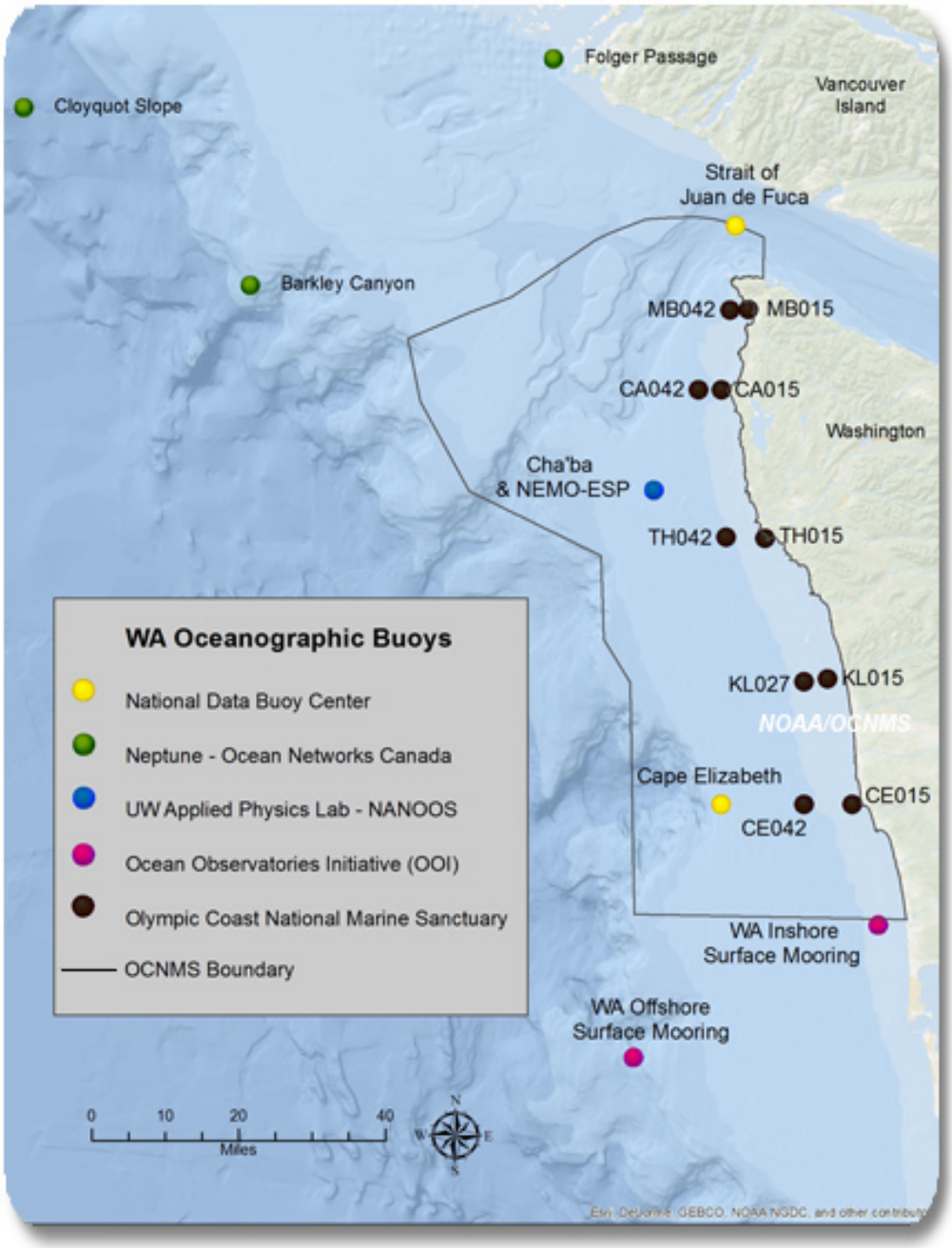


Exploring Options for an Olympic Coast Ocean Acidification Sentinel Site (OASeS)

