The Oregon Coordinating Council on
Ocean Acidification and Hypoxia

1st Biennial Report to the Legislature and Ocean Policy Advisory Council

Appendices D - H

Appendix D: Council Procedures

STRUCTURE AND ROLES

Co-Chairs
The Council is Co-Chaired by the Oregon Department of Fish and Wildlife and Oregon State University, per Senate Bill 1039. Co-Chairs (and staff) design agendas, prepare materials to address Council interests and information requests, as well as ensure that Council deadlines are met effectively and collaboratively. Co-Chairs will work with Council staff and the Governor's designee to coordinate the work of the Council with other policy processes.

Executive Committee
The Council may choose to elect from its members individuals to serve on an Executive Committee, to work with Co-Chairs and the Governor's designee between meetings. Duties may include work delegated by the full Council, facilitating working groups, building agendas, and other interim work. The Executive Committee position office terms will be held for a two-year calendar period. Reelections to subsequent terms is allowed. There is no office term limit.

Council Members
Council members serve on the Council representing key stakeholder interests, agencies, and the public, as described in Senate Bill 1039 enrolled. All members are expected to directly engage in the consensus-building process, including the identification of issues, recommendations, and solutions. The Council's recommendations and actions will be supported by science, informed by public input, and based on careful deliberation by Council members and working groups.

Members are expected to bring the concerns and perspectives of their various constituencies to the Council's table, as appropriate, for discussion and consensus building. It is understood that many members participate in other initiatives at local, state, regional, and national levels and may advocate in those forums for solutions on issues related to the Council's work, but will differentiate between personal perspective and the Council's group decision-making and recommendations.

To enhance the possibility of constructive discussions and dialogue as members educate themselves on the issues and engage in consensus building, members agree to be candid and respectful of the diversity of views on the topics the Council will address. Members agree to avoid personal attacks both at the table and away from the table amongst themselves and with the general public at large.

Working Groups
The Council may choose to identify areas of work that could best be achieved by a subset of Council members and individuals who are not sitting on the Council. When the Council

identifies these areas and creates a working group, a timeframe for service and deliverables will be identified by the full Council. It is the responsibility of a working group to regularly update the Council and the executive committee at each Council meeting on the progress of the working group. Working groups shall be comprised of Council members that equal or outnumber other working group members, unless the Council clearly describes the justification for a different composition and the method by which those members be selected. The intent of this is to make thoughtful and concise decisions to guide Council work. Working groups shall be in place no more than two years, at which time membership, purpose, and scope of work shall be revalued.

AGENDA DEVELOPMENT

Overall Policy Statement
The Council will attempt to follow an agenda at each meeting that balances the needs to expeditiously provide the necessary information to inform Council members, provide a forum for discussion and action on issues as needed, allow public notice of actions to be taken, and provide the public with a means to raise issues for consideration by the Council.

Agenda Development and Posting
The agenda for each Council meeting will be developed by the Co-Chairs and the Executive committee, incorporating guidance from the work program and task schedule agreed to by the Council, as well as Council member guidance gathered at each meeting. The Co-Chairs will also incorporate requests, as agenda scheduling allows, from the Governor, Oregon Legislators, or the public. Draft agendas will be posted on the Council website at least one week prior to Council meetings. The Council will vote at the beginning of each Council meeting to adopt as proposed or to amend the agenda for a given Council meeting.

CITIZEN INVOLVEMENT

Overall Policy Statement
The Council welcomes public involvement and input. The Council will provide citizens with meaningful opportunities for input on the Council's process and products, including policy formulation, plan preparation, plan review and adoption, and implementation.

Participation in Council Meetings and Deliberations
Citizens will be encouraged to participate in Council meetings in two ways:

1. General public comment. A specific "open mic" time for public comment to the Council will be set aside during each regular Council meeting and noted on the agenda. Members of the public intending to make comment will be asked to sign up, so that time can be equitably shared, and a record of those speaking is provided to assist in generating an accurate meeting summary.

2. Written comments (emails or letters) will also be accepted at any time from the public, including at Council meetings. Written comments will be shared with Council members by Council staff.
3. When applicable, members of the general public may be asked to serve on a Council working group by a Council member based on their expertise in a specific issue.

Notice of Council Meetings
It is the policy of the Council to ensure that citizens are informed as to when and where the Council will meet and the topics to be discussed, with special attention to note those items on which the Council may take official action. Council meeting announcements (including date, time, location, and agenda) will be posted on the State's public meetings calendar and on the Council's website.

