OREGON OCEAN SCIENCE TRUST SUMMIT REPORT

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MAY 11–12, 2016
NEWPORT, OREGON

Executive Summary

The Oregon Ocean Science Trust convened 45 ocean experts in Newport, Oregon May 11–12, 2016 to identify priority research and monitoring funding needs for Oregon's nearshore (territorial sea) area, scalable to budget resources available, that will provide baseline and trend data and inform key research questions related to changing ocean conditions as a result of climate change, marine habitat, and marine fish and wildlife populations as well as provide peer-reviewed science for state and federal agencies that have management responsibilities in the nearshore.

Representatives from the Oregon Department of Fish and Wildlife, Oregon State University, and Oregon Sea Grant provided a synthesis of key Oregon nearshore research and monitoring needs, then summit participants articulated and prioritized nearshore research and monitoring needs in four categories relating to the distribution and abundance of nearshore species and habitats, species and habitat associations and interactions, the effects people have on nearshore resources and the effects of nearshore resources on people and coastal communities; and the effects of climate change and ocean acidification on species and their habitats and ecological function.

Summit participants developed research questions to address priorities, focusing primarily on baseline information associated with nearshore species and habitats as well as key threats and stressors to the nearshore ecosystem, e.g., climate change effects, harmful algal blooms, and ocean acidification and how ecosystem function is affected by these threats and stressors.

Participants proposed two different approaches to nearshore monitoring. One approach would place a high priority on measuring ocean variability (La Nina and El Nino, HABs, hypoxia events, etc.) using gliders to provide the basic data and the context for any other research projects and management decisions, followed by secondary priorities to build and instrument shore-based stations that have ocean water intakes, and tertiary priorities to characterize the ocean by repeating the NH line on southern coast (an area that is currently not monitored). The second approach would measure physical, chemical, biological, and human parameters as well as both fishery-dependent and fishery-independent sampling, other types of uses (e.g., recreation), and recruitment and ocean variability.

The summit concluded with a discussion of the core elements of a comprehensive research and monitoring program focused on biodiversity, harmful algal blooms, and vulnerability/resilience, and based on biennial funding of less than $1 million, $1–3 million, and $3–5 million. Elements of a comprehensive nearshore research and monitoring program funded at less than $1 million per biennium, would start with base-level monitoring of physical parameters at coastal nodes, recruitment monitoring for species such as mussels and crab, seasonal boat-based abundance and distribution monitoring of rocky reef species, coast-wide socioeconomic monitoring, and data management, integration and synthesis. If $1–3 million were available per biennium, investigators would build on the previously described effort, adding boat-based surveys of rocky reef species for distribution and abundance information, conducting a benthic habitat inventory, expanding coastal monitoring nodes, conducting ship-based territorial sea sampling of biological, physical and chemical parameters, and conducting small-boat monitoring activities as well as species-level ocean acidification vulnerability research, predictive modeling of climate change vulnerability/ocean acidification impacts, and National Center for Ecological Analysis and Synthesis data integration and synthesis. For $3–5 million per biennium, investigators would build on the previously described work and expand monitoring of rocky reef species to obtain population assessments, launch a glider below Coos Bay, conduct expanded benthic habitat inventories, sample for pollutants, and enhance data integration and synthesis.

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OREGON OCEAN SCIENCE TRUST SUMMIT

May 11-12, 2016 Newport, Oregon

I. WELCOME AND INTRODUCTIONS

Louise Solliday, Chair of the Ocean Science Trust, welcomed everyone (a total of 46 people attended the summit – See Appendix A), emphasizing the importance of the summit to identify priority research and monitoring funding needs for Oregon's nearshore (territorial sea) area, scalable to budget resources available, that will provide baseline and trend data and inform key research questions related to changing ocean conditions as a result of climate change, marine habitat, and marine fish and wildlife populations as well as provide peer-reviewed science for state and federal agencies that have management responsibilities in the nearshore.

Gabriela Goldfarb from the Oregon Governor's office emphasized the importance of informing near-term ocean management decisions. She described the recommendation of the Nearshore Resources Task Force as a key driver in the creation of the Ocean Science Trust, acknowledging the presence of two legislators at the summit as a signal of the importance of the summit. Goldfarb described the pressing issues facing Oregon's nearshore and the need for both human dimensions and physical sciences to inform management decisions.

