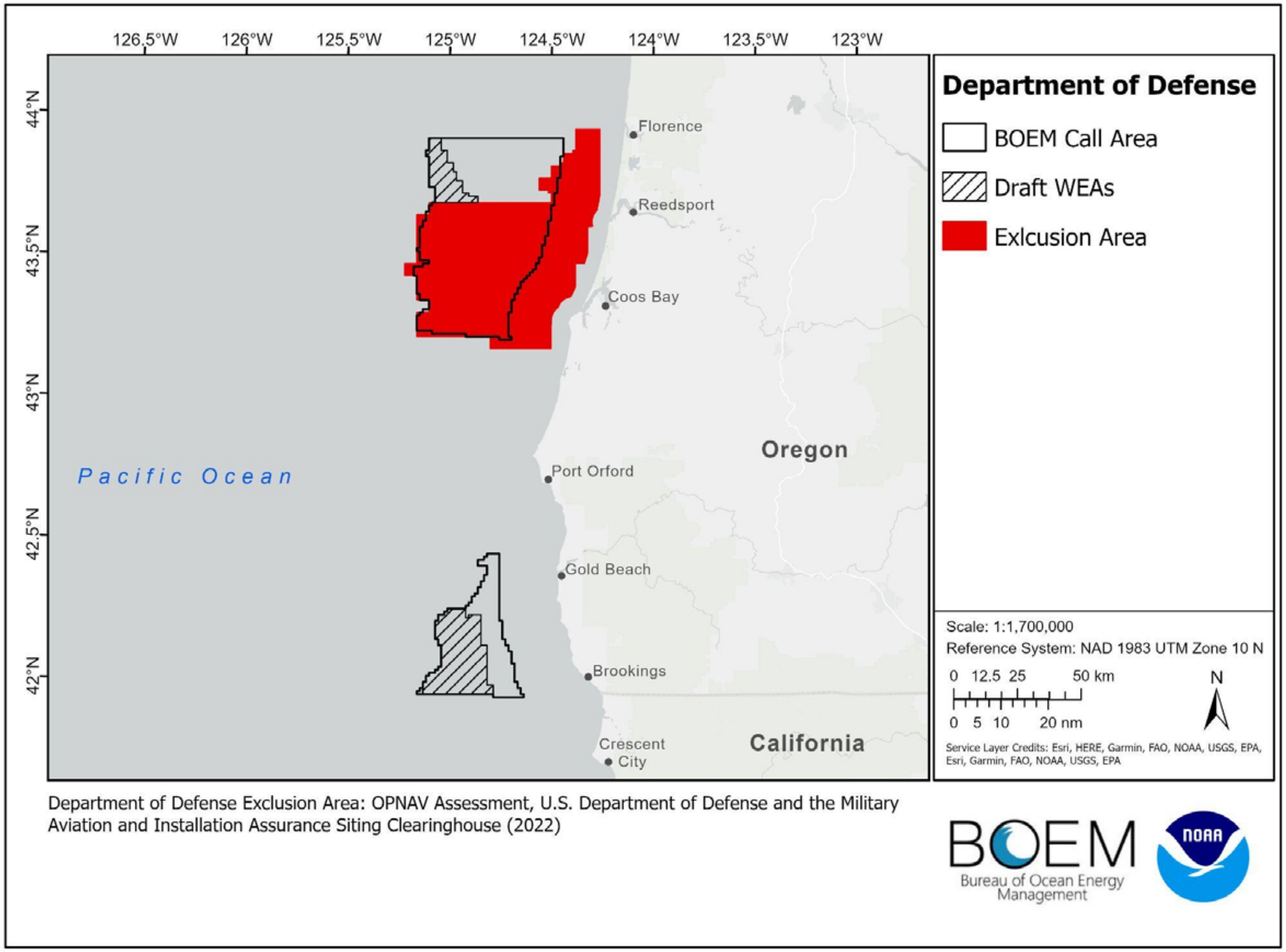

Figure 3.22. Department of Defense exclusion area in relation to the Draft WEAs. This data layer was utilized within the constraints submodel and given a relative suitability score of zero.

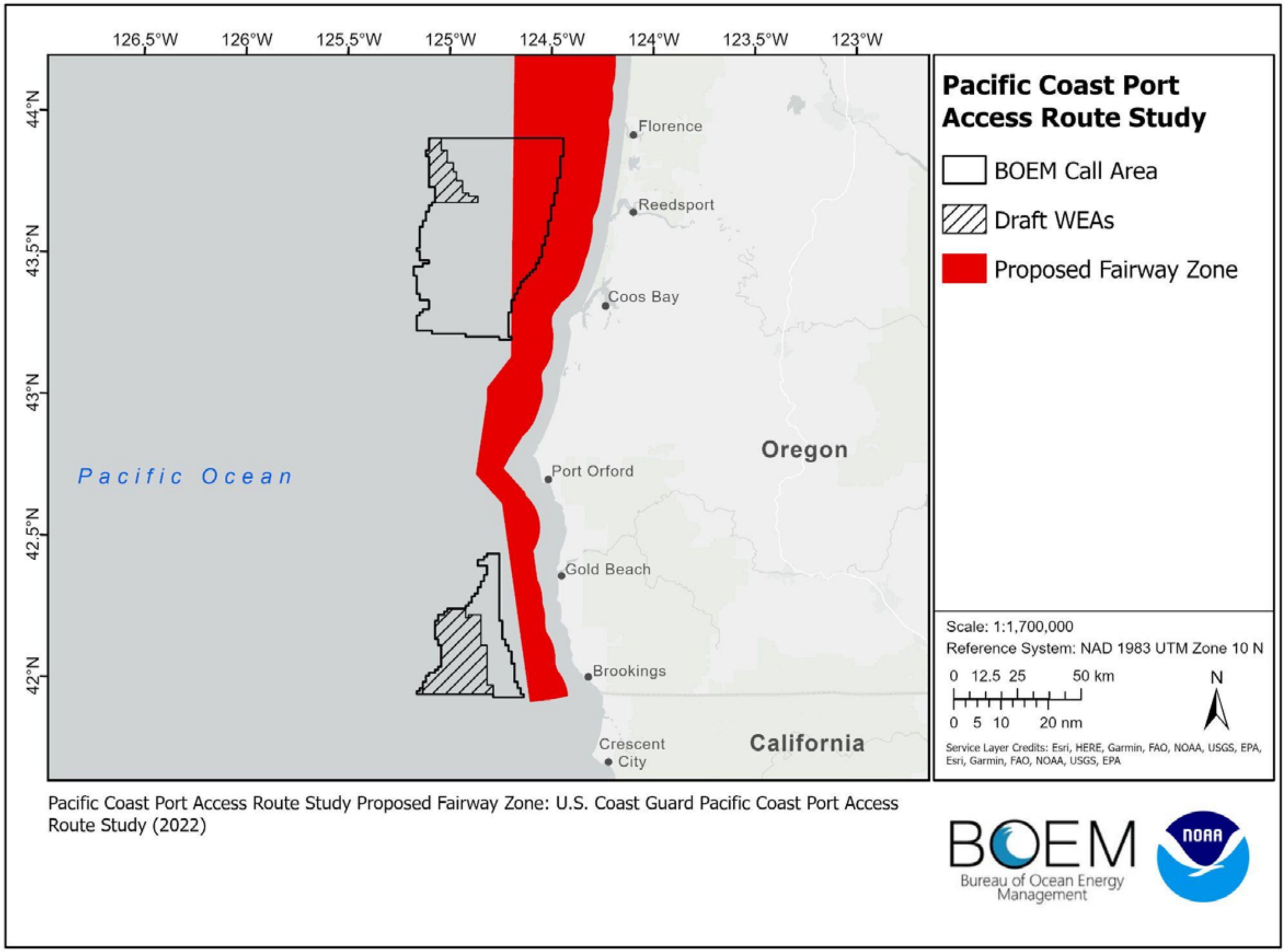

Figure 3.23. USCG Pacific Coast Port Access Route Study proposed fairway zone in relation to the Draft WEAs. This data layer was implemented within the constraints submodel and given a relative suitability score of zero.

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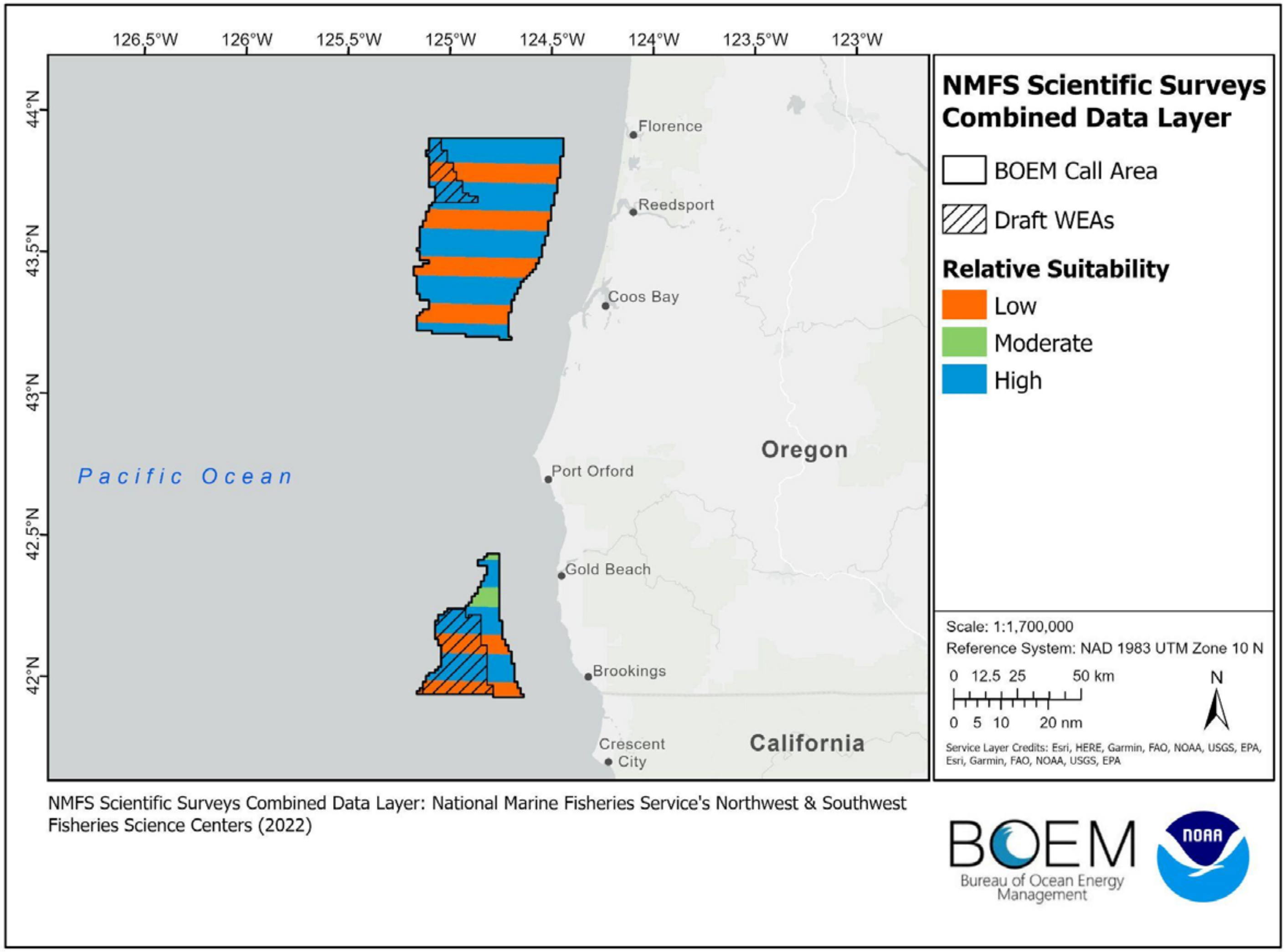

Figure 3.24. Relative suitability of the NMFS scientific surveys combined data layer in relation to the Draft WEAs. This data layer was implemented within the industry and operations submodel for the suitability analysis.

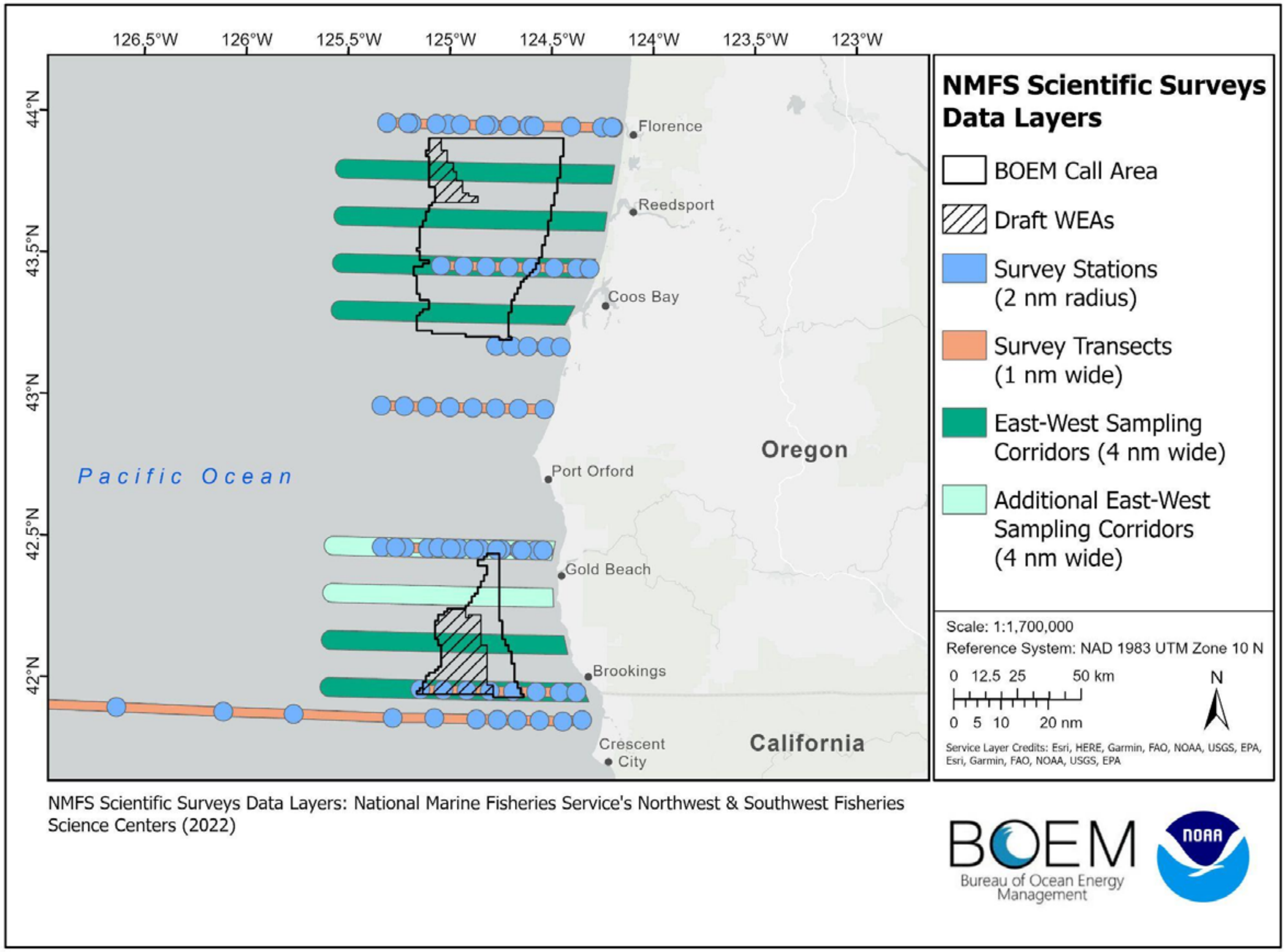

Figure 3.25. NMFS derived geospatial scientific survey data layers in relation to the Draft WEAs. These data were included in the NMFS scientific surveys combined data layer and not analyzed as individual layers in the suitability model. Of the 8 survey corridors within the Call Areas, covering a total of 1,828 km^2, the Draft WEAs intersect 348 km^2 (19%).

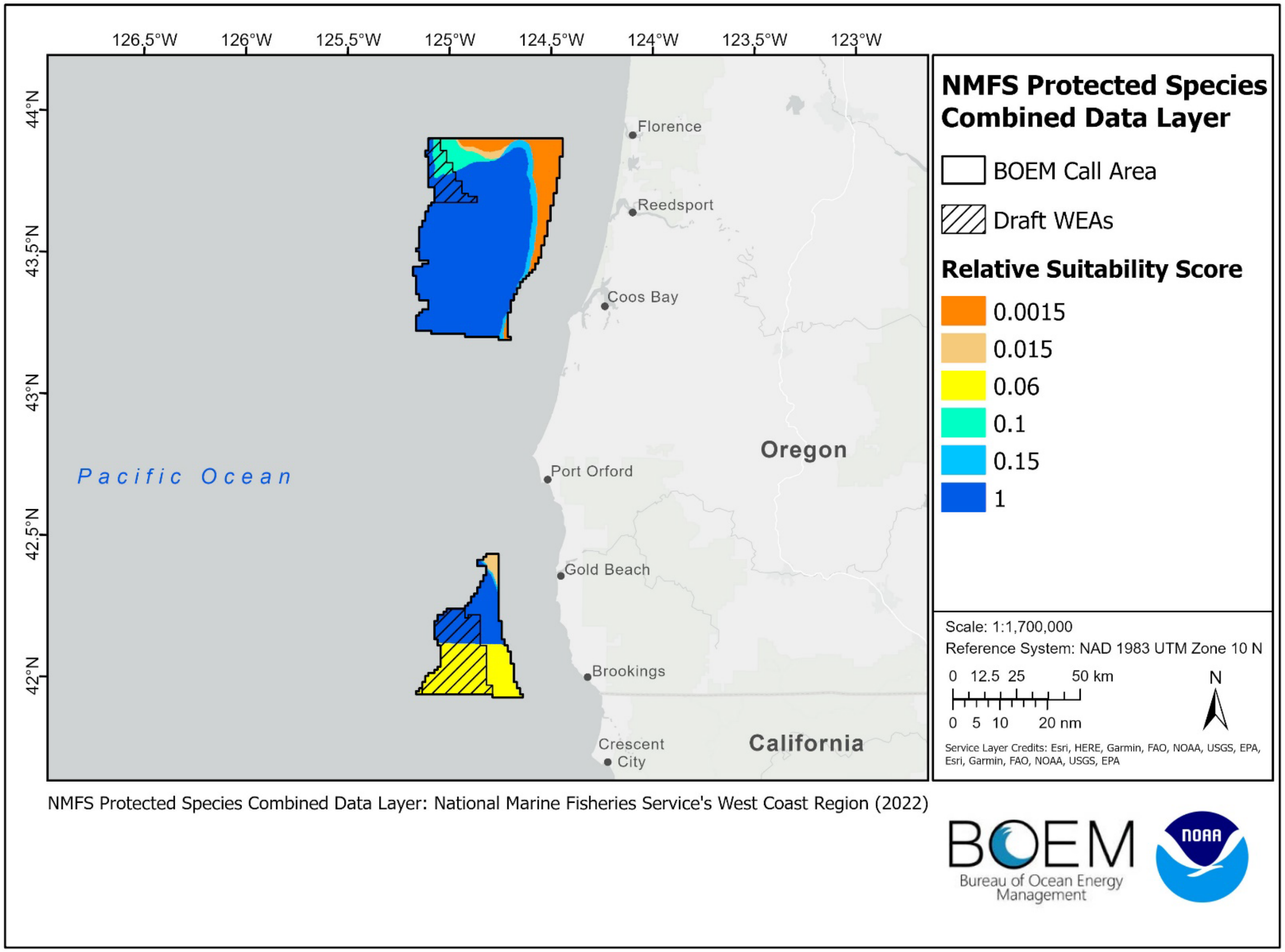

Figure 3.26. Relative suitability scores of the NMFS protected species combined data layer in relation to the Draft WEAs. This data layer was implemented within the natural resources submodel for the suitability analysis.

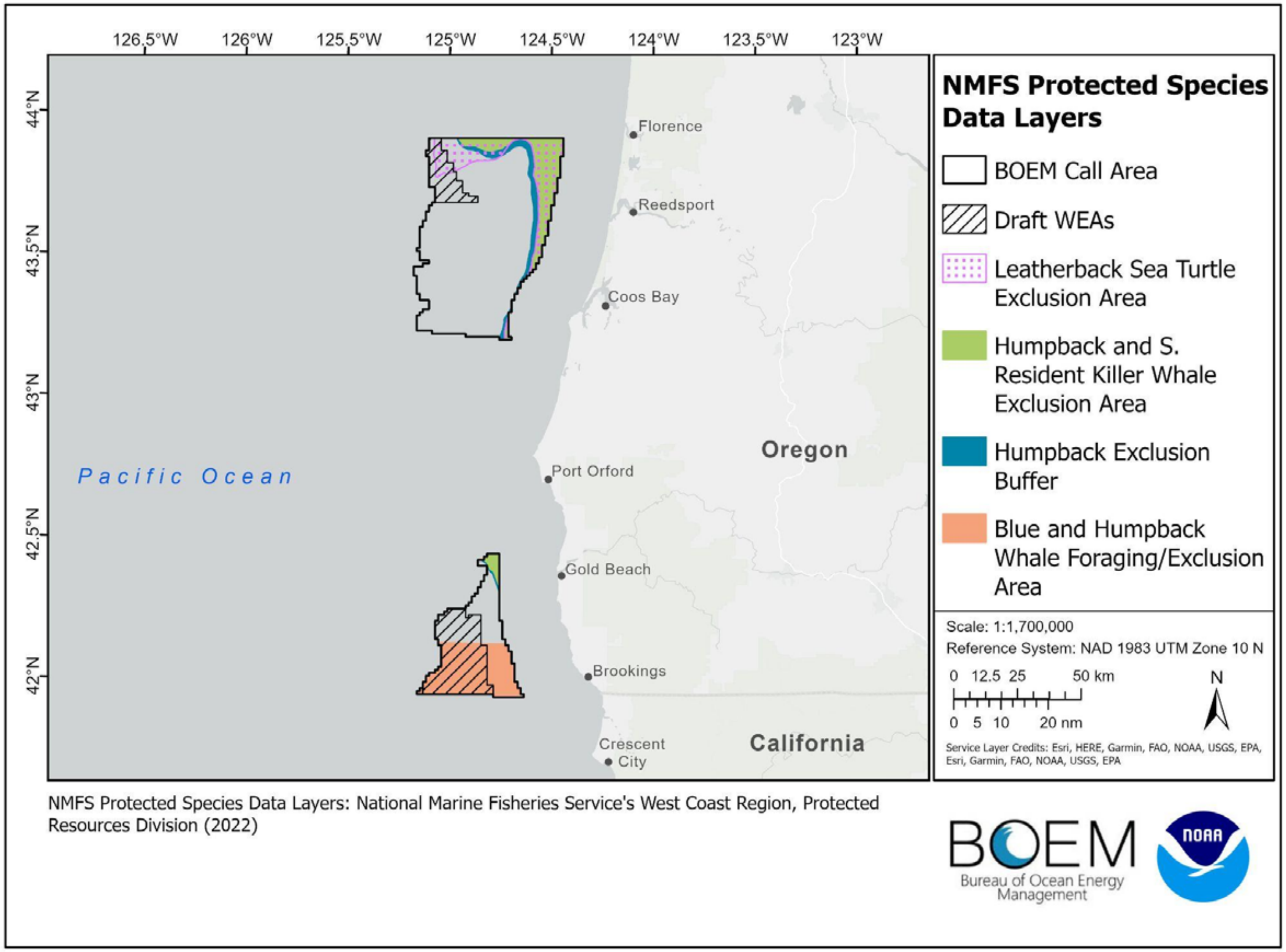

Figure 3.27. NMFS derived protected species data layers in relation to the Draft WEAs. These data were included in the NMFS protected species combined data layer and not analyzed as individual layers in the suitability model.

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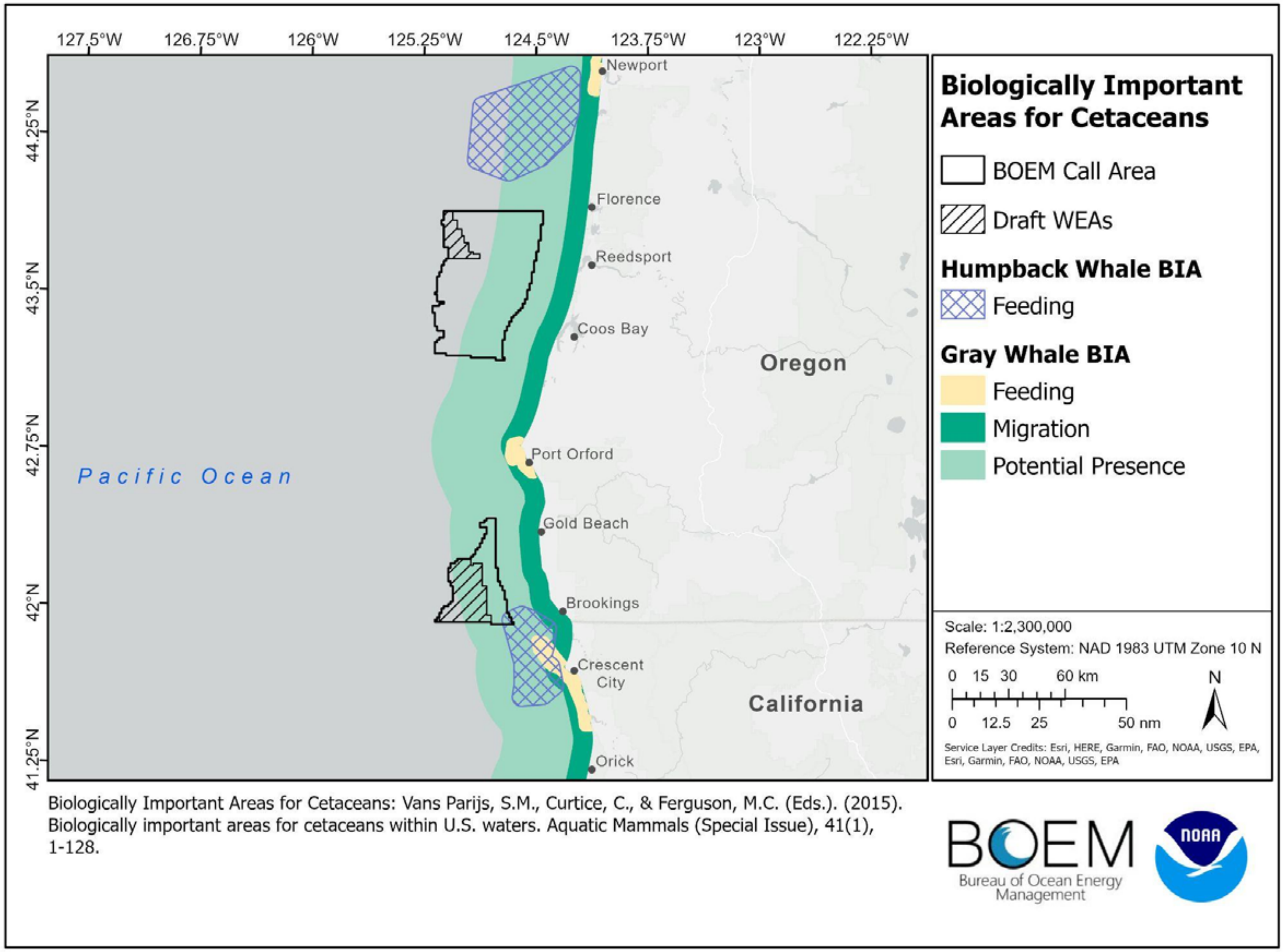

Figure 3.28. Biologically important areas for cetaceans in relation to the Draft WEAs. These data were not used in the suitability model.

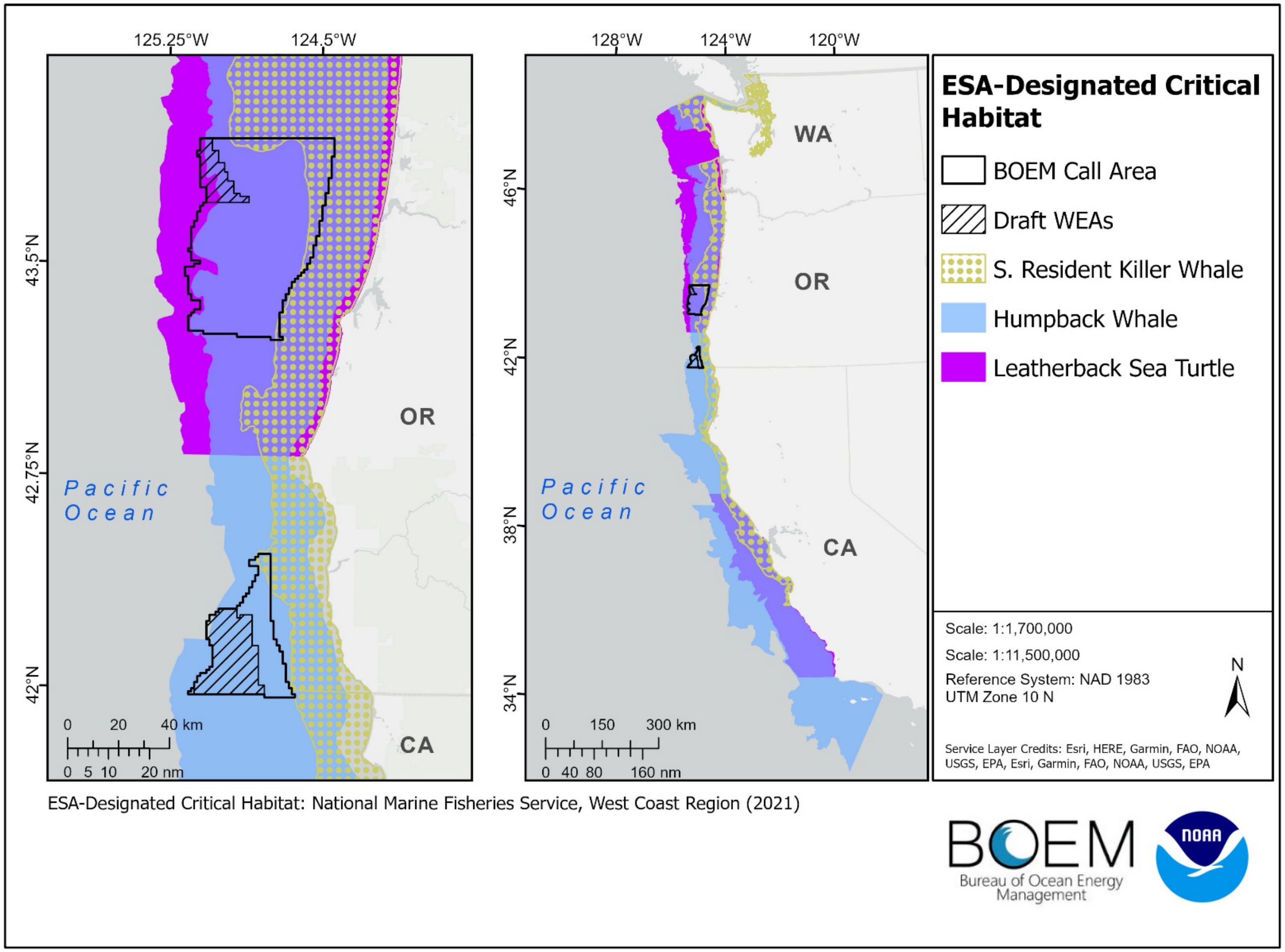

Figure 3.29. ESA-designated critical habitat for Southern Resident killer whale, humpback whale (Central America and Mexico DPSs), and leatherback sea turtle in relation to the Draft WEAs. These data were not used in the suitability model.

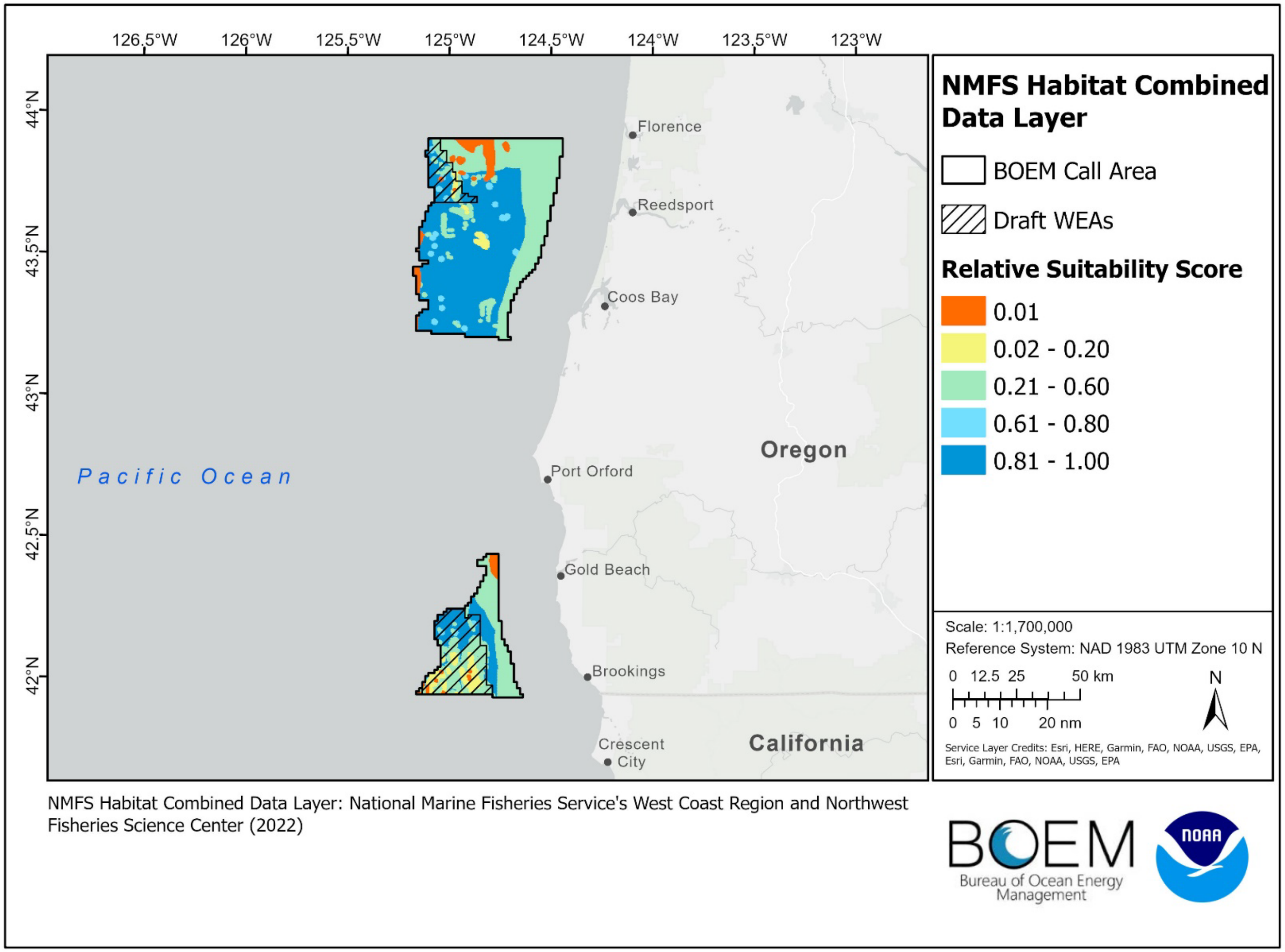

Figure 3.30. Relative suitability scores of the NMFS habitat combined data layer in relation to the Draft WEAs. This data layer was implemented within the natural resources submodel for the suitability analysis.

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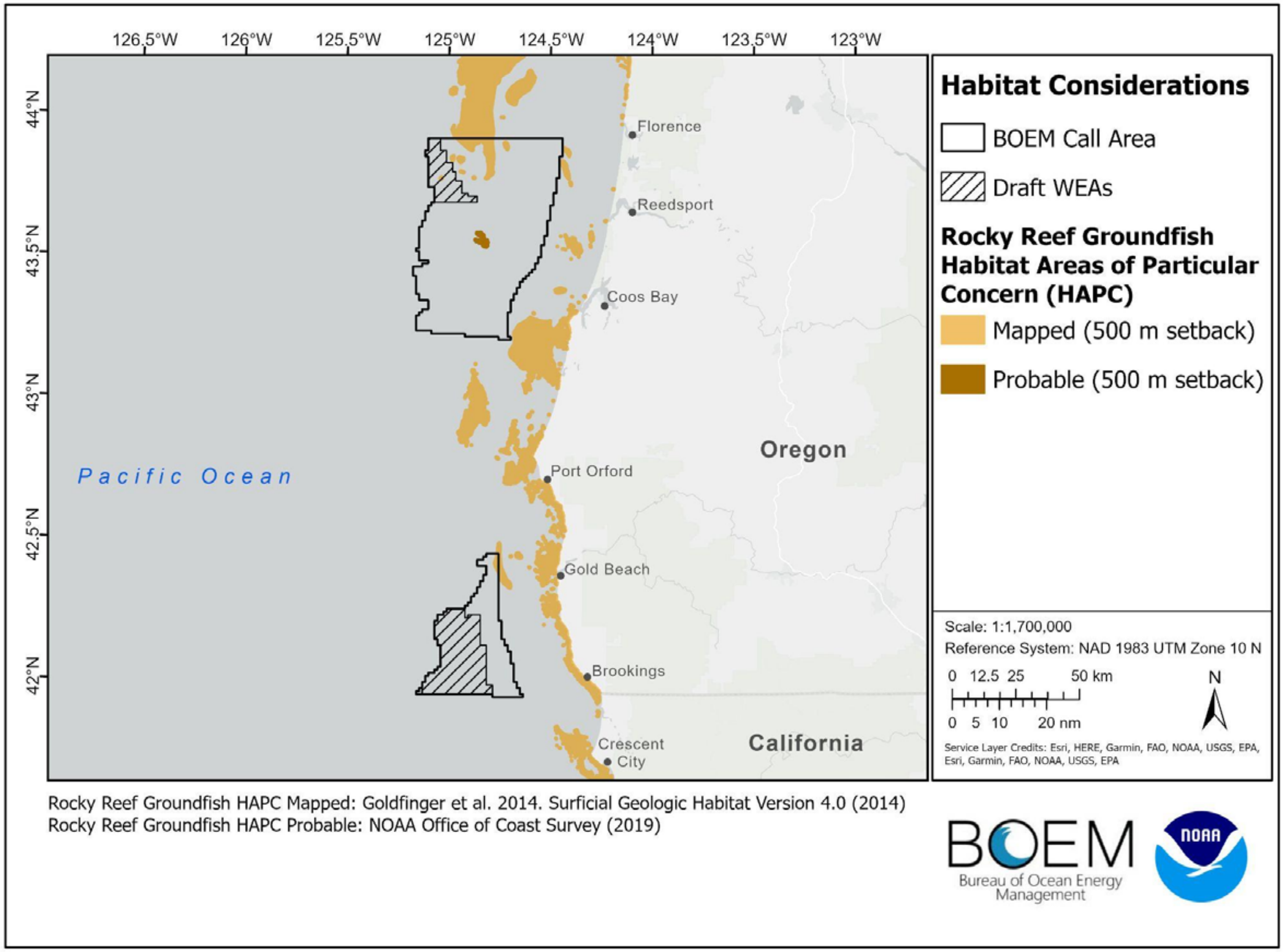

Figure 3.31. Rocky reef groundfish habitat areas of particular concern in relation to the Draft WEAs. These data were included in the NMFS habitat combined data layer and not analyzed as individual layers in the suitability model.

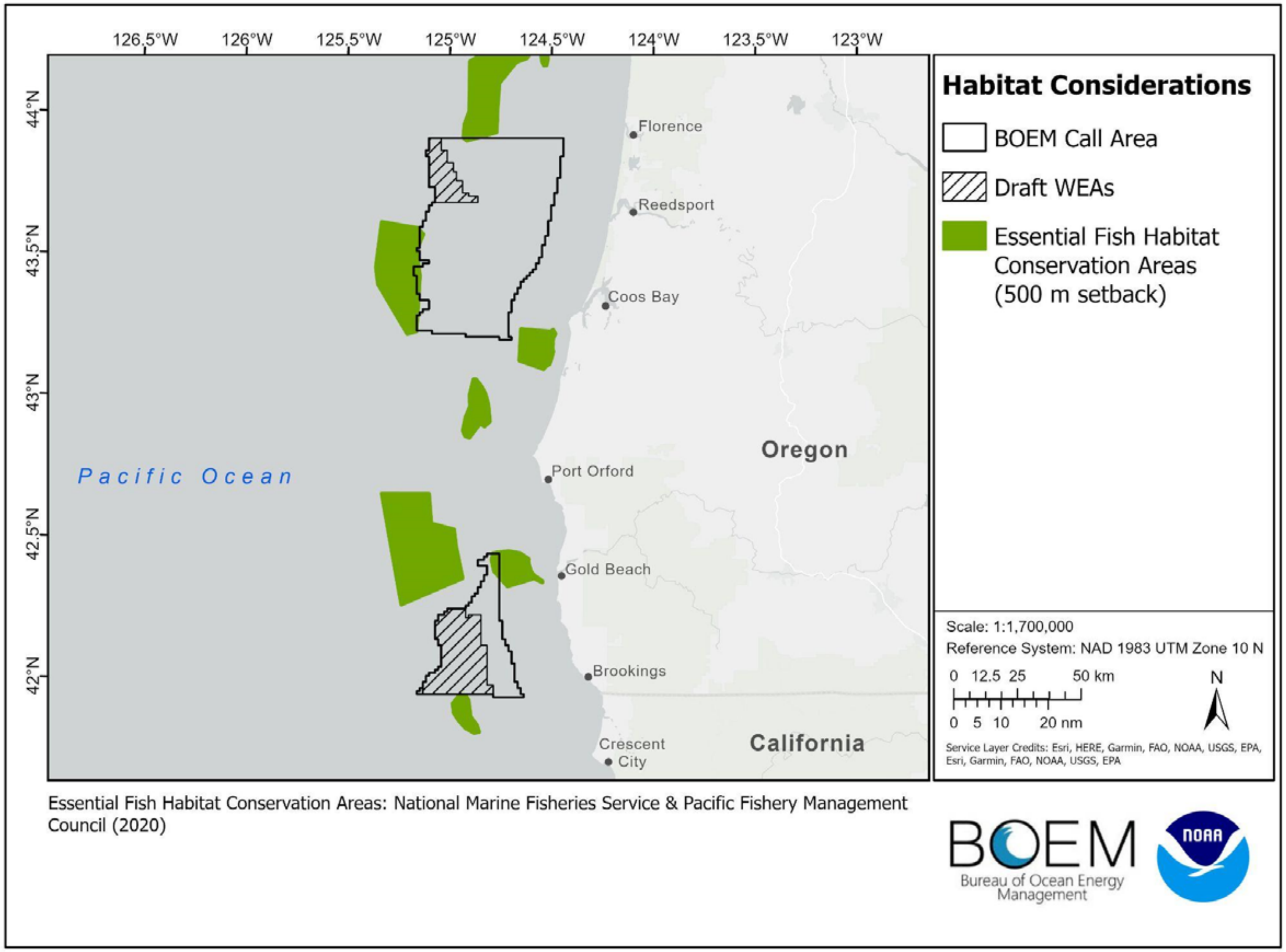

Figure 3.32. Essential fish habitat conservation areas (EFHCAs) in relation to the Draft WEAs. This data was included in the NMFS habitat combined data layer and not analyzed as an individual layer in the suitability model.

