The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT

September 15th 2020

Submitted by the Oregon Coordinating Council on Ocean Acidification and Hypoxia

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oregonocean.info/index.php/ocean-acidification

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OAH Council, Co-Chairs

Letter from Drs. Jack Barth and Caren Braby

Oregon is among the first places in the world to observe the direct impacts of ocean acidification and hypoxia (OAH). Since the early 2000s, OAH has been a challenge for the aquaculture industry's ability to grow larval oysters and has affected our fishing fleet who pull pots full of dead Dungeness crab during hypoxia events, and who suspect that productivity of crab may not be reliable in the future. While we have now implemented closed-tank systems to ensure sufficient water quality for oyster larvae production in many hatcheries and have a better understanding of regional variability of low-oxygen zones, changing OAH conditions are already undermining our ocean ecosystems and the communities that rely on them. Solutions to OAH challenges in Oregon's coastal waters are not as tractable as creating closed-tank systems in onshore aquaculture facilities. Ocean acidification and hypoxia (OAH) events are now annual seasonal events in Oregon ocean habitats, and are being compared to the Pacific Northwest late summer "fire season" by leading scientists. These events will continue and are predicted to intensify over time. Solutions are needed to help Oregon adapt to the changes we are already experiencing, and to be prepared for the projected worsening changes in our future.

The West Coast of North America is a hotspot of OAH change due to the nature of the upwelling system that transports low dissolved oxygen (DO), low pH, and high carbon dioxide (CO2) bottom-waters to our nearshore environments. Upwelling is responsible for the incredible diversity and productivity that fuel our wild fisheries, but at the same time these deep upwelled waters are now lower in dissolved oxygen and pH, especially during the late-summer OAH season. Fortunately, together we can continue to take action to address OAH, and we have a growing number of success stories from Oregon, the West Coast, and around the world to show examples of how this can be done. Through the ongoing dedication of the legislature, the Governor, and the legislatively created Oregon Coordinating Council on OAH (OAH Council), Oregon has been at the forefront of action in implementing change. We are making progress on OAH science, adaptation, and resilience planning – but there is still much more we can and should do together to create a stronger today and tomorrow.

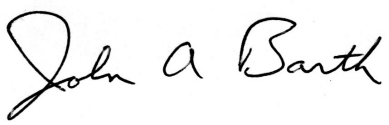
In 2019, Oregon's OAH Action Plan (Action Plan) was finalized at the Governor's request and was submitted to the International Alliance to Combat Ocean Acidification demonstrating our state's ongoing commitment to the region and world. The Action Plan, further explained in this report, is a step-wise 6-year plan based on the Council's 2018 OAH Legislative Report. The Action Plan identifies ways that our state and local governments, marine industries, and individuals throughout Oregon can learn about, adapt to, and mitigate OAH impacts. In creating the steps in the Action Plan, the OAH Council considered the scientific readiness, urgency of need, anticipated value of actions, and appropriate phasing of implementation steps for each action in five thematic areas: supporting science, reducing causes, building resilience, raising awareness, and implementing solutions.

In 2020, we have faced the nearly unthinkable COVID-19 pandemic that has demonstrated the fragility of Oregon's social and economic fabric. Previously undetected vulnerabilities, including in our coastal seafood businesses and markets, underscore the need to build an approach for now and into the future that relies on resilience and adaptation to change. Similarly, climate and ocean change are expected to occur both gradually, as well as in episodic and dramatic bursts. While this year the pandemic is front and center creating unprecedented change, OAH is quietly continuing unabated and promises to cause disruption and instability for decades to come. We must prepare and take action to avoid eroding our communities' abilities to get access to healthy reliable food sources from the sea to feed their families and provide marine-related jobs. As with COVID, there are solutions in the works that will benefit our human communities and the marine ecosystem on which they rely. We must continue to act through partnerships and coordination of resources throughout our State – while building in key pillars of environmental justice and community equity – so that all Oregonians are ready for climate change.

This 2020 OAH Legislative Report, documents the progress the State has made since the last biennium on implementing the recommendations in the 2018 OAH Legislative Report and the Action Plan. However, this process is only part of the many critical steps that need to be done to help our state and coastal communities. The Oregon OAH Council urges a strong coordinated approach moving forward, involving researchers, fishermen, NGOs, coastal communities and others, to implement actions needed to make Oregon more resilient to future economic and environmental change. Additional investments will be needed over time so that Oregon can continue to lead the nation and the world on new science, successful strategies to mitigate ocean change, and to build resilience and adaptation – the time to act is now.

We have much to do, with little time, and the risks are great. Failure and inaction are not options. Together we can prepare Oregon for the changes we are currently experiencing and those that lie ahead.

John (Jack) Barth, PhD



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Executive Summary

2nd Biennial Report to the Legislature and Ocean Policy Advisory Council
Submitted by the Oregon Coordinating Council on Ocean Acidification and Hypoxia

Oregon was one of the first places in the world to feel the impacts of Ocean Acidification and Hypoxia (OAH), which continues to affect our vulnerable Oregon coastline. Working with a dedicated team of OAH Council members and the public, the 2020 OAH Legislative Report shares Oregon's successes over the past two years, as well as plans and benchmarks for actions for the next 1-3 years. ***To protect our ocean, its species, and the communities that depend on them, we can and must act now.***

The actions highlighted below represent a series of strategic first steps in OAH **science**, **mitigation**, **adaptation**, **awareness**, and **policy**.

Highlights of the OAH Council achievements this biennium (2018-2020):

- ***Coordinated ongoing efforts to bolster OAH monitoring in Yaquina Bay - an economic and research hub for Oregon.***
- ***Participated in the Oregon 2020 Climate Adaptation Framework process, to align the OAH Council efforts with other state mitigation processes.***
- ***Advised the West Coast Ocean Data Portal on ocean acidification data synthesis in order to provide information for adaptation and resiliency planning within Oregon communities.***
- ***Created a working group of education and outreach experts from across disciplines to advise on OAH communications products – including document language translations.***
- ***Consulted with the Governor's Office on a new Executive directive that encourages state agencies to consider addressing OAH in their regulatory and management frameworks.***

Highlights of the OAH Council benchmarks for next biennium (2020-2022):

- ***Ensuring the continuation of OAH monitoring in Tillamook Bay – an ongoing effort of the Oregon Ocean Monitoring Group and regional partners.***
- ***Facilitating OAH data acquisition and convening of regional experts for ongoing Oregon water quality assessments.***
- ***Exploring the role of submerged aquatic vegetation in ecosystem resiliency to OAH impacts through academic-resource management partnerships.***
- ***Convening fishermen-scientist roundtable targeting at-risk communities and industries to share updates and next steps on OAH to Oregonians across the state.***
- ***Developing a multi-agency assessment for anticipated needs to address OAH within regulatory and management frameworks.***
  (Report to be submitted to the legislature in Feb 2021)

In order to benefit of our human communities and the marine ecosystem on which they rely, we must continue to act through partnerships and coordination of resources throughout Oregon, in a process that is guided and informed by strong science. Oregon's history is one of cultural and economic value of ocean and estuaries. Yet, our ocean is changing, and each of these species, and the human communities that rely on them, are already showing signs of impairment from OAH ***(Figure 1)***.

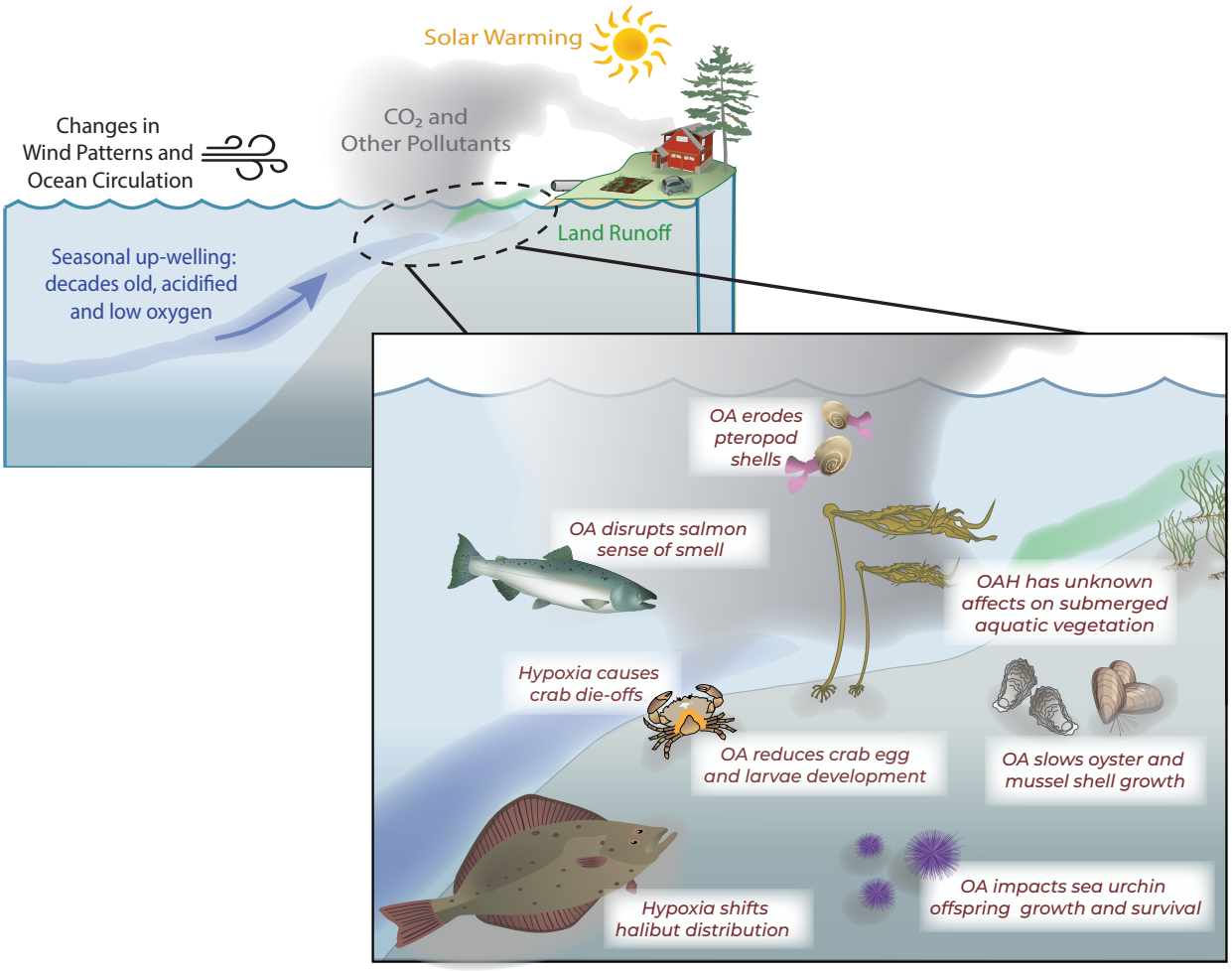


Figure 1. Schematic of the climate and other human drivers causing OAH, and the resulting OAH impacts on Oregon's iconic coastal ocean ecosystem.

In 2020, Oregon's coastal tourism, and seafood businesses were profoundly disrupted by the response to the pandemic and changing markets worldwide. Nevertheless, we are also resilient and in this time of change we have the opportunity to build a resilient future for Oregon on all fronts, including resilience to climate and ocean change. Ocean conditions further exacerbate these vulnerabilities and markets, underscoring the need to implement OAH actions that create community resilience and promote adaptation to rapid economic and environmental changes.

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

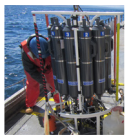
oregonocean.info/index.php/ocean-acidification

Oregon's OAH Action Plan

Development and Adoption

Oregon's OAH Action Plan (adopted by Governor Brown in 2019), is the 6-year roadmap for Oregon's efforts on OAH from 2019 to 2025. ***(see Appendix A - The 2019 OAH Action Plan)*** The Action Plan, which has been submitted to the International Alliance to Combat Ocean Acidification, serves as a model for others, relevant to their own geographical and political context, and demonstrates that local actions are meaningful in fighting the global challenges of climate and ocean changes ***(Figure 2)***.

The actions highlighted below represent a series of strategic first steps that Oregon has prioritized and committed to taking in OAH **science**, **mitigation**, **adaptation**, **awareness**, and **policy**.



1) Advance scientific understanding to address OAH vulnerabilities

- Invest in Oregon's existing research sites and tools
- Invest in monitoring of ocean life
- Assess the socio-economic impacts of OAH in Oregon

2) Develop and use strategies to reduce causes of excess CO_2 and other causes of OAH

- Enhance local and global communication networks working on CO_2 reduction
- Support research on effective and efficient ways to reduce excess CO_2 and OAH stressors
- Implement measures to reduce excess CO_2 and OAH stressors in Oregon

3) Support resilience to OAH in Oregon's ecosystems and communities

- Support data collection, synthesis, and modeling
- Restore, protect, and sustain native shellfish stocks and submerged aquatic vegetation
- Develop Best Management Practices based on current ecosystem and economic research

4) Share OAH science, impacts, and solutions to raise awareness

- Build OAH communications plan and outreach materials
- Provide timely updates to Oregon's decision-makers and affected communities
- Evaluate the effectiveness of OAH communications

5) Build sustained support and mobilize agencies to address OAH

- Governor issues a 2019 policy to address Oregon's OAH priorities
- Leadership, coordination, and policy guidance by Governor's Natural Resource Office
- Oregon agencies work to fill gaps in State OAH efforts

Figure 2. Diagram of OAH actions, and accompanying steps, that the OAH Council prioritized and committed to through the adoption of the 2019 OAH Action Plan.

To protect Oregon's environmentally sustainable marine-based food supply as well as our cultural and economic well-being, the OAH Council is facilitating strategic, scientific-based actions to adapt to and mitigate OAH throughout the state.

The OAH Council used a collaborative, science-based approach to developing and prioritizing actions in the OAH Action Plan, to ensure that Oregon is not only mitigating the causes, but proactively addressing and preparing for current and future impacts from OAH on our ecosystems and coastal communities. Public comment received on the 2018 Legislative Report also helped shape the Council's prioritization processes. In addition, Council staff conducted targeted survey and interview to gather input from over 70 experts across the state and provided the results to the Council to help inform the prioritization process. ***(see Appendix B - Community Survey)***

Members of the OAH Council carefully deliberated on and selected actions to prioritize, based on urgency of the need, the anticipated impact, and an available pathway (including staffing, funding) for implementation of each action. All recommendations and actions were agreed upon as important by all voting members on the Council. From the 38 specific actions developed in the 2018 OAH Legislative Report, the 6-year OAH Action Plan identified 5 actions, one from each of the 5 key themes. Identified actions are those that Oregon is ready to commit to and will flesh out the scope, methods, and resources needed to implement each action in future OAH Council Legislative Reports.

As a public convening entity, the OAH Council is committed to continuing to provide OAH information to the public and to facilitating alignment and collaboration in the State on OAH and climate issues. ***(see Appendix C - OAH Council Meeting Summaries)*** Currently, the OAH Council has been focusing on implementing actions prioritized in the 2019 OAH Action Plan. This 2020 Report to the Legislature focuses on updates on recent implementation of actions, as well as, plans for the next 1 – 3 years, and shows how our local, state-based action is making meaningful impact on the global issue of climate and ocean change.

The following section "Progress on Implementing the OAH Action Plan" describes the past successes and next steps that the OAH Council is taking in implementing actions in five thematic areas. In addition, each section includes a "Current Project Highlight", which provides additional detail for one of the actions listed.

Progress on Implementing the OAH Action Plan

1) Advance Scientific Understanding

Invest in Oregon's monitoring network to document oceanographic and biological conditions, and socio-economic vulnerabilities relating to Ocean Acidification and Hypoxia (OAH).

The Oregon OAH Action Plan identifies strategic augmentation of ocean monitoring and research that is essential to inform the State on how to mitigate and adapt to future OAH changes. While we must actively work to reduce the causes of OAH, we must also work to adapt to the effects and minimize the economic impacts of OAH by incorporating the best scientific information into management planning and decision-making. However, this will only be possible if we understand OAH trends well enough to foresee potential impacts. Currently, the State has a robust ocean monitoring network that produces long-term time series for physical, chemical, and biological properties of Oregon's nearshore ocean and some estuaries – however, there are large gaps in our monitoring networks that need to be filled (both geospatial and temporal monitoring).

OAH Council achievements this biennium (2018-2020):

- Continued to convene the Oregon Ocean Monitoring Group (OOMG) – a group of ocean monitoring experts and stakeholders (consisting of state and federal resource managers, academics, industry, and NGOs) with the aim of increasing Oregon OAH Monitoring. The group has been meeting since 2017.
- Facilitated data collection for the innovative collaborative OAH monitoring pilot project in Tillamook Bay - initiated by partners of the OOMG in 2018 as a two-year project funded by the Oregon Watershed Enhancement Board (OWEB).
- Established Yaquina Bay working group to build a long-term monitoring site to complement an historical time-series in the Bay. ***(OAH Action Plan - Step 1.1.1)***

OAH Council benchmarks for the next biennium (2020-2022):

- Securing funding for continued OAH monitoring in Tillamook Bay and Yaquina Bay to establish both of these areas as long-term monitoring sites. ***(OAH Action Plan - Step 1.1.3)***
- Securing funding and resources to co-locate OAH monitoring (intertidal and subtidal) alongside existing Marine Reserves biological sampling to leverage Oregon's existing research investments. ***(OAH Action Plan - Step 1.1.2)***

Current Project Highlight: Building long-term Yaquina Bay Monitoring
Start year 2020; continuous thereafter

Yaquina Bay has been used by communities for cultural, recreational, and commercial purposes for generations, including activities such as shellfish harvesting, fishing and fish processing, logging, shipping, tourism, aquaculture, and agriculture. The Bay is home to the Hatfield Marine Science Center (HMSC) a world class marine science facility housing academics and researchers from Oregon State University (OSU), state and federal resource managers, and the Oregon Coast Aquarium. The Bay is also the home of NOAA's Pacific Marine Operation Center and its research vessel fleet. Yet, OAH has the potential to adversely affect Yaquina Bay, and more monitoring is needed to track long-term changes.

Since the early 2000s, Yaquina Bay has been monitored for OAH and other OAH stressors through a series of short-term monitoring and research projects led by OSU as well as by the U.S. Environmental Protection Agency and the Oregon Department of Agriculture. However, due to a lack of resources, including funding and staff availability, many of these important monitoring programs have lapsed.

In order to start the process of building long-term OAH monitoring in Yaquina Bay, the OAH Council has organized a Working Group consisting of 14 regional experts and stakeholders who encompasses multiple perspectives and professional backgrounds. This Working Group has been meeting regularly since Spring 2020 to develop a research and data management plan for new monitoring as well as a community outreach plan to share project findings. ***(see Appendix D – Yaquina Bay OAH Monitoring Project)***

The goals of this Working Group include:

- Identify spatial, temporal, and technology gaps in monitoring data
- Pursue collaborations and resources to deploy new and maintain current monitoring
- Create pathways for real time accessibility of monitoring data
- Communicate findings in formats that inform community planning and state resource management

Part of the Working Group's charge is to identify OAH monitoring barriers and how to overcome them, including finding new external sources of funding for this effort. However, external project resources are unlikely to be forthcoming, unless there is also an investment from the State. **The OAH Council recommends that the State invest financial resources to implement monitoring in Yaquina Bay, to collect data that are essential to plan for current and future OAH impacts on our communities and ecosystems. State investment in this monitoring network station would inform help inform and direct the State's adaptation needs and priorities.**

Identified Barriers by this Working Group include:

- Funding to purchase and maintain additional high-resolution monitoring station(s) equipment in key location(s)
- Staff resources for maintaining equipment in the water, and to process data to allow for real-time access to datasets
- Additional analytical equipment to process discrete carbonate samples

Progress on Implementing the OAH Action Plan

2) Reduce Causes

Develop and integrate strategies to reduce causes of excess carbon dioxide (CO2) and Ocean Acidification and Hypoxia (OAH).

The Oregon OAH Action Plan identifies reducing causes and co-stressors of OAH as an integral step to combat OAH. It is the long-term goal of the OAH Council, and the State of Oregon (per EO No. 20-04), that Oregon measurably reduces CO2 emissions and stressors that compound OAH impacts to achieve ecosystem and economic benefits for both ocean and inland systems. While Oregon's emissions is only part of the global problem, Oregon is working to address our carbon footprint in a variety of ways that complement and reinforce the OAH Council's work.

OAH Council achievements this biennium (2018-2020):

- Participated in the development of the Oregon Department of Fish and Wildlife's (ODFW) Climate and Ocean Change Policy, which includes measures to protect ocean fisheries and habitats as well as reduce the agencies energy requirements. ***(see Appendix E – ODFW Climate and Ocean Change - OAH Council Letter)*** *(OAH Action Plan Step 2.2.3)*
- Participated in and reviewed Oregon's 2018/2020 Water Quality Assessment by providing public comment on the draft assessment and hypoxia data sources for future analysis. ***(see Appendix F –2018/2020 Oregon Water Quality Assessment - OAH Council Letter)*** *(OAH Action Plan Step 2.2.3)*
- Participated in and reviewed Oregon's 2020 Climate Adaptation Framework process by providing public comment on the draft plan and suggestions on how be further incorporate OAH and other ocean changes into the framework. *(OAH Action Plan Step 2.2.3)*

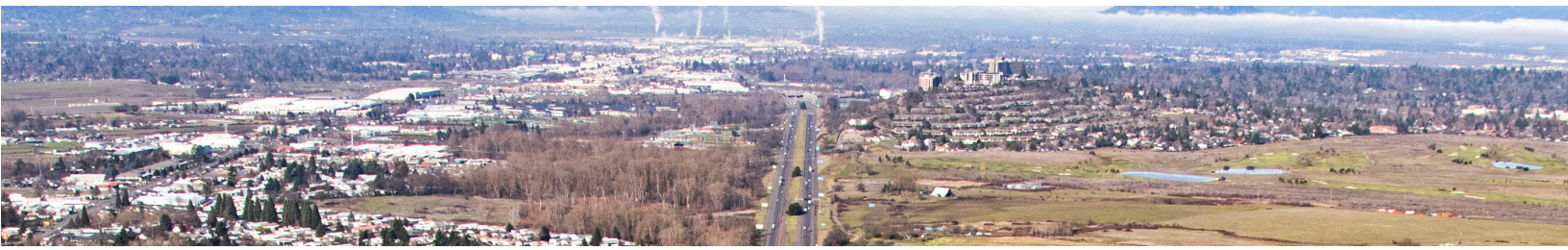
OAH Council benchmarks for the next biennium (2020-2022):

- Co-authoring the ocean change section of the 2021 Oregon Climate Change Research Institute (OCCRI5) Report to the legislature. *(OAH Action Plan Step 2.2.3)*
- Facilitating further OAH data acquisition, and convening of regional experts when applicable, for Oregon's future Integrated Water Quality Reports – developed by the Oregon Department of Environmental Quality to meet the requirements of the federal Clean Water Act. *(OAH Action Plan Step 2.2.3)*

Current Project Highlight: Oregon 2020 Climate Adaptation Framework
2020 Start year; continuous thereafter

Over the past year, the OAH Council has worked collaboratively with our partners throughout the State on climate and ocean change initiatives. Oregon has taken great strides to understand the effects of climate change on our ecosystem and economy, while providing leadership across the West Coast on CO2 emissions policy. Of particular note, is the 2020 Oregon Climate Adaptation Framework, which updates the 2010 Oregon Climate Change Adaptation Framework - outlining the approach needed to best leverage State resources.

A work group comprised of staff from 25 state agencies, coordinated by the Department of Land Conservation and Development (DLCD), prepared the 2020 Climate Adaption Framework. Agency members of the OAH Council have served on the interagency working group and have helped draft the framework, including some of the ocean change content. The OAH Council as a whole also has had the opportunity to provide public comments on the Framework, and have offered several suggestions on how to strengthen the ocean change adaptations sections to better reflect Oregon Coastal communities' unique needs for climate adaptation. The final draft of the framework is expected to be completed in early 2021. The Council is currently working on finishing their final review of the 2020 Climate Adaptation Framework, which sill be submitted to DLCD by October 31st 2020.



Progress on Implementing the OAH Action Plan

3) Create Resilience

Support activities and initiatives that promote adaptation and resilience to Ocean Acidification and Hypoxia (OAH), for Oregon's human communities and ecosystems.

The Oregon OAH Action Plan identifies the need for the state to promote OAH resilience and adaptation in our management decisions and in regional planning for ecosystems and coastal communities. To support both thriving marine habitats (e.g., submerged aquatic vegetation (SAV)) and economies in light of current and future ocean changes, it is essential to build strong collaborations among stakeholders in order to maximize resources and time. By supporting community-driven climate resilience and adaptation measures Oregonians from vulnerable coastal communities and industries will become part of the solution to help mitigate OAH impacts.

OAH Council achievements this biennium (2018-2020):

- Advised the West Coast Ocean Data Portal (WCODP) on ongoing ocean acidification data synthesis – information can aid adaptation and resiliency planning within Oregon communities. ***(OAH Action Plan Step 3.2.1)***
- Participated in the Oregon's Territorial Sea Plan, Part 3: Rocky Habitat Management Plan Update, which now includes new information and considerations for ocean change, OAH adaptation planning, and protections for SAV. ***(OAH Action Plan Step 3.1.1)***
- Served on the advisory boards of several regional scientific research projects focused on OAH adaptation and resiliency planning within Oregon communities and ecosystems. ***(OAH Action Plan Step 3.1.1)***
    - NOAA Grant (2018-2020): "Vulnerability and Adaptation to Ocean Acidification among Pacific Northwest Mussel and Oyster Stakeholders"
    - Lenfest Grant (2019-2022): "Geospatial Patterns and Species Impacts of Changing Ocean Chemistry on the West Coast"
    - NOAA Grant (2020-2024): "Assessing Community Vulnerability to Ocean Acidification Across the California Current Ecosystem"

OAH Council benchmarks for the next biennium (2020-2022):

- Building academic-resource management partnerships to explore the role of SAV in ecosystem resiliency to OAH impacts – initiated in 2020 through the submission of grant proposals to the U.S. Fish and Wildlife Service and the National Estuaries Partnership. ***(OAH Action Plan Step 3.2.2)***

Current Project Highlight: West Coast Ocean Data Portal OAH Data Synthesis
Start year 2020; continuous thereafter

Oregon has had a central role in the West Coast Ocean Data Portal (WCODP) – a regional partnership of academic institutions, stakeholders, and state and federal governments with the goal of increasing access to data and information to inform decision making. WCODP is currently in the preliminary stages of creating a West Coast "Ocean Health Scorecard." This scorecard will not only collect and synthesize ocean data, including an ocean acidification indicator, but will also define standards and critical thresholds concerning priority ocean health issues across the region. As such, this scorecard will provide an important tool to be used for community adaptation and resilience planning as well as for possible management purposes (e.g., State Water Quality Assessments).

Agency staff on the OAH Council, particularly from the Oregon Department of Land Conservation and Development (DLCD) and the Oregon Department of Fish and Wildlife (ODFW) have been active in the design of the "Ocean Health Scorecard". As this project moves forward, the Oregon Ocean Monitoring Group (OOMG) and the OAH Council have been asked to help compile and review Oregon ocean information, particularly on ocean acidification, and to provide context for how this information might be used by Oregon communities. The growing interest in this topic led to the inclusion of the Ocean Status Update section in this report ***(see Report pages 21 - 25)***.

Progress on Implementing the OAH Action Plan

4) Expand Public Awareness

Communicate Ocean Acidification and Hypoxia (OAH) science, impacts, and solutions to raise awareness and support decision-making.

The Oregon OAH Action Plan identifies that it is important that ocean experts and stewards continue to make OAH information accessible to all Oregonians with the goal of empowering coastal communities to take informed action today to build a more robust future. This can only occur through clear, strategic, and compassionate communications. As Oregon continues to observe the impacts from OAH, it is key that we support equity and environmental justice in our communications – as many underserved communities in rural and urban centers are expected to be disproportionately impacted by climate change due to limited access to resources and information. Communities' resiliency depends on us taking steps forward today in awareness of and planning for ocean change. By creating strong, diverse partnerships of informed individuals (who not only understand OAH science, but are well informed on their possible mitigation, adaptation, and resiliency options to take action) Oregon can continue our path towards combating OAH. ***(see Appendix H – OAH Outreach Materials and Activities)***

OAH Council achievements this biennium (2018-2020):

- Pursued nationally recognized science communication trainings for Council staff in order to continue to hone OAH Council outreach materials' visuals and messages (including the acceptance into the 2020 COMPASS Leaders for Sea Change Fellowship).
- Shared OAH science, impacts, and solutions information with Oregonians throughout the state in venues such as – State of the Coast, Oregon Coastal Economic Summit, as well as at various fishers' club meetings and fisheries regulatory council meetings. ***(see Appendix G – OAH Council Developed OAH Outreach Materials)*** ***(OAH Action Plan Step 4.2.3)***
- Convened an advisory Working Group with regional education specialists and industry to identify OAH outreach needs. ***(OAH Action Plan Step 4.1.1)***
- Developed an online library of outreach materials focusing on commercial species vulnerable to OAH, the science of OAH, and Spanish translations of materials – made publically accessible on the OAH Council website. ***(OAH Action Plan Step 4.2.3)***

OAH Council benchmarks for the next biennium (2020-2022):

- Developing a communications plan to meet the needs of diverse stakeholders and provide solutions-oriented messages on OAH science and impacts. ***(OAH Action Plan Step 4.1.2)***
- Convening and facilitating workshops and informational sessions on the OAH impacts and solutions. Projects currently under development include a November 2020 State of the Coast remote session and April 2021 Fishermen's-Scientist roundtable. ***(OAH Action Plan Step 4.2.2)***

Current Project Highlights: New Communications Working Group Initiatives Start year 2020; continuous thereafter

Current and projected OAH impacts will be harmful to ocean life and the economic stability of all Oregonians - yet it will take a strong common purpose, meaningful local action, and broad partnerships (regionally, nationally, and internationally) in order to successfully implement solutions. The OAH Council is dedicated to recognizing the variation in the populations of the people that will be affected by these changes, and provide information that speaks to these differing interests and needs. In order to truly mitigate change, we must listen to and learn from affected communities, and understand their concerns and needs, so that we can incorporate those needs into solutions.

To this end, the OAH Council has organized a Working Group consisting of 11 members, including regional education and outreach specialists, as well as industry members, representing multiple perspectives and professional backgrounds. This Working Group has been meeting since Winter 2019 with the aim to identifying key audiences and connecting newly developed messages to audiences' personal interests, emotions, and beliefs. ***(See Appendix H – Education and Outreach Working Group - OAH Communications Planning)***

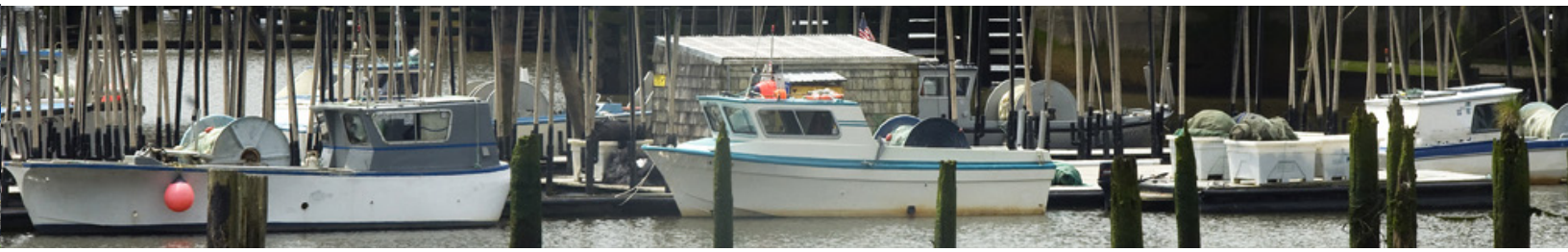
The goals of this Working Group include:

- ***Instilling OAH Understanding***
- ***Removing OAH Misconceptions***
- ***Acknowledging OAH Uncertainty***
- ***Building Motivation for OAH Action***
- ***Creating Hope for the Future***

The Working Group is currently developing a communications plan to meet the needs of diverse stakeholders and provide solutions-oriented messages to all Oregonians. A media firm who specializes in climate risk communications and messaging will ideally create the OAH Communications Plan (with anticipated delivery in 2023). In addition, the Working Group is working on several new initiatives including the development of a Fishermen's Roundtable.

2021 Fishermen-Scientist OAH Roundtable: *(Proposed for Spring 2021 – in person)*

In 2016 and 2017, Oregon Sea Grant, OSU and ODFW, along with others partners from around the State hosted two Ocean Acidification (OA) Fisherman's Roundtables, both in Newport, in order to share the current status of OA science and actions in Oregon. These roundtables were considered by the attendees (industry, managers, academics, decision-makers) to be valuable platforms for open dialog about the current status of our oceans health; these conversations spurred multiple collaborative research projects as a result. It is the goal of this workshop to describe the collaborations that have occurred, and focus on recent observations and opportunities to collaborate in the future. The Working Group has applied for and was awarded a small external grant to help support this workshop.



Progress on Implementing the OAH Action Plan

5) Build Sustained Support

Mobilize agencies to address Ocean Acidification and Hypoxia (OAH) priorities.

The Oregon OAH Action Plan identifies that developing a long-term OAH coordination strategy among state agencies, academia, the federal government, and industry will be a central and pivotal piece of Oregon's ongoing efforts to combat OAH. Oregon's ongoing leadership has already been invaluable for OAH science and decision-making both regionally and nationally, providing a model for other governments to follow. Moving forward, the state has already committed to continuing to support strong science-informed climate and ocean change policy through a series of important actions.

OAH Council achievements this biennium (2018-2020):

- Consulted with the Governor's Office on a new Executive directive that encourages state agencies to consider addressing OAH in their regulatory and management frameworks – accomplished through the Governor's letter to the OA Alliance adopting Oregon's 2019 OAH Action Plan. ***(see Appendix J – Governor Brown's Letter of Commitment to OAH Action)*** ***(OAH Action Plan Step 5.1.1)***
- Encouraged state agencies to propose anticipated needs in their biennial agency budget development process – Oregon Department of Fish and Wildlife (ODFW) and Department of Land Conservation and Development (DLCD) both included new ocean change measures in their proposed 2021-2023 biennium budgets to the Governor's Office in 2020. ***(OAH Action Plan Step 5.2.1)***
- Coordinated with state agencies to begin the process of identifying OAH priorities in their agencies current and future regulation and management frameworks. ***(OAH Action Plan Step 5.2.3)***

OAH Council benchmarks for the next biennium (2020-2022):

- Developing a multi-agency assessment report to describe current programs and anticipated needs to address OAH within current and future regulatory and management frameworks. (Report to be submitted to the legislature in Feb 2021) ***(OAH Action Plan Step 5.2.3)***

Current Project Highlight: Multi-agency OAH Needs Assessment
Start year 2019; continuous thereafter

In order to combat OAH long-term it is essential that all agencies develop clear defined goals to address projected ecosystem and economic impacts from OAH – as and where it is applicable. While OAH issues have been incorporated to some extent into some agencies regular planning processes for budget, staffing, and management outcomes, there are additional opportunities to integrate OAH into the day-to-day work of the State's policies and agency programs. The OAH Council's member agencies and 4 additional agencies are developing a multi-agency OAH needs assessment report which will include:

- ***An evaluation of current and potential management strategies for each agency, and management gaps that relate to OAH***
- ***Description of funding needs for OAH, for current and future budgeting processes***
- ***Recommendations on how to further promote inter-agency communication and collaboration on actions in the OAH Action Plan***

As a first step, the OAH Council identified eight key State agencies whose authorities have the most direct nexus with OAH impacts, adaptation, and mitigation. ***(see Appendix A – 2019 OAH Action Plan - OAH Action Plan Appendix D)*** These eight agencies will report to the legislature in February 2021, on existing programs and policies that are already at work to address OAH impacts, as well as the opportunities and resources needed to better-prepare Oregon for future ocean change. A key aspect of this combined report will be the opportunities to coordinate and effectively use limited resources.

Outline of state agency authorities and priorities outlined in the Oregon OAH Action Plan:

Oregon Department of Fish and Wildlife
- Emerging fisheries, resilient fishing communities, OAH research & monitoring

Department of State Lands
- Submerged aquatic vegetation, removal/fill permitting, mitigation of development impacts, authorization of use of state-owned navigable waterways

Department of Land Conservation and Development
- Ocean planning, coastal zone management, federal consistency, statewide planning goals, climate adaptation framework

Department of Environmental Quality
- Water quality, point and non-point source pollution, total maximum daily loads (TMDLs)

Oregon Department of Agriculture
- Food safety, aquaculture and agriculture permitting and practices

Oregon Department of Forestry
- Forested watersheds, carbon offset and mitigation, nonpoint source pollution on forested lands

Oregon Health Authority
- Impacted coastal communities

Oregon Department of Energy
- Carbon mitigation framework, impacts on ecosystem and economics.