(http://www.oregon.gov/transparency/pages/publicmeetingnotices.aspx)
(http://oregonocean.info/index.php/ocean-acidification)

Public Workshops
The Council intends to conduct workshops and community meetings whenever appropriate or necessary to solicit facts, opinions and ideas. Workshops will be structured to encourage an exchange of information and to facilitate discussion among participants. Public workshop announcements (including date, time, location, and agenda) will be posted on the Council's website.

(http://oregonocean.info/index.php/ocean-acidification)

Meeting Locations
In-person meetings will be held at both coastal and inland locations. For in-person meetings, efforts will be made to provide remote audience options for Council members and the public, whenever possible. Some Council meetings will be scheduled as remote attendance only. Remote participant information will be included on the agenda and on the Council website.

(http://oregonocean.info/index.php/ocean-acidification)

CONSENSUS AND DECISIONS

Overall Policy Statement
The Council will attempt to reach consensus on each policy item or plan decision, including recommendations and resolutions to the Governor, the State Legislature, the Oregon Ocean Science Trust, or state agencies. A consensus process will enable the Council to more feely discuss issues to arrive at a decision acceptable to all. In some circumstances, precise wording of a consensus decision may be developed by staff after review of recordings of the discussion for approval by the Council at a subsequent meeting.

Consensus Defined
Consensus is defined as the ability for each Council member to say that:

1. I was a respected member of the group that considered the decision;

2. My ideas (opinions, knowledge, concerns, beliefs, hopes) were listened to;
3. I listened to the ideas (opinions, knowledge, concerns, beliefs, hopes) of others; and
4. I can support the decision of the group, even though I might have come to a different decision had I acted alone.

The Council will seek consensus decisions on advisory recommendations. General consensus is a participatory process whereby, on matters of substance, the members strive for agreements that they can accept, support, live with, or agree not to oppose. In instances where after vigorously exploring possible ways to enhance the members' support for the final decision on a recommendation, and the Council finds that 100 percent acceptance or support is not achievable, final decisions will require the majority of a quorum of members. This majority decision rule underscores the importance of actively developing consensus throughout out the process on substantive issues with the participation of all members. The consensus process will preserve the opportunity for minority opinions to be expressed and reflected on in the record of the Council's deliberations.

Quorum/Voting

In those instances where consensus cannot be reached after debate and discussion, the Co-Chairs may initiate or entertain a motion to vote on the issue. All motions must be seconded to act upon. The Chair may also elect to suspend debate until a subsequent meeting. If needed, minority positions will be reflected in all products and positions of the Council, with the minority language approved by minority members.

A majority of the members of the Council, which may include the Co-Chairs, constitutes a quorum for the transaction of business. A Council member may attend a meeting, participate and vote by telephone. A quorum is necessary for an official vote of the Council (quorum is seven members for this Council of 13 members). A majority vote of the quorum present is necessary to take an action. The following table specifies the minimum number of concurring votes necessary to pass or reject a motion:

Number of OCCOAH Members Present	7	8	9	10	11	12	13
Votes necessary for a majority	4	5	5	6	6	7	7

The Council may meet, receive information, hear testimony, deliberate, discuss, and take informal "sense of the council" votes without a quorum of members but cannot take official action.

A motion to reconsider a decision may be entertained by the Co-Chairs if a majority of those present votes to reconsider.

Attendance

Council members take seriously the responsibilities of membership and will endeavor to attend and participate in all Council meetings. However, members recognize that unavoidable conflicts may prevent attendance at all meetings. Council members may choose to designate a member of the public as an alternate for their designated Council seat; alternates must be approved by the Co-Chairs. Council members may only have one alternate. Council alternates will not be counted as part of a quorum; however, alternates are allowed to participate in the discussions and deliberations on issues if they are able to represent the views and interests of their constituents. The primary Council member must keep the alternate apprised of the Council's work and progress, so that the alternate can be a productive participant in the Council meetings, when serving as the alternate.

When a Council member is absent from three successive Council meetings, regardless of whether their designated alternate was present, the Council ***may*** request that the appointing/designating authority remove that member and select another to fill the term of that position. When a member is absent four out of five successive Council meetings, the Council ***shall*** request that the appointing/designating authority remove that member and select another to fill the term of that position.

