MEMORANDUM OF AGREEMENT
THROUGH WHICH
THE WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
IS PURCHASING SERVICES FOR
INDICATOR DEVELOPMENT and ECOSYSTEM ASSESSMENT FOR THE WASHINGTON MARINE ECOSYSTEM
FROM
NORTHWEST FISHERIES SCIENCE CENTER/NMFS
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION/
U.S. DEPARTMENT OF COMMERCE
Agreement 14-260

PARTIES AND PURPOSE

1) This Memorandum of Agreement (MOA) establishes an agreement between the Washington State Department of Natural Resources (herein after referred to as "DNR") and the Northwest Fisheries Science Center (NOAA Fisheries), National Oceanic and Atmospheric Administration, U.S. Department of Commerce (herein after referred to as the "NWFSC"), through which DNR will pay NWFSC to develop a conceptual model of the structure and functional ecological properties for the marine waters of Washington state, and collate and evaluate a list of ecological indicators that reflect status and trends in Washington's marine waters.

2) The purpose of this MOA is to establish the conditions under which NWFSC shall provide analytical capacity and technical support for marine spatial planning to DNR, as detailed in the attached Statement of Work (SOW), and to define how funds will be transferred to cover the costs involved with these services.

Scope of Work

1. Background and Objective

The Northwest Fisheries Science Center Ecosystem Science Program (ESP) developed a list of candidate indicators using an approach modified from Kershner et al. (2011). These and a set of draft conceptual models representing the outer coast of the Washington Marine Ecosystem were presented to stakeholders at a workshop in May 2013 and delivered to the state marine spatial planning (MSP) staff in June. The ESP will continue to refine our portfolio of ecological indicators based on input from state MSP staff and outcomes from the workshop. We will develop new conceptual models for estuaries, further refine the initial draft ecological indicators, and clarify linkages between conceptual models and ecological indicators. An effective indicator portfolio should:

- be grounded in conceptual models of Washington's marine and estuarine ecosystems
- provide a snapshot of the overall health of those ecosystems
- provide an early warning of negative trends so that corrections can be made quickly
- show the impacts of new or ongoing management strategies
- transparently reveal how funding for management actions produces results

2. Tasks and Deliverables

- **Task 1: Conceptual Model Development**

The ESP developed base conceptual models representative of structural/ compositional elements and dynamic functional properties of the system. These base models depict interactions with human pressures and activities, ecological interactions, and environmental drivers, within five habitat types (sand/gravel beach, rocky intertidal, kelp forest, seafloor, pelagic). This was the first step in developing a consensus regarding components and linkages.

There was also a great deal of interest in more specific characterization of estuaries (which were outside the scope of the initial work), so the ESP will develop additional models for Grays Harbor and Willapa Bay estuaries. Estuaries are an important ecological component of the Washington Marine Ecosystem, differ substantially from the dynamic ocean environment and are influenced by different environmental drivers. They are also high use areas, link strongly to people's livelihood, and are have more diverse competing resource use interests. Stakeholders are likely to be very engaged and interested in marine spatial planning efforts here. The estuaries have relatively small footprints – which makes it feasible for us to incorporate local knowledge and regional expert opinion.

A. Refine conceptual models of the marine waters of Washington state by incorporating new information and feedback from the state MSP staff and regional experts. (from 2013 workshop)

B. Develop conceptual models for Washington state coastal estuaries
    1) Build draft conceptual models for Willapa Bay and Grays Harbor and deliver to state MSP staff. Finished models include overview, and submodels of human pressures, ecological interactions, and environmental drivers.
    2) Develop a list of potential estuarine indicators and objectively evaluate.
    3) Conduct an estuary conceptual model webinar in June 2014. The purpose of the webinar is to review the draft estuary model and related indicators and collect input from

participants to refine the estuary component in the conceptual models. Marine Spatial Planning staff, with help from the MSP Science Advisory Panel (SAP), will work with the ESP team to identify estuary webinar participants. The state MSP team will help plan the webinar and distribute background materials, and the ESP team will host the webinar.

4) Incorporate feedback from estuary webinar into conceptual models and indicators.
5) Explicitly link key indicators to the estuary model, and identify key links between the marine and estuary models.
6) Consult with state MSP team on ecological indicators and models as needed through June 2015.

Deliverables:

- Conceptual models for the marine habitats of the Washington coast and estuarine habitats of Washington coastal estuaries.
- List of draft estuarine indicators (August – October 2014).
- Quarterly progress reports to the State Ocean Caucus and as an attachment to each invoice.

• Task 2: Candidate indicator evaluation and mapping

A. Finalize ecosystem indicators
   1) Incorporate changes and suggestions from the Ecological Indicators workshop.
   2) Conduct a more in-depth evaluation of data availability, relationships between indicators, compatibility, response time and specificity, and cost of monitoring.
   3) Finalize ranked list of candidate indicators that link explicitly to conceptual models.
B. Create maps that show link between habitat attributes and indicators on the seascape.
C. Provide updates and overview on conceptual models and indicators to the State Ocean Caucus (quarterly) and the Washington Coastal Marine Advisory Council throughout and incorporate feedback where appropriate.
D. Provide all materials to Sea Grant for scientific review. Following scientific review, ESP will address reviewer comments.

Deliverables:

- Maps linking habitat attributes and indicators on the seascape. (September 2014)
- Presentations to the State Ocean Caucus and Washington Coastal Marine Advisory Council as needed (July-September 2014)
- Background information provided to Sea Grant for scientific review and summary of response to reviewers' comments. (October 2014 – January 2015)
- Final list of candidate indicators. (November 2014)

• Task 3: Washington coast status and trends analysis

A. Collaborate with the state MSP team and the Science Advisory Panel (SAP) to collect time series data for key ecological indicators from existing efforts (California Current IEA) and other sources.
B. Participating in regular meetings and check-ins with planning staff.
C. Work with state MSP team to define product format and style
D. Prepare final overview of status and trends of ecological indicators on the Washington coast.

Deliverable:

- Mid-project report on status and trends of ecological indicators
- Report on the status and trends of ecological indicators (March 2015)

- **Task 4: Graphic design**

  The NWFSC communications group will work with the ESP and state MSP teams to develop printable models, maps, flowcharts, and diagrams.

  Deliverables (all by October 2014):

  - Printable graphic (PDF) versions of pictorial version of each model and submodel (i.e., 6 habitat types, 3 interaction models each), and indicator linkages
  - Poster-sized (PDF) versions of these models and maps
  - Printable (PDF) versions of box-style flowchart diagrams (models, interaction submodels, indicator linkages) with species pictures/images integrated into the diagram for easy visual recognition