Ocean Status Update

How much ocean change has occurred?

Fossil fuel combustion and related accumulation of carbon dioxide (CO_2) and other greenhouse gases have led to climate change, ocean acidification and ocean deoxygenation (hypoxia). The earth's ocean has absorbed 30% of the excess CO_2 produced from fossil fuel combustion since the Industrial Revolution (mid 1800s). When absorbed by seawater, CO_2 undergoes chemical reactions that lower seawater pH (making it more acidic), and thus hampers shell formation in marine life. Hypoxia (low oxygen) conditions are also on the rise as a result of climate change, due to changing wind and weather patterns. This is leading to extended periods of hypoxia in some of Oregon's coastal waters, impacting a wide range of marine animals from crabs to fish. This has led to ecosystem and economic impacts, which are already reverberating through our tourism and seafood industries **(Figure 3)**.

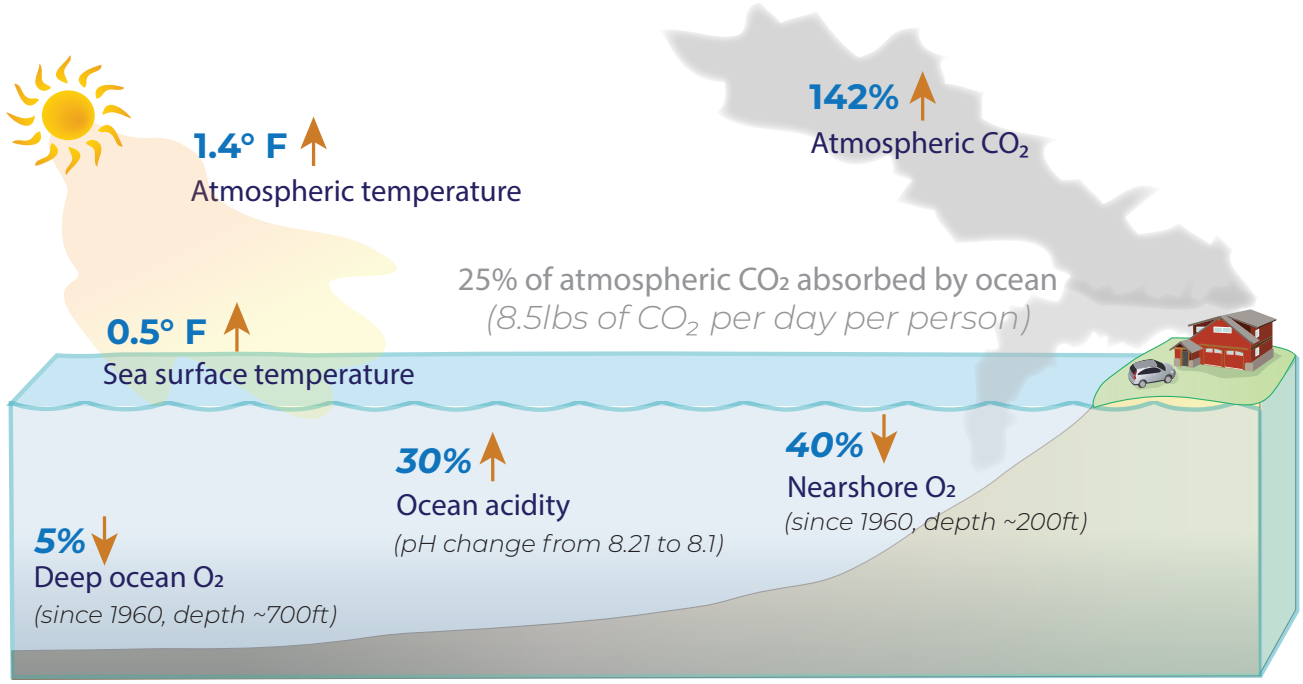


Figure 3. Schematic of anthropogenic climate driven changes in ocean and atmospheric conditions since the late 1800's.

References for schematic: *Pierce, S. D., J. A. Barth, R. K. Shearman and A. Y. Erofeev, 2012. Declining oxygen in the Northeast Pacific. J. Phys. Oceanogr., 42, 495-501. Schmidtko, S., L. Stramma & M. Visbeck, 2017. Decline in global oceanic oxygen content during the past five decades. Nature, 542, 335–339. https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature*

What is happening in the ocean in recent years?

In an ongoing effort to highlight recent scientific work from our region, and because of growing interest in Oregon on "What is happening in the ocean in recent years?" We present examples of the changes we are observing in the ocean over recent years. Moving forward, the OAH Council hopes this "Ocean Status Update" section will become a regular feature in our reports to the legislature, and will help to provide scientific context to Oregon's ongoing OAH ***science***, ***mitigation***, ***adaptation***, ***awareness***, and ***policy*** efforts.

The work of the OAH Council has been, and will continue to be, guided by strong science. As a region, the West Coast is at the forefront of oceanographic monitoring and OAH science with some of the world's premier long term oceanographic and intertidal data sites right off Oregon's coast including: NSF's Ocean Observatories Initiative , NOAA's Northwest Association of Networked Ocean Observing Systems and the Newport Hydrographic Line, and the Partnership for the Interdisciplinary Studies of Coastal Oceans (PISCO). The results of climate and ocean change have had far-reaching consequences, for both the ocean ecosystem and the economy, consequences that we, as a society, are only just beginning to understand and quantify, but world-class science institutions in Oregon and across the West Coast gives us a great advantage to both understand and develop solutions for OAH.

The Pacific Ocean, similar to other world ocean basins, is an interconnected system,with multiple climate and ocean change impacts manifesting and influencing each other at the same time. As we observe changing ocean conditions, we are seeing signs of shifting food webs, loss of fishery productivity and lost economic opportunities that are connected to OAH changes. This "Ocean Status Update" highlights a few recent oceanographic events that help describe Oregon's changing ocean conditions, including ocean warming, hypoxia, and the presence of Harmful Algal Blooms.

For more information on these topics, and other oceanographic indicators of climate and ocean change please visit the National Oceanographic and Atmospheric Administration's website:

https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-publications-reports

Ocean Warming and "The Blob" of 2015 – Oregon's first acknowledged Marine Heatwave

"The Blob", as it was initially dubbed, was a large mass of relatively warm water in the northeast Pacific Ocean caused by weak winter winds that failed to cool down the summer-warmed surface waters. First detected in late 2013, growing in 2014, and causing basin-wide ecosystem shifts by 2015, this marine heatwave was associated with the largest marine harmful algal bloom ever documented. The above-average warm sea surface temperature hugged the coast of Oregon (and California, Washington, Alaska) for multiple years. In 2019, the marine heatwave re-surfaced in the summer (having temporarily subsided to deeper depths), but then weakened by December 2019 ***(Figure 4)***. The lasting effects of both the 3-year 2015 event and the 6-month 2019 event on Oregon's ocean ecosystem are still unfolding. In general, these warming events can have long-lasting effects on oceanographic conditions. During the 2015-2019 period, in addition to the massive harmful algal bloom that closed fisheries and caused harm to ocean species, Oregon experienced multiple intense seasonal hypoxia events across the continental shelf that disrupted fishing and stock assessments, and documented species range shifts of dozens of ocean species.

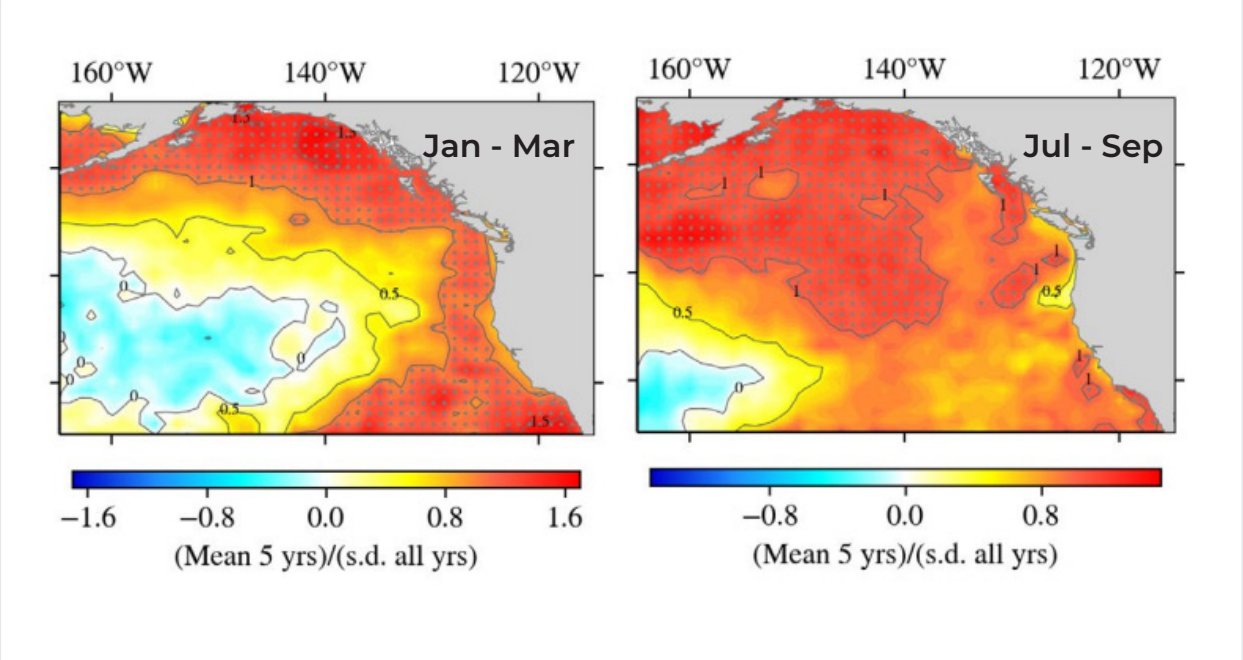


Figure 4. Mean Sea Surface Temperature (SST) anomalies in degrees Celsius (1°C = 1.8° F) for 2015-2019 (5 yrs), based on 1982-present satellite time series in winter January- March; left) and summer (July-September; right). Warm colors (yellow-red) indicates areas that are anomalously warmer than the 38-year average. Cool colors (aqua-blue) indicate areas that are anomalously cooler. (Reprinted from the 2020 California Current Integrated Ecosystem Assessment – CCIEA)

Ocean Hypoxia

Historically, it was normal for the Oregon coast to experience small areas of low oxygen (hypoxic) water occasionally near the sea floor along the outer and middle portions of the continental shelf. This is caused by Oregon's summer winds blowing from north to south, driving the surface waters offshore, and causing deeper, lower oxygen waters to rise toward the surface in a process called upwelling. Yet, the frequency of hypoxic events in Oregon's waters is increasing, and the low oxygen areas reach closer to shore, affecting our productive coastal ecosystems. The first zero oxygen event (anoxia) off Oregon was documented in 2006. Recently, hypoxia events are observed annually in late summer, and are occasionally severe (e.g. 2018 and 2019 offshore of Newport, ***Figure 5***).

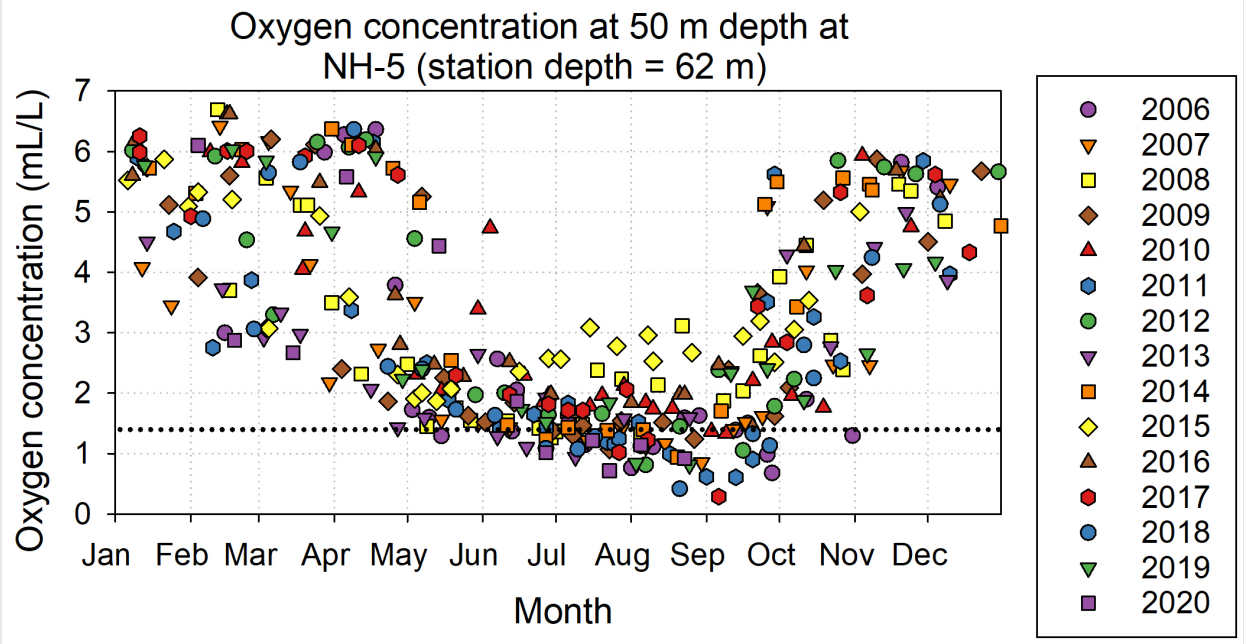


Figure 5. Oxygen concentration in bottom waters at a baseline station NH 05 (Newport Hydrographic line 5 miles off shore). Hypoxia is defined as waters with oxygen concentrations <1.4 ml/L, and is observed only during the coastal upwelling season, especially during Jun-Sep. (Reprinted from the NOAA Fisheries Summary of Ocean Indicators)

Harmful Algal Blooms (HABs)

HABs have been responsible for closures of shellfish and crab fisheries off the Oregon coast in recent years, resulting in negative social and economic impacts for coastal communities and across the state ***(Figure 6)***. Several studies have shown definitive evidence that HABs are impacted by warming oceans and increased ocean acidification (1,2). Ocean acidification may also increase the risk of more severe harmful algal blooms. This has been documented in the phytoplankton species *Pseudo-nitzschia* (which causes Domoic Acid), that has been shown to produce more toxins in lower pH water (3).

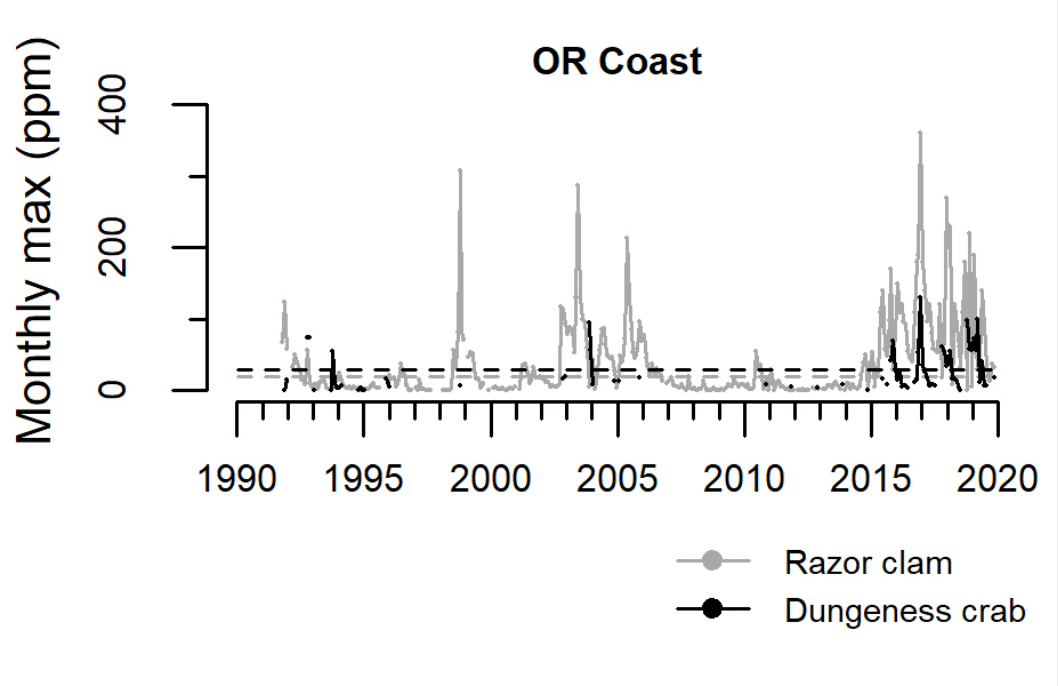


Figure 6. Monthly maximum domoic acid concentration (ppm) in razor clams (gray) and Dungeness crab viscera (black) through 2019 for Oregon. Horizontal dashed lines are the management thresholds of 20 ppm (clams in gray) and 30 ppm (crabs in black). (Reprinted from the 2020 California Current Integrated Ecosystem Assessment – CCIEA)

References: (1) Gobler, C.J., 2020. Climate change and harmful algal blooms: insights and perspective. Harmful Algae, 91, p.101731. (2) Raven, J.A., Gobler, C.J. and Hansen, P.J., 2020. Dynamic CO2 and pH levels in coastal, estuarine, and inland waters: Theoretical and observed effects on harmful algal blooms. Harmful algae, 91, p.101594. (3) Wilson, J.R., Wilkerson, F.P., Blaser, S.B. and Nielsen, K.J., 2020. Phytoplankton Community Structure in a Seasonal Low-Inflow Estuary Adjacent to Coastal Upwelling (Drakes Estero, CA, USA). Estuaries and Coasts, pp.1-19.

Regional Partners

Building Momentum for Action (2018 - 2020)

Oregon, the West Coast, and our nation have begun to make progress towards coordinated efforts to combat OAH. Below are several key state, regional, and national milestones, completed since 2018 OAH Legislative Report - each of which highlight strategic actions in OAH science, mitigation, adaptation, awareness, and policy.

It is critical we continue to build on these actions.

Oregon OAH Action Plan (August 2019): was developed from 2018-2019 by the OAH Council as our State's roadmap for action, and submitted this roadmap to the International Alliance to Combat Ocean Acidification. As requested by Governor Kate Brown, the OAH Council was central to this public process, which used the 2018 OAH Council legislative OAH Report as a starting point to identify the first actions that Oregon will take over the next several years.

Scoping Assessment For Pacific Northwest Blue Carbon Finance Projects (October 2019): was an assessment that investigated former tidal wetland sites in three estuaries (Skagit Delta, WA, Snohomish Estuary, WA, and Coos Estuary, OR) for their potential to be restored as carbon offset projects supported in part by carbon financing.

Oregon Executive Order 20-04 (March 2020): has directed State agencies to take actions to reduce and regulate greenhouse gas emissions to combat climate and ocean change – including OAH. Specifically, the Governor's order updates State carbon reduction goals, setting targets of a 45% reduction below 1990 levels by 2035, and an 80% reduction by 2050. It also directs agencies to alter building codes to prioritize energy efficiency, decrease reliance on fossil fuels, and make provisions for reducing state-wide food waste.

Federal Clean Water Act OAH Assessment (April 2020): was developed by the Oregon Department of Environmental Quality (DEQ). With the submission of this assessment Oregon became the first state in the nation to evaluate and include OAH ocean water conditions as part of its assessment of Oregon's waters under the federal Clean Water Act. Through this action the State formally recognized that OAH is a real and present danger and cause for concern for our coastal communities and ecosystems. Identification of the impacts of OAH on marine waters is the first step towards development of a strategic approach to identify the broad-scale underlying mechanisms contributing to these conditions, and how contributions from local sources could be addressed through water quality management. This assessment will be updated with new science every two years as DEQ is required to biennially assess and report the condition of Oregon's water quality to the U.S. Environmental Protection Agency (EPA).

Oregon campus of the NOAA Regional Institute for Climate, Ocean and Ecosystem Research (May 2020): has been formed with a regional consortium of faculty and staff from Oregon State University (OSU), University of Washington, and University of Alaska Fairbanks. The Institute will operate for four years (from 2021 – 2024) with the goal of contributing expertise, research capacity, technological development, and public outreach focused on a wide range of climate and ocean stressors including OAH. Federal funding for the consortium could be renewed for two cycles. OSU's existing Cooperative Institute for Marine Resources Studies (CIMRS) continues to also work on OAH-related science as it impacts the ocean's living marine resources.

Oregon's Territorial Sea Plan, Part 3: Rocky Habitat Management Plan revision (June 2020): has been developed by OPAC and will be finalized and adopted by LCDC in 2021. This updated plan (first adopted in 1994) includes policies, management prescriptions, and site-specific recommendations to guide management by local, state and federal agencies at nearly 90 sites on the Oregon coast. The draft includes new information and considerations for ocean change and OAH adaptation planning, including new policy on subtidal habitat and submerged aquatic vegetation (SAVs), such as kelp.

The Federal Climate Crisis Action Plan (July 2020): is the US Congressional roadmap to build a prosperous, clean energy economy that values workers and advances environmental justice. Created by members of the congressional working group including Oregon Representative Suzanne Bonamici, this Climate Action Plan stresses that the U.S. government has a moral, scientific, and economic duty to meet the climate change challenge. Specifically this plan outlines 12 key pillars designed to harness the technological innovation, entrepreneurs, the strength of our workers, and ongoing scientific developments in order to make directed and meaning full actions against climate and ocean change.

Moving Forward

Oregon's approach to addressing OAH impacts will take time and resources to implement. State investments, establishing clear priorities, and collaborations will be needed in order to implement the OAH Actions needed to make Oregon more resilient to future economic and environmental change.

Oregon benefits both culturally and economically to the natural beauty and bounty of the ocean and the health of its ocean and estuarine fisheries. Salmon, halibut, Dungeness crab, razor clams, oysters, pink shrimp, lamprey, rockfish, and other species have supported Oregon's indigenous people and coastal economies for generations. Yet, Oregon's ocean is changing, and each of these species, and the human communities that rely on them, are already showing signs of impairment from increasing intensity and durations of ocean acidification and hypoxia (OAH). Action is needed to help them adapt and become more resilient to change.

The Council encourages all who are ready and willing, to take action to address OAH impacts. There has already been some encouraging signs of State support over the last year from the Oregon Ocean Science Trust (OOST). The OOST is now authorized through the passage of SB753 (which established the legal framework) to work with outside partners to secure funding for ocean monitoring and health related research projects. The OOST has developed a new work plan for the next several years, and the OAH Council is ready to engage with OOST to meet common goals.

In the next biennium (2021-2023), the OAH Council recommends that Oregon focus on implementing steps outlined within the OAH Action Plan, specifically those relating to building resiliency in our coastal communities and ecosystems. Resiliency planning will not only help combat OAH but will assist communities as they begin to "rebuild" their stability given current economic uncertainties. This will require State prioritization and investment to be successful. When considering State investments we recommend both investing in our people and natural places to create value and benefits from sustainable ecosystem services. It may not be possible to implement all actions immediately; but through deliberate and thoughtful prioritization by the OAH Council members, the Action Plan continues to document what needs to be addressed first.

Together we can better prepare Oregon for the ocean changes happening now and to come.

The work of the OAH Council is ongoing, and the Council will continue to advise the State on current and future impacts that OAH and ocean change will have on our communities, so that the best science-based information is supporting decision-making.

Below is a timeline and preliminary estimated funding needs for OAH Actions as outlined in this OAH Action Plan in the following Action Categories: 1. Advance scientific understanding, 2. Reduce Causes, 3. Create Resilience, 4. Expand Public Awareness, 5.Build Sustained Support.

Values are ranges of preliminary estimates of costs for action, and were used to show the scale at which each action could be implemented. A dash (--) denotes actions for which there is uncertainty about whether there will be costs associated with the action, but costs may eventually be attributable to its implementation. An asterisk (*) denotes actions for which one or more external regional or national grant applications have been submitted to partially support estimated funding needs - at this time no grants have been awarded. TBD denotes funding needs yet to be determined *(no range set at this time)*.

Start Year	Action	Step	Estimated Funding Needs
2019	2	1. The OAH Council works with the Governor's Natural Resource Office to establish regular communication and coordination pathways with state agencies and other State entities to address excess CO_2 and OAH stressors locally and globally.	--
	4	1. 1. The OAH Council convenes an advisory working group with regional education/ outreach specialists to identify OAH outreach needs.	--
	5	1. 1. Governor issues a 2019 policy, directing relevant state agencies to consider work they are doing and their plans to address OAH priorities in the context of this Action Plan: Agencies document both existing and needed programs and regulations.	--
	5	1. 2. Agencies propose anticipated needs in biennial agency budget development process, starting with agency budget proposals for the 2021-2023 biennium.	--
	5	2. Governor's Natural Resources Office provides leadership, coordination, and policy guidance to agencies on OAH action priorities.	--
2019 - 2020	1	1. 1. Re-establish oceanographic monitoring to complement an historical time-series in Yaquina Bay.	*$50K-$200K (biennial costs)*
2019 - 2021	4	1. 2. The OAH Council develops a communications plan and outreach materials to meet the needs of diverse stakeholders and provide solutions-oriented messages on OAH science and impacts.	*$50K-$150K (onetime costs)*
2019 - 2025	4	2. 3. The OAH Council provides information in a variety of forms to impacted audiences including policy makers, at-risk industries, and coastal communities.	--
2020	4	2. 1. The OAH Council reports to the Oregon legislature on recommended OAH actions, through a biennial report (see step 1).	--
	4	2. 2. The OAH Council convenes "State of OAH" workshop for communities on OAH science, impacts, and solutions with policy makers as well as communities and at-risk industries.	*$25K-$100K (per workshop)*
2020 - 2023	3	1. 1. Allocate state funding for competitive grants and/or match to identify how to achieve ecosystem and economic resilience for Oregon.	*$200K-$300K (per project)*
	3	2. 1. Allocate state funding to support data collection, synthesis, and modeling to inform strategies that promote OAH resilient ecosystems: Develop maps to address the following information needs.	*$50K-$150K (onetime costs) **
	3	2. 2. Allocate state funding to support data collection, synthesis, and modeling to inform strategies that promote OAH resilient ecosystems: competitive grants and/or match to conduct ecosystem modeling.	*$200K-$400K (per project) **

Year	Action	Step	Estimated Funding Needs
2021	1	2. 1. Conduct a workshop to determine priority biological metrics for monitoring in Oregon coastal waters, including consideration of research results from regional partners.	*$25K-$100K (onetime costs)*
	3	1. 2. Industry and academics support continued research of resilient shellfish aquaculture strains.	*$200K-$600K (biennial costs)*
	5	1. 2. The OAH Council incorporates agencies' reports into ongoing development of recommendations to the State.	--
2021 - 2023	1	1. 2. Co-locate OAH oceanographic monitoring (intertidal and subtidal) alongside existing Marine Reserves biological sampling to leverage Oregon's existing research investments in Marine Reserves.	*$300K-$500K (biennial costs)*
	1	1. 3. Provide sustained funding for OAH oceanographic monitoring in Tillamook Bay.	*$50K-$100K (biennial costs)*
	1	1. 4. Support the maintenance of existing and installation of new climate grade OAH instruments in communities and at-risk industry locations.	*$100K-$200K (biennial costs)*
	1	2. 3. Augment on-going funding for the Newport Hydrographic Line to add biological and chemical OAH monitoring sensors and analysis to get the most value out of this existing monitoring program.	*$50K-$200K (biennial costs)*
	2	2. Fund competitive grants; funds could be used for match to attract additional investment or for full implementation); use outcomes to inform decision-making and future investments.	*$200K-$300K (per project)*
	2	3. Relevant state agencies implement measures to reduce excess CO_2 and OAH stressors.	*TBD*
	4	3. 1. The OAH Council develops communications evaluation tools to assess the OAH Council's outreach efforts and inform future outreach activities.	*$25K-$75K (onetime costs)*
2021 - 2025	5	3. State agencies implement measures to fill gaps, as described in agency OAH planning, in alignment with the Oregon Climate Adaptation Framework (2010), and with guidance from the Governor's Natural Resources Office.	*TBD*
2023	4	3. 2. The OAH Council revises outreach efforts and materials based on evaluation.	*$25K-$50K (onetime costs)*
2023 - 2024	1	2. 3. Augment Oregon Department of Fish and Wildlife's (ODFW) Shellfish assessment team to increase frequency and spatial scale of shellfish and submerged aquatic vegetation (SAV, e.g., eelgrasses) observations.	*$400K-$550K (biennial costs)*
	3	3. Agencies will develop Best Management Practices (BMPs), based on current ecosystem and economic research (as determined in Step 1) focused on Oregon's estuaries and nearshore.	*TBD*

About the Oregon Coordinating Council on Ocean Acidification and Hypoxia

In 2017, the Oregon Legislature created the Oregon Coordinating Council on Ocean Acidification and Hypoxia (OAH Council) via Senate Bill 1039. This bill passed with strong support from both legislative chambers and parties in recognition of the real and present threats that OAH impacts pose to our coastal communities and ecosystems. Through this legislative mandate, the State committed attention and resources toward understanding OAH impacts and charting a course for preparing for those impacts in our management decisions going forward. Subsequently, in 2018 Governor Brown committed the OAH Council to create Oregon's OAH Action Plan Oregon's roadmap to address OAH impacts. ***(see Appendix A - OAH Council Meeting Summaries)***

The OAH Council has been convening regularly, since January 2018, and is comprised of 13 members including State agencies, stakeholders, Tribes, NGOs and the Governor's office. During these public meetings, each Council member and members of the public have brought their unique perspective and expertise to bear on Council discussions - the OAH Council strives for an open and inclusive process.

Council members serve voluntarily for a 2 – 4 year appointment. In 2020, the OAH Council welcomed three new members as part of our staggered appointment schedule. The new seats include a new fisheries representative, commercial shellfish representative, and academic representative. The Council's diverse membership is critical for bringing together Oregonians and for the OAH Council moving forward.

The OAH Council continues to provide information and recommendations to the legislature and the Governor with a sense of urgency and importance, knowing that we have the remarkable opportunity to help strengthen Oregon's ecosystem, and the fishing and shellfish industries that rely on it. The OAH Council also recognizes that this will be an ongoing and dynamic process and will continue to keep the legislature, the Governor and Oregon Ocean Policy Council (OPAC) abreast of those changes through biennial reports, as directed in SB 1039.

OAH Council Guiding Principles

UNDERSTAND: *Develop an understanding of OAH science, how Oregon is impacted by increasing occurrence of OAH impacts, and what other entities in Oregon and the West Coast are working on these issues.*

RECOMMEND: *Identify action areas that are supported by all Council members, drawing from personal and professional experience, Council discussions, and presentations from subject matter experts.*

IMPLEMENT: *Consider the various options of how the recommended action areas could be refined and ultimately implemented.*

Council Member Biographies

DR. JOHN (JACK) BARTH, COUNCIL CO-CHAIR
Oregon State University

Jack Barth is the Executive Director of Oregon State University's (OSU) Marine Studies Initiative and is a Professor of Oceanography in OSU's College of Earth, Ocean, and Atmospheric Sciences. Jack received a Ph.D in Oceanography from the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution Joint Program. His research seeks to understand how coastal ocean circulation and water properties influence coastal marine ecosystems. Jack is interested in marine low-oxygen zones and has led a number of research, technology development, and ocean observing system projects. He serves on the Oregon Ocean Policy Advisory Council's Scientific and Technical Advisory Committee.

DR. CAREN BRABY, COUNCIL CO-CHAIR
Oregon Department of Fish and Wildlife

Caren Braby provides strategic leadership on all things 'ocean' within the state of Oregon and across the West Coast, as the Manager of the Marine Resources Program for the Oregon Department of Fish and Wildlife. Her work is grounded in both fishery and ecosystem issues, and is directed at facilitating and inspiring stewardship of ocean resources. Caren and her staff build partnerships with stakeholders and elected officials to collaboratively define, and achieve, both economic and ecosystem resilience. In particular, changing ocean conditions (particularly OAH) have become focal points for Caren's work over the past 7 years. Caren received a Ph.D. in Biological Sciences from Stanford University.

FRANK BARCELLOS
Oregon Department of Agriculture

Frank Barcellos is a Food Safety Program Managers for the Oregon Department of Agriculture. Frank relocated to the Pacific Northwest to share his knowledge and experience with the Oregon Dept. of Agriculture. He has responsibility over Dairy, Shellfish, and Personnel in his new position in Oregon. After graduating from University of Oklahoma with a degree in Microbiology, Frank worked for Oklahoma Department of Agriculture for over 40 years. His interests in OAH are from the perspective of the relationships between coastal communities and resources (e.g., dairy farming nutrient runoffs into shellfish estuaries).

JENNIFER WIGAL
Oregon Department of Environmental Quality

Jennifer Wigal serves as the Water Quality Deputy Administrator for the Oregon Department of Environmental Quality, where she has provides leadership to Oregon's water quality programs. Jennifer has over 20 years' experience working in water quality programs at the state and federal level. Jennifer received her Masters in Environmental Engineering from Johns Hopkins University and a B.S. in Civil Engineering from Washington State University.

ANDY LANIER
Department of Land Conservation and Development

Andy Lanier is the Marine Affairs Coordinator with Oregon's federally approved Coastal Management Program. He holds a M.S. degree in Marine Resource Management from OSU. Andy is the Co-Chair of the West Coast Ocean Data Portal and is a staffer to the Oregon Ocean Policy Advisory Council. Throughout his career he has been dedicated to promoting the inclusion of science based considerations regarding ocean acidification and hypoxia into state management and policy.

DR. JAMES SUMICH
Oregon Ocean Science Trust

James Sumich has worked in the field of marine science throughout the West Coast for over 50 years, receiving his M.S. and Ph.D. degrees from OSU. Recently retired as Professor of Marine Biology and Zoology at Grossmont Community College, California, his research interests have focused on the biology of gray whales and other mysticetes. James currently serves as a Trustee for Oregon Ocean Science Trust, where he provides scientific guidance to the board on the development of the Trust's scientific grant program. James's interest in OAH stems from his growing concern that local or regional solutions are increasingly crucial to address the problems associated with increasing atmospheric CO2 levels.

DR. SHELBY WALKER
Oregon Sea Grant

Shelby Walker is the director of the Oregon Sea Grant. She joined Oregon Sea Grant, coming to them from the NOAA Office of Oceanic and Atmospheric Research's Office of Policy, Planning and Evaluation, where she was responsible for NOAA research planning efforts and served as associate director for the NOAA RESTORE Act Science Program. Prior to NOAA, she was an associate program director in the National Science Foundation's Ocean Sciences Division, where she helped lead the Ocean Technology and Interdisciplinary Coordination Program. She holds a Ph.D. degree in Marine Science from the College of William and Mary, and is a former Sea Grant Knauss Fellow.

FRAN RECHT
Conservation Organization Representative

Fran Recht is the Habitat Program Manager for the Pacific States Marine Fisheries Commission. In her position she acts to conserve and restore freshwater, estuarine and ocean habitats. She works by advancing policies and actions through work with collaborative, multiparty groups such as the Pacific Fishery Management Council, the Pacific Marine and Estuarine Fish Habitat Partnership, forest service stewardship groups, and local watershed councils. She also brings her academic background in biochemistry and marine resource management to this issue.

VACANT
Shellfish Industry Representative

BRANDII HOLMDAHL
Fishing Representative

Brandii Holmdhl has worked in seafood processing and fishing, as well as political, regulatory, and educational aspects of commercial seafood for over 28 years. She is driven by opportunities to share knowledge and innovation. Brandii believes that one of the most important aspects of improving seafood harvest quality and sustainability is to create educational opportunities. To this end, she has taught classes, spoke at industry events, and worked with fishermen in AK, WA, and OR to guide them through independent marketing and processing. Brandii has also wrote a technical column for Fishermen News. Currently, she serves on the National Fisheries Institute and AK Seafood Marketing Institute committees.

DR. JESSICA MILLER
Academic Representative

Jessica Miller is a Professor of Fisheries and Wildlife at OSU and a member of the Coastal Oregon Marine Experiment Station at Hatfield Marine Science Center. She leads the Marine & Anadromous Fisheries Ecology Program and teaches courses on the early life history of fishes. She is also OSU's Project Director for the Living Marine Resources Cooperative Science Center, a NOAA-funded effort to promote underrepresented communities in marine science. Her research combines field and lab studies with biogeochemistry to address questions in marine and fisheries ecology that contribute to management and conservation. She received a BA in Zoology from the University of Montana, a MS in Fisheries from University of Washington, and a PhD in Biology from the University of Oregon.

