The Oregon Coordinating Council on Ocean Acidification and Hypoxia

THIRD BIENNIAL REPORT

September 15, 2022

Submitted by the Oregon Coordinating Council on Ocean Acidification and Hypoxia

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Letter from the OAH Council Co-Chairs

Over the past four and a half years, the Oregon Coordinating Council on Ocean Acidification and Hypoxia (OAH) has been implementing the legislature's vision of this Council, serving as a diverse stakeholder group that provides science-based recommendations to the State about our changing ocean. The legislature prioritized the creation of this Council after years of emerging problems related to OAH in the oyster aquaculture industry and a growing recognition of similar problems facing many of our wild stocks. The ocean is an integral part of Oregon's past, present and – with care – our future, as a source of food, recreation, solace, economic and cultural identity, and vitality. We benefit from maintaining healthy coastal habitats, the ocean intimately shapes the inland climate, moderates drought and extreme heat, and can help buffer against storm waves and tides. Yet, the ocean is showing signs of impacts related to fossil fuel combustion, elevation of carbon dioxide in the atmosphere, and the resulting broad impacts on weather, ocean conditions, temperature, and productivity. The various symptoms are complex, but we know that ocean acidification and hypoxia (low oxygen) are both profound elements of the big picture. The OAH Council's work to understand and strategize how to address these problems is timely, the importance also increases year-by-year, as we learn more about the challenges facing us and the need to adapt to change and build resilience for future generations.

Certainly, this report is a retrospective on the OAH Council's work over the past two years, as requested by the legislature in our origin legislation, Senate Bill 1039. It is also an interim report, providing an update on Oregon's implementation of the Oregon OAH Action Plan, adopted in 2019 (***Appendix A***). Importantly, this report is a communication tool between the OAH Council and the public, sharing the status, stories, and progress on adaption, mitigation, and ocean change resilience efforts. Our public is not only Oregonians, but also the region, the nation and the international community that are likewise concerned with and working to find solutions to the changes we face globally. The United States' recent decisions to re-join the Paris Accord and to become a member of the International Alliance to Combat Ocean Acidification (OA Alliance), reaffirm that the problems we see in Oregon are concerning at the highest levels of government. Lastly, this report is an important refocusing document for the Council, highlighting what we have achieved, and what we have still to do in implementing the 2019-2025 Action Plan.

We have achieved much over the past two years, including these highlights:

- ***Improved understanding, by convening scientific experts on OAH***
- ***Improved monitoring regionally, by facilitating the installation of equipment in Oregon, and coordinating with regional partners on the West Coast monitoring network***
- ***Raised awareness about problems and solutions by participating in and convening workshops, roundtables, and conferences, notably including the fishing community***
- ***Coordinated within the State agency family on authorities and strategic planning related to climate and ocean change***
- ***Provided leadership in the State and with other governments on OAH policy, science, and action***
- ***Operationalized House Bill 3114 (2021) funding for 11 different projects in science, monitoring, and communications, in collaboration with the Oregon Ocean Science Trust***

Yet, we have much to do. With three years remaining in our 6-year Action Plan, we will continue to implement the priorities of the legislature and Council, as we have the ability and resources to do so. OAH will be a challenge for decades to come, making the institutionalization of adaptive resilience and mitigation a critical short-term goal for fisheries, aquaculture, coastal communities, and resource managers. Durable funding and capacity are needed to fully integrate the recommendations into the work of agencies and partner organizations.

Serving as Co-Chairs of this Council is a sobering responsibility that we take very seriously. We are grateful for the opportunity to build a brighter future for Oregon.

Sincerely,

Laurie Juranek, PhD

Associate Professor
College of Earth, Ocean, and Atmospheric Sciences
Oregon State University

Caren Braby, PhD

Marine Resources Program Manager
Oregon Department of Fish and Wildlife

House Bill 3114

*On June 22, 2021, the Oregon legislature passed House Bill (HB) 3114 (**Appendix B**), representing a historic investment in Oregon's efforts to combat ocean acidification and hypoxia. With some direct appropriations to existing work groups at Oregon State University and Oregon Department of Fish and Wildlife, the bulk of the $1.9 million, one-time investment, was distributed through competitive grants led by the Oregon Ocean Science Trust (OOST). This was the first OOST "request for proposals" or RFP process, since the Trust was created by the legislature in 2013. All projects funded by the legislation were identified in the 2019-2025 Oregon OAH Action Plan (**Appendix A**), and are particularly aligned with outcomes in three of the five Action Plan thematic areas:*

Theme 1: Ocean and Estuarine Monitoring
Theme 3: Adaption and Resilience – Applied Research and Management
Theme 4: Raising Awareness – Communications Planning for OAH

More specifically, the projects are designed to advance scientific understanding of OAH impacts, mitigate the effects of OAH on Oregon's coastal resources and community livelihoods, and increase community understanding of these changes and threats, so Oregonians can best adapt to changes that are already occurring. Each of the funded projects are described in this report (*pages 10-19*).

As specified in HB3114, the OAH Council worked closely with the OOST over a nine-month period to design and run the inaugural grant program, with all awards announced in April 2022 for work that will continue through 2024. During the grant period, the OAH Council will meet with grantees and showcase their ongoing work in public venues, as their work progresses. For more information on the specific projects and teams doing this work, see the Ocean Science Trust website: ***oregonoceanscience.com***

Executive Summary

3rd 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 experience the direct impacts of ocean acidification and hypoxia (OAH). Hypoxia (low oxygen) events are now predictable each summer. The steady increase in acidification is approaching or meeting levels that are problematic not only for oysters, but for crab, mussels, urchins, salmon, rockfish, and other species that Oregonians care deeply about. Since its creation in 2017, the Oregon Coordinating Council on OAH has worked to understand, mitigate, adapt to, communicate, and strengthen Oregon's response to these changing ocean conditions and associated negative impacts (***Figure 1***).

Over the last two years, the Council invested significant time on two objectives: 1) exploring the ability of state agencies to address ocean change, as described in the ***Multiagency Report on OAH (2021)*** and 2) awarding funding per the ***Oregon legislature investment in OAH through House Bill 3114 (2021)***. The Multiagency Report outlines the existing authorities, roles, and potential contributions for eight of Oregon's state agencies that have a nexus with ocean change management. Passage of HB3114 marked the largest Oregon legislative investment in OAH initiatives as well as the first funding to be received by the Oregon Ocean Science Trust (OOST) for distribution through a competitive grants program. The projects funded by HB3114 have been OAH Council priorities since its inception (as described in the 2018 Report to the legislature); the OAH Council collaborated closely with the OOST to help create the grants program and ensure that rigorous projects, aligned with Oregon's needs, were funded.