Workshop Report

September 2016

Contents

Introduction

The evidence for ocean acidification in the Pacific Northwest is compelling. A combination of factors renders the Washington coast and coastal estuaries particularly vulnerable to acidified water. One of the most important regional factors contributing to ocean acidification is coastal upwelling, which brings offshore water that is rich in carbon dioxide and low in pH up from the deep ocean and onto the continental shelf. According to a recent assessment of the U.S. communities most vulnerable to ocean acidification, the Pacific Northwest is at high risk of economic harm, where corrosive waters are already negatively affecting Washington's $270 million shellfish aquaculture industry. Ocean acidification has the potential to seriously threaten the future health of the Pacific Northwest's marine waters and the significant economic benefits they provide.

The history and breadth of scientific achievement along the Olympic Coast, combined with the area's distinctive physical, biological, and cultural attributes, provide a unique and important opportunity for the region's organizations to cooperate in tracking, evaluating, mitigating, and adapting to the effects of ocean acidification. Understanding natural and societal impacts of ocean acidification on the Olympic Coast through joint operations will support forecasts of impending change to local resources--as well as those in adjacent water bodies including Puget Sound and coastal estuaries--and will directly inform community action across the region.

Sentinel sites are places where coordinated environmental observations and applied science by government, tribal, academic and citizen scientists enable detection and tracking of conditions that are changing because of natural events and human threats. Sentinel sites join, align, and focus capabilities for monitoring, research, data analysis, education, and outreach to raise awareness and inform our actions in response to pressing issues of concern, in this case ocean acidification.

Olympic Natural Resources Center – Forks, WA

In September 2016, a workshop in Forks, WA called *Exploring Options for an Olympic Coast Ocean Acidification Sentinel Site (OASeS)*, brought together 45 subject matter experts and resource managers representing Coastal Treaty Tribes, Federal and State agencies, academia, and non-government organizations (see Appendix A – Workshop Participants). The workshop was co-sponsored by NOAA's Ocean Acidification Program (OAP), Office of National Marine Sanctuaries (ONMS), and Olympic Coast National Marine Sanctuary (OCNMS). In addition, Washington Sea Grant was integral to workshop planning and provided a great deal of programmatic support.

The workshop was designed to facilitate discussion and collectively begin to articulate the desired core components and capabilities of an Ocean Acidification Sentinel Site for the Olympic Coast. The Goals of the workshop were:

1. Explore the scope and potential functions of an Olympic Coast Ocean Acidification Sentinel Site;

2. Identify relevant collaborations and partnerships to support an Olympic Coast Ocean Acidification Sentinel Site;
3. Determine priority information and products to meet science, management, communication and awareness needs regarding ocean acidification;
4. Explore how an Olympic Coast Ocean Acidification (OA) Sentinel Site can leverage larger ocean acidification efforts within NOAA and other organizations.

The purpose of this document is to provide a record of the workshop and to highlight the perspectives, themes, priorities, opportunities, needs, potential collaborations, and next steps identified during the two-day workshop. Detailed proceedings of the workshop are appended.

To provide context for the workshop discussions and break out groups, the workshop began with four panel discussions covering:

- **Science in National Marine Sanctuaries and OCNMS** – A facilitated discussion of ONMS conservation science programs and how a sentinel site would contribute to local, regional, and national initiatives;
- **Partners and Activities** - Panelists provided brief context of their research and outreach priorities regarding ocean acidification, with the intent to develop a common understanding of current activities and partner capabilities with respect to an Olympic Coast OA Sentinel Site;
- **Education and Communication** - Panelists explored communication channels and opportunities for formal and informal education and communications about ocean acidification, including congressional engagement and outreach; and
- **A Collective Vision of an Ocean Acidification Sentinel Site** – This panel facilitated discussion of our collective 'vision' for an Olympic Coast OA Sentinel Site based on summary results from a pre-workshop survey developed and distributed by Washington Sea Grant. The survey solicited input about key functions and outputs of a Sentinel Site, potential partnerships and collaborations, and outreach and education goals that could be supported by a Sentinel Site.