II. KEY OREGON NEARSHORE RESEARCH AND MONITORING NEEDS

Current nearshore research and monitoring needs were presented by representatives from the Oregon Department of Fish and Wildlife, Oregon State University, and Oregon Sea Grant.

Caren Braby, Oregon Department of Fish and Wildlife Marine Resources Program Manager, characterized the difficulty of sampling in Oregon's nearshore, but noted the importance of the nearshore to Oregon's sport and commercial fisheries (e.g., Dungeness crab fishery is largely centered in the nearshore). Lack of people, resources, and solutions drive the need to work with many partners and in numerous management venues. Federal partners rely on Oregon entities to be experts on species that exist in the nearshore, thus it is important to have an actionable strategy to make strategic investments in nearshore research and monitoring. ODFW's nearshore strategy is a State Wildlife Action Plan (SWAP) completed in conjunction with the US Fish and Wildlife Service to ensure ODFW is eligible for federal funding. The strategy is not a strategic plan – it's a statement of what is important and what opportunities exist to help frame nearshore issues, and it includes education and outreach, research and monitoring, and management and policy strategies – the purpose of the summit is to focus on research and monitoring. The nearshore strategy has been used in policy discussions, e.g., renewable energy siting.

Francis, Chan, Associate Professor, Senior Research, Department of Integrative Biology at Oregon State University, discussed his role as co-chair of the West Coast Ocean Acidification and Hypoxia Science Panel, which was convened by the California Ocean Science Trust. The panel, which consisted of 20 scientists, was charged with advancing understanding of developing options for addressing ocean acidification. They formulated 14 actions that could be accomplished within the next two years.

The goals of the panel were to make science accessible to everyone and create an achievable road map that has impact. It was noted that the scale of what is available to use is mismatched to the information available. Monitoring should:

- Be relevant to management, and scientists should work collaboratively to identify gaps.
- Be question driven – what will it inform?
- Include ecosystem monitoring – simply monitoring the chemistry or fish populations alone is insufficient.
- Build from what currently exists.
- Recognize that it's about the people that interpret the data.

Relative to research priorities:

- The numbers and effectiveness of solutions are proportional to existing knowledge.
- Current funding is unlikely to provide the resources necessary to implement priorities. There is a disconnect between what we are generating and what we need to manage.
- The focus is on developing models – we want to be able to evaluate effectiveness. Models have to be validated.
- Research priorities should address exposure, vulnerability, and adaptive capacity.
- The effectiveness of mitigation approaches should be evaluated.

The panel report was released in April of 2016, and outreach has occurred with decision makers, Ocean Policy Advisory Council (OPAC), National Oceanic and Atmospheric (NOAA) administrators (regionally and in DC), and the Environmental Protection Agency (EPA).

Of the 14 action items proposed by the panel in April of 2016, seven are currently being acted upon (e.g., revision of water quality criteria – a bill in California has been introduced to revise water quality criteria). Chan emphasized the importance of prioritizing opportunities and where disproportional impact exists.

Shelby Walker, Oregon Sea Grant Director, discussed the four new thematic areas Oregon Sea Grant has developed:

- Ecological, social, and economic aspects of coastal development
- Adaptation to acute or chronic coastal hazards
- Human and natural dimensions of coastal and marine fisheries
- Cultural beliefs, learning, and valuation of coastal and marine issues

She noted the importance of considering cumulative, synergistic effects versus a single-species focus, integrating the natural and social sciences, and bringing together tools and models as part of a comprehensive synthesis of information. Walker described the balance of long-term investments with short-term flexibility to address emerging ocean issues, and noted the National Science Foundation is investing in a 25-year ocean observing initiative. There is a scale mismatch that exists – we know something about so few places in the nearshore to assess vulnerability. She also emphasized the importance of partnerships.

III. TOP PRIORITIES FOR OREGON'S NEARSHORE RESEARCH AND MONITORING

Summit attendees were asked to convene in three small breakout groups to describe Oregon's top nearshore research and monitoring priorities in four categories, characterizing the research priorities as questions:

I. Distribution and abundance of nearshore species and habitats.

II. Species and habitat associations and interactions that exist in the nearshore to inform ocean health (ecosystem function).
III. The effects people have on nearshore resources and the effects of nearshore resources on people and coastal communities.
IV. The effects of climate change and ocean acidification on species and their habitats and how these key stressors will influence ecological function and species in nearshore habitats in the future.