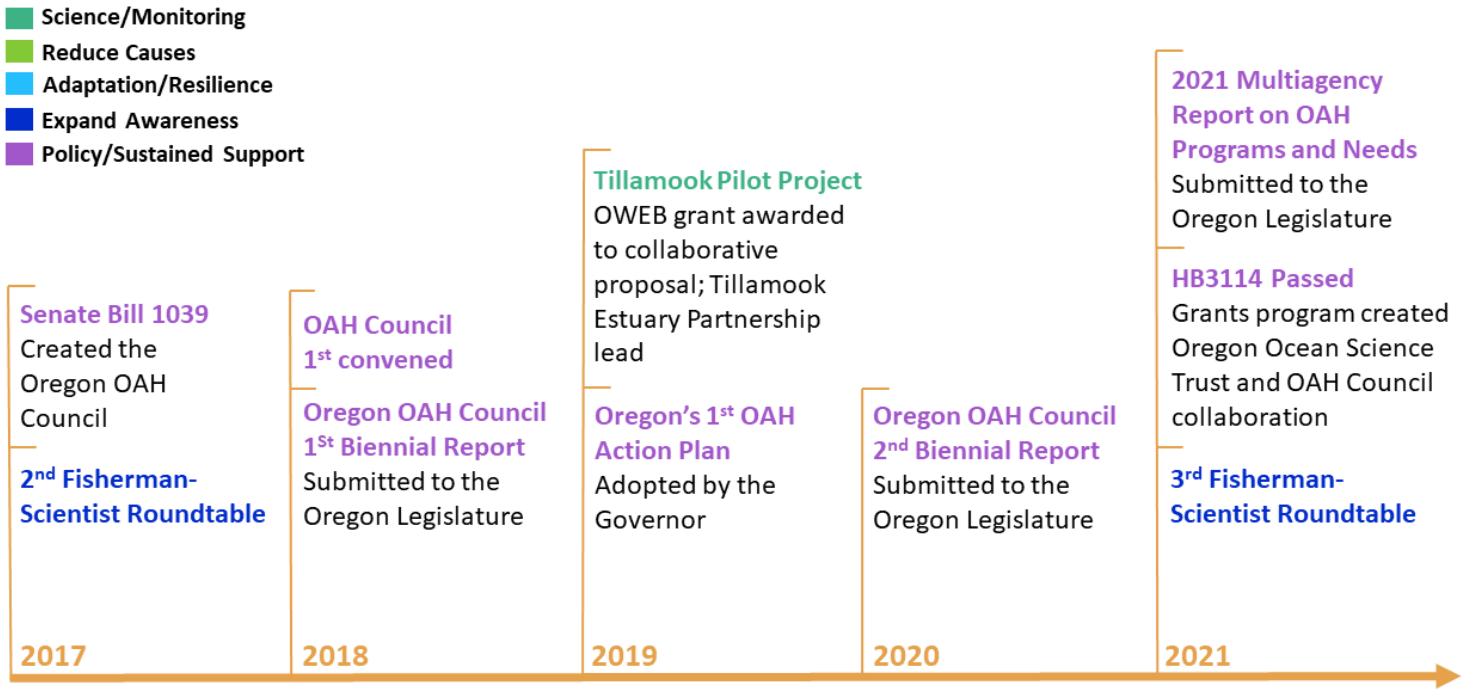
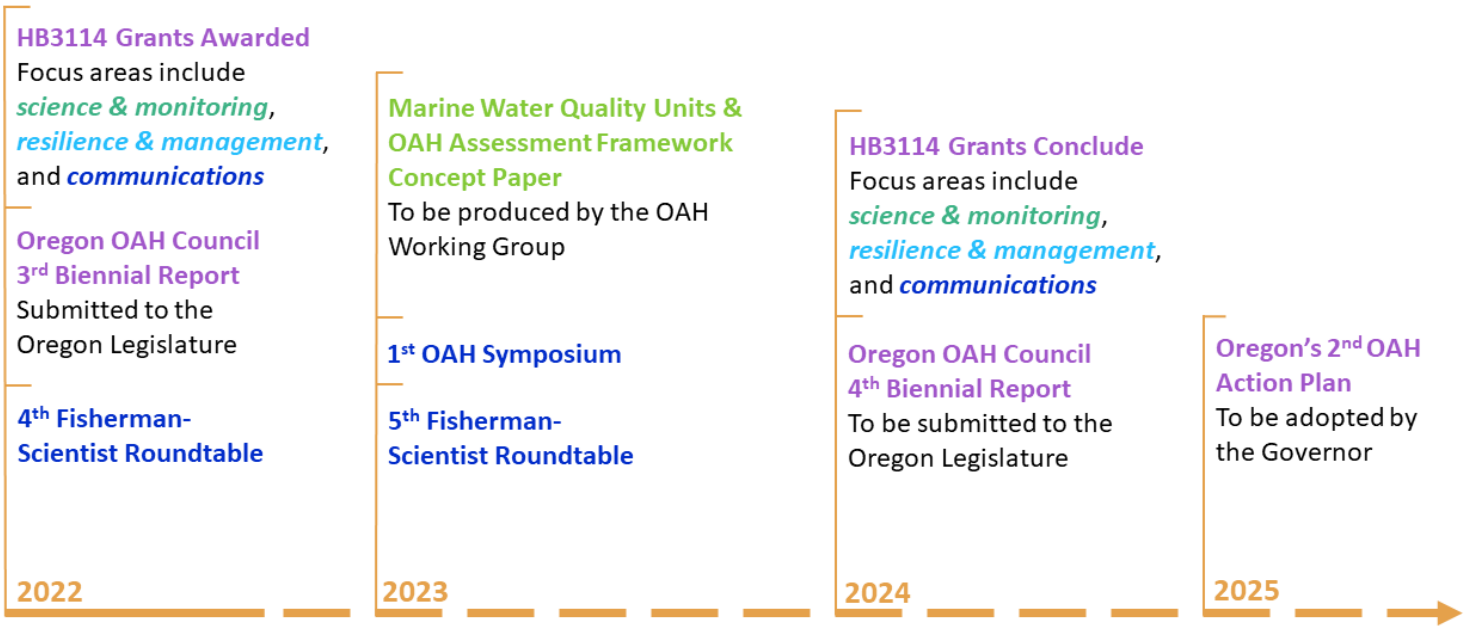


Figure 1. *Timeline of events since the Oregon OAH Council was created in 2017, as planned through 2025.*

HB3114 provided an unequivocal leap forward in facilitating the achievement of multiple benchmarks recommended by the OAH Council, and the Council has made significant progress in achieving other Action Plan goals. Of critical importance, the OAH Council has played a key role in building up Oregon's OAH monitoring network to document ocean trends (with a goal of distinguishing between natural variability and long-term change), which will in turn will be used in ocean management. Over the last four years, the OAH Council has helped establish monitoring programs in two of Oregon's most important bays, Tillamook and Yaquina, standing by the leadership from the partner institutions who founded these sites, the Tillamook Estuary Partnership and Hatfield Marine Science Center. Supported by competitive grant awards from the Oregon Watershed Enhancement Board (OWEB) and the OOST (from HB3114), these two sites now have a solid foundation and start of a long-term monitoring program, although both are in need of long-term funding to continue. **These long-term monitoring investments by the State will provide vital information about changes in Oregon's coastal ecosystems.**

Additionally, the OAH Council continues facilitating events to increase collaboration between fishermen, who are out on the water every day, and scientists, who have the academic skills to rigorously document change. Convening fisherman-scientist roundtables, hosting OAH sessions at conferences, and building a pilot project communications app (for mobile devices) to connect fishermen and scientists are contributions by the OAH Council, helping raise awareness and fostering collaboration. Over the next two years, the OAH Council will continue with these and other projects aimed at improving monitoring, awareness, and collaboration. The Council will work to achieve best outcomes from HB3114-funded projects, working closely with the OOST grant recipient that is tasked with creating an Oregon OAH Communications Plan. To highlight OOST project results and synergies, the OAH Council will also initiate and host an annual OAH symposium. As the next two-year period draws to a close, the OAH Council will look further in the future and start strategic planning for Oregon's 2nd OAH Action Plan (2025-2031). **These coordination efforts will lead to better-informed science and solutions to OAH impacts, while communications and planning efforts will keep Oregon moving forward and making progress on changing ocean conditions, preparing Oregon for the future.**



How is the ocean affected by CO_2?

The ocean covers more than 70% of the planet and is essential to the planet's climate, productivity, human survival, and livelihood (***Figure 2***). The ocean absorbs and accumulates carbon dioxide (CO_2) and heat from the atmosphere, causing chemical and thermal changes. When dissolved in seawater, CO_2 undergoes a chemical reaction that lowers the pH (making it more acidified). This has been shown to disrupt shell formation in some calcifying organisms, including well-known species like oysters and crabs, and lesser-known species such as sea butterflies ("pteropods"). Previously considered to be periodic or rare, hypoxia events are now part of our annual patterns and observations – like wildfire seasons on land – and may be increasing not only in frequency but also in severity. These events are a particular focus of current scientific research due to the potential impacts on some of Oregon's most commercially important species, like crab and halibut. These simultaneously occurring processes (OA and H) are inextricably linked and represent collectively a multiple stressor challenge for marine species, ecosystems, and human communities.

*Since the industrial revolution, there has been a **1.1 trillion-ton increase in atmospheric CO_2** from fossil fuel combustion with a global atmospheric temperature increase of 2° Fahrenheit (1° Celsius). The Oregon Governor and legislature have both taken steps to set greenhouse gas emission reduction goals. Relative to 1990 levels, these goals currently aim for a 45% reduction by 2030, and 80% reduction by 2050. Under existing policies, Oregon's current trajectories are **not on track with the State's GHG emissions reduction goals**.*