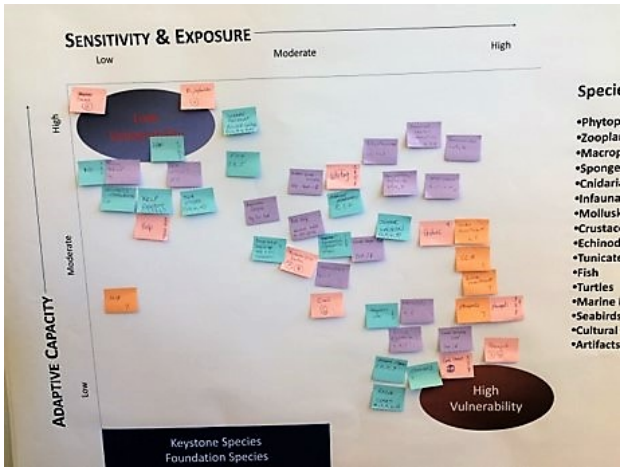
Education and Communication Panel Discussion

After the panel discussions, participants were divided into four breakout groups to better facilitate active and engaged discussion on: 1) Vulnerability and Associated Indicators; 2) Priority Questions to Ask of an Olympic Coast OA Sentinel Site; 3) Application of Information from an Olympic Coast OA Sentinel Site; and 4) The Awareness Campaign – Education and Communication. All four breakout groups addressed each topic.

Breakout Discussion A: Vulnerability and Indicators

The first breakout discussion of the workshop was titled Vulnerability and Indicators. The objective was to have workshop participants identify habitats and species known, or suspected, to be vulnerable to OA. Using the following criteria, participants selected up to five species/habitats/physical processes that they believed to be susceptible to impacts from OA: OCNMS management priority; Tribal priority; OA science community priority; Ecosystem importance; Commercial importance; Special management concern (i.e., threatened and endangered species); Early warning or other indicator; and Communication value. This exercise was intended to be a step towards identifying and prioritizing what should be monitored as part of an Olympic Coast OA Sentinel Site.

Overall, analysis of the results of this breakout discussion proved to be difficult. Individual participants within each group chose their species independently, often using differing terminology or taxonomic levels. Wide variation in rankings of sensitivity/exposure and adaptive capacity also proved difficult to compare. The same difficulties arose when trying to analyze the criteria chosen to support why a given resource (species, habitat) was important. It was therefore difficult to draw accurate comparisons across the groups. However, some trends were apparent at a macro-level.



Breakout Exercise: Vulnerability and Indicators - Species

Species

- All four groups selected **Pteropods**. All groups agreed that pteropods have High Sensitivity/Exposure, and Low Adaptive Capacity;
- All four groups selected **Razor clams**. Sensitivity/Exposure ranged from Moderate to Moderately High, and Adaptive Capacity ranged from Moderate to Moderately low;
- **Dungeness crab** was selected by all four groups, but both the Adaptive Capacity and Sensitivity ranged from 'Moderately High' to 'Low'. Dungeness crab was listed by 21 individual participants – more than any other species;
- **Fish** was listed, in some form (ichthyoplankton, whiting, salmon, forage fish), by at least 19 participants, the second highest listing by workshop participants. Sensitivity/Exposure ranged from 'Moderate' to 'Moderately High', while Adaptive Capacity ranged from 'Low' to 'High', resulting in wide variation in vulnerability indices.
- **Zooplankton** was listed, in some form, by 17 participants (zooplankton, copepods, etc.). Sensitivity/Exposure ranged from 'Moderate' to 'High', while Adaptive Capacity ranged from 'Low' to 'High', resulting in wide variation in vulnerability indices.
- Other species/groups listed included **Kelp**, **Corals/Sponges**, **Krill**, **Marine Mammals**, **Sea stars/Echinoderms/Urchins**, **Gelatinous zooplankton**, **Crustose coralline algae**, and **Barnacles**.