Voting Action

The Council will endeavor to provide effective notice to the public, groups, agencies and interest parties of official voting actions which the Council may take at a meeting and to provide to both Council members and any interested party written materials related to the proposed action. Whenever an item placed on the agenda may result in an official vote of the Council, that item shall be so noted on the agenda as an "Action Item" and shall be so indicated in the public notice of the meeting at which the item will be discussed. The Council, through its staff, will attempt to provide written information on any proposed "Action Item" which describes the proposed action, the issues involved, legal or policy implications and other information which will assist the public and the Council to understand the item and conclude discussion prior to a vote. This information will, if at all possible, be made available to the members and the public no less than one week prior to the meeting when action will be taken.

Meeting Records

All Council meetings will be videotaped or recorded to provide an official record of Council proceedings. Written minutes will be prepared, as required by Oregon law (ORS 192.650(1)).

Council Records

All public records of the Council, not otherwise exempt from disclosure by law, are available for inspection and copying. The Oregon Department of Fish and Wildlife will act as custodian of the public records of the Council. On behalf of the Council, ODFW will respond to public record requests in a reasonable time, in accordance with the provisions of OAR 660-040- 0005 and the Public Records Law, ORS 192.410 to 192.505.

Appendix E: Meeting Summaries

Table of Contents

OAH Council Meeting # 1 - Thursday, January 25th, 2018 2
OAH Council Meeting #2 - Monday, February 26th, 2018 4
OAH Council Meeting #3 - Tuesday, March 20th, 2018 6
Working Group 2 Meeting #1 - Monday, April 2nd, 2018 8
Working Group 3 Meeting #1 - Tuesday, April 3rd, 2018 10
Working Group 1 Meeting #1 - Thursday, April 5th, 2018 12
Working Group 4 Meeting #1 - Monday, April 9th, 2018 15
OAH Council Meeting #4 - Tuesday, April 17th, 2018 17
Working Group 1 Meeting #2 - Thursday, May 3rd, 2018 19
Working Group 2 Meeting #2 - Friday, May 4th, 2018 21
Working Group 4 Meeting #2 - Monday, May 21st, 2018 23
Working Group 3 Meeting #2 - Tuesday, May 22nd, 2018 25
OAH Council Meeting #5 - Wednesday, May 23rd, 2018 27
Working Group 3 Meeting #3 - Tuesday, June 5th, 2018 29
Working Group 2 Meeting #3 - Wednesday, June 6th, 2018 31
Working Group 4 Meeting #3 - Thursday, June 7th, 2018 33
Working Group 1 Meeting #3 - Friday, June 8th, 2018 35
OAH Council Meeting #6 - Monday, June 25th 2018 37
Working Groups 2 & 3 Meeting #4 - Thursday, July 12th 2018 39
Working Groups 1 & 4 Meeting #4 - Friday, July 13th, 2018 40
OAH Council Meeting #7 - Wednesday, July 17th 2018 41
Working Groups 1 – 4 Meeting #5 - Tuesday, July 31st, 2018 43
OAH Council Meeting #8 - Friday, August 18th, 2018 44
OAH Council Meeting #9 - Friday, August 24th, 2018 46

OAH Council Meeting # 1 - Thursday, January 25th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Hatfield Marine Science Center, Newport, Oregon

Attendees

OAH Council members: Dr. Kristen Sheeran, Dr. Jack Barth, Dr. Caren Braby, Frank Barcellos, Karen Tarnow, Andy Lanier, Louise Solliday (alternate for Dr. James Sumich), Dr. Shelby Walker, Liu Xin, Dr. Aaron Galloway, and John Schaefer. Absent: Fran Recht and Al Pazar.

Guest presenters: Alan Barton (Whiskey Creek Shellfish Hatchery), Dr. Francis Chan (OSU)

OAH Council Staff: Dr. Charlotte Regula Whitefield, Daniel Sund

Audience attendees: Terry Thompson (Lincoln county commissioner), Ed Bowles (ODFW, Fish Division Administrator), Deanna Caracciolo (DLCD), David Fox (ODFW). Also, 15 members of the general public via WebEx (remote).

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

[Video Section 1]:

10:05am **Co-Chair Caren Braby called meeting to order**

- Formal Greetings Provided by Co-Chairs (Caren Braby and Jack Barth) and Kristen Sheeran (on behalf of Governor Kate Brown).
- Council Logistics, including meeting locations and general agreement from council members on monthly meetings until the submission of the OAH legislative report in September 2018

10:50am **Caren Braby - Senate Bill 1039 - Power Point presentation**

Presentation on bill content and history, including what the council "shall" and "may" accomplish during its tenure

[Video Section 2]:

12:01pm **Alan Barton Whiskey - Creek Hatchery Story - Power Point presentation**

Presentation on how OAH has already affected Oregon oyster production, and steps taken to begin to adapt and mitigate regional stressors

12:25pm **Francis Chan - OAH 101: What it is and Why Oregon "Feels" It Power Point presentation**

A brief primer on what OAH is, as well as the status of regional OAH research and monitoring

12:38pm **Jack Barth West Coast OAH Science Panel - Power Point presentation**

A description of Science Panel purpose and outcomes. Meeting materials reference: West Coast OAH Science Panel Final Report.