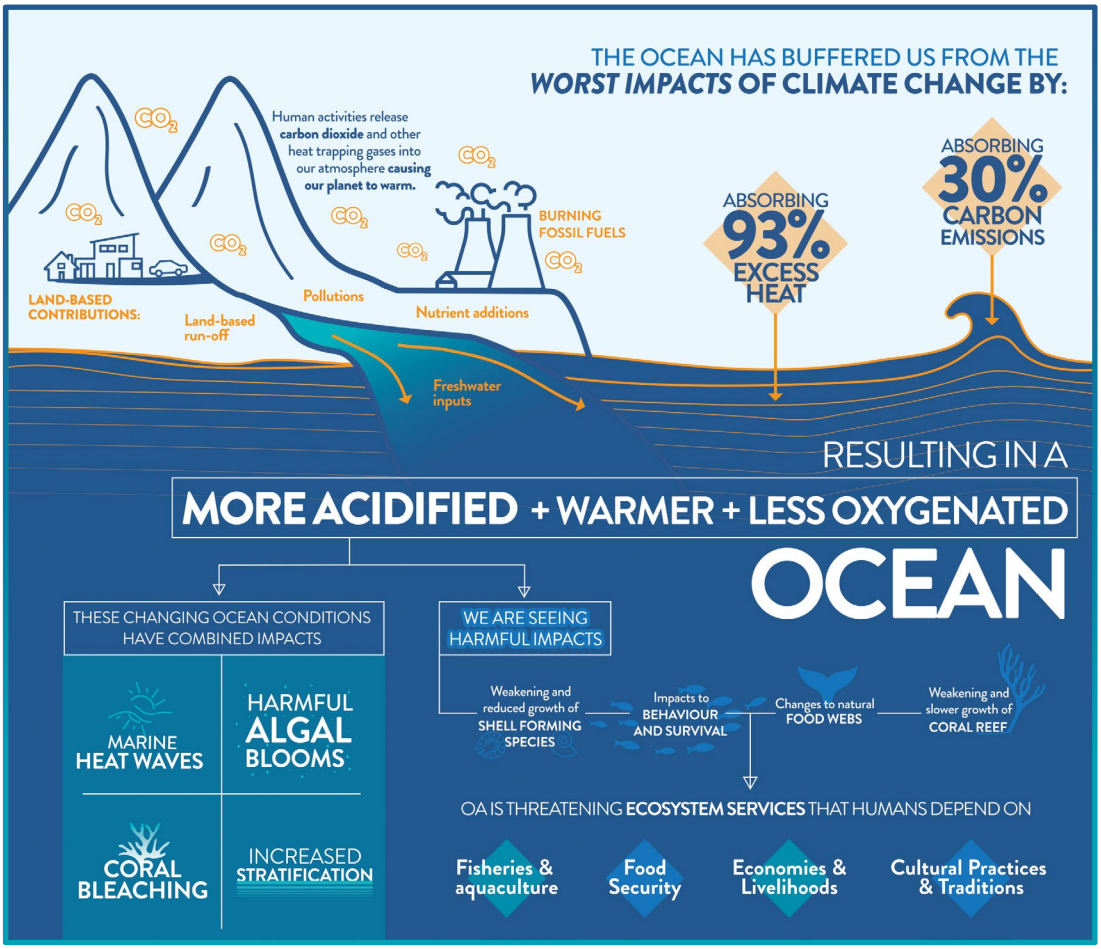


Figure 2. *Global impacts of ocean acidification on the marine environment, highlighting the climate relationship between the ocean, land, and atmosphere.* *Graphic Credit: sourced from the OA Alliance.*

Oregon's OAH Action Plan & achievements

Adopted by Governor Brown in 2019, Oregon's OAH Action Plan is a 6-year roadmap that outlines the State's efforts to address OAH from 2019-2025 ***(Appendix A)***. As a founding member, Oregon submitted the Action Plan to the International Alliance to Combat Ocean Acidification (OA Alliance), demonstrating to the international community how local actions are beneficial and can support the global efforts of combating climate and ocean change.

During the past two-year period, the Council completed or facilitated achievement of numerous benchmarks recommended by the Council in the 2020 Biennial Report. ***Figure 3*** **summarizes the five thematic areas of the Action Plan, with details of the Council's successes in the last two years in facilitating OAH** ***science & monitoring*****,** ***reducing causes*****,** ***adaptation & resilience*****,** ***awareness*****, and** ***building support*****:**

1) Advance scientific understanding to address OAH vulnerabilities

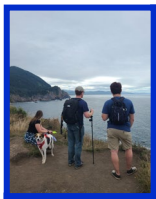
- Catalyzed and secured long-term OAH monitoring in Tillamook Bay through regional collaboration
- HB3114 funding secured to co-locate OAH monitoring in existing marine reserves
- HB3114 funding secured to establish a long-term OAH monitoring station in Yaquina Bay

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

- Supported OAH criteria development for ocean waters and other ongoing Water Quality Assessment work by DEQ
- Contributing authors to the 2021 Oregon Climate Change Research Institute Report

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

- Built academic-resource management partnerships to explore the role of submerged aquatic vegetation in ecosystem resiliency to OAH impacts
- HB3114 funding secured to develop best management practices in OR estuaries and shellfish industry, to support coastal resilience



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

- Convened fisherman-scientist roundtable events targeting at-risk communities and industries, creating opportunities for collaborative research
- HB3114 funding secured to build Oregon communications plan, on OAH impacts and solutions for Oregonians

5) Build sustained support and mobilize agencies to address OAH

- Completed a multi-agency assessment of opportunities to address OAH within existing regulatory and management frameworks. (Submitted to the legislature February 2021)
- Operationalized HB3114 grants program with OR Ocean Science Trust

Figure 3. *Diagram summarizing the Oregon OAH Action Plan themes (2019-2025), and Oregon's achievements over the last two-year period (2020-2022).*

Implementing the OAH Action Plan

Theme 1: Advance Scientific Understanding

Action: Invest in Oregon's monitoring network to document oceanographic and biological conditions, and the socio-economic vulnerabilities relating to ocean acidification and hypoxia (OAH)

Strategic enhancement of the State's robust ocean monitoring network will help us better track the extent and severity of ocean change at a local level. While global monitoring efforts are helpful in understanding large-scale change, they are not useful in telling us how severe ocean change is in one area of Oregon compared to another. However, we know that there are differences within Oregon, and a monitoring network will help us quantify differences and identify areas that are most vulnerable to and at risk from ocean change. Additionally, data from a strong monitoring network will help us better understand the causes as well as predict the frequency and severity of changing ocean conditions. Fostering a greater understanding could be important in focusing management decisions and resources in the places that most need it. Predictions of oceanic change and effective management responses will only be possible if we sufficiently understand OAH trends.

In the recent past, monitoring of changing ocean conditions has led to key management outcomes at the local scale. For example, in 2007, Oregon's Whiskey Creek Shellfish Hatchery and Oregon State University researchers worked hand-in-hand to discover why larval oysters were failing to grow. Monitoring led to the understanding that ocean acidification was the root cause and directed hatchery management practices to mitigate acidified waters. This partnership created practical solutions for continuing successful oyster hatchery production in the face of increasingly acidified conditions of Oregon's ocean waters.

Current Project Highlights

Intertidal ocean acidification monitoring in Oregon's marine reserves (OAH Action Plan Step 1.1)

To address the need for increased OAH monitoring, this project aims to better understand where and for how long OA events will persist under different climate conditions in intertidal regions. It also documents changes in the chemical state of the ocean and connectiveness between the inner continental shelf and the intertidal zone in different coastal regions**.** State support now means that Oregon has the longest record of intertidal OA exposure on the West Coast. This is enabled by a network of coastal residents who work directly with OSU researchers to keep up with observations and make Oregon's marine reserves a legacy resource for detecting, tracking, and communicating changes in our coastal ocean. **This research will foster a greater understanding of sense of place, ocean change, and its status in marine reserves as well as leverage existing research investments in marine reserves.**

Francis Chan (OSU), HB3114-OOST Project 1 (2022-2024)

Subtidal OAH monitoring in Oregon's marine reserves (OAH Action Plan Step 1.1)

Long-term monitoring data from Cape Perpetua Marine Reserve has served as a backbone of OAH observations in Oregon. This project continues decade-long monitoring efforts in the region by sustaining crucial time-series observations of OAH throughout Cape Perpetua. The researchers will develop a community supported OAH monitoring program by engaging fishing industry partners and utilizing existing partnerships and technology from the National Oceanic and Atmospheric Science Administration (NOAA) and awards from the National Science Foundation. State support has been essential and timely as dissolved oxygen levels dropped precipitously in August 2022, resulting in reports of Dungeness crab mortality from fishermen. State support has also resulted in expanded partnerships with Oregon's commercial fishermen who deployed sensors in waters adjacent to marine reserves that are providing crucial observations. **Aiming to increase OAH monitoring across the State, these efforts set the precedent for long-term OAH monitoring across Oregon's marine reserves.**

Francis Chan (OSU), HB3114-OOST Project 2 (2022-2024)

Enhanced OAH sampling on the Newport Hydrographic Line (OAH Action Plan Step 1.2)

The Newport Hydrographic Line (NHL) is a series of oceanographic sampling locations that run west from Newport, Oregon, where a NOAA-OSU collaboration has been collecting chemical, physical, and biological information for over 20 years, sampling every two weeks. This project leverages a long-standing federally (NOAA) supported ocean survey program at OSU's Cooperative Institute for Marine Ecosystem and Resources Studies to enhance a crucially needed understanding of how OAH will affect the coastal-ocean food web. Oregon's coastal-ocean food web sustains the growth of high value species such as juvenile salmon and larval Dungeness crabs. State support through HB3114 will enhance OAH monitoring at the NHL, augmenting observations of the coastal-ocean food web in concert with measurements of changing ocean conditions. These enhanced observations will also be valuable in the State's efforts to define water quality criteria and assess future impairment. **This project leverages Oregon's collaborative marine research community to understand and plan for a more resilient coastal ocean.**

Francis Chan (OSU), HB3114-OSU Project 1 (ongoing)

Hatfield Marine Science Center climate monitoring station (OAH Action Plan Step 1.1)

This project is focused on collecting a series of oceanographic data from Yaquina Bay, Oregon including climate-grade temperature, salinity, dissolved oxygen, turbidity, conductivity, total algae, chlorophyll a, CDOM, pCO_2, and TCO_2 time series data. These data will be collected at the newly constructed Hatfield Marine Science Center (HMSC) Climate Monitoring Station and shared near real-time via a public exhibit in the Oregon Sea Grant Visitor Center. Necessary oceanographic monitoring instrumentation has been ordered with a goal of having them on hand by the fall of 2022, with a space designed and designated specifically for collecting OA data. The research team is in the process of devising ideas for the public exhibit, developing communication strategies, and discussing ways to incorporate an OAH theme into other HMSC visitor center exhibits. **This project establishes a long-term OAH monitoring station in Yaquina Bay, a high-priority to strengthen Oregon's monitoring network, and will expose the public to scientific data collected in real-time through the HMSC visitor's center.**
Bob Cowen (OSU), HB3114-OOST Project 3 (2022-2025)