JOHN SCHAEFER
Tribal Government Representative

John Schaefer earned his B.S. degree from Oregon State University in biology, and has acted as the water protection specialist and biologist for the Confederated Tribes of the Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) since 2015. As part of the Department of Natural Resources & Culture team, John represents the CTCLUSI natural resource interests at local stakeholder meetings and watershed councils. Prior to working for the tribes, John was shellfish biologist for ODFW for over ten years. He is a Coos Tribal member with interests in first foods and other cultural resources, and is dedicated to preserving natural resources and creating local adaptation actions, in light of changing ocean conditions from OAH.

DR. KRISTEN SHEERAN, EX-OFFICIO
Governor's Office Representative

Kristen Sheeran serves as Climate and Energy Policy Advisor to Governor Kate Brown and is the Director of the Carbon Policy Office. An economist by training, she has researched and practiced in the field of energy and environmental policy for over fifteen years. Kristen earned her Ph.D. degree in economics from American University and B.S. degree in economics and political science from Drew University. Her career spans leadership positions in the private, public, and non-profit sectors. She has published numerous articles on carbon policy and other related climate issues.

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***Appendix I* - Governor Brown's Letter of Commitment to OAH Action**

Submitted to the Oregon Legislature and the Oregon Ocean Policy Advisory Council

As directed by Oregon Senate Bill 1039 (passed in 2017)

APPENDIX A

The 2019 OAH Action Plan

- *Action Plan*
- *Action Plan Executive Summary (English and Spanish Versions)*
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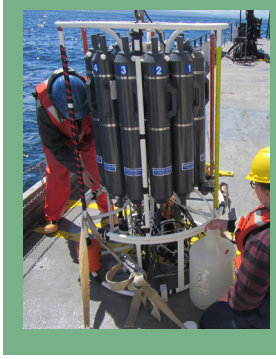
The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

Oregon Ocean Acidification and Hypoxia

Action Plan

2019 - 2025



About this Document

This ***Oregon Ocean Acidification and Hypoxia Action Plan*** was developed in recognition of the impacts that we see today, in hopes of minimizing the impacts for tomorrow, and to alter the trajectory of ocean changes for future generations - for Oregon, the Nation, and the world.

Oregon's OAH Action Plan, as adopted by Governor Brown, will guide Oregon's efforts and become Oregon's submission to the ***International Alliance to Combat Ocean Acidification***, and thus will be shared with the region and world. Because Oregon is one of the first states to feel the impacts of OAH, it is our hope that these actions can serve as a model for others to apply to their own geographical and political context. This work will also help demonstrate that local actions are meaningful in fighting the global challenges of climate and ocean changes.

For electronic copies of Oregon's Action Plan visit the OAH Council's website:
oregonocean.info/index.php/ocean-acidification

For printed copies of Oregon's Action Plan please contact:
Oregon Department of Fish and Wildlife • Marine Resources Program
2040 Marine Science Drive • Newport, OR 97365 • (541) 867-4741

KATE BROWN
Governor

August 19, 2019

Dear fellow members of the International Alliance to Combat Ocean Acidification:

With this letter, Oregon hereby presents the Ocean Acidification and Hypoxia Action Plan, as developed by the Oregon Ocean Acidification Coordination Council. Oregon endorses the Alliance's Global Call to Action, and commits to advance key goals that:

- Advance scientific understanding of ocean acidification.
- Reduce the causes of acidification.
- Protect the environment and coastal communities from the impacts of a changing ocean.
- Expand public awareness and understanding of acidification.
- Build sustained support for tackling this global problem.

This action plan is intended to provide guidance and policy directives to state agencies and local governments on the frontlines of combatting ocean acidification and hypoxia. I urge state agencies to consider and integrate the relevant recommendations within Oregon's Ocean Acidification and Hypoxia Action Plan into current management strategies by:

- Evaluating potential management and data gaps for ocean acidification and hypoxia,
- Incorporating funding needs for ocean acidification and hypoxia into 2021-2023 budgeting, and
- Promoting intra-agency communication and collaboration on projects and actions identified in the action plan.

Oregon is proud to submit our Ocean Acidification and Hypoxia Action Plan, and looks forward to leveraging current and future partnerships to combat the impacts of climate change on our lands, oceans, and people.

Sincerely,

Kate Brown

Governor Kate Brown

GKB:jm,kl

254 STATE CAPITOL, SALEM OR 97301-4047 (503) 378-3111 FAX (503) 378-8970
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This document was prepared for the State of Oregon by the Oregon Coordinating Council on Ocean Acidification and Hypoxia, whose membership is:

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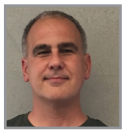
Al Pazar
Fishing Representative

Liu Xin
Shellfish Industry Representative

Dr. Aaron Galloway
University of Oregon

John Schaefer
Confederated Tribes of the Coos, Lower Umpqua & Siuslaw Indians



Dr. Kristen Sheeran, Ex-Officio
Governor's Natural Resources Office, Governor Kate Brown

Oregon Coordinating Council on Ocean Acidification and Hypoxia

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B. Carbon and Climate Policies
C. Oregon's OAH Action Plan Development Process
D. Build Sustained Support – State of Oregon Agency Authorities
E. Oregon OAH Council Report (2018)

For electronic copies of these appendices, visit the Council's website: oregonocean.info/index.php/ocean-acidification

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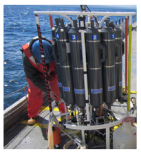
Executive Summary

Oregon OAH Action Plan

The Oregon Ocean Acidification and Hypoxia (OAH) Action Plan outlines actions that Oregon will take to adapt to and mitigate OAH impacts. Through this Action Plan, Oregon joins British Columbia, Washington, California, and other global partners in our commitment to building solutions for OAH impacts to better prepare for the future. Every action requires state leadership and resources to implement projects that lead to better understanding of OAH and to adaptation and mitigation steps. Broad partnerships with all Oregonians are essential to the success of this Action Plan.

Here are 5 ACTIONS the State of Oregon has identified to address OAH impacts over the next six years



1) Advance scientific understanding to address OAH vulnerabilities

- Invest in Oregon's existing research sites and tools
- Invest in monitoring of ocean life
- Assess the socio-economic impacts of OAH in Oregon

2) Develop and use strategies to reduce causes of excess CO_2 and other causes of OAH

- Enhance local and global communication networks working on CO_2 reduction
- Support research on effective and efficient ways to reduce excess CO_2 and OAH stressors
- Implement measures to reduce excess CO_2 and OAH stressors in Oregon

3) Support resilience to OAH in Oregon's ecosystems and communities

- Support data collection, synthesis, and modeling
- Restore, protect, and sustain native shellfish stocks and submerged aquatic vegetation
- Develop Best Management Practices based on current ecosystem and economic research

4) Share OAH science, impacts, and solutions to raise awareness

- Build OAH communications plan and outreach materials
- Provide timely updates to Oregon's decision-makers and affected communities
- Evaluate the effectiveness of OAH communications

5) Build sustained support and mobilize agencies to address OAH

- Governor issues a 2019 policy to address Oregon's OAH priorities
- Leadership, coordination, and policy guidance by Governor's Natural Resource Office
- Oregon agencies work to fill gaps in State OAH efforts

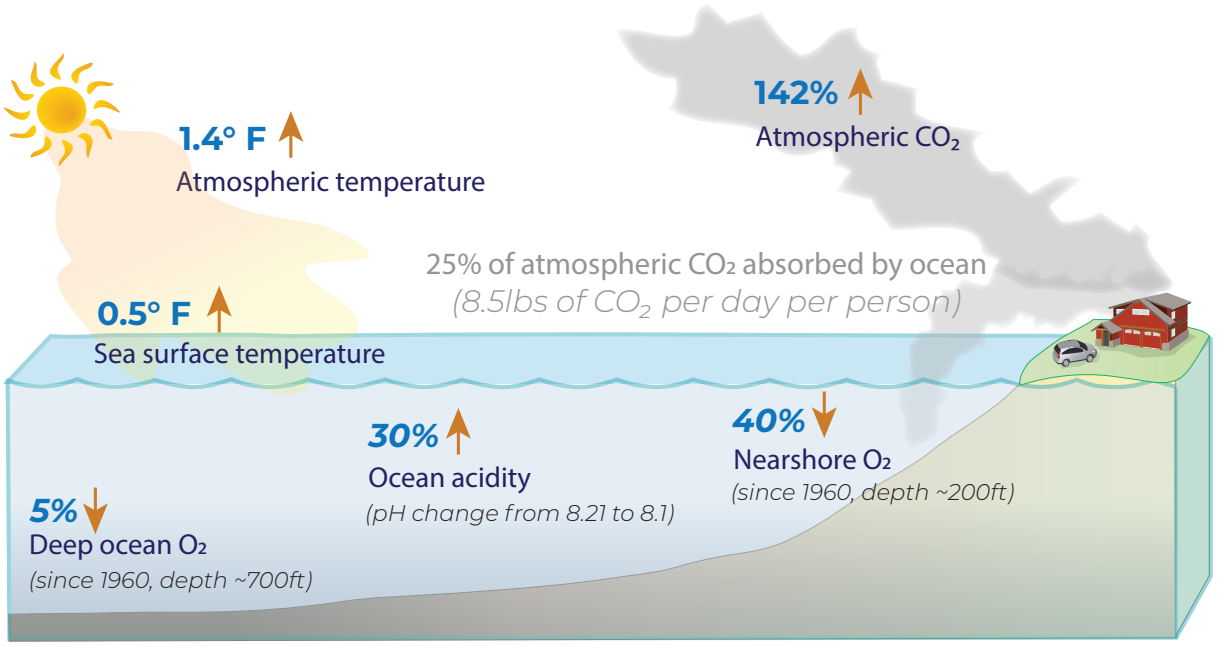
Why is this OAH Action Plan Needed?

Ocean acidification and hypoxia (OAH) are increasing, and are related to the same factor that is causing climate change.

The culprit? **Fossil fuel combustion and related accumulation of CO_2 and other greenhouse gases.**

The solution? **Local actions will lead to a brighter future, for the oceans, its species and the communities that depend on them. We can and must act now!**

Ocean Change since the Industrial Revolution *(Late 1800s)*



Referenced Data:
Pierce, S. D., J. A. Barth, R. K. Shearman and A. Y. Erofeev, 2012. Declining oxygen in the Northeast Pacific. J. Phys. Oceanogr., 42, 495-501
Schmidtko, S., L. Stramma & M. Visbeck, 2017. Decline in global oceanic oxygen content during the past five decades. Nature, 542, 335–339
https://earthobservatory.nasa.gov/world-of-change/DecadalTemp
https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature

The Oregon OAH Action Plan identifies ways that our government and individual Oregonians can make a difference to slow these impacts and adapt to the changes we are already seeing. Ocean Acidification and Hypoxia (OAH) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean.

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

What is at risk in Oregon?

> ***"The cost of inaction to me is about how it is going to become a lot harder to address ocean acidification and hypoxia the longer we wait. Over time I think that we are going to start to erode what were good options as the ecosystems change. Then it becomes a situation of "coulda, woulda, shoulda"***
>
> Dr. Francis Chan
> Department of Integrative Biology, Oregon State University

Oregon's history is one of cultural and economic value in ocean and estuarine fisheries and in the natural beauty and bounty of the ocean – all of these rely on our healthy ocean communities. Salmon, halibut, Dungeness crab, razor clams, oysters, pink shrimp, lamprey, and rockfish have supported Oregon's coastal economies for generations. Yet, Oregon's ocean is changing, and each of these species has already shown signs of distress from ocean acidification and hypoxia (OAH).

Ocean acidification and hypoxia are increasing, and are related to the same factor that is causing climate change in our own human habitats. The culprit?

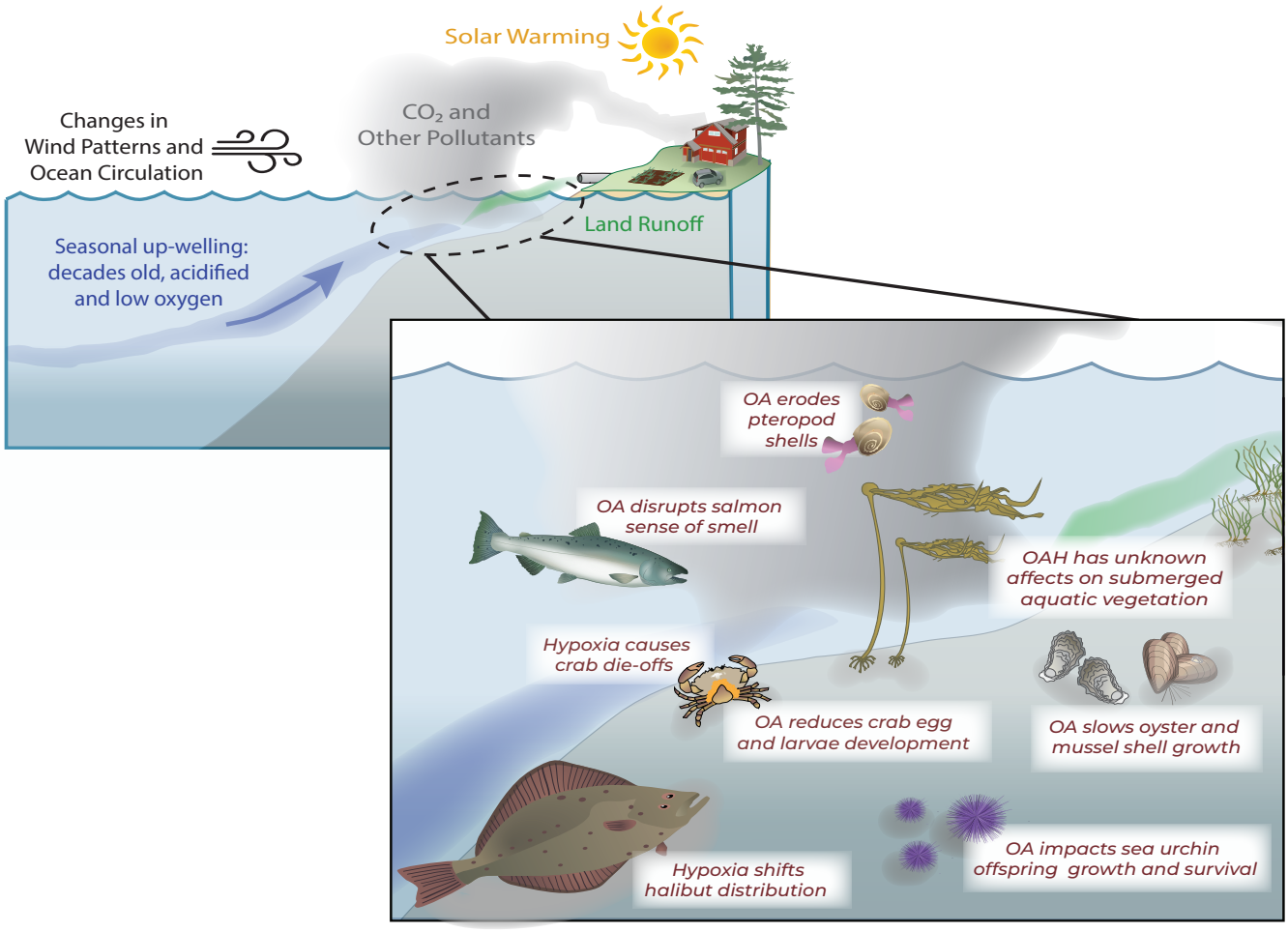
Fossil fuel combustion and related accumulation of **carbon dioxide (CO_2)** and other greenhouse gases has led to climate change, ocean acidification and ocean deoxygenation (hypoxia). The earth's oceans have absorbed 30% of the excess CO_2 produced from fossil fuel combustion since the Industrial Revolution (mid 1800s). When absorbed by seawater, CO_2 undergoes chemical reactions that lower seawater pH (making it more acidic), and thus hampers shell formation in marine life. Hypoxia (low oxygen) conditions are also on the rise as a result of climate change, due to changing wind and weather patterns. This is leading to extended periods of hypoxia in some of Oregon's coastal waters, impacting a wide range of marine animals from crabs to fish. This has led to major ecosystem and economic impacts, which are already reverberating through our tourism and seafood industries.

Oregon's commitment to understand, actively adapt to, and mitigate OAH requires us to invest funding and time to build a more predictable future. Oregon's approach to solving these problems requires addressing excess CO_2 and OAH stressors simultaneously (see **Appendix B** for a description of Oregon's actions of managing CO_2 and climate change). To build the brightest future for the ocean and its species and the communities that depend on them, and despite uncertainty, we can and must act now in a pro-active way that will improve ecosystem outcomes for resilience, as a "no-regrets" strategy.

This Oregon OAH Action Plan recommends ways to invest in our future, to better adapt to and mitigate the problems we are already seeing, and which will worsen in the decades to come.

The results of increasing OAH have had far-reaching consequences, for both the ocean ecosystem and the economy, consequences that we, as a society, are only just beginning to understand and quantify. Shifting food webs, loss of fishery productivity and lost economic opportunities are just some of the many impacts we are expecting to see as a result of increasing OAH.

Climate and other human drivers of ocean change ...



... impacts economically and ecologically important marine species.

For more information see:

Oregon Climate Change Adaptation Framework. December 2010. https://digital.osl.state.or.us/islandora/object/osl:4014

Oregon OAH Action Plan (2019-2025)

> ***"I think it is an obstacle that there are so many things changing in the environment, it is sometimes hard to make OAH a priority. But this should be a top priority - before we start to lose our shellfish, crab, salmon, and lamprey."***
>
> Mark Healey
> Marine Resource Manager, Coquille Tribe

This OAH Action Plan builds on the 2018 Report of the Oregon Coordinating Council on Ocean Acidification and Hypoxia, submitted to the Oregon Legislature and the Oregon Ocean Policy Advisory Council. The 2018 Report articulated 12 Recommendations and 38 Actions, organized under five Themes. Each of these actions are key to addressing OAH impacts at all levels, from science to policy, from education to adaptation. In creating this 6-year OAH Action Plan, the OAH Council considered the urgency of need, anticipated value of actions, and appropriate phasing of implementation steps for each action (see **Appendix C** for more detail on how the Report and Action Plan were developed).

It may not be possible to implement all actions immediately; this Action Plan articulates what needs to be addressed first. Below are 5 priority actions for Oregon.

1. **Invest in Oregon's monitoring network to document oceanographic and biologic conditions, and socio-economic vulnerabilities relating to OAH**
2. **Develop and integrate strategies to reduce causes of excess carbon dioxide (CO_2) and Ocean Acidification and Hypoxia (OAH)**
3. **Support activities and initiatives that promote adaptation and resilience to OAH, for Oregon's human communities and ecosystems**
4. **Communicate OAH science, impacts, and solutions to raise awareness and support decision-making**
5. **Mobilize agencies to address OAH priorities**

Oregon joins our regional partners (British Columbia, Washington, and California) in describing our intent and commitment to action, to fulfill the state's role in OAH and its solutions. For many years, the West Coast has provided critical leadership on OAH problem-solving, policy development, and supporting local actions to effect global change. Notably, the West Coast has conceived of and launched the International Alliance to Combat Ocean Acidification (OA Alliance). Oregon is a founding member of the OA Alliance, which has rapidly grown to a multi-national, multi-governmental collaborative body. The OA Alliance promotes voluntary government actions to address OAH, as part of our global responsibility to manage the problems from fossil fuel combustion.

Action Descriptions

With this document, Oregon fulfills our promise to global partners to develop and adopt an OAH Action Plan. For each of the five priority actions that are included in this OAH Action Plan, there are four distinct considerations for implementation that are described below.

Actions: Actions needed in order to achieve the vision.

Vision: The future Oregon we intend to create, as a result of the action(s).

Steps: Specific measures to implement the action, including who will implement the step. Order of steps are not necessarily an implication of time sequence.

Timeline and funding needs: Within each step, the timelines are specified for the start year, or range of years, as well as the timeframe over which the step is anticipated to occur. In ***Appendix A***, preliminary estimated funding needs are also provided, to indicate the scale of need for each action. All estimates are subject to further refinement as each action is implemented and specific budgets are developed.

Cross-Reference to the 2018 OAH Report: This text box, included at the bottom of each priority action section, lists the OAH Council Recommendations and Actions, as originally included in the September 2018 OAH Council Report, which would be implemented in whole or in part, by implementing the steps in this OAH Action Plan.

ACTION 1 - Invest in Oregon's monitoring network to document oceanographic and biologic conditions, and socio-economic vulnerabilities relating to Ocean Acidification and Hypoxia (OAH)

"I think that the best thing that we can really hope for now is to gather baseline data and gain a better understanding. I think we know what is causing Ocean Acidification and Hypoxia, but we need to know what the effects are going to be."

Bernie Lindley
Owner/Operator of F/V Sea Jay, Brookings, Oregon

VISION

Oregon has a robust monitoring network that produces long-term time series for physical, chemical, and biological properties of Oregon's nearshore ocean and estuaries. These data are used to understand Oregon's ecosystem and socio-economic vulnerabilities, to inform adaptation and mitigation efforts.

Step 1

Allocate state funding to use existing research reference sites and tools to enhance Oregon's oceanographic monitoring network.

- Re-establish oceanographic monitoring to complement an historical time-series in Yaquina Bay, an economic, research, and management hub for Oregon.
  (Start: 2019-2020 and continuing)

- Co-locate OAH oceanographic monitoring (intertidal and subtidal) alongside existing Marine Reserves biological sampling to leverage Oregon's existing research investments in Marine Reserves.
  (Start: 2021-2023 and continuing)

- Provide sustained funding for OAH oceanographic monitoring in Tillamook Bay, where a pilot program funded by Oregon Watershed Enhancement Board (OWEB) is providing baseline oceanographic observations for this Oregon hub of economic, research, and management activity.
  (Start: 2021-2023 and continuing)

- Support the maintenance of existing and installation of new climate grade OAH instruments in communities and at-risk industry locations.
  (Start: 2021-2023 and continuing)

Step 2 Allocate state funding to invest in monitoring of Oregon's ocean life by implementing consistent monitoring of the biological response to OAH.

- Conduct a workshop to determine priority biological metrics for monitoring in Oregon coastal waters, including consideration of research results from regional partners.
  (Start: 2021 and continuing)

- Augment on-going funding for the Newport Hydrographic Line to add biological and chemical OAH monitoring sensors and analysis to get the most value out of this existing monitoring program.
  (Start: 2021-2023 and continuing)

- Augment Oregon Department of Fish and Wildlife's (ODFW) Shellfish assessment team to increase frequency and spatial scale of shellfish and submerged aquatic vegetation (SAV) observations.
  (Start: 2023-2024 and continuing)

Step 3 Allocate state funding to a socio-economic vulnerability assessment to determine Oregon's vulnerabilities to OAH.

- Fund competitive grants and/or match (e.g. through the Oregon Ocean Science Trust), and use results to inform decision-making and investments.
  (Start: 2021 – 2023 and continuing)

Cross-Reference to 2018 OAH Report

Action 1.1.a. Maintain and support oceanographic and biological monitoring at significant research reference sites that provide high value to Oregon due either to prior State investments, the geographic location and/or historical data collection activities at that site. **Action 5.2.a.** Continue and expand State support for science funding entities in Oregon that provide grant funds to OAH science and response (e.g., Oregon Watershed Enhancement Board, Oregon Ocean Science Trust (OOST)). **Action 5.2.b.** Ensure the OOST has the institutional structure needed to receive and redistribute funds to support the State's OAH priorities. **Action 5.2.c.** Facilitate the acquisition of funding from a diversity of sources to address the State's OAH priorities. **Action 4.2.d.** Academics and researchers: Communicate research needs to build OAH solutions, as identified by the OAH Council and the OAH Action Plan. **Action 5.3.a.** Maintain Oregon's leadership role on OAH science by supporting prioritization of OAH research, education and outreach by Oregon universities. **Action 4.2.b.** At-risk industries and professions: Communicate with industries affected by OAH to strengthen cultural values of healthy and sustainable seafood and seafood industry and build relationships to strengthen collaborative solutions development. **Action 1.1.c.** Expand and implement monitoring to track the biological responses to OAH, to inform State natural resource decisions and management activities.

ACTION 2 - Develop and integrate strategies to reduce causes of excess carbon dioxide (CO_2) and Ocean Acidification and Hypoxia (OAH)

"Our oceans take a large brunt of the excess carbon. This is exactly what we should be relating climate change to and nothing can be more tied to CO_2 emissions than ocean acidification."

Charlie Plybon
Ocean Policy Coordinator, Oregon Surfrider

VISION **Oregon measurably has reduced carbon dioxide (CO_2) emissions and Ocean Acidification and Hypoxia (OAH) stressors to achieve ecosystem and economic benefits for both ocean and inland systems.**

Step 1 **The OAH Council works with the Governor's Natural Resource Office to establish regular communication and coordination pathways with state agencies and other State entities to address excess CO_2 and OAH stressors locally and globally.**
(Start: 2019 and continuing)

• Relevant state agencies (see Appendix D for agency descriptions) include:

o Oregon Department of Fish and Wildlife (ODFW)
o Department of Land Conservation and Development (DLCD)
o Department of Environmental Quality (DEQ)
o Oregon Department of Agriculture (ODA)
o Department of State Lands (DSL)
o Oregon Department of Forestry (ODF)
o Oregon Health Authority (OHA)
o Oregon Department of Energy (ODOE)

- Other relevant state entities include:

    - o Oregon Ocean Science Trust (OOST)
    - o Oregon Watershed Enhancement Board (OWEB)
    - o Oregon Ocean Policy Advisory Council (OPAC)
    - o Oregon Global Warming Commission (OGWC)
    - o Oregon's 4-year universities

- Relevant state entities (as described above) promote Oregon's continued participation in organizations and collaborations working to reduce excess CO_2 and promote OAH adaptation and mitigation. Entities include:

    - o Pacific Coast Collaborative
    - o International Alliance to Combat Ocean Acidification
    - o West Coast Ocean Alliance (regional ocean partnership)

Step 2 Allocate state funding to support scientific research leading to recommendations on effective and efficient ways to reduce excess CO_2 and OAH stressors.

- Fund competitive grants (e.g. through the Oregon Ocean Science Trust, or through the Oregon Watershed Enhancement Board); use outcomes to inform decision-making and future investments.
  (Start: 2021 – 2023 and continuing)

Step 3 Relevant state agencies implement measures to reduce excess CO_2 and OAH stressors and encourages action, as identified in Step 2 and other relevant processes.

(Start: 2021 and continuing)

Cross-Reference to 2018 OAH Report

Action 2.1.b. Strengthen communication and coordination on CO_2 and OAH management and mitigation among the OAH Council, State agencies, and other government entities (e.g., Oregon Global Warming Commission). **Action 5.2.a.** Continue and expand State support for science funding entities in Oregon that provide grant funds to OAH science and response (e.g., Oregon Watershed Enhancement Board (OWEB), Oregon Ocean Science Trust (OOST)). **Action 1.3.b.** Establish research priorities to identify effective measures to remove excess CO_2 from marine waters through technological means, sequestration, or bioremediation (e.g., culture and harvest kelp, thus removing CO_2 from local waters). **Action 5.2.b.** Ensure the Oregon Ocean Science Trust (OOST) has the institutional structure needed to receive and redistribute funds to support the State's OAH priorities.

ACTION 3 - Support activities and initiatives that promote adaptation and resilience to Ocean Acidification and Hypoxia (OAH), for Oregon's human communities and ecosystems

"Impacts of Ocean Acidification on the shellfish industry was really the first time that an economic cost could be associated with acidified sea water. This was the first time people could put a price on the effects of Ocean Acidification."

Dr. Chris Langdon
Oregon's Molluscan Broodstock Program

VISION

Oregon agencies and local governments promote Ocean Acidification and Hypoxia (OAH) resilience in management decisions, and Oregon's industries and communities work together to support thriving ecosystems and economic resilience to future changes.

Step 1

State agencies, in consultation with academia and industry, identify strategies to restore, protect, and sustain native shellfish stocks and submerged aquatic vegetation (SAV) in Oregon's estuaries and nearshore waters.

- Allocate state funding for competitive grants and/or match to identify how to achieve ecosystem and economic resilience for Oregon. Examples of project topics are listed below. ***(Start: 2020-2023 and continuing)***

    - o Productivity of nursery habitat for economically valuable shellfish species
    - o Restoration and protection of submerged aquatic vegetation (SAV) and native shell fish that provide ecosystem services
    - o Restoration and protection of water quality throughout Oregon's estuaries and near shore
    - o Effects of OAH on marine organism life history to identify vulnerable species.
    - o Ability of Oregon's coastal communities and marine industries to achieve economic resilience to OAH

- Industry and academic support continued research of resilient shellfish aquaculture strains. ***(Start: 2021 and continuing)***

Step 2 Allocate state funding to support data collection, synthesis, and modeling to inform strategies that promote OAH resilient ecosystems.

(Start: 2020-2023 and continuing)

- Develop maps to address the following information needs to promote resilience in decision-making in estuary and nearshore waters:

    - o SAV and native oyster core distribution areas – including historical and persistent regions
    - o Priority areas for habitat restoration and habitat protection

- Allocate state funding for competitive grants and/or match to conduct ecosystem modeling of estuary and nearshore ecosystems, including hydrodynamic and biogeochemical processes as well as SAV.

    - o Possible regions that could be considered for blue carbon and/or carbon mitigation offsets (if such programs are developed in Oregon)
    - o To inform aquaculture practices in Oregon's bays and estuaries

Step 3 Agencies will develop Best Management Practices (BMPs), based on current ecosystem and economic research (as determined in Step 1) focused on Oregon's estuaries and nearshore.

- Develop precautionary BMPs to ensure that coastal activities are sustainable and does not exacerbate OAH stressors. Examples of BMPs that might be developed are listed below. ***(Start: 2023-2024 and continuing)***

    - o Dredging
    - o Coastal development and infrastructure
    - o Aquaculture

Cross-Reference to 2018 OAH Report

Action 1.2.a. Develop and conduct an ecosystem vulnerability assessment to identify species vulnerable to OAH from among Oregon's commercially, recreationally, culturally, and ecologically important species. From this, identify research priorities for building adaptation and resilience strategies for species and species groups. **Action 1.2.d.** Establish research priorities to determine the benefits of conserving and restoring native species and vegetation in building ecosystem and socio-economic resilience. **Action 1.3.b. E**stablish research priorities to identify effective measures to remove excess CO_2 from marine waters through technological means, sequestration, or bioremediation (e.g., culture and harvest kelp, thus removing CO_2 from local waters).

ACTION 4 - Communicate Ocean Acidification and Hypoxia (OAH) science, impacts, and solutions to raise awareness and support decision-making

"People must understand the root problem. Without that they may turn a blind eye to CO_2 emissions and only focus on understanding and documenting OAH, which is not enough."

Catherine Corbett
Chief Scientist, Columbia River Estuary Partnership

VISION **Policy-makers, agencies, and the public have information on Ocean Acidification and Hypoxia (OAH) science, impacts, and solutions. This information supports decision-making across the state and leads to publicly-supported approaches to OAH adaptation and mitigation.**

Step 1 The OAH Council builds a communications plan and outreach materials to communicate OAH science, impacts, and solutions.

- The OAH Council convenes an advisory working group with regional education/outreach specialists to identify OAH outreach needs.
  (Start: 2019 and continuing)

- The OAH Council develops a communications plan and outreach materials to meet the needs of diverse stakeholders and provide solutions-oriented messages on OAH science and impacts.
  (Start: 2019-2021 and continuing)

Step 2 The OAH Council provides timely updates to Oregon Legislature, other policy-makers, and affected communities in Oregon to inform decisions on how best to invest in OAH research, adaptation, and mitigation.

- The OAH Council reports to the Oregon legislature on recommended OAH actions, through a biennial report (see step 1).
  (Start: 2020 and continuing)

- The OAH Council convenes "State of OAH" workshops for communities on OAH science, impacts, and solutions with policy makers as well as communities and at-risk industries.
  (Start: 2020 and continuing)

- The OAH Council provides information in a variety of forms to impacted audiences including policy makers, at-risk industries, and coastal communities.
  (Start: 2019-2025 and continuing)

Step 3 The OAH Council evaluates the effectiveness of OAH communication tools in filling information needs.

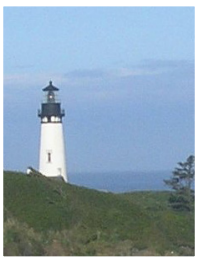
- The OAH Council develops communications evaluation tools to assess the OAH Council's outreach efforts and inform future outreach activities.
  (Start: 2021-2023 and continuing)

- The OAH Council revises outreach efforts and materials based on evaluation.
  (Start: 2023 and continuing)

Cross-Reference to 2018 OAH Report

Action 4.2.b. At-risk industries and professions: Communicate with industries affected by OAH to strengthen cultural values of healthy and sustainable seafood and seafood industry and build relationships to strengthen collaborative solutions development. **Action 4.1.b.** Build solutions-oriented messages on OAH science, impacts and solutions. Messages should include: simple language, positive tone, local connections, and actions for individuals and governments. **Action 4.2.a.** Policy makers and legislative staff: Inform decision-makers on the science, impacts and solutions, to help them shape strategic policy decisions. **Action 4.1.c.** Create an information resource and outreach catalog for the OAH Council and others that highlights OAH science, impacts and solutions using the positive messages strategy.

ACTION 5 - Mobilize agencies to address Ocean Acidification and Hypoxia (OAH) priorities



"Functionally, without a policy framework that directs the natural resource agencies to work collectively on an issue, we are then isolated in our resource management and in our planning processes. We are then not collectively maximizing the progress we could be having on Ocean Acidification and Hypoxia."

Davia Palmeri
Climate Change Policy Coordinator,
Oregon Department of Fish and Wildlife

VISION

Oregon state agencies have Ocean Acidification and Hypoxia (OAH) issues integrated into regular planning processes for budget, staffing, and management outcomes. Agencies have clear, defined goals to address projected ecosystem and economic impacts from OAH.

Step 1

Governor issues a 2019 policy, urges relevant state agencies to consider work they are doing and their plans to address OAH priorities in the context of this Action Plan.

- Agencies document both existing and needed programs and regulations (including compliance), that address OAH impacts, adaptation, and mitigation. Agencies report plans to address the gaps to the Legislature and Governor in February 2021.
  (Start: 2019 and continuing)

- Agencies propose anticipated needs in biennial agency budget development process, starting with agency budget proposals for the 2021-2023 biennium.
  (Start: July-December 2019 and continuing)

- The OAH Council incorporates agencies' reports into ongoing development of recommendations to the State on programs within and across agencies.
  (Start: 2021 and continuing)

Relevant state agencies (see **Appendix D** for agency descriptions) include:

- o Oregon Department of Fish and Wildlife (ODFW)
- o Department of Land Conservation and Development (DLCD)
- o Department of Environmental Quality (DEQ)
- o Oregon Department of Agriculture (ODA)
- o Department of State Lands (DSL)
- o Oregon Department of Forestry (ODF)
- o Oregon Health Authority (OHA)
- o Oregon Department of Energy (ODOE)

Step 2 **Governor's Natural Resources Office provides leadership, coordination, and policy guidance to agencies on OAH action priorities.**

- Expand expertise on ocean science and regulations within the Governor's Natural Resource Office.
  (Start: 2019 and continuing)

Step 3 **State agencies implement measures to fill gaps, as described in agency OAH planning (Step 1), in alignment with the Oregon Climate Adaptation Framework (2010), and with guidance from the Governor's Natural Resources Office.**
(Start: 2021-2025 and continuing)

Cross-Reference to 2018 OAH Report

Action 5.1.a. Develop and implement policy, directing agencies to address OAH priorities in agency planning. **Action 3.1.a.** Conduct an inventory of Oregon State agency programs and authorities that are relevant to OAH; identify opportunities to incorporate OAH adaptation and resilience strategies into current and future management actions, including implementation of Statewide Planning Goals. **Action 3.1.b.** Anticipate specific management and regulatory decision-making processes, into which OAH adaptation and resilience strategies can be incorporated. **Action 5.1.b.** Prioritize staffing in the Governor's Natural Resources Office to include expertise to provide leadership on ocean science and policy, to help guide and address OAH action priorities.

Evaluation

> *"One of the reasons I think monitoring is so important, is because a lot of the other OAH actions talk about strategies that we can implement to have an impact, mitigate bad responses, or try to make a resiliency strategy. Without having base monitoring, and the knowledge of the interactions in the ecosystems, it is going to be difficult to measure our success."*
>
> York Johnson, North Coast Basin Coordinator
> Oregon Department of Environmental Quality

The Oregon Coordinating Council on Ocean Acidification will review the status of this and subsequent Oregon OAH Action Plans in biennial reports to the Oregon Legislature, Oregon Ocean Policy Advisory Council (OPAC), and Governor (September of even years). Evaluation will inform the contents and focus of future recommendations by the OAH Council to Oregon.