1:00pm **Visit to the NOAA Alaska Science Center OAH Laboratory of Dr. Tom Hurst**

- *Visited the OA Fish laboratory and discussed the potential for interagency collaborations*

[Video Section 3]:

1:38pm **Caren Braby Developing Policy on OAH - Power Point presentation**

2:11pm **Public Comment Period**

- *No Public Comments from the audience or WebEx participants*

2:38pm **Co-chairs 2018 Goal-setting and Planning**

- *Focus on OAH Council Procedures document (draft) including use of an Executive Committee, Council member alternates, Working Groups, voting.*
- *Discussion with Council members on the overall goals and objectives of the Council, the timeline for 2018 work, and other Council business.*
- *Decision: further modifications and discussion needed on Procedures document; staff will revise for Council consideration at the February 26th meeting.*

3:02pm **Co-Chairs adjourned the meeting**

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 #2 - Monday, February 26th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Oregon Department of Fish and Wildlife, Salem, Oregon

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Attendees

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

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield, Daniel Sund

Audience attendees: Curt Melcher (ODFW Director), Terry Thompson (Lincoln County Commissioner), and John Serra (staffer for Representative Schrader). Deanna Caracciolo (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

[Video Section 1]:

10:05am **Co-Chair Caren Braby called meeting to order**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth) and Curt Melcher (on behalf of ODFW).
- **Action:** Draft agenda accepted. All in favor, none opposed.
- **Action Recommendation:** Rework procedures document to incorporate council concerns about the composition and process for creating and populating working groups. Procedures document was conditionally accepted, in light of changes - all in favor, none opposed.

10:25am **Caren Braby -** Introduction of the Ocean Acidification Action Plan Toolkit

- Presentation on Ocean Acidification Alliance (OA Alliance) and the tool kit

- The Council reached consensus to move forward under the following framework at this time in order to develop action recommendations:
    (1) Advance scientific understanding
    (2) Reduce causes of OA
    (3) Build Adaptation and Resiliency
    (4) Expand public awareness
    (5) Sustained support

[No video was provided for this section]:

10:45am **Breakout Groups (Part I): (Co-Chairs)**

- *Topic:* What are the deliverables, commitments, and priority work areas of the Council? Start defining actions of interest, within the framework of the 5 categories described above.

[No video was provided for this section]:

12:15pm **Working lunch:**

- Monitoring Chemistry 101 (Jack Barth)
- Monitoring in Oregon (Caren Braby, Daniel Sund)

[No video was provided for this section]:

1:45pm **Breakout Groups (Part II): (Co-Chairs)**

- *Topic:* Continuation of morning breakout group discussion.

[Video Section 2]:

2:15pm **Public Comment Period**

- The Cap and Invest Bill in the 2018 short session has a nexus with the OAH Council. Suggested that the Council release a recommendation or letter of support for the bill. Council discussion followed; no action.
- Territorial Sea Plan - Rocky Shores Amendment progress update.

2:50pm **Council Business -**

- **Action:** Al Pazar nominated by Fran Recht to the Executive Committee, seconded by Andy Lanier. All in favor, none opposed.

3:10pm **Co-Chairs adjourned the meeting**

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 #3 - Tuesday, March 20th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

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

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield, Daniel Sund

Audience attendees: Deanna Caracciolo (DLCD), David Fox (ODFW), Stacey Jochimsen (US Sen. Merkley), Tyler Janazah (State House Dist. 10), and Ali Mayeda (US Rep. Bonamici).