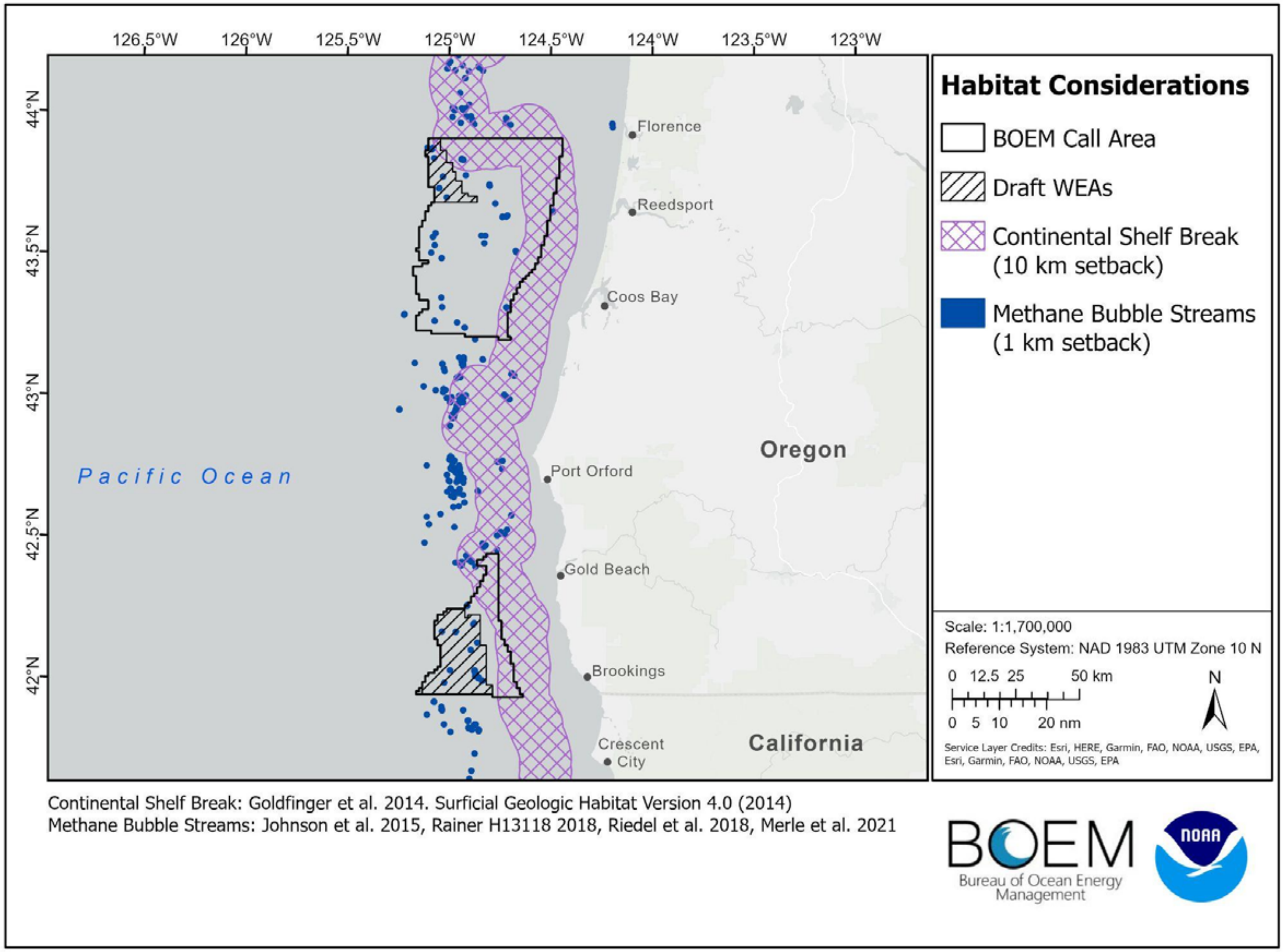

Figure 3.33. Continental shelf break and methane bubble streams in relation to the Draft WEAs. These data were included in the NMFS habitat combined data layer and not analyzed as individual layers in the suitability model.

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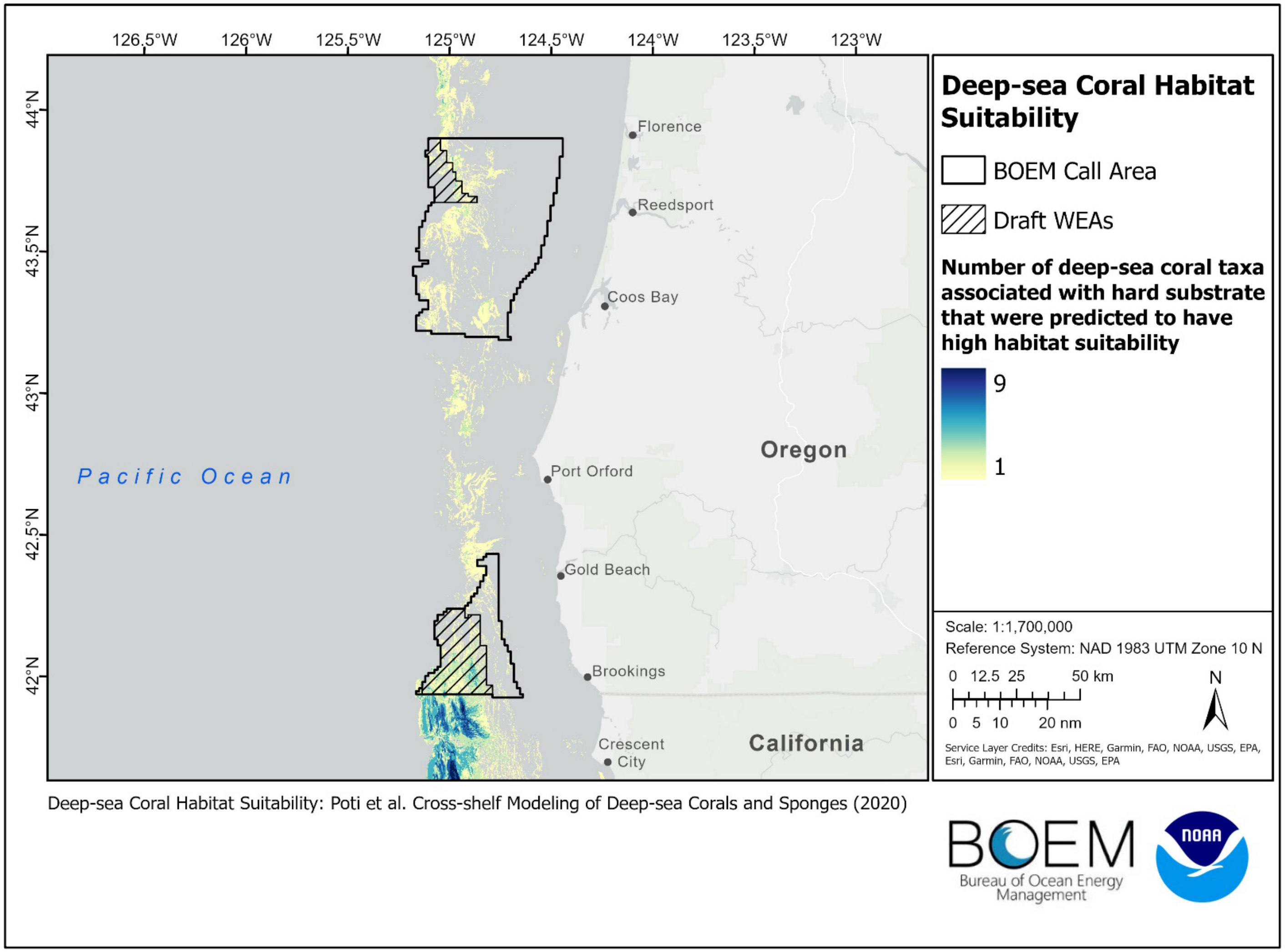

Figure 3.34. Deep-sea coral habitat suitability in relation to the Draft WEAs. This data was included in the NMFS habitat combined data layer and not analyzed as an individual layer in the suitability model.

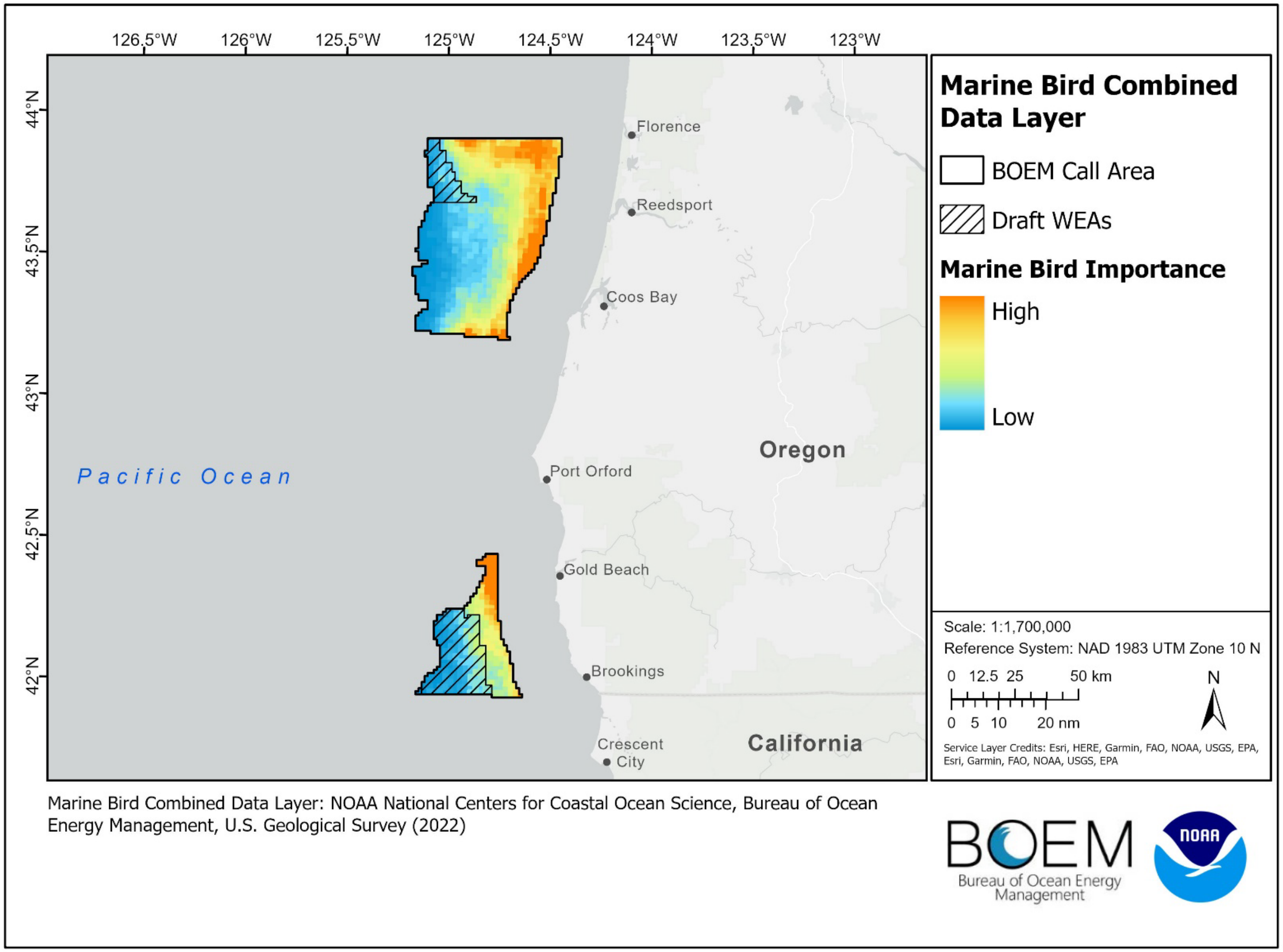

Figure 3.35. Relative bird importance for the marine bird combined data layer in relation to the Draft WEAs. This data layer was implemented within the natural resources submodel for the suitability analysis.

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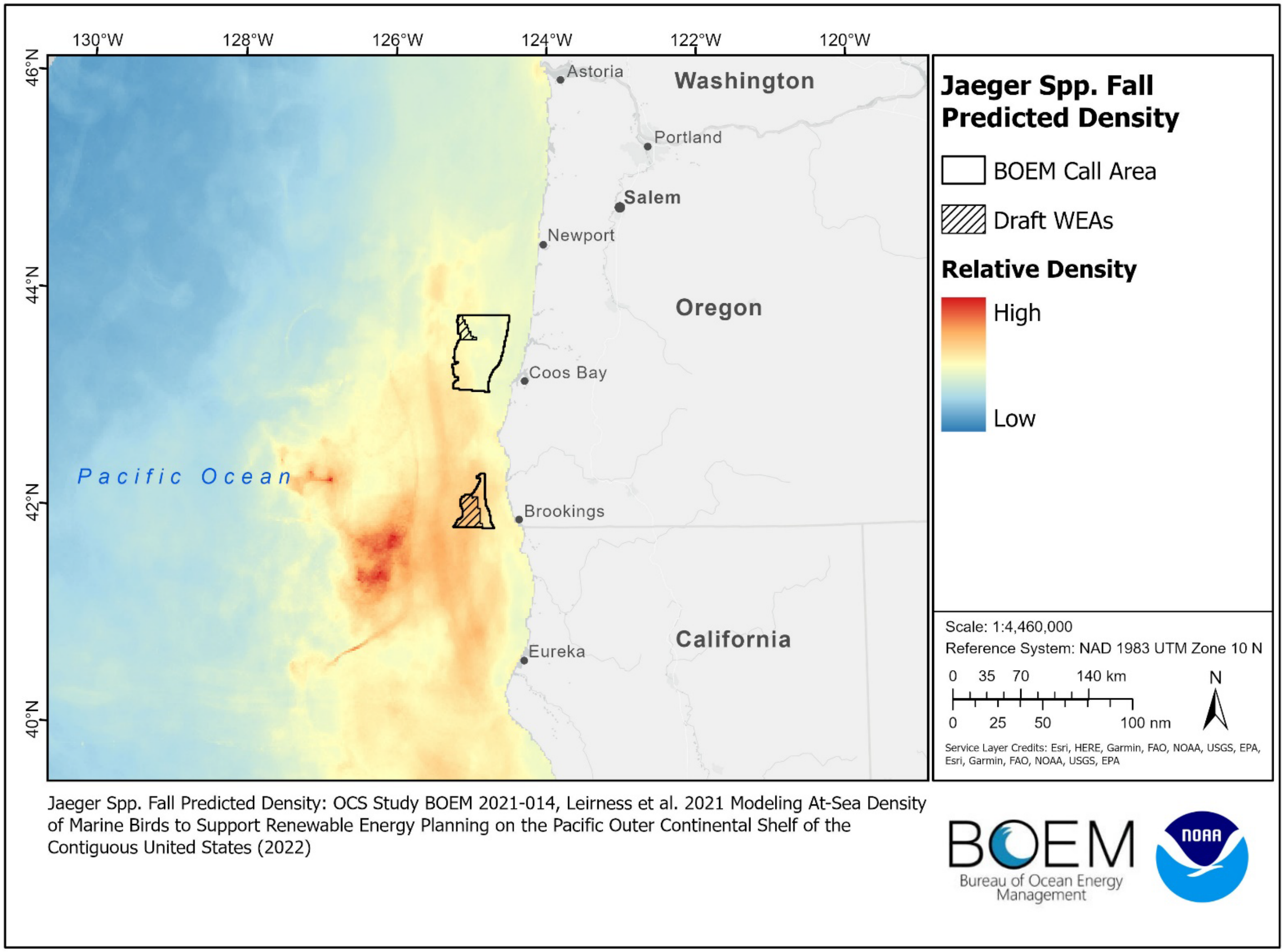

Figure 3.36. Fall predicted density of Jaeger species in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

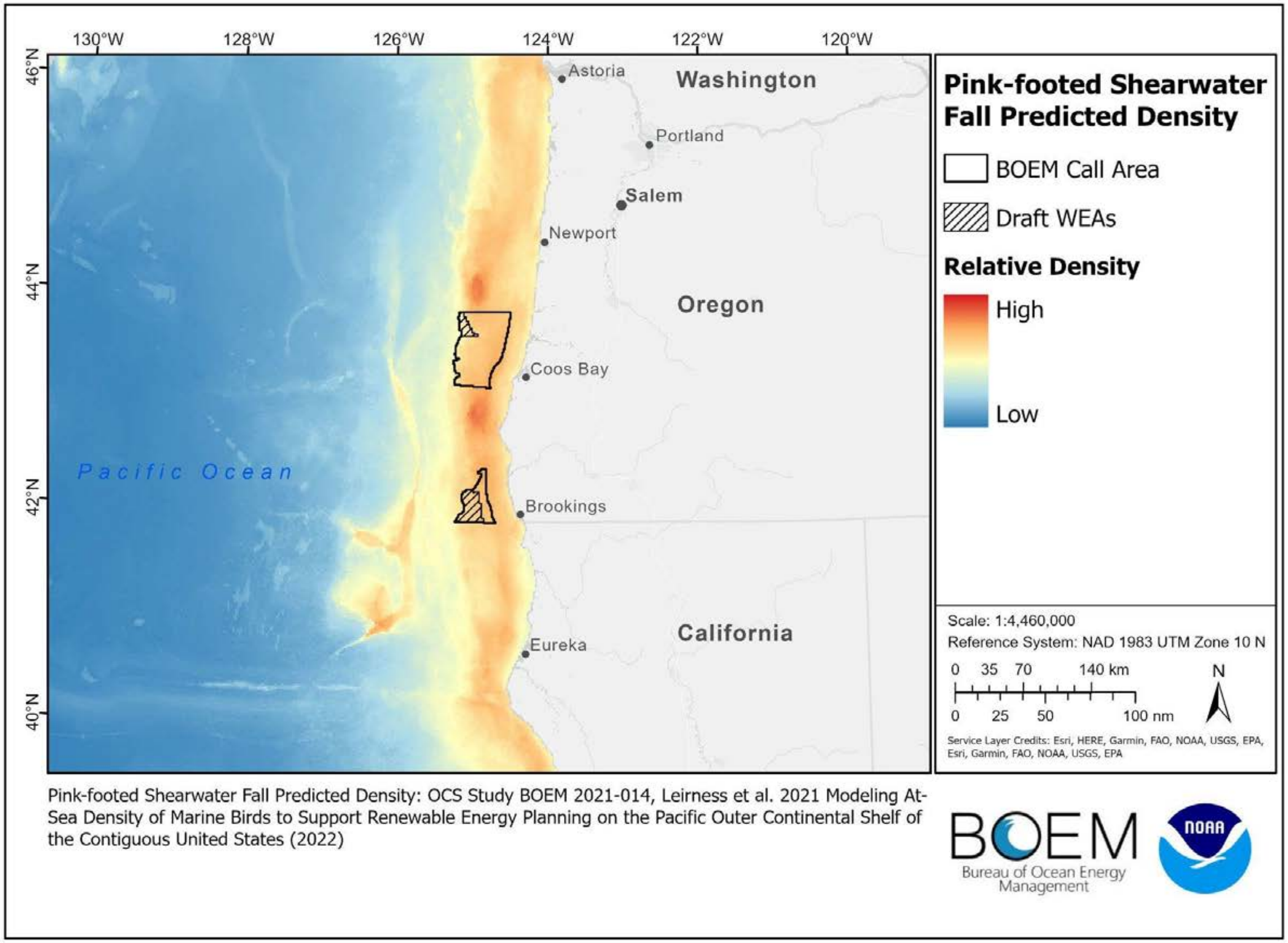

Figure 3.37. Fall predicted density of the Pink-footed Shearwater in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

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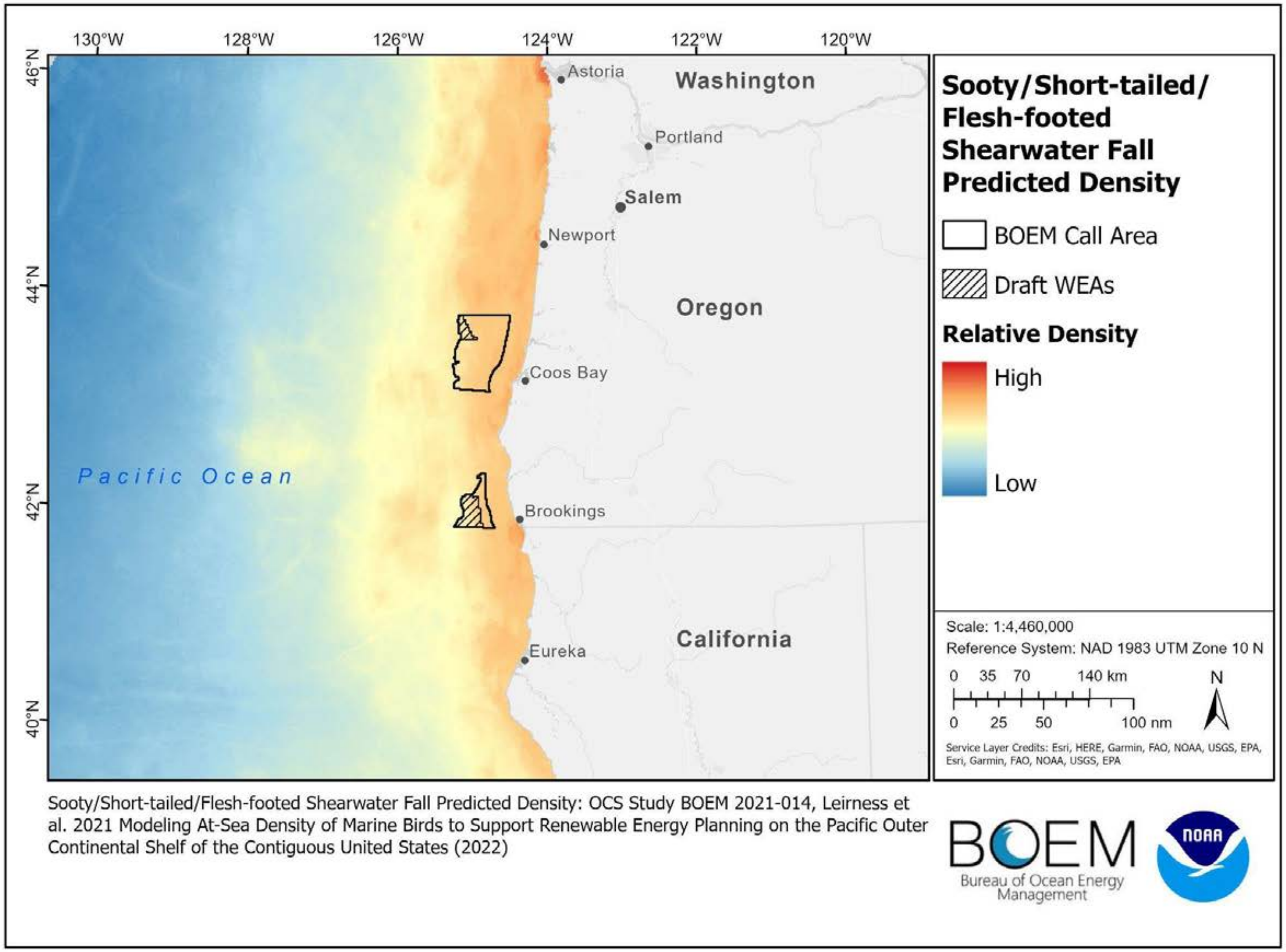

Figure 3.38. Fall predicted density of the Short-tailed/Sooty/Flesh-footed Shearwater in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

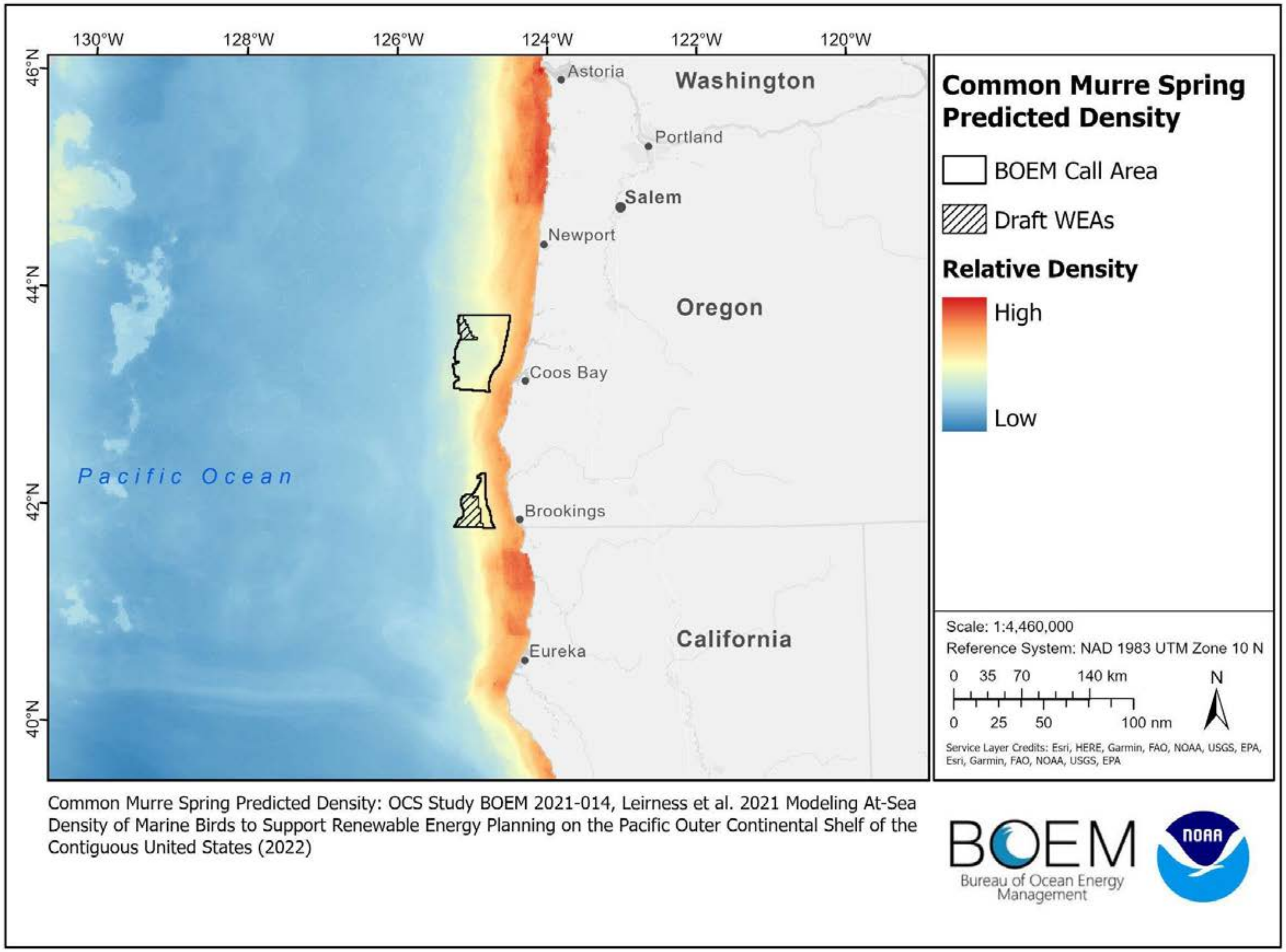

Figure 3.39. Spring predicted density of the Common Murre in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

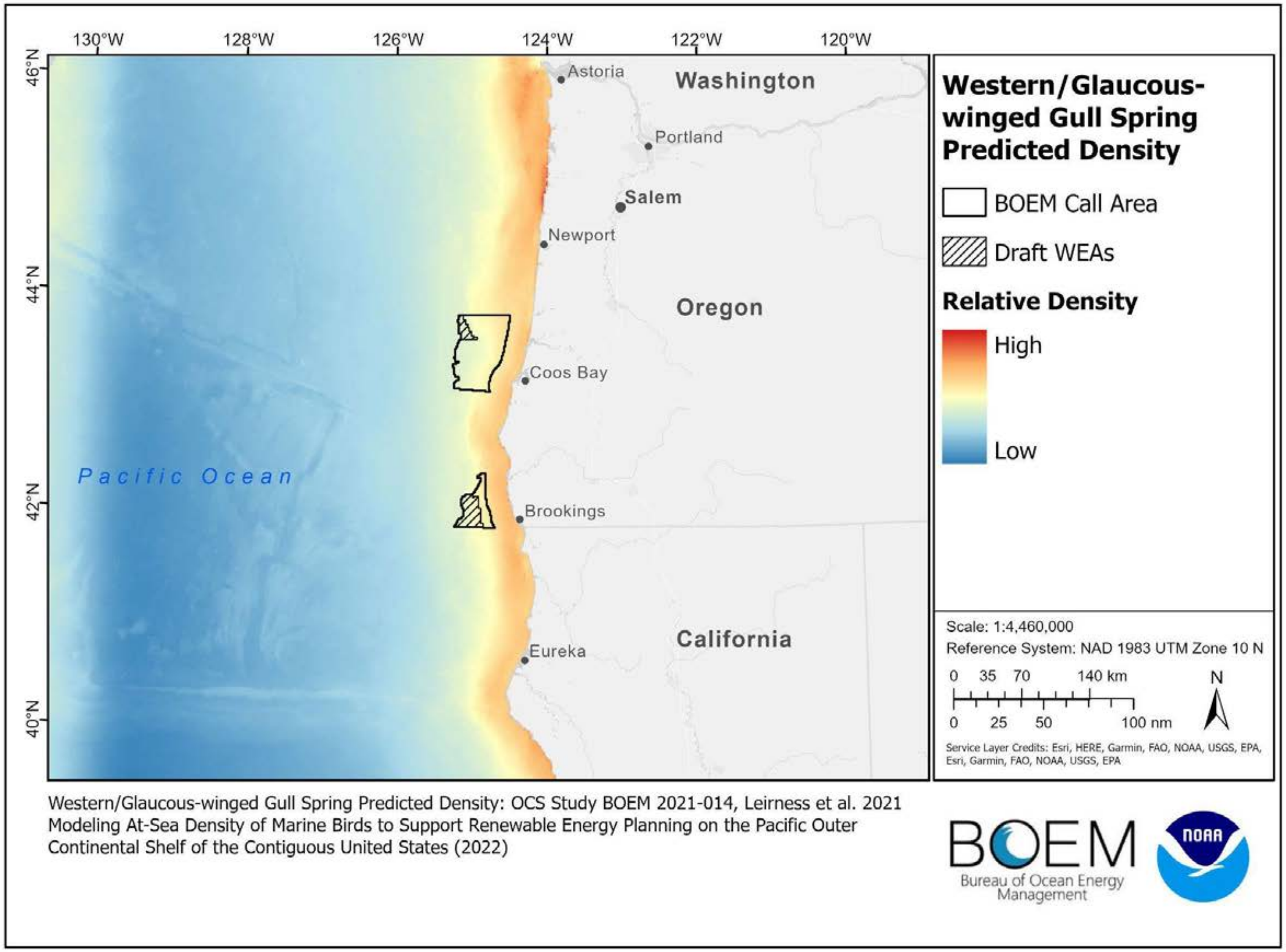

Figure 3.40. Spring predicted density of the Western/Glaucous-winged Gull in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

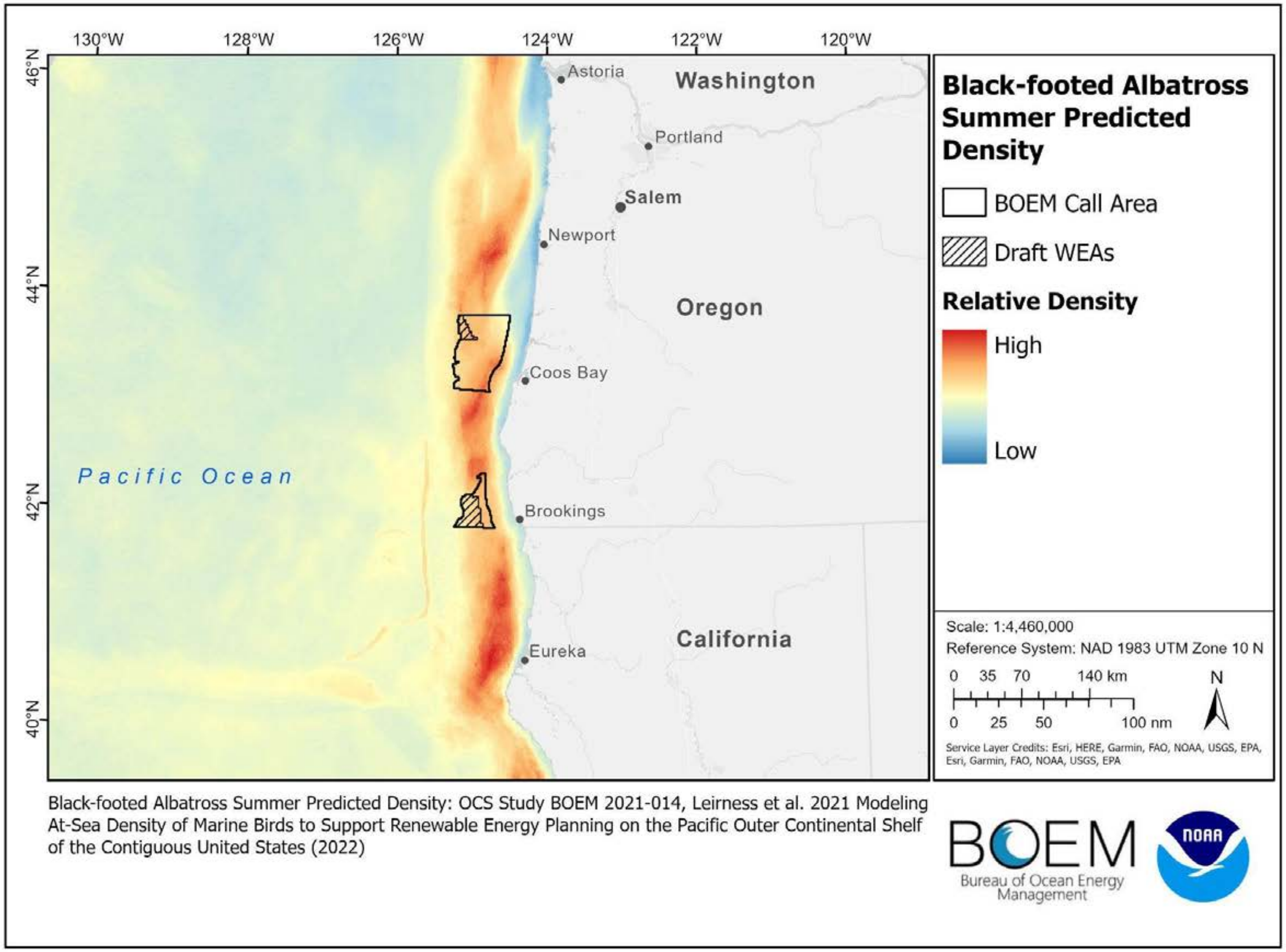

Figure 3.41. Summer predicted density of the Black-footed Albatross in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

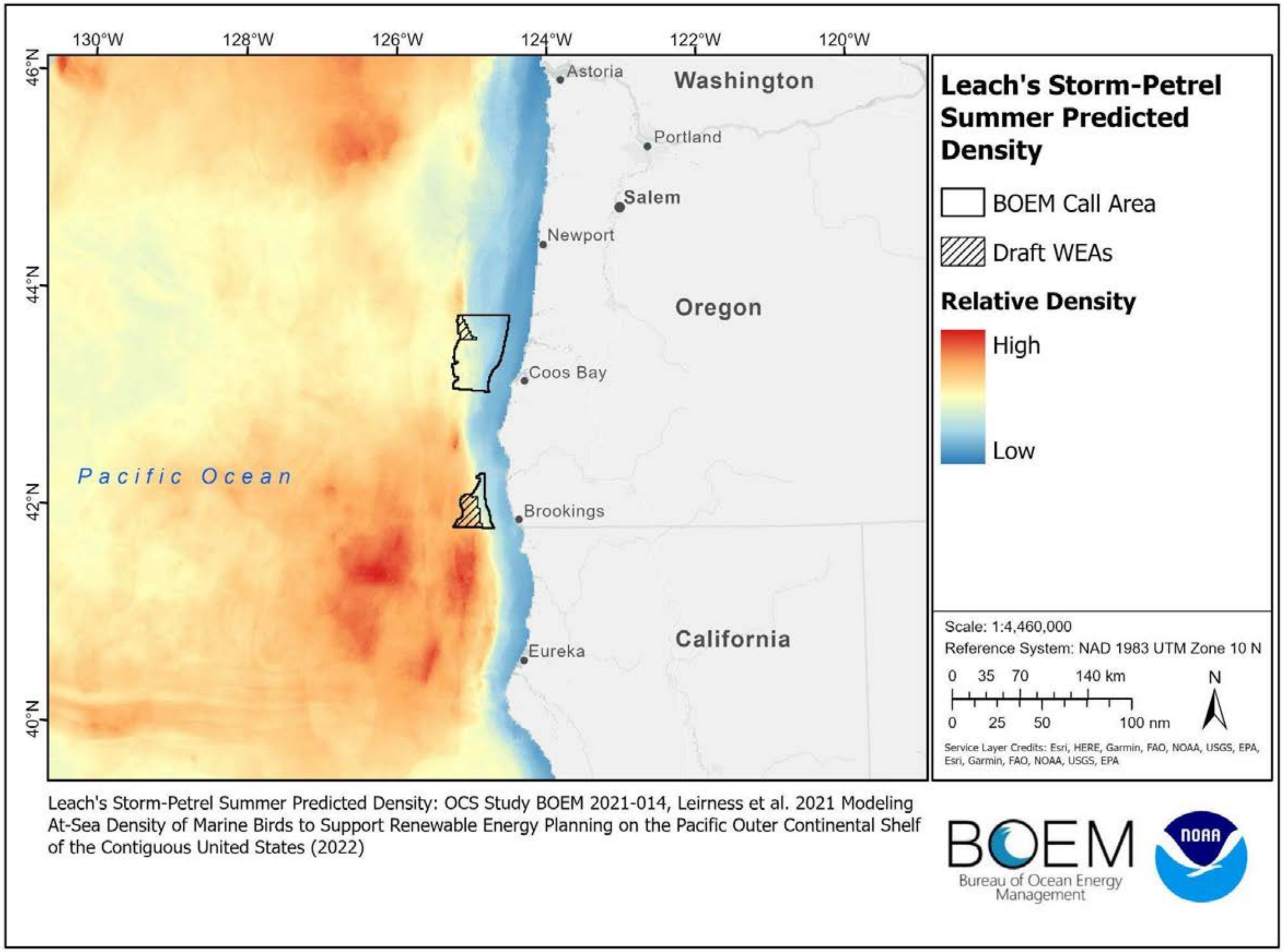

Figure 3.42. Summer predicted density of the Leach's Storm-Petrel in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

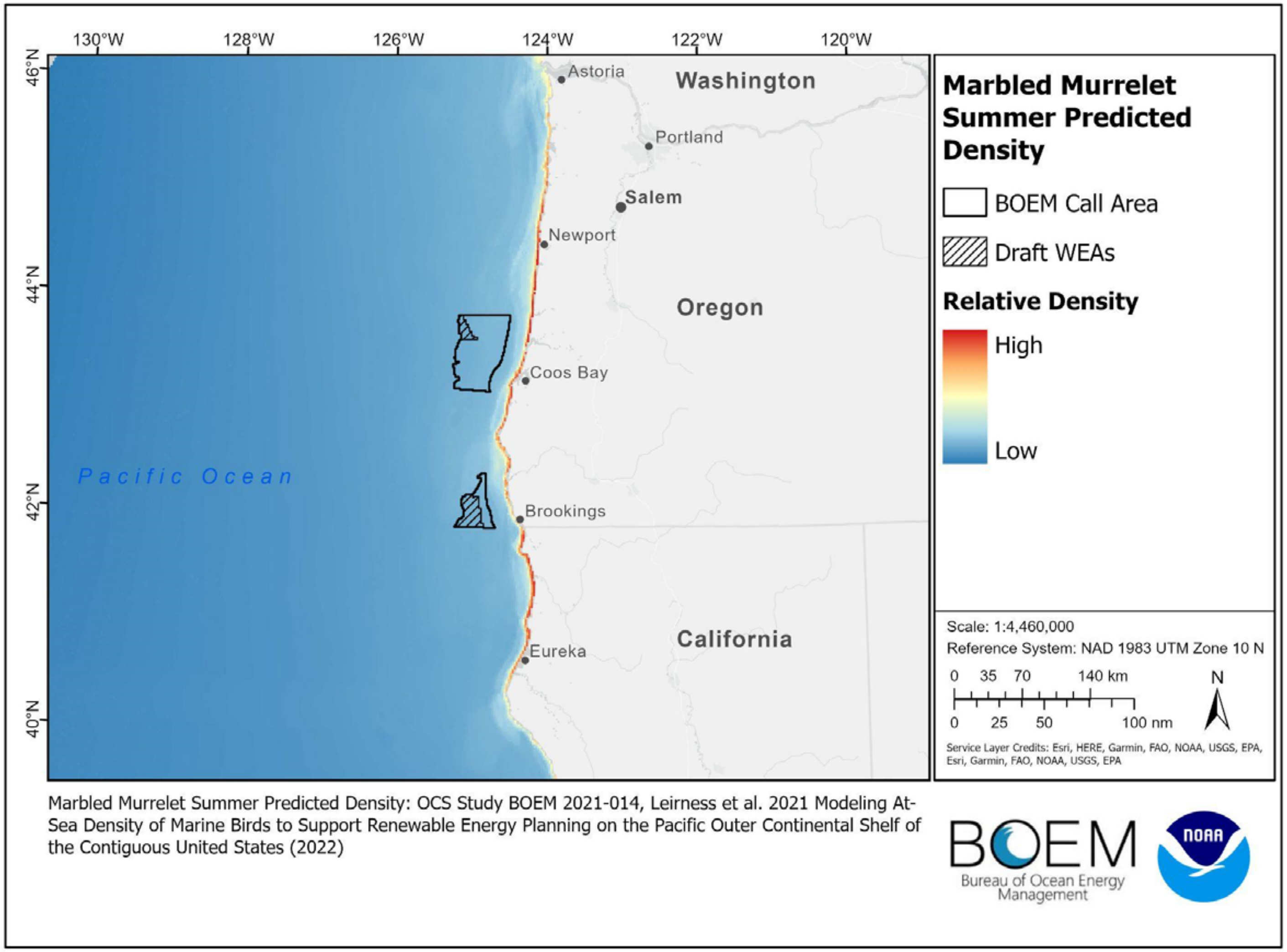

Figure 3.43. Summer predicted density of the Marbled Murrelet in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

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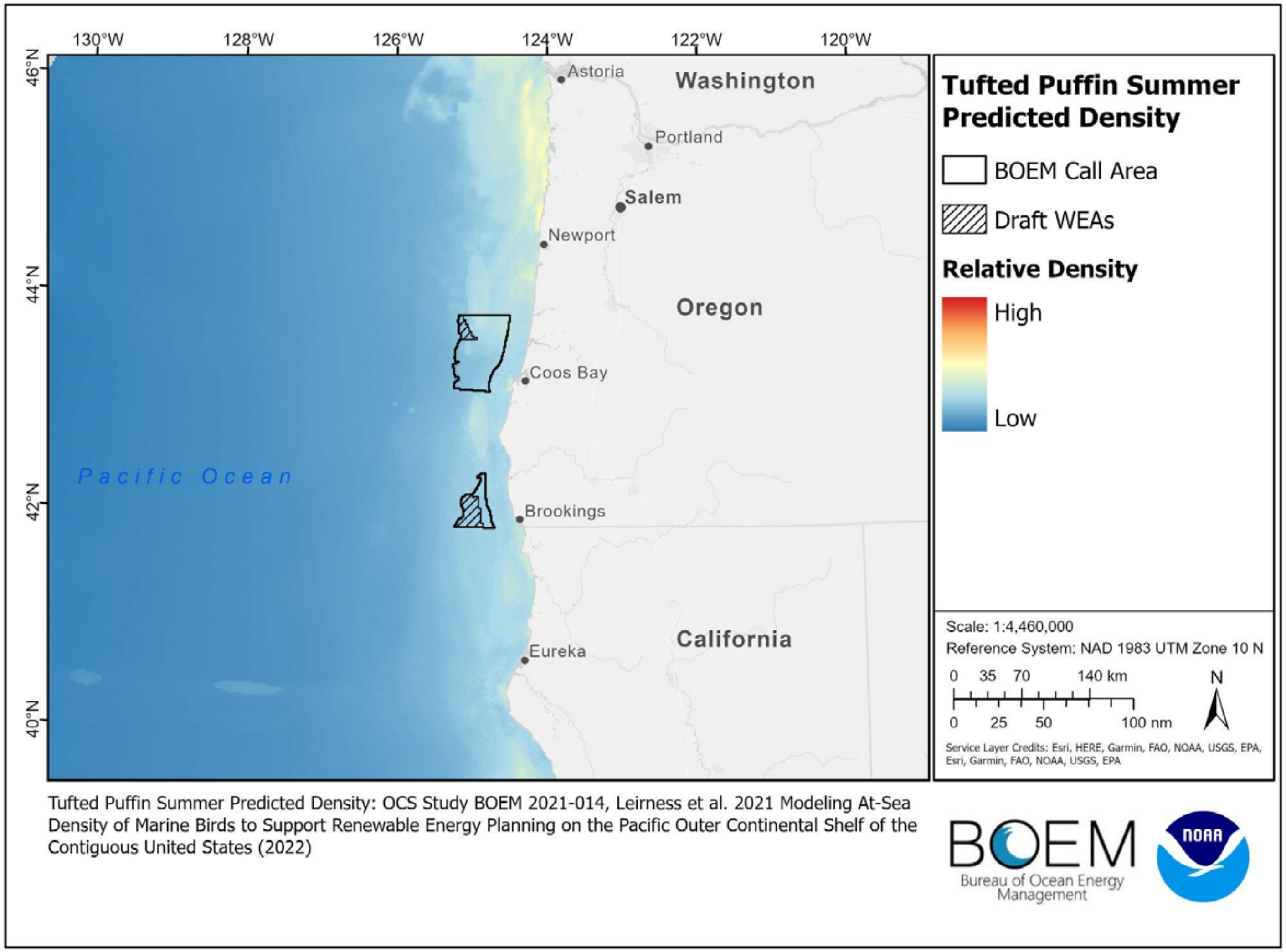

Figure 3.44. Summer predicted density of the Tufted Puffin in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

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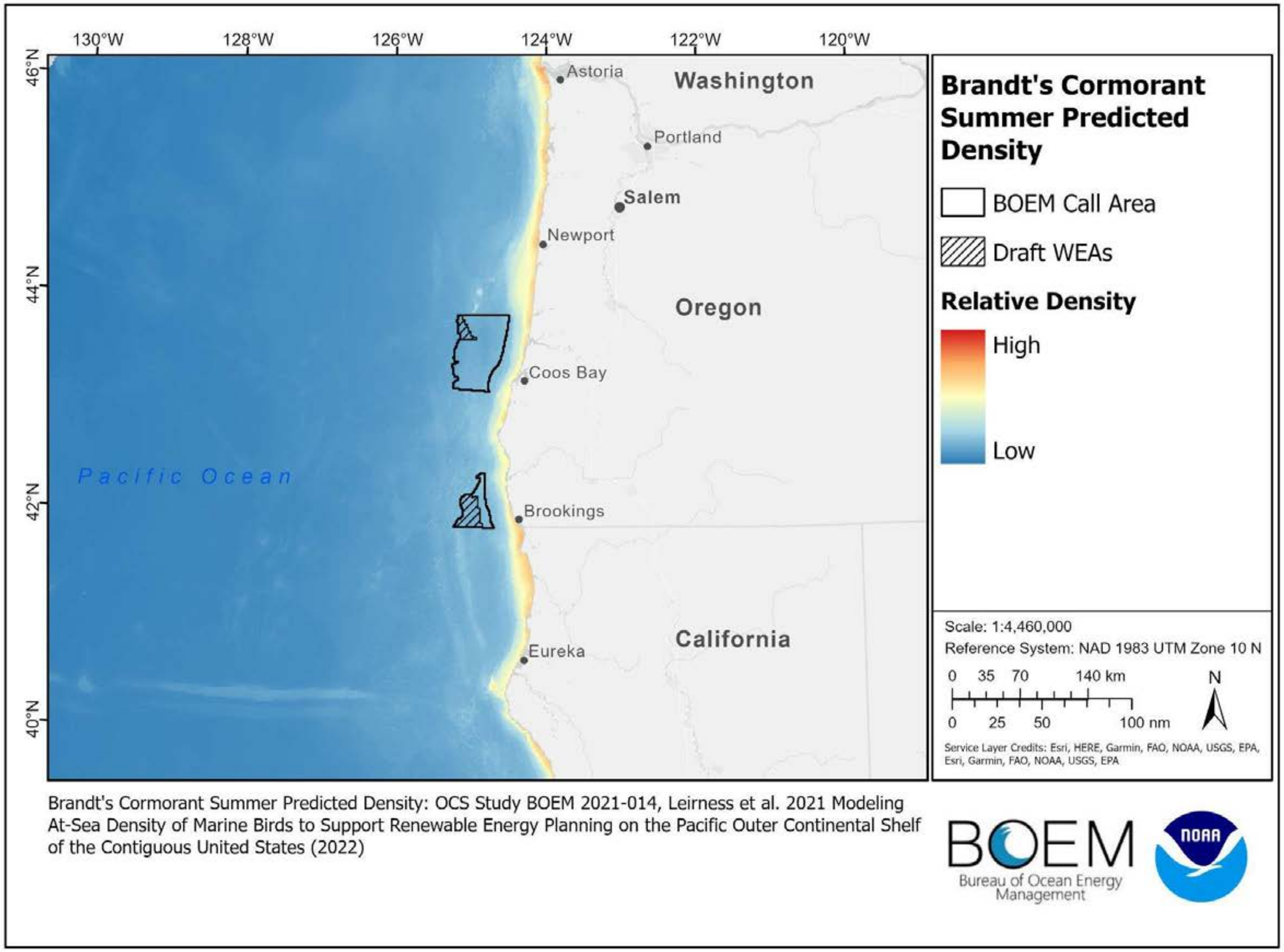

Figure 3.45. Summer predicted density of the Brandt's Cormorant in relation to the Draft WEAs. This data was included in the marine bird combined data layer and not analyzed as an individual layer in the suitability model.