Evaluating the interaction of water quality and eelgrass in Coos Bay, Oregon using a biophysical model (OAH Action Plan Step 1.2)

Oregon's bays are where river and ocean waters meet, mix, and create a special ecosystem that provides habitat and nursery grounds for many species. Rich eelgrass beds are particularly important and are thought to provide protection from changing ocean conditions and buffer from physical storms and chemical extremes. This project builds on previous research, using existing and publicly available data to develop a biochemical ecosystem model that will explore the interaction of ecological and hydrodynamic factors in delivering or mitigating OAH vulnerabilities. Once the model is developed and validated, eelgrass vulnerability to OAH, the potential future absence of eelgrass, and resulting OAH extremes in response to climate change will also be explored. **The results of this project will help us understand the interactions among OAH vulnerability, eelgrass abundance, climate change, and hydrography of Coos Bay**.
Tarang Khangaonkar (University of Washington), HB3114-OOST Project 4 (2022-2024)

Estuary shellfish and habitat surveys (OAH Action Plan Step 1.2)

Often, Oregon's estuaries include ports that act as cultural and economic centers on the coast. They are productive and beloved habitats that support recreational activities, fishing and mariculture, and nursery grounds for many species. The ODFW Shellfish and Estuary Assessment of Coastal Oregon (SEACOR) team was established in 2008 to document the shellfish and habitat of Oregon's estuaries and has been actively assessing these areas since. This additional one-time funding allows the team to double its effort during the 2022 field season, increasing the frequency of assessments and providing timely data during the current legislatively created Tillamook Bay clam management process (Senate Bill 1025; 2019). Under routine funding levels, the team is able to visit each of Oregon's estuaries once every ten years to conduct clam stock assessments and eelgrass bed mapping. **This project bolsters a long-term data series, including both biological and oceanographic measures in Tillamook Bay, one of Oregon's highest-priority locations for understanding ocean change.**
Tony D'Andrea (ODFW), HB3114-ODFW Project 1 (2022-2023)

Ocean acidification monitoring at Whiskey Creek Shellfish Hatchery (OAH Action Plan Step 1.1)

After massive losses of young oysters by mariculture businesses in 2007, a collaboration between Whiskey Creek Shellfish Hatchery and Oregon State University revealed that acidified waters, not disease as originally suspected, was to blame. Coastal waters are used by shellfish hatcheries to rear young oysters, but these waters are becoming too corrosive for this delicate life stage. This necessitates careful monitoring and adjustment of water conditions in rearing tanks. In 2009, Dr. Burke Hales developed the "Burke-O-Lator." This instrument measures pCO_2 and dissolved inorganic carbon (DIC) at oyster hatcheries, such as the Whiskey Creek Shellfish Hatchery (WCSH), so that they can carefully control water chemistry in their facilities. HB3114 supports the ongoing long-term monitoring efforts at WCSH, including system maintenance, water sampling, and data analysis. To date, WCSH appears to be experiencing some of the highest observed CO_2 levels since monitoring began. **OA monitoring at WCSH is critical in order to maintain adequate water quality in the facility, to avoid problems previously experienced, and to support the continuation of Oregon's production of juvenile oysters.** *Burke Hales (OSU), HB3114-OSU Project 2 (ongoing)*

Ecological spotlight: Submerged aquatic vegetation (SAV)

What is SAV?

SAV are rooted aquatic plants and seaweeds that grow underwater such as flowering seagrasses or kelp. On the Oregon coast, eelgrass beds are found throughout the State's 22 major estuaries, while kelp forests form in cold, nutrient-rich water along the coast.

Why are SAV important?

SAV can provide water quality benefits, cultural resources, shoreline protection, nutrient cycling, and habitat that promotes biodiversity. Eelgrass beds serve as nursery habitat for many of Oregon's commercially important species of fish and shellfish. Kelp forests support a range of species, from small zooplankton and forage fish to large marine mammals and seabirds. One acre of SAV is estimated to house up to 40,000 fish and 50 million invertebrates.

What are the threats to SAV?

A reduction in SAV habitat imposes additional challenges to the resilience of Oregon's coastal marine ecosystems. Major contributors to the decline in SAV include climate change, warming water, harmful algal blooms, sea level rise, sedimentation, pollution, coastal development, and predator loss in the kelp forests.

How do SAV interact with OAH?

Considered an important source of "blue carbon", these aquatic plants absorb CO_2 and release oxygen through photosynthesis. ***Promoting the restoration of SAV may serve as an important natural buffer against extreme ocean change and increase coastal resilience and sustainability.***

Implementing the OAH Action Plan

Theme 2: Reduce Causes

Action: Develop and integrate strategies to reduce causes of excess carbon dioxide (CO_2) and ocean acidification and hypoxia (OAH)

Oregon is developing frameworks for action that reduce causes and co-stressors of OAH. It is a long-term goal of the OAH Council and the State of Oregon (per Executive Order No. 20-04 and Senate Bill 1025) that Oregon reduce CO_2 and greenhouse gas emissions and stressors to create a pathway towards a sustainable future. Governing bodies have committed to reducing causes of excess CO_2 and OAH through the development of policy initiatives that reduce greenhouse gas emissions while improving air and water quality. For example, the State is phasing in the implementation of clean fuel standards and clean fuel credits for electrification and is considering other ways to decrease our reliance on fossil fuel combustion. Efforts to reduce OAH impacts are integral to the health of coastal industries, such as tourism and fisheries, given that Oregon's natural resources are heavily dependent on the health of coastal and inland systems.

Current Project Highlight

Clean Water Act water quality program & criteria development (OAH Action Plan Step 2.2, 2.3)

Per the Federal Clean Water Act (CWA) responsibilities, the Oregon Department of Environmental Quality (DEQ) is required to assess the condition of Oregon's waters and document water quality in the biennial Integrated Report, filed with the U.S. Environmental Protection Agency. In the 2020 Integrated Report, DEQ listed Oregon territorial (coastal) waters as an area of potential concern (category 3B) for ocean acidification and for hypoxia. A category 3B listing indicates that there is cause for concern, but either data and/or methods to assess data are insufficient to determine impairment.

Since that time, and consistent with publicly-vetted agency workload priorities, DEQ formed a technical workgroup to assist with developing science-based methodologies for assessing both ocean acidification and hypoxia. The technical workgroup is comprised of researchers from academic and scientific institutions, agency staff from USEPA, ODFW, and other subject matter experts who are recommending the appropriate and most meaningful metrics to employ for assessing potential water quality impairments. The OAH Council played an important role in identifying this work as a priority, assisting with identifying technical group participants, securing a Sea Grant fellow to support the workgroup, and participating on the technical group. Based upon input from the technical workgroup, DEQ will conduct a separate peer review process of the draft methodologies and also consider peer review comments in its adoption of new or revised assessment methodologies for future Integrated Reports.

Developing OAH water quality criteria and assessment methodologies are critical management tools for Oregon to accurately assess, adapt to and/or mitigate ocean change. Multi-state and multi-agency participation in this process is likely to provide an important model for other states engaging in similar work.

Implementing the OAH Action Plan

Theme 3: Create Resilience

Action: Support activities and initiatives that promote adaptation and resilience to ocean acidification and hypoxia (OAH), for Oregon's human communities and ecosystems

To support Oregon's thriving marine habitats and economies through current and future ocean changes, State agencies and local governments work to promote OAH resilience in management decisions. The OAH Council envisions continued collaboration between Oregonians, agencies, and industry members to identify and conserve Oregon's commercially, recreationally, culturally, and ecologically relevant species. Building strong collaboration among key stakeholders is imperative to maximize resilience for the State's natural resources.

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. For example, Oregon is leading the way by becoming the first U.S. state to integrate the benefits of blue carbon and submerged aquatic vegetation in coastal habitats, which help offset the cumulative impacts of climate change. The OAH Council continues its commitment to facilitating alignment and collaboration in the State on OAH and climate issues. However, the likelihood of future resilience to the impacts OAH is dependent upon continued and timely action.