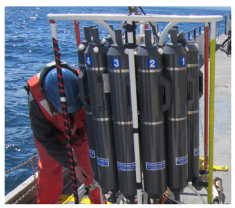
OAH Action Plan progress will be evaluated by the OAH Council based on the following factors:

- Timely completion of identified actions
- Successful implementation of actions at achieving the vision and goals in this OAH Action Plan
- Achievement of criteria or benchmarks developed on a per action basis, as each is implemented
- Updated research priorities as they are identified

Take Action

The Oregon Ocean Acidification and Hypoxia (OAH) Action Plan outlines actions that Oregon will take to adapt to and mitigate OAH impacts. We need all Oregonians to help make a difference facing this global problem.

Here is how YOU can help make a difference



Help Monitor Ocean Change

- Establish local and regional community-based monitoring networks
- Join an existing research or management survey as a volunteer

Reduce Excess Carbon and Prevent OAH Stressors

- Plant and maintain trees and restore coastal habitats
- Support State regulatory and voluntary programs to improve water quality
- Be mindful of your personal carbon footprint and reduce where you can - food waste, water usage, home heating/cooling/lighting, and driving patterns

Build Resilience to Ocean Change

- Work with industry, managers, and researchers to develop OAH specific adaptation/mitigation steps
- Support sustainable and adaptable local coastal business growth as OAH impacts occur

Learn about OAH Science and Solutions

- Encourage local schools and universities to teach about OAH
- Attend science and policy lectures, speaker series, and outreach events
- Use your network to share information about OAH science, impacts, and solutions

Encourage and Participate in Public Processes

- Support your local communities, cities, or organization to join coalitions and formulate their own OAH Action Plans
- Speak with and organize letters to your state and local government representatives for OAH Action

As requested by
Oregon's Governor Kate Brown

Recommended Citation:
Oregon Governor's Natural Resource Office. Oregon Ocean Acidification and Hypoxia Action Plan 2019 - 2025. August 2019. URL: https://www.oregonocean.info

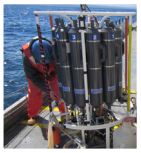
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Executive Summary

Oregon OAH Action Plan

The Oregon Ocean Acidification and Hypoxia (OAH) Action Plan outlines actions that Oregon will take to adapt to and mitigate OAH impacts. Through this Action Plan, Oregon joins British Columbia, Washington, California, and other global partners in our commitment to building solutions for OAH impacts to better prepare for the future. Every action requires state leadership and resources to implement projects that lead to better understanding of OAH and to adaptation and mitigation steps. Broad partnerships with all Oregonians are essential to the success of this Action Plan.

Here are 5 ACTIONS the State of Oregon has identified to address OAH impacts over the next six years



1) Advance scientific understanding to address OAH vulnerabilities

- Invest in Oregon's existing research sites and tools
- Invest in monitoring of ocean life
- Assess the socio-economic impacts of OAH in Oregon

2) Develop and use strategies to reduce causes of excess CO_2 and other causes of OAH

- Enhance local and global communication networks working on CO_2 reduction
- Support research on effective and efficient ways to reduce excess CO_2 and OAH stressors
- Implement measures to reduce excess CO_2 and OAH stressors in Oregon

3) Support resilience to OAH in Oregon's ecosystems and communities

- Support data collection, synthesis, and modeling
- Restore, protect, and sustain native shellfish stocks and submerged aquatic vegetation
- Develop Best Management Practices based on current ecosystem and economic research

4) Share OAH science, impacts, and solutions to raise awareness

- Build OAH communications plan and outreach materials
- Provide timely updates to Oregon's decision-makers and affected communities
- Evaluate the effectiveness of OAH communications

5) Build sustained support and mobilize agencies to address OAH

- Governor issues a 2019 policy to address Oregon's OAH priorities
- Leadership, coordination, and policy guidance by Governor's Natural Resource Office
- Oregon agencies work to fill gaps in State OAH efforts

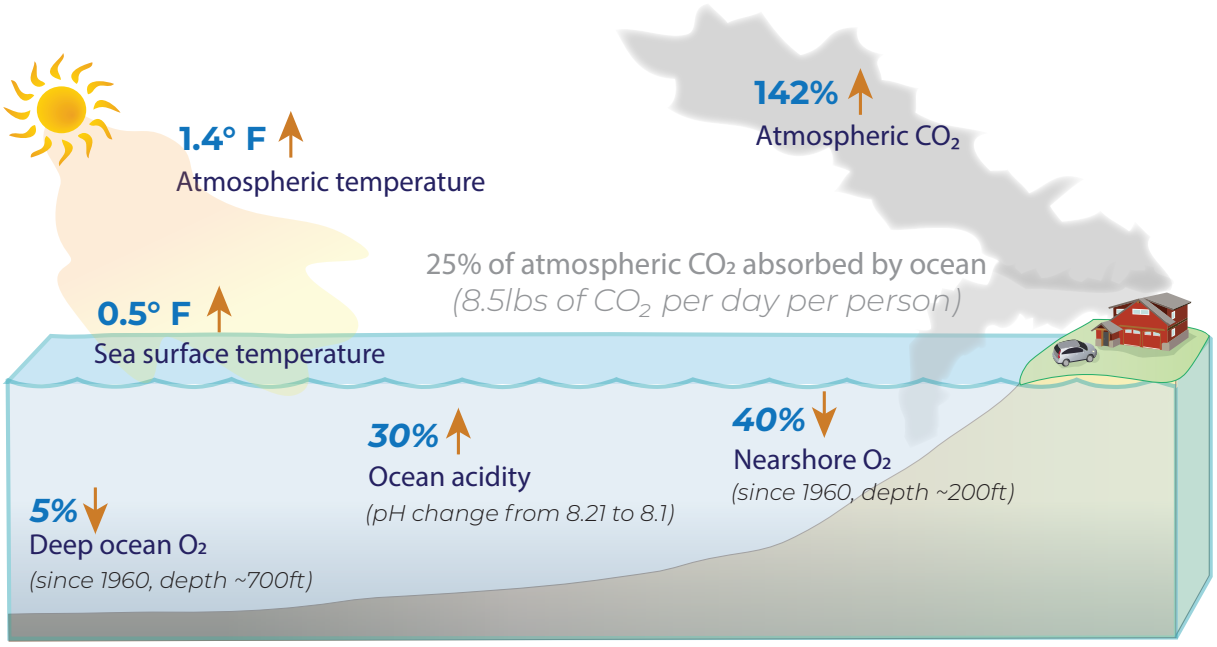
Why is this OAH Action Plan Needed?

Ocean acidification and hypoxia (OAH) are increasing, and are related to the same factor that is causing climate change.

The culprit? **Fossil fuel combustion and related accumulation of CO_2 and other greenhouse gases.**

The solution? **Local actions will lead to a brighter future, for the oceans, its species and the communities that depend on them. We can and must act now!**

Ocean Change since the Industrial Revolution *(Late 1800s)*



Referenced Data:

Pierce, S. D., J. A. Barth, R. K. Shearman and A. Y. Erofeev, 2012. Declining oxygen in the Northeast Pacific. J. Phys. Oceanogr., 42, 495-501
Schmidtko, S., L. Stramma & M. Visbeck, 2017. Decline in global oceanic oxygen content during the past five decades. Nature, 542, 335–339
https://earthobservatory.nasa.gov/world-of-change/DecadalTemp
https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature

The Oregon OAH Action Plan identifies ways that our government and individual Oregonians can make a difference to slow these impacts and adapt to the changes we are already seeing. Ocean Acidification and Hypoxia (OAH) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean.

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To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

El Consejo de Coordinación de Oregón sobre Acidificación Oceánica e Hipoxia

Resumen Ejecutivo

Plan de acción de la AOH de Oregón

El Plan de Acción de Oregón acerca la Acidificación Oceánica e Hipoxia (AOH) describe medidas que Oregón adoptará para adaptarse y así mitigar los impactos de la AOH. Con este Plan de Acción, Oregón se une a la Columbia Británica, Washington, California, y otros socios globales en nuestro compromiso a encontrar respuestas a los impactos de la AOH para prepararnos mejor para el futuro. Cada medida requiere tanto de liderazgo estatal como de recursos para la implementación de proyectos que conlleven a mejorar el entendimiento acerca de la acidificación oceánica e hipoxia, al igual que de los pasos a seguir para su adaptación y mitigación. Para alcanzar el éxito del Plan de Acción, es esencial contar con la amplia colaboración de todos los residentes de Oregón.

Aquí hay 5 MEDIDAS que el estado de Oregón ha identificado para hacer frente a los impactos de la Acidificación Oceánica e Hipoxia durante los próximos seis años

1) Avanzar el entendimiento científico para hacer frente a las vulnerabilidades de la AOH

- Invertir en los sitios y herramientas de investigación existentes en Oregón
- Invertir en el monitoreo de la vida oceánica
- Evaluar los impactos socioeconómicos de la AOH en Oregón

2) Desarrollar y usar estrategias para reducir las causas del exceso de CO_2 y otras causas de la AOH

- Mejorar las redes de comunicación locales y globales que trabajan en la reducción de CO_2
- Apoyar la investigación de manera efectiva y eficiente para reducir el exceso de CO_2 y los factores estresantes de la AOH
- Implementar medidas para reducir el exceso de CO_2 y los factores estresantes de la AOH en Oregón

3) Apoyar la resiliencia a la AOH en los ecosistemas y las comunidades de Oregón

- Apoyar la recopilación de datos, su síntesis y los elaboración de modelos
- Restaurar, proteger y conservar las poblaciones nativas de mariscos y la vegetación subacuática
- Desarrollar Mejores Prácticas mejores de Gestión basadas en la investigación actual del ecosistema y la economía

4) Divulgar la ciencia de la AOH, los impactos y las soluciones para fomentar la sensibilización

- Establecer un plan de comunicación acerca de la importancia de AOH y crear materiales de divulgación
- Proporcionar actualizaciones oportunas a los responsables de la toma de decisiones y a las comunidades afectadas de Oregón
- Evaluar la eficacia de la comunicación relacionada a sobre la AOH

5) Establecer el apoyo constante y movilizar agencias para hacer frente a la AOH

- Que en el 2019, el Gobernador proponga una política para hacerle frente a las prioridades de AOH en Oregón
- Que la oficina de Recursos Naturales del Gobernador brinde el liderazgo, la coordinación, y las directrices políticas
- Que las agencias de Oregón trabajen para llenar los vacíos encontrados en los esfuerzos del Estado relacionados con la AOH

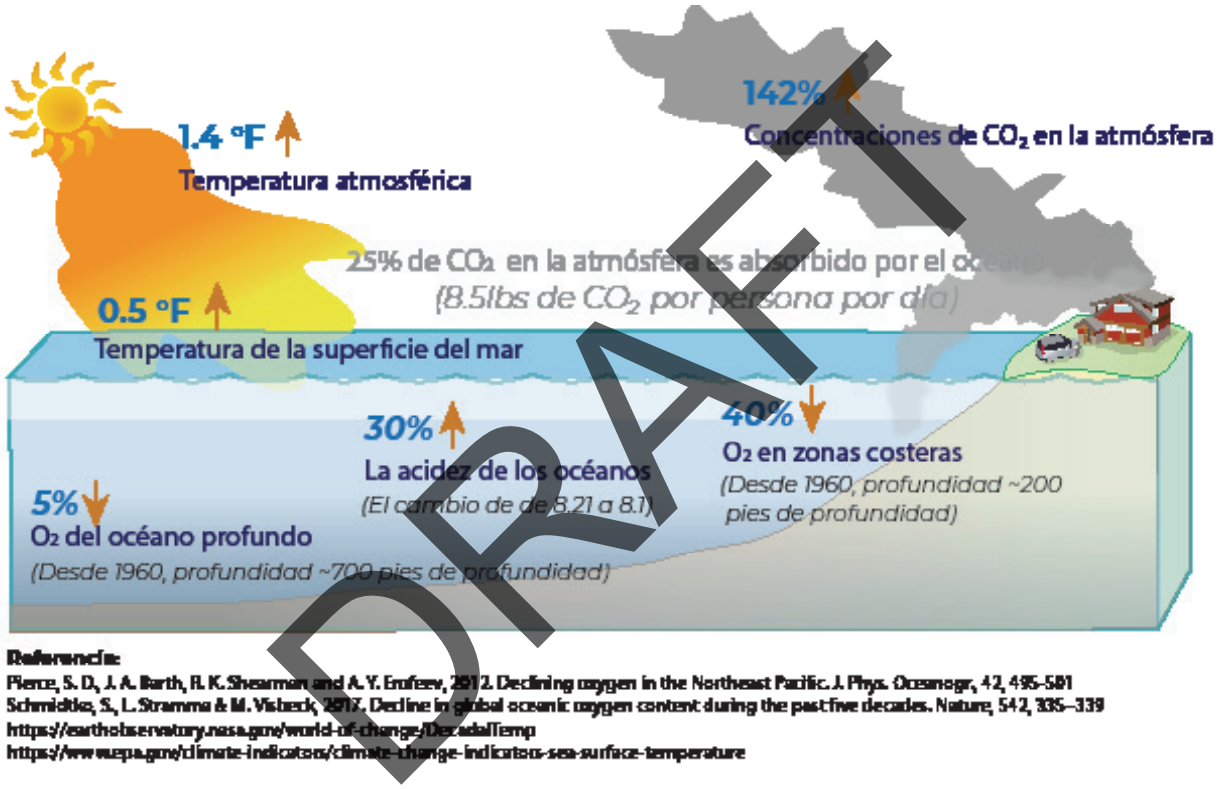
¿Por qué necesitamos este Plan de Acción sobre la AOH?

La Acidificación Oceánica e Hipoxia (AOH) están aumentando, y ellas están relacionadas con el mismo factor que está provocando el cambio climático.

¿Quién es el culpable? El consumo de combustibles fósiles y la respectiva acumulación de CO_2 al igual que otros gases de efecto invernadero.

¿La solución? Llevar a cabo medidas a nivel local conducirá a un futuro más favorable para los océanos, sus especies y las comunidades que dependen de ellos. ¡Podemos y debemos actuar ahora mismo!

Los cambios oceánicos desde la revolución industrial *(Finales de los años 1800)*



Referencia:
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Schmidtko, S., L. Stramma & M. Visbeck, 2017. Decline in global oceanic oxygen content during the past five decades. Nature, 542, 335–339
https://earthobservatory.nasa.gov/world-of-change/DecadalTemp
https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature

El Plan de Acción de Oregón sobre Acidificación Oceánica e Hipoxia identifica maneras que nuestro Gobierno y los Residentes de Oregón pueden llevar a cabo para tener una influencia decisiva y así reducir los impactos y a su vez, adaptarse a los cambios que estamos experimentando actualmente. La Acidificación Oceánica e Hipoxia (AOH) son dañinas no solo para la vida oceánica sino que también para la estabilidad económica de los residentes de Oregón que dependen de un exosistema marion saludable.

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Para obtener mayor información acerca la ciencia de la AOH, los impactos, y las soluciones propuestas, por favor visite el sito web del consejo de la AOH:

oregonocean.info/index.php/ocean-acidification

Funding and Timeline

*Oregon OAH Action Plan - **Appendix A***

Below is a timeline and preliminary estimated funding needs for OAH Actions as outlined in this OAH Action Plan in the following Action Categories: 1. Advance scientific understanding, 2. Reduce Causes, 3. Create Resilience, 4. Expand Public Awareness, 5.Build Sustained Support. Values are ranges of preliminary estimates of costs for action, and were used to show the scale at which each action could be implemented. A dash (--) denotes actions for which there is uncertainty about whether there will be costs associated with the action, but costs may eventually be attributable to its implementation. TBD denotes funding needs yet to be determined *(no range set at this time)*.

Start Year	Action	Step	Estimated Funding Needs
2019	2	1. The OAH Council works with the Governor's Natural Resource Office to establish regular communication and coordination pathways with state agencies and other State entities to address excess CO_2 and OAH stressors locally and globally.	--
	4	1. 1. The OAH Council convenes an advisory working group with regional education/ outreach specialists to identify OAH outreach needs.	--
	5	1. 1. Governor issues a 2019 policy, directing relevant state agencies to consider work they are doing and their plans to address OAH priorities in the context of this Action Plan: Agencies document both existing and needed programs and regulations.	--
	5	1. 2. Agencies propose anticipated needs in biennial agency budget development process, starting with agency budget proposals for the 2021-2023 biennium.	
	5	2. Governor's Natural Resources Office provides leadership, coordination, and policy guidance to agencies on OAH action priorities.	--
2019 - 2020	1	1. 1. Re-establish oceanographic monitoring to complement an historical time-series in Yaquina Bay.	*$50K-$200K (biennial costs)*
2019 - 2021	4	1. 2. The OAH Council develops a communications plan and outreach materials to meet the needs of diverse stakeholders and provide solutions-oriented messages on OAH science and impacts.	*$50K-$150K (onetime costs)*
2019 - 2025	4	2. 3. The OAH Council provides information in a variety of forms to impacted audiences including policy makers, at-risk industries, and coastal communities.	--
2020	4	2. 1. The OAH Council reports to the Oregon legislature on recommended OAH actions, through a biennial report (see step 1).	--
	4	2. 2. The OAH Council convenes "State of OAH" workshop for communities on OAH science, impacts, and solutions with policy makers as well as communities and at-risk industries.	*$25K-$100K (per workshop)*
2020 - 2023	3	1. 1. Allocate state funding for competitive grants and/or match to identify how to achieve ecosystem and economic resilience for Oregon.	*$200K-$300K (per project)*
	3	2. 1. Allocate state funding to support data collection, synthesis, and modeling to inform strategies that promote OAH resilient ecosystems: Develop maps to address the following information needs.	*$50K-$150K (onetime costs)*
	3	2. 2. Allocate state funding to support data collection, synthesis, and modeling to inform strategies that promote OAH resilient ecosystems: competitive grants and/or match to conduct ecosystem modeling.	*$200K-$400K (per project)*

Year	Action	Step	Estimated Funding Needs
2021	1	2. 1. Conduct a workshop to determine priority biological metrics for monitoring in Oregon coastal waters, including consideration of research results from regional partners.	*$25K-$100K (onetime costs)*
	3	1. 2. Industry and academics support continued research of resilient shellfish aquaculture strains.	*$200K-$600K (biennial costs)*
	5	1. 2. The OAH Council incorporates agencies' reports into ongoing development of recommendations to the State.	--
2021 - 2023	1	1. 2. Co-locate OAH oceanographic monitoring (intertidal and subtidal) alongside existing Marine Reserves biological sampling to leverage Oregon's existing research investments in Marine Reserves.	*$300K-$500K (biennial costs)*
	1	1. 3. Provide sustained funding for OAH oceanographic monitoring in Tillamook Bay.	*$50K-$100K (biennial costs)*
	1	1. 4. Support the maintenance of existing and installation of new climate grade OAH instruments in communities and at-risk industry locations.	*$100K-$200K (biennial costs)*
	1	2. 3. Augment on-going funding for the Newport Hydrographic Line to add biological and chemical OAH monitoring sensors and analysis to get the most value out of this existing monitoring program.	*$50K-$200K (biennial costs)*
	2	2. Fund competitive grants; funds could be used for match to attract additional investment or for full implementation); use outcomes to inform decision-making and future investments.	*$200K-$300K (per project)*
	2	3. Relevant state agencies implement measures to reduce excess CO_2 and OAH stressors.	*TBD*
	4	3. 1. The OAH Council develops communications evaluation tools to assess the OAH Council's outreach efforts and inform future outreach activities.	*$25K-$75K (onetime costs)*
2021 - 2025	5	3. State agencies implement measures to fill gaps, as described in agency OAH planning, in alignment with the Oregon Climate Adaptation Framework (2010), and with guidance from the Governor's Natural Resources Office.	*TBD*
2023	4	3. 2. The OAH Council revises outreach efforts and materials based on evaluation.	*$25K-$50K (onetime costs)*
2023 - 2024	1	2. 3. Augment Oregon Department of Fish and Wildlife's (ODFW) Shellfish assessment team to increase frequency and spatial scale of shellfish and submerged aquatic vegetation (SAV, e.g., eelgrasses) observations.	*$400K-$550K (biennial costs)*
	3	3. Agencies will develop Best Management Practices (BMPs), based on current ecosystem and economic research (as determined in Step 1) focused on Oregon's estuaries and nearshore.	*TBD*

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

Carbon and Climate Policies

*Oregon OAH Action Plan - **Appendix B***

The Oregon OAH Action Plan identifies problems and develops solutions to ocean acidification and hypoxia, a challenging consequence of global climate change attributable to anthropogenic greenhouse gas emissions. While Oregon's carbon footprint is only part of the global problem, Oregon is working to address emissions in a variety of ways that complement and reinforce our work on OAH. While the OAH Council developed the recommendations that led to this OAH Action Plan, other Oregon entities have the expertise on CO_2 directly. This appendix briefly describes the entities and responsibilities in Oregon (outside of the OAH Council process), that are addressing CO_2 adaptation and mitigation.

Oregon has taken great strides to manage CO_2 emissions, understand the effects of climate change on our ecosystem and economy, and provide leadership across the West Coast and the globe on CO_2 emissions policy.

Oregon Global Warming Commission (OGWC) was created by the Legislature in 2007 (HB3543) to track trends in greenhouse gas emissions and recommend ways to coordinate state and local efforts to reduce emissions in Oregon. In the past 12 years, the OGWC has produced several reports documenting state and regional actions on global warming impacts and existing greenhouse gas reduction policies. The commission consists of 25 members, 11 of which are voting members appointed by the Governor. Members include state agencies, NGOs, academics, and industry. Staff support for the commission is provided by the Oregon Department of Energy (ODOE).

Greenhouse Gas Emission Goals (2007) were set by the same bill that created the OGWC (HB3543). The emission goals commit Oregon to a 10% reduction from 1990 levels by 2020, and 75% reduction by 2050.

Oregon Climate Change Research Institute (OCCRI) was also created by the Legislature in 2007 to form a network of over 150 researchers from Oregon public universities and affiliated federal and state labs, to achieve a climate-prepared Northwest by cultivating informed communities and advancing the understanding of regional climate, impacts and adaptation. A representative of OCCRI holds one of the 11 voting seats on the OGWC and is responsible for providing technical assistance to the commission. The institute is administered by Oregon State University and also the National Oceanic and Atmospheric Administration's (NOAA) - Pacific Northwest Climate Impacts Research Consortium (CIRC), which is one of 11 Regional Integrated Sciences and Assessments (RISA) projects from around the United States.

Pacific Coast Collaborative (PCC) was created in 2008 by the Executive governments of the four West Coast jurisdictions: British Columbia, Washington, Oregon, and California. The goal of the PCC is to coordinate and promote Climate and Energy policies, aimed at dramatically reducing greenhouse gas emissions and creating a vibrant, low carbon regional economy. Key focus areas for the PCC have included clean energy buildings and transportation systems, food waste reduction management, and ocean acidification and hypoxia. By connecting governments (both regional and local) at the regional level the PCC facilitates collaboration on climate issues that cross borders and jurisdictional boundaries.

International Alliance to Combat Ocean Acidification (OA Alliance) was created through PCC collaboration in 2016, with Oregon as a founding member. The goal of the OA Alliance is to bring together international, regional, and local governments and organizations in order to encourage government action to mitigate and adapt to Ocean Acidification, in order to protect coastal communities and ecosystems. The OA Alliance currently has 42 member groups and governments developing their own OA Action Plans. Oregon's OAH Action Plan, as adopted by Governor Brown, becomes Oregon's submission to the OA Alliance, and thus will be shared with the region and world.

United States Climate Alliance is a bipartisan coalition of states formed in 2017 that are committed to honoring the 2015 Paris Agreement on climate change objectives and goals within their borders. Oregon is a founding member, and as a member has agreed to make steps to achieve the U.S. goal of reducing greenhouse gas emissions 26–28% from 2005 levels and targets of Clean Power Plan before 2025. This State-based Alliance has now become a platform for its members to further develop and strengthen their existing Climate policies, through sharing of information and best practices.

Oregon Climate Agenda (OCA) was developed in 2018 by Governor Kate Brown to create a roadmap to explain and implement Oregon's goals on carbon, climate change and ocean acidification and hypoxia. The OCA describes strategies to reduce carbon and GHG emissions, including:

- Implement market-based carbon program and create the Oregon Climate Authority to better align state programs and expertise to achieve the state's climate policy goals at the least possible cost, while protecting our manufacturing sector and mitigating impacts and providing opportunities for low-income and rural communities, communities of color, and Tribes.
- Hasten the pace of electrification of vehicles in Oregon by expanding electric vehicle infrastructure and incentives.
- Decarbonize the electricity sector by achieving the state's renewable energy targets, encouraging grid modernization and expand opportunities for residential, municipal, and commercial customers to access clean energy services.
- Maintain and strengthen strong energy efficiency investments in residential, commercial, industrial and agricultural sectors, expand the reach of energy efficiency programs to ensure all communities benefit, improve the energy efficiency of state building codes, and support world-leading industrial efficiency initiatives by Oregon's large industrial utility customers.
- Pursue climate solutions that benefit rural communities and Tribes, support working lands, and foster resilience to climate change.

Other Oregon Initiatives that relate to addressing carbon, climate change, and OAH:

- Cleaner Air Oregon (2018): rule making by the Oregon Department of Environmental Quality to set standards that regulate heavy metals and other toxic chemicals released by industrial facilities.
- 100 Year Water Vision (2018): Oregon will steward its water resources to ensure clean and abundant water for our people, our economy and our environment, now and for future generations. Strategic investments and policies will result in resilient natural and built water systems across the state to support safe and healthy communities, vibrant local economies and a healthy environment.
- Oregon Environmental Protection Act (2019): solidifies protective federal clean air, water, and drinking water standards as a baseline for Oregon's rulemaking.

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

Action Plan Development Process

Oregon OAH Action Plan - ***Appendix C***

In 2017, the Oregon Legislature created the Oregon Coordinating Council on Ocean Acidification and Hypoxia (OAH Council) with the passage of Oregon Senate Bill 1039. Through this action, the State committed both attention and resources toward understanding OAH science, impacts, and solutions. The Council began meeting in January 2018, and is comprised of agencies, stakeholders, Tribes, NGOs and the Governor's office. The OAH Council prides itself on leading an open and transparent process for developing recommendations for State actions.

As part of the OAH Council establishment, the following three guidelines were embraced:

UNDERSTANDING: The OAH Council developed an understanding of OAH science, how Oregon is impacted by increasing occurrence of OAH impacts, what other entities in Oregon and the West Coast are working on these issues.

RECOMMENDATIONS: The OAH Council identified action areas that are supported by all OAH Council members, drawing from personal and professional experience, OAH Council discussions, and presentations from subject matter experts.

CAPACITY: The OAH Council considered the various options of how the recommended action areas could ultimately be implemented.

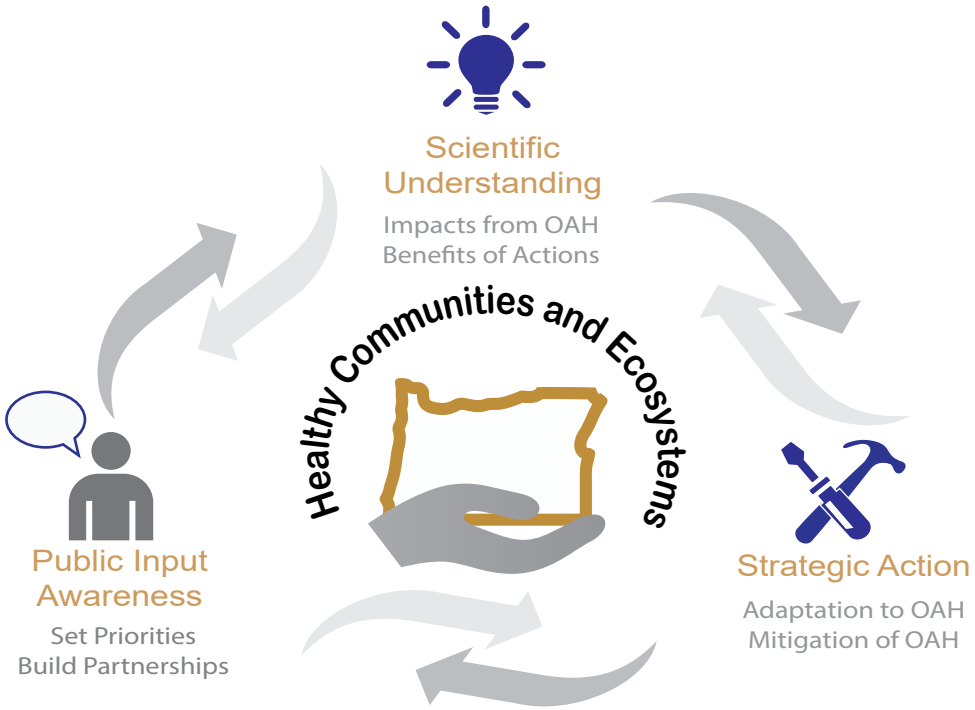
Oregon OAH Council and 2018 Report

(January 2018 – September 2018)

To develop the OAH Council's first biennial report (submitted to the Oregon legislature on September 15, 2018), the OAH Council met monthly from January to August 2018. Working groups (comprised of a subset of OAH Council members) met between each OAH Council meeting from March-July 2018. All OAH Council and working group meetings were open to the public (including scheduled public comment periods), and followed Oregon's public meeting transparency guidelines. When the OAH Council was established, the Governor requested that the OAH Council draft Oregon's OAH Action Plan as part of Oregon's commitment to the International Alliance to Combat Ocean Acidification. The 2018 Report was intended to provide step 1, of the OAH Action Plan drafting process. In the OAH Council's 2018 Report, 12 recommendations with 38 nested actions were articulated as a comprehensive set of ideas for future actions. The intent is for OAH Council reports, to broadly inform decisions and management activities across entities, as capacity and opportunities are available, for all who are ready to take action to address OAH impacts and develop solutions. As part of finalizing the first OAH biennial report, the OAH Council members rated the relative value of each actions in the report, and elevated 7 actions to needing immediate attention (see **Table C1**). By articulating concerns and ideas for solutions-based actions, the OAH Council intended to generate broad discussions and activities that will help prepare Oregon for the next fifty years by stimulating actions now.

Prioritization of OAH Actions
(December 2019)

Building on the recommendations and actions developed in the September 2018 OAH report, the OAH Council members conducted a second prioritization exercise in October 2018 in order to reevaluate the rating of each report action. Careful deliberation and selections of actions by OAH Council members were based on urgency, anticipated impact, and pathway for implementation of each action (see **Table C1**). This reevaluation also considered public input on the 2018 Report.



Oregon OAH Community Survey
(February 2019 – April 2019)

In order to ensure that the OAH Council heard from as many diverse groups of Oregonians as possible, a community survey was also developed to aid in the development of the State's OAH Action Plan draft.

This survey was sent to 70 carefully selected people across Oregon and the region, and consisted of an online questionnaire and an optional 40 minute interview. Respondent groups included academics, State and Federal Agencies, Tribal organizations/governments, industry, and funding entities. Individuals were selected to participate because of their expertise and ability to help represent their colleagues' interests, concerns, and/or knowledge of OAH and how it will affect Oregon. The survey asked for participants' perceptions and opinions about Oregon's best opportunities to implement OAH mitigation and adaptation strategies.

Feedback from this survey was reviewed by the OAH Council and incorporated into the State's OAH Action Plan (see **Table C1**). Thirty-seven (37) individuals responded to the online survey (53% response rate) and 23 of these opted to participate in follow-up interviews (33% response rate).

From the interviews and online surveys there were three common themes that emerged:

INTERCONNECTION: This Action Plan should make clear the interconnection of actions and the State's needs.

LEVEL OF INFLUENCE: There is a sense of urgency that Oregon can and should act on local scales, while recognizing that OAH is also a global problem that requires global solutions. Respondents felt we need to communicate with all Oregonians, especially those who can be decision makers in their communities (business owners, policy makers, resource managers).

KNOWLEDGE GAPS: While we know a great deal about OAH Science, we still need more information to fully understand the OAH impacts to build solutions. Many felt that at this time they did not have access to all the information they need to address OAH within their community (i.e. on which to base local decisions). Two knowledge gaps that were repeatedly mentioned were 1) the need for more oceanographic monitoring of frequency and duration of OAH and 2) expanding our understanding of socio-economic impacts on Oregon communities.

Draft OAH Action Plan Public Comment Period

(June 2019 – July 2019)

At each meeting and webinar, the OAH Council has always welcomed public participation and comment and has used this feedback to guide OAH Council decisions throughout their processes. Formal public comment on the draft Oregon OAH Action Plan was open from June 10th through July 9th, 2019, which was widely advertised. As part of the public comment period, two webinars were held with both in-person and remote participation options. Each of these webinars was also recorded and the posted webinars, as well as all presented materials, are available on the OAH Council's website. Public input was taken as written or oral comments during and following the webinars, as well as via email, calls, or post throughout the public comment period.

RECORDED WEBINARS OCCURRED ON:

June 11th 6:00pm – 8:00pm
In person at Oregon Department of Fish and Wildlife, Newport, and remote

June 14th 10:00am – 12:00pm
In person at Oregon State University, Corvallis, and remote

Following formal public comment, the OAH Council and staff carefully reviewed all feedback and worked diligently to incorporate suggestions. The Council has taken a thoughtful and collaborative, science-based approach to developing recommendations, encouraging participation by all Oregonians in the crystallization of these ideas from the 2018 OAH Report, into the draft Oregon OAH Action Plan.

Table C1: Progression of actions to be included in the draft Oregon OAH Action Plan, as the Action Plan developed. Twenty (20) key actions were identified from the original 38, as described in the 2018 Report. **Bold red** font denotes the 5 key actions highlighted in the 2019 OAH Action Plan.

OAH Report Priorities *January - September 2018*	**Prioritization Exercise** *December 2018*	**OAH Council Community survey** *February - April 2019*	**OAH Action Plan** *June - July 2019*
1.1.a 1.1.c	1.1.a 1.1.c 1.1.b	1.2.b 1.2.d	**1.1.a** **1.1.c** 1.2.b 1.2.c 1.3.b
2.1.b	2.1.a 2.1.b		2.1.a **2.1.b**
3.2.a 3.2.b	3.2.a		3.1.a **3.2.a** **3.2.b** 3.1.b
4.2.a	4.2.a	4.1.b 4.2.b	4.1.a 4.1.b **4.2.a** 4.2.b
5.1.a	5.2.a 5.2.b 5.2.c		**5.1.a** **5.1.b** 5.2.a 5.2.b 5.2.c

Build Sustained Support

Oregon OAH Action Plan - **Appendix D**

This appendix lists each of the 8 State agencies who's authorities have the most direct nexus with OAH impacts, adaptation, and mitigation. Here, we outline issues that connect the agency authorities to the goals and priorities of the Oregon OAH Action Plan, that can serve as a starting point for agencies conducting evaluation of programs, regulations and compliance (as described in this Oregon OAH Action Plan, Action 5, Step 1). Additional authorities and nexus points may also be relevant.

Oregon Department of Fish and Wildlife

• emerging fisheries, resilient fishing communities, OAH research & monitoring

Nexus with 2018 Report Recommendations: 1.1, 1.2, 3.2, 5.1

Department of Land Conservation and Development

• ocean planning, coastal zone management, federal consistency, statewide planning goals, climate adaptation framework

Nexus with 2018 Report Recommendations: 3.2, 1.2, 1.1, 5.1

Department of Environmental Quality

• water quality planning, point and non-point source pollution, TMDLs

Nexus with 2018 Report Recommendations: 2.2, 5.1

Oregon Department of Agriculture

• food safety, aquaculture and agriculture permitting and practices

Nexus with 2018 Report Recommendations: 2.2, 3.2, 5.1

Department of State Lands

• submerged aquatic vegetation, removal/fill permitting, mitigation of development impacts, authorization of use of state-owned navigable waterways (includes estuaries and the territorial sea)

Nexus with 2018 Report Recommendations: 3.2, 5.1

Oregon Department of Forestry

• forested watersheds, carbon offset and mitigation, nonpoint source pollution on forested lands

Nexus with 2018 Report Recommendations: 2.2, 5.1

Oregon Health Authority

• impacted coastal communities

Nexus with 2018 Report Recommendations: 3.1, 4.2, 5.1

Oregon Department of Energy

• carbon mitigation framework, impacts on ecosystem and economics.

Nexus with 2018 Report Recommendations: 1.1, 2.2, 5.1

State of Oregon agency authorities

Below are examples of possible ways to incorporate OAH into agency planning, this list is not exclusive or comprehensive, and is meant as a starting place to help guide relevant agency planning.

Oregon Department of Fish and Wildlife *(ODFW; OAH Co-Chair Member)*

- Encourage development of emerging fisheries in federal and state waters, add socio-economic resilience in fisheries portfolios.