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

[Video]:

9:35am **Co-Chair Caren Braby called meeting to order AND Current events/ updates**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth).
- Brief **overview** of the status of the Oregon Carbon Policy and connections to OAH Action Planning (Kristin Sheeran).
- Council voted to adopt **February meeting summary**, **March meeting agenda**, and updated **procedures document.** Fran Recht moved to adopt all documents, James Sumich moved to second. All in favor none opposed.
- Brief **overview** of the status of the Federal Appropriations for the Federal agencies integrated ocean acidification research program (Ali Mayeda staff for US Rep. Bonamici)

10:21am **Working Group Formation (Jack Barth)**

- *Workload and Expectations:* Specifically, the Council reviewed how to: identify what has already been done, identify what can be done with minimal effort, and prioritize longer term actions.
- Four working groups were identified, and membership (primary and secondary participants) was finalized. **Spreadsheet** from Feb meeting and **final WG membership.**

11:15am **Break**

11:34am **Considerations for planning - Presentation (Charlotte R. Whitefield)**

- The Council considered nuances of: Audience, Funding, Timeline. Also considered Action Planning **facilitation tools** that might be useful.

11:42am **OAH Council recommended actions – Discussion (Caren Braby)**

- *Audience:* Two main Report audiences were determined - the Governor's office /Oregon Policy Makers (State and local levels) were considered the primary audiences. Discussed other audiences including Oregonians, and institutions that will aid in implementation.
- *Funding:* Funding sources other than the Oregon General Fund (e.g., Oregon Ocean Science Trust, Sea Grant) were discussed as important considerations for OAH recommendations.

12:15pm **Public Comment**

- No public comment provided

12:16pm **OAH Council recommended actions – Discussion (Caren Braby and Jack Barth)**

- *Timeline:* The timing of biannual reports will be critical to get OAH recommendations aligned with State agency and regional universities budgets.

12:25pm **Council Business (Caren Braby and Jack Barth)**

- Working group meetings will be scheduled before the **April 17 Council meeting** (needing 48 hour notice for posting). An updated **OAH Council Workplan** was considered, relative to September report deadline.
- Council agreed to convene all working group meetings as posted public meetings, under the State law definition. All in favor none opposed.

12:35pm **Co-Chairs adjourned the meeting**

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

Working Group 2 Meeting #1 - Monday, April 2nd, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Reducing Causes of OAH – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Kristen Sheeran, Dr. Jack Barth, Karen Tarnow, John Schaefer, and Fran Recht. Absent: Frank Barcellos

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

8:08am **Getting Started (Council Co-chair Jack Barth)**

8:05am **Expectations of Participants**

Guest speakers at subsequent WG meetings:

Angus Duncan - Global Warming Commission
York Johnson - DEQ North Coast Basin
David Waltz - DEQ Mid Coast Basin
Bryan Duggan - DEQ South Coast Basin
Department of Transportation Representative
Oregon Climate Research Initiative Representative

External members:

Global Warming Commission Representative

- Intended to address WG concerns that our Councils recommendations should be complimentary and not redundant to ongoing State-wide efforts.

8:25am **Report Audience and Implementation**

WG materials will be written with a board "voice" in order to engage multiple audiences
Audience considered in terms of "Actions":

- Legislature and Governor's office: Policy
- General Public: Changes in behavior

8:35am **Working Group Leadership**

Karen Tarnow self-nominated as working group lead, all in favor none opposed

8:45am **Information/Data Needs**

Data Needs

- DEQ regional water quality reports (with permits renewal timing)
- Pacific Estuaries eelgrass report
- Oregon Shellfish Initiative: Native Oyster restoration report

Prioritization of actions (Time and Need) – ACTION to be completed for next WG meeting

- SB 1039
- OA Action Toolkit
- Portland State University OA Action tool kit brainstorm
- OAH Council February OA Action tool kit brainstorm

9:30am **Working Group Topics of Interest**

Topics/Recommendations
State Regulations (Land-Sea Interactions)

- Enforcing Existing Regulations
- Suggestions of Needs for Future Regulations

Identifying Local Sources (Land-Sea Interactions)

- Industry point sources and intensities
- Sources and intensities of terrestrial run

Carbon Sequestration and Oxygen Replenishment in the Ocean

- Native Oyster restoration
- Kelp forest and eel grass bed reservation
- Marsh reservation

9:40am **Adjourn**

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

Working Group 3 Meeting #1 - Tuesday, April 3rd, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Building Adaptation and Resilience – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Frank Barcellos, Dr. Aaron Galloway, Fran Recht, and Dr. Caren Braby.
Absent: None

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

2:30pm **Getting Started (Council Co-chair Caren Braby)**

2:40pm **Expectations of Participants**
Suggested Guest speakers at subsequent WG meetings:

- Steve Rumrill – ODFW (Oregon Aquatic vegetation update and buffering capacity)
- Shannon Davis – ODFW (Socioeconomic impacts of OAH)
- Oregon Marine Reserves Program
- David Wrathall – Oregon State University (Socioeconomic impacts of OAH)
- Terrie Klinger – University of Washington (Ocean Acidification and resilience)