Current Project Highlights

Science-based best management practices for co-management of Oregon submerged aquatic vegetation (SAV) and shellfish (OAH Action Plan Steps 3.1, 3.3)

This study evaluates environmental interactions between shellfish and submerged aquatic vegetation (SAV), and how these interact with Oregon's existing policies, regulations, and management strategies. It also aims to identify how stakeholder groups perceive and envision the combined management of shellfish and SAV, and how these perspectives can be integrated into a best management practice (BMP) framework. The research team is working with existing information (established BMPs and study results) as well as building an advisory group with participants from across Oregon to guide the project. **This project will improve our understanding of how SAV can protect Oregon's shellfish, better inform management of estuarine habitats, and improve BMPs.**

Melissa Ward (San Diego State University), HB3114-OOST Project 5 (2022-2024)

Olympia oyster growth and survival with climate change (OAH Action Plan Steps 3.1, 3.2)

This study, based in Yaquina Bay, examines the growth and composition of shells and tissue in native Olympia oysters, employing a method used for studying slow ecological processes. Additionally, the study will measure carbonate chemistry, salinity, temperature, and food quantity/quality throughout the bay. Environmental data will be synthesized to identify timescales and processes to understand the underlying causes and effects on Olympia oyster fitness, growth, and survival. These data will contribute to building a statistical growth model based on environmental variables. Researchers have conducted early boat survey work, trialed their flow-through seawater system, deployed juvenile Olympia and Pacific oysters at five sites throughout Yaquina Bay, and have conducted two successful surveys of surface water PCO_2. **This project will further inform our understanding of oyster growth and survival under different environmental variables such as food quantity/quality and OA. Using this data, the scientific community will better understand oyster lifecycles in a changing ocean.**

George Waldbusser (OSU), HB3114-OOST Project 6 (2022-2024)

Effects of OAH on Pacific oyster larvae (OAH Action Plan Step 3.1)

This project investigates the effects of OAH on Pacific oyster larvae from select families derived from the Molluscan Broodstock Program (MBP) at Hatfield Science Center. Oysters that are most resistant to OAH impacts will be made available to the Whiskey Creek Hatchery in Netarts Bay. Researchers are currently building flow-through systems to expose larvae to consistent OAH conditions and expect to be finished by the end of 2022. Parent broodstock oysters have been genotyped and selected to produce larvae for the experiment in 2023. **This research contributes to the development of oyster strains that are more resilient to ocean stressors, including OAH. If successful, oyster farms would be able to maintain their production and avoid widespread die-offs in the future.**

Chris Langdon (OSU), HB3114-OSU Project 3 (ongoing)

Implementing the OAH Action Plan

Theme 4: Expand Public Awareness

Action: Communicate ocean acidification and hypoxia (OAH) science, impacts, and solutions to raise awareness and support decision-making

Public awareness is key to unlocking broad engagement and creative problem-solving for tough issues. As such, the OAH Council has set a goal for increasing communication and accessibility of information on OAH science and policy to empower coastal communities to take part in building a more robust future. This future can only occur through clear, strategic communications that resonate with multiple stakeholder groups. Additionally, as Oregon continues to experience the impacts from OAH, it is vital that we acknowledge equity and environmental justice concerns related to ocean change in our actions and our communications. Many underserved communities in rural and urban centers are expected to be disproportionately impacted by climate and ocean change due to limited access to resources and information.

Community resilience relies upon understanding where vulnerabilities lie, then taking action to decrease those vulnerabilities through strategic planning and mitigation. We can benefit from complementing scientific knowledge with traditional ecological knowledge and experiential knowledge from those who are regularly out on the ocean. By fostering diverse partnerships of engaged and informed individuals (who understand OAH science, and are well-informed on mitigation, adaptation, and resiliency options), Oregon will stand on the best foundation in combating negative impacts from our changing ocean.

Current Project Highlights

Oregon OAH communications plan (OAH Action Plan Steps 4.1, 4.2, 4.3)

Ocean change is both complex to understand and communicate effectively. Success lies in the artful and simple extraction of essential information into digestible, factual units. This project engages a professional communications team to help Oregon talk about the science, problems, and potential solutions for ocean change in a way that motivates action and change. Using working groups and pilot-testing, the communications team is developing messages for targeted audiences, measurable success metrics, and a communications toolkit for the OAH Council and interested partners to use in communicating our work. The team will create an implementation plan outlining how to use these messages locally, regionally, and statewide. To date, the team has conducted front-end interviews and workshops with the OAH Council and working groups. **This project will help the OAH Council raise awareness about OAH through solutions-oriented messaging.**
Pathways Collaborative, HB3114-OOST Project 7 (2022-2024)

Fisherman-scientist OAH roundtables & app (OAH Action Plan Steps 4.2)

Oregon Sea Grant, OSU, ODFW, and (starting in 2021) the OAH Council have hosted four Fishmen-Scientist OAH Roundtable sessions to facilitate a dialog about our changing ocean and support research collaborations that can generate an improved understanding of science and trends in Oregon. These roundtables have spurred multiple collaborative research projects, resulting in lasting relationships and benefits. Conversations at the 2021 and 2022 roundtable sessions resulted in a pilot-project effort to build a mobile device "Fishermen's App", which will allow fishermen and recreationalists to document their observations of unusual sightings at sea and share with their peers, scientists, and managers on shore. ODFW hosted a Sea Grant Summer Scholar in 2022 to begin a pilot project on this app. **Fisherman-scientist roundtables provide a communication channel to convey real-time changes in our ocean, particularly between at-risk industry leaders and scientists. Out of these roundtables, we are scoping a Fishermen's app that could propel research forward by providing real-time insight into changes in ocean conditions.**

State of the Coast panel discussions (OAH Action Plan Steps 4.2)

The annual coastal meeting "State of the Coast" engages interested coastal community members in "hot topics" during an ocean-focused day of talks, workshops, and networking. Ranging from science to art to food, the meeting is cross-disciplinary and provides a great opportunity to gain new perspectives on current problems. The OAH Council has hosted sessions at both State of the Coast meetings during this biennial period. In 2020, the Council hosted a session on communicating the risks and impacts of OAH and climate change in ways that connect with Oregonians' personal experiences. In 2021, the OAH Council brought commercial fishermen together in a facilitated panel discussion to share their observations on ocean change, the challenges they face, information needs, and ideas for collaboration. **These panels provided OAH information to impacted audiences including at-risk industries and coastal communities.**

Implementing the OAH Action Plan

Theme 5: Build Sustained Support

Action: Mobilize agencies to address ocean acidification and hypoxia (OAH) priorities

Developing a long-term OAH coordination strategy among state agencies, academia, the federal government, and industries is central to Oregon's ongoing success in combating ocean change and OAH. Leadership by the State's elected officials has been invaluable for setting OAH science and monitoring goals as well as decision-making on policy issues. In turn, this leadership has been valuable regionally and nationally, providing a model for other governments. Oregon's commitment to strong science-informed climate and ocean change policy has been demonstrated by directed funding under HB3114 to better understand OAH, mitigate its impacts, and increase ecological and economic resilience. There is no one-size-fits-all solution, and the advancement of scientific underpinnings of successful management will help us strategically design and implement solutions. Utilizing what we have learned and implementing scientific knowledge into proactive management programs requires adaptive effort and collaboration among numerous State and federal agencies.

Current Project Highlight

2021 Multiagency Report on Ocean Acidification and Hypoxia (OAH) Programs and Needs

(OAH Action Plan Steps 5.1, 5.3)

To combat the near and long-term effects of OAH, it is essential that relevant state agencies have the authority to develop clearly defined goals and strategies to achieve Oregon's adaptation and mitigation of climate and ocean change. These strategies will benefit community, economic, and ecosystem resilience. While OAH strategies have been incorporated into some aspects of agency planning processes, the 2021 Multiagency Report on Ocean Acidification and Hypoxia (OAH) Programs and Needs (the Report) is a landmark and novel collaboration among eight state agencies to describe existing and potential opportunities to integrate OAH into the day-to-day work of state agency programs. Specifically, the Report includes a section for each agency, addressing the following:

1. ***Authority and nexus with climate/ocean change***
   A description of agency authorities, responsibilities and key policies that relate to OAH Program

2. ***Elements that relate to climate/ocean change and OAH Action Plan goals***
   A description of current management strategies for each agency that relate to OAH

3. ***Opportunities for augmenting programs and actions***
   An evaluation of potential enhancements in agency capacity to further prioritize OAH adaptation into agency programs and activities. Potential augmentation in science, monitoring, reducing stressors, resilience, education/outreach, and policy/regulation improvements.

For the OAH Council and eight Oregon agencies, the Report is an integral step in recognizing the State's long-term goals to reduce OAH stressors and the importance of creating a pathway to socio-economic resilience. The ODFW Co-Chair of the Council led the development of the Report, orchestrating the thematic content, coordination, and collaboration among agencies. The Report identifies priority potential opportunities that would better prepare the State for future ocean change, thereby describing a potential roadmap to advancing Oregon's climate and ocean change preparation. Additional information about progress on initiatives from the 2021 Multiagency Report on OAH Programs and Needs can be found in ***Appendix C*.**

The OAH Council promotes an effective and efficient use of State resources through collaboration with sister agencies. By clearly articulating agency roles, programs and opportunities, the multiagency report approach promotes vital and well-coordinated OAH action, minimizing redundancy within state programs.

Noteworthy Milestones

Increased OAH awareness has led to growing regional, national, and international mitigation efforts. The actions showcased here are of particular note for the State of Oregon, the West Coast (including British Columbia), and the nation to combat the ecosystem and socio-economic effects of OAH. In a recent milestone, the ***U.S. has become a member of the International Alliance to Combat Ocean Acidification (OA Alliance)****, an international association of governments that are committed to addressing OA.*

Around Oregon

Oregon Climate Change Research Institute - Fifth Oregon Climate Assessment (2021): This biennial report disseminated the latest climate science and climate change effects on Oregon's natural and human systems. Written by over 30 authors in state agencies, academia, and tribal groups, the Assessment discusses natural hazards of climate change and strategies to adapt to climate-related challenges. A chapter on ocean change reviews observed and potential impacts of ocean acidification and its impacts on local species.