- Encourage monitoring and research on fisheries species distribution patterns, as a result of OAH (e.g., halibut distributions to hypoxia).

- Build OAH monitoring considerations into existing research and monitoring efforts/metrics.

- Continue coordination of the Oregon OAH Monitoring Group (OOMG) and OAH monitoring community in Oregon.

Department of Land Conservation and Development *(DLCD; OAH Council Member)*

- Consideration of OAH in the regulation and permitting of the at-sea processing of fish waste; ocean floor/space for projects such as open ocean aquaculture, windfarms, oil/mineral exploration, and other such uses that could stress ecosystems and exacerbate the regional impacts of OAH.

- Work with local governments to strength local planning efforts, particularly to OAH and the following planning goals: Oregon Statewide Planning Goals: 5 – Natural Resources, Scenic and Historic Areas, and Open Spaces, 17 – Coastal Shorelands, 18 – Beaches and Dunes, 19 – Ocean Resources, 16 - Estuary Management

Department of Environmental Quality *(DEQ; OAH Council Member)*

- Evaluate and update approaches within water quality programs to effectively address the control of pollutants relevant to causes of ocean acidification and hypoxia, especially near coastal regions and/or river basins that empty into coastal regions that are near OAH sensitive habitats/species/communities.

- Review approach to permits and for non-point sources to take into account coastal regions and/or river basins that empty into coastal regions that are near OAH sensitive habitats/species/communities.

- Prioritize and/or ensure that development of total maximum daily loads (TMDLs) in coastal basins also address nutrients and other relevant water quality goals.

Oregon Department of Agriculture *(ODA; OAH Council Member)*

• Consider the interplay between harmful algal blooms (HAB) biotoxins and OAH in crab, clam, and oyster testing and regulations.

• Improvement and regulation of aquaculture reporting standards – standard size of basket, production levels that can be used as monitoring metrics for the vulnerability of the aquaculture industry to the ongoing effects of OAH.

• Consider agricultural lands use and how to best promote water shed resilience and health, including through the use of incentive programs for land owners.

Department of State Lands *(DSL)*

• Saltmarsh preservation – prioritization of regions with the potential for carbon sequestration and/or that are within regions sensitive to OAH.

• Consider policy development to promote the protection, restoration, and maintenance of SAV's throughout coastal Oregon.

• Consideration of ecosystem resilience to withstand OAH projected changes, such as in permitting and mitigation measures for human development projects in Oregon estuaries and coastal areas.

Oregon Department of Forestry *(ODF)*

• Consideration of the regulatory ecosystem services (e.g., climate control, water, water quality) that forests provide to estuarine and nearshore from OAH stressors (e.g., warming temperature, toxic contaminants).

• Consideration of OAH causes and OAH stressors in carbon offset programs and mitigation and climate adaptation frameworks.

• Consideration of OAH stressors in annual meetings with other agencies on the sufficiency of forest practices regulations.

• Facilitate DEQ's work with the Oregon Departments of Forestry, USEPA, and NOAA to resolve concerns about the Coastal Non-point Pollution Control program with regard to forest practices on private lands.

Oregon Health Authority *(OHA)*

• Consideration of OAH impacted coastal communities and industries, designation of at-risk and impacted communities as a result of carbon mitigation programs.

Oregon Department of Energy *(ODOE)*

• Consideration of OAH causes and OAH stressors in regional carbon mitigation and climate adaptation frameworks.

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

APPENDIX B

Community Survey

- *Background and Oral Questions*
- *Summary Presentation*

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

OAH Community Survey

Oregon 2020 Legislative Report - Appendix B

The OAH Council strategically gathered input from experts and interested parties, to build into Oregon's OAH Action Plan in order to ensure that the OAH Council recommendations were representing an informed and diverse group of Oregonians. A community survey was specifically designed to gather this input. The survey asked for participants' perceptions and opinions about Oregon's best opportunities to implement OAH mitigation and adaptation strategies.

The OAH Community Survey consisted of a 15 minute online questionnaire and an optional 40 minute one-on-one interview. This survey was sent to 70 individuals across Oregon selected based on their expertise and ability to help represent their colleagues' interests, concerns, and/or knowledge of OAH and how it will affect Oregon and the region. Respondent groups included academics, state and federal agencies, tribal organizations/governments, industry, and funding entities. Feedback from this survey was reviewed by the OAH Council and incorporated into the State's OAH Action Plan and into the OAH Council's 2020 Legislative report actions.

Brief Summary of Survey Results:

(Combined across the online and oral surveys)

1.Need for Interconnection

- Interconnection of actions and needs, we cannot address the issue without addressing all themes together.

2. Lack of Control

- OAH is a global problem was a common response to ranking theme 2 and Action 2.1b lower than other themes and actions. There was a sense of urgency without the ability to act.
- The lack of control of compounding stressors.
- Respondents felt we needed to communicate best with those who have influence and ability to act (Policy makers and industries who can lobby)

3. Lack of Knowledge

- Respondents felt they do not have access to information they need to address OAH – it is unclear if this data is not collected or is not accessible in a usable format.
- Theme 1 and Action 1.1a/c (of the OAH Action Plan) were both ranked highest, there was a common idea that we need more information on long term trends and attribution of OAH on biology.
- Theme 3 Action 3.2a/b (of the OAH Action Plan) were ranked low, because although most people recognized the habitat benefits of SAV there was a lack of knowledge on mitigation benefits.

***** For a comprehensive analysis of survey results please reference the survey presentation***

OAH Community Survey: Follow-up Interviews Questions

Introduction Text:

Thank you for participating in our online OAH Community Survey and for agreeing to participate in our follow-up in-person interview. Together, the survey and interview responses will be used to capture and describe awareness of, engagement in, and priorities for OAH mitigation and adaptation strategies. Your responses will be used by the OAH Council in developing recommendations, and in finalizing the Oregon OAH Action Plan in 2019. This interview should take about 40 minutes to complete. Prior to this interview, you should have received an email containing a copy of your responses to the OAH Community Survey (online survey), as well as the OAH Council Report themes and actions.

Oral Survey Questions:

1. In your opinion and based on your knowledge of projected OAH changes, are there foreseeable impacts you expect to observe in the next 20-50 years? Please explain the impacts you anticipate and how it will affect the ecosystem or natural resource you monitor, manage, or use.
2. In question 10 of the online survey, you stated that your organization, agency, constituents, or industry has _____(not considered/considered/begun/ completed)_____ planning for OAH impacts (adaptation and/or mitigation). Can you briefly explain what has helped/or hindered your organization, agency, constituents, or industry planning for OAH impacts?
3. Are there obstacles preventing or making actions difficult, for your organization, agency, constituents, or industry in addressing OAH management and mitigation?
4. Which OAH action, recommendation, or topic do you think was most important in the OAH Council report, relative to the ecosystem or natural resource you monitor, manage, or use?
5. Are there any actions, recommendations, or topics that you think should have been included in the Oregon OAH Council Report, but were not?
6. What recommendations do you have, for providing the funding needed by the State to better understand OAH science, impacts and solutions? Do you have ideas on how to diversify the portfolio of funding sources?
7. What modes of communication would be most effective in reaching members of your organization, agency, constituency, or industry? For example, public meetings, brochures, websites, or educational events?
8. Is there anything else do you want to share with us, as we move forward on building Oregon's OAH Action Plan?
9. Would you be willing to be contacted to participate in a future review of the draft Action Plan?

Oregon OAH Community Survey

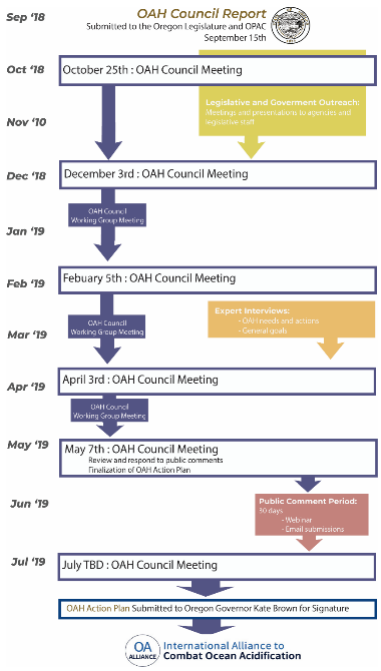
Oregon's Coordinating Council on Ocean Acidification and Hypoxia

OAH Community Survey

As part of a multifaceted community outreach strategy, the OAH Council conducted the **OAH Community Survey**, an online questionnaire and one-on-one interviews.

The survey asked for participants perceptions and opinions about Oregon's best opportunities to implement OAH mitigation and adaptation strategies.

Following the online survey, the OAH Council staff conducted a series of one-on-one interviews as a way to capture more of the details about the expectations and advice on Oregon's next steps.



OAH Community Survey

OVERVIEW

70 Participants were invited to participate in the surveys

Survey invitations were emailed out February 1st
The survey remained **open for 63 days** *(closed April 3rd)*

37 respondents to the **online survey** (53% response rate)
There were 27 components to the online survey
Average survey time was about 15min

23 respondents to the **one-on-one survey** (33% response rate)
There were 9 questions to the one-on-one surveys
Average survey time was 40min

OAH Community Survey

OVERVIEW

RESPONDENT GROUPS:

State Agencies: ODFW, DLCD, DEQ, ODF, ODA,

Federal Agencies: NOAA, EPA, USFW

Tribal Governments: Oregon tribal governments/organizations

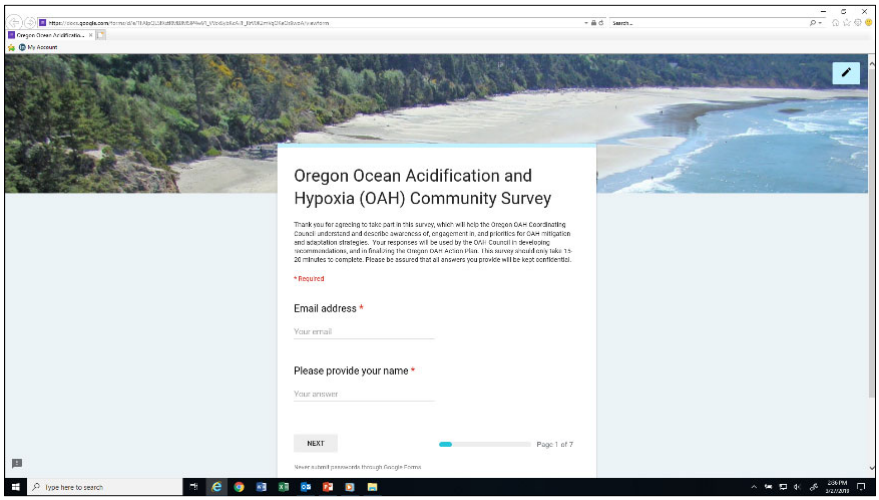
Industry: Shellfish, Crabbing, Restaurant, Trade Commissions

Academic: OSU, UO, PSU

Funding: Packard, Lazar, Meyer, Pew

OAH Community Survey Results - Online

Google forms (37 respondents)



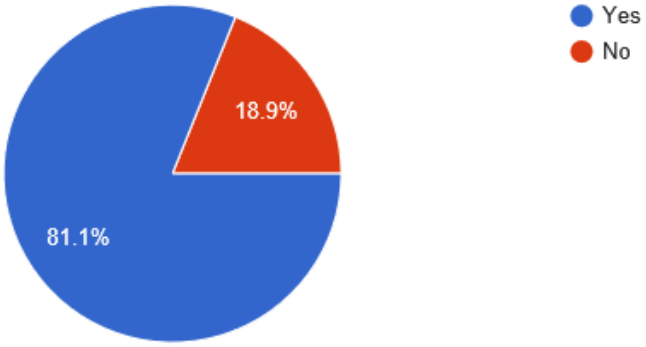
OAH Community Survey Results - Online

RESPONDENT GROUPS:

Group	Invited Participants	Respondents	Response Rate
State Agencies	14	10	**71 %**
Federal Agencies	5	4	**80 %**
Tribal Governments	13	3	**23 %**
Industry	13	4	**40 %**
Academic	13	9	**69 %**
Funding	4	1	**25 %**
Environmental/ Education	8	5	**63 %**
	70	**37**	**53 %**

OAH Community Survey Results - Online

Are you willing to participate in a 40 minute follow-up interview?

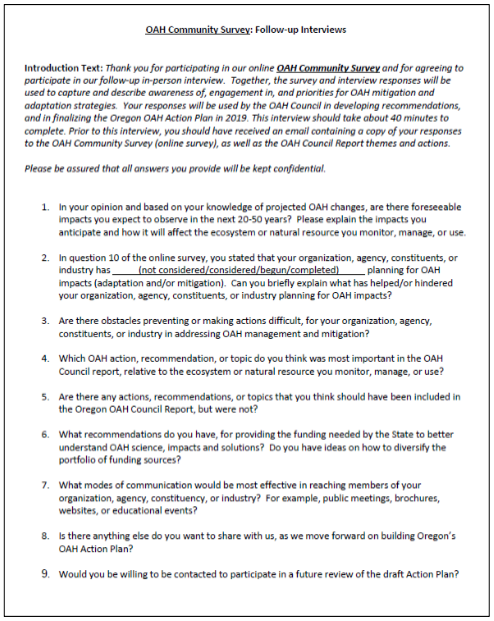


OAH Community Survey Results – One-on-One

One-on-one surveys – (23 respondents)
go-to-meeting software

807 minutes of recoded tape

8 interviews were in person
15 interviews were remote



OAH Community Survey: Follow-up Interviews

Introduction Text: *Thank you for participating in our online **OAH Community Survey** and for agreeing to participate in our follow-up in-person interview. Together, the survey and interview responses will be used to capture and describe awareness of, engagement in, and priorities for OAH mitigation and adaptation strategies. Your responses will be used by the OAH Council in developing recommendations, and in finalizing the Oregon OAH Action Plan in 2019. This interview should take about 40 minutes to complete. Prior to this interview, you should have received an email containing a copy of your responses to the OAH Community Survey (online survey), as well as the OAH Council Report themes and actions.*

Please be assured that all answers you provide will be kept confidential.

1. In your opinion and based on your knowledge of projected OAH changes, are there foreseeable impacts you expect to observe in the next 20-50 years? Please explain the impacts you anticipate and how it will affect the ecosystem or natural resource you monitor, manage, or use.
2. In question 10 of the online survey, you stated that your organization, agency, constituents, or industry has _____ (not considered/considered/begun/completed) _____ planning for OAH impacts (adaptation and/or mitigation). Can you briefly explain what has helped/or hindered your organization, agency, constituents, or industry planning for OAH impacts?
3. Are there obstacles preventing or making actions difficult, for your organization, agency, constituents, or industry in addressing OAH management and mitigation?
4. Which OAH action, recommendation, or topic do you think was most important in the OAH Council report, relative to the ecosystem or natural resource you monitor, manage, or use?
5. Are there any actions, recommendations, or topics that you think should have been included in the Oregon OAH Council Report, but were not?
6. What recommendations do you have, for providing the funding needed by the State to better understand OAH science, impacts and solutions? Do you have ideas on how to diversify the portfolio of funding sources?
7. What modes of communication would be most effective in reaching members of your organization, agency, constituency, or industry? For example, public meetings, brochures, websites, or educational events?
8. Is there anything else do you want to share with us, as we move forward on building Oregon's OAH Action Plan?
9. Would you be willing to be contacted to participate in a future review of the draft Action Plan?

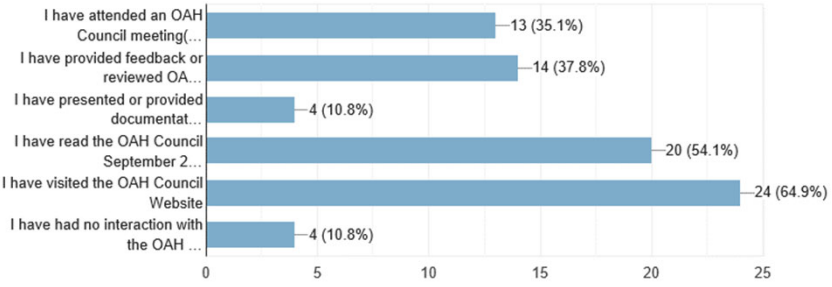
OAH Community Survey Results – One-on-One

RESPONDENT GROUPS:

Group	Invited Participants	Respondents	Response Rate
State Agencies	14	5	**36 %**
Federal Agencies	5	2	**40 %**
Tribal Governments	13	3	**23 %**
Industry	13	2	**15 %**
Academic	13	5	**38 %**
Funding	4	1	**25 %**
Environmental/ Education	8	3	**37 %**
	70	**23**	**33 %**

OAH Community Survey Results - Online

How would you classify your level of interaction with the Oregon OAH Council? Please click all options that apply.

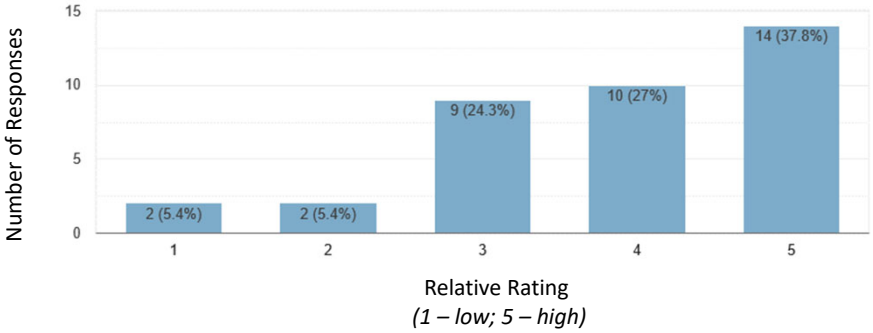


Number of Responses

OAH Community Survey Results - Online

Question 1)

In your opinion, **<u>are changing OAH conditions currently impacting the natural resources and ecosystems</u>** that you monitor, manage, or use?



Average response rate: 3.86 ± 1.16

OAH Community Survey Results – Online

Question 2)

<u>How concerned are you</u> personally, about the future impacts of OAH on Oregon's natural resources and ecosystems?

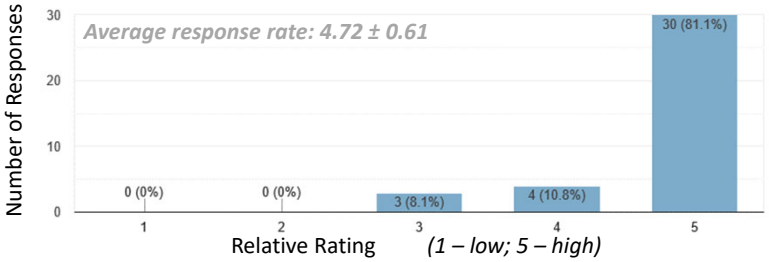
Question 3)

<u>How concerned is your organization, agency, constituents, or industry</u> about the future impacts of OAH on Oregon's natural resources and ecosystems?

OAH Community Survey Results – Online

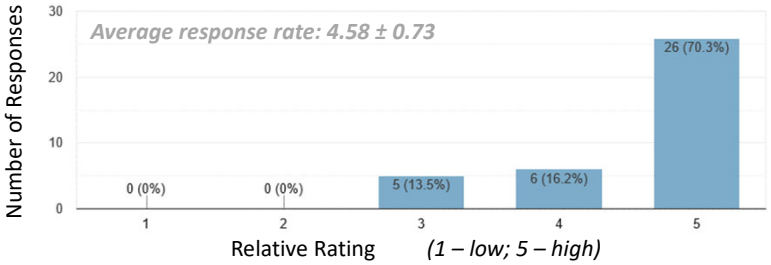
Question 2) How concerned are you

Paired t-test: p=0.032



(1 – low; 5 – high)

Question 3) How concerned is your organization



(1 – low; 5 – high)

OAH Community Survey Results – Online

Questions 4-9)

Prioritize the following 5 theme areas identified in the OAH Council Report using a weighted rank scale in the order of importance relative to the natural resources and ecosystems that you monitor, manage, or use. You may use the same ranking for more than one theme area.

THEME 1

Strengthen OAH science, monitoring, and research

THEME 2

Reduce causes of OAH

THEME 3

Promote OAH adaptation and resilience

THEME 4

Raise awareness of OAH science, impacts and solutions

THEME 5

Commit resources to OAH actions

OAH Community Survey Results – Online

Questions 4-8)

Theme	Average Response	Grouping
Theme 1	4.46 ± 0.84	1
Theme 2	4.00 ± 1.22	1 & 2
Theme 3	4.11 ± 1.10	1 & 2
Theme 4	3.76 ± 1.14	2
Theme 5	4.08 ± 0.86	2

Repeated Measures ANOVA: p=0.037, f= 2.643

OAH Community Survey Results - Online

Questions 9) Please briefly explain why you ranked the 5 theme areas as you did.

TEXT WAS CODED:

Scale of Problem –
- *Global*
- *Not Local*
- *National*

Lack of Knowledge–
- *Do not know*
- *Need more data*
- *Can not show attribution*

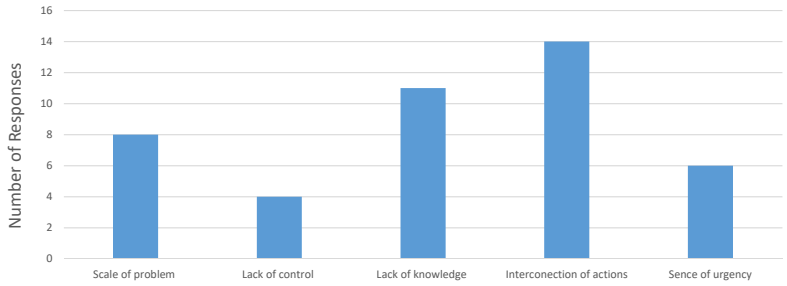
Sense of Urgency –
- *Cusp*
- *Still time*
- *Desperate need*
- *Too late*

Lack of Control –
- *Too large*
- *Too Complicated*
- *Too many parts*

Interconnection of Actions –
- *Together*
- *Equally important*
- *Need one for the other*

OAH Community Survey Results – Online

Questions 9)



"None of these are unimportant, but working toward adaptation, resilience seems most appropriate. CO2 reduction is critical, but since there is already so much stored and to be upwelled, we are compelled to respond to coming challenge as we try to reduce new CO2."

Interconnection of actions, Sense of urgency

Typed response to answer: 33 respondents from 37
Respondents may choose multiple responses

OAH Community Survey Results – Online

Questions 9) Please briefly explain why you ranked the 5 theme areas as you did.

TEXT WAS CODED:

Types of Impacts –

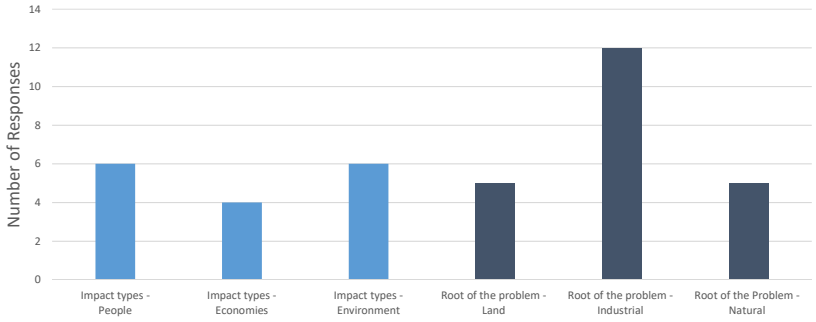
- *"People"*
  - *Food supply*
  - *Traditional knowledge*
  - *Communities*
- *"Economies"*
  - *Money*
  - *Fish supply*
  - *Jobs*
- *"Environments"*
  - *Loss of diversity*
  - *Animals moving away*
  - *Fewer animals homes*

Root of Problem –

- *"Land"*
  - *Run off*
  - *Agriculture*
- *"Industrial"*
  - *CO_2*
  - *Emissions*
  - *Coal*
- *"Natural"*
  - *Upwelling*

OAH Community Survey Results – Online

Questions 9)



"Because OAH is affecting not only the ocean, is affecting the coastal area, the forest, the tourism and the economy." *Impact types*

"All of the Themes are important but reducing green house gas and developing a technical response seemed primary actions that need investment. " *Root of the problem*

Typed response to answer: 33 respondents from 37
Respondents may choose multiple responses

OAH Community Survey Results – One-on-One

Question 4) Which OAH action, recommendation, or topic do you think was most important in the OAH Council report, relative to the ecosystem or natural resource you monitor, manage, or use?

Common ideas included:

- The report was so large there are many important actions
- It has been so long since I had time to read the report
- The report was not easy to read, and it was hard to see myself in the actions

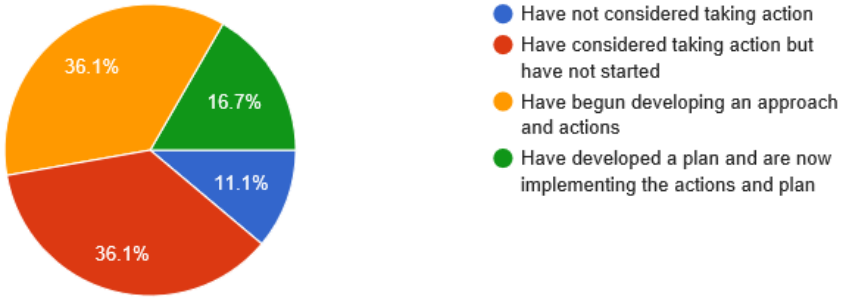
- **We need to know more before we can act, but we need to act before it is too late**

This question was one of the most skipped questions on the survey

OAH Community Survey Results - Online

Question 10)

Has your organization, agency, constituents, or industry considered or begun to develop actions to manage or mitigate OAH?



OAH Community Survey Results – One-on-One

Question 3

In question 10 of the online survey, you stated that your organization, agency, constituents, or industry has _____(not considered/considered/begun/completed)_____ planning for OAH impacts (adaptation and/or mitigation). Can you briefly explain what has helped/or hindered your organization, agency, constituents, or industry planning for OAH impacts?

Resources -
- Monetary funds
- Intellectual capacity

Regulatory/Mission Mandates -
- Administrate guidance or structure
- Regulatory mandate

Conception of Urgency -
- Quantifying the costs of inaction now

THEME 5

Commit Resources to Ocean Acidification and Hypoxia Actions. Support a sustained, long-term approach to addressing OAH including a policy declaration, funding for actions that require additional capacity, and reinforcement of Oregon's intellectual capital to meet future challenges.

OAH Community Survey Results – One-on-One

Question 6

What recommendations do you have, for providing the funding needed by the State to better understand OAH science, impacts and solutions? Do you have ideas on how to diversify the portfolio of funding sources?

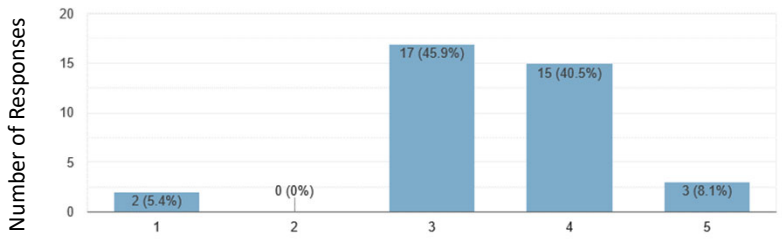
Common ideas included:

- Public / Academic / Agency partnerships are key to maximizing current resources for both science and communications - this should extend beyond state resources to tap into regional and federal resources.
- The most common response to increasing diversity of funding was through the cap-and-invest bill (HB2020)

OAH Community Survey Results - Online

Question 11)

Does your organization, agency, constituents, or industry currently have easy or convenient access to OAH-relevant data and information that you want to use in management, policy, or business decisions?



Relative Rating *(1 – low; 5 – high)*

Average response rate: 3.44 ± 0.87

OAH Community Survey Results – Online

Questions 12-18)

Please prioritize the following audiences identified in the OAH Council Report using a weighted rank scale in the order of importance for keeping up-to-date on OAH science, impacts and solutions. You may use the same ranking for more than one audience.

The "So What?" Prism. Adapted from *Escape from the Ivory Tower: A Guide to Making Your Science Matter*, by Nancy Baron (Island Press, 2010).

OAH Community Survey Results – Online

Questions 12-18)

Audience	Average Response	Group
Policy Makers and legislative staff	4.68 ± 0.47	1
At risk industries and professions	4.62 ± 0.59	1
K-12 school educators and students	3.11 ± 0.88	2
Academics and researchers	3.86 ± 1.16	3
Media	3.68 ± 0.94	2, 3, 4
Local government representatives	3.97 ± 1.04	4, 3
Informal education venues	3.11 ± 0.93	4

Repeated measures ANOVA: p=0.001 f=16.49

OAH Community Survey Results – Online

Questions 19) Please briefly explain why you ranked the above audiences as you did.

TEXT WAS CODED:

Perception to Act –
Could do things
Actively move
Capable to provide impute

Lack of Need –
Irreverent
Find on its own
Abstract

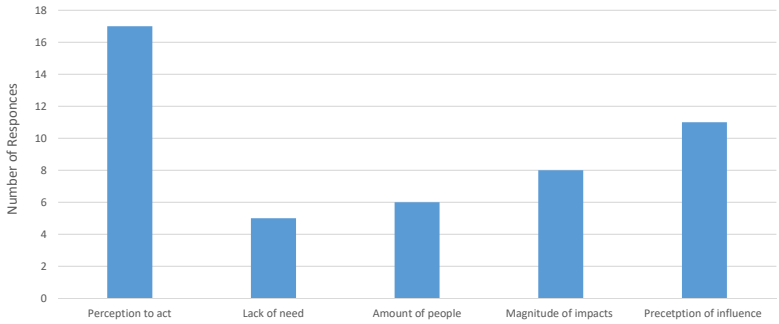
Amount of People –
Reach Everyone
All
Large Group

Magnitude of Impacts –
Directly affected
Affect constituents
Livelihoods lost

Perception of Influence –
Respect
Lobby for change
Put into action

OAH Community Survey Results - Online

Questions 19) Please briefly explain why you ranked the above audiences as you did.



"We need legislative action to change the current trajectory and I don't believe that we have the time to think school kids now will be able to do something 10-20 years from now when they may be in a position of power. The media will spin the findings however will get the most clicks."

Perception to act, Lack of need

Typed response to answer: 29 respondents from 37

OAH Community Survey Results – One-on-One

Question 7)

What modes of communication would be most effective in reaching members of your organization, agency, constituency, or industry? For example, public meetings, brochures, websites, or educational events?

Format of Information –
- Need both digital and in person
- Visual component critical
  - Cartoons
  - Videos

Style of the materials–
- Plan language
- Connection to people

Accuracy of the Message –
- Importance of correct information
- Balance of not making the issue too "positive"
- Do not make the issue too "negative"

OAH Community Survey Results - Online

Questions 20-24)

Please rank the following actions in order of importance relative to the natural resources and ecosystems that you monitor, manage, or use. You may use the same ranking for more than one action.

- **Support and maintain Oregon's monitoring of OAH oceanographic metrics and biological response metrics (Actions 1.1.a/c)**
- **Incorporate OAH into CO_2 management and mitigation discussions in the state (Action 2.1.b)**
- **Support new initiatives to promote natural ecosystem resilience (Actions 3.2.a/b)**
- **Keep legislators and policy-makers up-to-date on the science, impacts of and solutions for OAH (Action 4.2.a)**
- **Develop high-level policy guidance for the state's government agencies on prioritizing OAH in agency workload (Action 5.1.a)**

OAH Community Survey Results - Online

Questions 20-24)

Audience	Average Response Rate	Group
Actions 1.1a/c	4.57 ± 0.60	1
Action 2.1.b	4.05 ± 1.02	1, 2
Action 3.2a/b	3.68 ± 1.16	2
Action 4.2a	4.13 ± 1.08	1, 2
Action 5.1a	4.30 ± 0.81	1

Repeated measures ANOVA: p=0.002, f= 4.34

OAH Community Survey Results - Online

Questions 25) Please briefly explain why you ranked the above actions as you did.

Mention of SAV – 10 responses

"I see data as the backbone for addressing OAH in a sound way, and requiring OR agencies to pay attention to OAH will help with solutions and mitigation. SAV helps ecosystems, but I'm not sure I buy the concept that it will really buffer OA."

"Seagrass and macroalgae are not effective long-term carbon-sequestration solutions. There are many reasons to protect these ecosystems, but 'blue carbon' is not one of them."

"Mitigation strategies for SAV may be a drop in the bucket for carbon sequestration but offer critical additional ecological benefits for marine and estuarine species habitat and ecosystem resilience. For these reasons, conservation and restoration strategies for SAV should be prioritized."

Typed response to answer: 24 respondents from 37

OAH Community Survey Results - Online

Questions 25) Please briefly explain why you ranked the above actions as you did.

Mention of Carbon – 9 responses

"We have peoples attention with Carbon, but they are not making the ocean link. This needs to be strengthened."

"I think understanding the issues and practical approaches to adaption or mitigation at the ecosystem level is most appropriate. Blanket CO2 management I think is too blunt an instrument. Most of Oregon would be burdened by these with a unclear benefit for few. "

Typed response to answer: 24 respondents from 37

OAH Community Survey Results – One-on-One

Question 5) Are there any actions, recommendations, or topics that you think should have been included in the Oregon OAH Council Report, but were not?

Common ideas included:

- Developing a network of knowledge "ambassadors" to aid with collection of data and the communication of information
- Engage tribal governments more in planning and decision processes
- Strengthen the importance of Social science in our action plan – understanding what will be happening to the people
- Develop a Oregon focused OAH conference which brings together select groups of policy makers, stakeholders, and researchers every 5 years to update on the status of mitigation and adaptation progress
- Access to live data and information – live data portals and citizen science

This question was one of the most skipped questions on the survey

OAH Community Survey Results

SUMMARY

Interconnection was a common idea in most responses –

- Interconnection of actions and needs, we can not address the issue without addressing all themes together.

Lack of Control was a common idea in most responses –

- OAH is a global problem was a common response to ranking theme 2 and Action 2.1b lower then other themes and actions. There was a sense of urgency without the ability to act.
- The lack of control of compounding stressors.
- Respondents felt we needed to communicate best with those who have influence and ability to act (Policy makers and industries who can lobby)

OAH Community Survey Results

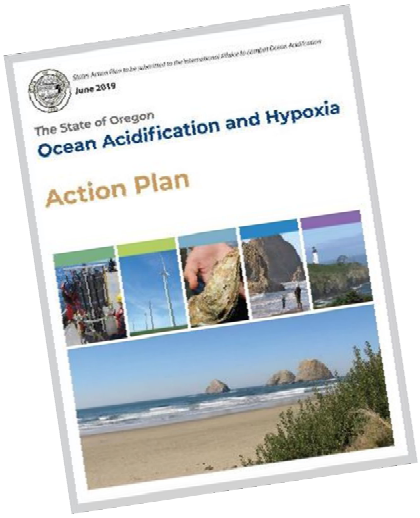
SUMMARY

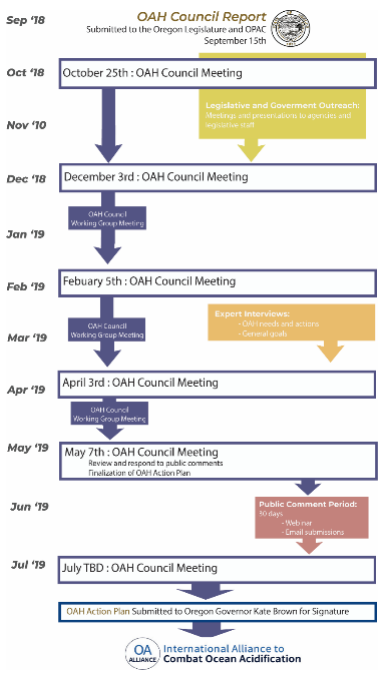
Lack of Knowledge was a common idea in most responses –

- Respondents feel they do not have access to information they need to address OAH – it is unclear if this data is not collected or is not accessible in a usable format.
- Theme 1 and Action 1.1a/c were both ranked highest, there was a common idea that we need more information on long term trends and attribution of OAH on biology.
- Theme 3 Action 3.2a/b were ranked low, because although most people recognized the habitat benefits of SAV there was a lack of knowledge on mitigation benefits.

OAH Community Survey Results

What are the next steps ?





APPENDIX C

OAH Council Meeting Summaries

(since 2018 Biennium Report)

- *10/25/18*
- *12/03/18*
- *02/05/19*
- *04/04/19*
- *05/07/19*
- *07/17/19*
- *09/20/19*
- *01/13/20*
- *04/29/20*
- *07/31/20*
- *08/25/20*

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

Oregon Coordinating Council on Ocean Acidification and Hypoxia

DRAFT: Meeting Summary
Thursday, October 25th, 2018
10:00 AM – 12:50 PM PDT

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Frank Barcellos, Jennifer Wigal, Andy Lanier, Dr. James Sumich, Dr. Shelby Walker, John Schaefer, Fran Recht, and Al Pazar. Absent: Liu Xin, Dr. Kristen Sheeran, Dr. Aaron Galloway.