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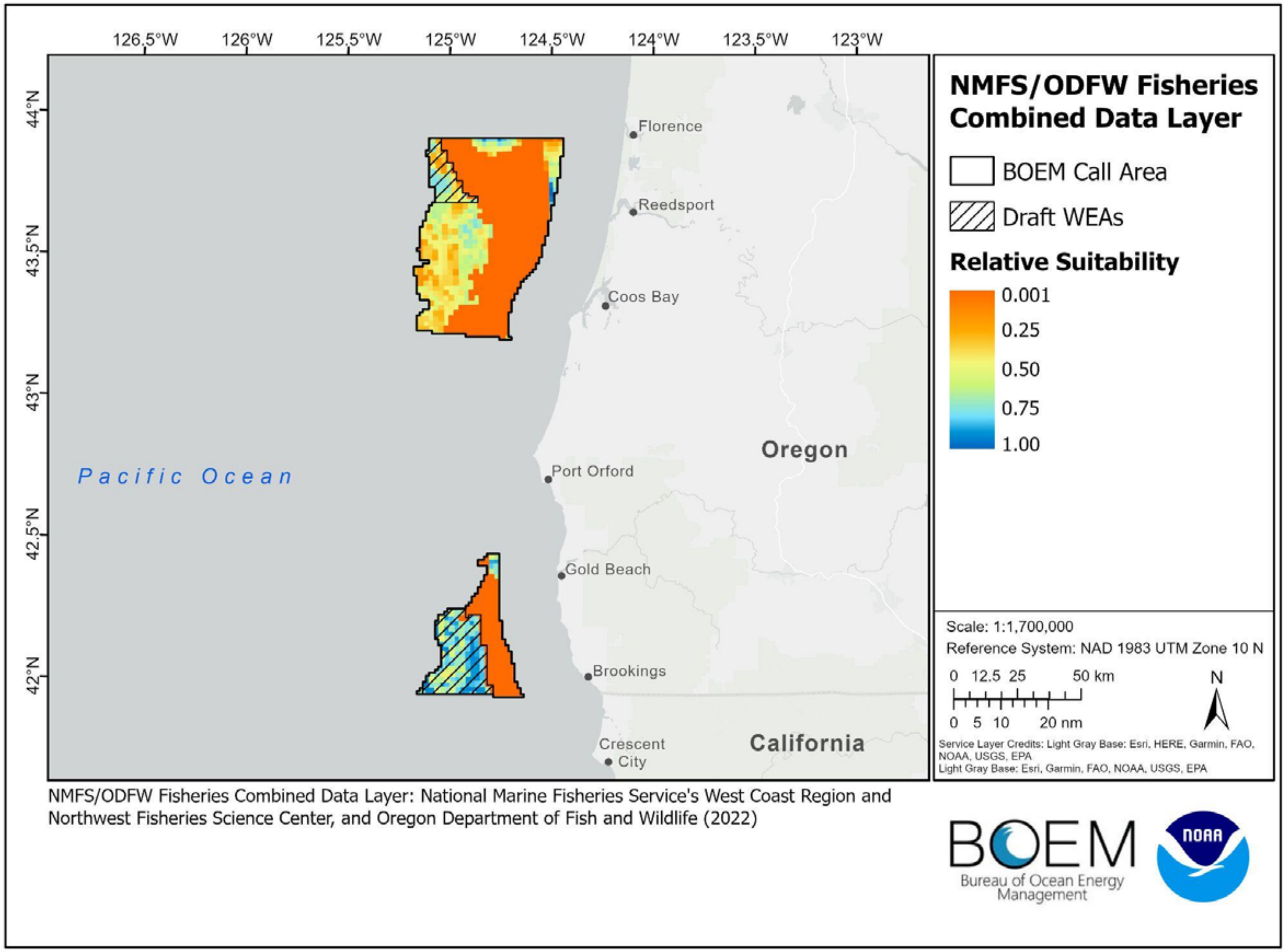

Figure 3.46. Relative suitability of the NMFS & ODFW fisheries combined data layer in relation to the Draft WEAs. This data layer was implemented within the fisheries submodel for the suitability analysis.

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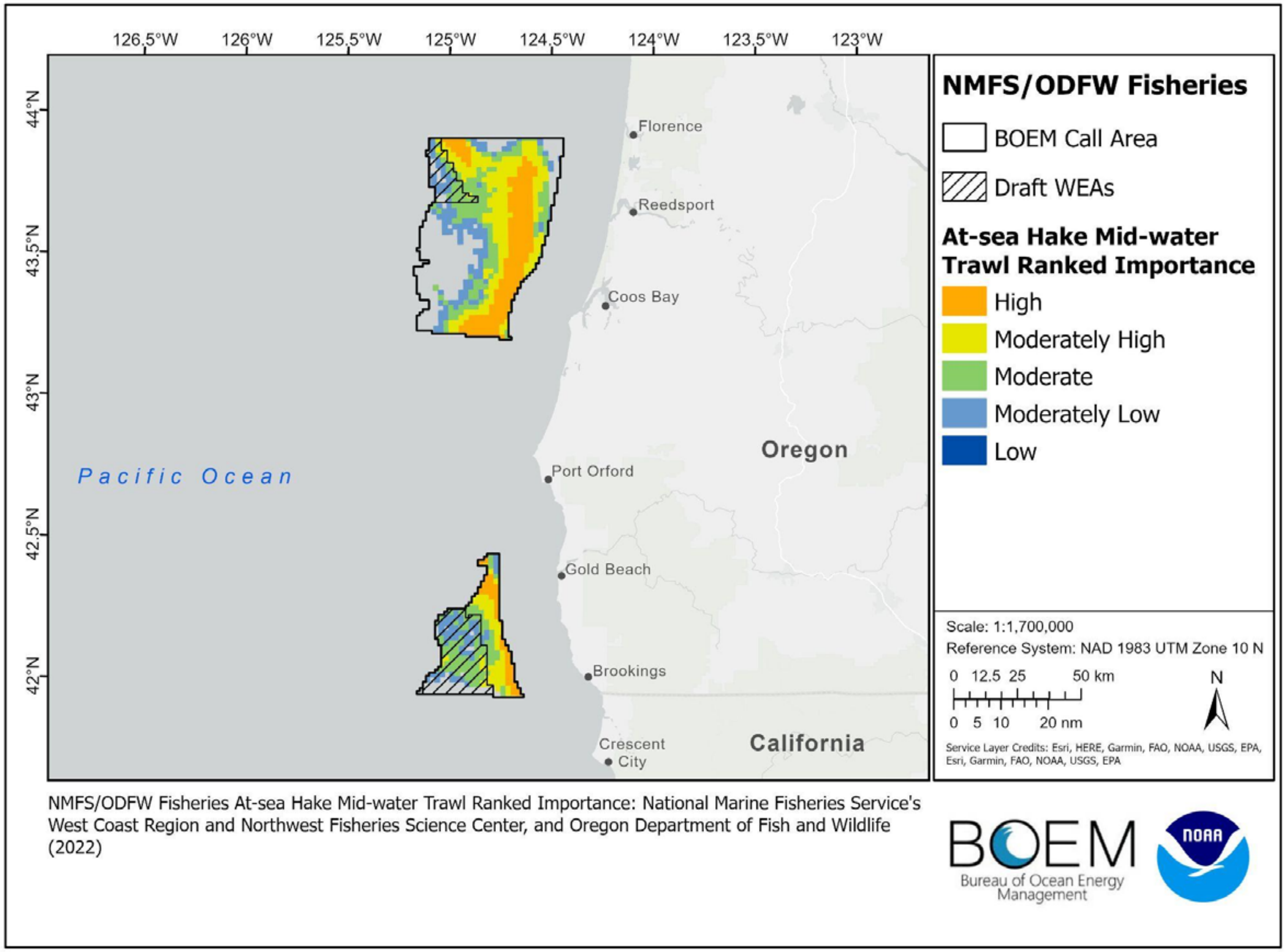

Figure 3.47. Ranked importance of the at-sea hake fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

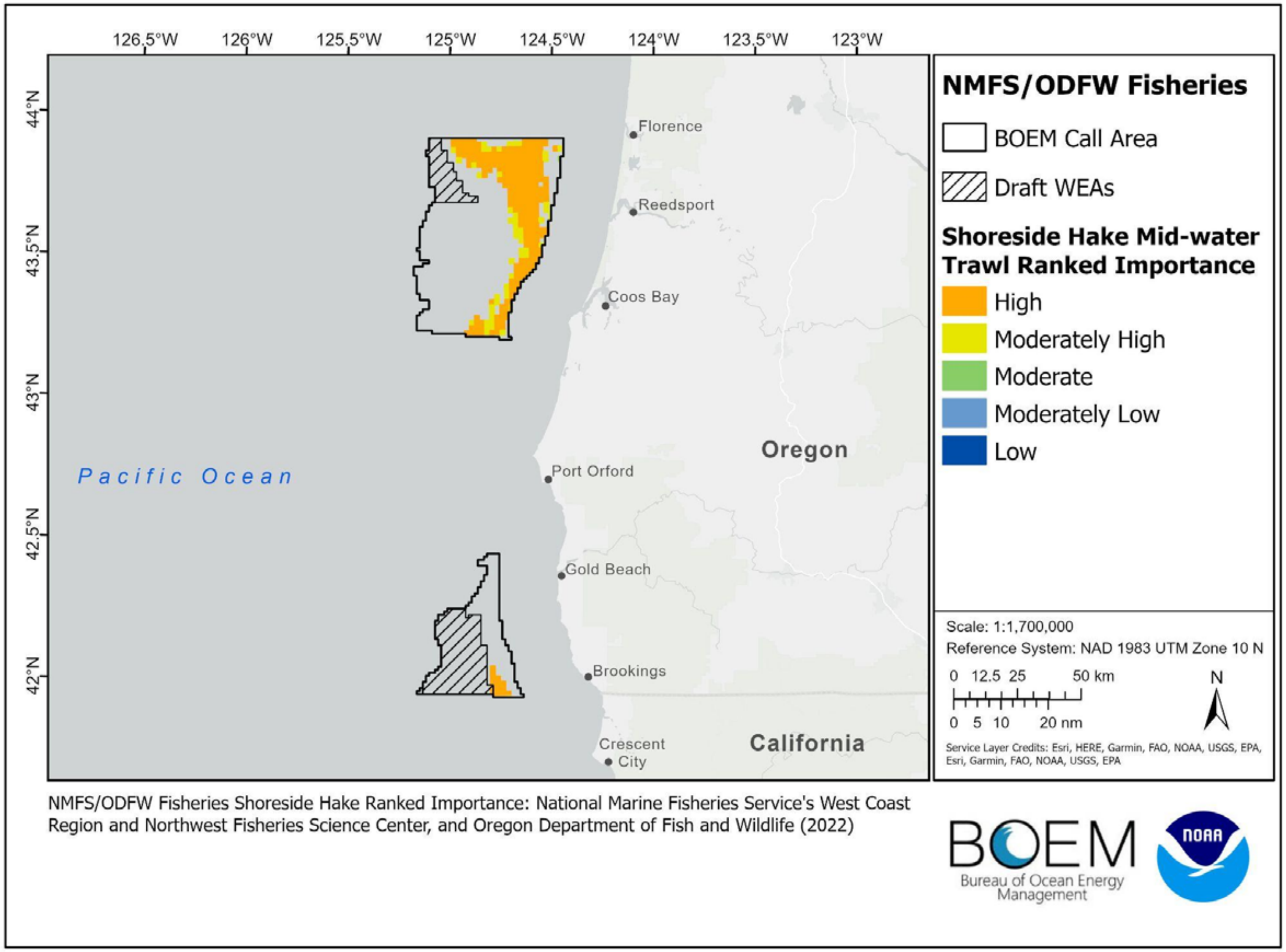

Figure 3.48. Ranked importance of the shoreside hake fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

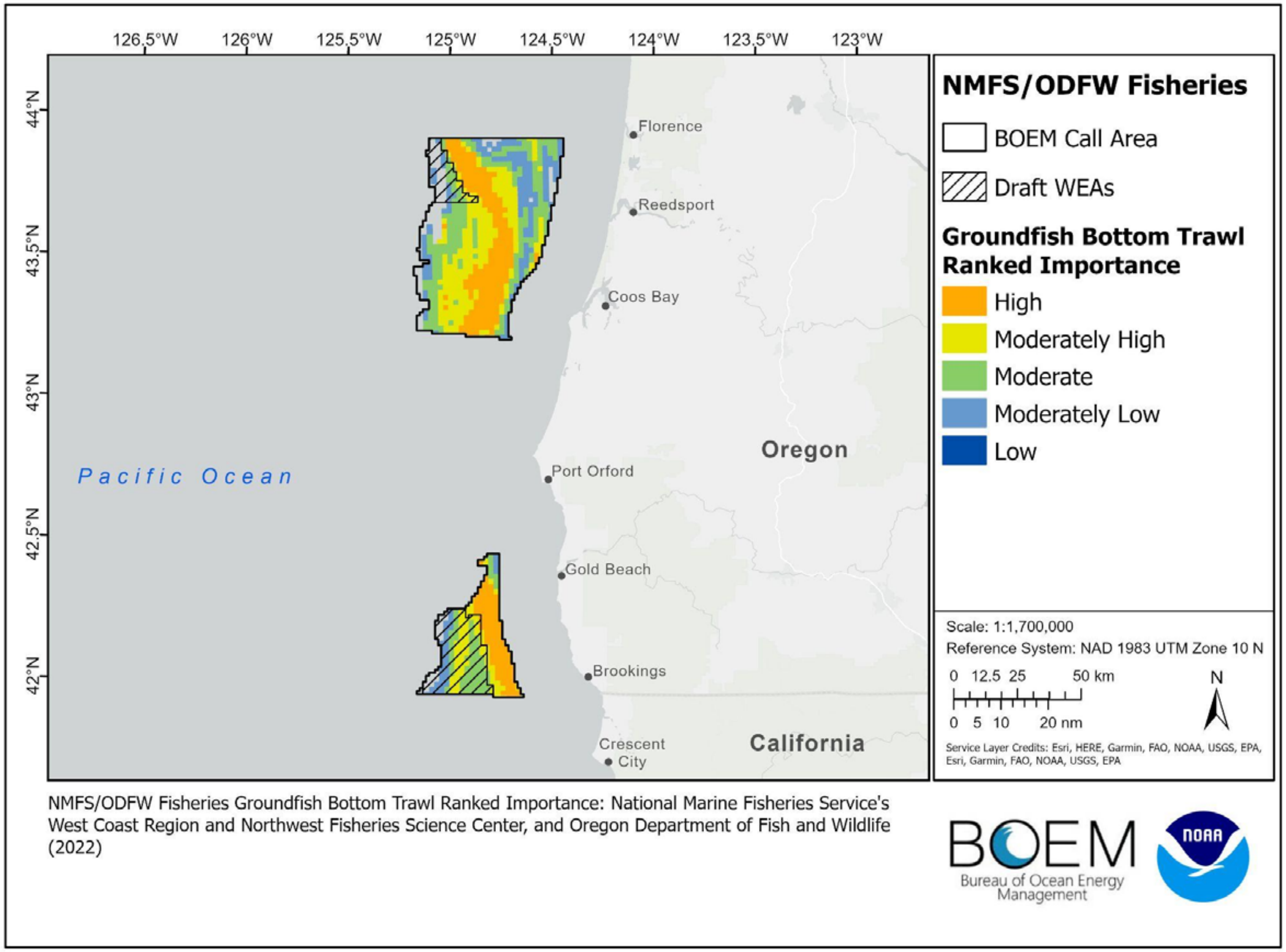

Figure 3.49. Ranked importance of the groundfish bottom trawl fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

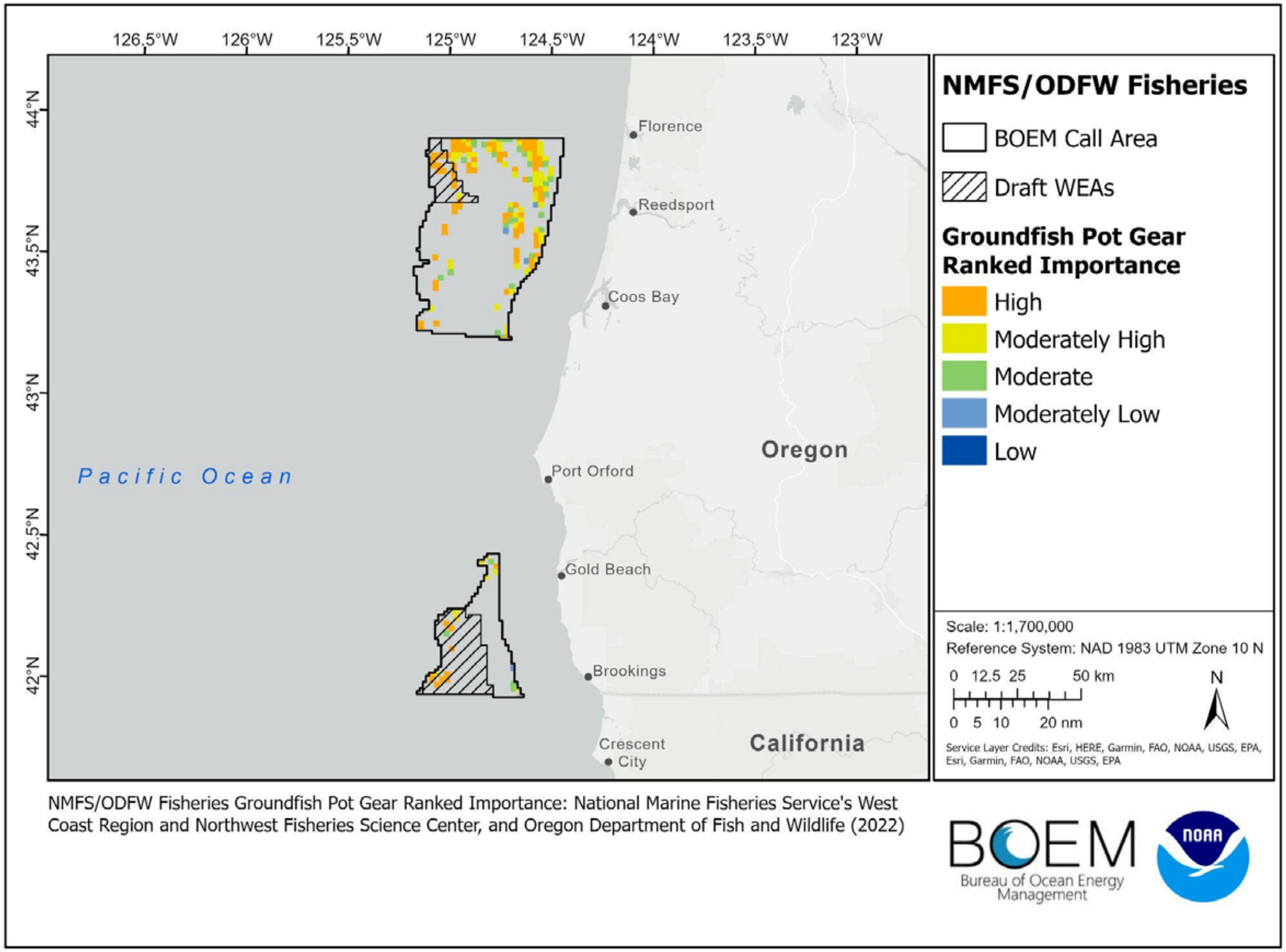

Figure 3.50. Ranked importance of the groundfish pot gear fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

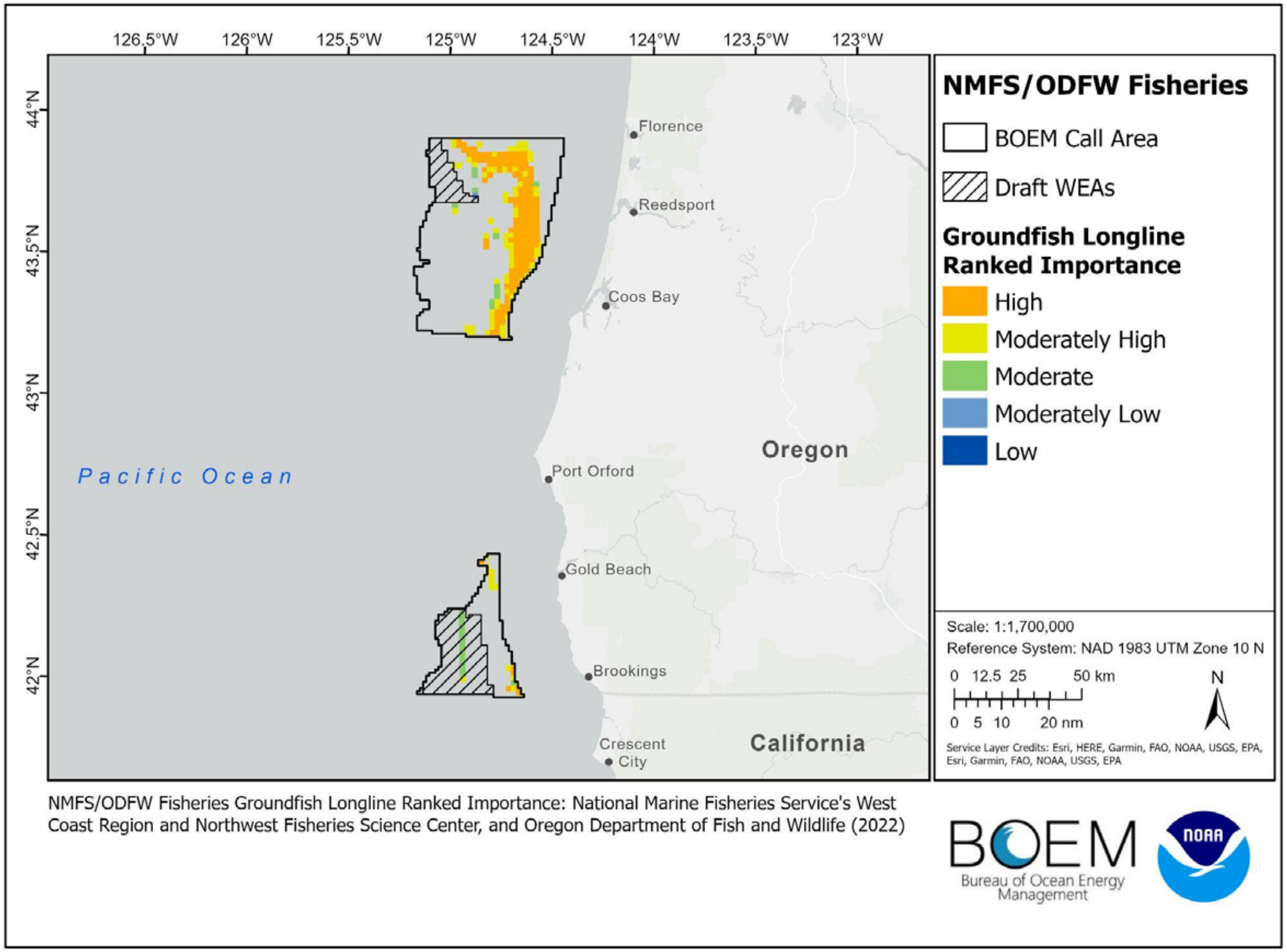

Figure 3.51. Ranked importance of the groundfish longline fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

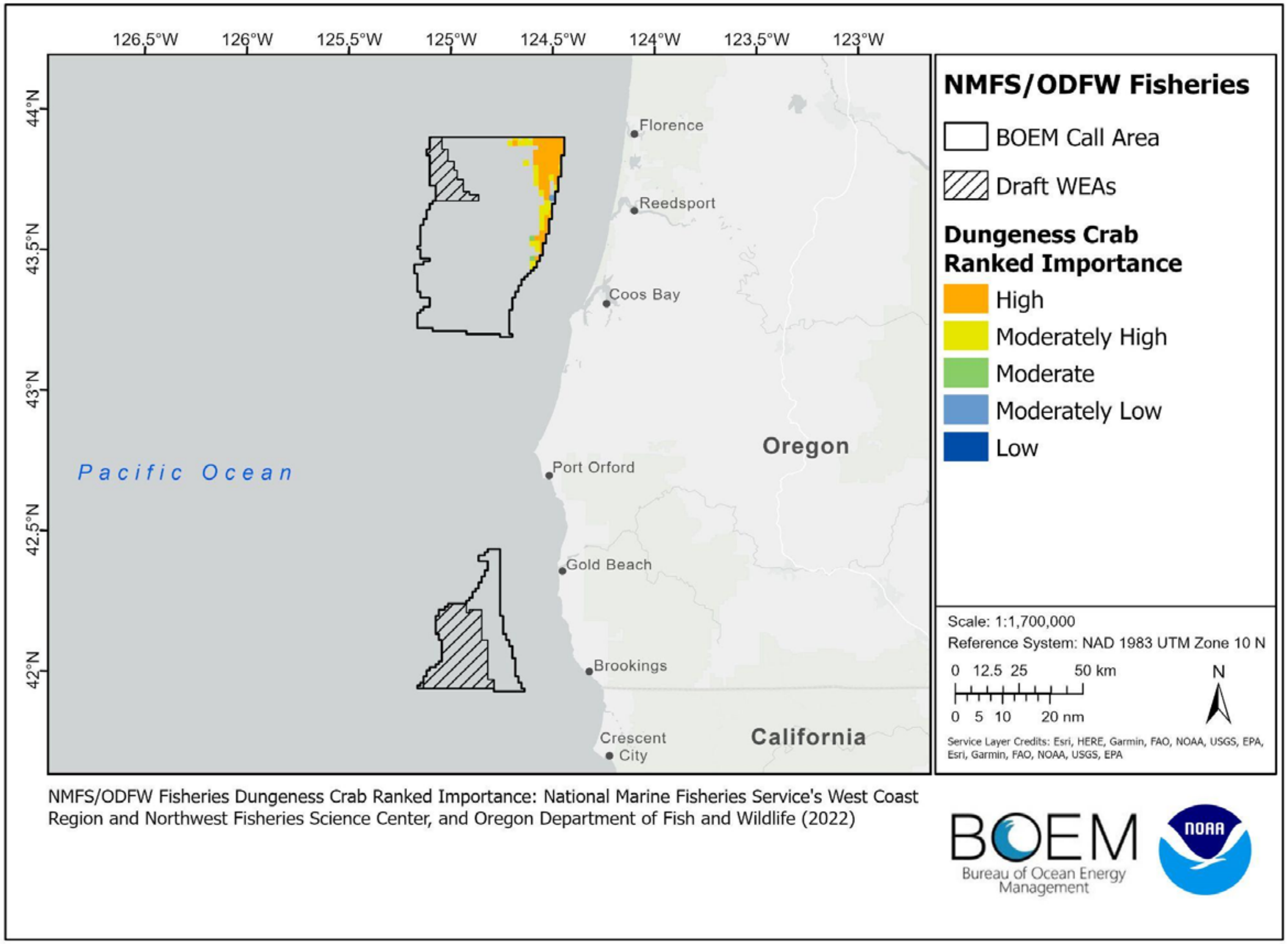

Figure 3.52. Ranked importance of the Dungeness crab fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

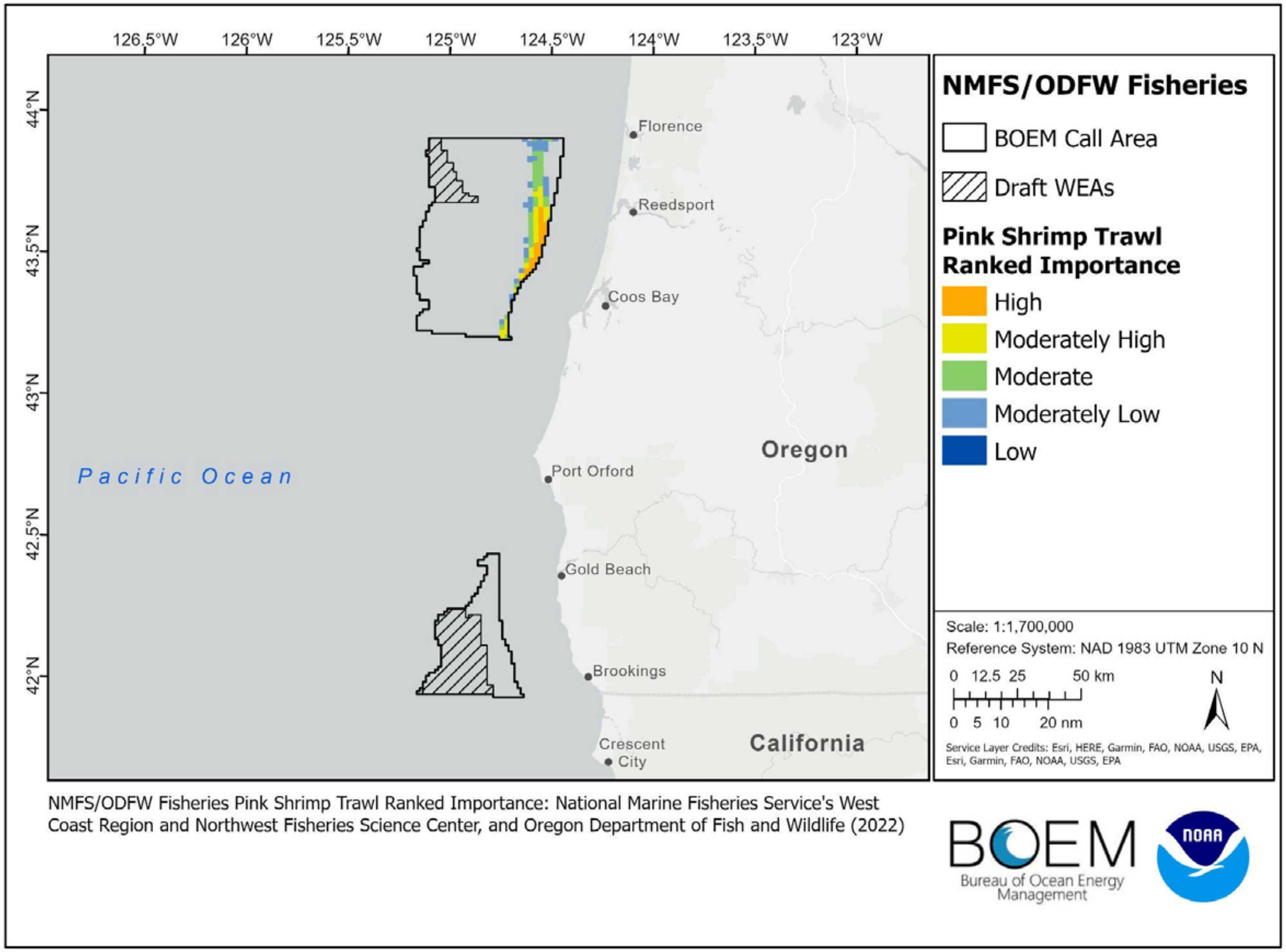

Figure 3.53. Ranked importance of the pink shrimp trawl fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

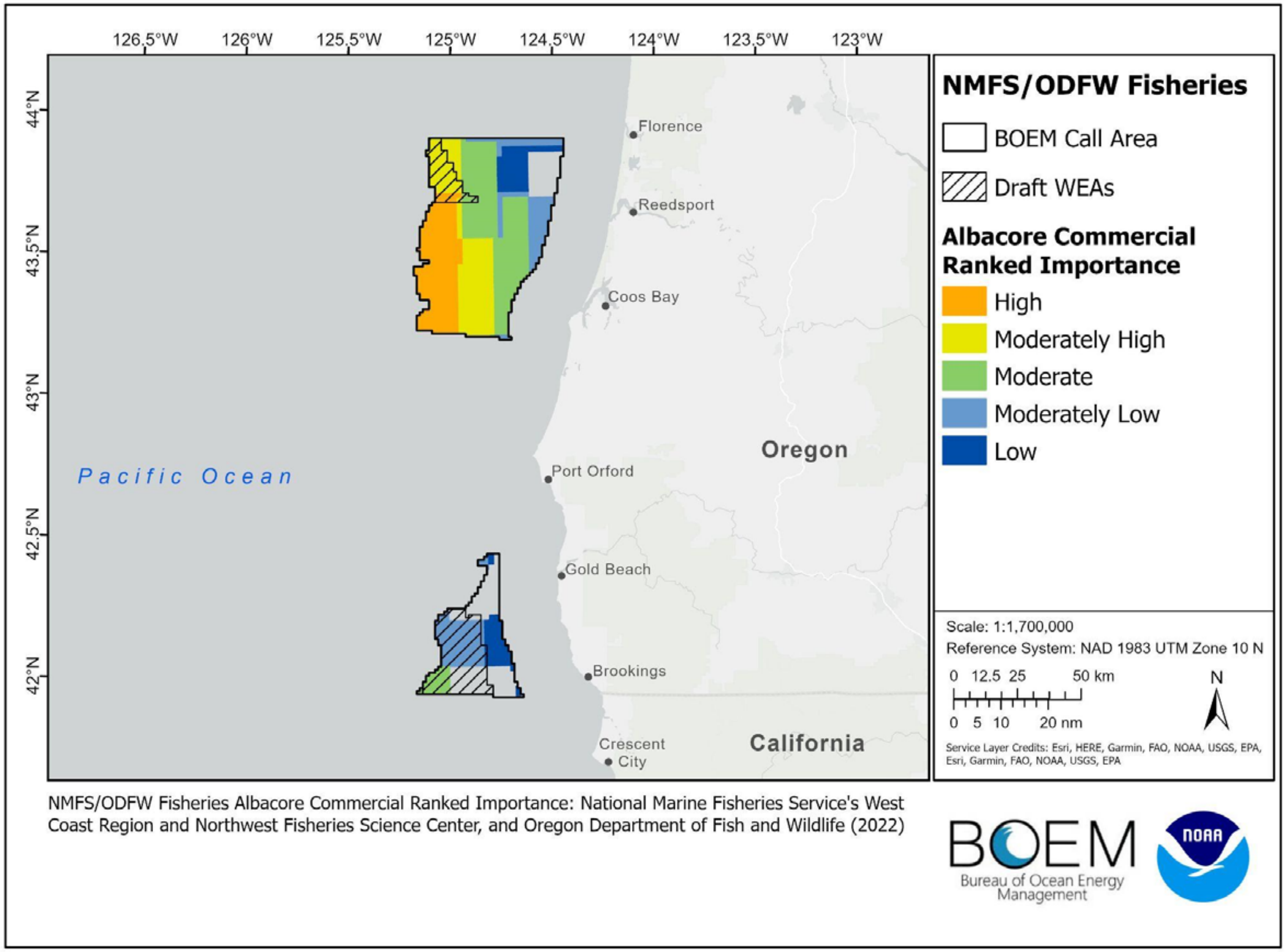

Figure 3.54. Ranked importance of the albacore commercial fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

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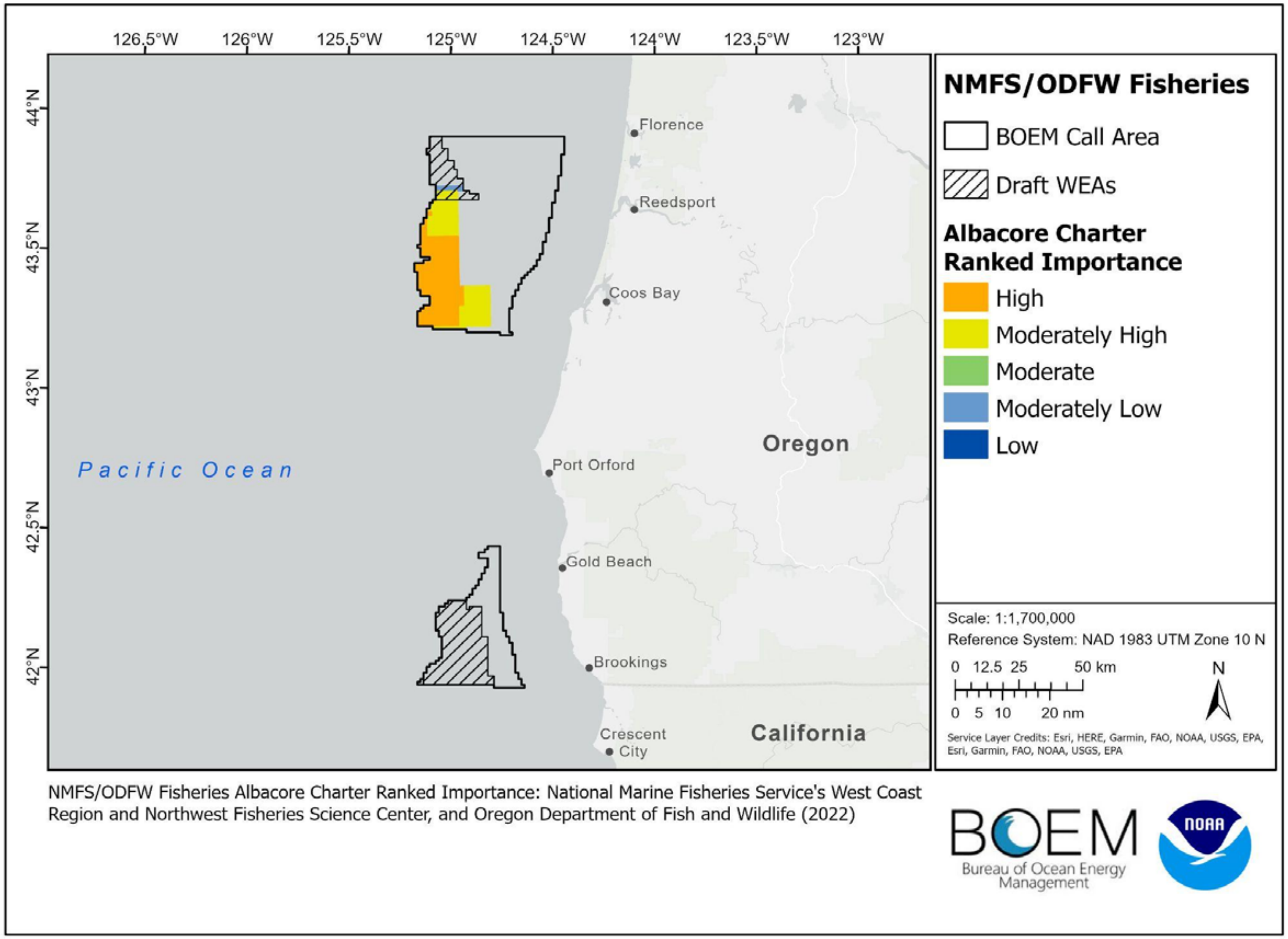