Habitats

- **Kelp Forest** was selected by all four groups, and was chosen by more individual participants (17) than any other habitat. Kelp was chosen by all groups as both an important species and habitat.
- **Rocky Intertidal** was also selected by all four groups. This habitat was the second most-commonly listed by workshop participants (11). It was hard to draw a conclusion other than simply stating that everyone identified the rocky intertidal as an important habitat.
- **Pelagic / Water Column** was chosen by ten individual participants (three of the four groups). Both 'Influential Species Affected' and 'Sensitivity/Exposure' were consistently ranked as Moderately High to High.
- Other habitats identified as being potentially vulnerable to OA impacts include **Offshore Benthic**, **Nearshore Subtidal**, **Nearshore Intertidal**, **Deep Sea Corals/Sponges**, **Tide Pools**, **Sandy Beaches**, **Canyons**, and the **Shelf Break**.

Breakout Discussion A: Vulnerability and Indicators

Physical Processes

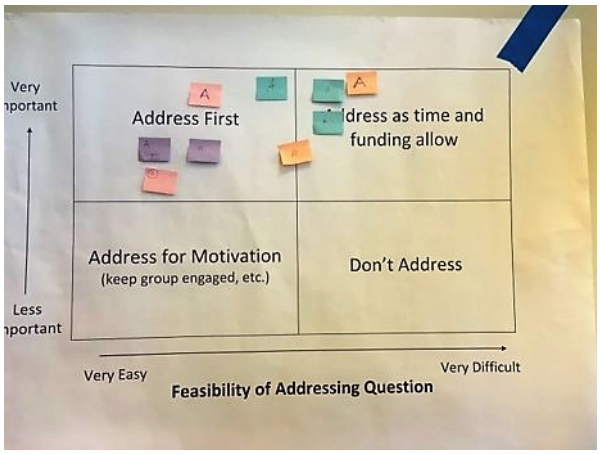
Only three of the four groups had enough time to address physical processes. All three groups identified the following five processes as they relate to OA:

- **Upwelling** was, by far, the most commonly listed physical process identified. The 'Rate of Change' was identified as Moderate to Moderately High, but the 'Influence on Acidification' was universally recognized as High.
- **Harmful Algal Blooms** were the second most commonly identified physical process by workshop participants. The 'Rate of Change' was Moderate to High, but the 'Influence on Acidification' ranged from Low-to-Moderate to High.
- **Respiration/Metabolism** - Both 'Rate of Change' and 'Influence on Acidification' ranged from Moderately-high to High.
- **Recruitment** - Both 'Rate of change' and 'Influence on Acidification' ranged from Moderately-high to High.
- **Hypoxia** - 'Rate of change' was Moderately-high, while 'Influence on Acidification' ranged from Moderate to Moderately-high.

Breakout Discussion B: Explore Priority Questions of an Olympic Coast OA Sentinel Site

This session focused on identifying the research questions most relevant to the creation of a successful Olympic Coast OA Sentinel Site. Participants focused not only on OA science needs (i.e., research and monitoring), but also on the needs of resource managers, and the best approaches and tools to address the research questions. Participants focused on building upon existing tools and approaches and identified new products or resources that could be produced in support of the sentinel site.

Seventeen priority questions were distilled from a long list of critical OA research questions that had been culled from several relevant regional ocean acidification reports.[1] Groups then rated the importance of each question on a continuum from *Least Important* (1) to *Most Important* (5), and rated the feasibility of addressing the question on a continuum from *Most Feasible* (1) to *Least Feasible* (5).



Breakout Discussion B: Ranking Exercise

Importance

The four questions ranked as most important were:

- How might marine food webs be altered?
- How rapidly is seawater chemistry changing, and at what locations will it change the most?
- Are OA and hypoxia impacting biota now?
- How can laboratory findings related to OA impacts on key species be supported through in-situ field validation efforts?