External members:
None mentioned

3:00pm **Report Audience and Implementation**
General Audience of Legislative and scientific communities

3:10pm **Working Group Leadership**

Leader was identified after the meeting as Frank Barcellos

3:15pm **Information/Data Needs and Working Group Deliverables**

Data Needs

- Research paper: Clarifying the role of coastal and marine systems in climate mitigation (Howard et al. 2017)
- Report: Emerging Understanding Of Seagrass and Kelp as an Ocean Acidification Management Tool in California

Prioritization of actions (Time and Need) – to be completed for next WG meeting

- SB 1039
- OA Action Toolkit
- Portland State University OA Action tool kit brainstorm
- OAH Council February OA Action tool kit brainstorm

Topics

- Aquatic vegetation restoration and protection
- Importance of incorporating food safety management programs
- Marine Reserves – Placement of Oregon's sites relative to OAH hotspots and refugia
- Multi-trophic aquaculture
- Incorporating OAH resilience in management processes (e.g. Territorial Sea Plan)
- Native oyster restoration

Recommendations

- Align actions and timing of recommendations with current management and regulatory actions
    - Rocky Shore management process (timeline 2019)
    - Marine Reserves Program review (timeline 2023)
- Coordinate with State agencies current and anticipated management needs

4:20pm **Adjourn**

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

Working Group 1 Meeting #1 - Thursday, April 5th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Scientific Understanding and Data Gaps – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Jim Sumich, Liu Xin, Al Pazar, and Dr. Caren Braby. Absent: Andy Lanier and Dr. Shelby Walker.

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

10:05am **Getting Started (Council Co-chair Caren Braby)**

10:10am **Proposed Draft Working Group Focus**
"Identify missing information that convinces ourselves and others to continue to build and collect the best available data for the purposes of science, adaptation, and mitigation of ocean acidification and hypoxia throughout Oregon"

10:25am **Working Group Deliverables**
Topics/Recommendations

1) Identifying Types of Data Gaps
    - Chemical Monitoring – Oregon Ocean Monitoring Group and the Pacific Coast Collaborative data portal
    - Ecological Monitoring and Laboratory Research (including plants and animals)
    - Industry Monitoring – Aquaculture and Fisheries needs
    - Public perception of information needs – Potentially forming a Workshop

- Regions – Ocean, Nearshore, Estuarine, Freshwater and River

2) Biological Proxies
    - Capitalize on citizen science initiatives for Coast wide monitoring
    - Small sized organisms with fast reproductive cycles (short generation times)
    - Decrease resource demands for expensive chemical monitoring
        - *Research and literature review needed to identify 3 widely distributed and biologically sensitive species to use as proxy*
3) Regional Gaps for Industry Partnerships
    - Yaquina Bay, Tillamook Bay, Coos Bay, and Netarts Bay are all major shellfish regions
    - Importance of matching resources to stakeholder and industry needs
        - *Yaquina Bay was identified as high priority region of interest*
    - Leveraging other Oregon institutions, collaborations to Address Data Gaps
    - Oregon Ocean Science Trust – work together with the OOST to develop priorities and funding recommendations (SB 1039 suggests OAH Council make recommendations to the OST)
        - *Formulate clear recommendations for the OOST and funding needs, coinciding with the development of OOST priorities and funding opportunities*
    - Oregon State Universities - Marine Studies Initiative connections due to their mission to mentor and guide student research (referenced in SB 1039), as well as MSI interest in OAH center of excellence
        - *Formulate fellowships and mentorships between MSI students, regional industries and agencies to address specific OAH data gaps*

11:25am **Expectations of Participants**

Guest speakers at subsequent WG meetings:

George Waldbusser – Oregon State University

South Slough National Estuarine Research Reserve

External members: None directly identified at this time

11:35am **Working Group Leadership**

Liu Xin was selected as working group lead, all in favor none opposed

11:40am **Information/Data Needs**

Public perception of information needs

Informational "one pagers" created by the Education and Outreach WH – including oysters, mussels, Coho salmon, and Dungeness crab

- *Logbooks to gather feedback and additional information that the public are interested in learning more about - placed at local stores and in regional docks along the Coast*

Prioritization of actions (Time and Need) – to be completed for next WG meeting

- SB 1039
- OA Action Toolkit

- Portland State University OA Action tool kit brainstorm
- OAH Council February OA Action tool kit brainstorm