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Deanna Caracciolo (DLCD), Bryn Hudson, Kristopher Murphy, Tom Calvanese (OSU), Shannon Davis, Travis Kauduston (KVAL reporter), Jena Carter, Bruce Quicky

Meeting Materials

Copies of all power point presentations, video recordings, and meeting documents are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

10:00am Getting Started

- Current events and updates from Council Members
  - **Al Pazar** – SeaCast research progress; community and fisheries monitoring systems development
  - **Jack Barth** – NOAA Coastal Hypoxia Grant recently awarded to OSU research team
  - **Shelby Walker** – Finial planning on the State of the Coast (occurring 10/27/18); Sea grant bi-annual RFP research grant

10:36am Oregon Legislature Bill Proces

- Project List was reviewed – additional information on project descriptions were requested by the Council
- Council member edits were requested to be submitted to the OAH Council staff by (10-31-18)

11:38am Break

11:45am Oregon OAH Action Plan – Planning

- Public process planning options were discussed
- Further discussions will occur in the next OAH Council meeting (12/3/18)

12:36pm Public Comment

- Tom Calvanese – Update on Port Orford port development and the possibility of installing OAH monitoring interments on the docks

12:45pm Council Business (Council Co-Chairs)

- Future Council meeting planning
  - 12/3/18
  - 02/5/18

1:50pm Adjourn

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Comments or Questions? Please contact

Council Co-Chairs
Caren.E.Braby@state.or.us or Jack.Barth@oregonstate.edu
Council staff
Charlotte.M.RegulaWhitefield@state.or.us

Oregon Coordinating Council on Ocean Acidification and Hypoxia

Draft Meeting Agenda
Monday, December 3rd, 2018
10:00 AM - 3:00 PM PDT

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Frank Barcellos, Jennifer Wigal, Andy Lanier, Dr. Shelby Walker, Dr. Aaron Galloway, Fran Recht, and Louise Solliday (OOST – Council Alternate to James Sumich)

Absent: Liu Xin, Dr. Kristen Sheeran, John Schaefer, Al Pazar, Dr. James Sumich

Guest presenters: Dr. Francis Chan (OSU)

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Deanna Caracciolo (DLCD), Davia Palmeri (ODFW), Shaun Clements (ODFW), Ken Armstrong (DOF), Jenna Sullivan (OSU), Bryn Hudson (GRNO), Peggy Joyce (League of Women Voters).

Meeting Materials

Copies of all power point presentations, video recordings, and meeting documents are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

10:00am Getting Started

- Brief introductions – Council and Audience
- **Council votes to adopted**:
  10/25/2018 Meeting Summary

12/3/2018 Meeting Agenda

- Current events and updates from Council members
  - Oregon Legislature Bill update (Council Co-chairs)
  - Congressional staff briefing update (Council Co-chairs)
  - Lawsuit Launched Over Federal Failure to Address Ocean Acidification in Oregon

10:25am Transitioning from the report to the Oregon OAH Action Plan (Council Co-chairs)

- Criteria of "Importance" – Benefit, Implementation, Urgency
- Ranking of Actions – Highest importance or 5 themes

10:40am Prioritization Activity

- Review of online survey – Work in three small groups consisting of Council members

12:00pm Lunch

12:40pm Presentation from Dr. Francis Chan – California OA Action planning process

- CA OA Action Plan
- Presentation

1:20pm Prioritization Activity

- PACE Prioritization Matrix – Implementation and Benefit

2:30pm Public Comment – No Public Comment Provided

2:40pm Council Business

- Expert Interview List and Questions
- Working Group formation (select by the end of today's meeting)

3:00pm Adjourn

Oregon Coordinating Council on Ocean Acidification and Hypoxia

Draft Meeting Summary
Tuesday, February 5th, 2019
10:00 AM - 1:00 PM PDT

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Frank Barcellos, Jennifer Wigal, Andy Lanier, Dr. James Sumich, Dr. Shelby Walker, Dr. Aaron Galloway, John Schaefer, Fran Recht, and Al Pazar. **Absent:** Dr. Kristen Sheeran, Liu Xin,

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Deanna Caracciolo (DLCD), Adriana Morales, Bryn Hudson

Meeting Materials

Copies of all power point presentations, video recordings, and meeting documents are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

10:00am Getting Started

- **Council voted to adopt:** 12/3/2018 Meeting Summary and 2/5/2019 Meeting Agenda
- Current events and updates from Council members
  - Caren Braby - Hatfield Marine Science Center Presentation
  - Al Pazar - Yaquina Bay Monitoring
  - Fran Recht – Siuslaw Watershed Presentation
  - Jennifer Wigal – DEQ update on EPA not declaring OA as a pollution under imparted water listings

10:40am Oregon Legislature Bill update (Jack Barth)

10:50am Review PACE Results from 12/3/18 Council meeting (Charlotte Whitefield)

11:25am Meeting Break

11:30am Action Plan Process

- Council deferred the Broader Public Survey project development until after the Summer 2019 OAH Action Plan submission (likely as one of the actions described in the action plan)
- Council decided to schedule an additional full Council meeting in April 2019
- Council agreed that the OAH Action Plan Working Group will write and review materials for the OAH Action Plan in between full Council meetings. Working meetings will be public meetings.

12:30pm Public Comment

- No Public Comments were received

12:40pm Council Business

- OAH Council Development of Communications (DRAFT edits) (Charlotte Whitefield)
  - Council expressed interest in having more solutions messaging on one-pagers
  - Council expressed interest in incorporating more hypoxia information on one-pagers
  - Council expressed interest in highlighting the economic effects of OAH on one-pagers
- Update on the progress of the ODFW project: Oregon's Vulnerable Fisheries Infographic Project (Charlotte Whitefield)

12:50pm Adjourn

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Comments or Questions? Please contact

Council Co-Chairs
Caren.E.Braby@state.or.us **or** Jack.Barth@oregonstate.edu
Council staff
Charlotte.M.RegulaWhitefield@state.or.us

Oregon Coordinating Council on Ocean Acidification and Hypoxia

DRAFT: Meeting Summary
Thursday, Apr 4, 2019
10:00 AM - 1:00 PM PDT

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Frank Barcellos, Jennifer Wigal, Andy Lanier, Dr. James Sumich, Dr. Shelby Walker, John Schaefer, Fran Recht, and Al Pazar. **Absent:** Dr. Kristen Sheeran, Liu Xin, Dr. Aaron Galloway

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Bryn Hudson

Meeting Materials

Copies of all power point presentations, video recordings, and meeting documents are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

10:00am Getting Started

- Brief introductions
- Vote to adopt 2-5-19 meeting summary, 4-4-19 meeting agenda
- Outreach, Current events, and General updates
  - Hatfield Marine Science Day (4-13-19)
  - OSU – NSF Design tester program (Spring – fall 2019)
  - OSU- PPOL 524 Applied Research Methods: Oregon Agency OAH Needs Assessment (4-3-19/6-10-19)
  - Watershed Council Presentation (4-3-19)
  - Future of our oceans conference (05-19-19)
  - *Others?*

10:30am OAH Action Plan Timeline

- General Processes
- Scheduling meeting
- Timelines and due dates

11:00am OAH Council Working Group Update and Process

- 3-20-19 meeting summary

11:15am OAH Community Survey Presentation and Discussion

- Data presentation
- Next steps
- Use of information in action plan development

12:30pm Public Comment

12:45pm Council Business

- OAH Council Logo development
- Discussion of dropping April 24th Council Meeting, and adding early May one on one council members update meetings instead
- Discussion of adding a July 17th or 19th in person meeting

1:00pm Adjourn

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Comments or Questions? Please contact

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Council staff
Charlotte.M.RegulaWhitefield@state.or.us

Oregon Coordinating Council on Ocean Acidification and Hypoxia

DRAFT: Meeting Summary
Tuesday, May 7, 2019
10:00 AM - 3:00 PM PDT

In Person Meeting:
The Oregon Dept. of Fish & Wildlife HQ Office
4034 Fairview Industrial Dr SE, Salem, OR 97302

Attendees

OAH Council members: Dr. Caren Braby, , Dr. Jack Barth, Al Pazar Jennifer Wigal, Andy Lanier, Dr. James Sumich, Dr. Shelby Walker, , John Schaefer, and Fran Recht. **Absent:** Dr. Kristen Sheeran, Frank Barcellos, Dr. Aaron Galloway, and Liu Xin

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Deanna Caracciolo (DLCD), Bryn Hudson (Governor's Office)

Meeting Materials

Copies of all power point presentations, video recordings, and meeting documents are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

10:00am Getting Started

- Brief introductions
- Vote to adopt 2-5-19 meeting summary, 4-4-19 meeting agenda
- Outreach, Current events, and General updates
    - Future of our oceans conference (05-19-19)

10:30am OAH Action Plan Framework

- OAH Council Working Group Update
    - 4-18-19 meeting

- 5-3-19 meeting
- Timelines and due dates
- Audience
- Overarching length/tone/content

11:30am OAH Action Plan – Step-wise presentation

12:30am Lunch

1:00pm OAH Action Plan – Group breakout

2:00pm Moving Forward – Additional Draft edits
- Debrief on small groups
- Who is available to asset with continued drafting?
- Public comment period (6-1-19 / 6-30-19)
  Community webinars: 6-10-19 (12:30-2:00pm)
  6-11-19 (6:00-8:00pm)

2:30pm Public Comment

2:45pm Council Business
- OAH Council Logo development
- Additional meetings in May
  - WG meeting scheduled for May 21st 11am-12pm

3:00pm Adjourn

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Comments or Questions? Please contact

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Caren.E.Braby@state.or.us or Jack.Barth@oregonstate.edu
Council staff
Charlotte.M.RegulaWhitefield@state.or.us

Oregon Coordinating Council on Ocean Acidification and Hypoxia

DRAFT: Meeting Summary
Wednesday, Jul 17, 2019
10:00 AM - 11:00 AM PDT

Location: Remote

Attendees

OAH Council members: Dr. Caren Braby, Dr. Jack Barth,

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: None

Meeting Materials

Copies of all power point presentations, video recordings, and meeting documents are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

Public Comment session on OAH Council's Draft OAH Action Plan –
No Formal Comments were Received

Oregon Coordinating Council on Ocean Acidification & Hypoxia

DRAFT: Meeting Summary

Friday, Sep 20, 2020
08:30 AM – 9:30 AM

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Andy Lanier, Dr. James Sumich, Dr. Shelby Walker, and Fran Recht. Absent: Dr. Kristen Sheeran, Al Pazar, Liu Xin, Frank Barcellos, Jennifer Wigal, Dr. Aaron Galloway, and John Schaefer.

OAH Council Staff: Dr. Charlotte Regula Whitefield,

Audience attendees: None

Meeting Materials

Copies of all power point presentations, video recordings, and information packets are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

**** No formal meeting agenda – brief overview of 2018 OAH Legislative report submission was provided by the Council Co-chairs and staff.**

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Comments or Questions? Please contact

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Caren.E.Braby@state.or.us or Jack.Barth@oregonstate.edu
Council staff
Charlotte.M.RegulaWhitefield@state.or.us

Oregon Coordinating Council on Ocean Acidification & Hypoxia

DRAFT: Meeting Summary

Monday, Jan 13, 2020
12:00 PM - 3:00 PM

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Frank Barcellos, Jennifer Wigal, Andy Lanier, Dr. James Sumich, Dr. Shelby Walker, Dr. Aaron Galloway, John Schaefer, and Fran Recht. Absent: Dr. Kristen Sheeran, Al Pazar, Liu Xin

OAH Council Staff: Dr. Charlotte Regula Whitefield,

Audience attendees: Bill Davis, Steve Marx, Michael Moses (DLCD)

Meeting Materials

Copies of all power point presentations, video recordings, and information packets are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

12:00pm – 12:35pm General Updates

Caren Braby -

OAH Action Plan "rollout" and Outreach - OA Alliance meeting in NYC
UN Commitment Completed
https://oceanconference.un.org/commitments/?id=19307
OAH Bill Update – 2020 Session

Charlotte Whitefield-

NOAA B-WET project - Letter of Support to Sea Grant
Yaquina Bay Research Project Update

Jack Barth-

NOAA CHRP research project update

Shelby Walker-

Reinstating the "Fisherman's Roundtables"

James Sumich-

Oregon Ocean Science Trust (OOST) update

Andy Lanier-

Recent OSU webinar
https://www.openchannels.org/webinars/2020/ocean-victim-solution-climate-change

12:35pm - 1:30pm **Council 2020 Work Plan**

Council 2020 meeting quarterly schedule was agreed on, contingent on the outcome of the 2020 short legislative session.

Caren Braby and Andy Lanier –

Provided updates on council seat reappointment

Caren Braby and Charlotte Whitefield –

OAH Action Plan – 2020 Implementation Work Plan

2020 Legislative Report due September 15th 2020
Agency OAH Gaps Analysis
Communication and Outreach Working Group
Yaquina Bay Monitoring Research
"State of OAH" workshop

1:30pm - 2:05pm **OAH Action Plan Commitments - Theme 5: Agency Gaps Planning**

Andy Lanier and Charlotte Whitefield-

Oregon 2020 Climate Adaptation Framework

Caren Braby- ODFW update

Fish and Wildlife Team
Agency Strategic Plan & Policy
https://www.dfw.state.or.us/agency/commission/minutes/20/01_Jan/index.asp

Andy Lanier- DLCD update

OAH Action Plan presentation to LCDC
Rocky Shores Management Plan
West coast ocean data portal "ocean health scorecard"

Jennifer Wigal- DEQ update

2018/2020 Integrated Report (process and public comment)

ODA (representative was absent from the meeting)

Caren Braby –

One –on –on meetings with 7 sister agencies & ODFW
(Agencies include DSL, ODOE, ODF, and OHA)

2:05pm – 2:15pm **OAH Action Plan Commitments - Theme 4: Education and Outreach WG**

First meeting of working group scheduled January 14th

Group Discussion on the vision of the working group

Key ideas that arose -

Levels of messaging, coordination of existing and future OAH communications, identifying key audiences

2:15pm – 2:15pm **Public Comment**

(No public comment received)

2:25 pm **Co-Chairs adjourned the meeting**

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Comments or Questions? Please contact

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Council staff
Charlotte.M.RegulaWhitefield@state.or.us

Oregon Coordinating Council on Ocean Acidification & Hypoxia

OAH Council Meeting Summary (DRAFT) - spring 2020
Wed, Apr 29th, 2020
10:00 AM - 12:00 PM

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Jennifer Wigal, Andy Lanier, Dr. Jim Sumich, Dr. Shelby Walker, John Schaefer, Brandii Holmdahl, and Fran Recht.

Absent: Dr. Kristen Sheeran, Liu Xin, Frank Barcellos, Jessica Miller

OAH Council Staff: Dr. Charlotte Regula Whitefield

Public Audience: Bob Kemp, Lori Steele, Carolyn Fish, Karen Tarnow, Andrea Celentano, Peggy Joyce

Meeting Materials

Copies of all power point presentations, video recordings, and information packets are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

**** Due to technical issues a recording of this meeting is not available ****

Meeting Agenda (Actual) Summary

10:00am – 10:45am **General Updates** *(from last meeting on January 13th 2020)*

- Introduction of New Council Members **(Caren Braby)**
  - Jessica Miller, Academic Seat Appointment
  - Brandii Holmdahl, Fishing Interest Seat.

- Oregon 2020 Legislative Session Summary **(Jack Barth)**
  - SB 1554 passed out of committee but was not approved by Ways and Means
  - Elements of the OAH action plan made it into the session-end, omnibus HB5204-6, but funding was not approved for the OAH items
  - We will need to explore with the Coastal Caucus the possibility of reintroducing this bill in the 2021 long session

- Oregon Ocean Protection Advisory Council (OPAC) Meeting on May 6th **(Andy Lanier)**
  - Rocky Shores Management Plan amendments to the plan will be presented
  - OPAC will be voting on the OAH Council conservation seat appointment

- West Coast Ocean Data Portal "Ocean Health Scorecard" **(Andy Lanier)**

    - Pacific Coast states' collaboration to build a set of universal ocean indicators
    - Northwest Association of Networked Ocean Observing Systems (NANOOS) has been contracted to conduct much of this work (working through Dr. Jan Newton)
- 2020 Ocean Sciences Meeting – OA Alliance Workshop **(Caren Braby)**
    - Workshop was well-attended and very productive, focusing on building and sustaining partnerships, capitalizing on existing research and archived data, and continuing to standardize information moving forward.

- ODFW Climate and Ocean Change Policy – update **(Caren Braby)**
    - April 2020 ODFW commission meeting was postponed (new date TBD), and so the new policy has not yet been presented to the commission for adoption.
    - ODFW commission is expected to revisit this policy at their next in person meeting, date TBD

- 2018/2020 Water Quality Assessment Report **(Jennifer Wigal)**
    - Submitted to EPA in April 2020
    - New call for data will occur in Fall 2020, for the next integrated report in 2020/2022
    - OAH Council has offered to support ongoing efforts for public awareness of the process and facilitating call for data and new methodology

10:45am - 11:15am **OAH Education and Outreach Working Group**

- Meeting Summary from January 14th 2020 **(Charlotte Whitefield)**
    - Meeting summary was reviewed by council, no council edits or comments were received

- Working Group Timeline **(Charlotte Whitefield)**
    - Meeting timeline was reviewed by council, no council edits or comments were received

- OAH Education and Outreach Working Group Meeting Schedule (Charlotte Whitefield)
    - Council agreed on meeting schedule, no changes requested
        May 27th 2020, 10:00 AM - 12:00 PM
        Aug 5th 2020, 9:00 AM - 11:00 AM
        Sept 23rd 2020, 9:00 AM – 10:00 AM
        Nov 6th 2020 11:30 AM - 1:30 PM

- State of the Coast – OAH Breakout session **(Charlotte Whitefield; Shelby Walker; Group Discussion)**
    - Council agreed on submitting a proposal for a breakout session (Due May 15th)
    - Basic ideas were discussed – Council focused in on a session revolving around "how to communicate OAH"
    - Council agreed on creating a small working group of members to help facilitate content development.

- Goals and Visions **(Group Discussion)**
    - Conversations about how do we move in "today's new reality" - basic needs for now versus planning for the future through climate action.

- The use of parallels between the COVID pandemic and climate disasters – need to make OAH relevant today – use of ideas like sea star wasting, HAB, other ecological diseases outbreaks to help build understanding.
- Importance of keeping our messages tangible, trackable, and possible – while keeping them positive and locally focused.

11:15am - 12:30pm **Council 2020 Work Plan**

- Council Seat Reappointment Updates **(Caren Braby)**
  - Oregon Department of Agriculture (ODA) – Liu Xin's seat, representing the Shellfish Industry, is up for open solicitation
  - No applications were received by ODA for the seat during application period of January – February 2020.
  - ODA is working with the OAH Council to determine when the best time would be to reopen this application solicitation for a Shellfish Industry Seat. Timing TBD.

- OAH Council Budget Expectations **(Caren Braby)**
  - The State of Oregon is currently experiencing enormous shortfall in lottery funding and general funding.
  - It is going to be important for the OAH Council moving forward to continue to be creative with our funding, in light of current situations.
  - Actual budget constraints will not be fully known for another 3 to 4 months.

- Council 2020 Meeting Schedule **(Jack Barth; Charlotte Whitefield)**
  July 31st 2020, 10am – 1pm
  Nov TBA 2020 - Council will coordinate via email to set a time for meeting

- Yaquina Bay Research **(Jack Barth; Charlotte Whitefield)**
  - Project is moving forward and is still in planning stages
  - Concern with possible reduced funding pools (e.g., OWEB grant in Oct 2020 (lottery funded); and other federal grants).
  - OAH Council staff will be continuing to pursue diverse funding options.
  - Timeline for project can be found in Council work plan – OAH Council members had no edits for this section of the work plan.

- OAH Agency Gaps Analysis – Theme 5 in OAH Action Plan **(Charlotte Whitefield)**
  - Initial agency one-on-one meetings occurred October 2019 – January 2020
  - Second set of agency one-on-one meetings/check-ins are occurring April –June 2020
  - Timeline for agency work can be found in Council work plan – OAH Council members had no edits for this section of the work plan.

- Fisherman's Roundtable **(Charlotte Whitefield; Group Discussion)**
  - OAH focused fisherman roundtables first occurred in Oregon in 2017, Council members have voiced interest in holding them again in 2020.
  - Timeline for roundtables can be found in Council work plan – OAH Council members suggested that the timing for the round tables be adjusted to better reflect fishing seasons and other competing regulatory processes.
  - Council agreed on creating a small working group of members to help facilitate content development.

- 2020 Legislative Report Outline - due September 15th 2020 **(Jack Barth; Charlotte Whitefield)**
    - No council edits or comments were received

12:30pm **Public Comment**

- No public comment received

12:30pm – 12:45pm **Closing Remarks**

- Council staff will work with Council Members to schedule a November meeting
- Council Staff will reach out to Council Members to formulate the two new working groups
- Council Co-chairs and staff will keep Council Members updated as events continue to develop in light of COVID restrictions and budgetary restraints.

The proceedings of the OAH Council are open to the public and will be recorded (audio or audio/video). All printed and recorded materials will be made available to the public after the meetings. For more information on the OAH Council, to access documents or recordings.
Please visit: www.OregonOcean.info

Comments or Questions? Please contact
Council Co-Chairs: **Caren.E.Braby@state.or.us** or **Jack.Barth@oregonstate.edu**
Council staff: **Charlotte.M.RegulaWhitefield@state.or.us**

Oregon Coordinating Council on Ocean Acidification & Hypoxia

OAH Council Meeting Summary - summer 2020
Fri, Jul 31, 2020
10:00 AM - 12:30 PM

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Jennifer Wigal, Andy Lanier, Dr. Jim Sumich, Dr. Shelby Walker, John Schaefer, Brandii Holmdahl, Jessica Miller, and Fran Recht. Absent: Dr. Kristen Sheeran and Frank Barcellos

OAH Council Staff: Dr. Charlotte Regula Whitefield, Carlos Avedano (summer intern)

Public Audience: Susan Chambers, George Robison, and Andrea Celentano

Meeting Materials

Copies of all power point presentations, video recordings, and information packets are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

10:05am – 10:10am **Council Business (Caren Braby)**

- Move to accept agenda and 04/29/20 Spring OAH Council meeting summary

10:10am – 10:40am **General Updates (Charlotte Whitefield)**

- Invitation to contribute to fifth Oregon Climate Assessment
- US Congressional Climate Action Plan Summary
- COMPASS communications – Leaders for Sea Change (staff awarded fellowship)
- The Nature Conservancy - Climate Scenario Planning for Crab Fisheries **(Fran Recht)**
- Oregon State of the Coast Conference being switched to virtual format **(Shelby Walker)**

10:30am – 10:50am **OAH Education and Outreach Working Group Update (Charlotte Whitefield)**

- Meeting summary was emailed to Council members for review on 05/27/20
- Working Group was awarded a Oregon Sea Grant Conference Assistance Award for their 2021 fisherman's roundtable workshop

- The OAH Council is hosting a Oregon State University – Marine Studies Initiative summer intern until 09/05/20
- Next working group meeting to be held remotely on 08/05/20

10:45am – 11:00am **OAH Yaquina Bay Monitoring Working Group Update (Jack Barth)**

- Next working group meeting to be held remotely on 08/19/20

11:00am – 11:30am **2020 Legislative Report Conversation and Edits (Caren Braby)**

- Council received first draft of the 2020 OAH legislative report on 07/28/20
- Interest in reframing sections of the report which focus on OAH risks and impacts in both the future and the present tense – OAH is effecting us now and will continue to affect us
- General consensus on report tone, length, and content – additional edits will be sent from Council members via email prior to 08/13/20

11:30am – 12:00pm **Council 2020-2021 Work Plan Document (Charlotte Whitefield)**

- Work plan was emailed to Council members for review on 05/27/20
- No changes were made on the 2020/2021 work plan

12:00pm – 12:00pm **Public Comment**

- No public comments were provided

12:00pm – 12:30pm **Next Steps & Closing Remarks**

- Next Council meeting is scheduled for 08/25/20 to review the

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Please visit: www.OregonOcean.info

Comments or Questions? Please contact

Council Co-Chairs: Caren.E.Braby@state.or.us or Jack.Barth@oregonstate.edu

Council staff: Charlotte.M.RegulaWhitefield@state.or.us

OAH Council Meeting Summary - 2020 Report Review
Tue, Aug 25, 2020
3:00 PM - 5:00 PM (PDT)

Location: Remote

Attendees

OAH Council members: Dr. Jack Barth, Dr. Caren Braby, Jennifer Wigal, Andy Lanier, Dr. Jim Sumich, Dr. Shelby Walker, John Schaefer, Brandii Holmdahl, Jessica Miller, and Fran Recht. Absent: Dr. Kristen Sheeran and Frank Barcellos

OAH Council Staff: Dr. Charlotte Regula Whitefield

Public Audience: None

Meeting Materials

Copies of all power point presentations, video recordings, and information packets are available on the Council website at: ***http://oregonocean.info/index.php/ocean-acidification***

Meeting Agenda (Actual) Summary

**** Nor formal meeting agenda was made – Council members reviewed the current 2020 Legislative Report**

The proceedings of the OAH Council are open to the public and will be recorded (audio or audio/video). All printed and recorded materials will be made available to the public after the meetings. For more information on the OAH Council, to access documents or recordings.
Please visit: www.OregonOcean.info

Comments or Questions? Please contact

Council Co-Chairs: **Caren.E.Braby@state.or.us** or **Jack.Barth@oregonstate.edu**

Council staff: **Charlotte.M.RegulaWhitefield@state.or.us**

APPENDIX D

Yaquina Bay OAH Monitoring Project

- Project Scope and Planning
- Working Group Meeting Summary 06/04/20
- Working Group Meeting Summary 08/19/20

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

Yaquina Bay OAH Monitoring

Oregon 2020 Legislative Report - Appendix D

The Oregon OAH Action Plan identifies strategic augmentation of ocean monitoring and research that is essential to inform the State on how to mitigate and adapt to future OAH changes. While we must actively work to reduce the causes of OAH, we must also work to adapt to the effects and minimize the economic impacts of OAH by incorporating the best scientific information into management planning and decision-making. However, this will only be possible if we understand OAH trends well enough to foresee potential impacts. Currently, the State has a robust ocean monitoring network that produces long-term time series for physical, chemical, and biological properties of Oregon's nearshore ocean and some estuaries – however, there are large gaps in our monitoring networks that need to be filled (both geospatial and temporal monitoring).

2019 OAH Action Plan Theme 1 - Step 1.1.1:

Re-establish oceanographic monitoring to complement an historical time-series in Yaquina Bay, an economic, research, and management hub for Oregon.

Estimated Funding Needs: $50K - $200K biannual cost

As part of the mid-coast watershed, Yaquina Bay is a semi-enclosed bay fed by the Yaquina River and Big Elk Creek - connecting the forestry town of Toledo to the coastal port of Newport. Yaquina Bay has been used by communities for cultural, recreational, and commercial purposes for generations, including activities such as shellfish harvesting, fishing and fish processing, logging, shipping, tourism, aquaculture, and agriculture. The bay is home to the Hatfield Marine Science Center (HMSC; a world class marine science facility housing academics and researchers from Oregon State University (OSU), state and federal resource managers, and the Oregon Coast Aquarium). The Bay is also the home of NOAA's Pacific Marine Operation Center and its research vessel fleet. Yet, OAH has the potential to adversely affect Yaquina Bay, and more monitoring is needed to track long-term changes.

In order to start the process of building long-term OAH monitoring in Yaquina Bay, the OAH Council has organized a Working Group consisting of 14 regional experts and stakeholders that encompasses multiple perspectives and professional backgrounds. This Working Group has been meeting regularly since Spring 2020 to develop a research and data management plan for new monitoring as well as community outreach plan to share project findings.

The goals of this Working Group include:

- ***Identify spatial, temporal, and technology gaps in monitoring data***
- ***Pursue collaborations and resources to deploy new and maintain current monitoring***
- ***Create pathways for real time accessibility of monitoring data***
- ***Communicate findings in formats that inform community planning and state resource management***

WORKING GROUP MEMBERS:

Dr. Jack Barth	Oregon State University (OSU); Marine Studies Initiative (MSI); OAH Council Co-chair
Dr. Caren Braby	Oregon Dept. of Fish and Wildlife (ODFW); OAH Council Co-chair
Alex Manderson	Oregon Dept. of Agriculture (ODA)
Dr. Angee Doerr	Oregon Sea Grant – Lincoln County Extension Agent
Dr. Francis Chan	OSU; Partnership on Interdisciplinary Studies of Coastal Oceans
Dr. George Waldbusser	OSU
Dr. Jonathan Fram	OSU; Ocean Observatories Initiative (OOI)
Dr. Robert Cowen	OSU; Hatfield Marine Science Center (HMSC)
Dr. Cheryl Brown	Environmental Protection Agency (EPA)
Dr. Stephen Pacella	EPA
Paul Engelmeyer	Mid-coast Water Shed Council
Liu Xin	Oregon Oyster Company
Craig Risien	OSU; OOI; Northwest Association of Networked Ocean Observing Systems (NANOOS)

**** Representatives from the following groups were also invited to join the Yaquina Bay OAH Monitoring Working Group, but have not attended working group meetings at this time:**

The Confederated Tribes of Siletz
The Wetlands Conservancy of Oregon

Collaborations, Resources, Funding:

Part of the Working Group's charge is to identify OAH monitoring barriers and how to overcome them, including finding new external sources of funding for this effort.

Identified Barriers by this Working Group include:

- ***Funding to purchase and maintain additional high-resolution monitoring station(s) equipment in key location(s)***
- ***Staff resources for maintaining equipment in the water***
- ***Staff resources to process data to allow for real-time access to datasets and to disseminate processed data to stakeholders in actionable formats***
- ***Additional analytical equipment to process discrete carbonate samples***

Currently, the Working Group is pursuing several regional grants (e.g., Oregon Water Enhancement Board (OWEB)) and national grants (e.g., National Estuaries Partnership) to aid in funding of new equipment and staff time. The Working Group is also looking into the possibility of utilizing research equipment from past OAH monitoring efforts throughout the State, including in Netarts Bay and Tillamook Bay, to be used for short-term redeployment within Yaquina Bay.

Academic partners in the Working Group are also exploring opportunities to use this OAH monitoring time-series as a teaching tool, maximizing learning and staff time by involving students in data collection and analysis. The Marine Studies Initiative's (MSI) is currently helping to expand the academic, research, and outreach and engagement efforts at OSU's Hatfield Marine Science Center (HMSC) on the shores of Yaquina Bay. The Working Group hopes to work with MSI and HMSC to develop new internship opportunities for MSI students to aid in OAH monitoring in the Bay and alleviate some staff requirements from partnering State agencies. However, external project resources are unlikely to be forthcoming, unless there is also an investment from the State. The OAH Council recommends that the State invest financial resources to implement monitoring in Yaquina Bay, to collect data that are essential to plan for current and future OAH impacts on our communities and ecosystems.

State investment in this monitoring tool would be a proactive step towards climate and ocean change adaptation for Yaquina Bay businesses, and would inform the State on the magnitude of change in OA in this thriving port community.

Moving Forward:

Yaquina bay has both been a key test bed for OAH monitoring, and has been the subject of multiple independent efforts because of the importance of the region to Oregonians. Since the early 2000's, Yaquina Bay has been monitored for OAH and other OAH stressors through a series of short-term monitoring and research projects lead by OSU academic researchers as well as by the USEPA and ODA water quality managers. However, due to a lack of resources, including funding and staff availability, many of these important monitoring programs have lapsed.

Since Governor Brown's adoption of the OAH Action Plan in 2019, several new research and monitoring projects have started within Yaquina Bay. The U.S. EPA has purchased of a state-of-the-art carbonate chemistry instrument (colloquially known as the "Burke-o-lator", after Oregon's Dr. Burke Hales who invented the instrument) that continuously monitors for OA variables directly from the mouth of the Bay. In addition, researchers from OSU have started a new OA and oyster monitoring project in collaboration with industry, which will be assessing the effects of acidified bay water on oysters grown throughout the Bay. Each of these projects represent important steps forward in continued OAH monitoring efforts in the region.

The first step of the Working Group has been to identify spatial and temporal gaps in data, as well as document which instrumentation and data parameters have been collected by past monitoring and research projects. This will allow the Working Group to designate new sampling sites, if needed. However, the Yaquina Bay is a dynamic estuary with little homogeny across sample sites and extreme seasonal variability, which has complicated the selection of new monitoring sites. In addition, identifying gaps in data and instrumentation will allow the Working Group to determine the feasibility of creating a coordinated bay-wide monitoring program. Utilizing existing resources, to leverage new resources, the development of a Yaquina bay-wide OAH monitoring program would not only address the local needs of resource managers, industry, and community planners in the region, but overtime could reflect Oregon's role in OAH conversation nationally by providing an example of stakeholder driven holistic monitoring system of a natural system.

This ongoing work of the Working Group will be to continue to provide a platform of resources and expertise to continue to integrate existing and build new OAH monitoring in Yaquina Bay. Through focusing on stakeholder needs the Working Group aims to establish a long-term and expanding bay-wide monitoring system that meets the needs of Oregon's leading research and training enterprises, forward planning resource management, and resiliency planning for vital coastal industries and communities.

Status of Monitoring in Yaquina Bay:

U.S. Environmental Protection Agency (EPA):

INSTRUMENTATION IN WATER –

- *YSI (Model # 6600 V2-4, presently)*
  Parameters: T, S, depth, chlorophyll A, pH, DO, turbidity
  Location: Attached to the pump dock at HMSC
  Depth: 1.8 M off bottom
  Years of Operation: 2011 to present (note: prior to sweepers on probes significant biofouling in early years; and gaps)
  Data Storage Location: Internally at EPA, data can be released with a data acquisition request
- Burke-o-Lator
  Parameters: continuous measurements of pCO2, DIC
  Location: Attached to the pump dock at HMSC
  Depth: Water pumped from 1.5 M off bottom
  Years of Operation: expected install winter 2020/21
  Data Storage Location: To be determined

INSTRUMENTATION PREVIOUSLY IN WATER -

- YSI (Model # 6000 UPG, 6600 and 6600 EDS)
  Parameters: T, S, depth, chlorophyll A, pH, DO
  Location: Oregon Oyster Farm (through ~ Jan. 2008), Criteser's Moorage (through ~ Dec. 2012), and Riverbend (through ~ May 2004), OSU (surface)
  Depth: variable
  Years of Operation: starting year of 1999
  Data Storage Location: Internally at EPA, data can be released with a data acquisition request

NANOOS/OSU/Oregon Sea Grant:

INSTRUMENTATION IN WATER –

- Aqua TROLL 100 Data Logger
  Parameters: T and Conductivity (derived Salinity)
  Location: Newport Commercial Dock 5
  Depth: 3M, 7M, 11M from surface
  Years of Operation: 2018 – present (15min/30min interval readings)
  Data Storage Location: Raw data live streamed to NANOOS website for public access (http://nvs.nanoos.org/Explorer?action=oiw:fixed_platform:OSU_Yaquina:observations:H1_Salinity)

INSTRUMENTATION PREVIOUSLY IN WATER -

- No past Yaquina Bay specific OAH monitoring projects.

Oregon State University (OSU) - Dr. George Waldbusser's Laboratory:

INSTRUMENTATION IN WATER –

- *Bottle Samples for Burk-o-lator*
  Parameters: Discrete sampling for DIC, pCO2
  Location: Hatfield Marine Science Center, Oregon Oyster Farm, and Paddle Park
  Depth: Surface
  Years of Operation: Weekly/Bi-weekly for how long (~2 years now)
  Data Storage Location: Stored on Laboratory computer - likely public after publications

- *Nutrient Samples (Westco Smartchem)*
  Parameters: Nitrate, phosphate, ammonium, silicate
  Location: Hatfield Marine Science Center, Oregon Oyster Farm, and Paddle Park
  Depth: Surface
  Years of Operation: Weekly/Bi-weekly for how long (~2 years now)
  Data Storage Location: Stored on Laboratory computer - likely public after publications

- *Particulates*
  Parameters: Chlorophyll a, particulate organic matter, total suspended particulate matter
  Location: Hatfield Marine Science Center, Oregon Oyster Farm, and Paddle Park
  Depth: Surface
  Years of Operation: Weekly/Bi-weekly for how long (~1 year now)
  Data Storage Location: Stored on Laboratory computer - likely public after publications

- *Onset Hobo U-24-002-C*
  Parameters: S, T,
  Location: Hatfield Marine Science Center, Oregon Oyster Farm, and Paddle Park
  Depth: surface
  Years of Operation: ~ 2 years, 15 min interval??
  Data Storage Location: Stored on Laboratory computer - likely public after publications

- *Biological Parameters and Bioenergetics Modeling*
  Oyster shell dissolution and grow-out
  Pacific Oyster shell dissolution ~2 years
  Olympia oyster shell dissolution ~1 year
  Pacific oyster growth ~1 year

- *Salinity/Alkalinity gradient calculations*

INSTRUMENTATION PREVIOUSLY IN WATER -

- *No past Yaquina Bay specific OAH monitoring projects.*

Oregon Coordinating Council on Ocean Acidification & Hypoxia

Yaquina Bay Monitoring Project Meeting
Thursday, June 4, 2020
1:00 PM - 2:00 PM

Attendees:

Dr. Jack Barth; Dr. Caren Braby; Alex Manderson; Dr. Angee Doerr; Dr. Francis Chan; Dr. George Waldbusser; Dr. Jonathan Fram; Dr. Robert Cowen; Dr. Cheryl Brown; Dr. Stephen Pacella; Paul Engelmeyer; Liu Xin; Craig Risien.