Figure 3.55. Ranked importance of the albacore charter fishery in relation to the Draft WEAs. This data was included in the NMFS & ODFW fisheries combined data layer and not analyzed as an individual layer in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

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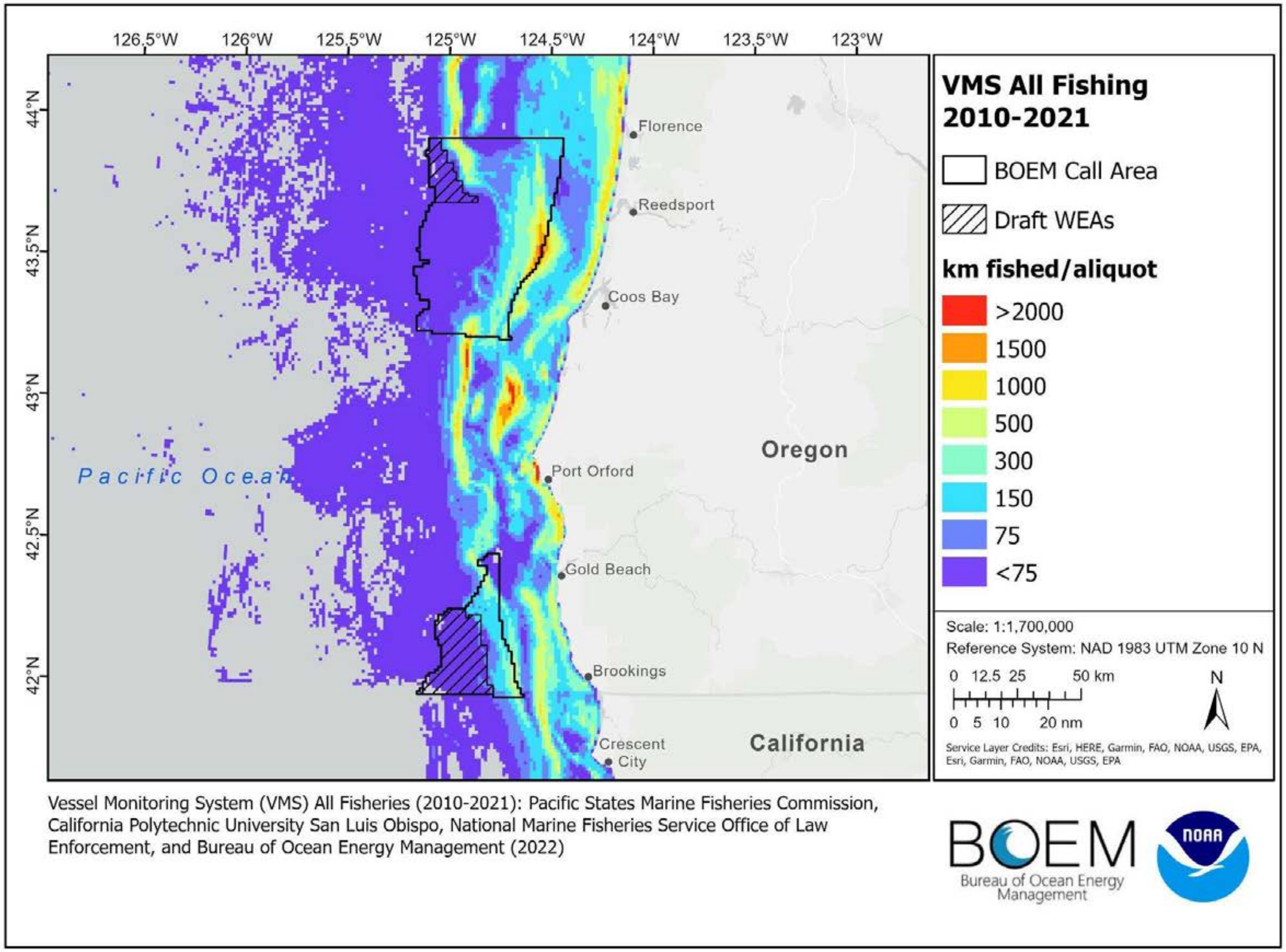

Figure 3.56. VMS all fishing types for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

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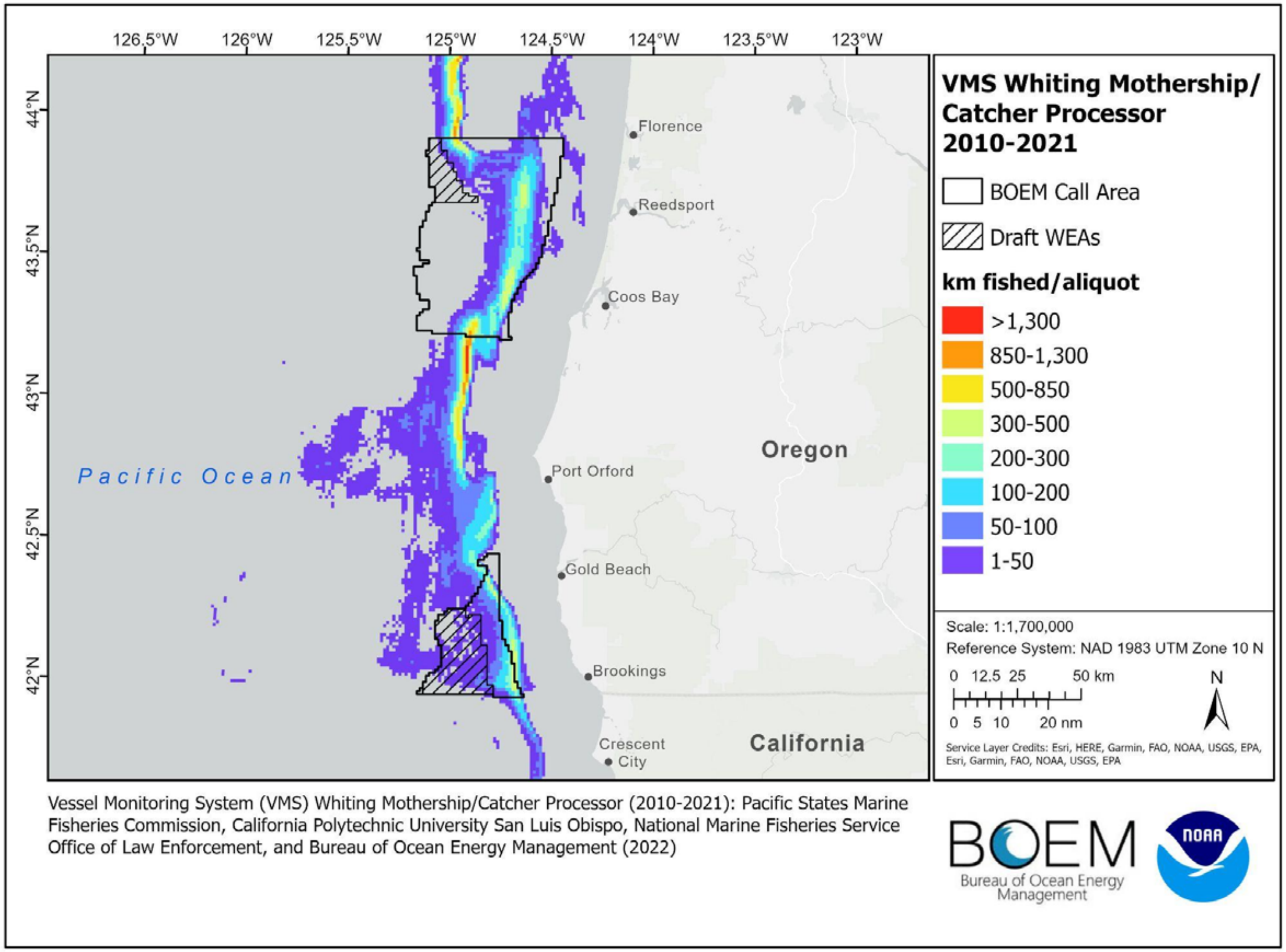

Figure 3.57. VMS whiting mothership/catcher processor for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

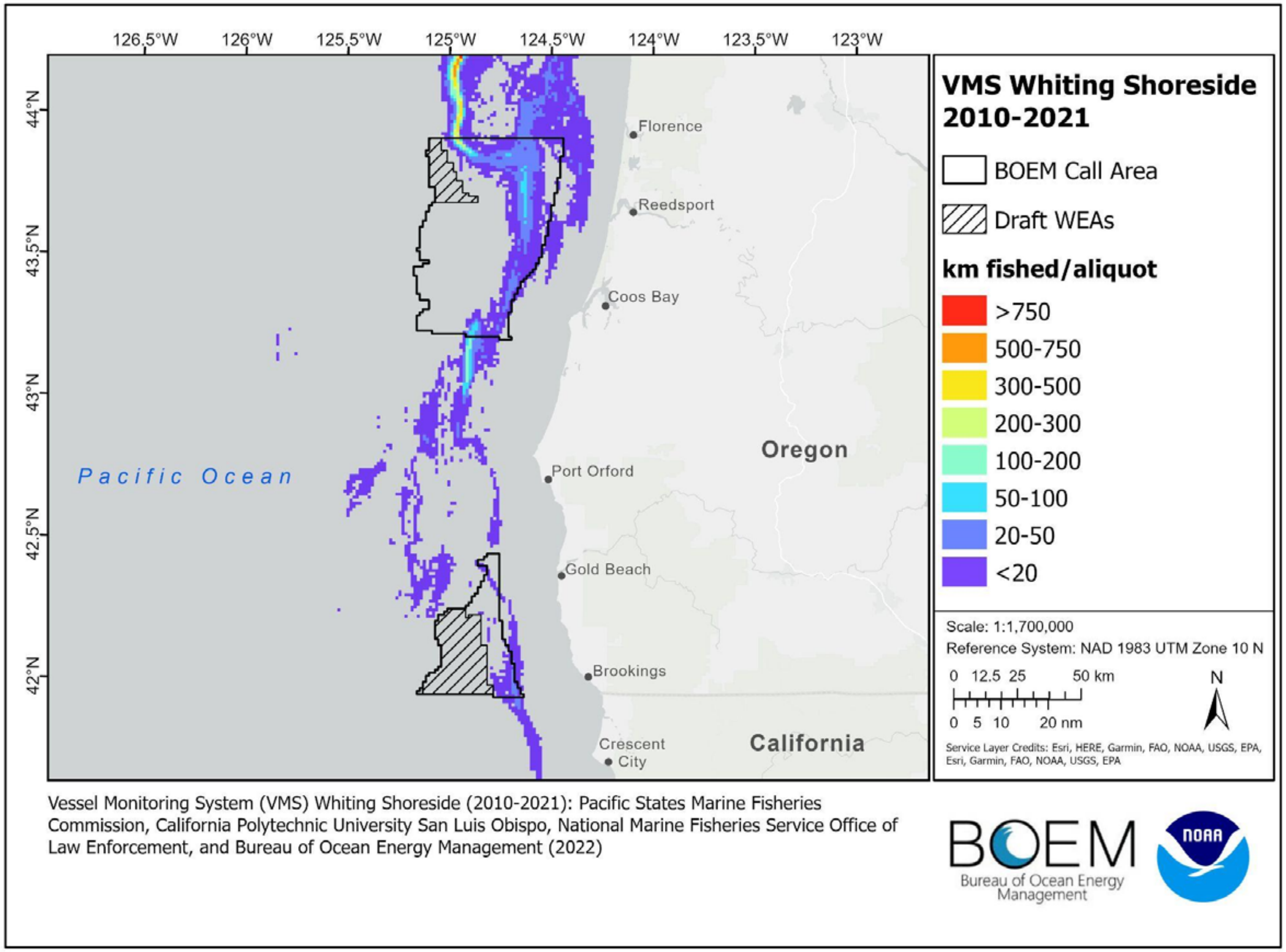

Figure 3.58. VMS whiting shoreside for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

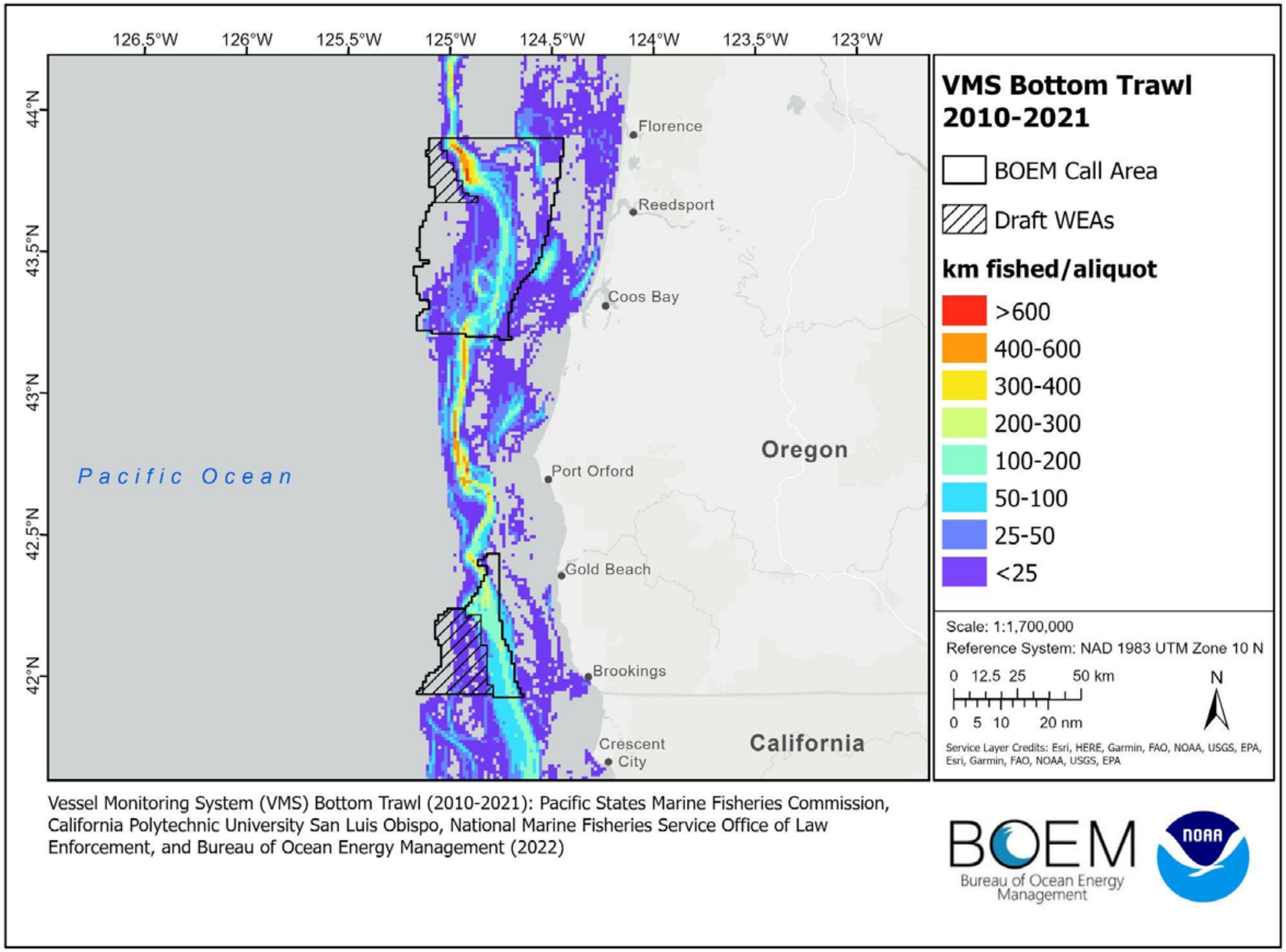

Figure 3.59. VMS bottom trawl for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

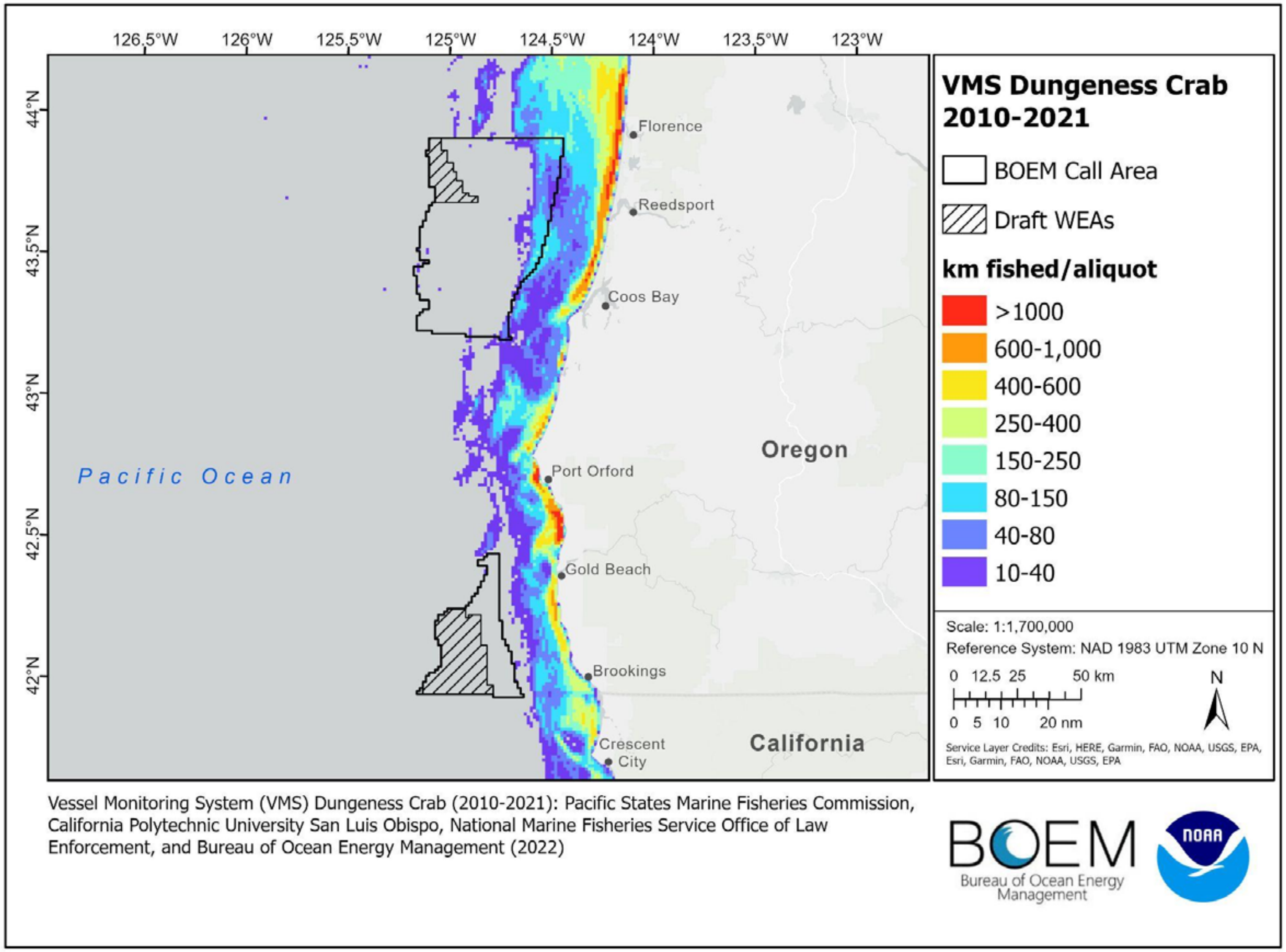

Figure 3.60. VMS Dungeness crab for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

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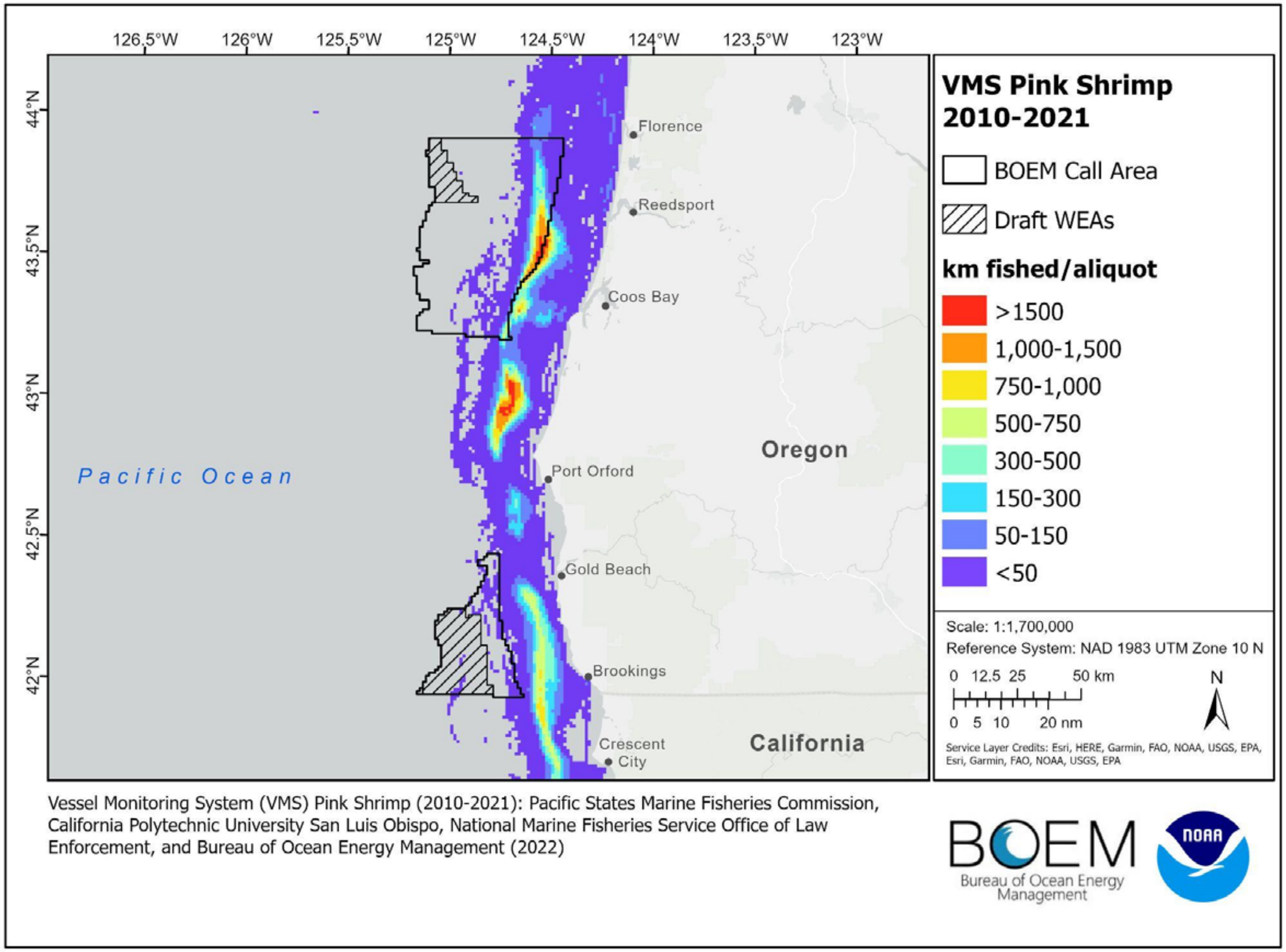

Figure 3.61. VMS pink shrimp for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

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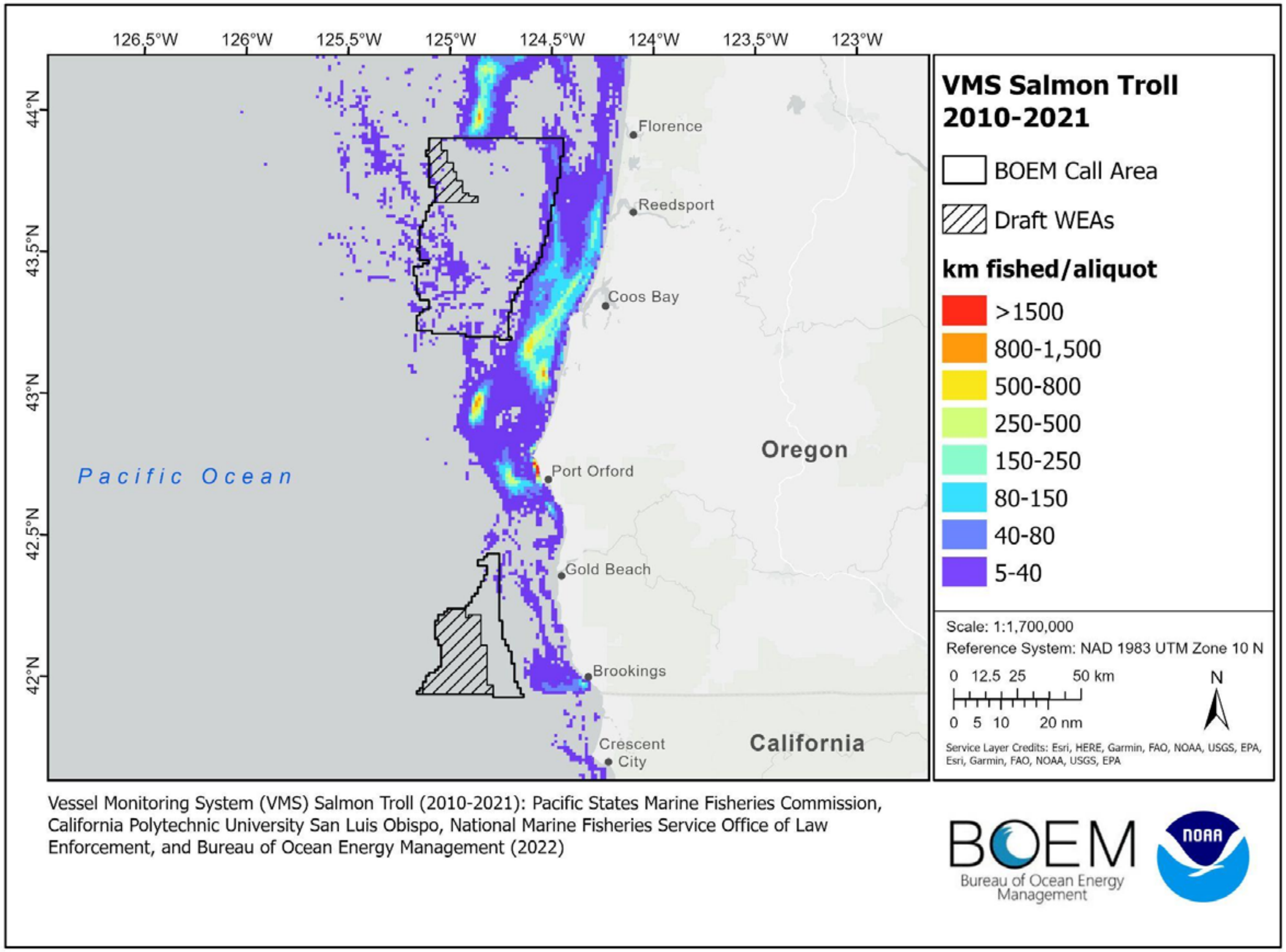

Figure 3.62. VMS salmon troll for 2010–2021 in km fished per aliquot grid (1.2 km^2 grid) in relation to the Draft WEAs. These data were not used in the suitability model. Grid cells containing fewer than three vessels are not displayed for confidentiality purposes.

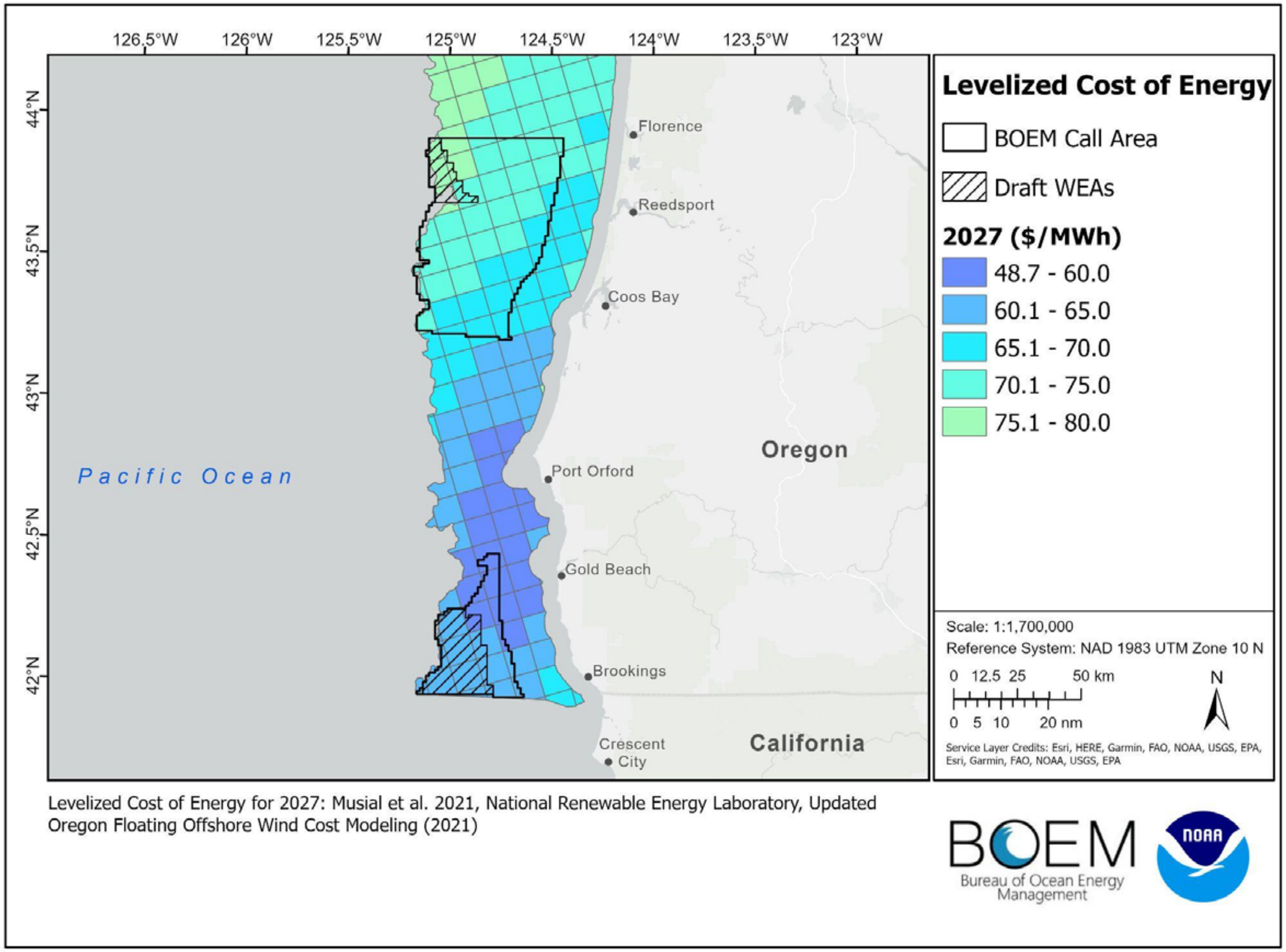

Figure 3.63. Levelized cost of energy for 2027 in relation to the Draft WEAs. This data layer was implemented within the wind submodel for the suitability analysis.

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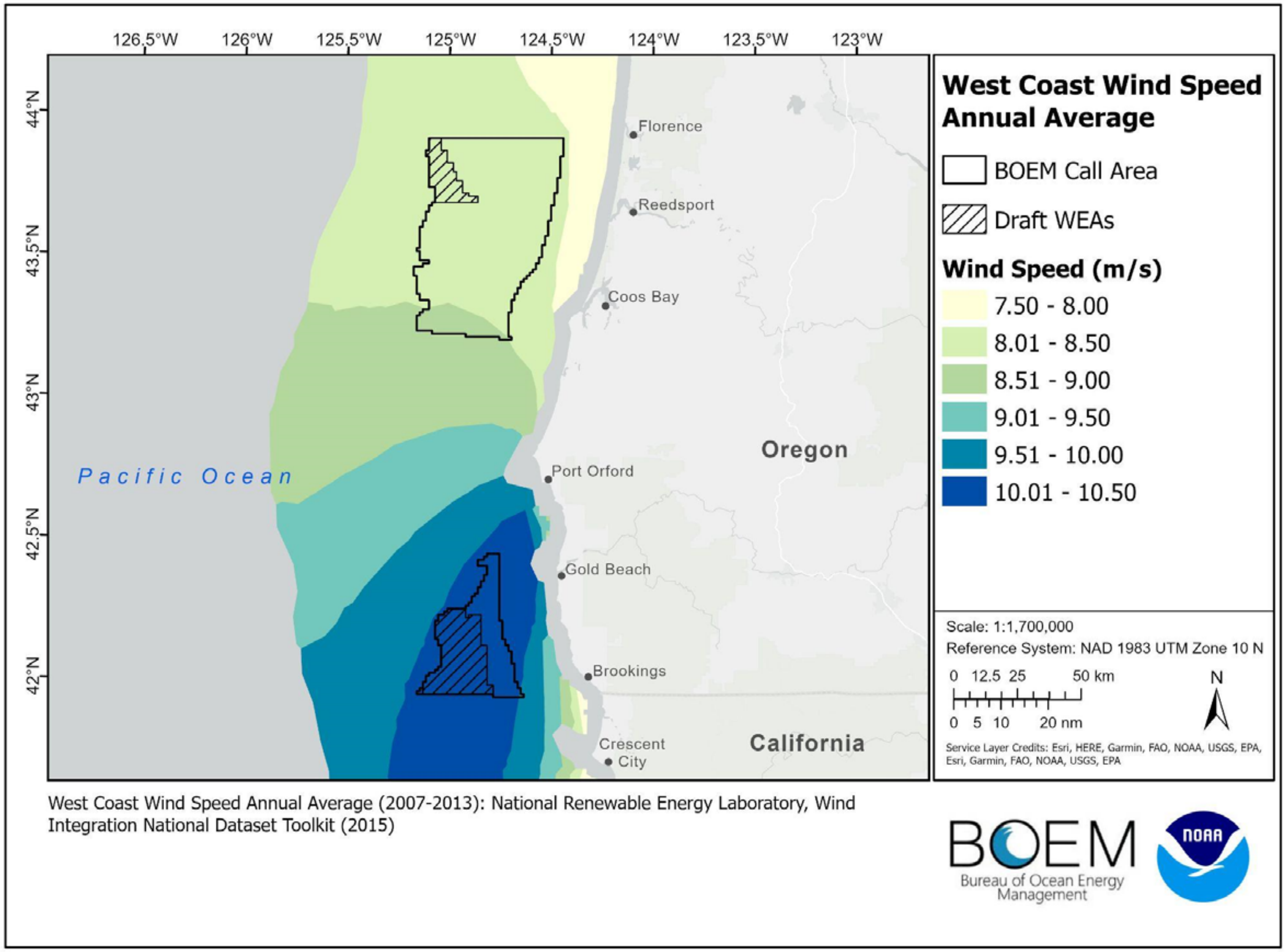

Figure 3.64. Annual average West Coast wind speed in relation to the Draft WEAs. This data was not used in the suitability model.

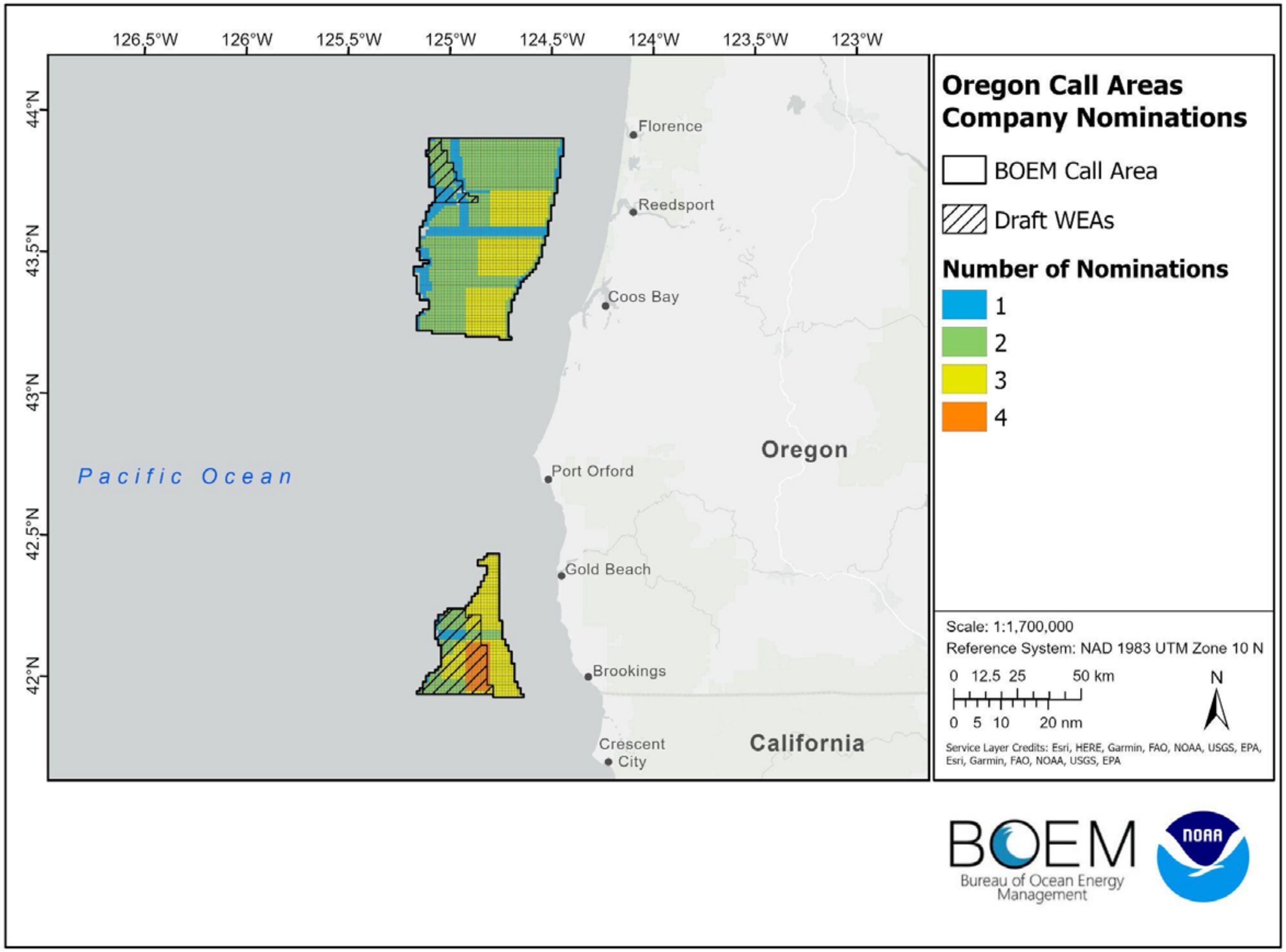

Figure 3.65. Nomination areas of competitive interest in relation to the Draft WEAs. These data were not used in the suitability model.

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Appendix A - Oregon Draft WEA Siting Data Inventory

Table A-1. National security data layers.

Data Layer	Source	Source/Link	Metadata Link
Department of Defense - Exclusion Area	DOD	Unpublished	Unpublished

Table A-2. Natural resource data layers.

Data Layer	Source	Source/Link	Metadata Link
Leatherback sea turtle exclusion area	NOAA NMFS	Protected Species Combined Data Layer	Unpublished
Southern Resident killer whale critical habitat	NOAA NMFS	Protected Species Combined Data Layer	Unpublished
Humpback whale Central America DPS	NOAA NMFS	Protected Species Combined Data Layer	Unpublished
Humpback whale Mexico DPS	NOAA NMFS	Protected Species Combined Data Layer	Unpublished
Blue whale exclusion area	NOAA NMFS	Protected Species Combined Data Layer	Unpublished
Essential fish habitat (EFH) conservation areas (EFHCAs)	NOAA NMFS	Habitat Combined Data Layer	https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-groundfish-and-salmon
Rocky Reef Habitat Areas of Particular Concern (HAPC) - mapped	NOAA NMFS	Habitat Combined Data Layer; Goldfinger et al. 2014 Surficial Geologic Habitat v.4.0	https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2014-662-Vol-1.pdf

Data Layer	Source	Source/Link	Metadata Link
Rocky Reef Habitat Areas of Particular Concern (HAPC) - probable	NOAA NMFS	Habitat Combined Data Layer	Unpublished
Deep-Sea Coral Habitat Suitability	NOAA NMFS	Habitat Combined Data Layer; Poti et al. 2020	https://espis.boem.gov/final%20reports/BOEM_2020-021.pdf
Shelf Break	NOAA NMFS	Habitat Combined Data Layer; Goldfinger et al. 2014 Surficial Geologic Habitat v.4.0	https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2014-662-Vol-1.pdf
Methane Bubble Streams	NOAA NMFS	Habitat Combined Data Layer	Unpublished
Marine bird combined data layer	BOEM NOAA USGS	Unpublished	Unpublished; https://espis.boem.gov/final%20reports/BOEM_2021-014.pdf; https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2016-043.pdf; https://www.usgs.gov/publications/collision-and-displacement-vulnerability-offshore-wind-energy-infrastructure-among
ESA-designated Critical Habitat	NOAA NMFS	https://noaa.maps.arcgis.com/home/item.html?id=f66c1e33f91d480db7d1b1c1336223c3	https://www.fisheries.noaa.gov/resource/map/national-esa-critical-habitat-mapper
Biologically Important Areas for Cetaceans	NOAA NMFS	https://www.fisheries.noaa.gov/inport/item/48853	https://coast.noaa.gov/digitalcoast//data/biologicallyimportantareas.html

Table A-3. Commercial and recreational fishing data layers.

Data Layer	Source	Source/Link	Metadata Link
Groundfish bottom trawl (hours trawled)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Groundfish fixed gear - pot (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Groundfish fixed gear - longline (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
At-sea hake mid-water trawl (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Shoreside hake mid-water trawl (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Commercial albacore - troll/hook-and-line (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Charter albacore - troll/hook-and-line (days fished)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Pink shrimp - trawl (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
Dungeness crab - pot (effort and revenue)	NOAA NMFS; ODFW	Fisheries Combined Data Layer	Unpublished
VMS all fisheries (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request
VMS whiting mothership/catcher processor (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request
VMS whiting shoreside (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request
VMS bottom trawl (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request

Data Layer	Source	Source/Link	Metadata Link
VMS Dungeness crab (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request
VMS pink shrimp (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request
VMS salmon troll (2010-2021)	PSMFC; CALPOLY; NMFS OLE; BOEM	Unpublished	Upon request

Table A-4. Industry, navigation and transportation data layers.

Data Layer	Source	Source/Link	Metadata Link
Pacific Coast Port Access Route Study (PACPARS)	USCG	https://homeport.uscg.mil/Lists/Content/Attachments/77149/Draft%20PAC-PARS.pdf	Unpublished
East-West Scientific Sampling Corridors 4-nm wide	NOAA NMFS	Scientific Surveys Combined Data Layer	Unpublished
Additional East-West Scientific Sampling Corridors 4-nm wide	NOAA NMFS	Scientific Surveys Combined Data Layer	Unpublished
Scientific Survey Transects 1-nm wide	NOAA NMFS	Scientific Surveys Combined Data Layer	Unpublished
Scientific Survey Stations 2-nm radius	NOAA NMFS	Scientific Surveys Combined Data Layer	Unpublished
Submarine Cables	NOAA and BOEM (i.e., marinecadastre.gov)	https://marinecadastre.gov/downloads/data/mc/SubmarineCable.zip	https://www.fisheries.noaa.gov/inport/item/66194

Table A-5. Wind logistics data layers.

Data Layer	Source	Source/Link	Metadata Link
Levelized Cost of Energy, 2027	NREL	Upon request	https://www.boem.gov/sites/default/files/documents/regions/pacific-ocs-region/environmental-science/PR-20-OWC-presentation.pdf
Coastal Relief Model	NOAA NCEI	https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.ngdc.mgg.dem:348/html	https://www.ncei.noaa.gov/products/coastal-relief-model
West Coast Annual Average Wind Speed	NREL	https://data.nrel.gov/submissions/70	https://www.nrel.gov/grid/wind-toolkit.html

DRAFT

Appendix B - NMFS Protected Species Data

NCCOS Spatial Modeling of Oregon Call Areas

Protected Species Considerations Provided by NOAA's National Marine Fisheries Service (NMFS)

3/16/23

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[1] NMFS West Coast Region (WCR)

Purpose of this Document

NOAA's National Marine Fisheries Service's (NMFS) West Coast Region (WCR) and Northwest and Southwest Fisheries Science Centers (NWFSC, SWFSC) developed data layers regarding protected species, i.e., species listed under the Endangered Species Act (ESA) and/or Marine Mammal Protection Act (MMPA), for inclusion in the spatial model developed by NCCOS for BOEM's OR Call Areas and proposed WEA designation. We are providing this document to accompany those data layers, which we provided to NCCOS. It provides a high-level overview of the data layers and the basis for our recommendations. Our recommendations align with our official comments on the OR Call Areas in our 6/28/2022 letter to BOEM.

● Disclaimer for NMFS' role in NCCOS Offshore Wind Spatial Planning Work for BOEM

NCCOS is providing BOEM with technical assistance to support BOEM's spatial planning in relation to offshore wind projects. This support is being provided with funding resources from NCCOS and through reimbursable support from BOEM to NCCOS. NMFS is providing technical assistance to NCCOS regarding available science (i.e., data layers and modeling methods) for BOEM's consideration in their spatial modeling efforts. These efforts are supporting BOEM's ocean and coastal planning activities related to siting of Call Areas, Wind Energy Areas, and transmission cable routing. The information provided by NMFS to NCCOS is purely technical in nature and does not reflect or constitute an official agency policy, position, or action. Official NMFS positions related to spatial planning for offshore wind activity will be submitted by NMFS through written comments to BOEM during the planning and review processes for each activity.

● Important Note about ESA and MMPA Consultations

Nothing NMFS provides through this modeling effort should be construed as part of an ESA Section 7 consultation or MMPA authorization process. Please refer to our 6/28/2022 letter to BOEM for information and guidance regarding those processes with NMFS.

Protected Species Included, Data, and Recommendations for Modeling

Species for which NMFS provided data layers align with the information and recommendations provided in our 6/28/2022 letter to BOEM:

- Endangered Leatherback Sea Turtle - a Species in the Spotlight
- Endangered Southern Resident killer whale - a Species in the Spotlight
- ESA-listed Humpback Whale (two distinct population segments (DPSs))
    - Endangered Central America DPS
    - Threatened Mexico DPS
- Endangered Blue Whale

● Data and Methods

NMFS subject matter experts (SMEs) considered a list of protected species (see Tables 4 and 5 below) to include in the model. For each species selected, NMFS provided a score based on their population status and trend (see Table 1) using the method NMFS used for protected species data layers in NCCOS's Aquaculture Opportunity Areas models and in the Gulf of Mexico Offshore Wind Siting model.

Table 1. Scoring method NMFS used for species in the protected species data layers.

Status	*Trend*	*Scores*
Endangered	declining, small population[1] or both	**0.1**
Endangered	stable or unknown	**0.2**
Endangered	increasing	**0.3**
Threatened	declining or unknown	**0.4**
Threatened	stable or increasing	**0.5**
ESA-Listed Low-Use Area	n/a (default score for ESA-listed species in low-use areas)	**0.5**
MMPA Strategic[2]	declining or unknown	**0.6**
MMPA-listed	small population* or unknown/declining	**0.7**
MMPA-listed	large population or stable/increasing	**0.8**
MMPA-listed Low-Use Area	n/a (default score for MMPA-listed species in low-use areas)	**0.9**

[1] Small population equates to populations of 500 individuals or less (Franklin 1980).

[2] A strategic stock is defined by the Marine Mammal Protection Act as "...a marine mammal stock for which the level of direct human-caused mortality exceeds the potential biological removal level; which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the Endangered Species Act within the foreseeable future; or, which is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA."

Not all protected species that may occur in the area were included in NMFS recommendations for the model due to data and/or time limitations. For example, some data types for species were qualitative, non-continuous, or too coarse to provide constructive contrast within the framework being used. The species listed in Table 2 received a score. Scoring criteria are based on the most recent (2021) Marine Mammal Stock Assessment Reports by Region | NOAA Fisheries, from Curtis et al. 2022[1] (for Central America distinct population segment (DPS) humpback whales only), Farmer et al. (2022)[2], and in the Aquaculture Opportunity Area Atlases Southern California (Morris et al. 2021).

NMFS proceeded only with the first five species in Table 1 for inclusion in the data layers due to data and/or time limitations. Information about these species and our concerns about these species were elaborated upon in our 6/28/2022 letter to BOEM. We provided information about additional species (see shaded rows in Table 1), however; and we note that fin and sperm whale

[1] Curtis, K.A., Calambokidis, J., Audley, K., Castaneda, M.G., De Weerdt, J., García Chávez, A.J., Garita, F., Martínez-Loustalot, P., Palacios-Alfaro, J.D., Pérez, B. and Quintana-Rizzo, E., 2022. Abundance of humpback whales (*Megaptera novaeangliae*) wintering in Central America and southern Mexico from a one-dimensional spatial capture-recapture model.

[2] Farmer NA, Powell JR, Morris Jr. JA, Soldevilla MS, Wickliffe LC, Jossart JA, MacKay JK, Randall AL, Bath GE, Ruvelas P, Gray L, Lee J, Piniak W, Garrison L, Hardy R, Hart KM, Sasso C, Stokes L, Riley KL., 2022. Modeling protected species distributions and habitats to inform siting and management of pioneering ocean industries: A case study for Gulf of Mexico aquaculture. PloS ONE 17(9): e0267333.

density maps, harbor porpoise density maps, and Biologically Important Areas (BIA) identified for migrating and feeding gray whales all illustrate these species' potential presence along the West Coast relative to the locations considered for wind energy development siting. Numerous other protected species may also occur within the areas affected by wind siting decisions. Note that updates to BIAs that will include the most updated and best science available are expected to be published and available soon.

Table 2. Scores for species considered for the model. (E = endangered, T = threatened, CH = critical habitat). Shaded rows indicate additional species for which we provided population and status information but did not include in the spatial mapping information and recommendations.

Species	ESA Status	MMPA Strategic stock?	Trend	Species Score
Leatherback sea turtle	E/CH	N/A	Declining, Small population	0.1
Southern Resident killer whale	E/CH	Yes	Declining, Small population	0.1
Humpback whale - Central America DPS	E/CH	Yes	Increasing	0.3
Humpback whale - Mexico DPS	T/CH	Yes	Increasing	0.5
Blue whale	E	Yes	Unknown	0.2
Fin whale	E	Yes	Increasing	0.3
Sperm whale	E	Yes	Unknown	0.2
North Pacific right whale	E/CH	Yes	Unknown, **Small population**[3]	0.1
Gray whale East North Pacific	not ESA-listed	No	Increasing, Large population	0.8
Gray whale Western North Pacific	E	Yes	Increasing, **Small population**[3]	0.1
Harbor porpoise	not ESA-listed	No	Stable or slightly increasing	0.8
Guadalupe fur seal	T	Yes	Increasing, Large population	0.5

It is important to emphasize that regarding the data we provided, we applied the best available science at the time, and that does not account for future shifts in species distributions, which are likely to alter their potential overlap with offshore wind energy development. The compressed

[3] Endangered status and small population size are the limiting factors to this population.

timeframe for this effort precluded any consideration of such factors. NOAA's California Current Integrated Ecosystem Assessment team is currently assessing shifts in species distributions that will provide this type of data in the future.

● NMFS Recommendations for the Constraints Submodel and Natural Resources Submodel

NMFS provided three scenarios in order of preference to NCCOS for consideration by BOEM in the model. These scenarios align with the areas we recommended for exclusion in our 6/28/2022 letter to BOEM. Scenario 1 is our recommended scenario and, as advised by NCCOS, we provided two alternative scenarios in the event BOEM chooses not to include this recommendation in the constraints submodel. See Table 3.

Table 3. NMFS protected species recommended data layers and scores; scenarios in order of preference.

Species	Scenario 1 (Recommended)	Scenario 2	Scenario 3
Leatherback sea turtle - *Species in the Spotlight*	**0**	**0**	**0.1**
Southern Resident killer whale - *Species in the Spotlight*	**0**	**0**	**0.1**
Blue whale	**0**	**0.2**	**0.2**
Humpback whale Central America DPS	**0**	**0.3**	**0.3**
Humpback whale Mexico DPS	**0**	**0.5**	**0.5**
0 = Constraints submodel 0.1-0.9 = species scores based on the methods in Table 1 (above) for inclusion in the Natural Resources submodel.			

List of Other Protected Species in the Area

Several other species protected under the ESA and MMPA occur within the two OR Call Areas. A list of these species was provided in our 6/28/2022 letter to BOEM and is copied below. Please refer to our letter for more information.

Table 4. [Table 1 in our 6/28/2022 letter.] ESA-listed species that occur within the two OR Call Areas and surrounding area, their listing status (endangered (E), threatened (T)) and designated critical habitat (CH).

Species	Status and CH	Listing and CH Code of Federal Regulations (CFR) Citations
Marine mammals		
Southern Resident killer whale (*Orcinus orca*) ➤***Also a NMFS Species in the Spotlight***[4]	E / CH	50 CFR 224.101; 50 CFR 226.206
Blue whale (*Balaenoptera musculus*)	E	50 CFR 224.101
Fin whale (*Balaenoptera physalus*)	E	50 CFR 224.101
Gray whale (*Eschrichtius robustus*) - Western North Pacific stock	E	50 CFR 224.101
Humpback whale (*Megaptera novaeangliae*) - 2 DPSs		
-Central America DPS	E / CH	50 CFR 224.101; 50 CFR 226.227
-Mexico DPS	T / CH	50 CFR 223.102; 50 CFR 226.227
North Pacific right whale (*Eubalaena japonicus*)	E / CH	50 CFR 224.101
Sei whale (*Balaenoptera borealis*)	E	50 CFR 224.101
Sperm whale (*Physeter macrocephalus*)	E	50 CFR 224.101
Guadalupe fur seal (*Arctocephalus townsendi*)	T	50 CFR 223.102
Sea turtles		
Pacific leatherback sea turtle (*Dermochelys coriacea*) ➤***Also a NMFS Species in the Spotlight***[5]	E / CH	50 CFR 224.101; 50 CFR 226.207
Chinook salmon (*Oncorhynchus tshawytscha*) - 3 ESUs		
Sacramento River winter-run Chinook salmon ESU	E / CH	50 CFR 224.101; 50 CFR 226.204
Central Valley spring-run Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.204
California Coastal Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.211
Lower Columbia River Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212
Upper Columbia River Spring-run Chinook salmon ESU	E / CH	50 CFR 223.102; 50 CFR 226.212
Snake River Fall Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212
Upper Willamette River Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212
Coho salmon (*Oncorhynchus kisutch*) - 2 ESUs		
Central California Coast coho salmon ESU ➤***Also a NMFS Species in the Spotlight***[6]	E / CH	50 CFR 224.101; 50 CFR 226.210
Southern Oregon/Northern California Coast coho salmon ESU	T / CH	50 CFR 223.102: 50 CFR 226.210
Lower Columbia River coho salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212
Oregon Coast salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212

[4] https://www.fisheries.noaa.gov/species/killer-whale#spotlight
[5] https://www.fisheries.noaa.gov/species/leatherback-turtle#spotlight
[6] https://www.fisheries.noaa.gov/species/coho-salmon-protected#spotlight

Species	Status and CH	Listing and CH Code of Federal Regulations (CFR) Citations
Steelhead (*Oncorhynchus mykiss*) - 3 DPSs		
California Central Valley steelhead DPS	T / CH	50 CFR 223.102; 50 CFR 226.211
Central California Coast steelhead DPS	T / CH	50 CFR 223.102; 50 CFR 226.211
Northern California steelhead DPS	T / CHH	50 CFR 223.102; 50 CFR 226.211
Sturgeon		
North American green sturgeon (*Acipenser medirostris*) - Southern DPS	T / CH	50 CFR 223.102; 50 CFR 226.219
Eulachon		
Pacific eulachon (*Thaleichthys pacificus*) - Southern DPS	T / CH	50 CFR 223.102; 50 CFR 226.222

Table 5. [Table 2 in our 6/28/2022 letter.] Marine mammals that occur within the two OR Call Areas and surrounding area (status for ESA-listed species: endangered (E), threatened (T), and designated critical habitat (CH)).

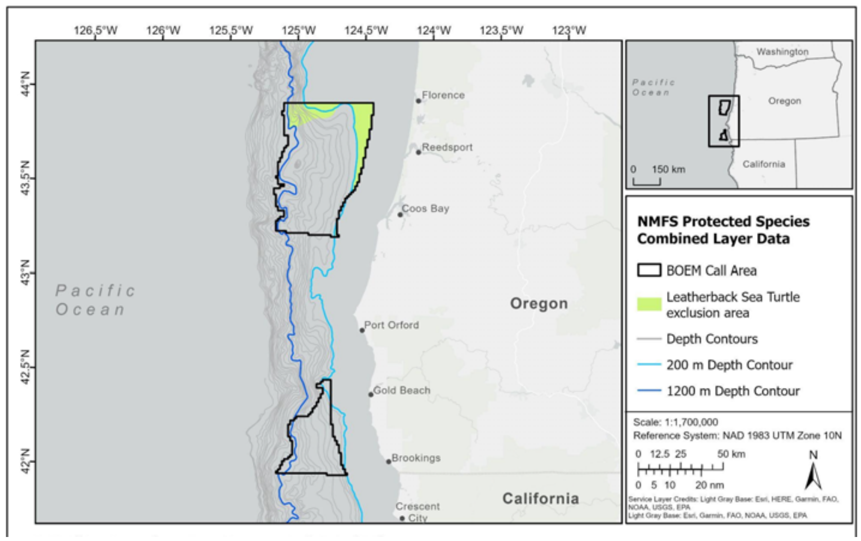
Non-ESA-listed marine mammals	ESA-listed marine mammals (see also Table 1)
Gray whale (*Eschrichtius robustus*) - Eastern North Pacific stock	Gray whale (*Eschrichtius robustus*) - Western North Pacific stock - E
Minke whale (*Balaenoptera acutorostrata*)	Fin whale (*Balaenoptera physalus*) – E
Killer whale (*Orcinus orca*) - Eastern North Pacific Offshore stock	Killer whale – Southern Resident killer whale – E / CH
Killer whale (*Orcinus orca*) - West Coast Transient stock	Blue whale (*Balaenoptera musculus*) – E
Mesoplodont beaked whale (*Mesoplodon* spp.)	Humpback whale (*Megaptera novaeangliae*) - 2 DPSs
Northern right whale dolphin (*Lissodelphis borealis*)	-Central America DPS - E / CH
Short-finned pilot whale (*Globicephala macrorhynchus*)	-Mexico DPS - T / CH
Short-beaked common dolphin (*Delphinus delphis*)	North Pacific right whale (*Eubalaena japonicus*) - E / CH
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	Sei whale (*Balaenoptera borealis*) – E
Risso's dolphin (*Grampus griseus*)	Sperm whale (*Physeter macrocephalus*) – E
Dall's porpoise (*Phocoenoides dalli*)	Guadalupe fur seal (*Arctocephalus townsendi*) – T
Harbor porpoise (*Phocoena phocoena*) – Northern California/Southern Oregon stock	
Northern elephant seal (*Mirounga angustirostris*)	
*Steller sea lion (*Eumetopias jubatus*)	
Harbor seal (*Phoca vitulina*)	
Northern fur seal (*Callorhinus ursinus*)	
California sea lion (*Zalophus californianus*)	

*Although the eastern DPS of Steller sea lions were delisted from the ESA in 2013 (78 FR 66140; Nov. 4, 2013), critical habitat remains designated for major Steller sea lion rookeries, including Sugarloaf Island and Cape Mendocino (south of the WEA at 40° 26' N latitude; 124° 24.0' W longitude), Humboldt County, California. NMFS determined that critical habitat for the Steller sea lion should remain in effect for the listed, endangered western DPS, as the designated critical habitat continued to support the western DPS's important biological functions (e.g., feeding and resting); however, the western DPS of Steller sea lions is not found breeding, resting or foraging at or near these rookeries

Appendix -- Maps

Below are the maps NCCOS created using the NMFS recommendations. Rationale for these recommended areas and accompanying maps is found in our 6/28/2022 letter to BOEM.

Species Maps

<table>
<tr>
<td>Leatherback sea turtle</td>
<td>
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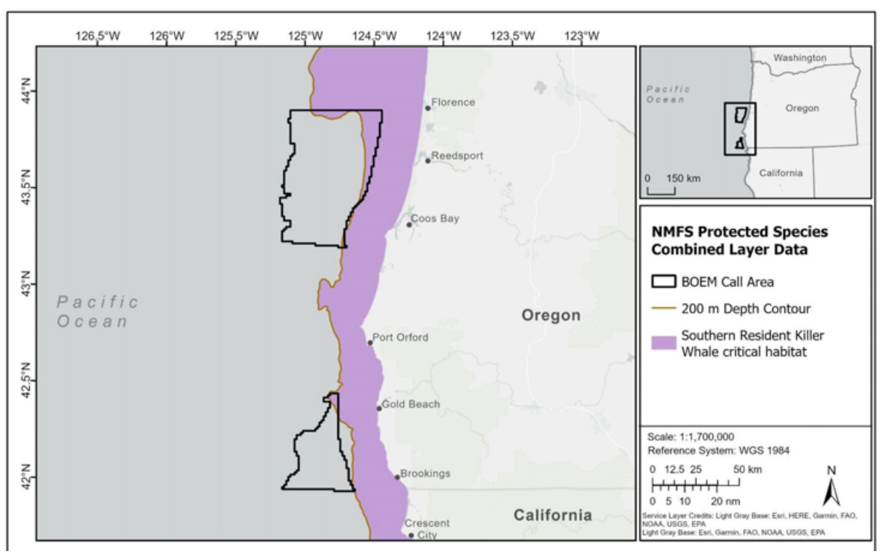
<tr>
<td>Southern Resident killer whale</td>
<td>
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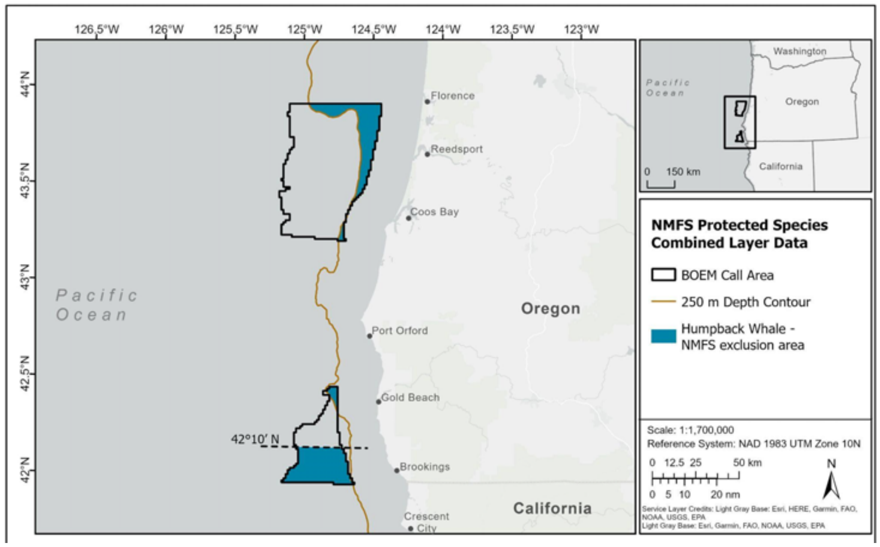
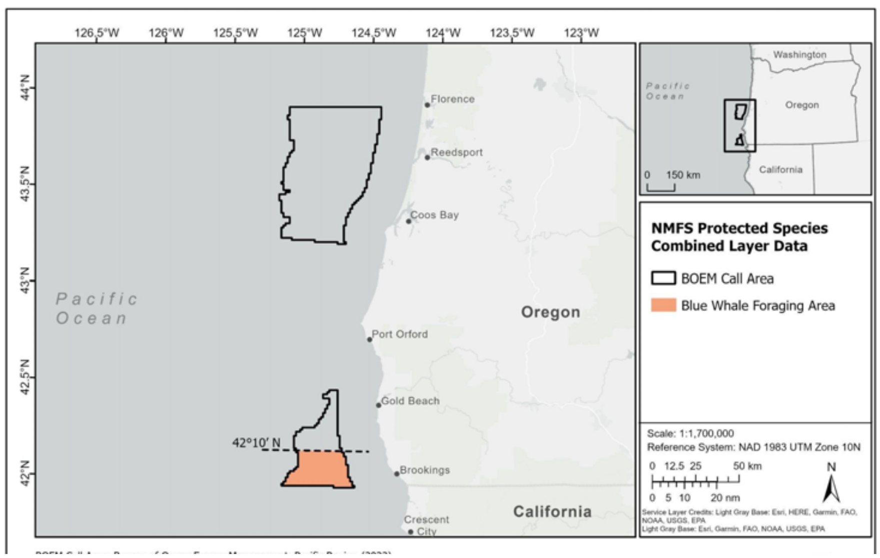
Humpback whale

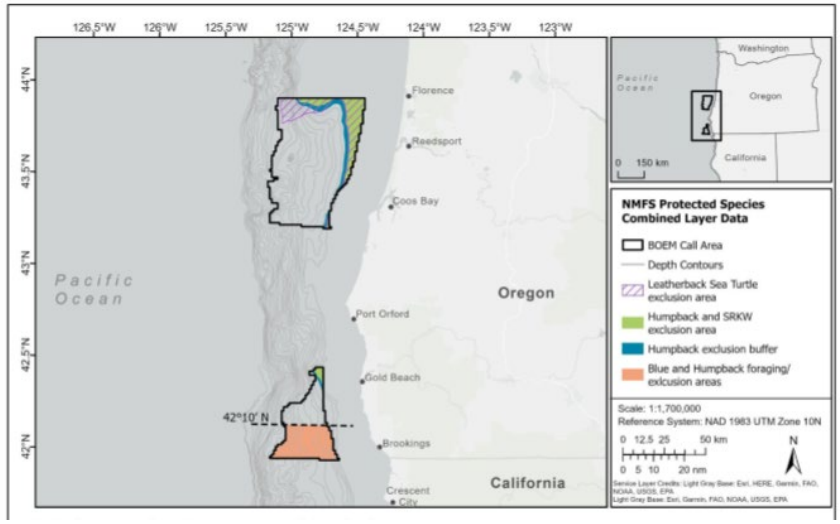


Blue whale



Combined:

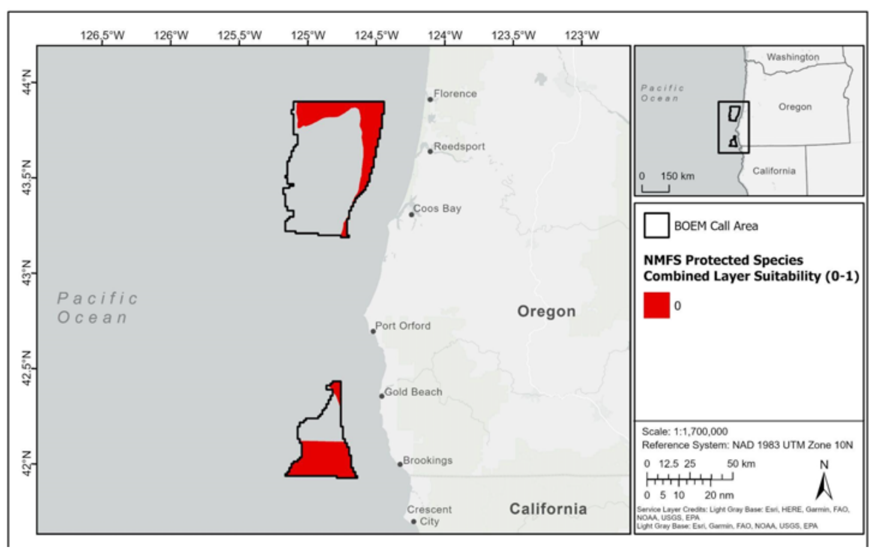
- Leatherback sea turtle
- Southern Resident killer whale
- Humpback whale
- Blue whale



Maps of Scenarios

We note that the NCCOS model suitability scores, illustrated in the following scenarios, are of *relative* suitability, and based on the information incorporated. Therefore, even in a cell with a "high suitability" score, various protected species (as noted in Tables 4 & 5 above) are likely to be present.

Scenario 1 - (Recommended)
All areas for exclusion / layers in the constraints submodel



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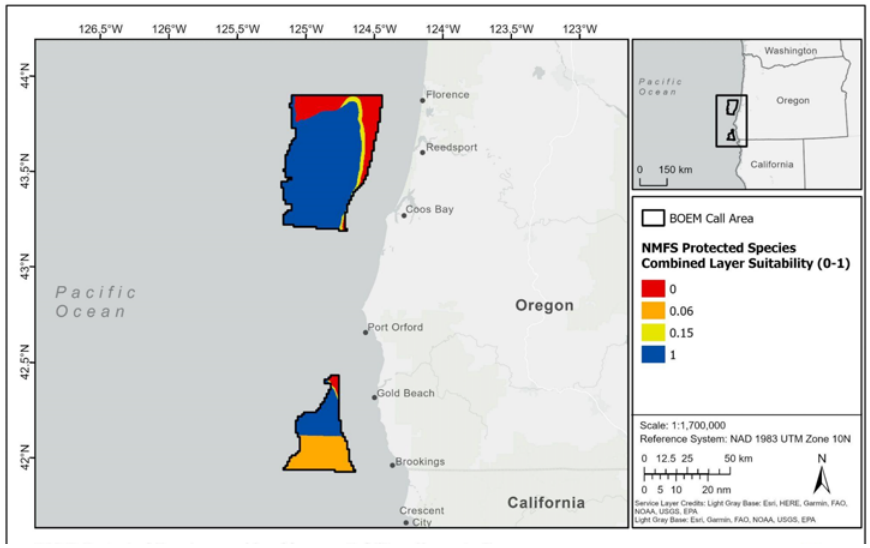
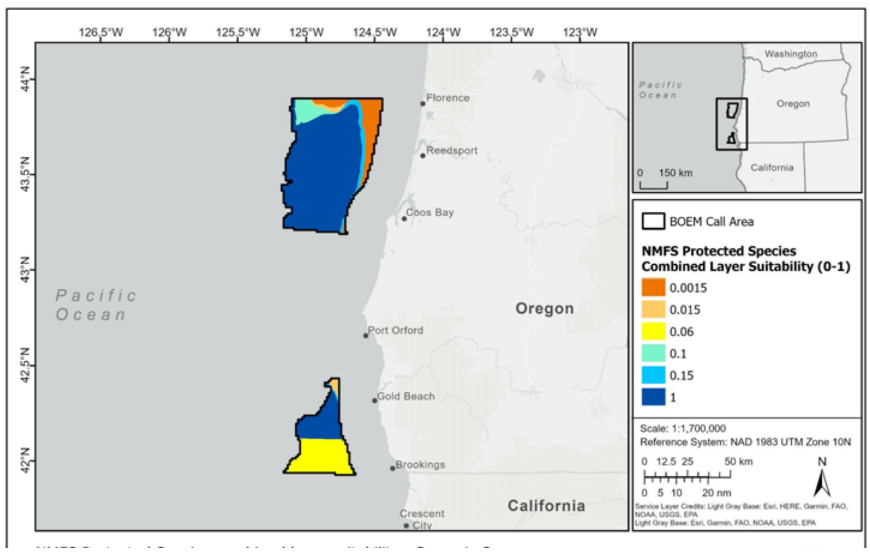
Scenario 2 - -- Areas for exclusion / layers in the constraints submodel: Leatherback sea turtle and Southern Resident killer whale AND --Remainder of areas (blue and humpback whales) in the natural resources submodel with offshore wind suitability scores	
Scenario 3 - All in the natural resources submodel with offshore wind suitability scores	

Appendix C - Habitat Data

NCCOS Spatial Modeling of Oregon Call Areas

Habitat Considerations Provided by NOAA's National Marine Fisheries Service (NMFS)

3/16/23

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[1] NMFS West Coast Region (WCR)
[2] NMFS Northwest Fisheries Science Center (NWFSC)

Purpose of this Document

NOAA's National Marine Fisheries Service's (NMFS) West Coast Region (WCR) and Northwest Fisheries Science Center (NWFSC) developed data layers regarding habitat to include in the spatial model developed by NCCOS for BOEM's OR Call Areas and proposed WEA designation. We are providing this document to accompany those data layers, which we provided to NCCOS. It provides a high-level overview of the data layers and the basis for our recommendations. Our recommendations align with our official comments on the OR Call Areas in our 6/28/2022 letter to BOEM.

● Disclaimer for NMFS' role in NCCOS Offshore Wind Spatial Planning Work for BOEM

NCCOS is providing BOEM with technical assistance to support BOEM's spatial planning in relation to offshore wind projects. This support is being provided with funding resources from NCCOS and through reimbursable support from BOEM to NCCOS. NMFS is providing technical assistance to NCCOS regarding available science (i.e., data layers and modeling methods) for BOEM's consideration in their spatial modeling efforts. These efforts are supporting BOEM's ocean and coastal planning activities related to siting of Call Areas, Wind Energy Areas, and transmission cable routing. The information provided by NMFS to NCCOS is purely technical in nature and does not reflect or constitute an official agency policy, position, or action. Official NMFS positions related to spatial planning for offshore wind activity will be submitted by NMFS through written comments to BOEM during the planning and review processes for each activity.

● Important Note about Magnuson-Stevens Act (MSA) Essential Fish Habitat Consultations

Nothing NMFS provides through this modeling effort should be construed as part of an MSA consultation for essential fish habitat. Please refer to our 6/28/2022 letter to BOEM for information and guidance regarding that process with NMFS.

Habitat Layers Included, Data, and Recommendations for Modeling

Habitat types for which NMFS provided data layers align with the information and recommendations provided in our 6/28/2022 letter to BOEM. We included five broad habitat types in this effort. See Table 1 for details and data sources.

1. **Essential fish habitat (EFH) conservation areas (EFHCAs):** Shapefiles depicting boundaries of EFH conservation areas are available via the NMFS EFH resource site. These shapefiles are not legal boundaries but are rather geospatial representations of what is published in the Code of Federal Regulations (50 CFR 660).
2. **Rocky Reef Habitat Areas of Particular Concern (HAPC) (mapped)**: Shapefiles depicting rocky reef HAPCs are available via the NMFS EFH resource site. These shapefiles are quite dated (circa 2005), and as such we decided to mine more recently published regional seafloor habitat layers to develop a more up-to-date geospatial representation of rocky reef HAPCs for the purposes of this particular effort. We examined the Goldfinger et al. 2014 Surficial Geologic Habitat v.4.0 layer because it provided a consistent habitat interpretation across the model domain, and a crosswalk between lithologic classes (e.g., rock, boulder, gravel, sand, mud) and Coastal and Marine Ecological Classification Standard (CMECS) substrate component attributes (class, subclass, group, subgroup) and modifiers (bedrock, boulder, cobble, gravel). The

overall goal of this effort was to extract the CMECS substrate components and modifiers that best align with the official definition of rocky reef HAPCs. Given the time constraints, our interpretations have not gone through adequate peer review, and as such may not reflect the most appropriate interpretation of the CMECS substrate attributes. Regardless, we feel the updated representation is a vast improvement over the circa 2005 version.

3. **Rocky Reef HAPCs (probable):** In addition to interpreting the latest versions of regional seafloor habitat maps, new information on seafloor habitats is continually being collected. During a joint NOAA- and BOEM-funded cruise aboard the NOAA Ship *Reuben Lasker* in 2019, areas of hard seafloor induration within the Coos Bay Call Area were identified and surveyed. Because these newly identified areas likely meet the definition of rocky reef HAPCs, we suggested including them in the model, though with a slightly lower priority ranking due to the lack of adequate peer review.
4. **Deep-Sea Coral Habitat Suitability:** Two data products on deep-sea coral and sponges were considered: 1) NOAA National Database for Deep-Sea Corals and Sponges focuses on occurrences within the United States Exclusive Economic Zone (McGuinn et al. 2020), and 2) BOEM-funded Cross-Shelf Habitat Suitability Modeling of Coral and Sponge Habitat Suitability provides spatial predictions of relative habitat suitability for a number of coral and sponge taxa (Poti et al. 2020). Since the national database only represents where surveys have occurred and does not include absence records, we felt the predicted habitat suitability products better represent the potential distributions of these important biogenic habitat-forming organisms. In order to examine patterns of habitat suitability across multiple taxa, the Poti et al. (2020) study developed two aggregate products, both of which we felt would be most useful to the NCCOS model:

    1) Number of deep-sea coral taxa associated with hard substrate that were predicted to have high habitat suitability, and
    2) Number of deep-sea coral taxa associated with hard substrate that were predicted to have robust-high habitat suitability.

   Instead of integrating habitat suitability models for individual taxa, these two aggregate products show the number of taxa predicted to have high or robust-high habitat suitability, respectively, for each grid cell. We specified the robust-high product to be a constraint in the model, with the more inclusive high habitat suitability product to be considered as an alternative. The aggregate products exclude sea pens because most sea pen species do not associate with hard substrate, and exclude sponges due to the low taxonomic specificity, and consequent broad substrate affinities, of input records. Like many deep-sea corals, some sponges, especially glass sponges (e.g., *Heterochone calyx*) provide structural habitat for other organisms including some groundfishes. These structure-forming sponges are also vulnerable to mechanical damage. We advise that

NCCOS consider including individual structure-forming sponge habitat suitability products from Poti et al. in future model runs.

5. **Shelf Break:** The continental shelf break is a physiographic feature that is sometimes represented as a particular isobath but is more appropriately delineated from geophysical data. We used the Goldfinger et al. 2014 Surficial Geologic Habitat v.4.0 layer to be the boundary between continental “shelf” and “slope” physiographic habitat types. The line between these polygons was extracted and buffered by 10-km on either side.
6. **Methane Bubble Streams:** Methane bubble streams identified during multibeam sonar surveys often indicate the location of methane seeps and associated seep communities on the seafloor. We curated data layers from recent publications that summarize the point locations of these bubble streams. Recent remotely operated vehicle (ROV) surveys have confirmed active gas venting on the seafloor for some of these locations, as well as the presence of methane seep communities.

Although we did not include mesoscale eddies data layers largely due to time constraints, we note their importance in the area (see *Other Habitat* section of this document).

It is important to emphasize that the data we provided applied the best available science at the time and does not account for future shifts in species and habitat distributions, which will alter their potential overlap with offshore wind. The compressed timeframe for this effort precluded any consideration of such factors. NOAA’s California Current Integrated Ecosystem Assessment team is currently assessing shifts in species and habitat distributions that will provide this type of data in the future.

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Table 1. Habitat types included in NMFS recommended data layers, basis of our recommendations, and supporting data.

Habitat Type	Recommendation	Basis for Recommendation (see NOAA 6/28/2022 letter to BOEM)	Data
Essential Fish Habitat Conservation Areas (EFHCA)	Exclusion + 500-m buffer	See page 4 of NOAA cover letter and pages 17 and 19-23 of enclosure 2 - NMFS comments.	EFH- Groundfish and Salmon (NMFS)
Rocky Reef Groundfish Habitat Areas of Particular Concern (HAPC) *Subcategories: a) Mapped, and b) Probable	Exclusion + 500-m buffer	See page 4 of NOAA cover letter and pages 17 and 19-23 of enclosure 2 - NMFS comments.	--EFH - Data Inventory (noaa.gov) **Mapped:** --Goldfinger et al. 2014 SGH v.4; mapped "hard" and "mixed" induration classes, excluding CMECS subclass = "Fine Unconsolidated Sediment" **Probable:** Recent Multibeam surveys (Fairweather W00474) + Elizabeth Clarke (unpublished data [AUV *Popoki* dives d20191011_3 and d20191012_4, ROV *Yogi* dive 147])
Deep-sea coral habitat suitability *Subcategories: a) Robust-High Habitat Suitability, and b) High Habitat Suitability	Avoid + 500-m buffer	See pages 17-18 of enclosure 2 - NMFS comments.	BOEM-funded Cross-Shelf Modeling of Deep- Sea Corals and Sponges (Poti et al. 2020); see p. 37 for description of "aggregate predictions"
Shelf Break	10-km buffer on either side of line delineating shelf break	See page 4 of NOAA cover letter, "Upwelling and other oceanographic processes" and page 17 of enclosure 2 - NMFS comments. The shelf break is an important oceanographic feature and is generally an area of high productivity.	Goldfinger et al. 2014 SGH v.4.0 layer showing boundary between "shelf" and "slope" as described in Physiographic Habitat Type values.
Methane bubble streams	1-km buffer of input points	See pages 17-19 of enclosure 2 - NMFS comments. A 1-km buffer is recommended at this time due to the spatial uncertainty associated with the data, which are based on methane bubble streams discovered during several recent multibeam surveys that indicate location of methane seeps on the seafloor, not all of which have been ground-truthed.	Merle et al. (2021), Riedel et al. (2018), Johnson et al. (2015), and Rainier H13118 (2018)

● NMFS Recommendations for the Constraints Submodel and Natural Resources Submodel

NMFS subject matter experts ranked the habitat types based on relative sensitivity to offshore wind energy development and provided a recommendation (Scenario 1) to NCCOS for consideration by BOEM in the model. We provided an additional scenario, as advised by NCCOS, in the event BOEM chooses not to include our preferred recommendation. See Table 2.

Table 2. NMFS recommended priority ranks and scenarios for habitat types; scenarios in order of preference.

Habitat Type (including recommended buffers in Table 1)	Buffer Distance	Scenario 1 (Recommended)	Scenario 2 (Alternative)
EFHCA	500 m	**0**	**1**
Rocky Reef HAPC (mapped)	500 m	**0**	**1**
Rocky Reef HAPC (probable)	500 m	**2**	**2**
Deep-sea coral habitat suitability	500 m	**0** robust-high habitat suitability (>= 1 taxon)	**3** high habitat suitability (using Z membership function, (>= 1 taxon))
Shelf Break	10 km	**4**	**4**
Methane bubble streams	1 km	**5**	**5**
Click here to enter text.0 = Constraints submodel 1-5 = habitat ranks based on SME judgment (1=most sensitive / least suitable for offshore wind, 5=least sensitive / more suitable for offshore wind) for inclusion in the Natural Resources submodel.			

Other Habitat in the Area - Mesoscale Eddies

In addition to the shelf break, there are smaller more regional features such as mesoscale eddies that also can be areas of high productivity. These features may be identifiable from regional satellite imagery of ocean color but due to lack of time we are not able to provide further descriptions of their occurrence and distribution other than to note their importance.

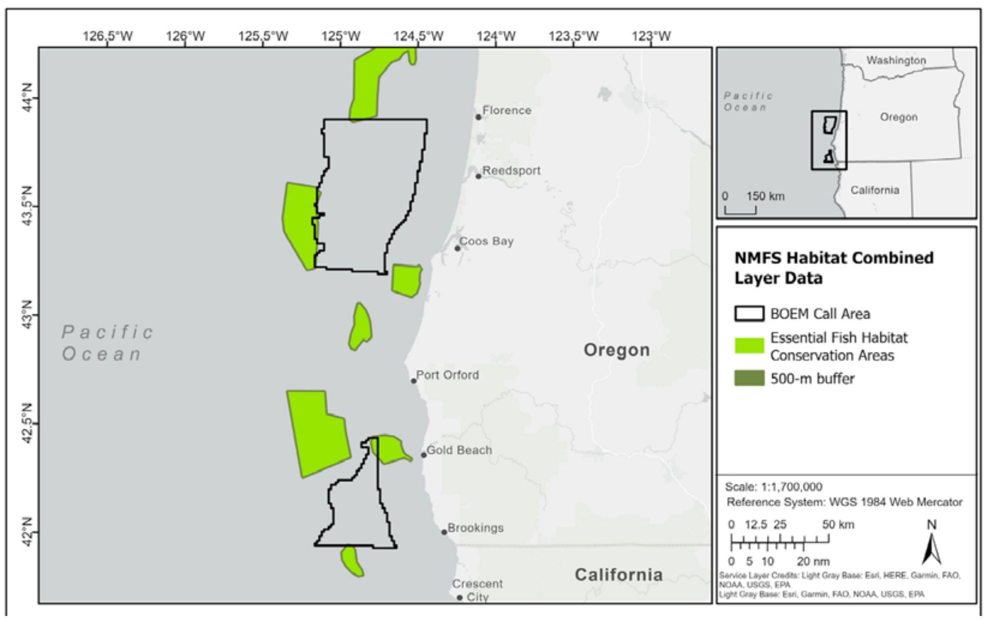
Other environmental and oceanographic features, including current associations, preferred temperature ranges and water depths, chlorophyll concentrations, or centers of target prey distribution, can also determine important habitat areas for a variety of federally managed species. Although information regarding these features is improving (e.g., due to technological advancements), we were not able to provide it in a format that would be suitable for this modeling exercise, given the time constraints. Furthermore, there may be other habitat types, features, etc. that may be adversely affected by offshore wind energy related activities, but the compressed timeframe for this effort precluded an extensive literature review or consultation with other subject matter experts.

Appendix -- Maps

Below are the maps NCCOS created using the NMFS recommendations. Rationale for these recommended areas and accompanying maps is found in our [6/28/2022 letter to BOEM](#).

Habitat Maps

<table>
<tr>
<td>EFHCA

+ 500-m buffer</td>
<td>
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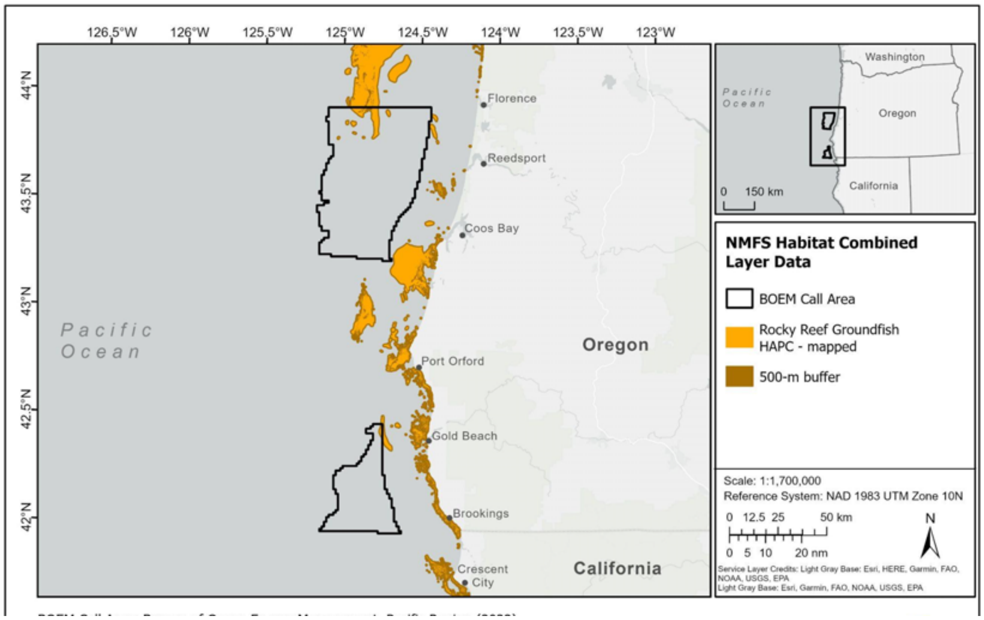
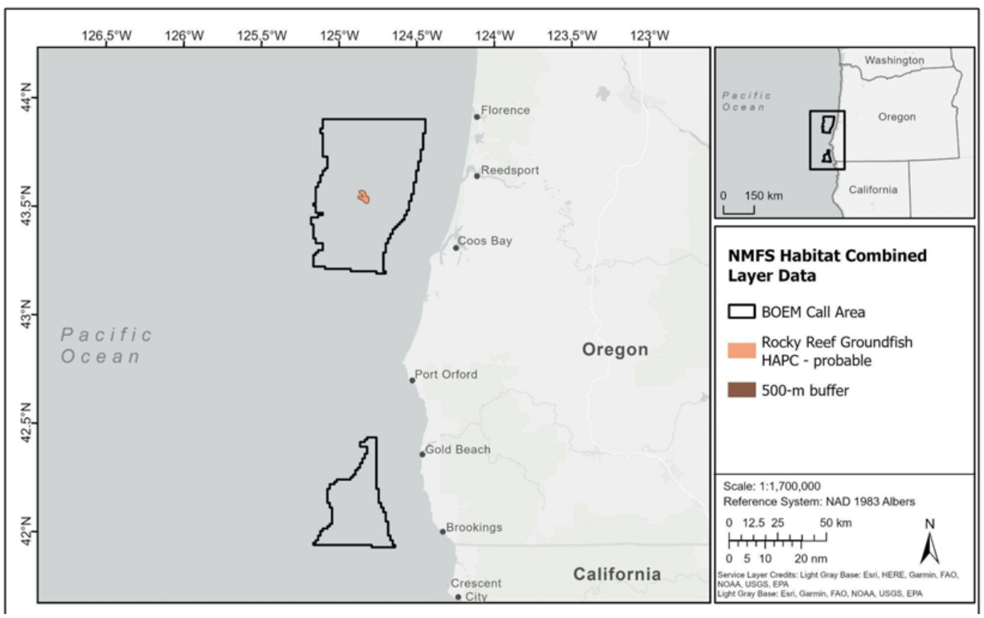
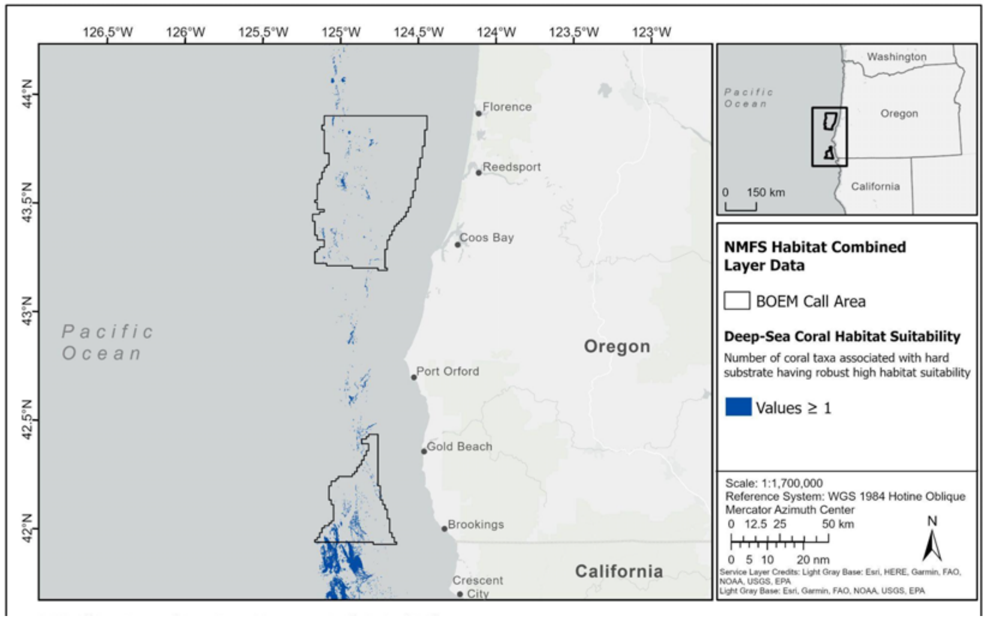
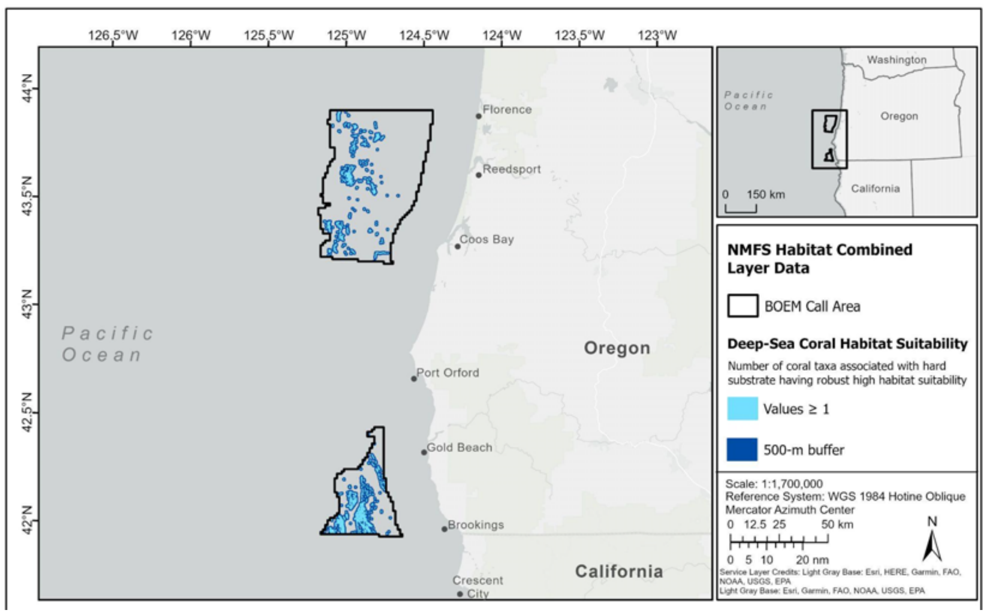
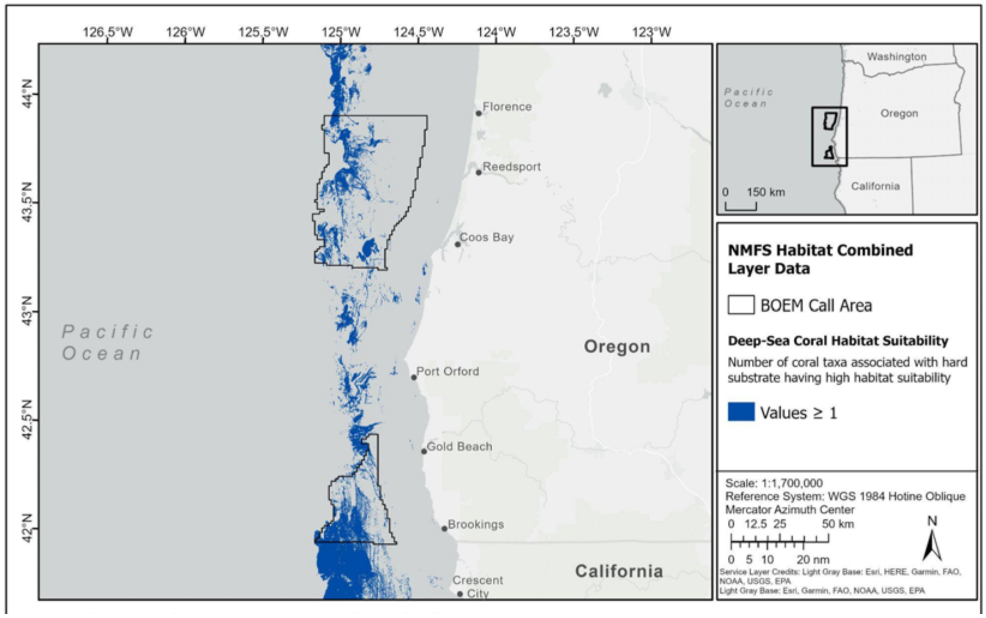
Rocky Reef HAPC (mapped) + 500-m buffer	
Rocky Reef HAPC (probable) + 500-m buffer	

Deep-Sea Coral Habitat Suitability - **robust-high** habitat suitability Number of coral taxa associated with hard substrate having (values > 1) **WITHOUT** 500-m buffer	
Deep-Sea Coral Habitat Suitability - **robust-high** habitat suitability Number of coral taxa associated with hard substrate having (values > 1) + 500-m buffer	

<table>
<tr>
<td>Deep-Sea Coral Habitat Suitability - <u>high</u> habitat suitability

Number of coral taxa associated with hard substrate having high habitat suitability ((values > 1) with Z membership function applied)

<u>WITHOUT</u>
500-m buffer</td>
<td>
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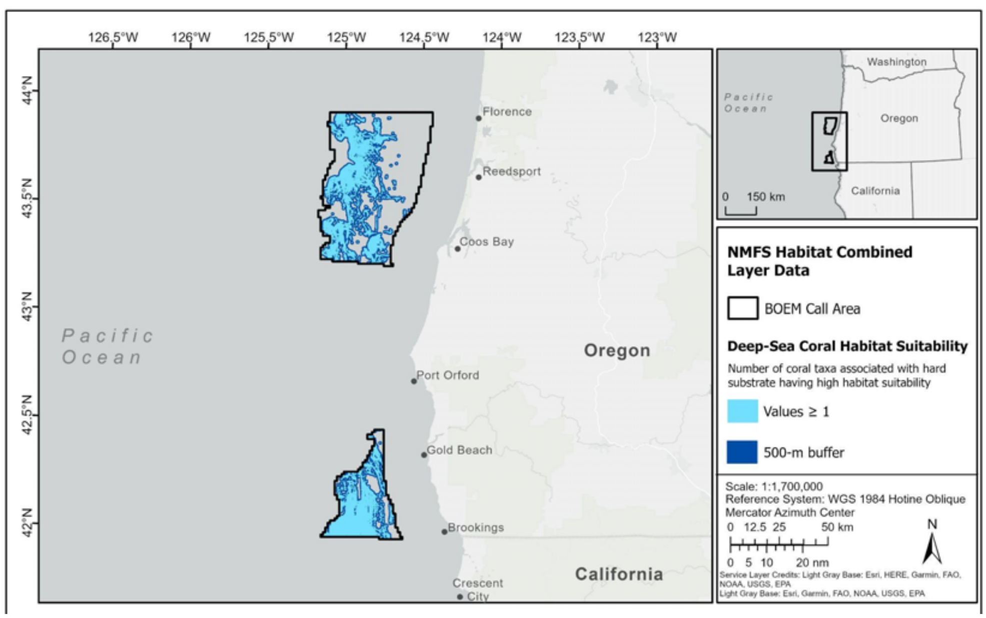
</tr>
<tr>
<td>Deep-Sea Coral Habitat Suitability - <u>high</u> habitat suitability

Number of coral taxa associated with hard substrate having high habitat suitability ((values > 1) with Z membership function applied)

+ 500-m buffer</td>
<td>
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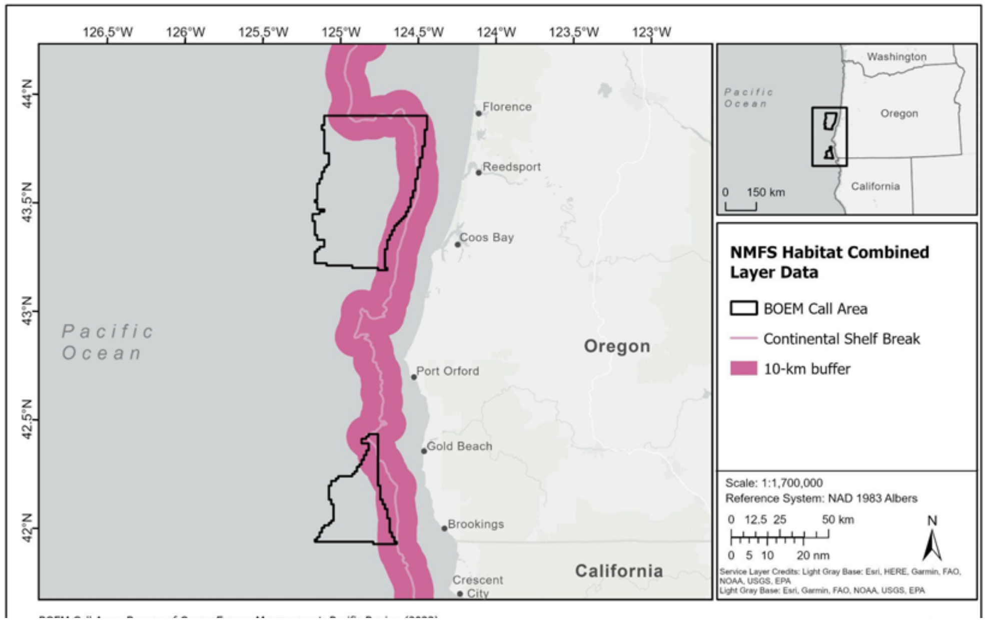
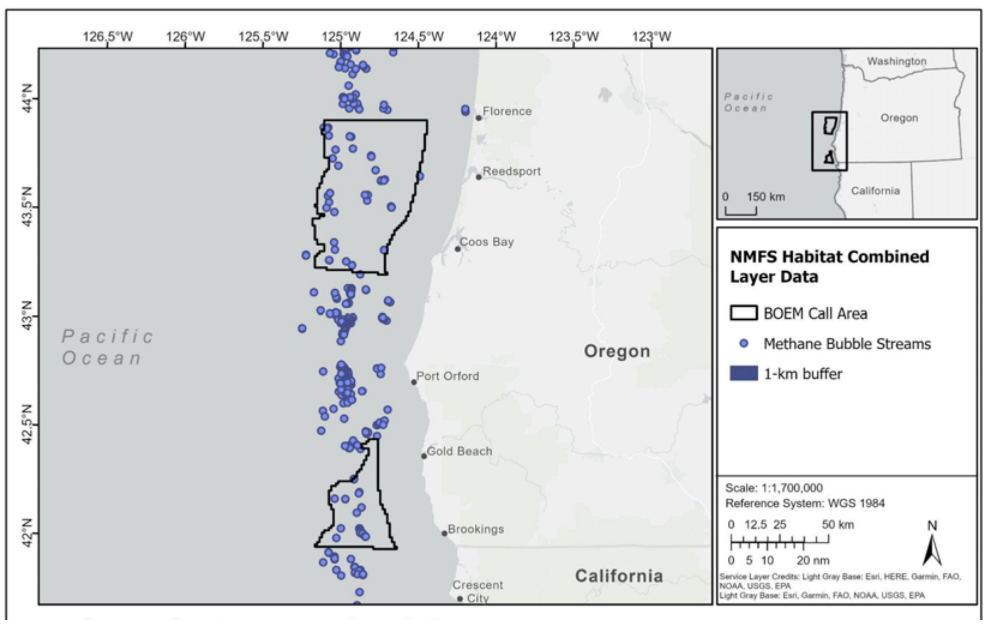
Shelf Break

+ 10-km buffer



Methane bubble streams

+ 1-km buffer



Maps of Scenarios

We note that the NCCOS model suitability scores, illustrated in the following scenarios, are of *relative* suitability, and based on the information incorporated. Therefore, even in a cell with a "high suitability" score, habitats identified in Table 1 may be present.

<table>
<tr>
<td>

Partial Scenario 1:

Areas recommended for exclusion / layers for the constraints submodel only from Scenario 1

(Areas for exclusion: EFHCA, RR-HAPC, + Robust-high coral suitability)

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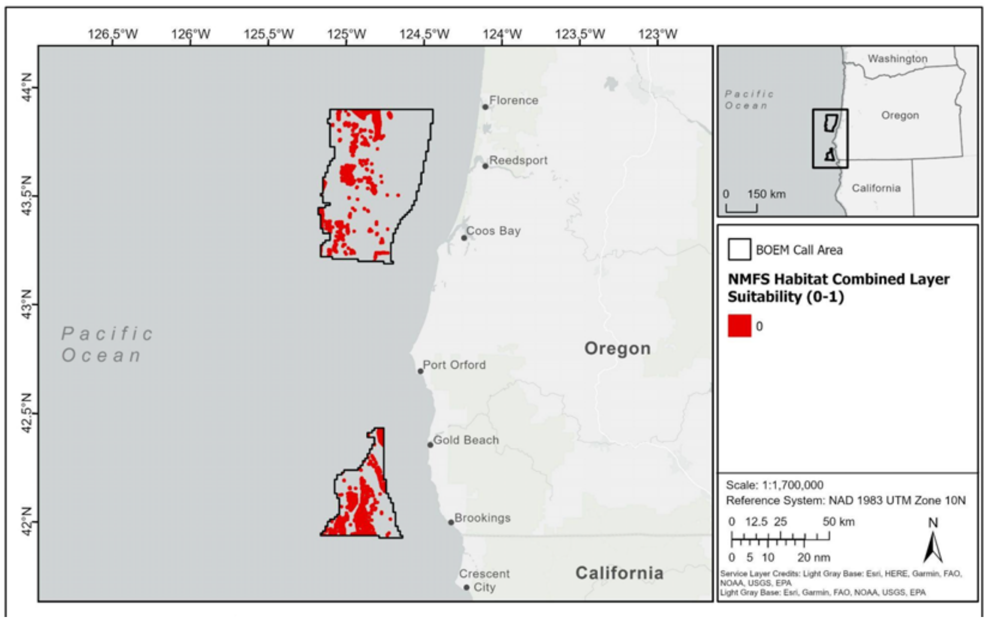

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Scenario 1 (Recommended)

Areas for exclusion / layers for the constraints submodel: EFHCA, RR-HAPC, + Robust-high coral suitability

All other layers in the natural resources submodel

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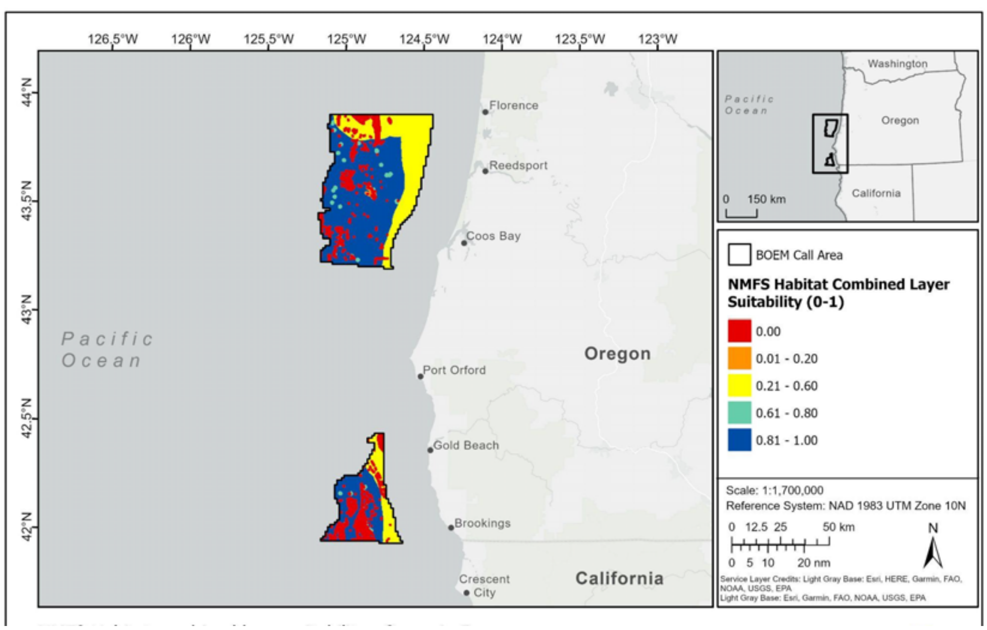

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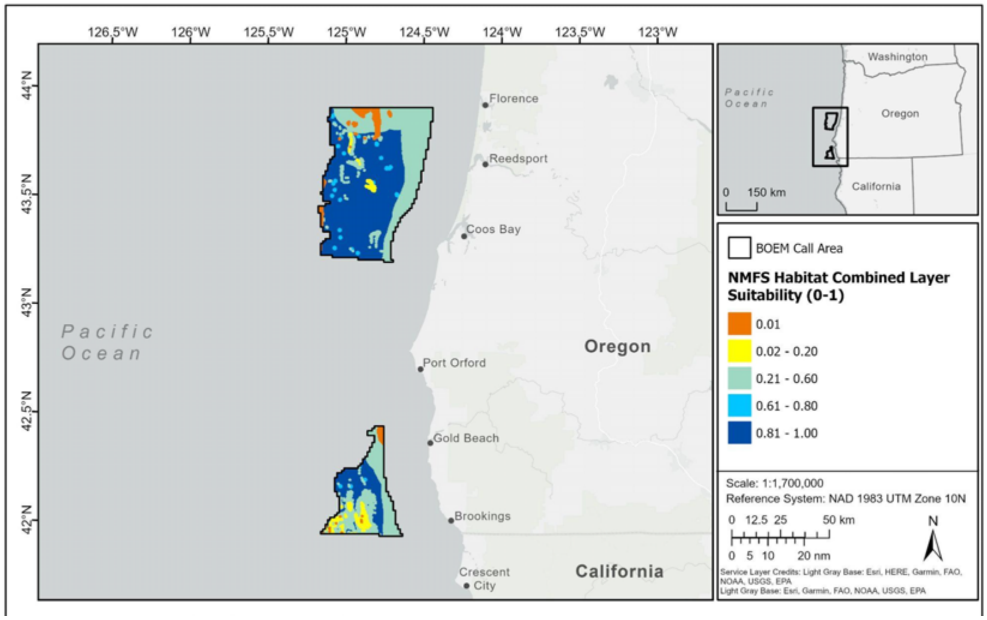
Scenario 2 (Alternative) (uses <u>High</u> coral suitability), All layers in the natural resources submodel	

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Appendix D - NMFS Scientific Surveys Data

NCCOS Spatial Modeling of Oregon Call Areas

Scientific Survey Considerations Provided by NOAA's National Marine Fisheries Service (NMFS)

3/16/23

Curt Whitmire[1], Information Technology Specialist, Curt.Whitmire@noaa.gov
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Roger Hewitt[2], roger.hewitt@noaa.gov

[1] NMFS Northwest Fisheries Science Center (NWFSC)
[2] NMFS Southwest Fisheries Science Center (SWFSC)

Purpose of this Document

NOAA's National Marine Fisheries Service's (NMFS) Northwest Fisheries Science Center (NWFSC) and Southwest Fisheries Science Center (SWFSC) developed data layers representing the geographic footprint of our scientific surveys to include in the spatial model developed by NCCOS for BOEM's OR Call Areas and proposed WEA designation. We are providing this document to accompany those data layers, which we provided to NCCOS. It provides a high-level overview of the data layers and the basis for our recommendations. Our recommendations align with our official comments on the OR Call Areas in our 6/28/2022 letter to BOEM.

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NCCOS is providing BOEM with technical assistance to support BOEM's spatial planning in relation to offshore wind projects. This support is being provided with funding resources from NCCOS and through reimbursable support from BOEM to NCCOS. NMFS is providing technical assistance to NCCOS regarding available science (i.e., data layers and modeling methods) for BOEM's consideration in their spatial modeling efforts. These efforts are supporting BOEM's ocean and coastal planning activities related to siting of Call Areas, Wind Energy Areas, and transmission cable routing. The information provided by NMFS to NCCOS is purely technical in nature and does not reflect or constitute an official agency policy, position, or action. Official NMFS positions related to spatial planning for offshore wind activity will be submitted by NMFS through written comments to BOEM during the planning and review processes for each activity.

Survey Layers Included, Data, and Recommendations for Modeling

NMFS regularly conducts several mission-critical scientific surveys along the U.S. West Coast to inform its fisheries and protected species management decisions and monitor living marine resources, their habitats, and the CA Current Ecosystem. Scientific surveys for which NMFS provided data layers to NCCOS for the spatial model align primarily with the information and recommendations provided in our 6/28/2022 letter to BOEM. We included four layers representing the locations of scientific survey operations (footprints) in this effort. See Table 1 for details and data sources. All NMFS scientific surveys are intended to be treated equally, though we request the E-W sampling corridors described in our comment letter (6/28/2022) to be included in the submodel as either a constraint (score = 0; Scenario 1), or at a minimum, with the lowest practical suitability scores (score = 0.01; Scenario 2). Additional areas of scientific survey operations not within the requested sampling corridors could be scored more suitable (score = 0.50) but are still important for continued access by NMFS to these survey areas.

Lastly, some scientific surveys conducted by NMFS include designs that are not well suited to fixed stations or transect, and/or include broad geographic coverage across and outside of the entire geographic extent of the two Oregon Call Areas. Consequently, those surveys cannot be adequately represented by the layers described in this document, nor included in these spatial models. However, they should to the extent possible be characterized as part of the model documentation.

Table 1. Scientific Surveys included in NMFS recommended data layers, basis of our recommendations, and supporting data.

Layer Representing Location of Scientific Surveys	Recommendation	Basis for Recommendation (see NOAA 6/28/2022 letter to BOEM; number in brackets below are from Table 4 of 6/28/2022 letter)	Data
E-W Sampling Corridors 4-nm wide centered at: 43°20' N, 43°30' N, 43°40' N, 43°50' N (Coos Bay) and 42°00' N and 42°10' N (Brookings)	Exclusion	See page 56 enclosure 2 - NMFS comments.	Geospatial data provided by Curt Whitmire - NOAA Federal Feature class: "NCCOS_Modeling_OR_NMFS_Surveys_Scenario1_SamplingCorridors"
Additional E-W Sampling Corridors 4-nm wide centered at 42°20' N and 42°30' N (Brookings)	Avoid	Although not requested in our letter from 6/28/2022, these additional corridors would provide continued access at consistent latitudinal intervals (10-nm) for our Integrated Ecosystem and Pacific Hake [#2] and West Coast Pelagic Fish [#3] surveys, in particular, as well as opportunities to sample during our West Coast Groundfish Bottom Trawl Survey [#1].	Geospatial data provided by Curt Whitmire - NOAA Federal Feature class: "NCCOS_Modeling_OR_NMFS_Surveys_Scenario2_SamplingCorridors"
Survey stations (points)	Avoid + 2-nm buffer of input points	Although not requested in our letter from 6/28/2022, these additional areas would provide continued access for our Pre-Recruit [#7] and Northern California Current Ecosystem [#13] surveys.	Geospatial data provided by Curt Whitmire - NOAA Federal Feature class: "NCCOS_Modeling_OR_NMFS_Surveys_Scenario2_Stations_buff_2nm"
Survey transects (lines)	Avoid + 1-nm buffer of input lines	Although not requested in our letter from 6/28/2022, these additional areas would provide continued access for our Pre-Recruit [#7] and Northern California Current Ecosystem [#13] surveys.	Geospatial data provided by Curt Whitmire - NOAA Federal Feature class: "NCCOS_Modeling_OR_NMFS_Surveys_Scenario2_Transects_buff_1nm"

● NMFS Recommendations for the Constraints Submodel and Industry and Navigation Submodel and/or relevant Submodel

NMFS subject matter experts developed geospatial representations of NMFS scientific survey operations (footprints) and provided a preferred (Scenario 1) recommendation to NCCOS for consideration by BOEM in the model. We provided one alternative (Scenario 2), as advised by NCCOS, should BOEM choose not to include this recommendation in the constraints submodel. See Table 2.

Table 2. NMFS recommended scores and scenarios for scientific surveys, for inclusion in the Industry and Navigation submodel, in order of preference.

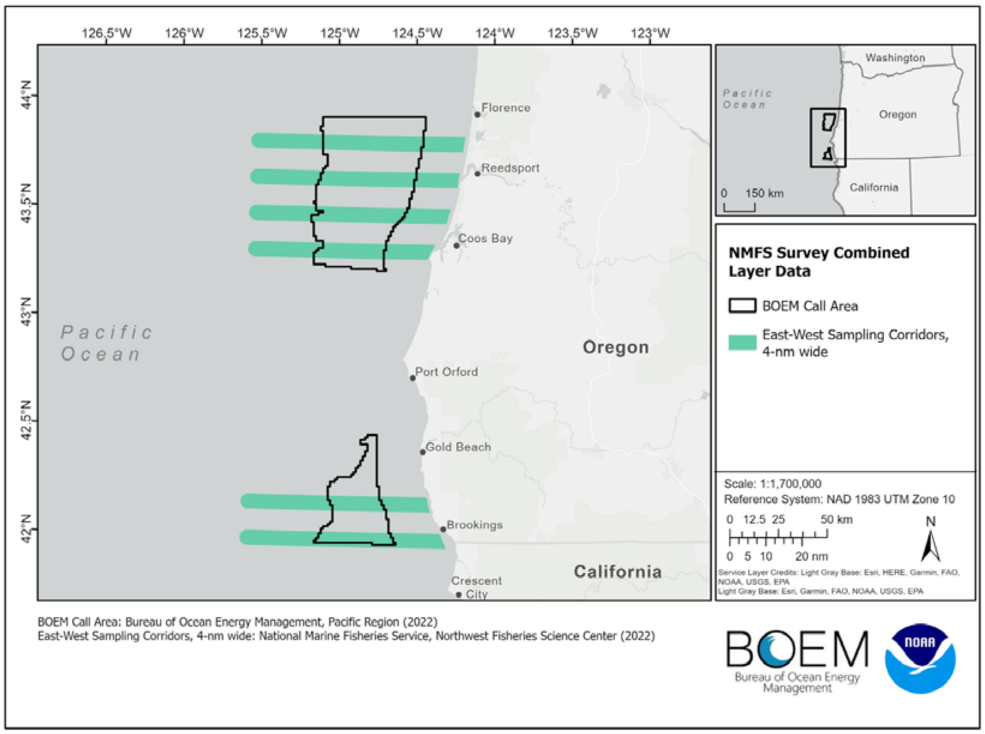
Data Layer	Buffer Distance	Scenario 1 (Recommended)	Scenario 2 (Alternative)
E-W Sampling corridors **4-nm wide, centered at:** **43°20’ N, 43°30’ N, 43°40’ N, 43°50’ N (Coos Bay) and** **42°00’ N and 42°10’ N (Brookings)**	2-nm radius	**0**	**0.01**
Additional E-W Sampling corridors **4-nm wide, centered at** **42°20’ N and 42°30’ N (Brookings)**	2-nm radius	**0.50**	**0.50**
Survey stations (points)	2-nm radius	**0.50**	**0.50**
Survey transects (lines)	1-nm radius	**0.50**	**0.50**
0 = Constraints submodel 0.01 = score intended to apply a high weight (low suitability) to additional sampling corridors that might accommodate other surveys with historical time series; for inclusion in the Industry and Navigation submodel and/or relevant submodel. 0.50 = score intended to treat all other survey footprints equally; for inclusion in the Industry and Navigation submodel and/or relevant submodel.			

Appendix -- Maps

Below are the maps NCCOS created using the NMFS recommendations. Rationale for these recommended areas and accompanying maps is found in our 6/28/2022 letter to BOEM and in Table 1 above.

Scientific Survey Maps

<table>
<tr>
<td>4-nm wide, East-West Sampling Corridors, as requested in our 6/28/2022 letter to BOEM

+ 2-nm radius buffer on either side of line, centered at:
43°20’ N, 43°30’ N, 43°40’ N, 43°50’ N (Coos Bay)
and
42°00’ N and 42°10’ N (Brookings)</td>
<td>
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<td>

<u>Additional</u> 4-nm wide, East-West Sampling Corridors

+ 2-nm radius buffer on either side of line, centered at:
42°20’ N and 42°30’ N (Brookings)

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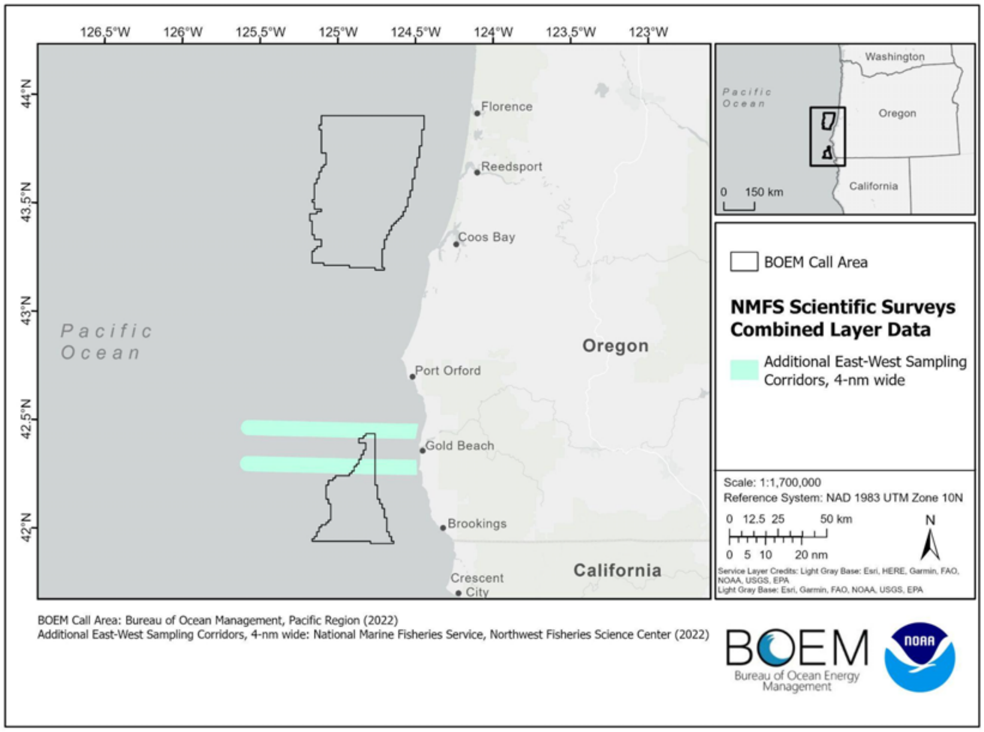

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<tr>
<td>

Survey stations

+ 2-nm radius buffer from station point

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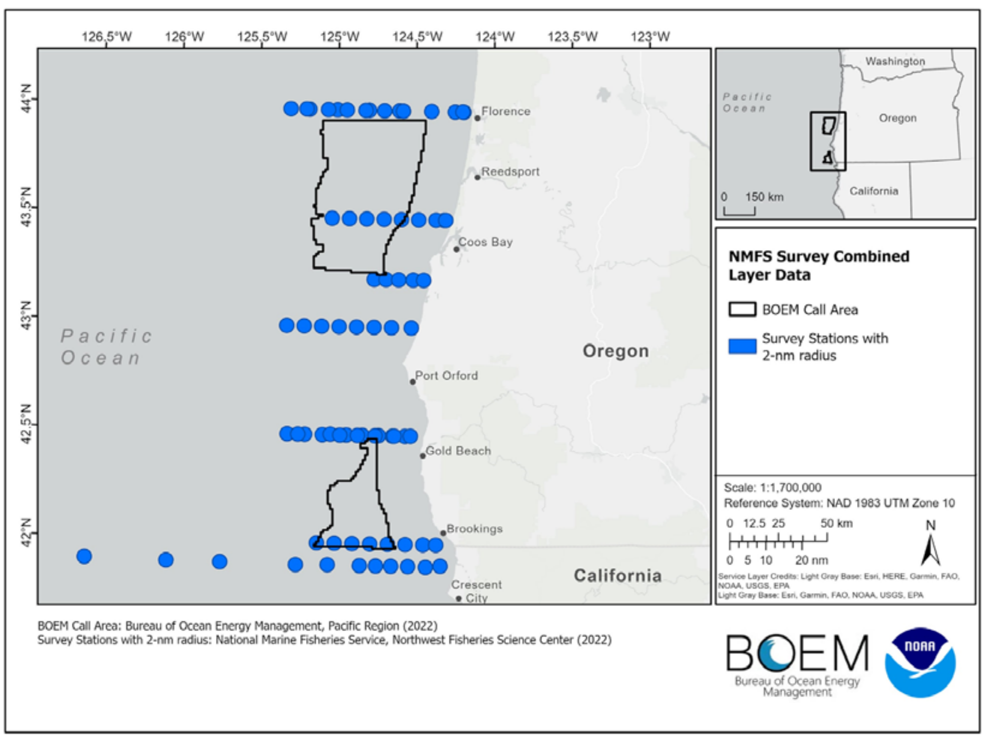

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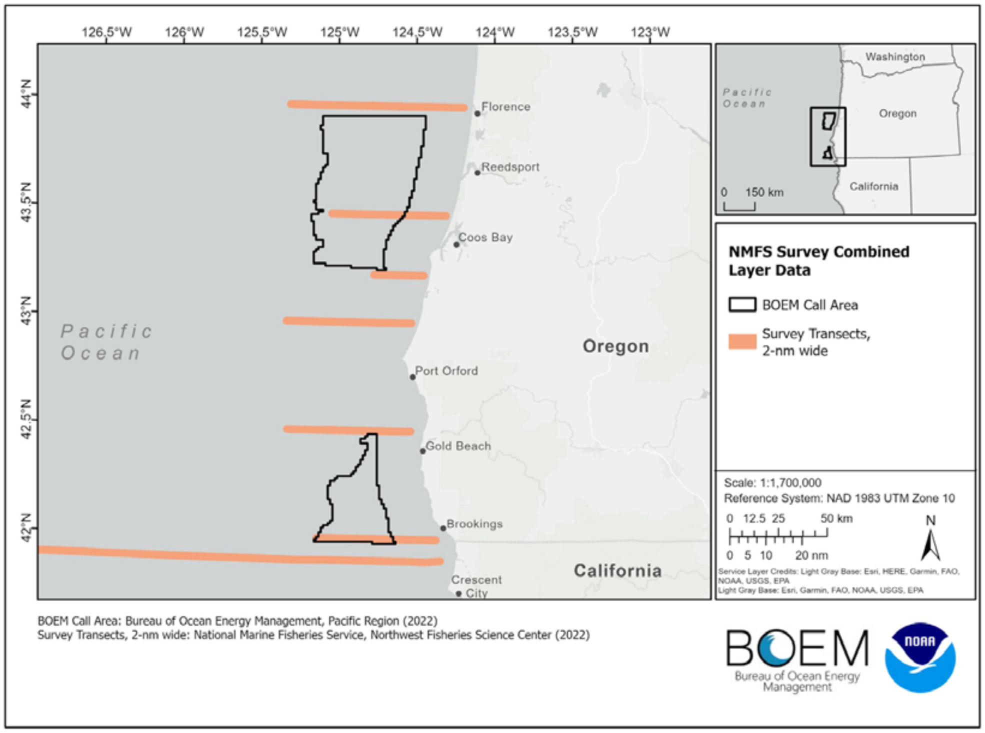
<table>
<tr>
<td>Survey transects

+ 1-nm radius buffer on either side of transect line</td>
<td>
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Maps of Scenarios

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Scenario 1

using the “*minimum*” method to calculate final suitability scores

Layers with a score of zero for inclusion in the constraints submodel

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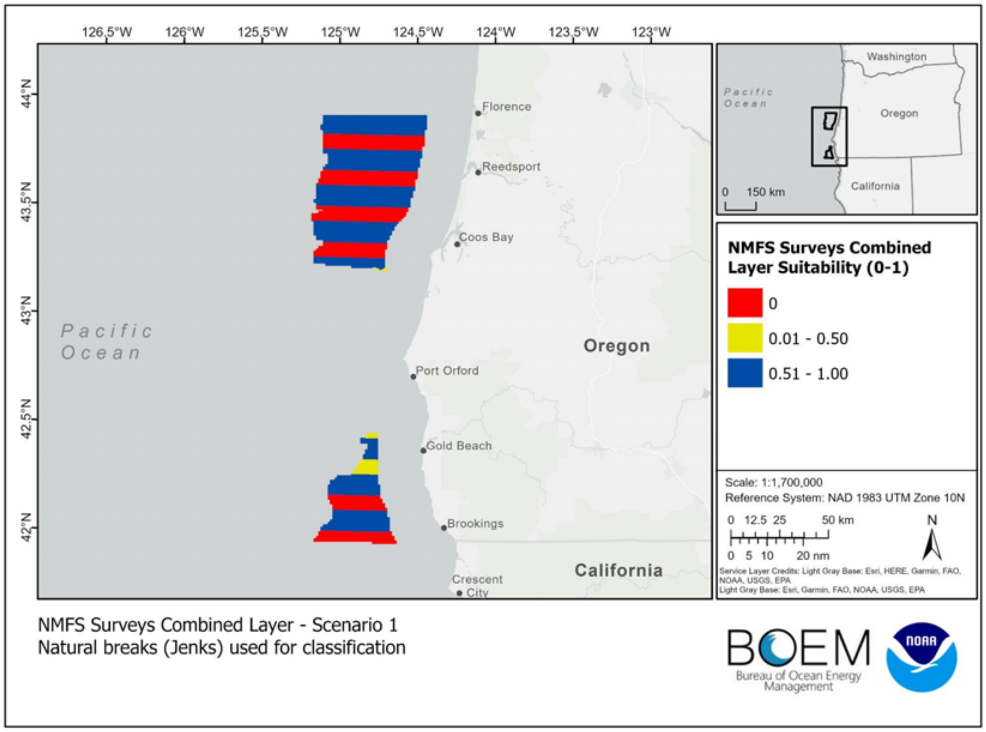

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<td>

Scenario 2

using the “*minimum*” method to calculate final suitability scores

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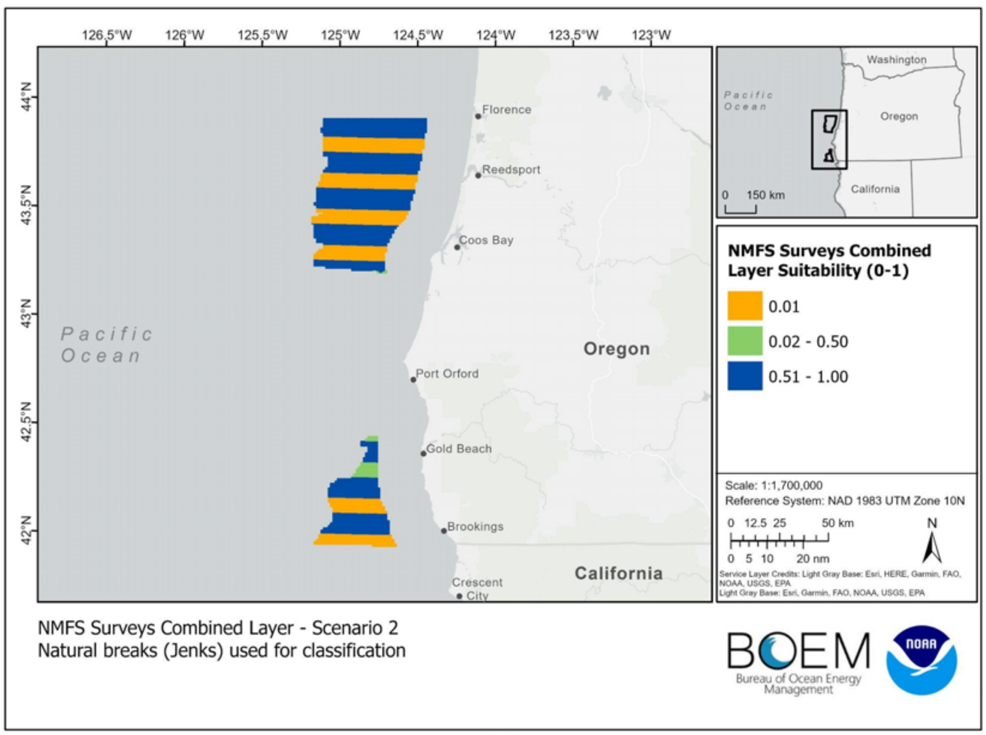

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Appendix E - Fisheries Data

NCCOS Spatial Modeling of Oregon Call Areas

Fisheries Considerations Provided by NOAA's National Marine Fisheries Service (NMFS) and Oregon Department of Fish and Wildlife (ODFW)

3/23/2023

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Purpose of this Document

NOAA's National Marine Fisheries Service's (NMFS) West Coast Region (WCR) and Northwest Fisheries Science Center (NWFSC) and the Oregon Department of Fish and Wildlife (ODFW) collaborated to develop fisheries data layers we recommend for inclusion in the spatial model developed by NCCOS for BOEM's OR Call Areas and proposed WEA designation. This document provides a high-level overview of the fisheries included, types of data used for each fishery, and the basis for our joint recommendations for areas to exclude from siting consideration. Some fisheries were considered for the analysis but not included, and we provided a short qualitative description of those fisheries.

Disclaimer for NMFS' role in NCCOS Offshore Wind Spatial Planning Work for BOEM

NCCOS is providing BOEM with technical assistance to support BOEM's spatial planning in relation to offshore wind projects. This support is being provided with funding resources from NCCOS and through reimbursable support from BOEM to NCCOS. NMFS is providing technical assistance to NCCOS regarding available science (i.e., data layers and modeling methods) for BOEM's consideration in their spatial modeling efforts. These efforts are supporting BOEM's ocean and coastal planning activities related to siting of Call Areas, Wind Energy Areas, and transmission cable routing. The information provided by NMFS to NCCOS is purely technical in nature and does not reflect or constitute an official agency policy, position, or action. Official NMFS positions related to spatial planning for offshore wind activity will be submitted by NMFS through written comments to BOEM during the planning and review processes for each activity.

Similarly, ODFW provided official recommendations that can be found in the ODFW comment letters referenced below.

Fisheries Included, Data, and Recommendations for Modeling

● List of Fisheries Included

NMFS and ODFW considered eleven fisheries for this effort. Nine of these fisheries were included in the data layers for use in suitability modeling (see Table 1 and Figure 1), and two fisheries that operate in the Call Areas (salmon and halibut) were not included due to spatial data limitations and time constraints that prevented acquisition of spatial data. With the exception of the albacore recreational charter fishery, recreational fisheries were not included because spatial data for most are not available.

(*Continued next page*)

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Table 1. List of nine fisheries NMFS and ODFW identified for inclusion in the model.

	Federal / State	Fishery Management Plan	Fishery	Normalized Rank Metric	Indicator	Period	Source(s) of Data
1	Federal	Pacific Groundfish	Groundfish **bottom trawl** (limited entry plus catch shares)	Hours trawled	Cumulative sum of hours trawled	2002–2020	Logbooks from PacFIN via the NMFS NWFSC observer program database
2	Federal	Pacific Groundfish	At-sea **hake** mid-water trawl (mothership and catcher/processor vessels)	a) Inflation-adjusted revenue b) Hours trawled	Highest normalized value between ranked revenue and effort layers	a) 2011–2020 b) 2002–2019	a) NWFSC Observer Program, PacFIN b) Logbooks from PacFIN via the NMFS NWFSC observer program database
3	Federal	Pacific Groundfish	Shoreside **hake** mid-water trawl	a) Inflation-adjusted revenue b) Hours trawled	Highest normalized value between ranked revenue and effort layers	a) 2011–2020 b) 2002–2020	a) NMFS NWFSC Observer Program, PacFIN b) Logbooks from PacFIN via the observer program database for 2011 - 2019 and logbooks for 2002 - 2010 & 2020 from ODFW
4	Federal	Pacific Groundfish	Groundfish **fixed gear - pot**	a) Inflation-adjusted revenue b) Gear hours soaked	Highest normalized value between ranked revenue and effort layers	2011–2020	ODFW
5	Federal	Pacific Groundfish	Groundfish **fixed gear - longline**	a) Inflation-adjusted revenue b) Gear hours soaked	Highest normalized value between ranked revenue and effort layers	2011–2020	ODFW
6	Federal	WC Highly Migratory Species (HMS)	Commercial **albacore** - troll/hook-and-line	a) Inflation-adjusted revenue b) Hours fished	Highest normalized value between ranked revenue and effort layers	a) 2011–2020 b) 2005–2021	a) NMFS SWFSC, PacFIN b) NMFS SWFSC
7	Federal	WC Highly Migratory Species (HMS)	Recreational charter **albacore** - troll/hook-and-line	Days fished	Cumulative sum of days fished	2005–2021	NMFS SWFSC
8	State	OR Trawl Fishery for Ocean Shrimp	**Pink shrimp** (trawl)	a) Inflation-adjusted revenue b) Hours trawled	Highest normalized value between ranked revenue and effort layers	2011–2020	ODFW logbook, PacFIN
9	State	OR Dungeness Crab	**Dungeness crab** (pot)	a) Inflation-adjusted revenue b) Number of pots	Highest normalized value between ranked revenue and effort layers	a) 2011–2020 b) 2007/08–2010/11 and 2018/19–2019/20 seasons	ODFW logbook, PacFIN

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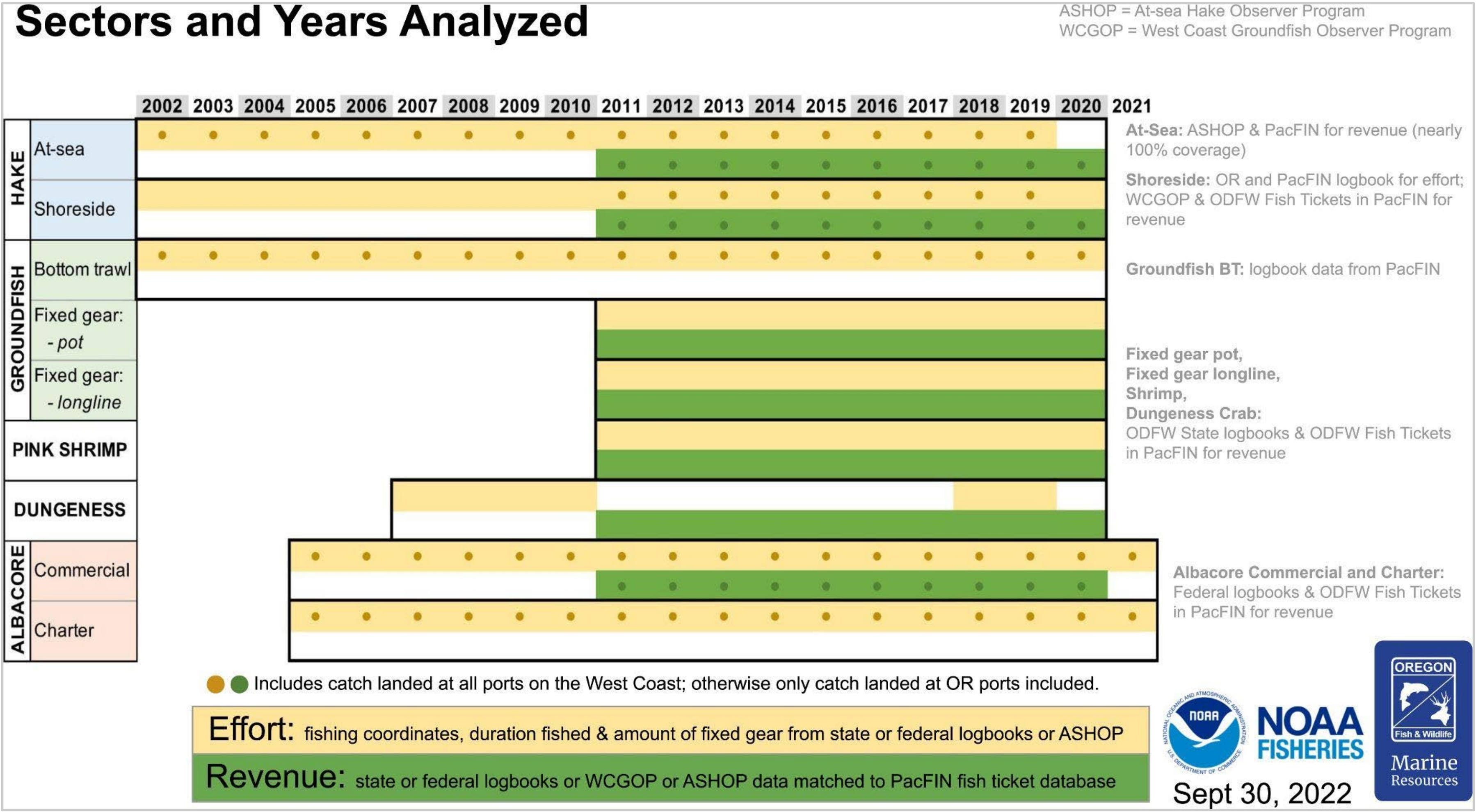
Figure 1. Details of data sources and years analyzed for fisheries effort and associated revenue for each of the nine fisheries used in the analysis.



● Fisheries Data and Methods

It is essential in the suitability model to represent the importance of ocean space to West Coast fisheries accurately with the best scientific information available, which we determined is a combination of effort and revenue data. The data we provided is the best available at this time and under the short timeline. Both effort and revenue data were used, where available. All nine fisheries included have both, except for recreational charter albacore and groundfish bottom trawl, for which only effort data were available at the time of this analysis.

Fishing location information and duration fished were extracted or calculated from State and Federal logbook and Federal observer program datasets for each fishing event for each of the nine fisheries. Straight lines were drawn between the fishing start and end geocoordinates to create fishing event lines when both values were available; point locations were created when only a single fishing event geocoordinate was available. Each line or point location was matched to corresponding Pacific Fisheries Information Network (PacFIN) fish ticket information to retrieve inflation-adjusted ex-vessel (in 2020 USD) revenue derived from each fishing event. These lines and points of fishing effort and revenue were then overlaid and summarized on a 2x2-km grid.

Exploratory analyses suggested that highly skewed distributions of fishing effort and revenue, in which a very small number of grid cells had exceptionally high values of effort and/or revenue, would grossly underestimate the amount of ocean space used by these nine fisheries. In order to account for these skewed distributions, we rank-transformed the fishing effort and revenue data. In order to combine and capture the most important characteristic (either 'effort' or 'revenue') of each fishery for each grid cell, we normalized (between 0 and 1) the rank-transformed effort and revenue data and then selected the highest normalized value for each grid cell. We term this final metric "Ranked Importance". Finally, the 'Ranked Importance' values for all nine fisheries were integrated into a single value for each grid cell, using methods described in NOAA's Aquaculture Opportunity Area Atlas. This resulted in a final relative suitability score for each grid cell for offshore wind energy development relative to fisheries.

It is important to emphasize that the data we provided, i.e., maps of fishing activity and associated revenue, represent conditions over the past 10-20 years and do not account for future shifts in species distributions and corresponding shifts in fisheries activity, which will alter the potential overlap with offshore wind energy development. The compressed timeframe for this effort precluded any consideration of such factors. NOAA's California Current Integrated Ecosystem Assessment team is currently assessing shifts in species distributions that will provide this type of data in the future.

● Recommendations for the Constraints Submodel, i.e., Areas Recommended for Exclusion

It is essential that the model represent the space fisheries need to reasonably operate so that when considering siting to allow for co-use, key fishing grounds and logistical needs are protected. We note, however, that some fisheries are more operationally flexible than others due to gear and/or spatial distribution/variability of target species.

Trawl fisheries (bottom and mid-water trawl), in particular, have little flexibility in where they fish due to their operational logistics. The gear requires large spaces for maneuverability and is incompatible with other structures and cables/mooring lines in the water, including what would likely be infrastructure for floating offshore wind platforms and anchors. The targeted species are also associated with locations along the shelf and slope and specific depth ranges. Therefore, these fisheries are especially vulnerable to fragmentation of fishing grounds. Four trawl fisheries operate within the two OR Call Areas:

- Groundfish bottom trawl (Federal)
- At-sea hake mid-water trawl (Federal)
- Shoreside hake mid-water trawl (Federal)
- Pink shrimp trawl (State)

For the four trawl fisheries, NMFS and ODFW calculated the regions where the top 75% of the ranked importance values occur. We recommend that BOEM exclude these regions from further consideration in siting, i.e., these regions received a score of zero in our recommendations for inclusion in the constraints submodel. We provided a map layer of this 75% region to facilitate processing in the modeling. Additionally, we provided map layers of the areas where 60% and 50% of the ranked importance values occur as alternative recommended constraints. In other words, we recommend the following scenarios in this order of priority (or preference):

- Constraints Scenario 1: 4 Trawl Fisheries - 75%
- Constraints Scenario 2: 4 Trawl Fisheries - 60%
- Constraints Scenario 3: 4 Trawl Fisheries - 50%

We also note that these constraints may benefit other fisheries with smaller vessels that operate closer to shore and on the eastern sides of the Call Areas.

● Recommendations for the Fisheries Submodel

We recommend the other five fisheries and the remainder of the trawl data be incorporated and ranked/scored in the fisheries submodel as we provided to NCCOS.

● Overview of Recommended Scenarios

Table 2. Scenarios NMFS and ODFW provided to NCCOS for modeling and for BOEM consideration, in order of preference from Scenario 1 (most preferred) to Scenario 5 (least preferred). For most fisheries, effort and revenue layers were ranked; for recreational charter albacore, effort was ranked; and for the four trawl fisheries, effort and/or revenue layers were ranked. 0=recommendation for the constraints submodel.

	Fisheries	Scenario 1 - Trawl @ 75%	Scenario 2 - Trawl @ 60%	Scenario 3 - Trawl @ 50%	Scenario 4 - Trawl @ 75%	Scenario 5 "Baseline"
1	**Four trawl fisheries**	**0**	**0**	**0**	**0.001**	Ranked
2	Remainder of Four trawl fisheries (what is not in constraints)	Ranked	Ranked	Ranked	Ranked	Ranked
3	Groundfish pot gear (primarily **sablefish and hagfish**)	Ranked	Ranked	Ranked	Ranked	Ranked
4	Groundfish longline gear (primarily **sablefish**)	Ranked	Ranked	Ranked	Ranked	Ranked
5	Commercial troll/hook-and-line **albacore** (non charter boats)	Ranked	Ranked	Ranked	Ranked	Ranked
6	Charter vessel **albacore** troll/hook-and-line	Ranked	Ranked	Ranked	Ranked	Ranked
7	**Dungeness crab**	Ranked	Ranked	Ranked	Ranked	Ranked

**Bolded species indicate the targeted species.*

Description of Other Fisheries in the Area Considered but not Included

● Ocean Salmon Fisheries

Pacific salmon fisheries are generally not monitored like the other species considered in these analyses, e.g., no observer or logbook data are available. The best available method for generating effort and revenue maps is much coarser, spatially, and involves extrapolating into the ocean using data contained in the Pacific Fishery Management Council "blue book" landings and revenue summaries. Preliminary analyses on the Chinook fishery, which accounts for the vast majority (~93%) of ocean salmon revenue off the Oregon coast, indicate that the majority of Chinook salmon fishing occurs in depths shallower than 200 m (110 fathoms), which is shoreward of the two Call Areas, so there should be limited overlap.

More information about Pacific salmon fisheries can be found at: https://www.fisheries.noaa.gov/west-coast/sustainable-fisheries/ocean-salmon-fisheries-west-coast and https://www.fisheries.noaa.gov/species/pacific-salmon-and-steelhead#west-coast-fisheries

- Pacific Halibut

Pacific halibut fisheries also occur off the coast of Oregon. The United States and Canada coordinate on Pacific halibut management through the International Pacific Halibut Commission (IPHC). NMFS and the North Pacific and Pacific Fishery Management Councils are responsible for allocating allowable catch among harvesters in the U.S. fisheries. More information at Halibut Catch Sharing Regulations.

Logbook reports are required from commercial vessels at least 26 feet in length, and report significant catch from commercial vessels landing fish at several ports near the BOEM Call Areas (e.g., Coos Bay, Charleston, Port Orford, Brookings). From 2015 to 2021, Pacific halibut catch in Oregon (by weight) was 35% on average inside the BOEM Call Areas (range 10%–66%), while 65% on average outside the BOEM Call Areas (range 34%–90%). In the most recent year, 2021, 39% of the Pacific halibut catch occurred in Oregon inside the BOEM Call Areas (IPHC estimated directed commercial halibut removals). Future development of spatial data could be based on logbooks from IPHC but could not be achieved on the short timeline allocated for this effort.

- Recreational fisheries

Recreational fisheries take place in waters deeper than 200 meters and could be negatively impacted by offshore wind energy development. Both private and charter fisheries are important components of Oregon fishing communities, but (except for albacore charter included in recommendations above) the data currently available are insufficient to describe recreational fishing grounds at appropriate spatial scales.

NMFS provided information about recreational fisheries off Oregon in our 6/28/2022 comment letter to BOEM. ODFW provided information on recreational fisheries off Oregon in our 8/20/2021 comments to BOEM on OROWindMap fishery data layers and in our 6/27/2022 joint State agency comment letter to BOEM on Call Areas.

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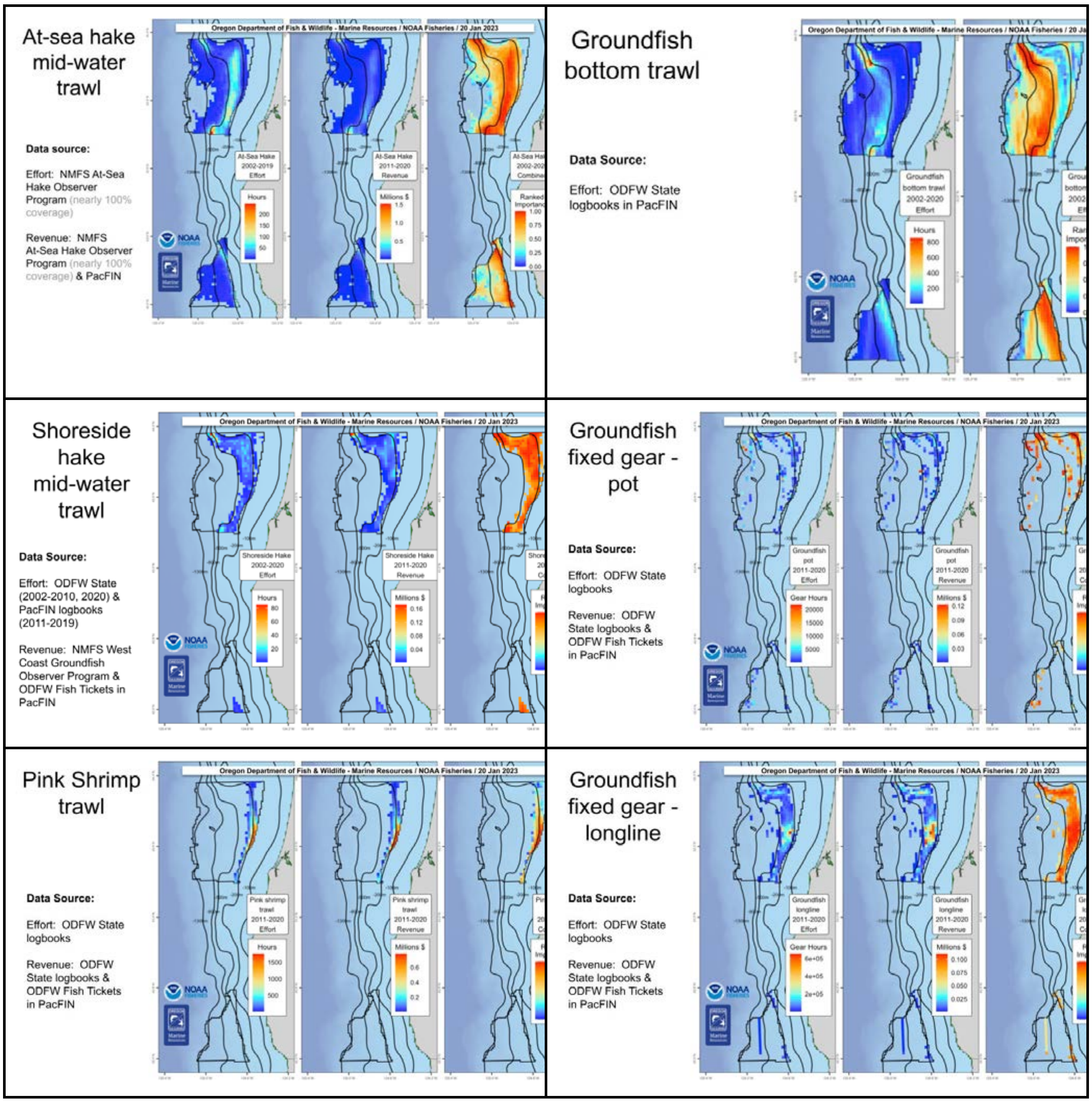
Appendix -- Maps

Maps of Fisheries - Produced by NMFS & ODFW

Below are nonconfidential maps that NMFS and ODFW prepared for each of the nine fisheries. For each fishery, the map on the left shows raw effort, middle map shows raw revenue, and the map on the right shows the ranked importance (i.e., combined effort and revenue), with the exception of groundfish bottom trawl and recreational charter albacore that do not have a revenue map.



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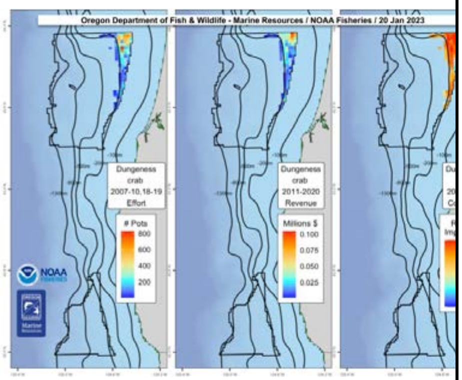
<td>Dungeness crab

Data Source:

Effort: ODFW State logbooks

Revenue: ODFW State logbooks & ODFW Fish Tickets in PacFIN</td>
<td>
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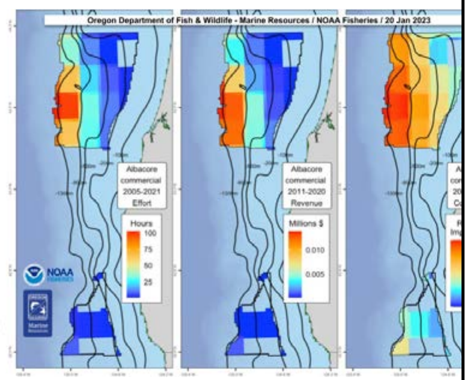
<td>Albacore commercial

*Resolution of fishing coordinates was at 10 arcmin grid - we downscaled to 2x2-km grid

Data Source:

Effort: NMFS SWFSC federal logbooks

Revenue: NMFS SWFSC federal logbooks & ODFW Fish Tickets in PacFIN for revenue</td>
<td>
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<tr>
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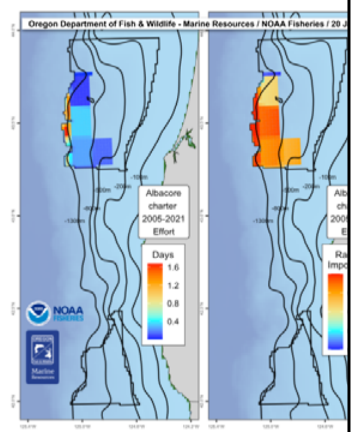
<td>Albacore charter

*Resolution of fishing coordinates was at 10 arcmin grid - we downscaled to 2x2-km grid

Data Source:

Effort: NMFS SWFSC federal logbooks</td>
<td>
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Maps of Fisheries - Produced by NCCOS

Below are the corresponding maps created by NCCOS using the data and recommendations provided by NMFS and ODFW.

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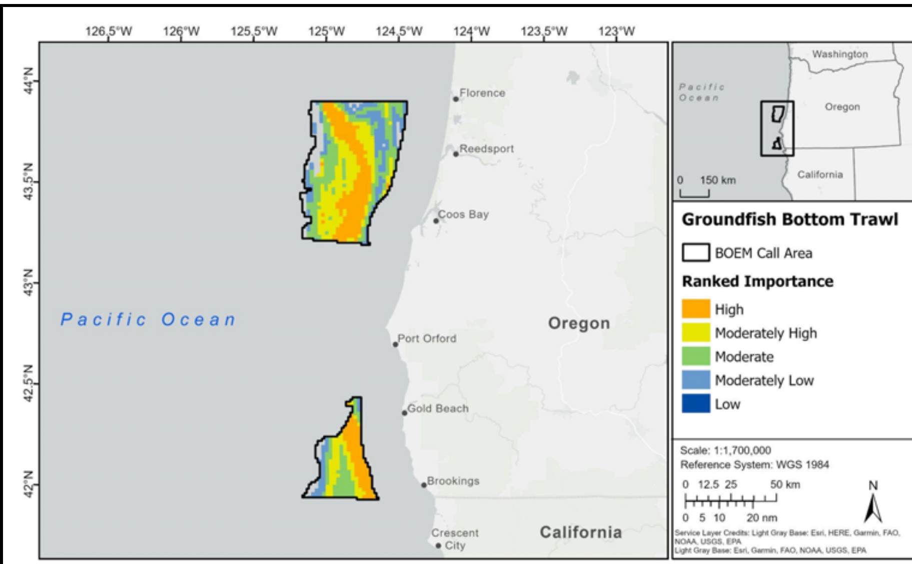
<td>Groundfish:
Bottom Trawl

Time Period: 2002–2020 (effort only)

Cells containing data with < 3 vessels have been removed due to confidentiality.</td>
<td>
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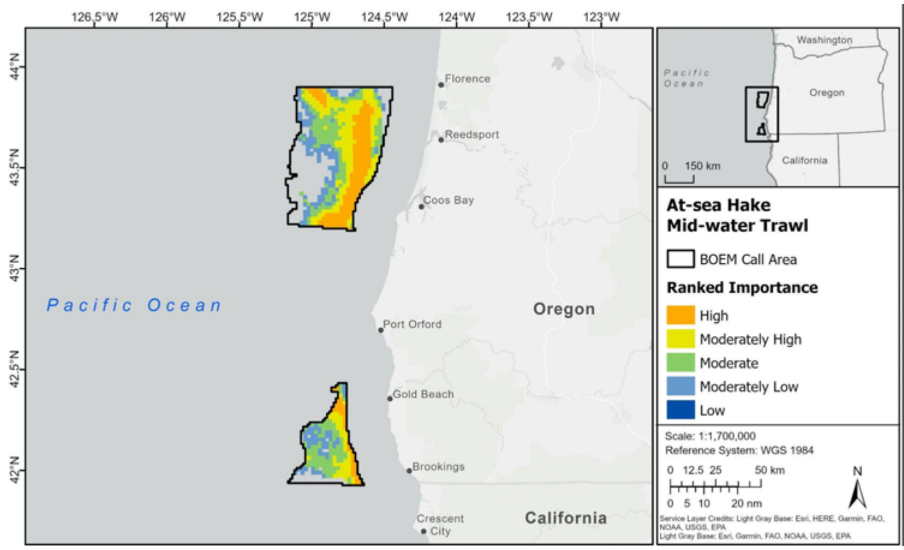
At-sea Hake - Mid-water Trawl

Time Periods:
a) revenue: 2011–2020
b) effort: 2002–2019

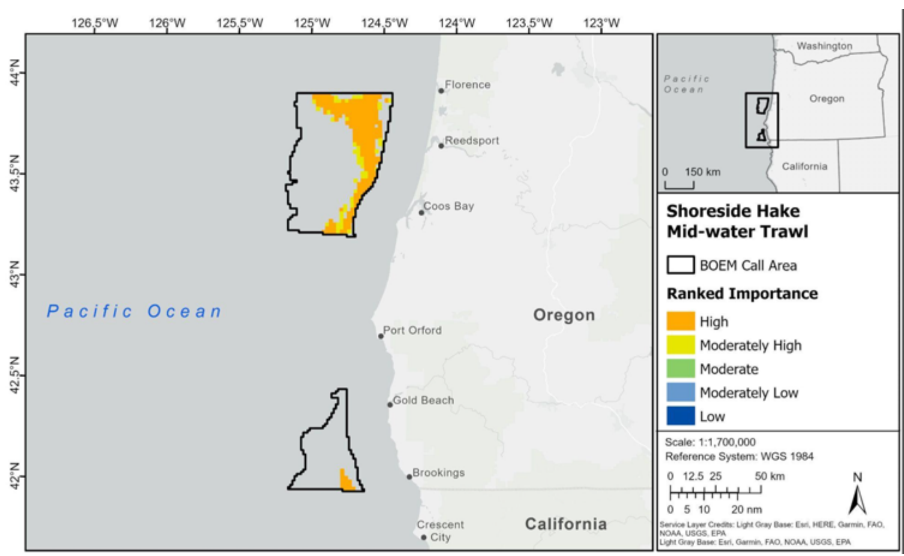
Cells containing data with < 3 vessels have been removed due to confidentiality.



Shoreside Hake - Mid-water Trawl

Time Periods:
a) revenue: 2011–2020
b) effort: 2002–2020

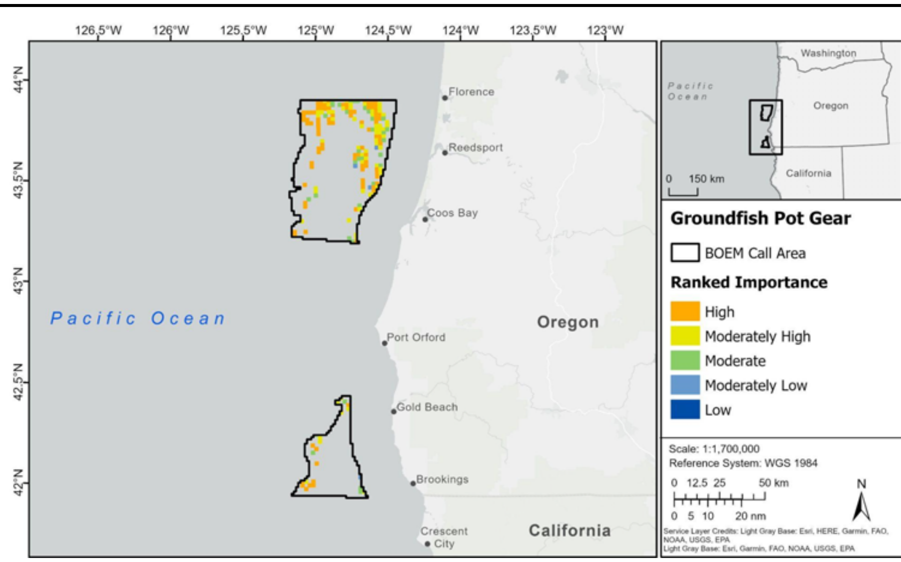
Cells containing data with < 3 vessels have been removed due to confidentiality.



Groundfish fixed gear - pot

Time Period: 2011–2020

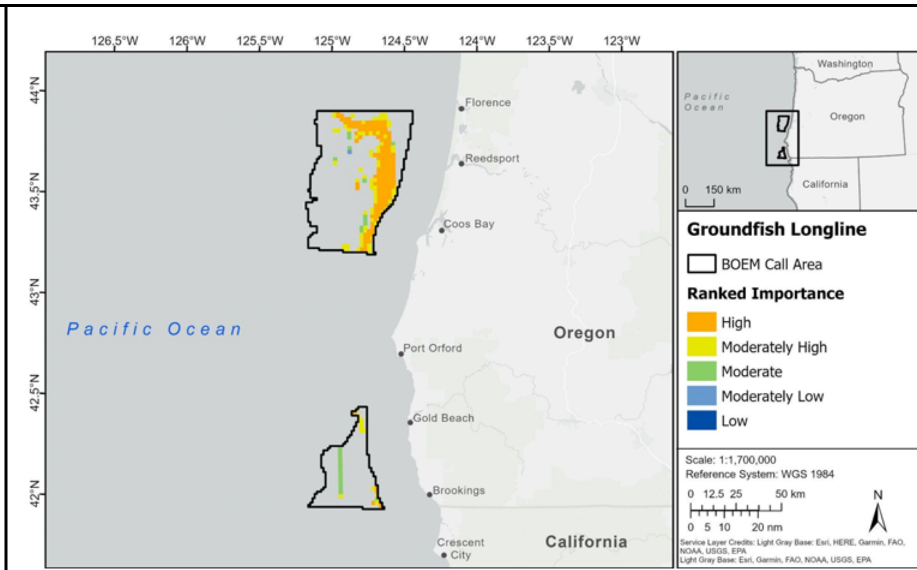
Cells containing data with < 3 vessels have been removed due to confidentiality.



Groundfish fixed gear - longline

Time Period: 2011–2020

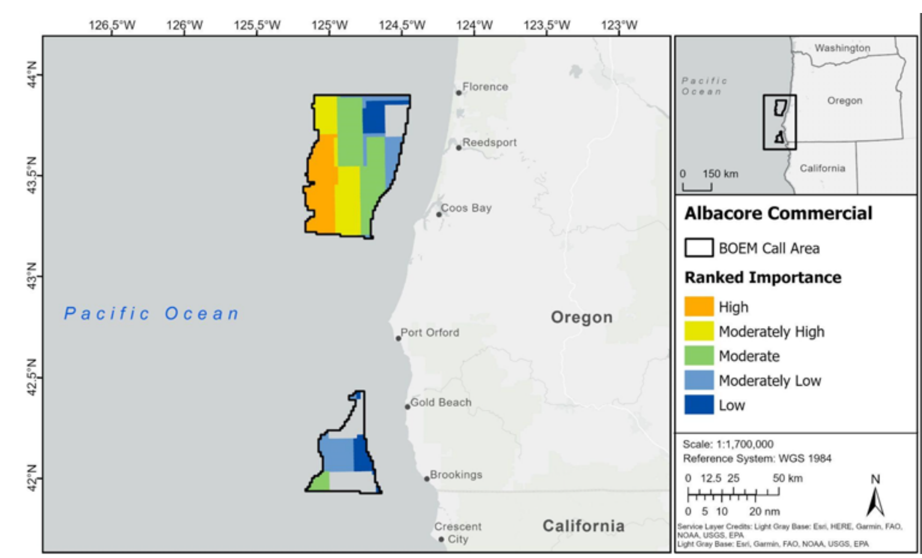
Cells containing data with < 3 vessels have been removed due to confidentiality.



Commercial Albacore: Troll / Hook-and Line

Time Periods:
a) revenue: 2011–2020
b) effort: 2005–2021

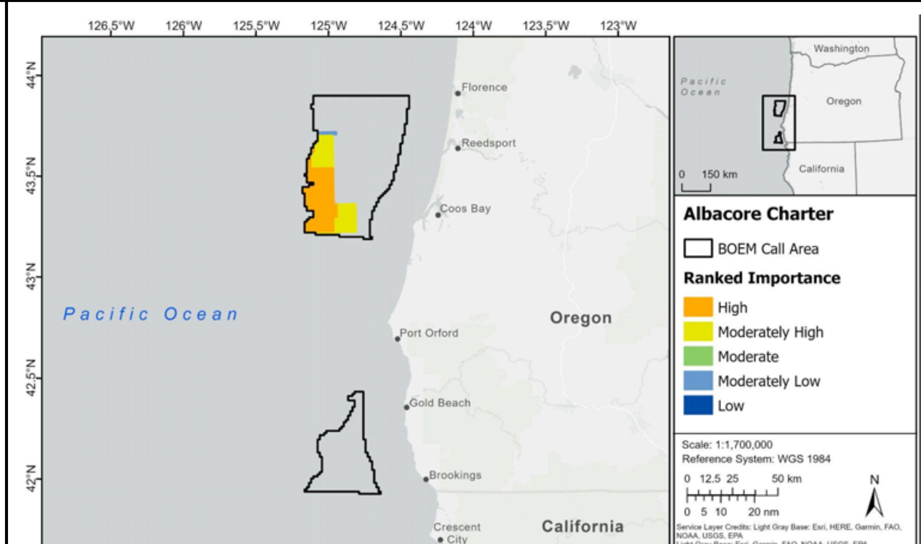
Cells containing data with < 3 vessels have been removed due to confidentiality.



Charter Albacore:

Time Period: 2005-2021 (effort only)

Cells containing data with < 3 vessels have been removed due to confidentiality.



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OR Pink Shrimp - Trawl

Time Period: 2011–2020

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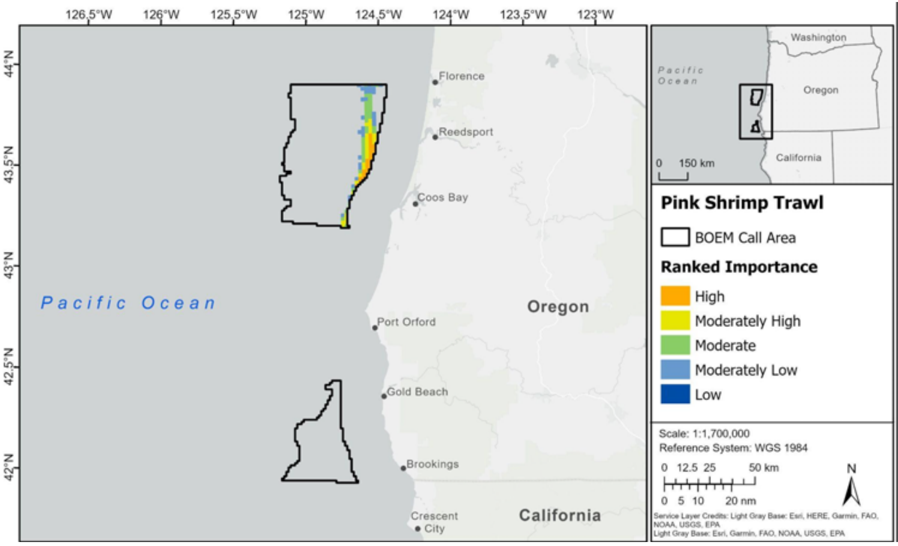

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OR Dungeness Crab - Pot

Time Periods:
a) revenue: 2011–2020
b) effort: 2007/08–2010/11 and 2018/19–2019/20 seasons

Cells containing data with < 3 vessels have been removed due to confidentiality.

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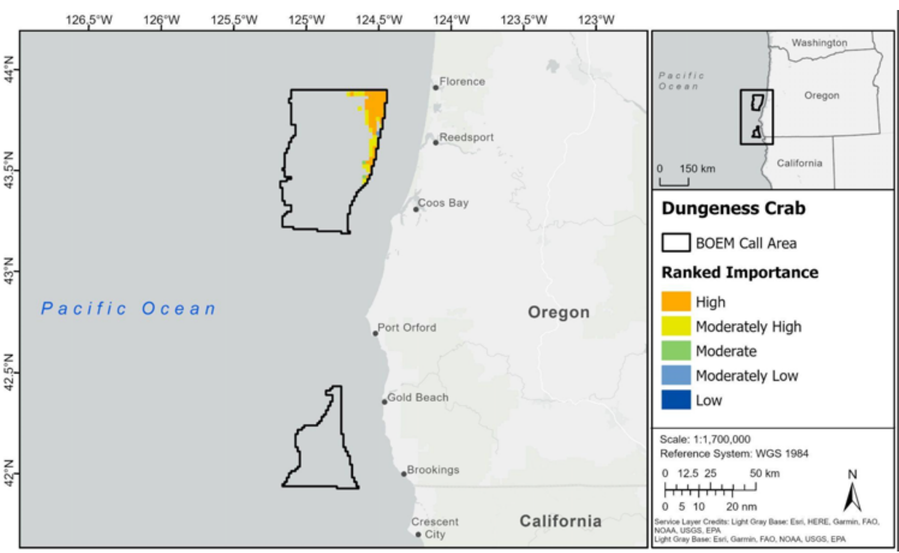

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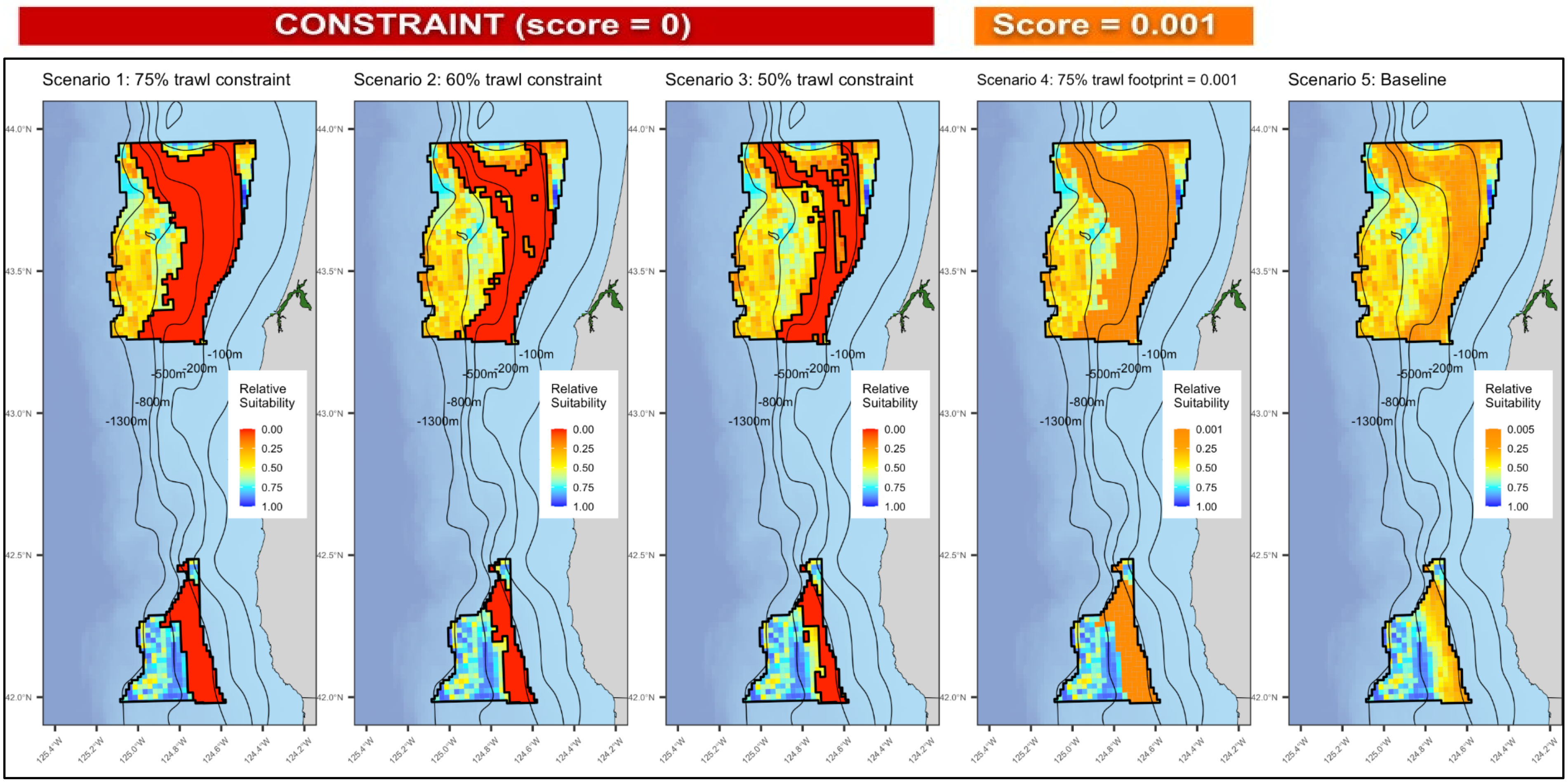
Maps of Scenarios

We note that the NCCOS model suitability scores are of *relative* suitability, and fishing could still occur in a cell with a “high suitability” score. In such cases, it could be that there was incomplete information (e.g., due to data and/or time limitations), and engagement with fisheries stakeholders could fill in any such gaps.

Maps of the recommended scenarios from NMFS and ODFW for the fisheries submodel with NCCOS model suitability scores across the nine fisheries. Percent calculation = ranked importance of the combined revenue and effort metrics for the four trawl fisheries.



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Appendix F - Juvenile and Larval Fish Distribution Data

NCCOS Spatial Modeling of Oregon Call Areas

Juvenile and Larval Fish Distributions Provided by NOAA's National Marine Fisheries Service (NMFS)

July 10, 2023

Kelly Andrews, NMFS Northwest Fisheries Science Center (NWFSC), Kelly.Andrews@noaa.gov
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Rebecca Miller, Fisheries Collaborative Program, University of California Santa Cruz and NMFS SWFSC

Purpose of this Document

NOAA's National Marine Fisheries Service (NMFS) provided[1] maps of juvenile and larval distributions for select fish species to include in the area characterization section of the report developed by NCCOS for BOEM's OR Call Areas and proposed WEA designation. These were not included in the data layers NMFS provided to BOEM for the model in September 2022. NMFS subsequently provided the maps herein to BOEM in July 2023 for their consideration after hearing Tribal Nation's concerns about the potential impact of offshore wind development on ecosystem and oceanographic processes, including larval fish distributions, during the May 2023 meeting of the Pacific Fishery Management Council's Marine Planning Committee.[2] The Tribes' concerns over these impacts were not limited to within wind farms themselves, given the potential for large wind farms to affect ocean circulation dynamics far beyond the footprint of the farm itself.

[1] ***Disclaimer for NMFS' role in NCCOS Offshore Wind Spatial Planning Work for BOEM:*** NCCOS is providing BOEM with technical assistance to support BOEM's spatial planning in relation to offshore wind projects. This support is being provided with funding resources from NCCOS and through reimbursable support from BOEM to NCCOS. NMFS is providing technical assistance to NCCOS regarding available science (i.e. data layers and modeling methods) for BOEM's consideration in their spatial modeling efforts. These efforts are supporting BOEM's ocean and coastal planning activities related to siting of call areas, wind energy areas, and transmission cable routing. The information provided by NMFS to NCCOS is purely technical in nature and does not reflect or constitute an official agency policy, position, or action. Official NMFS positions related to spatial planning for offshore wind activity will be submitted by NMFS through written comments to BOEM during the planning and review processes for each activity.

[2] https://www.pcouncil.org/documents/2023/05/c-3-a-mpc-report-1.pdf/

Importance of Considering Juvenile and Larval Fish Distribution

Characterizing spatial and temporal variation in the distributions of juvenile and larval fish species is critical to our understanding of the growth and survival of these commercially, culturally, and recreationally important NOAA trust resource species in the California Current Marine Ecosystem. Consequently, this information is an important consideration for understanding how offshore wind energy development siting may affect ecosystem processes, marine species, and the communities that depend on these species.

The sampling of fish species' these early life-history stages occurs at various scales and across a variety of government and academic institutions. NMFS has conducted several broad-scale scientific surveys over the last three decades that can provide important baseline data and context to the magnitude of variation in the distribution of these life stages – see NMFS Surveys in the Industry and Operations submodel and Appendix D for descriptions of each survey. The California Cooperative Oceanic Fisheries Investigations (CalCOFI) partnership between NMFS, CDFW, and Scripps Institution of Oceanography also performs surveys and collects data on early life-history stages of many commercially and culturally valuable species off the coast of California that could contribute to and inform BOEM's marine spatial planning efforts. Data from NMFS' surveys have been used with recent advances in species distribution models to identify areas off the West Coast that may be important to these life stages or that highlight the temporal variation inherent in the distribution of these life stages. Here, we present a few examples of spatially explicit information that could be used to inform decisions related to the siting of offshore wind energy developments and that establish 'baseline' conditions that can be compared with projected or predicted future spatial distributions of these early life-history stages resulting from local and distant ecosystem impacts of offshore wind projects.

Fish Species Included

Pacific Hake (Whiting) and Sablefish (Black Cod)

Pacific hake and sablefish are two important species of the California Current Marine Ecosystem, in terms of biomass and associated ecosystem services. They are important predators in their respective communities, amongst the most economically important target species to the commercial fishing industry and important species to some West Coast Tribal Nations (see Northwest Indian Fisheries Commission's Groundfish page).

Identifying habitats that are important to the early life-history stages of these species provides critical information on their ecology and helps focus and inform tradeoffs related to potential spatial management strategies and decisions by defining essential fish habitat (Tolimieri et al. 2020[3]). In areas near the Call Areas off the coast of Oregon, the relative importance of benthic juvenile habitat to Pacific hake and sablefish is generally higher in depths shallower than 200 m (110 fathoms) and are generally greatest just inshore of the northern boundaries of the Coos Bay Call Area (Figure F-1). Coastwide estimates for 13 different groundfish species and for each year from 2003 to 2018, based on NMFS bottom trawl surveys,

[3] Tolimieri N, Wallace J, Haltuch M (2020) Spatio-temporal patterns in juvenile habitat for 13 groundfishes in the California Current Ecosystem. PLoS ONE 15(8): e0237996. https://doi.org/10.1371/journal.pone.0237996

are currently available for use in future analyses (Tolimieri et al. 2020) that examine potential offshore wind energy project impacts on marine circulation and upwelling (e.g., Raghukumar et al. 2023[4]).

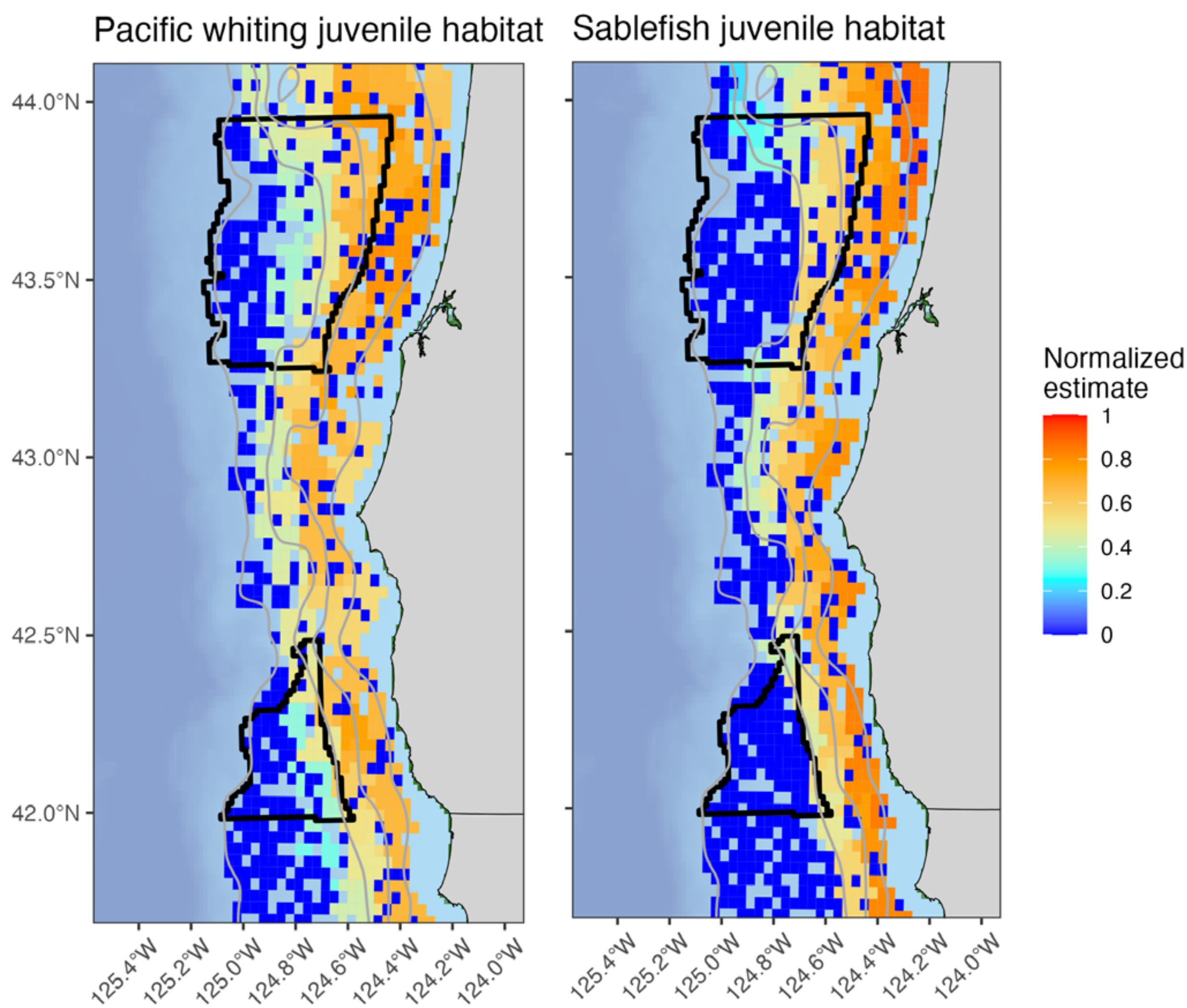

Figure F-1. Relative estimates of juvenile habitat in and surrounding the offshore wind energy Call Areas off the southern coast of Oregon for ages 0-1 Pacific whiting, *Merluccius productus* (left) and age-0 sablefish, *Anoplopoma fimbria* (right) as measured by the average density of individuals sampled by NMFS's West Coast Groundfish Bottom Trawl survey from 2003-2018. Data from Tolimieri et al. 2020.

[4] Raghukumar K, Nelson T, Jacox M, Chartrand C, Fiechter J, Chang G, Cheung L, Roberts J (2023) Projected cross-shore changes in upwelling induced by offshore wind farm development along the California coast. Commun Earth Environ 4, 116. https://doi.org/10.1038/s43247-023-00780-y

Pelagic Young-of-the-Year (YOY) Rockfish and Pacific Hake (Whiting)

Rockfish (*Sebastes* spp.) are an important species for commercial and recreational fisheries off the U.S. West Coast. They are a long-lived, slow growing species and most adults are associated with benthic habitats. Rockfish are live-bearers and young-of-the-year (YOY) rockfish undergo a pelagic life stage, during which they are important forage for many seabirds and other fish species. Annual YOY rockfish abundances are highly variable, with the relative year class strength generally set during the first 30 days of life. Pacific hake early life history stages are also pelagic during the first 50–200 days of their lives and are also found throughout the California Current Marine Ecosystem, although adults typically spawn in its southern waters and juveniles migrate seasonally to increasingly northern waters with age.

During the May–June period from 2001–2022, a midwater trawl survey conducted in late Spring throughout most of the U.S. West coast suggests that the abundance of pelagic YOY rockfish, typically 2–6 cm in length and between 50–150 days of age, were greatest in central and southern California, and generally less abundant in the offshore waters north of Cape Mendocino (Field et al. 2021). However, catches did exhibit high spatial variability, and in many years the catches of pelagic YOY were greater in the north than in the central and southern California Current regions. Moreover, the high catches in southern waters were disproportionately smaller "forage" species of rockfish, such as shortbelly rockfish (*Sebastes jordani*), while commercially important species such as widow (*S. entomelas*) and yellowtail (*S. flavidus*) rockfish made up a larger fraction of the species encountered in the north. Despite high spatial variability from year to year, the data did not seem to indicate any regions of substantially greater or lower abundance throughout Oregon offshore waters (Figure F-2).

Although not included in the initial analysis, the pelagic juvenile rockfish surveys utilized for that analysis also encounter pelagic YOY Pacific hake, typically in the range of 2–5 cm in length (and approximately 100–200 days of age). An analysis was developed using the databases and methods identical to Field et al. (2021) for rockfish to provide some additional information on this commercially and ecologically important species. The only notable exception was that the data used for this figure were from 2001–2022 (rather than 2001–2019 in the initial analysis). The results indicate that pelagic YOY Pacific hake were more abundant at this life history stage, and during this time of year, in Southern and Central California waters, similar to the observations made for the rockfish species included in the earlier analysis, potentially with a slightly sharper decline in abundance from south to north. Similar to pelagic YOY rockfish, there was no indication of specific regions with substantially greater or lower abundance of pelagic juveniles throughout Oregon offshore waters.

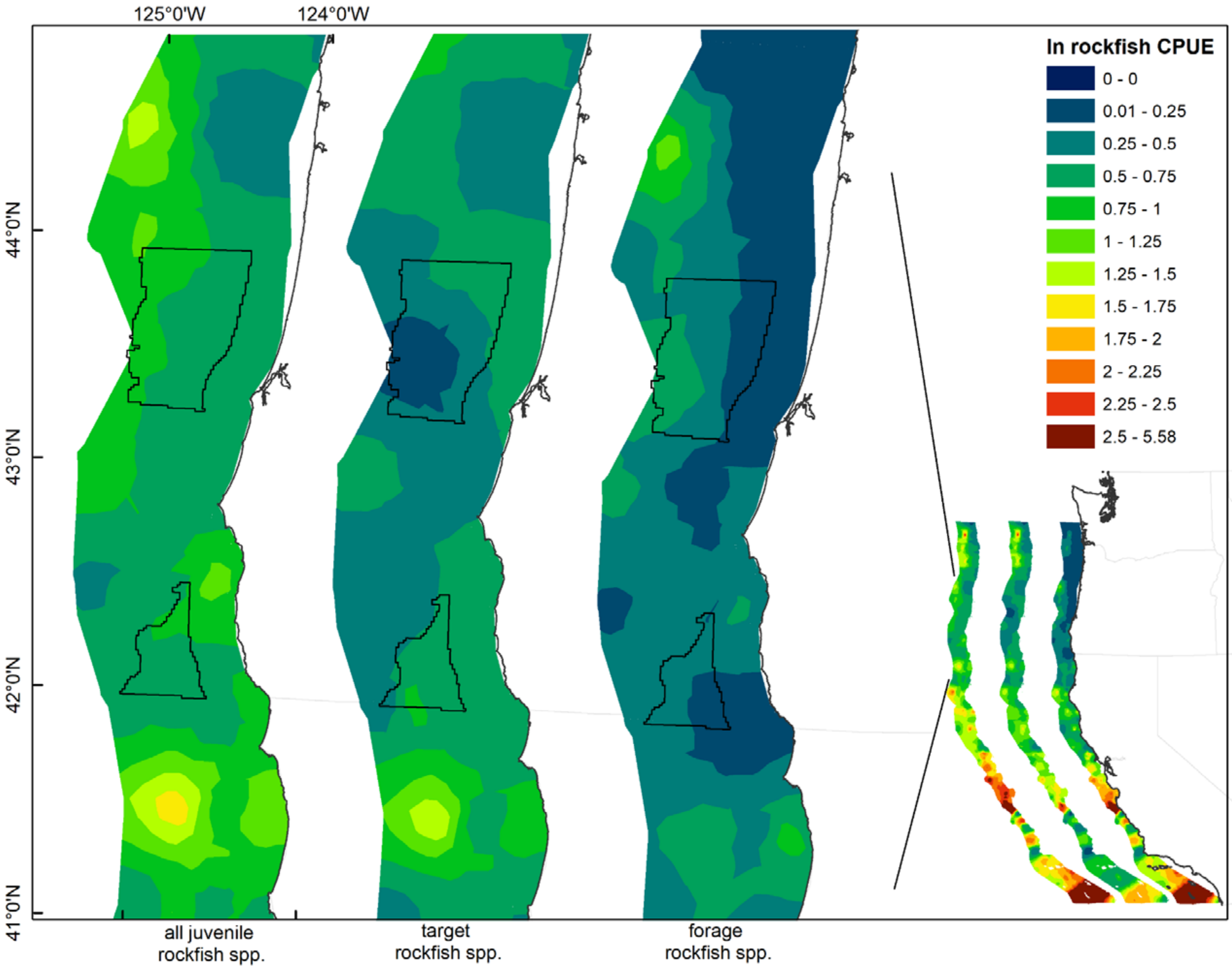

Figure F-2. Excerpt from Figure 3 in [Field et al 2021]() with OR Call Areas overlaid. Climatological distribution of pelagic young-of-the-year (YOY) rockfish when target or non-target (forage) species are pooled, showing that the abundance is dominated by non-commercially important taxa in southern waters.

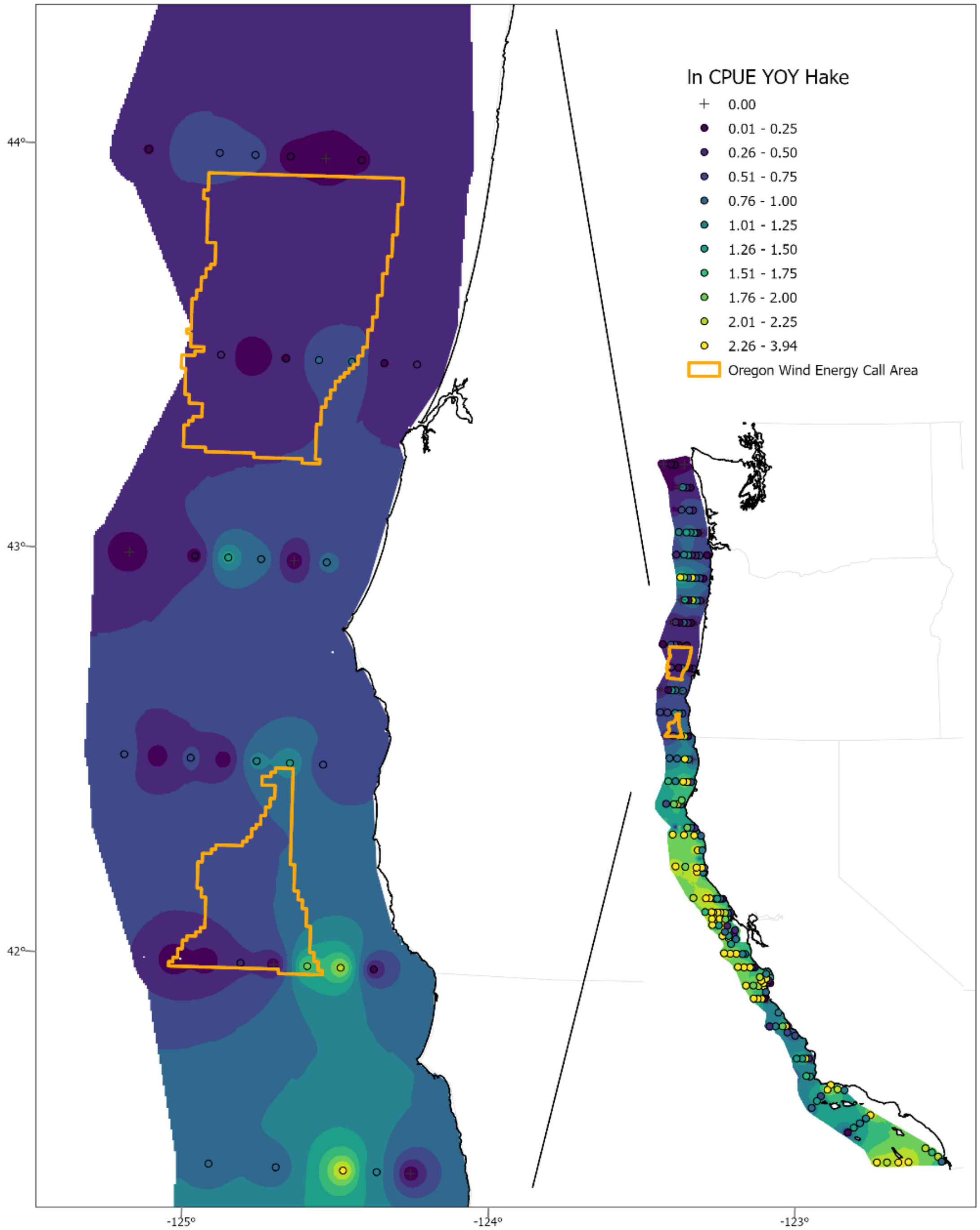

Figure F-3. Climatological distribution of pelagic young-of-the-year (YOY) Pacific hake; data and analytical methods identical to those of Field et al. (2021) for pelagic YOY rockfish.

It is important to emphasize that the data we provided was based on the best available science at the time and do not account for future shifts in species and habitat distributions, which will alter their potential overlap with offshore wind. The compressed timeframe for this effort precluded any consideration of such factors. NOAA's California Current Integrated Ecosystem Assessment team is currently assessing shifts in species and habitat distributions that will provide this type of data in the future.

NMFS Recommendations for Considerations of Fish Larval Distribution

NMFS recommends that BOEM consider the spatial distribution of these early life-history stages of commercially and recreationally important species, in addition to critical forage species that form the base of the food web for the rest of the California Current Marine Ecosystem. The California Current Integrated Ecosystem Assessment routinely produces status reports on juvenile fish and forage species in their annual Ecosystem Status Reports. These indicators provide an overarching context of the environmental drivers and stressors experienced by the rest of the ecosystem, although these reports typically do not show spatial distributions or climatologies of most of these taxa. Here, we have provided a small number of examples that can be used as baseline conditions based on data collected from NMFS long-term scientific surveys along the West Coast. Monitoring and calculating changes in spatial distributions in the future will be important considerations for future siting of offshore wind development; partitioning the impacts from offshore wind development from background climate variability and change; and, our overall understanding of long-term impacts of offshore wind development on the California Current Marine Ecosystem.

Appendix G - Marine Bird Data

Marine Bird Considerations for Marine Spatial Planning for the Oregon Offshore Wind Energy Call Areas

March 2023

Jeffrey B. Leirness[1,2]
David M. Pereksta[3]
Frank Pendleton[3]
Jessica L. Carlton[1,2]
Jonathan A. Jossart[1,2]
Josh Adams[4]
Jonathan J. Felis[4]
Emma C. Kelsey[4]

[1] CSS, Inc. Fairfax, VA, USA
[2] National Centers for Coastal Ocean Science, National Ocean Service, NOAA
[3] Bureau of Ocean Energy Management, Pacific Region
[4] U.S. Geological Survey, Western Ecological Research Center, Santa Cruz, CA, USA

Purpose

Through collaboration with NOAA's National Centers for Coastal Ocean Science (NCCOS), U.S. Geological Survey (USGS), and Bureau of Ocean Energy Management (BOEM), a marine bird importance data layer was developed for inclusion in the spatial suitability model for siting considerations in the Oregon Call Areas. This document describes the process and data sources used to develop the marine bird data layer. This is the first effort to develop a combined data layer of marine birds to inform the sitting of offshore Wind Energy Areas in the U.S. Understanding spatial distributions and densities of marine birds at sea potentially can be used to minimize impacts to wildlife associated with offshore wind energy development and operation.

Disclaimer for USGS' role in NCCOS Offshore Wind Spatial Planning Work for BOEM
The views and conclusions in this article represent the views solely of the authors from USGS but do not represent the views of the USGS. This information is preliminary or provisional and is subject to revision. It is being provided to meet the need for timely best science. The information has not received final approval by the USGS and is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

Data and Methods

Utilizing existing spatially-explicit model-predicted density data for marine birds in Pacific Outer Continental Shelf (OCS) waters (Leirness et al. 2021; data accessible at https://doi.org/10.25921/xqf2-r853), a combined spatial distribution data layer of marine bird density was created for the Pacific OCS Region. A total of 124 seasonal predicted density layers for 30 individual species and 12 taxonomic groups were selected for inclusion (Table G-1). Seasonal predicted density layers from Leirness et al. 2021 were summed to create an annual predicted density layer for each species or taxonomic group, assuming zero density for seasons that were not modeled by Leirness et al. 2021[1]. Annual predicted density values were then rescaled by dividing the value of each grid cell by the sum of all values within a given layer. Rescaling was used to ensure that the combined-species layer was representative of all species considered, regardless of abundance.

Each species or taxonomic group was then assigned an overall vulnerability rating based on its sensitivity to offshore wind development in the region (Adams et al. 2017; Kelsey et al. 2018). Species-specific population, collision, and displacement vulnerability metrics from Kelsey et al. 2018 were matched to each individual species and taxonomic group from Leirness et al. 2021. Taxonomic groups were assigned the largest value, for each metric, of all species that comprised the group. Vulnerability metrics were then rescaled by subtracting the minimum possible value and dividing by the difference between the maximum and minimum possible values of each metric. This ensured that all rescaled values were between 0 and 1. An overall vulnerability rating was then calculated for each species or taxonomic group by multiplying the rescaled population vulnerability by either the rescaled collision or displacement vulnerability, whichever was larger.

Finally, a combined-species data layer was created by calculating the weighted mean of all rescaled annual predicted density layers, with weights equal to the overall vulnerability rating for each species or taxonomic group. The final data layer was clipped to the Call Areas and rescaled so that all values were between 0.01 and 1.00 for use in the suitability model analysis. Table G-1 provides the marine bird species and taxonomic groups by season that were included in the development of the combined data layer.

Results

This data layer integrates species-specific predicted density values, weighted by a combination of several metrics, that assess species-specific vulnerability to wind energy infrastructure. Greater values indicate areas of greater importance for marine birds, suggesting less suitability for wind energy development. Figure G-1 displays the final composite of the combined data layer representing marine bird importance.

[1] For cormorants, Leirness et al. 2021 developed predicted density layers of individual species for the spring and summer seasons and of a combined taxonomic group (cormorant spp.; see Table 1.1) for the fall and winter seasons. Therefore, annual predicted density for the cormorant spp. group was calculated by summing across all individual cormorant species and the cormorant spp. group predicted density layers. Annual predicted density layers were not calculated for individual cormorant species.

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Table G-1. List of species and seasons included in the marine bird combined data layer.

Common Name	Scientific Name	Family	Spring	Summer	Fall	Winter
Scoter spp.	*Melanitta* spp.	Anatidae	X	X	X	X
Western/Clark's Grebe	*Aechmophorus occidentalis/clarkii*	Podicipedidae	X		X	X
Phalarope spp.	*Phalaropus* spp.	Scolopacidae	X	X	X	X
South Polar Skua	*Stercorarius maccormicki*	Stercorariidae			X	
Jaeger spp.	*Stercorarius pomarinus/parasiticus/ longicaudus*	Stercorariidae	X	X	X	X
Common Murre	*Uria aalge*	Alcidae	X	X	X	X
Pigeon Guillemot	*Cepphus columba*	Alcidae	X	X		
Marbled Murrelet	*Brachyramphus marmoratus*	Alcidae	X	X		
Scripps's/Guadalupe/Craveri's Murrelet	*Synthliboramphus scrippsi/hypoleucus/craveri*	Alcidae	X			
Ancient Murrelet	*Synthliboramphus antiquus*	Alcidae	X			
Cassin's Auklet	*Ptychoramphus aleuticus*	Alcidae	X	X	X	X
Rhinoceros Auklet	*Cerorhinca monocerata*	Alcidae	X	X	X	X
Tufted Puffin	*Fratercula cirrhata*	Alcidae	X	X		
Black-legged Kittiwake	*Rissa tridactyla*	Laridae	X		X	X
Sabine's Gull	*Xema sabini*	Laridae	X	X	X	
Bonaparte's Gull	*Chroicocephalus philadelphia*	Laridae	X		X	X
Heermann's Gull	*Larus heermanni*	Laridae		X	X	X
California Gull	*Larus californicus*	Laridae	X	X	X	X
Herring/Iceland Gull	*Larus argentatus/glaucoides*	Laridae	X	X	X	X
Western/Glaucous-winged Gull	*Larus occidentalis/glaucescens*	Laridae	X	X	X	X
Caspian Tern	*Hydroprogne caspia*	Laridae	X	X		
Common/Arctic Tern	*Sterna hirundo/paradisaea*	Laridae	X	X	X	
Royal/Elegant Tern	*Thalasseus maximus/elegans*	Laridae	X	X	X	
Loon spp.	*Gavia* spp.	Gaviidae	X	X	X	X
Laysan Albatross	*Phoebastria immutabilis*	Diomedeidae	X			X
Black-footed Albatross	*Phoebastria nigripes*	Diomedeidae	X	X	X	X
Fork-tailed Storm-Petrel	*Hydrobates furcatus*	Hydrobatidae	X	X	X	X
Leach's Storm-Petrel	*Hydrobates leucorhous*	Hydrobatidae	X	X	X	X
Ashy Storm-Petrel	*Hydrobates homochroa*	Hydrobatidae	X	X	X	
Black Storm-Petrel	*Hydrobates melania*	Hydrobatidae	X	X	X	
Northern Fulmar	*Fulmarus glacialis*	Procellariidae	X	X	X	X
Murphy's Petrel	*Pterodroma ultima*	Procellariidae	X			

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Common Name	Scientific Name	Family	Spring	Summer	Fall	Winter
Cook's Petrel	*Pterodroma cookii*	Procellariidae	X	X	X	
Buller's Shearwater	*Ardenna bulleri*	Procellariidae		X	X	
Pink-footed Shearwater	*Ardenna creatopus*	Procellariidae	X	X	X	
Short-tailed/Sooty/Flesh-footed Shearwater	*Ardenna tenuirostris/grisea/carneipes*	Procellariidae	X	X	X	X
Black-vented Shearwater	*Puffinus opisthomelas*	Procellariidae	X		X	X
Brandt's Cormorant	*Phalacrocorax penicillatus*	Phalacrocoracidae	X	X		
Pelagic Cormorant	*Phalacrocorax pelagicus*	Phalacrocoracidae	X	X		
Double-crested Cormorant	*Phalacrocorax auritus*	Phalacrocoracidae	X	X		
Cormorant spp.	*Phalacrocorax* spp.	Phalacrocoracidae			X	X
Brown Pelican	*Pelecanus occidentalis*	Pelecanidae	X	X	X	X

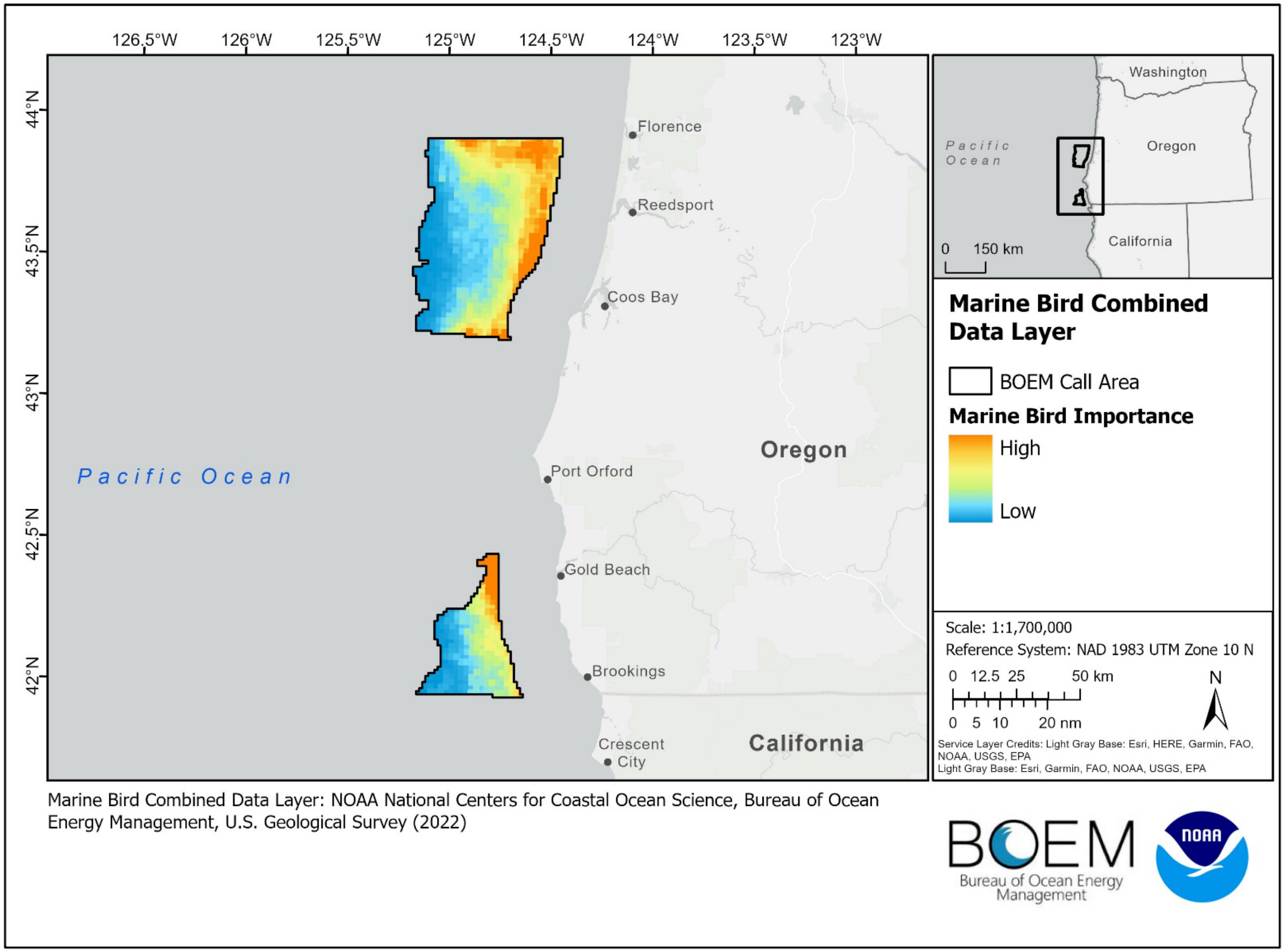

Figure G-1. Map depicting marine bird importance relative to the Oregon Call Areas to be used in the suitability analysis.

References

Adams J, Kelsey EC, Felis JJ, Pereksta DM. 2017. Collision and displacement vulnerability among marine birds of the California Current System associated with offshore wind energy infrastructure (ver. 1.1, July 2017). U.S. Geological Survey Open-File Report 2016-1154.116p.

Kelsey EC, Felis JJ, Czapanskiy M, Pereksta DM, Adams J. 2018. Collision and displacement vulnerability to offshore wind energy infrastructure among marine birds of the Pacific Outer Continental Shelf. Journal of Environmental Management. 227:229-247.

Leirness JB, Adams J, Ballance LT, Coyne M, Felis JJ, Joyce T, Pereksta DM, Winship AJ, Jeffrey CFG, Ainley D, Croll D, Evenson J, Jahncke J, McIver W, Miller PI, Pearson S, Strong C, Sydeman W, Waddell JE, Zamon JE, Christensen J. 2021. Modeling at-sea density of marine birds to support renewable energy planning on the Pacific Outer Continental Shelf of the contiguous United States. Camarillo (CA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-014. 385p.

Appendix H - National Security Data

Memoranda from the Department of Defense providing review of Oregon Call Areas.

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

ENERGY, INSTALLATIONS, AND ENVIRONMENT

17 May, 2022

Necitas Sumait
Renewable Energy Section Chief
Bureau of Ocean Energy Management (BOEM)
Office of Renewable Energy Programs
Pacific Regional Office

Reference: Attachment (1) (U) DOD Assessment Map of the Oregon Offshore Planning and Call Areas (U)

Dear Ms. Sumait,

As requested, the Military Aviation and Installation Assurance Siting Clearinghouse coordinated within the Department of Defense (DoD) a review of the Oregon Offshore Planning and Call Areas. The results of our review (as depicted in Attachment 1) identified an area within and adjacent to the Coos Bay Call Area that would adversely impact DoD's mission.

A large portion within and adjacent to the Coos Bay Call Area is incompatible for development due to existing classified infrastructure. DoD requests wind development be excluded to ensure this infrastructure is not discovered or damaged by the construction of wind energy facilities. The Department of the Navy also conducts low-altitude aviator training within Military Training Route IR-346. The DoD requests wind development be excluded in this area as wind turbines will conflict with the safe and effective use of the airspace for training. (See Attachment 1)

- DON POC: Matthew Senska: matthew.senska@navy.mil; 571-970-8400

The areas shown in yellow (See Attachment 1) lie within radar line of site of multiple North American Aerospace Defense Command (NORAD) radar sites and will degrade NORAD operations. Considering both the expected heights of offshore turbines and future cumulative wind turbine effects, these adverse impacts are potentially mitigatable through Radar Adverse-impact Management (RAM). For projects where RAM mitigation is acceptable, we ask that BOEM include the following in any sale notification and project approval conditions:

1) Project owner will notify NORAD 30-60 days ahead of project completion and when the project is complete and operational for RAM scheduling;
2) Project owner contribute funds to DoD of no less than $80,000 toward the execution of the RAM for each Radar system affected;
3) Curtailment for National Security or Defense Purposes as described in the leasing agreement.

These conditions shall be accomplished by the lessee entering into an agreement with the DoD. The DoD requests that BOEM require the developer to enter into an agreement to mitigate the identified impact. Sixth Generation Over the Horizon Radar is currently in development. Offshore wind turbines may create adverse impacts to that system, but are not definitive at this time.

- NORAD POC: Frederick Shepherd: frederick.l.shepherd.civ@mail.mil; 719-556-3260

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Thank you for the opportunity to coordinate on the Oregon Offshore Planning and Call Areas. We are providing the contact information for the affected missions to facilitate open mitigation discussions, but the Clearinghouse retains ovesight when official DoD input is required. If you have any questions, please contact me at steven.j.sample4.civ@mail.mil or at 703-571-0076.

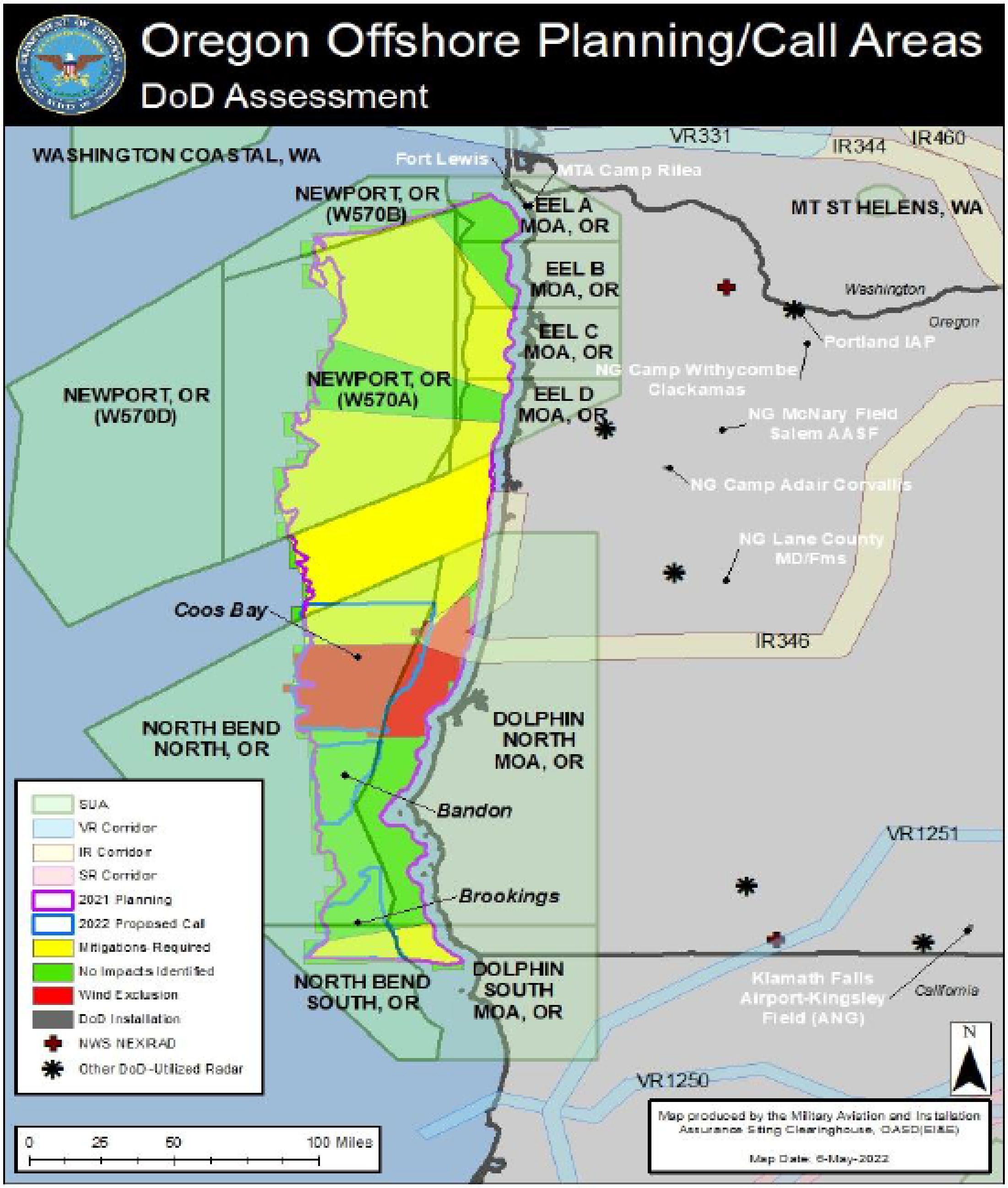
Sincerely,

Steven J. Sample
Executive Director
Military Aviation and Installation
Assurance Siting Clearinghouse

DRAFT

Attachment (1)

DOD Assessment Map of the Oregon Offshore Planning and Call Areas



Appendix I - Scoring Rationale

Table I-1. Data for constraints submodel, scoring, and rationale.

Data Layer	Score	Rationale for Score
Department of Defense - Exclusion Area	0	This zone contains existing classified infrastructure and national security features that are incompatible with wind energy development. This area was assigned a score of 0 for complete avoidance.
Pacific Coast Port Access Route Study (PACPARS)	0	These areas delineate activities and regulations for marine vessel traffic. Due to regulations, high and variable use, and needed avoidance, these fairways were assigned a score of 0 for complete avoidance.

Table I-2. Data for industry and operations submodel, scoring, and rationale.

Data Layer	Score	Rationale for Score
Submarine Cables with 0-500 m & 501-1,000 m setbacks	0.6 & 0.8	Submarine cables are responsible for many international and national communications as they are quicker than satellites. Many cables are also high voltage. These cable areas, along with a 500 m and a 501-1,000 m setback were scored a 0.6 & 0.8, respectively.
East-West Scientific Sampling Corridors 4-nm wide	0.01	This layer was used within the NMFS scientific surveys combined data layer for the Draft WEA suitability model. Due to the importance of these surveys, corridors were assigned a score of 0.01.
Additional East-West Scientific Sampling Corridors 4-nm wide	0.5	This layer was used within the NMFS scientific surveys combined data layer for the Draft WEA suitability model.
Scientific Survey Transects 1-nm wide	0.5	This layer was used within the NMFS scientific surveys combined data layer for the Draft WEA suitability model.

Data Layer	Score	Rationale for Score
Scientific Survey Stations 2-nm radius	0.5	This layer was used within the NMFS scientific surveys combined data layer for the Draft WEA suitability model.

Table I-3. Data for natural resources submodel, scoring, and rationale.

Data Layer	Score	Rationale for Score
Leatherback sea turtle exclusion area	0.1	This layer was used within the NMFS protected species combined data layer for the Draft WEA suitability model. A score of 0.1 was assigned based on species listing as endangered under the ESA and also has declining or small population trends.
Southern resident killer whale critical habitat	0.1	This layer was used within the NMFS protected species combined data layer for the Draft WEA suitability model. A score of 0.1 was assigned based on species listing as endangered under the ESA and also has declining or small population trends.
Humpback whale Central America DPS	0.3	This layer was used within the NMFS protected species combined data layer for the Draft WEA suitability model. A score of 0.3 was assigned based on species listing as endangered under the ESA and also has increasing population trends.
Humpback whale Mexico DPS	0.5	This layer was used within the NMFS protected species combined data layer for the Draft WEA suitability model. A score of 0.5 was assigned based on species listing as threatened under the ESA and also has increasing population trends.

Data Layer	Score	Rationale for Score
Blue whale exclusion area	0.2	This layer was used within the NMFS protected species combined data layer for the Draft WEA suitability model. A score of 0.2 was assigned based on species listing as endangered under the ESA and also has unknown population trends.
Essential fish habitat (EFH) conservation areas (EFHCAs) with 500 m setback	0.01	This layer was used within the NMFS habitat combined data layer for the Draft WEA suitability model. Due to the importance of this habitat, areas were assigned a score of 0.01.
Rocky Reef Habitat Areas of Particular Concern (HAPC) - Mapped with 500 m setback	0.01	This layer was used within the NMFS habitat combined data layer for the Draft WEA suitability model. Due to the importance of this habitat, areas were assigned a score of 0.01.
Rocky Reef Habitat Areas of Particular Concern (HAPC) - Probable with 500 m setback	0.01	This layer was used within the NMFS habitat combined data layer for the Draft WEA suitability model. Due to the importance of this habitat, areas were assigned a score of 0.01.
Deep-Sea Coral Habitat Suitability with 500 m setback	Cont.	This layer was used within the NMFS habitat combined data layer for the Draft WEA suitability model. Rescaling was conducted using the fuzzy logic Z-shaped membership function from 0.01–1.
Shelf Break with 10 km setback	0.6	This layer was used within the NMFS habitat combined data layer for the Draft WEA suitability model.
Methane Bubble Streams with 1 km setback	0.8	This layer was used within the NMFS habitat combined data layer for the Draft WEA suitability model.
Marine bird combined data layer	Cont.	Rescaling was conducted using the fuzzy logic Z-shaped membership function from 0.01–1.

Table I-4. Data for fisheries submodel, scoring, and rationale.

Data Layer	Score	Rationale for Score
At-sea hake mid-water trawl	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Shoreside hake mid-water trawl	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Groundfish bottom trawl	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Groundfish pot gear	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Groundfish longline gear	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Commercial troll/hook-and-line albacore	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Charter vessel albacore troll/hook-and-line	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Dungeness crab	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.
Pink shrimp trawl	Ranked Importance	This layer was used within the NMFS & ODFW fisheries combined data layer for the Draft WEA suitability model.

Table I-5. Data for wind submodel, scoring, and rationale.

Data Layer	Score	Rationale for Score
Levelized Cost of Energy for 2027	Cont.	As the cost of energy increases, compatibility decreases. Rescaling was conducted using a linear function from 0.8–1.