Feasibility

The four questions ranked as most feasible to address were:

- To what extent does upwelling intensity affect ocean acidification?
- How rapidly is seawater chemistry changing, and at what locations will it change the most?
- Can corrosive conditions in the nearshore or at hatcheries be anticipated by conditions offshore?
- Are changes in oceanographic patterns (e.g., upwelling and its effects on OA) linked to hypoxia and harmful algae blooms?

In some cases, the importance and feasibility of questions resulted in a mismatch. For example, "How might marine food webs be altered?" ranked as the most important question, but was also ranked as one of the least feasible to answer, while the question "To what extent does upwelling intensity affect ocean acidification?" ranked as the most feasible, but one of the least important to address.

Priority

Based on both the importance of the question and feasibility of answering the question, the four highest priority questions to come out of this exercise were:

- How rapidly is seawater chemistry changing, and at what locations will it change the most?

[1] State of Ocean Acidification in Washington Waters_MRAC_2015
The West Coast Ocean Acidification and Hypoxia Science Panel: Major Findings, Recommendations, and Actions. 2016.
Scientific Summary of OA in Washington State Marine Waters, NOAA OAR Special Report, 2012.
OCNMS Climate Change and Ocean Acidification 1-pager (2010) and OCNMS Sentinel Site website / OA

- Are OA and hypoxia impacting biota now?
- How are the abundance, distribution and diversity of living resources affected by ocean acidification?
- What species, populations, or ecological properties are most sensitive to OA and hypoxia?

It was noted during the session that the questions provided may not be specific enough for the geographic location. It was recommended that research/monitoring questions that are specific to the outer coast of Washington be developed using the results of the importance/feasibility prioritization from this breakout exercise. Determining best approaches and tools to address these questions, including building on those that exist and identifying new products or resources will ultimately be an integral part of a joint research/monitoring plan for the Sentinel Site.

Breakout Discussion C: Application of Information from an OA Sentinel Site
This session determined how information generated from an Olympic Coast OA Sentinel Site might be used. All four groups participated in a facilitated discussion focused on four questions:

Early Warnings

Is an early warning indicator a feasible or useful goal? What would be needed for episodic rapid response, for example to monitor an emerging oceanographic event related to ocean acidification?

- Early warning signals could come from water quality parameters and currents at surface and at depth, using bottom sensors (including temperature, dissolved oxygen, aragonite, pH, salinity)
- Data needs to be easily discoverable and available to users
- Monitoring locations that could help warn of an emerging OA-related event were identified as canyon heads (Juan de Fuca and Quileute), Quinault canyon (~200 m), and a mid-shelf location (~100 m depth)
- Resource managers could potentially receive a text message from an instrument/sensor, producing a warning and facilitating rapid response including increased monitoring
- Target players in an episodic response included fishermen, Tribal members, and sentinel site partners
- Early warning systems could be helpful for human health in regards to disease concerns

Audiences

What are the audiences for indicators, data or information?

- Commercial and recreational fishers
- Coastal Treaty Tribes
- Federal, Tribal, State, and local resource agencies
- Coastal communities / general public
- Policy makers, State, Tribal and Federal

- Advisory bodies (Pacific Fishery Management Council, WA Marine Resources Advisory Council, Washington Coast Marine Advisory Council, Sanctuary Advisory Council, etc.)
- State and Tribal Legislators
- Shellfish industry
- Recreational users (surfers, beach walkers, kayakers, etc.)
- Academia

Management responses

What management responses are available to address management needs? Who can implement them?

- OCNMS could consider changes to existing regulations and permitting criteria based on anticipated future impacts on resources (e.g., allowances for nutrient loading or restrictions on discharges).
- NPS and WDFW have the ability to close razor clam harvest for non-tribal response.
- Tribal governments could consider regulatory criteria that is sensitive to the state of the knowledge of OA both in the context of co-management and tribal community specific.
- Citizen science volunteers could mobilize additional monitoring or increase sampling to better characterize events.
- Reports on seasonal conditions are used by fisheries managers to incorporate data into projection models for specific species (e.g., hake, salmon, forage fish, krill, halibut) and to inform regulatory decisions.
- Forecasts are available (e.g. NOAA's hurricane forecast) but there needs to be a self-explanatory product that people don't need to manipulate themselves.