Oregon Climate Adaptation Framework (2021): This framework, updating and expanding an initial effort from 2010, is the product of public input and the work of 25 state agencies, with the goal of guiding state leadership and staff decision-making on response to climate change. The 4 OAH Council agencies served on the interagency working group and contributed to ocean change content that best reflects Oregon coastal communities' unique needs for climate adaptation. The report urges the state to integrate climate and ocean change work into agency programs and business in a transformative, coordinated, and efficient manner. This second revision of the Oregon Climate Adaptation Framework outlines guiding principles to adapt and mitigate climate change, presents necessary administration actions, and describes collaborative strategies for state agencies to implement.

Oregon Global Warming Commission (OGWC) – Natural and Working Lands Report (2021): This report recommended net carbon sequestration and storage goals for Oregon's natural and working lands, in response to Executive Order 20-40. The OGWC stresses that natural and working lands must be a part of climate change action and can lead Oregon to becoming net carbon neutral. Specifically, the Report emphasizes the preservation and restoration of forested tidal wetlands due to their carbon storage potential and other ecosystem services. Following the OGWC recommendations would make Oregon a leader in carbon sequestration policy.

Around the region, nation, and globe

California Ocean Science Trust: Enhancing California's Ocean Acidification and Hypoxia Monitoring Network (2020): This report by the California Ocean Protection Council Ocean Acidification and Hypoxia Task Force (Task Force); identifies ocean acidification as a key management priority for California. The Task Force recommends

increasing connections between chemical and biological OAH monitoring, improving OAH models, and adding monitoring effort into less represented areas.

California Current Integrated Ecosystem Assessment (2022): This annual report documents the connected and changing California Current Ecosystem by describing its biology, climate, physical, and social conditions. NOAA scientists and collaborators who work on the U.S. West Coast produce this report to support ecosystem-based management. This year's report highlighted widespread near-bottom hypoxia and upwelling that occurred in 2021 from Oregon to Washington.

****Pacific Coast Collaborative (PCC) – Climate Resilience on the Pacific Coast: Framework for Collaborative Action (2021):*** PCC member governments of British Columbia, Washington, Oregon, and California created this framework to provide a climate resilience roadmap for the region. Emphasizing actions for regional resilience, the Framework recommends five near-term priorities including mainstreaming climate resilience into public processes and decision-making, utilizing natural and working lands for carbon sequestration, and analyzing the economic impacts of climate change and resilience.

Cooperative Institute for Climate, Ocean, and Ecosystems Studies – Annual Report (2021): This report highlights research projects, employees, and yearly activities from the Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES). CICOES promotes research collaboration between NOAA, the University of Washington, the University of Alaska Fairbanks, and Oregon State University.

****Coastal Management Journal (CMJ) Special Issue on Ocean Acidification (2021):*** This special edition of CMJ has contributions from OA Alliance members, including an article by Oregon OAH Council Co-Chairs and staff on collaboration. The special edition details the partnerships made by a variety of state governments to increase scientific data and monitoring, disseminate information, and initiate political action.

NOAA Ocean, Coastal, and Great Lakes Acidification Research Plan 2020 – 2029: Created by nearly 70 federal researchers and academic partners, this plan includes regional and national research priorities, outlines current acidification research, and guides future science to understand the ecosystem-related impacts to commercial activities, subsistence and recreational fishing, tourism, and other social identifiers. This plan is in furtherance of the Federal Ocean Acidification Research and Monitoring (FOARAM) Act of 2009.

****International Alliance to Combat Ocean Acidification (OA Alliance) – Highlights, Impacts, and Progress Report (2021):*** This annual report celebrates major achievements, details actions that supported climate-ocean leadership for members, and outlines the OA Alliance's objectives for the next three years. The OA Alliance is an international group of governments, dedicated to taking urgent action to protect coastal communities and livelihoods from the threat of ocean acidification and other climate-ocean impacts. Oregon is a founding member.

The CHIPS and Science Act Subtitle E: Coastal and Ocean Acidification Research and Innovation (2022): This Congressional Act reauthorizes the FOARAM Act through Fiscal Year (FY) 2027. After a lapse in FY 2012, NOAA will receive $120.5 million, and the National Science Foundation will receive $20 billion for OA-related activities from 2023-2027. This provision expands the definition of ocean acidification to include estuaries and defines coastal acidification to recognize mechanisms that cause changes in aquatic chemistry. This act will increase our understanding of the socioeconomic effects of ocean acidification and coastal acidification.

**** = The Oregon OAH Council contributed directly to achieving these milestones***

Ocean Status Update

The ocean's surface waters are currently at the lowest pH level (acidification) they have been in 23,000 years (World Meteorological Organization, 2021). In order to remain resilient as the impacts of climate and ocean change unfold, we must continue to act and do so through partnerships, coordination, and use of the best available science. This Ocean Status Update is intended to provide insight into the latest trends and science in OAH. Oregon's cultural and economic history are strongly tied to the marine ecosystem, yet ocean change is occurring at a rate faster than our ability to understand and respond. Human communities and ocean industries will remain susceptible to the ongoing ecological and biological impacts of ocean acidification and hypoxia until we fully understand what is happening and how to address it.

Oregonians feel a strong connection to the ocean via the species that we have come to associate with a healthy ocean, that we rely on in our fisheries, and that are iconic to our way of life. Dungeness crab is a great example of a species that has been central to Oregon's socio-economic activity and vitality for decades. ***Figure 4*** summarizes multiple ways that Dungeness crab are vulnerable to and/or impacted by ocean change, including impacts on crab biology, habitat, fishery economics, and ocean ecology. An emerging concern about crab fishery gear entanglements has led to a new understanding of how this complex management issue has come about, at least in part, due to ocean change (marine heatwaves) causing greater fishery overlap with federally protected migratory whale species in recent years.

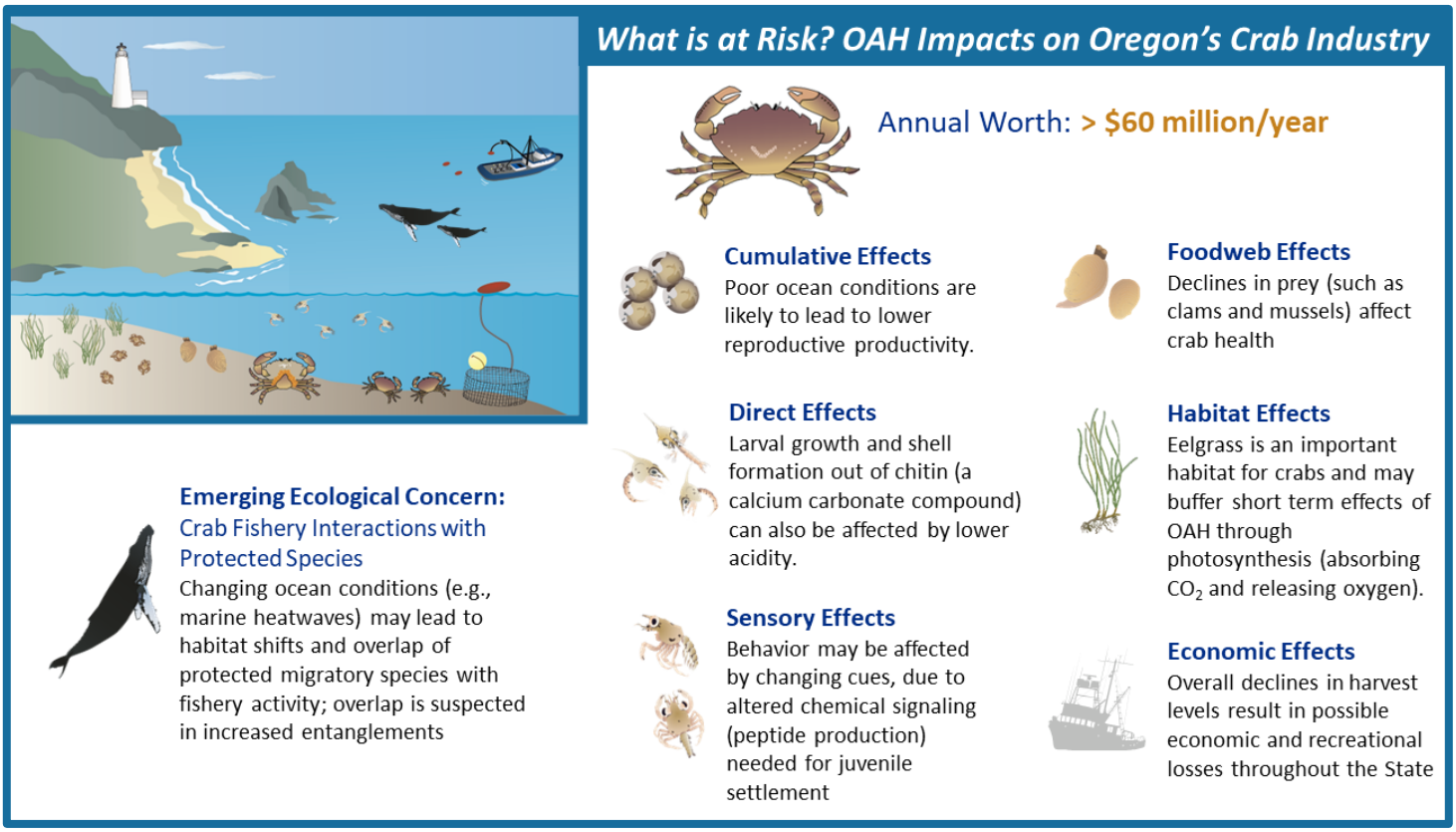


Figure 4. *The ecological, biological, and economic impacts of OAH on Oregon's top marine fishery.* *Graphic image credits: Integration and Application Network (ian.umces.edu/media-library).*

Table 1. *Species of concern in Oregon and status of our knowledge on their response to OAH. Peer-reviewed literature sources were evaluated to draw conclusions on* ***vulnerability*** *(impacts impair species function),* ***resilience*** *(impacts do not affect species function),* ***mixed response*** *(impacts are inconclusive between sources), or* ***data needed*** *(there is insufficient literature to draw a conclusion). Referenced literature is from the West Coast or California Current Region.*

Fisheries & Mariculture Species	Ocean Acidification					Ocean Hypoxia			
	Calcification	Reproduction, Growth, & Development	Physiology	Behavior	Survival	Reproduction, Growth, & Development	Physiology	Behavior	Survival
Shellfish									
Dungeness crab	Mixed	Resilient	Resilient	Resilient	Data Needed	Vulnerable	Mixed	Mixed	Vulnerable
Pink shrimp	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed
Red sea urchin	Data Needed	Mixed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed
Pacific oysters	Mixed	Vulnerable	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed
Olympia oysters	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Vulnerable	Data Needed	Data Needed	Resilient
Groundfish									
Black rockfish		Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed
Copper rockfish		Resilient	Mixed	Mixed	Data Needed	Data Needed	Mixed	Mixed	Vulnerable
Blue rockfish		Vulnerable	Resilient	Resilient	Data Needed	Data Needed	Mixed	Data Needed	Data Needed
Cabezon		Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Resilient	Mixed	Data Needed
Lingcod		Data Needed	Data Needed	Data Needed	Data Needed	Vulnerable	Mixed	Data Needed	Data Needed
Sablefish		Data Needed	Data Needed	Data Needed	Data Needed	Resilient	Resilient	Vulnerable	Data Needed
Pacific whiting		Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Resilient	Data Needed
Pacific halibut		Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed
Salmon									
Coho		Data Needed	Data Needed	Data Needed	Data Needed	Vulnerable	Resilient	Vulnerable	Mixed
Chinook		Data Needed	Data Needed	Data Needed	Data Needed	Vulnerable	Mixed	Vulnerable	Vulnerable
Steelhead		Data Needed	Data Needed	Data Needed	Data Needed	Vulnerable	Mixed	Data Needed	Vulnerable
Tuna									
Albacore		Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed	Data Needed

Other Key Species

Pacific herring		Data Needed	Data Needed	Data Needed	Data Needed	Resilient	Data Needed	Resilient	Data Needed
Market squid		Vulnerable	Data Needed	Data Needed	Data Needed	Vulnerable	Vulnerable	Vulnerable	Data Needed
Krill	Data Needed	Mixed	Mixed	Data Needed	Data Needed	Resilient	Mixed	Resilient	Data Needed
Pteropods	Vulnerable	Data Needed	Data Needed	Data Needed	Mixed	Data Needed	Data Needed	Data Needed	Resilient
Red abalone	Data Needed	Vulnerable	Data Needed	Data Needed	Resilient	Vulnerable	Vulnerable	Data Needed	Vulnerable
California mussels	Mixed	Mixed	Mixed	Data Needed	Data Needed	Data Needed	Resilient	Data Needed	Resilient

Ocean hypoxia

The Oregon coast has historically experienced annual hypoxic events near the sea floor and deeper areas of the continental shelf due to seasonal upwelling which brings water that is low in pH and oxygen from the deep ocean into nearshore waters in the summer. Like a forest wildfire season, Oregon's coastal marine ecosystems experience a "hypoxia season," which is linked to the timing of seasonal coastal upwelling. The intensity of hypoxic seasons is variable in that some years will be more severe than others. Oceans continue to absorb CO_2, and upper ocean surface temperatures are rising. In turn, hypoxic events are exacerbated, leading to increased frequency, severity, and duration of OAH conditions that impact Oregon's ecological, cultural, and economic resources.

In the spring of 2021, a very early onset of spring upwelling triggered a hypoxia season and stimulated early phytoplankton blooms (***Figure 5***). When the blooms die, sink, and decompose, they consume oxygen and release CO_2, further intensifying OAH beyond the low values brought up by upwelling from the deep ocean. The long duration of an upwelling season, or an increase in upwelling intensity due to prevailing wind patterns, can cause a particularly strong drawdown of oxygen and low pH in bottom waters. This increases the potential for widespread "dead zones" when deep dwelling species that are stationary, or cannot quickly escape, perish due to oxygen deprivation. During the 2021 season, hypoxic water was detected only six miles offshore from Oregon and Washington. By mid-summer, the hypoxic water spanned 8,000 square miles and observed oxygen levels near zero; making it the earliest and longest hypoxic event compared to previous records.

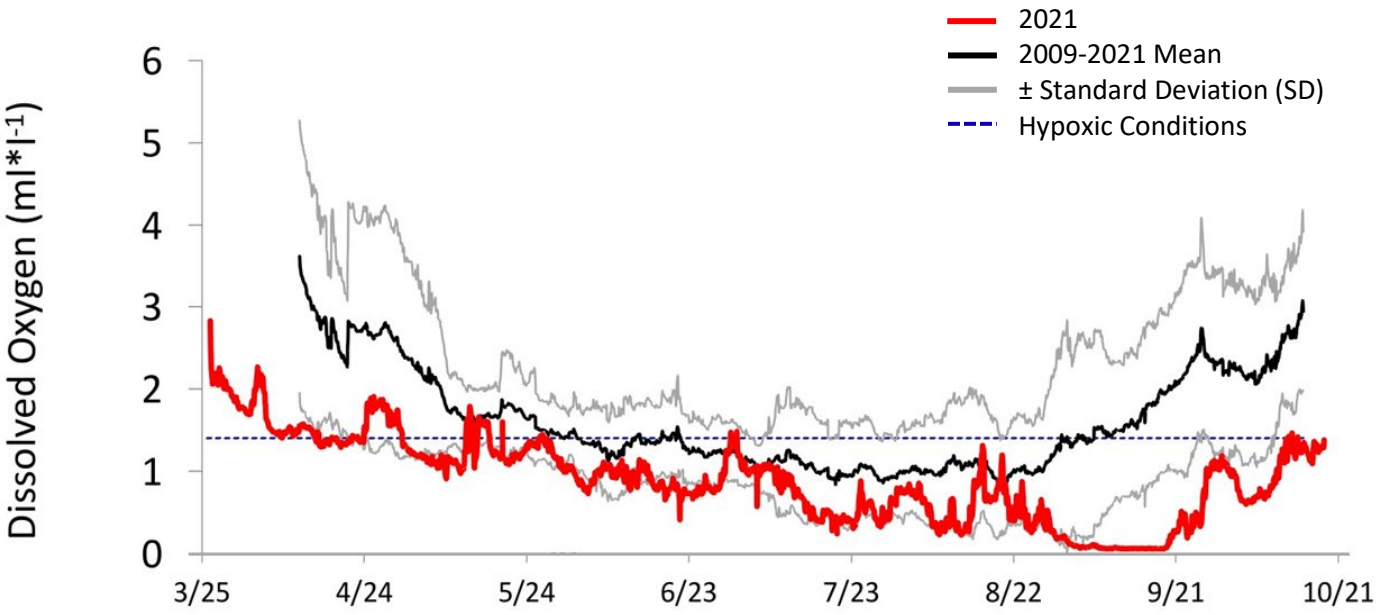


Figure 5. *Dissolved oxygen concentration collected at Cape Perpetua Marine Reserve in 2021 (red) compared to 2009-2021 mean (black) ± standard deviation (grey) from March to October. Hypoxia is defined as waters with oxygen concentrations <1.4ml/L (blue), and is observed during the coastal upwelling season, especially during June-September.* *Credit: Francis Chan (OSU).*

Coastal upwelling

The process of coastal upwelling is initiated when strong winds blow southward ("northerly winds") along the Oregon coast from April to September. Cool, nutrient-rich, CO_2-rich, and oxygen-poor deep water from offshore is brought up to shallower depths on the continental shelf. This process stimulates phytoplankton blooms that form the base of the marine food web and contribute to Oregon's productive fisheries. The onset of an upwelling season is marked by the spring transition, which represents the shift from predominantly northward moving winds in winter to southward moving winds in spring (***Figure 6***).

Ocean conditions that lead to hypoxia – including wind stress – vary year to year (***Figure 7***). In 2021, the shift to northerly winds in March initiated the earliest spring transition in 35 years. The long upwelling season duration resulted in the earliest recorded hypoxia season and caused widespread concern regarding the implications for coastal economies, especially for the Dungeness crab fishery. In a rare occurrence, low oxygen conditions also spread north into Canadian waters. Changing wind patterns and warming further exacerbate hypoxia due to increased stratification in the water column. When winds decrease (or "relax"), as they did several times in 2021, the upward movement of deeper water is subdued, which causes waters to become stagnant and intensifies the accumulation of low oxygen and high CO_2. These intense upwelling-driven hypoxia events can disrupt fisheries, stock assessments, and can cause habitat shifts in a substantial number of Oregon's marine species.