Meeting Agenda (Actual) Summary

1:00 pm- 1:30 pm	Attendee Introductions (Background and Interest in the Group)
1:30 pm – 1:50 pm	Group Discussion on Past and Current OAH Monitoring Equipment in the Yaquina Bay (Equipment types, location, length of monitoring)
1:50 pm – 2:00 pm	Next Steps: Scheduling next meeting, Follow-up email correspondence on equipment needs and project obstacles.

Oregon Coordinating Council on Ocean Acidification & Hypoxia

Yaquina Bay Monitoring Meeting - #2
Wednesday, August 19, 2020
10:00 AM - 11:30 PM

Attendees:

Dr. Jack Barth; Alex Manderson; Dr. Francis Chan; Dr. George Waldbusser; Dr. Jonathan Fram; Dr. Robert Cowen; Dr. Cheryl Brown; Dr. Stephen Pacella; Paul Engelmeyer; Craig Risien.

Absent: Dr. Caren Braby; Dr. Angee Doerr; Liu Xin;

Meeting Agenda (Actual) Summary

10:00 am – 10:35 am	Updates on Current and Planned Projects
10:35 am – 10:45 am	Review of Draft Yaquina Bay Project Narrative of OAH Council 2020 Legislative Report Appendix C
10:45 am – 11:00 am	Next Steps: Scheduling next meeting, Follow-up email correspondence on Bay-wide coordination efforts and upcoming grant opportunities.

APPENDIX E

Oregon Department of Fish and Wildlife Climate and Ocean Change - OAH Council Letter

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

Oregon Coordinating Council on Ocean Acidification & Hypoxia

Date: July 9th, 2020

To: Oregon Fish and Wildlife Commission

Re: Letter of Support for Adoption of the Oregon Department of Fish and Wildlife Agency Climate and Ocean Change policy

Good afternoon,

As a Co-Chair of the legislatively created Oregon Coordinating Council on Ocean Acidification and Hypoxia (or "OAH Council"), I appreciate the opportunity to offer a letter of support for the Oregon Department of Fish and Wildlife's newly drafted Climate and Ocean Change policy. This proposed agency policy relates to ongoing adaption and resiliency goals within the Oregon OAH Action Plan 2019-2025, and will aid the State in supporting prioritization of OAH research and science-based management of key species and habitats in light of changing climate and ocean conditions. As a co-chair of the OAH Council, I highly encourage the Oregon Fish and Wildlife Commission to vote "yes" on adopting this important climate and ocean policy directive. To build the brightest future for the ocean and its species and the communities that depend on them, and, despite uncertainty, we can and must act now in a pro-active way that will improve ecosystem and community outcomes for resilience.

Oregon is among the first places in the world to observe direct impacts of OAH, due to our unique geographic and oceanographic context, putting our fragile marine ecosystems and coastal communities at risk. Our nearshore waters are home to sport and commercial fisheries, and contain critical nursery grounds for important species including Dungeness crab, salmon, sea urchin, abalone, rockfish, oysters, and others – all critical marine resources which are managed by the agency. Ocean and climate change, including OAH, are expected to increasingly hinder Oregon Department of Fish and Wildlife's ability to achieve its agency mission and meet its statutory mandates to our native fish and wildlife.

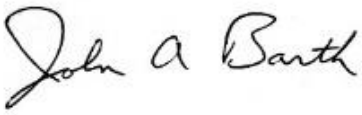
In September 2018, the OAH Council submitted their first biennial report to the Oregon Legislature, which directly identified the need to reduce carbon dioxide and other emission sources, support resiliency within Oregon's ecosystems, and coordinate climate and ocean management coordination (see Theme 2, Theme 3, and Theme 5 of the 2018 report). The currently proposed policy would offer an enormous opportunity to ensure that ODFW implements a strategic response that improves protections for our fish and wildlife while providing critical management framework for our state's understanding of larger regional climate change impacts.

The OAH Council appreciated the ODFW's inclusive and transparent process in developing the Climate and Ocean Policy and for allowing the wider environmental community to provide feedback on early drafts of the policy. The results of increasing OAH have had far-reaching consequences, for both the ocean ecosystem and the economy, consequences that we, as a society, are only just beginning to understand and quantify. Shifting food webs, loss of fishery productivity and lost economic opportunities are just some of the many impacts we are expecting to see because of increasing OAH. The proposed policy will help ensure a healthy Oregon marine ecosystem on which Oregon's fishing industry relies.

In summary, as a Co-Chair of Oregon's OAH Council I strongly support the Oregon Department of Fish and Wildlife's newly drafted Climate and Ocean Change policy. The Climate and Ocean Policy will allow the State to continue to characterize OAH vulnerabilities and pursue science-based adaptation/resilience strategies for preserving Oregon's marine ecosystem and socio-economic assets. Through scientific understanding and awareness, we can work together to combat the threat of climate and ocean change to Oregon's marine ecosystem and coastal economies.

Thank you for your consideration of this letter of support and welcome any questions.

Sincerely,



John Barth, PhD

Oregon State University

Executive Director
Marine Studies Initiative
Oregon State University

Email: jack.barth@oregonstate.edu

APPENDIX F

The 2018/2020 Oregon Water Quality Assessment – OAH Council Letter

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

Oregon Coordinating Council on Ocean Acidification & Hypoxia

Date: January 6th, 2019

To: Oregon Department of Environmental Quality, Water Quality Division
700 NE Multnomah
Portland, OR 97232-4100

Re: Oregon's 2018/2020 Integrated Report

Good afternoon,

As the Co-Chairs of the legislatively created Oregon Coordinating Council on Ocean Acidification and Hypoxia (or "OAH Council"), we appreciate the opportunity to offer public comment on Oregon's 2018/2020 Integrated Report, as part of the State's Clean Water Act reporting. We first want to recognize and show appreciation for the work that the Oregon Department of Environmental Quality (ODEQ) staff and managers have done in the development of Oregon's 2018/2020 Integrated Report 303(d) list. With this letter, we provide ODEQ with comments and suggestions on how to improve Oregon's water quality standards so that we can better protect our state's coastal communities and ecosystems in light of changing ocean conditions. Below are four key areas of the Integrated Report on which we will focus.

- We commend ODEQ for listing Oregon coastal waters as being impaired for ocean acidification (3B categorization – likely impaired but lacking data) through the use of a biocriteria for pteropods. However, we encourage ODEQ to also review methodology for pH narrative criteria to consider including a "0.2 unit excursions from natural conditions" clause similar to as was done in California and Washington. Also we encourage ODEQ to work with regional academics and resource managers to reconsider developing other criteria for ocean acidification such as aragonite saturation state.

- We would also like to commend ODEQ for listing of marine waters as being impaired (category 5 listing) for Harmful Algal Blooms (HABs) through the application of shellfish harvest use impairment. HABs affect not only Oregonians' ability to harvest marine resources (e.g., clams and crab), but can also have detrimental cascading effects throughout the whole marine ecosystem. As ocean conditions continue to change with changing climate, it will be important for the State to continue to consider the compounding effects of water quality criteria of HABs, ocean acidification, and hypoxia. Several research studies suggest that as ocean OAH conditions increase in intensity and duration, this could have a direct effect on the concentration and toxicity of HABs within our coastal waters.

- We strongly encourage ODEQ to list Oregon coastal waters as impaired for dissolved oxygen. The Oregon coast has been experiencing ocean hypoxia since the early 2000s, which has impacted our coastal fisheries and marine ecosystems. There are data currently available to support listing our State's coastal waters as a Category 5 impairment, and we would like to offer

our ongoing assistance to ODEQ in accessing these publically available data sets so that dissolved oxygen could be include in the 2018/2020 Integrated Report, as well as in future Integrated Reports.

- We would once again like to acknowledge ODEQ on the great strides forward in the data collecting and consideration of some marine water quality standards in the 2018/2020 Integrated Report. While we support ODEQ for the modernization of their reporting system with new story maps and data portals, we encourage ODEQ to provide some supplemental summary tables to make it clear which marine water bodies have been listed and for what. This information is difficult to access through the current online interfaces. We offer our assistance to ODEQ in future calls for data to help facilitate better access to the wider marine community and increase regional participation in this important process of setting and amending State water quality standards.

Background

Oregon's coastal economies rely on our vibrant marine ecosystem. Our nearshore waters are home to sport and commercial fisheries, all of the State's mariculture operations, and contain critical nursery grounds for economically important species including rockfish, oysters, salmon, pink shrimp, Dungeness crab, and others. Oregon is also among the first places in the world to observe direct impacts of OAH, due to our unique geographic and oceanographic context, putting our fragile marine ecosystem at risk. Addressing intensifying OAH conditions here in Oregon is critical to our understanding of larger regional climate change impacts through management strategies. The OAH Council's September 2018 report as well as the Oregon OAH Action Plan (2019 -2025) identifies water quality as an important consideration in reducing the causes of OAH (Theme 2). In these documents, the OAH Council encourages the State to make improvements to water quality by not only identifying pollutants that amplify or exacerbate OAH impacts, but also ensure that existing regulations are achieving their expected outcomes.

Concluding Remarks

As Co-Chairs of Oregon's OAH Council, we have taken on the charges set forth by the Oregon Legislature with a sense of urgency and importance, knowing that the State has a remarkable opportunity to help prepare our coastal communities and marine ecosystems for current and future OAH and HAB conditions. We once again want to commend ODEQ staff and managers for their dedication to protecting our States water resources, and offer our ongoing support in developing and improving the State water quality standards and Integrated Reports.

Thank you for your consideration of these public comments and we welcome any questions.

Sincerely,

John Barth, PhD

Executive Director
Marine Studies Initiative
Oregon State University

Caren Braby, PhD

Marine Resources Program Manager
Oregon Department of Fish and Wildlife

APPENDIX G

Council Developed OAH Outreach Materials

- Take Action (English and Spanish Versions)
- Research Needs
- Species Highlights – Dungeness crab
- Species Highlights – Oysters
- Species Highlights – Salmon
- Hypoxia – Effects on Oregon Coastline

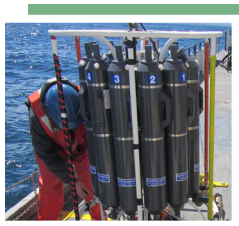
The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

Take Action

The Oregon Ocean Acidification and Hypoxia (OAH) Action Plan outlines actions that Oregon will take to adapt to and mitigate OAH impacts. We need all Oregonians to help make a difference facing this global problem.

Here is how YOU can help make a difference



Help Monitor Ocean Change

- Establish local and regional community-based monitoring networks
- Join an existing research or management survey as a volunteer

Reduce Excess Carbon and Prevent OAH Stressors

- Plant and maintain trees and restore coastal habitats
- Support State regulatory and voluntary programs to improve water quality
- Be mindful of your personal carbon footprint and reduce where you can - food waste, water usage, home heating/cooling/lighting, and driving patterns

Build Resilience to Ocean Change

- Work with industry, managers, and researchers to develop OAH specific adaptation/mitigation steps
- Support sustainable and adaptable local coastal business growth as OAH impacts occur

Learn about OAH Science and Solutions

- Encourage local schools and universities to teach about OAH
- Attend science and policy lectures, speaker series, and outreach events
- Use your network to share information about OAH science, impacts, and solutions

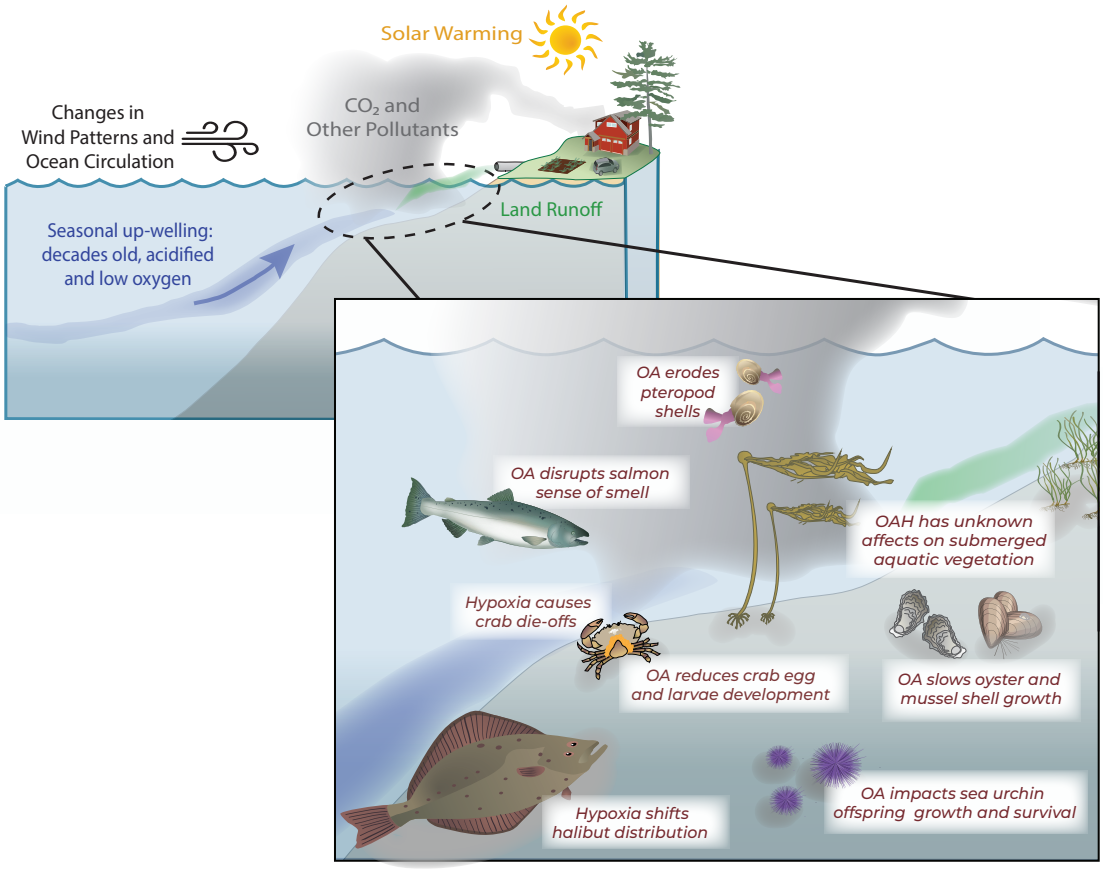
Encourage and Participate in Public Processes

- Support your local communities, cities, or organization to join coalitions and formulate their own OAH Action Plans
- Speak with and organize letters to your state and local government representatives for OAH Action

Why is the Oregon OAH Action Plan Needed?

Oregonians have always treasured the ocean's bounty and natural beauty. But our ocean's resources are at risk. Fossil fuel combustion and related accumulation of carbon dioxide (CO_2) and other greenhouse gases has led to climate change, ocean acidification, and ocean hypoxia that threaten our future reliance on ocean resources. Crab, salmon, oysters, halibut, and prey species that feed ocean life have already shown vulnerability.

Climate and other human drivers of ocean change ...



... impacts economically and ecologically important marine species.

The Oregon OAH Action Plan identifies ways that our government and individual Oregonians can make a difference to slow these impacts and adapt to the changes we are already seeing. Ocean Acidification and Hypoxia (OAH) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean.

Graphic Credits - several graphics in this document were purchased from or used courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/)

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

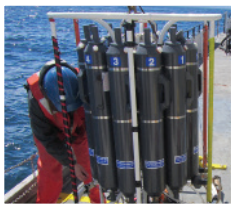
oregonocean.info/index.php/ocean-acidification

El Consejo de Coordinación de Oregón sobre Acidificación Oceánica e Hipoxia

Toma medidas

El Plan de Acción de Oregón sobre Acidificación Oceánica e Hipoxia (AOH) describe medidas que Oregón adoptará para adaptarse y así mitigar los impactos de la AOH. Necesitamos la ayuda de todos los residentes de Oregón para marcar una diferencia con este problema global.

Aquí es como puede marcar una diferencia



Ayudar el monitoreo de los cambios oceánicos.

- Establecer redes de supervisión basadas en las comunidades locales y regionales
- Participar en investigaciones existentes o encuesta administrativa como voluntario

Reducir el exceso de carbono y impedir los factores estresantes de la AOH

- Plantar y mantener árboles y restaurar hábitats costeros
- Apoyar los reglamentos mandatorios y voluntarios del Estado para mejorar la calidad del agua
- Sea considerado con su huella de carbono personal y reducir adonde puede - desechos alimentarios, utilización de agua, calefacción/enfriamiento/iluminación del hogar, y hábitos de conducción

Fomentar la resiliencia a los cambios oceánicos

- Trabajar con la industria, administradores, y investigadores a desarrollar solusiones que conlleven a mejorar la adaptación/mitigación de la AOH
- Apoyar el crecimiento del adaptación y sustentabilidad del negocios locales y costeros cuando los impactos del AOH ocurren

Aprender más sobre la ciencia y los impactos de la OAH

- Alentar escuelas locales y universidades a enseñar más sobre la AOH
- Asistir conferencias científicas y políticas, serie de discursos, y actividades de divulgación
- Usar su red a compartir informacion de ciencias de la AOH, los impactos, y las soluciones

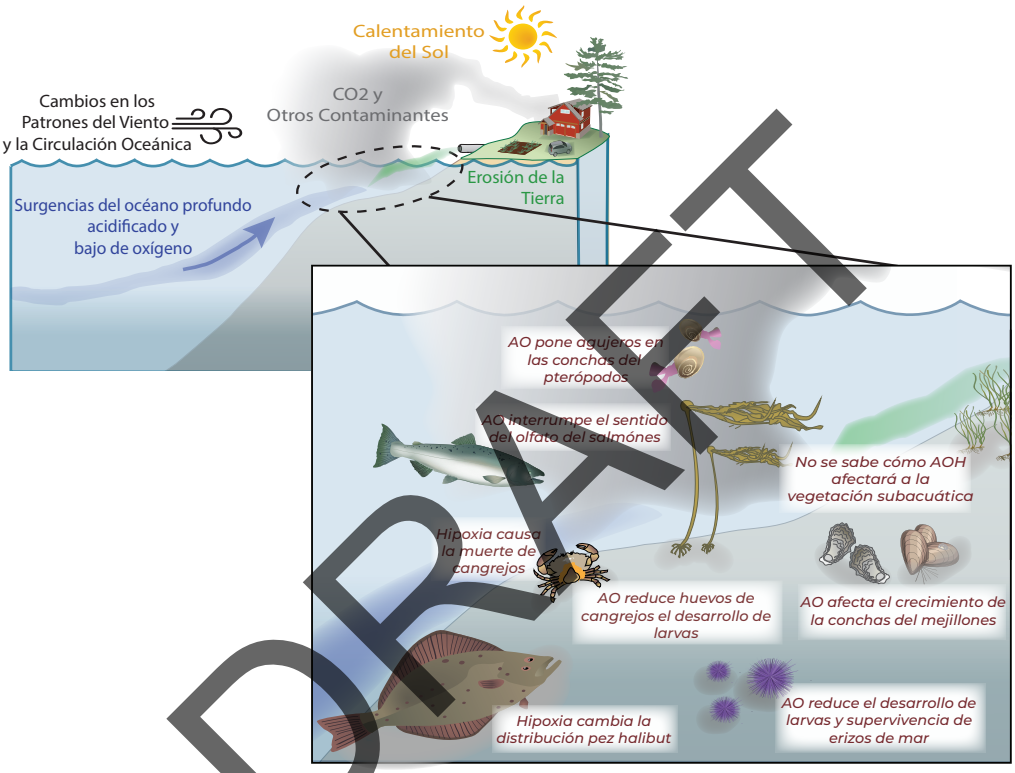
Fomentar y participar en los procesos públicos

- Apoyar las comunidades, ciudades, o organizaciones locales a formar coaliciones y formular sus propios Planes de Acción de la AOH
- Hablar con y organizar letras para representantes de su gobierno estatal y local para acción sobre AOH

¿Por qué necesitamos El Plan de Acción sobre la AOH?

Los residentes de Oregón siempre han valorado las bondades y belleza natural del océano. Pero, los recursos oceánicos están en peligro. El consumo de combustibles fósiles y la respectiva acumulación del dióxido de carbono (CO_2) al igual que otros gases de efecto invernadero ha causado el cambio climático, la acidificación oceánica e hipoxia que amenazan a nuestros dependencia de recursos oceánicos del futuro. Cangrejos, salmónes, ostras, halibuts, y las especies predadoras que alimentan la vida oceánica ya han demostrado vulnerabilidad.

Fuerzas de Clima de Los Cambios Oceánicos ...



... afecta especies marinas que son importante para la encomia y ecológica de Oregon.

El Plan de Acción de Oregón sobre Acidificación Oceánica e Hipoxia identifica maneras que nuestro Gobierno y los Residentes de Oregón pueden llevar a cabo para tener una influencia decisiva y así reducir los impactos y a su vez, adaptarse a los cambios que estamos experimentando. La Acidificación Oceánica e Hipoxia (AOH) son dañinas no solo para la vida oceánica sino que también para la estabilidad económica de los residentes de Oregón que dependen de un océano sano.

Créditos de la Imagen - Varios gráficos en este documento fueron comprados o usadas a la cortesía de la Integración y Red de Aplicaciones, El Centro de Ciencias Ambientales de la Universidad de Maryland (ian.umces.edu/imagelibrary/)

Para obtener mayor información acerca la ciencia de la AOH, los impactos, y las soluciones propuestas, favor visite el sito web del consejo de la AOH:

oregonocean.info/index.php/ocean-acidification

Research Needs

The Oregon Ocean Acidification and Hypoxia (OAH) Action Plan identifies ways that Oregonians can make a difference to slow OAH impacts and adapt to the changes we are already seeing. This abbreviated list of research actions from the OAH Action Plan was prioritized by the OAH Council. This list is meant to be a starting place to help guide researchers and funding groups on what the OAH Council thinks are top priorities for the state of Oregon. Additional research needs and priorities will be developed as needed.

Here are the top RESEARCH ACTIONS that can make a difference

Advance Scientific Understanding

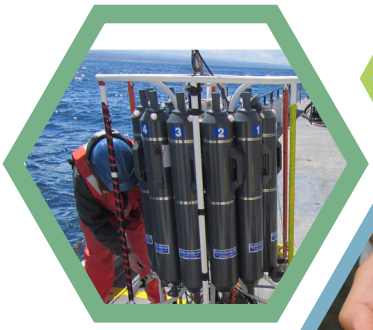
- Re-establish OAH monitoring in Yaquina Bay
- Co-locate existing Marine Reserves sampling with new OAH intertidal and subtidal OAH monitoring
- Add biological and chemical OAH monitoring to the Newport Hydrographic Line
- Sustain OAH monitoring in Tillamook Bay
- Maintain and support new OAH instruments within communities and alongside at-risk industries
- Provide a workshop to prioritize biological monitoring metrics for OAH
- Conduct a socio-economic vulnerability assessments of Oregon's vulnerabilities to OAH

Reduce Causes

- Develop effective and efficient ways to reduce excess CO_2 and OAH stressors

Create Resilience

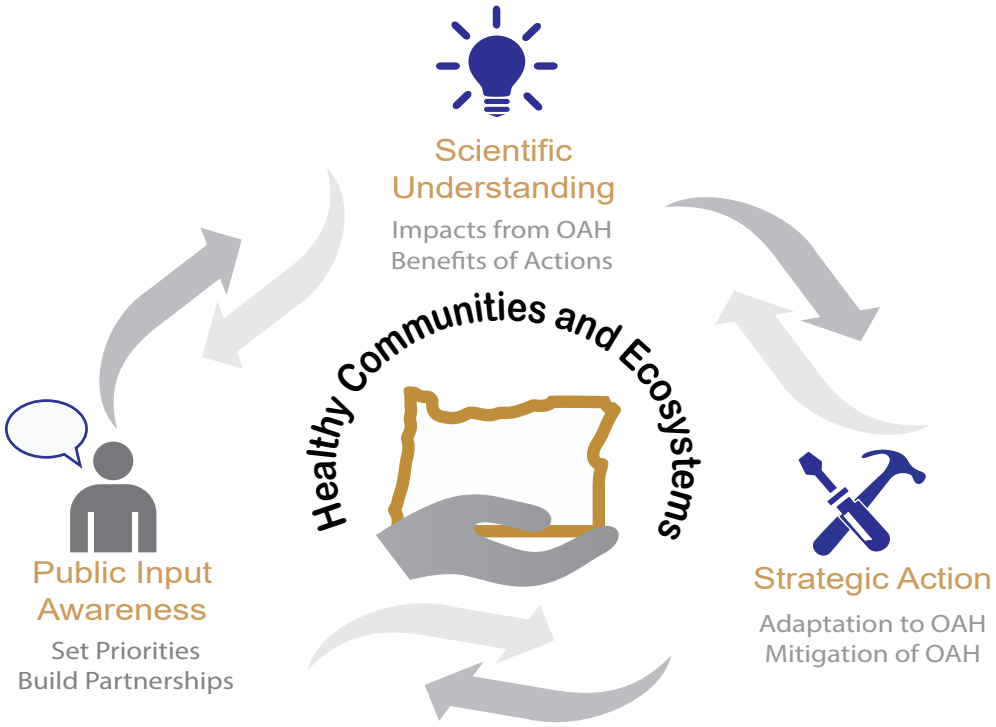
- Identify strategies to restore, protect, and sustain: (1) Nursery habitat for valuable shellfish, (2) Submerged Aquatic Vegetation (SAV) and native shellfish, (3) Oregon's water quality, (4) Life history stages of OAH vulnerable marine species, (5) Economic resilience in coastal communities and marine industries
- Research of resilient shellfish aquaculture strains
- Develop maps to that promote resilience in: (1) SAV and native oyster core distribution areas, (2) Priority areas for habitat restoration and protection
- Conduct an ecosystem modeling of SAV, and hydrodynamic and biogeochemical processes to inform: (1) Regions considered for blue carbon and/or carbon mitigation offsets, (2) Aquaculture practices in Oregon's bays and estuaries



Why is the Oregon OAH Action Plan Needed?

Oregon's commitment to understand, actively adapt to, and mitigate OAH requires us to invest funding and time to build a more predictable future. Oregon's approach to solving these problems requires addressing excess CO_2 and OAH stressors simultaneously recommends will take time to implement. To build the brightest future for the ocean and its species and the communities that depend on them, and despite uncertainty, we can and must act now in a pro-active way that will improve ecosystem outcomes for resilience, as a "no-regrets" strategy.

The Oregon OAH Action Plan identifies ways that our government and individual Oregonians can make a difference to slow these impacts and adapt to the changes we are already seeing. Ocean Acidification and Hypoxia (OAH) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean.



To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

Oregon's Coordinating Council on
Ocean Acidification and Hypoxia

Species Spotlight

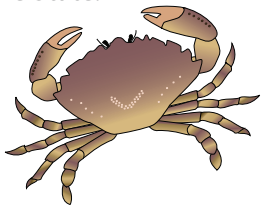
Dungeness Crab

Ocean Acidification (OA) and Hypoxia (H) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean. The Dungeness crab fishery is one of Oregon's highest harvest values commercial fisheries, and is an iconic pastime for recreational harvesters.

What is at risk?

Economic Effects

Overall declines in harvest levels, resulting in possible economic and recreational losses throughout the State.



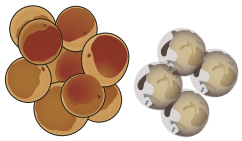
Foodweb Effects

Declines in food (such as clams and mussels) affect crab health.

Habitat Effects

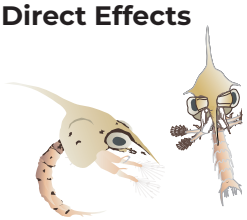
Eelgrass is an important habitat for crabs, and may buffer short term effects of OAH through photosynthesis (absorbing CO_2 and releasing oxygen).

Cumulative Effects



Poor ocean conditions are likely to lead to lower productivity.

Direct Effects



Larval growth and shell formation out of chitin (a calcium carbonate compound) can also be affected by lower acidity.

Sensory Effects

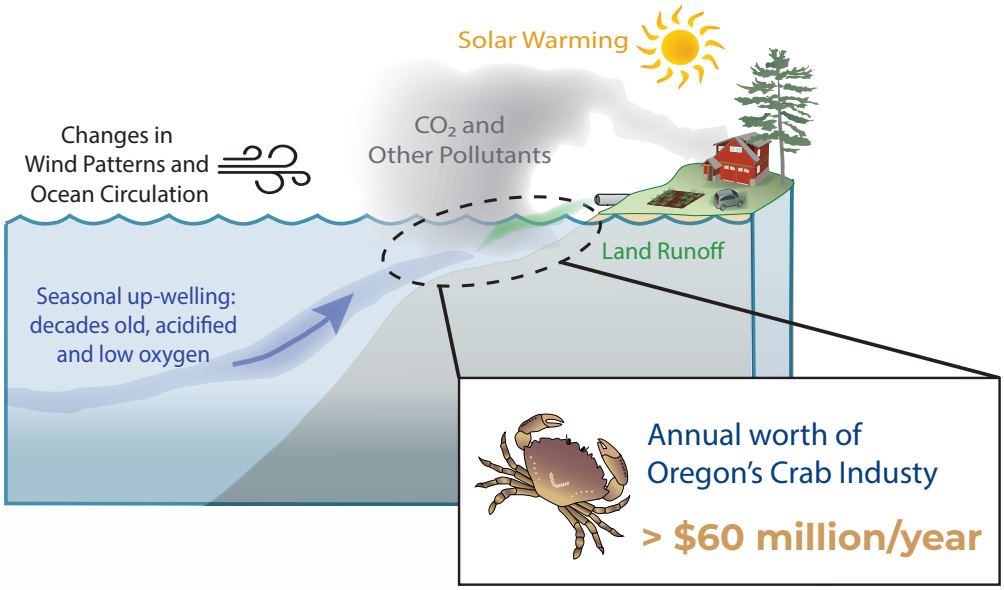
Behavior maybe affected by changing cues, due to altered chemical signaling (peptide production) needed for juvenile settlement.

What is OAH?

Ocean acidification and hypoxia (OAH) are increasing, and are related to the same factor that is causing climate change.

The culprit? **Fossil fuel combustion and related accumulation of CO_2 and other greenhouse gases.**

The solution? **Local actions will lead to a brighter future, for the oceans, its species and the communities that depend on them. We can and must act now!**



The earth's oceans have absorbed 30% of the excess CO_2 produced from fossil fuel combustion since the Industrial Revolution (mid 1800s). When absorbed by seawater, CO_2 undergoes chemical reactions that lower seawater pH (making it more acidic), and thus hampers shell formation in marine life. Hypoxia (low oxygen) conditions are also on the rise as a result of climate change, due to changing wind and weather patterns. This is leading to extended periods of hypoxia in some of Oregon's coastal waters, impacting a wide range of marine animals from crabs to fish.

Support Action!

Ocean Acidification and Hypoxia (OAH) will not stop on its own, and actions must be taken by regional and national governments, communities, and scientists now in order to address the growing problems. Through coordination and collaboration, such as through the **Oregon OAH Action Plan**, Oregon will be able to adapt and mitigate the effects of OAH. Solutions are needed to help Oregon's wild fisheries and marine resources withstand the projected changes in OAH.

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

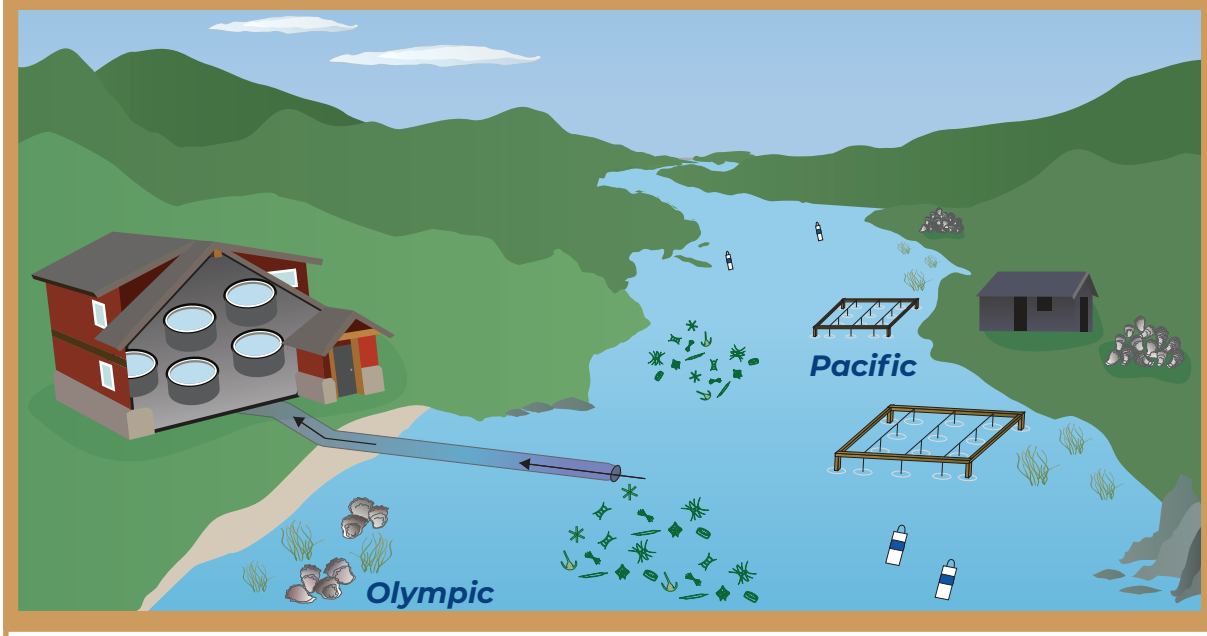
Oregon's Coordinating Council on
Ocean Acidification and Hypoxia

Species Spotlight

Olympic and Pacific Oysters

Ocean Acidification (OA) and Hypoxia (H) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean. Olympic oysters (native) and Pacific oysters (cultured) provide important ecological and industry opportunities throughout coastal Oregon.

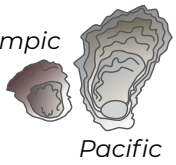
What is at risk?



Habitat Effects

Eelgrass, habitat for Olympic and Pacific oysters, may buffer short term effects of OAH through photosynthesis (absorbing CO_2 and releasing oxygen).

Cumulative Effects



Small changes in pH make a large difference in growth conditions, which could affect Olympic and Pacific oysters throughout their life.

Direct Effects

Larval growth and calcium carbonate shell formation in Olympic and Pacific oysters are lowered by OA.

Hatchery Effects

Pumped seawater used in hatcheries now must be chemically modified to reduce the effects of OAH on larval Pacific oysters.

Foodweb Effects

Species shifts in phytoplankton, feed for Olympic and Pacific oysters, may occur with changing ocean conditions.

Economic Effects

With declining larval supplies, Pacific oyster farmers may experience declines in production.

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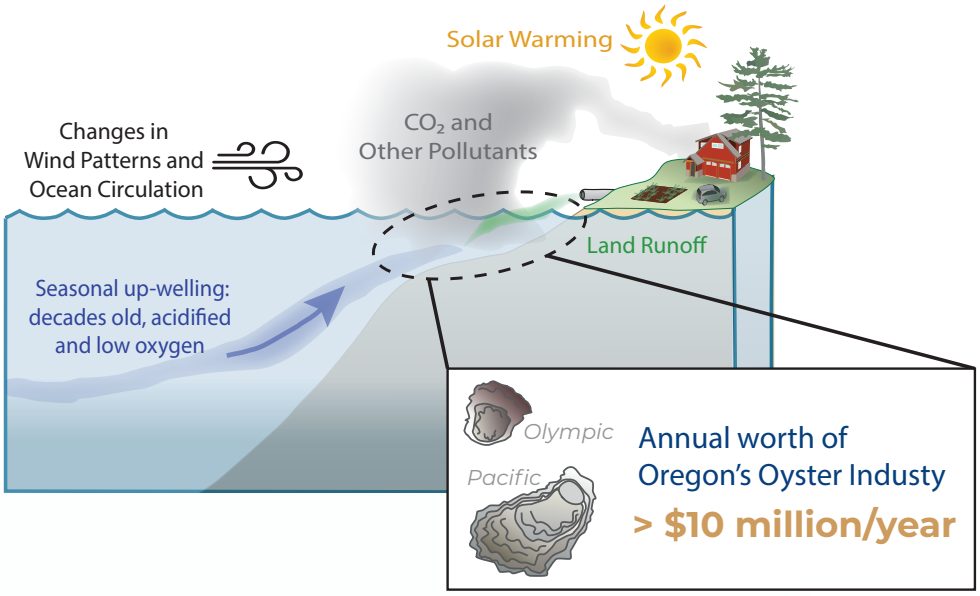

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Ocean Acidification and Hypoxia (OAH) will not stop on its own, and actions must be taken by regional and national governments, communities, and scientists now in order to address the growing problems. Through coordination and collaboration, such as through the **Oregon OAH Action Plan**, Oregon will be able to adapt and mitigate the effects of OAH. Solutions are needed to help Oregon's wild fisheries and marine resources withstand the projected changes in OAH.

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oregonocean.info/index.php/ocean-acidification

Oregon's Coordinating Council on Ocean Acidification and Hypoxia

Species Spotlight

Salmon

Ocean Acidification (OA) and Hypoxia (H) are harmful to ocean life and the economic stability of the Oregonians who rely on a healthy ocean. Salmon are one of the favorite pursuits of Oregon's recreational and commercial anglers, as well as being an essential cultural resource Northwest tribes.

What is at risk?

Habitat Effects

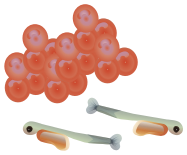
Changes in OAH can not only affect oceans but are also experienced in estuarine and river environments.

These environmental effects have carryover into all aspects of the Salmon life cycle.

Foodweb Effects

Pteropods (marine snails) are key prey, whose shells are sensitive to OA and are pitted by increased acidity.

Cumulative Effects



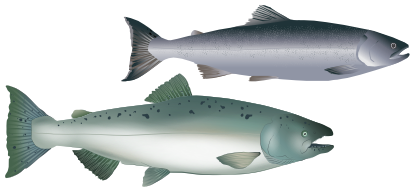
Early Salmon life stages' survival could be altered as a result of material diet changes due to OAH.

Direct Effects

Juveniles may experience reduced growth rates, which can increase the risk of predation.

Sensory Effects

Signaling in brains can be disrupted, causing fish to possibly not recognize prey, predators, or migration cues.



Economic Effects

Fisheries managers and researchers are not certain how OAH effects may compound across Salmon life stages and on habitats, or if there will be any effects on commercial and recreational Salmon harvests.

What is OAH?

Ocean acidification and hypoxia (OAH) are increasing, and are related to the same factor that is causing climate change.

The culprit? **Fossil fuel combustion and related accumulation of CO_2 and other greenhouse gases.**

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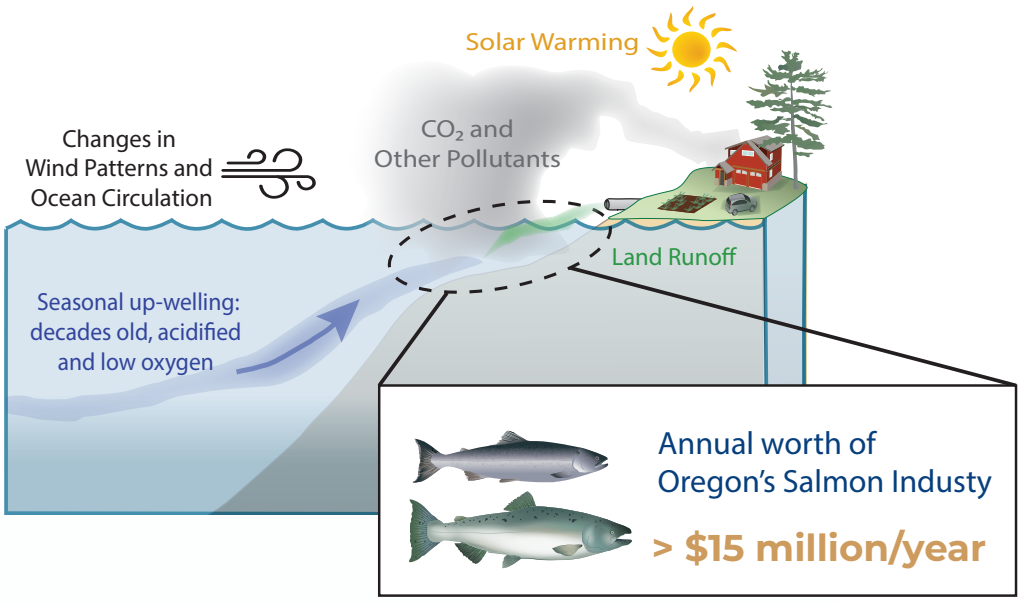

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Support Action!

Ocean Acidification and Hypoxia (OAH) will not stop on its own, and actions must be taken by regional and national governments, communities, and scientists now in order to address the growing problems. Through coordination and collaboration, such as through the **Oregon OAH Action Plan**, Oregon will be able to adapt and mitigate the effects of OAH. Solutions are needed to help Oregon's wild fisheries and marine resources withstand the projected changes in OAH.

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

Hypoxia

Understanding its effects on Oregon

Low oxygen can cause stress and even death for fish and other aquatic animals.

Oxygen is essential for most life on earth including fish and other aquatic animals like shellfish, which extract it from water. If oxygen levels in seawater get too low, it is called Hypoxic.

What is the issue?

- The frequency of hypoxic events in Oregon's waters is increasing, and the low-oxygen areas are coming closer to shore, affecting our productive coastal ecosystems and fisheries.

What are the causes?

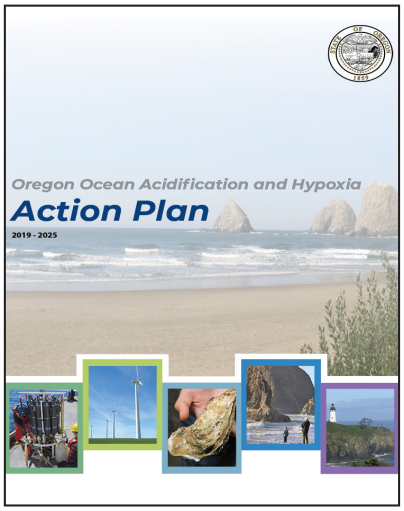
- Each year on the West Coast, there is upwelling. Upwelling is driven by wind currents that cause deep ocean water, rich in nutrients to replace surface level ocean water.
- When the nutrient-rich, low oxygen water reaches Oregon's coast, microscopic plants called phytoplankton begin growing. When Phytoplankton sink to the sea floor they are then decomposed by microbes that consume oxygen further decreasing oxygen levels along our shores.
- Unlike the Gulf of Mexico and in other parts of the world, the primary cause of Oregon's ocean hypoxic events is wind driven upwelling of low oxygen, nutrient-rich waters - not nutrient runoff from the land.

Why is it important?

- Hypoxic events can cause a decrease in the number of species as well as where certain species can live - Oregon has already seen this occur in shifts in our Dungeness crab and Halibut fisheries.

What can YOU do about hypoxia?

In addition to regional and national governments, communities, and scientists working on this issue, Oregonians like **YOU** need to act now to address the causes impact of hypoxia.



Through coordination and collaboration, such as through the **Oregon Ocean Acidification and Hypoxia (OAH) Action Plan**, Oregon will be able to adapt and mitigate the effects of OAH. Solutions are needed to help Oregon's wild fisheries and marine resources withstand the projected changes in OAH.

Support Action!

To reverse the loss of oxygen in our ocean, we all must act together.

Oregon OAH Action plan highlights many steps that ***YOU*** can do to make a difference!

- **Join an existing citizen science project**

- **Reduce where you can food waste, water usage, home heating/cooling/lighting, and driving patterns**

- **Support sustainable and adaptable local coastal business growth as OAH impacts occur**

- **Educate yourself and others on hypoxia by visiting the OAH Councils online resource library.**

- **Encourage and work with your local communities on joining coalitions and formulating OAH Action Plans, receive updates on regional action.**

To learn more about OAH science, impacts, and solutions, please visit the Oregon OAH Council's website:

oregonocean.info/index.php/ocean-acidification

APPENDIX H

Education and Outreach Working Group – OAH Communications Planning Project

- Project Scope and Planning
- Fishermen's Round-table Proposal
- Working Group Meeting Summary 01/14/20
- Working Group Meeting Summary 05/27/20
- Working Group Meeting Summary 08/05/20

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

New Communications Working Group Initiatives

Oregon 2020 Legislative Report - Appendix H

The Oregon OAH Action Plan identifies that it is important that ocean experts and stewards continue to make OAH information accessible to all Oregonians with the goal of empowering coastal communities to take informed action today to build a more robust future. This can only occur through clear, strategic, and compassionate communications. As Oregon continues to observe the impacts from OAH, it is key that we support equity and environmental justice in our communications – as many underserved communities in rural and urban centers are expected to be disproportionately impacted by climate change due to limited access to resources and information. Communities' resiliency depends on us taking steps forward today in awareness of and planning for ocean change. By creating strong, diverse partnerships of informed individuals (who not only understand OAH science, but are well informed on their possible mitigation, adaptation, and resiliency options to take action) Oregon can continue our path towards combating OAH.

2019 OAH Action Plan Theme 4 - Step 4.1.1:

The OAH Council convenes an advisory working group with regional education/outreach specialists to identify OAH outreach needs.

Estimated Funding Needs: None

One of the key aspects of the OAH Action Plan is to communicate OAH science, impacts and solutions to raise awareness and support decision-making. Scientific experts know that current and projected OAH impacts can be harmful to ocean life and the economic stability of all Oregonians who rely on a healthy ocean and all who eat seafood. It will take a strong common purpose, meaningful local action and broad partnerships regionally, nationally, and internationally in order to successfully implement solutions – this will take strategic communications.

The OAH Council has organized a Working Group consisting of 11 members, including regional education and outreach specialists, representing multiple perspectives and professional backgrounds.

WORKING GROUP MEMBERS:

Dr. Jack Barth	OSU; MSI; OAH Council Co-chair
Dr. Caren Braby	ODFW; OAH Council Co-chair
Fran Recht	Pacific States Marine Fisheries Commission; OAH Council Member
Dr. Shelby Walker	Oregon Sea Grant; OAH Council Member
Tracy Crews	Oregon Sea Grant
Dr. Kerry Carlin-Morgan	Oregon Coast Aquarium
Charlie Plybon	Oregon Surfrider
Susan Chambers	West Coast Seafood Processors Association
Margaret Pilaro	Pacific Coast Shellfish Growers Assoc. (PCSGA)
Sara Bywater	PCSGA
Dr. Francis Chan	OSU; PISCO

This Working Group has been meeting since Winter 2019 with the aim to propose a path forward for OAH awareness by identifying key audiences and connecting messages to their personal interests, emotions, and beliefs.

The goals of this Working Group include:

- ***Instilling OAH Understanding***
- ***Removing OAH Misconceptions***
- ***Acknowledging OAH Uncertainty***
- ***Building Motivation for action***
- ***Creating Hope for the future***

DEVELOPING AN OAH COMMUNICATIONS PLAN:

The Working Group and the OAH Council are developing a communications plan to meet the needs of diverse stakeholders and provide solutions-oriented messages to all Oregonians (OAH Action plan step 4.1.2.). To this end, the Working Group has been developing four key principles for inclusion in this OAH communications plan, which will ideally be created by a media firm who specializes in climate risk communications and messaging (with anticipated delivery in 2023).

Principle 1: Expanding capacity for distributing messaging

Like all messaging campaigns, it is often difficult to reach people from different demographics across the State. This is why it is important to consider not only the audience and message, but also the messenger. Messengers must be trusted sources in the local communities and have the time and resources to share information. One way to expand capacity is through "Teach the Teacher" programs that will focus on training regional educators (both formal educators such as K-12 teachers and informal such as docents or tour guides) to create new messengers for sharing OAH information in communications that these "teachers" already serve.

Principle 2: Building and keeping momentum for behavior change

Climate and ocean change are long-term problems that will take decades and significant resources to combat. As an illustration of this, if we completely stop global human (anthropogenic) carbon emissions today, it will take an estimated 40 years for the residual effects of OAH in our oceans to reach Oregon's shores through upwelling. Therefore, an integral part of the OAH communications plan will be to carry people's interests forward, to create long-term behavior change in our communities.

Principle 3: Creating synergy and leveraging existing efforts throughout the State and region

Locally, regionally, and globally, there are many efforts currently underway to slow or reverse various drivers of climate and ocean change. Moving forward, it will be important for the Working Group and the OAH Council to stay attuned to new strategies, initiatives and successes, so that the Council's recommendations use the most accurate information and best approaches. This will help the State of Oregon and our partners to maximize limited resources.

Principle 4: Acquiring resources to deliver messaging and facilitate local action

By leveraging common goals and missions from other local and regional projects, the Working Group and the OAH Council will be able to use limited resources for the greatest local impacts. To create an OAH communication plan, we will work toward hiring a skilled contractor that specializes in climate science risk communications. In addition, we will evaluate how successful messaging platforms are at reaching diverse groups of Oregonians and if there are factors limiting community access to and understanding of OAH content, including communities' access to reliable high-speed internet as well as the translation of messages onto multiple languages.

2019 OAH Action Plan Theme 4 - Step 4.2.3:

The OAH Council provides information in a variety of forms to impacted audiences including policy makers, at-risk industries, and coastal communities.

Estimated Funding Needs: None

Our communities' resiliency depends on us taking steps forward today in awareness of ocean changes we are seeing today, and planning for those to come tomorrow. By creating strong diverse partnerships of informed individuals who not only understand OAH science, but are well informed on their possible mitigation, adaptation, and resiliency options to take action, Oregon can continue our path towards combating OAH. One of the key aspects of the OAH Action Plan is to support positive communication styles, which are fact driven and empower personal change. (See Appendix G - Outreach materials)

The Working Group and the OAH Council are dedicated to building content that not only is relevant to today, but also ties into audience values. Messages and content developed by the Working Group will stress that science and research are key tools for change, and demonstrate a clear need and pathway for "what can be done" by everyday Oregonians and local governments. To this end, the Working Group has developed several key message themes that are directly tied to OAH and are relevant tie into today's new social, political, and economic realities:

Key Message Themes:

- ***Food Security (access to local protein though fish and shellfish as well as marine algae)***
- ***Blue Economy (access to marine related jobs through new sustainable markets developed)***
- ***Self-Resiliency (access to adaption tools and planning to build community stability)***
- ***Environmental Health (access to marine ecosystem services – clean air, food, and water)***

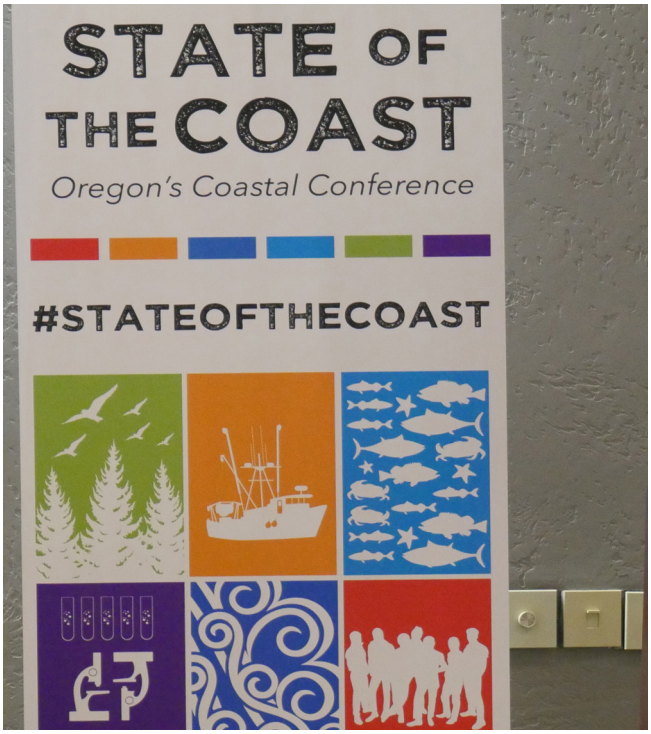
2019 OAH Action Plan Theme 4 - Step 4.2.2:

The OAH Council convenes "State of OAH" workshops for communities on OAH science, impacts, and solutions with policy makers as well as communities and at-risk industries.

Estimated Funding Needs: $25K- $100K (per workshop)

In order to truly mitigate ocean and climate change, we must listen to and learn from affected communities, and understand their concerns and needs, so that we can incorporate those needs into solutions. The Working Group and the OAH Council are dedicated to recognizing and amplifying local voices throughout Oregon to ensure many perspectives, values and community needs are heard regionally and globally. A pillar of the OAH Action Plan is ensuring that we continue to engage local communities. Due to COVID-19, many of the OAH Council's plans to hold in-person community events in 2020 have been postponed. Nonetheless, the Working Group is continuing with plans for two small events, whose timing (occurring in 2020 or 2021) and format (in person or remote) will remain flexible to ensure safety of our audience.

State of the Coast Workshop – OAH Breakout session:
(Proposed for Fall 2020 – remote)



State of the Coast is the annual coastal meeting, convened by Oregon Sea Grant, that engages all interested coastal community members in "hot topics" during an ocean-focused day of talks, workshops, and networking. As with all public events, the plans for this year's workshop (October 2020) are in flux; however, the OAH Council plans to participate in 2020 if the meeting is held (remotely), or in 2021. The focus of the OAH Council workshop session will be to discuss best practices for communicating with communities about the risks and impacts of OAH and climate change in meaningful ways that connect with our communities' personal experiences during today's chaotic, ever changing social landscape, being mindful of communities' ongoing needs and concerns. It is our aim that participants will leave the remote session with a broader set of communications tools that they can use in their own OAH communications and a better understanding of how to relate with diverse Oregon communities.

2021 Fishermen-Scientist OAH Roundtable:
(Proposed for Spring 2021 – in person)

In 2016 and 2017, Oregon Sea Grant, OSU and ODFW, along with others partners from around the State hosted two Ocean Acidification Fisherman's Roundtables, both in Newport, in order to share the current status of OA science and actions in Oregon. These roundtables were considered by the attendees (industry, managers, academics, decision-makers) to be valuable platforms for open dialog about the current status of our oceans health; these conversations spurred multiple collaborative research projects as a result. It is the goal of this workshop to describe the collaborations that have occurred, and focus on recent observations and opportunities to collaborate in the future. In addition to sharing information, the group will be asked to create audio-visual outreach materials targeting the fishing community to communicate the opportunity to collaborate on OAH research and on the observed impacts of OAH on the Oregon coast. The proposed 2021 Fishermen-Scientist OAH Roundtable ties into larger State initiatives. The Working Group has applied for and was awarded a small external grant to help support this workshop.

2020 Ocean Acidification and Hypoxia Fisherman's Roundtable

Oregon Sea Grant Workshop Assistance Proposal Awarded June 2020 for $2,000

Oregon's history is one of cultural and economic value in ocean and estuarine fisheries and in the natural beauty and bounty of the ocean – all of these rely on our healthy ocean communities. Salmon, halibut, Dungeness crab, razor clams, oysters, pink shrimp, lamprey, and rockfish have supported Oregon's coastal economies for generations. Yet, Oregon's ocean is changing, and each of these species has already shown signs of distress from ocean acidification and hypoxia (OAH). In order to help support the future sustainability of our marine resources, and Oregonians' ability to rely on them, we must begin to act now to spread awareness and promote communities ability to adapt and become resilient to OAH changes over time.

In 2016 and 2017, Oregon Sea Grant along with partners from around the State hosted two Ocean Acidification Fisherman's Roundtables, both in Newport, in order to share the current status of OA science and actions in Oregon. Both of these meetings were considered by both industry and academics as extremely valuable platforms for open dialog about the current status of our oceans health, and conversations from these events spurred several collaborative research projects. **It is the goal of this workshop assistance proposal to build on the collaborations built in these meetings and restate these roundtables by requesting funds to host two similar roundtables in 2021.**

The 2021 proposed 2021 fisherman's roundtable ties into larger state initiatives being coordinated by the legislatively created Oregon Coordinating Council on OAH (established by the 2017 Senate Bill 1039). The 2018 Report articulated 12 Recommendations and 38 Actions, organized under five Themes. Specifically, the Roundtable addresses the following action:

> **2018 OAH Report Action 4.2.b** At-risk industries and professions:
> Communicate with industries affected by OAH to strengthen cultural values of healthy and sustainable seafood and seafood industry and build relationships to strengthen collaborative solutions development.
>
> i. Convene specialists and/or industry representatives across industries and regions using round tables and workshops (include a diversity of participants including fishermen, seafood processers, shellfish producers, retail food industry practitioners.

PROPOSED ROUNDTABLE LOGISTICS

Meeting Goals:

- Reinstate successful OA roundtables similar to those that occurred in 2016 and 2017 in coordination with the Oregon Sea Grant.
- Focus on open and collaborative communications among fishing communities and regional academic researchers to share concerns and opportunities for new research.

- Provide an opportunity to create audio/visual outreach materials with the fishing community to communicate the impacts of OAH along the Oregon coast through antidotal stories.

Timing:

- April 2021
  - Coincides with the past fishermans' roundtables
  - Coincides with off-seasons for many ocean fisheries

Locations:

- Newport – HMSC Library Center
  - 2016 and 2017 Roundtables were held in Newport at HMSC
  - Easy access for OSU researchers and the Newport based fishing fleet
- Coos Bay – Facility TBD
  - Good attendance, and crab commission, UO there

Participants:

- Roughly 30-40 people including:
  - Fishermen (commercial - multiple gears, fisheries)
  - Scientists (OSU, UO, PSU, State and Federal researchers – NOAA, EPA, ODFW, DLCD, DEQ)
  - Invited observers (federal, state, regional – resource managers, fishing regulatory boards, and State commodities commission members)

Format:

- Two separate - 5 hour workshop with a 1hr catered lunch.
- Use a combination of formats including: research presentation, large group discussions, small break-out group discussions, and panel focused Q/A.
- Lunch will be unstructured to allow for networking and open communications among participants.
- "Free times" (including lunch, breaks, and before/after the workshop) will be used to collect antidotal stories from participants to be used in audio/visual communication materials development.

Topics:

- Fishermen observations and concerns regarding OA
- Highlight current collaborative Academic / Researcher projects
  - NOAA CHRP – Hypoxia Sensors in Crab Pots
    - Work done by Drs. Chan and Barth in conjunction with local fisherman
  - Sea Grant – Salinity/Hypoxia sensor in Newport Commercial Harbor
    - Work done by Ian Black (OSU) and others
- Fishermen and Scientist Dialogue -- How can we continue to work together?
- Research Priorities for the future
- Next Steps and Reflections

Budget:

- Location – TBD with costs most likely waved by location
- Food / Catering – $600 (40 people at $15 a person) for each location
- Outreach Materials development - TBD based on who will be contracting the project

OAH Council – Education and Outreach Working Group
Meeting Summary: 01/14/2020

Working Group Members:

Caren Braby	*(Oregon Department of Fish and Wildlife, Marine Program Manager)*
Jack Barth	*(Oregon State University, Marine Studies Initiative Director)*
Tracy Crews	*(Oregon Sea Grant, Marine Education Program Manager)*
Kerry Carlin-Morgan	*(Oregon Coast Aquarium, Director of Education)*
Shelby Walker	*(Oregon Sea Grant, Director)*
Charlie Plybon	*(Oregon Surfrider, Policy Coordinator)*
Fran Recht	*(Pacific States Marine Fisheries Commission, Habitat Program)*
Susan Chambers	*(The West Coast Seafood Processors Association, Director)*
Sara Bywater	*(Pacific Coast Shellfish Growers Assoc., Outreach and Projects)*
Margaret Pilaro	*(Pacific Coast Shellfish Growers Assoc., Director)*
Francis Chan	*(Oregon State University, Associate Professor)*

Working Group Staff:

Charlotte R. Whitefield	*(Oregon Department of Fish and Wildlife, OAH Council Staff)*

Key Topics: Working Group (WG) Motivations, Visions, and Audiences

Concerns of the WG:

- Expanding capacity for distributing messaging
  - It is very difficult to reach people across the state from different demographics
  - Interested in teach the teacher programs to make new "messengers" for sharing information
- Building and keeping momentum for behavior change
  - OAH is a long term issue, and we need to address it over time
  - "Carry peoples interests forward"
- Acquiring resources to deliver messaging and facilitate action
  - We need money and personal to accomplish messaging
- Creating synergy and leveraging existing efforts throughout the state and region
  - Know what is occurring and where the "gaps" are to fill for most impact

Motivation of WG:

Change behavior of Oregonians through -

Awareness	"People know what is happening"
Action	"People actively do something"
	(Personal action and/or Policy action)

Themes behind WG messaging and what type of behavior change corresponds:

Science	-	Gains Awareness
Adaptation (and Resilience?)	-	Gains Awareness, Facilitates Action
Mitigation	-	Gains Awareness, ~~Facilitates Action~~

(Some hesitation from some WG members to directly address mitigation actions)

Core concepts in WG messaging:

- Instill "Understanding"
- Remove "Misconceptions"
- Acknowledge "Uncertainty"
- Build "Motivation"
- Create "Hope"

(Achieved through connecting to audiences personal interests, emotions, and beliefs)

Messenger identified by the WG:

- Informal Education: "Teach the Teachers" – messenger
- Industry and fishers/aquaculture personal – messenger

Audiences identified by the WG:

- "General public": hesitation in the some of the WG to use this term since it is too "broad" as a definition of the audience
- The "next generation": k-12 who will be keeping the momentum going longer term
- Venues that reach wide range of concerned citizens
    - Media
    - Watershed councils
- Legislature
- People not on the coast
- Larger cities
- Local governments
- Some WG members stated that we may want to possibly stay away from formal educators, since they are already well served

Prioritization of audiences by WG will occur:

- <u>Influence</u> of the Audience	-	Ability to "change behavior"
- <u>Power</u> of the Audience	-	Resources to "change behavior"
- <u>Momentum</u> of the Audience	-	Eagerness to "change behavior"
- <u>Reach</u> of the Audience	-	Effectiveness to "change behavior"

Upcoming State-wide and region-wide initiatives to possibly connect to:

- PCSGA communication planning
- Oregon Coast Aquarium messaging of exhibits and new summer intern
- Legislative session with the "Ocean Bill" – comprehensive funding for ocean projects
- Regional trade association meetings (e.g., West coast seafood processes)

Proposed Projects (or side projects) for the WG:

- Fisheries round table
- "State of OAH" workshop
- Resources and materials for the economic impacts of OAH
- Oregon specific impacts of OAH on marine species

Follow-up information for the next meeting:

- ONREP documents– Informal Environmental Education Network
  (Documents will be shared via email)

OAH Council – Education and Outreach Working Group
Meeting Summary: 05/27/2020

Working Group Members: (Present)

Caren Braby	*(Oregon Department of Fish and Wildlife, Marine Program Manager)*
Shelby Walker	*(Oregon Sea Grant, Director)*
Fran Recht	*(Pacific States Marine Fisheries Commission, Habitat Program)*
Susan Chambers	*(The West Coast Seafood Processors Association, Director)*
Francis Chan	*(Oregon State University, Associate Professor)*

Working Group Members: (Absent)

Jack Barth	*(Oregon State University, Marine Studies Initiative Director)*
Tracy Crews	*(Oregon Sea Grant, Marine Education Program Manager)*
Kerry Carlin-Morgan	*(Oregon Coast Aquarium, Director of Education)*
Sara Bywater	*(Pacific Coast Shellfish Growers Assoc., Outreach and Projects)*
Margaret Pilaro	*(Pacific Coast Shellfish Growers Assoc., Director)*
Charlie Plybon	*(Oregon Surfrider, Policy Coordinator)*

Working Group Staff:

Charlotte R. Whitefield	*(Oregon Department of Fish and Wildlife, OAH Council Staff)*

Key Topics: Short term and Long term planning

General Updates:

- Legislative session with the "Ocean Bill" – comprehensive funding for ocean projects
  - SB 1554 did not pass 2020 short session
- NOAA OA Small grant opportunities
  - Oregon Sea Grant and Surf Rider both did not submit due to COVID related timing issues
- Hatfield Marine Science Day and Oregon Coast Aquarium Table Display
  - Both canceled due to social distancing
- Unlikely that OWEB will be granting in 2020 due to State lottery and general fund shortfalls
- Oregon Coast Aquarium MSI sponsored OA summer internship and OA messaging development
  - Timing TBD based on COVID related social distancing and project holds

Concerns of the WG: Navigating the "New Normal"

- Concerns with too many or too strong of "Asks" to get attention or funding in a time like this.
- Interest for the WG to entering into a planning period instead of an action period.
- Need to consider reframing the issue of OAH communication and renege audiences for the for the "long haul"
- Need to figure out how to best get audience's attention – what is the urgency of OAH in light of basic needs of communities in a recession.

General Ways to engage*:* Tie the issue into issues of today

Tactics:

- Science and research as a tool for change
- Positive communication styles – fact driven and empower personal change
- Messages need to have a clear need and pathway for "what could be done"
- Make connections to COVID and the new normal

Concepts:

- Food security = local protein and local access
- Blue jobs and Blue economy
- Frame as self-resiliency = fundamental resilience and stainability of communities
- Environmental health and climate change
- Resources and materials for the economic impacts of OAH
- Issues with how to make stories less messy – not a clear of an OA story with other species
    - Ocean change (multi-driver systems)
    - Political stability
    - International markets

Short Term Planning (Opportunities for 2020):

Fisheries round table:

- Sea Grant Conference Support (Application will be submitted ASAP) - Funding to support conference and messaging content to create outreach materials
- Interest in making the roundtable interactive with highlights from researchers who actively collaborate with the fishing communities.
- Interest in having visual/audio messaging instead of just printed materials
    - Interest in pushing the OA story out of just the oyster industry
    - Targeted people – crab, shrimp, learn their stories along-side new research
    - Capture Fisherman's stories
        - Capitalize on antidotes, stories, visuals,
        - Person to person stories and engagement

State of the Coast workshop – OAH Breakout session:

- 2020 State of the Coast - OAH Breakout Session (Proposal submitted - May 15th)
- Format and platform for the workshop will likely be changing in light of COVID – information will be provided to breakout session submitters in coming weeks.

Long Term Planning

- General Timeline was approved by the working group
- Need to focus efforts in light of limited resources – work flow TBD in coming weeks

Follow-up information for the next meeting:

- Contact - Flaxan Conway (OSU/Oregon Sea grant) about her past work on the 2016 Fisherman's round tables and her past project working with a video team to capture regional fisherman's stories.
- Contact – Dr. Francis Chan / Dr. Jack Barth (Both OAH WG members) about their NOAA CHERP grant which has some funds to work on outreach, and the possibilities for collaboration on video outreach at the 2020/2021 fisherman's roundtables.

OAH Council – Education and Outreach Working Group
Meeting Summary: 08/05/2020

Working Group Members: (Present)

Caren Braby	*(Oregon Department of Fish and Wildlife, Marine Program Manager)*
Shelby Walker	*(Oregon Sea Grant, Director)*
Fran Recht	*(Pacific States Marine Fisheries Commission, Habitat Program)*
Susan Chambers	*(The West Coast Seafood Processors Association, Director)*
Francis Chan	*(Oregon State University, Associate Professor)*
Tracy Crews	*(Oregon Sea Grant, Marine Education Program Manager)*
Kerry Carlin-Morgan	*(Oregon Coast Aquarium, Director of Education)*
Margaret Pilaro	*(Pacific Coast Shellfish Growers Assoc., Director)*

Working Group Members: (Absent)

Jack Barth	*(Oregon State University, Marine Studies Initiative Director)*
Sara Bywater	*(Pacific Coast Shellfish Growers Assoc., Outreach and Projects)*
Charlie Plybon	*(Oregon Surfrider, Policy Coordinator)*

Working Group Staff:

Charlotte R. Whitefield *(Oregon Department of Fish and Wildlife, OAH Council Staff)*
Carlos Avendano *(Marine Studies Initiative Summer Intern)*

Key Topics: Outreach Materials Development

General Updates:

- Marine Studies Initiative Summer Fellow currently working with the OAH Council until 09.05.20
- OAH Council Staff have been awarded a COMPASS leaders of sea change fellowship for science communication – this will be an opportunity for the OAH Council and working group to have regional experts help shape outreach materials.
- The OAH Council was awarded a $2,000 conference assistance grant to fund the 2021 Fishermen's Roundtable.

OAH Council 2020 Legislative Report – Theme 4 section review

- Working Group members were provided with a draft Education and Outreach section for review by 08.13.20
- No edits were received by working group members at the meeting

Outreach Materials Development: Document Translation

- Identified a need to translate OAH outreach materials into other languages – especially Spanish
    - Large portion of the Oregon population is Spanish speaking – such as within seafood processing and the aquaculture/fishing labor force.
    - The OAH Council currently does not have any materials translated into other languages; Summer intern is fluent in Spanish and has offered assistance.
    - OAH Action plan executive summary and take action documents have already been translated by the summer intern.
- Discussion tense of translations – informal "tu" verse formal "usted"
    - Within Spanish language there is a generational and situational use of the word you, which will need to be considered in OAH outreach documents
    - No decision was reached on which to use, but further will be done by staff and the intern into what other regional groups use.
- Discussion on use of "You" verse "You" plural verse "we"
    - Within the Spanish language there are many ways to speak directly to a group of people.
    - Working group members want to keep outreach materials referencing "you" as the subject, to keep messages targeted and personal to the reader.

Outreach Materials Development: New Document / Materials Development

- Need to create new Hypoxia focused outreach one-pagers was discussed
    - The summer intern will create new materials. At least two documents were proposed: General what is Hypoxia, Industry focused Hypoxia impacts.
    - New materials will be translated into Spanish
    - Council does not currently have a specific Hypoxia focused materials
- Creation of video or podcast materials for communication of OAH impacts
    - Topic was brought up at the last working group meeting as a way to reach Oregonians in a more personal way
    - Dr. Francis Chan mentioned that his recent CHRP grant has allocated a decent amount of money for the development of a new video focused on hypoxia research.
        - Expected start date for filming is 2022/2023.
        - Working group will be working the Dr. Chan to see if there is any assistance we can provide with messaging or content for the video.
        - Exploring the possibility of this effort considering with the 2021 fisherman's roundtable.
- Creation of a survey tool to help guide further OAH working group efforts.
    - Topic was briefly discussed and Working group staff and summer intern will explore this further and provide an update to the group at the next meeting (09.23.20).

Long Term Planning

- Interest by the working group to focus on strategic planning and implementation planning at the same time – working towards a longer term larger goal while making progress on actionable steps forward now
- Staff proposal will be presented to the working group members at the 09.23.20 meeting to help guide conversations about next steps for the working group.

APPENDIX I

Governor Brown's Letter of Commitment to OAH Action

The Oregon Coordinating Council on Ocean Acidification and Hypoxia

SECOND BIENNIAL REPORT APPENDICES

KATE BROWN
Governor

August 19, 2019

Dear fellow members of the International Alliance to Combat Ocean Acidification:

With this letter, Oregon hereby presents the Ocean Acidification and Hypoxia Action Plan, as developed by the Oregon Ocean Acidification Coordination Council. Oregon endorses the Alliance's Global Call to Action, and commits to advance key goals that:

- Advance scientific understanding of ocean acidification.
- Reduce the causes of acidification.
- Protect the environment and coastal communities from the impacts of a changing ocean.
- Expand public awareness and understanding of acidification.
- Build sustained support for tackling this global problem.

This action plan is intended to provide guidance and policy directives to state agencies and local governments on the frontlines of combatting ocean acidification and hypoxia. I urge state agencies to consider and integrate the relevant recommendations within Oregon's Ocean Acidification and Hypoxia Action Plan into current management strategies by:

- Evaluating potential management and data gaps for ocean acidification and hypoxia,
- Incorporating funding needs for ocean acidification and hypoxia into 2021-2023 budgeting, and
- Promoting intra-agency communication and collaboration on projects and actions identified in the action plan.

Oregon is proud to submit our Ocean Acidification and Hypoxia Action Plan, and looks forward to leveraging current and future partnerships to combat the impacts of climate change on our lands, oceans, and people.

Sincerely,

Kate Brown

Governor Kate Brown

GKB:jm,kl

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