12:00pm **Adjourn**

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

Working Group 4 Meeting #1 - Monday, April 9th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Expand Public Awareness – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Al Pazar, Dr. Shelby Walker, John Schaefer, Karen Tarrnow, Andy Lanier, Deanna Caracciolo, and 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

2:35pm **Getting Started (Council Co-chair Jack Barth)**

2:40pm **Working Group Leadership**
Shelby Walker self-nominated as working group lead, all in favor none opposed

2:40pm **Expectations of Participants**
Guest speakers at subsequent WG meetings:
Scientific Public Engagement –
Dr. Francis Chan (OSU)
Dr. George Waldbusser (OSU)
Educational Curriculum Collection and Development –
Brian Erickson (OSU MSI Graduate student)
Outreach through Regional Monitoring Networks "Translation from field to people":
NANOOS
US Array
External members:
None identified by the working group at this time

2:45pm **Working Group Deliverables**

1) Topics/Recommendations
   - "Next generation" engagement through local based school curriculum development
   - Dispelling misconceptions
   - Targeted education programs – Policy makers and legislative staff
   - Coordination with State agencies and programs – STEM Hubs and Dept. of Education
   - Messaging - Simple, positive, local connections
   - Utilizing the "Public Arena" – info access, media "take homes", industry connections
   - Teacher training programs – "Best methods" for long term information distribution
   - Connection education actions with values – including monetary gains and savings

2) Short-term Outreach Recommendations
   - Standardized "Roadshow": Prepared power point slides and one pagers
   - Engagement with seafood processers and food industry (i.e. chefs and restaurants)
   - General Public Surveys and "logbooks" – Questions will be developed with Sea Grant

3) Report Audience and Implementation
   WG materials will be written with two main considerations:
   "Who are we serving?" - Media, students, educators, regulators, regional government officials
   "Who are we talking to?" - State legislators, State Governor

4:10pm **Information/Data Needs**

Data Needs

NOAA Ocean Acidification Education Needs Report

Prioritization of actions document (which includes text from SB 1039 and OA Action Toolkit) should be reviewed by the next WG meeting

4:15pm **Adjourn**

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 #4 - Tuesday, April 17th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

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

Guest presenters: California Ocean Protection Council (OPC) – Deborah Halberstadt; Washington Marine Resources Advisory Council (MRAC) – Martha Kongsgaard

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Deanna Caracciolo (DLCD), Stacey Jochimsen (US Sen. Merkley), Tyler Janazah (State House Dist. 10), Shannon Davis, and Jena Carter.

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

[Video/Audio Recoding]:

10:00am **Getting Started (Co-chairs)**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth)

10:10am **California: OAH Action Planning process (OPC, Halberstadt)**

- Described California's recent actions in absence of a formal OAH Action Plan, as well as their current process to formalize. CA Action Plan targeted to be completed by early 2019.

10:30am **Washington: Blue Ribbon Panel process, OA Action Plan (MRAC, Kongsgaard)**

- Described the Washington's original and recently updated (2017) Blue Ribbon Panel reports, origins. Represents WA's OAH Action Plan.

11:00am **Break**

11:30am **Working Group Updates and Meeting Summaries**

- WG1: Scientific Understanding and Data Gaps
- WG2: Reducing Causes of OAH
- WG3: Building Adaptation and Resilience
- WG4: Expand Public Awareness

12:00pm **Oregon public processes: Rocky Shores Process and Territorial Sea Plan (Lanier)**

- Described the TSP and on-going Rocky Shores (Part 3) revision process.
- Council was interested in exploring the intersect between this plan, the OAH Council plan, and the Oregon Ocean Science Trust priorities.

12:15pm **Public Comment**

- No public comment provided

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

- Update on report development process, draft vision statement development
- Working group meetings will be scheduled before the May 23rd Council meeting (needing 48 hour notice for posting)
- US Representative Bonamici's federal OAH legislative initiatives

1:00pm **Adjourn**

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

Working Group 1 Meeting #2 - Thursday, May 3rd, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Scientific Understanding and Data Gaps – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Jim Sumich, Liu Xin, Al Pazar, Andy Lanier, Dr. Caren Braby, Dave Fox. Absent: Dr. Shelby Walker.