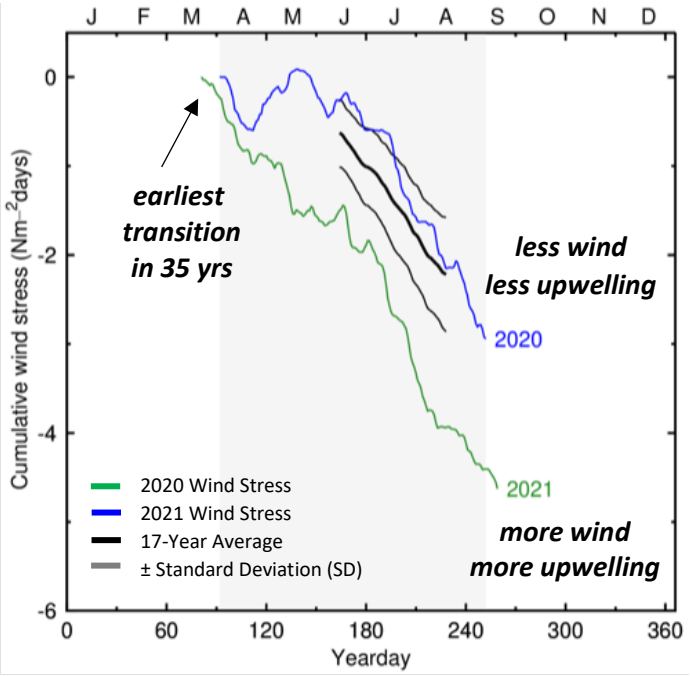


Figure 7. *Comparison of annual coastal upwelling trends on the Oregon coast, showing extreme 2021 conditions compared to 2020 and the previous 17-year average (± SD). The spring transition is indicated by the start of each trendline at y=0. Upwelling intensity for a given year is indicated by consistent negative (southward moving) wind stress (steeper line slope). Periods of relaxation where hypoxia could be particularly bad are indicated by periods of minimal change in wind stress, which causes water to become stagnant. Credit: Jack Barth and Steven Pierce (OSU).*

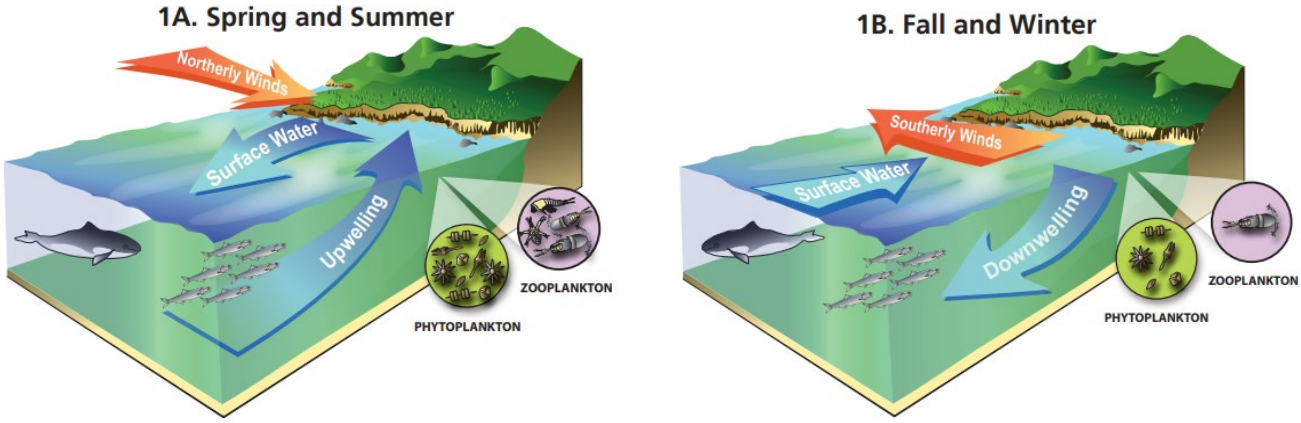


Figure 6. *Transition process of seasonal coastal upwelling between A) Spring and Summer and B) Fall and Winter. Graphic Credit: Greg Krutzikowsky* (ODFW).

Moving Forward

OAH Council benchmarks for 2022-2024

The projects on these two pages indicate the priorities for the OAH Council over the next two year period, from 2022-2024. These align with the OAH Action Plan, the Multiagency Report, and HB3114 funded projects.

Research & monitoring projects

Action Plan step; in-progress projects	Action Plan Reference	Funded after 2024?
"Allocate state funding to use existing research reference sites and tools to enhance Oregon's oceanographic monitoring network" • **OAH monitoring at marine reserves** (HB3114-OOST Project 1-2) • **OAH monitoring in Yaquina Bay** (HB3114-OOST Project 3) • **Whiskey Creek monitoring program** (HB3114-OSU Project 2)	1.1	No
"Allocate state funding to invest in monitoring of Oregon's ocean life by implementing consistent monitoring of the biological response to OAH" • **Newport Hydrographic Line** (HB3114-OSU Project 1) • **Water Quality/Eelgrass, Coos Bay** (HB3114-OOST Project 4) • **Shellfish/Estuary Assessment** (HB3114-ODFW Project 1**)**	1.2	No
"Identify strategies to restore, protect, and sustain native shellfish stocks and submerged aquatic vegetation (SAV) in Oregon's estuaries and nearshore waters" • **SAV, shellfish, management** (HB3114-OOST Project 5) • **OAH-resilient oyster broodstock** (HB3114-OSU Project 3)	3.1	No
"Support data collection, synthesis, and modeling to inform strategies that promote OAH resilient ecosystems" • **Olympia oyster growth in Yaquina Bay** (HB3114-OOST Project 6)	3.2	No
"Develop Best Management Practices (BMPs) based on current ecosystem and economic research focused on Oregon's estuaries and nearshore" • **SAV, shellfish, management** (HB3114-OOST Project 5)	3.3	No

Coordination

Action Plan step; in-progress projects	Action Plan Reference	Funded after 2024?
"Implement measures to reduce OAH stressors" • **Continue participating in water quality criteria and development coordination**	**2.2, 2.3**	N/A
"Agencies document both existing and needed programs and regulations (including compliance) that address OAH impacts, adaptation, and mitigation" • **Continue coordination on initiatives under the 2021 OAH Multiagency Report**	**5.1, 5.3**	N/A

Communication

Action Plan step; in-progress projects	Action Plan Reference	Funded after 2024?
"Build a communication plan and outreach materials to communicate OAH science, impacts, and solutions. Convene an advisory working group specialists to identify OAH outreach needs. Develop a communications plan that meets the needs of diverse state holders and provide solutions-oriented messages on OAH science and impacts" • **Pathways Collaborative planning** (HB3114-OOST Project 7)	**4.1**	No
"Provide timely updates to the Legislature and affected communities in Oregon to inform decisions on how best to invest in OAH research, adaptation, mitigation" • **OAH Symposium** (2023) • **Fisherman-Scientist Roundtables** (2023, 2024)	**4.2**	Yes

Long-term goals

The most apparent, long-term goals of the OAH Council include strategic planning and preparation for the 2025-2031 OAH Action Plan, assessing and securing funding for long-term OAH monitoring, and establishing marine water quality standards to prepare Oregon for the impacts of climate and ocean change.

Oregon's OAH Council Members

The Oregon Coordinating Council on Ocean Acidification and Hypoxia was convened by Senate Bill 1039 in 2017, which specified the 13 seats and representation of Oregon interests on the Council. Including this 2022 OAH Report, this diverse body has completed 3 biennial Reports to the Legislature and the first Oregon OAH Action Plan ***(Appendix A)***, since 2018. Additional information on the Council and its members can be found in ***Appendix D***.

DR. LAURIE JURANEK
Council Co-Chair
Oregon State University

DR. CAREN BRABY
Council Co-Chair
Department of Fish and Wildlife

ALEX MANDERSON
Department of Agriculture

RIAN vanden HOOFF
Department of Environmental Quality

ANDY LANIER
Department of Land Conservation and Development

DR. CHRISTINE MOFFITT
Oregon Ocean Science Trust

DR. KARINA NIELSEN
Oregon Sea Grant

FRAN RECHT
Conservation Organization Representative

BOB KEMP
Fishing Representative

KRISTEN PENNER
Shellfish Industry Representative

DR. JESSICA MILLER
Academic Representative

JOHN SCHAEFER
Tribal Government Representative

AMIRA STREETER
Governor's Office Representative

Thank you to past council members and staff that have contributed so much to the OAH Council's success:

Dr. Jack Barth (OSU Co-Chair), Frank Barcellos, Karen Tarnow, Jennifer Wigal, Dr. Jim Sumich, Dr. Shelby Walker, Dr. Aaron Galloway, Al Pazar, Brandii Holmdahl, Liu Xin, Dr. Kristen Sheeran, Daniel Sund, and Dr. Charlotte Regula-Whitefield

Appendices: Table of Contents

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

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