A. RESEARCH

The compilation of the breakout groups is described by theme within each of the four categories:

I. DISTRIBUTION AND ABUNDANCE OF NEARSHORE SPECIES AND HABITATS

What is the geomorphology, oceanography, species present (including key priority focal species), and physical and biological habitats in the nearshore?

- **Methodologies/technologies**
  - What are non-traditional user-informed methods as well as best survey methodologies/new technologies of collecting information on distribution and abundance of nearshore species and habitats (e.g., age structure and life history)?
  - How do we map all habitats, and what are the best methods? How do we understand the variability? What are they key gaps? How do we map the inner shelf?
  - How can we combine research and monitoring efforts to analyze multiple phenomena simultaneously?
  - How can we use species to help describe habitats?
  - Are there key surrogates or proxies?
- **Habitat shifts**
  - Are benthic/pelagic habitats and species shifting (e.g., geospatially) (compared to historical patterns), will they shift over time and how (e.g., variability), and how does this knowledge relate to economics, business, culture and policy decisions?
- **Data**
  - How can we use fishery-dependent data to improve our monitoring efforts?

II. SPECIES AND HABITAT ASSOCIATIONS AND INTERACTIONS THAT EXIST IN THE NEARSHORE TO INFORM OCEAN HEALTH (ECOSYSTEM FUNCTION)

- **Harmful Algal Blooms (HABs)**
  - What ocean conditions and their drivers lead to HABs, and where and when are areas most susceptible to HABs (e.g., off shore vs. shoreside impacts)?
  - How do we communicate with people about HABs?
- **Food web relationships**
  - What is the relationship among ocean conditions and fishing behavior on forage fish abundance?
  - What are the impacts and changes in forage fish abundance?

- How does the species-specific food chain influence production?
- What are the roles of copepods, kelp, larval plankton, top level predators (marine birds), juvenile fish, forage fish, xxx species in specific habitats, and how do management actions affect these interactions?

- **Recruitment**
  - What causes variability in recruitment and does it correlate to marine organism abundance?

- **Habitats**
  - What are the habitat characteristics/features that correlate to/index with fish stocks?
  - What are the habitat types (oceanic, atmospheric, physical) that exist in the nearshore, and where are they physically located?
  - What are the connections among habitats, and what are the indicator species (and their competition/interactions) that will help identify the connections and inform management?
  - What are the important, sensitive or unique species and habitats within the nearshore, from an ecological and economic perspective, and do we understand ecological succession to assess the effects of individual species over time?
  - What are the drivers (habitats, physical processes< abundance of food) for species distribution and abundance?
  - What specific habitats are limiting?

- **Species-habitat associations/interactions (including people)**
  - What is the strength and persistence of species-habitat association in time and space?
  - What are the primary drivers of shifts in species-habitat associations and interactions?

- **Ecosystem Function**
  - What aspects of ecosystem functions are most important?
  - What aspects of food web nodes, including forage fish and other key species, are most critical to monitor?
  - How do invasive species effect the ecological function of the nearshore?

III. THE EFFECTS PEOPLE HAVE ON NEARSHORE RESOURCES AND THE EFFECTS OF NEARSHORE RESOURCES ON PEOPLE AND COASTAL COMMUNITIES

- **People**
  - How do people relate to protected areas and the ocean generally, and do changes in ocean literacy change policy and individual behavior?
  - What are the demographic and/or behavioral changes we can anticipate in Oregon, and how do these changes influence how we value and impact ocean resources i.e., invasive species (shifting coastal uses)?
  - What are the effects of human development on nearshore resources and uses?
  - What other factors affect people on the coast?

- **Pollution**

- Are there places on the Oregon Coast where estuarine inputs influence ocean chemistry greater than ocean upwelling (OA), where anthropogenic input outweighs natural offshore changes?
- What are cumulative impacts of non-industrial, non-point source pollution in the nearshore/mouth of estuary?
- What are the impacts of land use on water quality in the nearshore and potential synergistic effects with climate change?
- What is the spatial distribution of pollution inputs on the Oregon coast?

- **Fisheries**
  - What are the effects of fisheries and fisheries management on coastal communities?
  - How does fishing pressure affect marine populations?
  - How do we understand perceived conflicting fisheries management strategies on the fishery resource?

- **Ecosystem Services**
  - What is the spatial distribution of ecosystem services derived from the ocean and how does this distribution change with changing climate and demographics?

- **Climate change**
  - How will climate change impact the amount, timing, and location of contaminants entering the ocean? How do these changes relate to threshold impacts? How do perceptions of mitigation strategies influence strategy acceptance?
  - How will climate change affect distribution and equity of people in Oregon?

IV. THE EFFECTS OF CLIMATE CHANGE AND OCEAN ACIDIFICATION ON SPECIES AND THEIR HABITATS AND HOW THESE KEY STRESSORS WILL INFLUENCE ECOLOGICAL FUNCTION AND SPECIES IN NEARSHORE HABITATS IN THE FUTURE.

What and where are the primary manifestations of climate change expected on the Oregon Coast?

- **Climate Change Impacts**
  - What are the synergistic impacts on organisms and habitats of the key manifestations of climate change?
  - What are the detectable cultural changes that are manifesting in our communities as a result of climate change?
  - What is the correct spatial and temporal scale to monitor changes?
  - What are projections for climate change vulnerability/ocean acidification (CCV/OA) and variability for Oregon's nearshore?
  - Are there places that are more/less susceptible to CCV?
  - How are species affected by CCV/OA? What are the sentinel species to indicate CCV/OA effects?
  - What are economic, cultural, and political impacts of CCV/OA?
  - Can we mitigate for or adapt to the direct and indirect impacts of harmful CCV/OA?
  - How can we use collaborative research and citizen science to gather climate change data?

- **Ecological Function**
    - What is the most impactful research to understand ecological function in Oregon territorial waters?
    - What are the key indicators for specific habitats?

B. MONITORING

Breakout session participants discussed what, where, and how to monitor Oregon's nearshore to inform key management decisions. There was discussion about considering major events in which managers needed data and information, but that information may have been missing. Examples of such events include hypoxia, domoic acid and crabs, in-season closure of nearshore fisheries, oyster production and ocean acidification, ocean energy permitting, poor salmon returns, hypoxia events, marine reserve siting, groundfish collapse, RCA closures, harmful algal blooms and seabird die-offs, clam closures.

It was noted that any new measurements taken should fully integrate with Integrated Observing Systems, and that a key first step may be to compile an organized catalog of existing datasets to identify data gaps as well as existing resources (e.g., the National Marine Fisheries Service California Current report could provide examples of potential indicators; tribal sovereign nation members may collaborate on historical and future use of specific sites).

To address **what is measured**, two approaches were offered:

A. One approach would place a high priority on measuring ocean variability (La Nina and El Nino, HABs, hypoxia events, etc.) to provide the basic data and the context for any other research projects and management decisions. Such an approach would require that measurements be integrated with existing ocean observing systems. Physical parameters (temperature, salinity, conductivity, DO, pCO2, velocity) would be collected at 6–7 sites using gliders. The second priority for this approach would be to build and instrument shore-based stations that have ocean water intakes. The third priority for this approach would be to characterize the ocean by repeating the NH line on southern coast (an area that is currently not monitored).

B. The second approach would measure physical, chemical, biological, and human parameters as well as both fishery-dependent and fishery-independent sampling, other types of uses (e.g., recreation), and recruitment and ocean variability.

- Physical and chemical parameters (EOV's)
    - Temperature, salinity, ocean nutrient distributions (nitrates, etc.), dissolved oxygen, pCO2, velocity, pH, alkalinity, chlorophyll fluorescence, light, emerging contaminants (see research priorities), conductivity

- Biological Parameters (Biological EOV's)
    - Key indicator species at multiple trophic levels (seabirds, marine mammals, etc.) – process to identify these or adopt existing indicator framework, recruitment, HABs, essential biodiversity variables

- Human Parameters

        - Use patterns, land use, cultural and historical value, economic contribution to coastal communities, attitudes/perceptions WRT the ocean, Surfrider Foundation, Oregon Parks and Recreation Department, counties
        - Demographic data

    - Fishery-dependent sampling

    - Consider other users (recreational, etc.)

    - Fishery-Independent Sampling of Nearshore Rocky Reef Species – Other monitoring priority to inform stock assessments
        - Abundance and distribution, stock assessments, habitat mapping (including benthic zone)

<u>Recruitment variability</u>
- Effort shift in fisheries behavior as well as physical and chemical factors

<u>Ocean variability</u>
- La Nina and El Nino, etc., HABs, hypoxia events

To address **where measurements** occur, participants proposed the following:
- Each biogeographic region along the Oregon coast - border to border oceanographic cruise to characterize spatial differences
- Map of Oregon coast (Appendix B) showing ship surveys, coastal nodes and glider lines
- Intertidal areas to beyond the Territorial Sea (e.g., 80 meters)
- Outer Continental Shelf
- Political boundaries, counties, population centers as they relate to the map in Appendix B
- Existing marine reserves (4 out of 5 of Oregon's marine reserves exist within the areas currently surveyed by ships, coastal nodes and gliders)

Participants addressed **how often we measure**, noting it depends on the variable being measured, and discussing the need to independently gather physical and human dimensions data in the winter, and at a minimum, quarterly or during the winter/summer.

Participants discussed ways to **report results**. Participants proposed the Ocean Science Trust convene a two-day workshop with scientific investigators to:
- Assess data gaps and data sharing challenges to inform information sharing of long-term datasets and data collection to build information products and tool development (data portal); support the collection of long-term data sets that inform the status of the state of the Oregon coast and thus are capable of informing management decisions.
- Review and consider using the NMFS California Current Integrated Ecosystem Assessment (IEA) report, Puget Sound Partnership Vital Sign Indicators, and Baja to Bering as potential frameworks
- Identify a manager for State of the Coast datasets
- Possible data catalog system, environmental report card
- Social vulnerability and resilience analyses
- Identify key data gaps

Participants noted that for less than $1 million per biennium, the state would receive a snapshot of information, with some spatial distribution and seasonal variability. For $1-3 million, the state would receive an enhanced snapshot with more sampling that could include demographic and economic changes. And for $3–5 million, more data layers could be added, e.g., habitat, genetic, species, age-structure variability, and that longer-term sampling could be achieved.

C. A COMPREHENSIVE RESEARCH AND MONITORING PROGRAM FOR OREGON'S NEARSHORE

A comprehensive research and monitoring project design that included three themes (Biodiversity, HABs, Vulnerability/Resilience) was proposed:

Elements of **Emerging Technologies, Methods, and Innovation:** Imaging tech, DNA analysis, fisheries-independent methods, recruitment, and pollutants.

Pollution & CCV/OA—What are human impacts on nearshore environment, especially pollution-related impacts?

- Distribution of existing and emerging pollutants (pilot studies)
    - Synergistic and cumulative impacts of pollutants on key species (e.g., keystone species, commercially important species, humans)

The three levels of funding for the comprehensive program area additive, and would include:

$<1 MILLION PER BIENNIUM

Monitoring: (See Appendix A as a reference)

- $50-100K per coastal monitoring node (one site) (pH/alkalinity, salinity, temp., etc.)
- $20K per site for recruitment monitoring (Crab, mussels, etc.)
- $100K per site per season for boat-based abundance and distribution monitoring of rocky reef species (reference site(s)/expandable) – fishery independent sampling
- $100K for coast-wide socioeconomic monitoring

Research:

- $50K socioeconomic study
- $100K Data management
- Data integration and synthesis

$1–3 MILLION PER BIENNIUM

Monitoring:

- $200K for boat-based abundance and distribution monitoring of rocky reef species (expand to 3 sites)
- $300K per year for benthic habitat inventory (locations TBD)
- $300K per coastal monitoring node (Expand to six sites)
- $100K per year (two sites, two surveys/year) for ship-based territorial sea sampling of biological parameters

- $100K per year (two sites, two surveys/year) for ship-based territorial sea sampling of physical and chemical parameters
- $100K for small boat for monitoring activities ($2-4K per day and 20 days min. a year)
- Limited availability of state-funded research vessel research (then $25K/day)

Research:

- $100K per year for species-level OA vulnerability research
- $50-100K per year predictive modeling of CCV/OA impacts
- $250K for "lite" National Center for Ecological Analysis and Synthesis (NCEAS)-style data integration and synthesis (GIS)

$3-5 MILLION PER BIENNIUM

Monitoring:

- $200–500K for boat-based abundance and distribution monitoring of rocky reef species (expand to 5 sites or coast-wide at upper budget level) – population assessment of rocky reef species
- $150K for glider line off Cape Blanco (no current gliding below Coos Bay)
- $300K per year for benthic habitat inventory (locations TBD)
- $300–$500/sample for pollutant monitoring

Research:

- $250K per year NCEAS-style data integration and synthesis

APPENDIX A. SUMMIT ATTENDEES.

Laura	Anderson	Member	OST	laura@localocean.net
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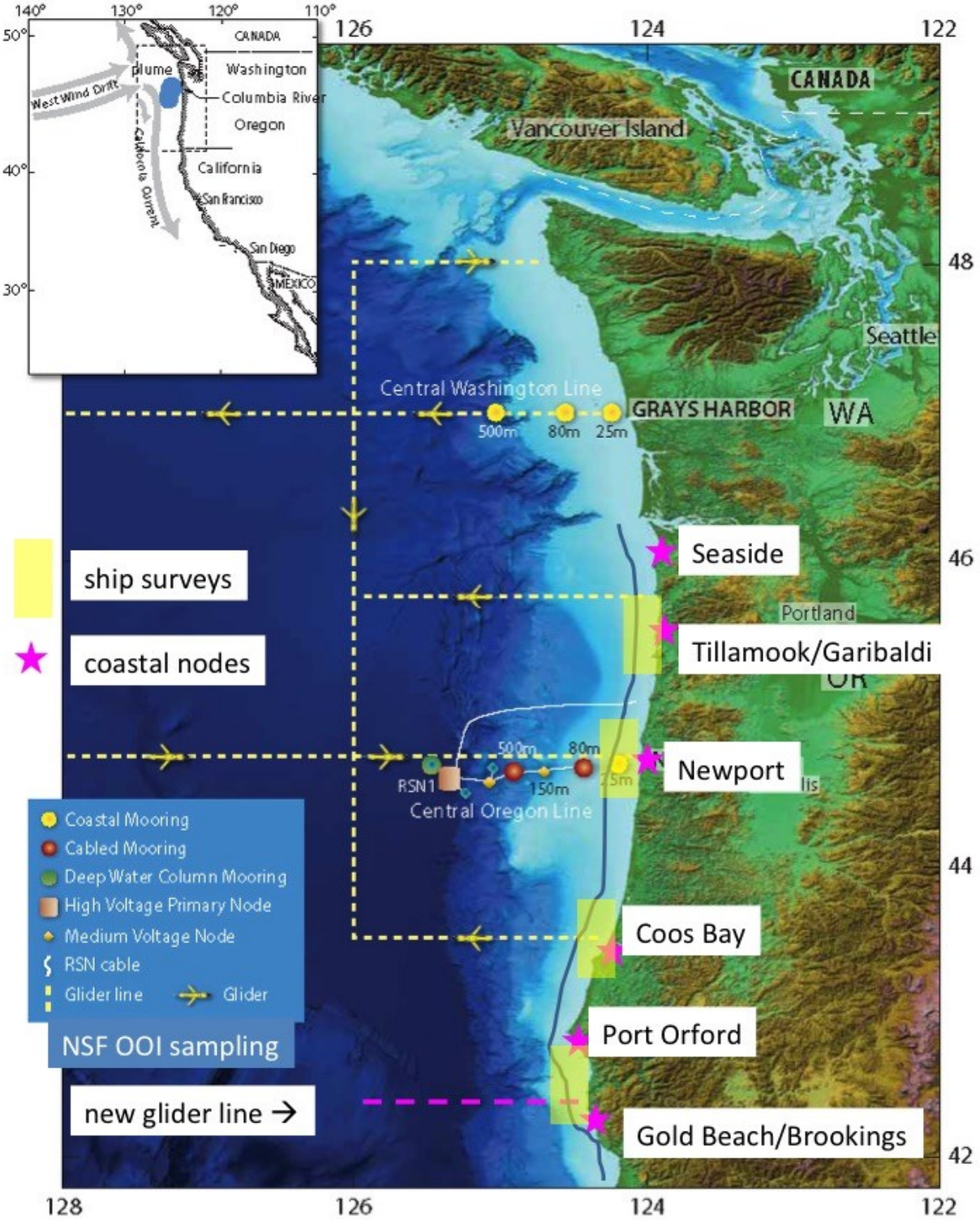
APPENDIX B. POTENTIAL REPRESENTATIVE SITES FOR MONITORING OREGON'S NEARSHORE.



Existing Trinidad Head (41° 3.5'N) glider (NANOOS/CeNCOOS/NOAA)