Unmet needs

What unmet information, applications, or needs can be addressed through a sentinel site, including observations, regular forums or meetings?

- Inconsistent funding and resources for research and long-term studies to understand life cycles of impacted organisms (e.g. larval studies). A sentinel site could serve to focus funding attention.
- Additional monitoring sites are needed (e.g., moorings throughout the water column in Juan De Fuca canyon), as well as upgraded instrumentation as OA sensor technology advances.
- Gaps in habitats monitored span the intertidal to deep sea.
    - The focus on changes in the intertidal zone has primarily been on single species rather than communities.
- Quarterly bulletins, as well as annual summaries, for both harmful algal blooms and OA could be developed to keep user groups informed.
- NANOOS could add an alert response system, targeted at shellfish growers, for corrosive waters.

- A joint research plan for OA would focus efforts and aid in funding requests/proposals for a Sentinel Site.
- A reliable research and monitoring vessel, dedicated to the area, is needed to support all of these efforts.

Breakout Discussion D: The Awareness Campaign – Education and Communication
This final breakout discussion identified the key types of information needed for particular audiences and best ways to deliver that information. Participants discussed potential goals of an awareness campaign and began to identify target audiences, develop messages and approaches for communicating about the results of research and activities taking place at the Sentinel Site.

Eight different audiences were identified as targets for this exercise: 1) resource managers; 2) scientists and academics; 3) educators and interpreters; 4) Sanctuary visitors; 5) elected officials; 6) media; 7) local communities and 8) virtual visitors. Each breakout group was asked to consider two of the eight audiences.

Resource Managers

- Concise and objective synthesis products to tell the story and scale of ocean acidification while connecting data to place/communities
- In addition to ocean acidification, it is important to consider other parameters and water quality stressors including hypoxia, harmful algal blooms, etc.
- Important to not focus on the good and the bad exclusively, but rather present the facts of how things will be different - including "opportunities" and "challenges" – then allow audiences to develop their own conclusions
- The needs of scientists and resource managers are similar

Scientists

- To better serve awareness, real-time water quality data must be accessible and useable
- An OA Sentinel Site awareness campaign could provide opportunities to increase collaborations and partnerships in science and research and attract more funding and scientists to Olympic Coast, and ultimately increase the availability of OA products derived from the data collected by scientists
- There is a need to characterize marine species assemblages, as this baseline data will assist in developing messaging

Educators

- Increase awareness of ocean acidification using geographical focal point (a pristine area like the Olympic Coast)
- Opportunity to communicate other stressors of water quality
- Highlight the value of the commercial resources on the Olympic Coast
- Suggested outreach tools including educational curricula, electronic media, articles, kiosks, teacher trainings, webcams and other visuals

Visitors

- Ability to participate in citizen science using tools such as “apps” to collect data on things such as razor clams and pH measurements
- Citizen science opportunities could be shared on social media
- Access to scientists and educators working directly with Sentinel Sites – a Network of Sentinel Site Ambassadors - would help connect local communities and virtual audiences to the Sentinel Site and issue of ocean acidification

Elected Officials

- Awareness campaign could provide needed visibility, support and funding at all legislative levels
- Support, including financial, for ecosystem-based decision making at local levels will only be increased through a higher-level (federal, tribal and state) understanding of the place-based challenges of an acidifying ocean
- Expand the local understanding of human/community health and its direct connection to the health of their local environment or “place” (raising awareness with the Elected Official’s audience)
- Provide a trusted source for current information

Media

- Can provide message amplification and refinement raising public awareness while increasing local ownership of the issue
- Promote a wide spread ‘call to action’
- Media needs identified contacts, as well as flashy/splashy news or a “scoop” including effective graphics and data visuals
- It is also important that media has consistent messaging

Local Communities

- A good awareness campaign could lead to individual and community-based behavior changes through community buy-in
- A well-defined and executed awareness campaign has the potential to cultivate OA ambassadors (a Network of Sentinel Site Ambassadors) within a community, rallying their neighbors and community members
- Create tools to reach local communities such as fact sheets or infographics, public presentations and social media campaigns

Virtual Visitors

- Concise information, charismatic beautiful pictures and stories, and the “wow” factor image are key tools to fully engage this virtual audience
- Utilizing popular social media platforms like Facebook, Twitter, and Instagram
- Using web cams, public television and radio stations to provide more visual access, and leveraging partner networks to increase the reach of a dynamic awareness campaign

- Limited internet connectivity within Olympic Coast communities is a critical obstacle, and so increased funding and human resources are required to fully realize the potential of this audience

Partner Perspectives

As a wrap up to the OASeS workshop, a number of participants were asked to offer their perspectives on workshop highlights, outstanding concerns, topics that remain to be explored, any take away ideas and/or actions, and general opinions on the future of an Olympic Coast OA Sentinel Site.

Christopher Krembs, from the Washington Department of Ecology, spoke of the potential of a sentinel site as it relates to outreach regarding OA. He stated that "the main concern is the lens: how does ocean acidification affect our state? How does OA affect the state economy?" Chris also highlighted the need to "make the connection between the sanctuary and inland waters – Why does the sanctuary matter to the majority of the state's population (i.e., the Salish Sea)?"

Jan Newton represented the Washington OA Center and NANOOS. Jan began by stating that collectively, we're still struggling with "what is a sentinel site?" She quickly followed up by assuring everyone that this is not a problem, and that it might take a while to define. She stated that it doesn't matter if this is an OA Sentinel Site or and OA/HAB/Hypoxia site, because if we're studying OA, we're capturing all of those other concerns. Jan highlighted the need to determine the top 3-5 questions in the various OA action plans that can be addressed on the outer coast, noting that there must be integrated chemistry and biology in OA research and monitoring. Jan summarized her opinion on the potential for an OA Sentinel Site by self-declaring the sentinel site!

Richard Feely, from NOAA's Pacific Marine Environmental Labs, began by stating that we "must define explicitly what we consider a sentinel site…we need to establish it, agree upon it, and support it!" He stated a need for us to collectively figure out a way to express the concerns regarding OA sensitivity and impacts on this region. He asked that we create an inventory of OA work that is being conducted, and actively maintain that inventory. He asked that while we all have our own resources, how do we work together? He noted that this will take time and effort, but there is a great sense of opportunity. He ended by emphasizing his belief that if we [here in the Pacific NW] establish a Sentinel Site, define it, and execute research and mitigation – our nation will follow.

Libby Jewett, Director of NOAA's Ocean Acidification Program, began her wrap up by outlining a concern: "How will we distinguish this [Sentinel Site] effort from all the other OA efforts in this region?" She reminded participants of many of the OA efforts already underway. Libby again reiterated the importance of combining chemistry and biology, noting that she was looking to the Pacific NW to figure out best practices, and to display methods of effective and coordinated bio-chemical monitoring and research. She added that an inter-agency working group is creating a National OA Information Exchange that might have some special use for sentinel sites. Overall, she expressed support for the concept expressing her hope that this Sentinel Site effort would result in a transferrable model for other regions to utilize collaborative methods of responding and adapting to the threat of OA.

Joe Schumaker, representing the Quinault Indian Nation, notes that these types of efforts have come and gone in the past, but that "this one is important" and we need to "keep the momentum going." Joe also requested that we collectively define what it is to be a Sentinel Site, and consider the value added that being a Sentinel Site brings to the region. Joe highlighted the need to share important OA information (i.e., Revelle factors) with our communities. Joe stated that the Federal government has a trust responsibility to maintain resources for the Tribes, and that an OA Sentinel Site may directly assist in those efforts. He also stated that tribal leaders have unique access to funding, and can use the information/products/messages that the Sentinel Site puts forth to attract additional funding to support mitigation efforts.