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

10:00am **Getting Started (Council Co-chair Caren Braby)**

10:07am **Oregon Ocean Science Trust Update (presented by Jim Sumich)**

- There is currently proposed an Oregon legislative policy package for funding the OOST's 5-year granting plan at 3.5M (2M for monitoring, 1M for research, 0.5M for administrative services).
- Specific areas of interest including: 1) Effects of OA on crab and shrimp larvae; 2) Effects of OA on mussel and other non-commercial species; 3) Continued monitoring in OR Marine Reserves; 4) Building out additional monitoring lines and sites throughout Oregon.
- OOST is building a partnership with the Oregon Community Foundation to help with financial logistics.

- Suggestions for "next steps": 1) OOST consideration for both a RFP (completive grants) and a non-RFP (direct grant) funding pathways; 2) Considering the value of supporting the Newport Oceanographic Line; and 3) Reinstate operation of the EPA's OAH monitoring system at Yaquina Bay.

10:32am **Current research: Socioeconomic assessments (presented by Charlotte Whitefield)**

- Discussion on the newly developed research grant on marine bivalves responses to OA - visualization web tool and the shellfish aquaculture industry - Dr. Wrathall (OSU), Dr. Waldbusser (OSU), Dr. Kling (OSU), Bobbi Hudson (PSI) – Title: "Vulnerability and Adaptation to Ocean Acidification among Pacific Northwest Mussel and Oyster Stakeholders"
- Dr. George Waldbusser – Invited to full OAH Council meeting on June 25th

10:50am **Review and Discussion of Prioritization Document**

- DRAFT: Crosswalk Document
- DRAFT: Combined WG priorities

11:50am **Information/Data needs to support further WG discussion**

- Proposed Draft Focus Statement (further review required)
  "Identify missing information that convinces ourselves and others to continue to build and collect the best available data for the purposes of science, adaptation, and mitigation of ocean acidification and hypoxia throughout Oregon."
- Feedback on the Log-book mock-up

12:00pm **Adjourn**

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

Working Group 2 Meeting #2 - Friday, May 4th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Reducing Causes of OAH – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Frank Barcellos, Dr. Jack Barth, Karen Tarnow, John Schaefer, Fran Recht, and Dr. Caran Braby. Absent: Dr. Kristen Sheeran

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

2:11pm **Getting Started (Group Leader Karen Tarnow and Charlotte Whitefield)**

2:15pm **ODEQ Point Source Land-Sea Pollution Reports Update (presented by Karen Tarnow)**

- 2011/2013 reports were provided to act as reference for the types of information that DEQ has collected in the South and North coast regions.
- Synthesis identified with WG1 on identifying, and then filling, data gaps in estuary discharge and monitoring programs at DEQ.
- Synthesis identified with WG1 on "Back of the Envelope" calculations of the relative impacts of each identified point source pollution location and their effects on surrounding macro- and micro-environments. Focus recommendations for site reductions that make the largest differences.
- York Johnson (DEQ North Coast Basin) and David Waltz (DEQ Mid Coast Basin) have been invited to the next working group meeting to discuss: (suggested as joint work between WG1 and WG2)

1. *What are the main things you work on in your geographic area?*
2. *In what ways does your work touch upon issues related to OAH?*
3. *What ongoing projects/activities are you aware of that you believe are important to advance OAH interests?*
4. *What kinds of things do you think the Council should consider when it formulates its recommendations for actions needed to advance Oregon's efforts to address OAH?*

2:30pm **Oregon Global Warming Commission OGWC (presented by Charlotte Whitefield)**

- Discussion on the status of the commission and potential overlap with the OAH Councils recommendations.
- An invitation was extended to the OAH Council for them to attend the OGWC June Commission meeting and to cross-post on website.
- **Angus Duncan (Chair of OGWC) was invited to full OAH Council meeting on June 25th.**

3:00pm **Review and Discussion of Prioritization Document**

- DRAFT: Crosswalk Document
- DRAFT: Combined WG priorities

3:50pm **Information/Data needs to support further WG discussion**

4:00pm **Adjourn**

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

Working Group 4 Meeting #2 - Monday, May 21st, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Expand Public Awareness – Meeting Summary Draft
Location: Remote

Attendees

OAH Council Members: Dr. Jack Barth, Dr. Shelby Walker, Al Pazar, Karen Tarnow, and Andy Lanier.
Absent: John Schaefer

Guest Presenters: Brian Erickson

OAH Council Staff: Dr. Charlotte 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

8:00am **Getting Started (Charlotte Whitefield and Jack Barth)**

- Brief introductions and updates from the full OAH Council

8:08am **OA Education Curriculum Development (presented by Brian Erickson)**

- Presentation of outcomes from a 4 day, 50 minute each day, OA lesson series given to 3 classrooms in Lincoln County (roughly 300 high school students). