Olympic Coast National Marine Sanctuary Advisory Council
OCNMS Moorings Working Group
July 12, 2012
University of Washington/Applied Physics Lab

In attendance: Jan Newton (Chair, UW & NANOOS), John Mickett (UW-APL), Jennifer Hagen (Quileute Tribe), Simone Alin (NOAA), Ryan McCabe (UW Ocean), Emillio Mayorga (UW-APL & NANOOS), Sarah Giddings (UW Ocean), Henry Cheng (DFW), Joe Schumacker (Quinault Indian Nation), Sandra Brooke (Marine Conservation Inst.), Steve Joner (Makah Tribe), George Galasso (OCNMS), Liam Antrim (OCNMS)

Meeting Goal: to define science needs that OCNMS moorings can provide and to give input on current design, future needs, and recommendations.

→ Research briefs were provided by some of the oceanographers:

- Dr. Mickett reviewed new findings from Cha'ba buoy data - significant internal waves on 12-h intervals, substantial energy and mixing throughout the water column – indicating there is much to learn about the complexity of the coastal system, and that the nearshore data would be useful for this.
- Dr. McCabe described his and Dr. Hickey's research on cross shelf circulation, with a mooring installed about 2003-2007 but that had no current measurements. He noted the rich data set from the OCNMS data and it's utility to assess water properties that would be associated with different current patterns (e.g., low salinity with northward advection of Columbia R. plume).
- Dr. Alin described PMEL cruises in 2007, 2011, and 2012 working on developing and testing an aragonite saturation model/algorithm for the WA coast. She said more work is needed in areas of hypoxic conditions, which are most likely to experience acidic ocean waters, and noted the potential for the OCNMS data to aid this research.
- Dr. Giddings and Dr. MacCready are modeling the region south of 43 degrees latitude, looking at algal blooms. In general, there is little oxygen data, and OCNMS' data are useful for model validation.

***A recurring theme was that there are limited financial resources for oceanographic study in this area and also insufficient resources for data analysis.***

→ Discussion then focused on identifying priority science needs that the OCNMS mooring data could provide. Science needs described by the group included the need to study:

- behavior of internal waves as these come inshore (Mickett)
- water properties as these relate to fish extraction and habitat (Hagen)
- empirical relations between hypoxia and ocean acidification (OA) status (Alin)
- Columbia River plume dynamics in the nearshore (McCabe)
- mooring data for model verification/validation (Giddings)
- fish habitat quality (Cheng)
- how fish kills in discrete areas may link with hypoxia and OA (Schumacker)
- predictive capacity for climate change (Brooke)
- what conditions correlate with successful fish runs; avoid by-catch (Joner)

→ Dr. Newton provided a summary of preliminary results from the OCNMS mooring data that was conducted by Dr. Neil Banas (UW), who could not attend the meeting but sent his plots. The plots of near-surface chlorophyll, near-bottom oxygen, and oxygen versus temperature revealed variation on seasonal, interannual, and spatial scales. Of note, the spatial patterns of chlorophyll showed along-coast variation that did not stay consistent between the years. The along-coast variation in oxygen was more consistent, but an interannual variation was evident. These very preliminary views offer that the moorings are picking up signals of variation in time and space, and thus that locations or deployment periods are not redundant.

***The general conclusion was that the OCNMS moorings have provided a rich data set, with appropriate placement of sensors in the water column and along the coast. Group members placed high value on the timeseries data.***

→ Further discussion of the moorings was divided into six topic, presented in order discussed:

1. System design – time, space, and sampling frequency
2. Mooring design – optimal sensors deployed
3. Science and data analysis priorities
4. Data delivery and access – data format and visualization of analyses
5. Support for the OCNMS mooring program – how to advocate for adequate funding
6. Analysis useful for management applications

1. System/program design:

- The existing time series from these locations leads to the group's support for the continuation of these (or similar, if needed) stations. Data are sparse in this area, so this multi-year timeseries is very precious.
- The Quinault Canyon is origin of some events (e.g., hypoxia on shelf waters) so this supports moorings deployed in that area.
- The 15m moorings are useful for assessing cross-shelf water properties.
- Placement in areas with fishery restrictions could reduce interaction with this industry (relevant to high rate of mooring loss from 65m locations).
- Addition of deeper locations would provide data most useful for fisheries questions.
- Year round deployment and data acquisition would be ideal. John Mickett offered to provide a mooring design for year-round deployment, if this path is followed.

***In summary: No specific recommendations were offered for changing from the current mooring locations.***

2. Mooring design:

- Temperature and oxygen data are useful for supporting the PMEL algorithm for aragonite saturation.
- Parameters currently being monitored are appropriate; especially temperature, salinity and oxygen are key parameters.
- There is desire to add plankton monitoring, but technology for this is neither simple nor inexpensive.

[*N.B. After this meeting, OCNMS staff noted that for 2010-2012 OCNMS have collected surface plankton samples at the 15m stations and provided to Anthony Odell (UW ONRC) for analysis.*]

- There is a strong desire for real time data transmission or surface download capacity; this would require additional investment for these improvements.
- ADCP (Acoustic Doppler Current Profiler) sensors are recommended.
  [*N.B. After this meeting, OCNMS staff noted that OCNMS has one ADCP sensor that was loaned to UW for incorporation on the Cha'ba mooring at La Push, WA. OCNMS has requested that this ADCP be returned in 2013 and deployed as part of the OCNMS mooring array in 2013.*]
- Taking full water column profiles with a CTD during mooring servicing would be useful.
  [*N.B. After this meeting, OCNMS staff noted that full water column CTD profiles (with DO and chlorophyll) have been a routine practice when servicing the moorings but the data have not been served as along with the mooring array data, though there are plans to do so. When hypoxic conditions are observed OCNMS has a protocol for additional full water column profiles to be collected over a pre-determined wider area stations to determine geographic extent of the event. In 2012 OCNMS had such an event and these additional stations were monitored weekly for approximately 6 weeks.*]

***In summary: The current sensor design, although additions/improvements are desired, is appropriate and useful for many applications; however, not having access to real-time data limits other applications. Investment in this improvement is recommended if funding can be identified.***

3. Science and data analysis priorities:
In addition to the items identified early in the discussion (p. 1)

- A major theme was the need to increase our understanding of hypoxic events and links to fish kills, ocean acidification, and coincidence with shellfish larval pelagic periods.
- A goal is to use these data to understand these dynamics well enough to improve predictive capacity.
- The spatial and temporal coverage of the data would allow for investigation of interannual variation and spatial differences along the coast, and may facilitate identification of the underlying drivers of variation.
- While the current data set is rich, data are also needed from deeper areas in order to assess conditions of deep sea habitats, corals, hypoxic events, and aragonite saturation.

4. Data delivery and access:

- Rapid data sharing is critical to enhance data utility.
  [*N.B. Subsequent to this meeting, significant progress on this item was made. See footnote 1 at end of this document.]*
- ASCII files are useful for data sharing, especially by scientists.
- Visual presentations of summarized / analyzed data are useful for management discussions.
- A basic summary of mean/minimum/maximum values of a time period (daily, weekly, etc.) would be useful.
- Quality control validation – there is need to review current process used by OCNMS.

5. Support for the OCNMS mooring program:
   - Support for maintenance of the current program is critical and a priority. How can we best get the word out that these data are valued and sustained funding is required?
   - Improvements cannot be made unless stability of program is assured.
   - As resources allow, encourage testing of new sensors under development.

6. Analysis useful for management applications:
   - Fisheries Management: Data are useful for linking oceanographic conditions with specific fish natural history events, e.g., fish spawning; salmon smolts entering marine waters (and survival); survival and productivity under different temperature regimes.
   - Natural Resources: Data are useful for linking oceanographic conditions with plankton abundance cycles and harmful algal bloom occurrence.

→ We then focused the discussion on what our consensus was for an "ideal" mooring program.

**An ideal mooring program would have:**
- Year-round deployment
- Inductive (real-time) data delivery (either radio for real-time data transmission or surface port for data download without mooring recovery and re-deployment)
- Additional sensors: ADCP for near full water column current profile; oxygen near the surface; plankton sensors
- Additional coverage: deeper moorings (farther off shore)

→ The working group felt substantial progress was made in the course of the discussion. They also identified additional topics that would have utility.

**Future meeting topics could focus on:**
1. Reviewing OCNMS' quality control procedures
2. Assessing improvements to the current mooring design
3. Developing an optimal mooring design
4. Improving data access[1]

[1]Subsequent to the July 2012 meeting, significant progress was made regarding data access: The moorings web page on the OCNMS portal now features an area for accessing mooring data: http://olympiccoast.noaa.gov/science/oceanography/oceanographic_moorings/oceanographic_moorings_data.html

In addition, a link to this web page is available via the NANOOS Visualization System (NVS): http://www.nanoos.org/nvs/nvs.php?section=NVS-Assets&infoWindow=action::auto_open||asset_class::mloc||tab::observations||asset_id::OCNMS_Transects

The current presence of this asset on NVS does not make the data directly accessible, per se, as users are referred to the OCNMS web page, but it makes the OCNMS mooring program integrated and discoverable within NANOOS and IOOS. This also makes the OCNMS moorings

directly a part of the NANOOS monitoring asset inventory, with inclusion into regional and national "gap analysis" efforts.