Next Steps

As a direct result of the OA Sentinel Site Workshop in September 2016, a number of participants collaborated on the submission of two successful funding applications through NOAA's Ocean Acidification Program including: "The Olympic Coast as a Sentinel: An Integrated Social-Ecological Regional Vulnerability Assessment to Ocean Acidification," and "Development of Ocean Acidification "pHyter" – Plankton Monitoring Tools & Curriculum." Both proposals focus on ocean acidification work on the Olympic coast, and the projects began in late 2017. OCNMS is currently working with its advisory council to further develop the concept of an OA Sentinel Site, and is working to seek additional funding to implement key components of the Sentinel Site, which include enhanced monitoring, research, education, and outreach.

The value of a Sentinel Site program is not simply the act of collecting sound science-based information. It is a holistic approach of resource management where science is integral to education, outreach, management and public engagement campaigns to address a specific threat to marine resources. The Olympic Coast OA Sentinel Site would directly address OA by supporting OA-related activities or investments in each of the following six focus areas:

- **Science** – Conducting and/or facilitating research and monitoring (natural resources and socioeconomic considerations);
- **Education** – Formal and informal activities and programs;
- **Outreach and Awareness** – Social media and direct public engagements;
- **Partnerships** – Develop or promote new partnerships to increase capacity and reach;
- **Management Goal** – Defined for the Sanctuary, partners, and local communities; and
- **Steering Committee** – Establish a group to coordinate activities and distribute results.

One immediate next step identified for an Olympic Coast OA Sentinel Site calls for the formation of a steering committee, including Terms of Reference for that body. The committee would assist in the development of the overall management goal(s) and help define priorities and activities for future OA work along the Olympic Coast.

Appendix A - Workshop Participants

Exploring Options for an Olympic Coast Ocean Acidification Sentinel Site (OASeS)

NAME	AFFILIATION	NAME	AFFILIATION
Libby Jewett	NOAA-OAP	Kara Cardinal	The Nature Conservancy
Jennifer (Jenn) Mintz	NOAA-OAP Education	Lee Whitford	SAC Chair, Education seat
Jan Newton	UW-APL/ OA Center	Rich Osborne	UW-ONRC
Dick Feely	UW-PMEL	Christopher Krembs	WDOE
Simone Alin	NOAA/PMEL	Evelyn Lessard	UW
Carol Bernthal	OCNMS	Parker MacCready	UW
Kevin Grant	OCNMS	Micah Horwith	WDNR
Liam Antrim	OCNMS	Jennifer Hennessey	WDOE
Jenny Waddell	OCNMS	Brad Warren	Global Ocean Health
Meg Chadsey	Washington Sea Grant	Dan Ayres	WDFW
Gabrielle Canonico	IOOS	Scott Noakes	GRNMS
Mitchell Tartt	ONMS	Laura Francis	CINMS
Steve Gittings	ONMS	Nicole Harris	OCNMS
Paul McElhany	NOAA NWFSC	Karlyn Langjahr	OCNMS
Ben Haskell	NOAA-SBNMS		
Jacqueline Laverdure	OCNMS		
Steve Fradkin	ONP		
Joe Schumacker	Quinault Indian Nation		
Jennifer Hagen	Quileute Tribe		
Adrianne Akmajian	Makah Tribe		
Joe Gilbertson	Hoh Tribe		
Angie Thomson	MRAC/Puget Sound Partnership		

NOTE TAKERS:

Laura Spencer	UW SAFS PhD student (starting fall 2016)
Mariko Kobayashi	UW College of the Environment grad (B.S.)
Alex Mitchell-Morton	UW Oceanography graduate (B.S.)
Rebecca Lewis	OCNMS Americorps service member
Chris Butler Minor	OCNMS Volunteer, M.S. Portland State University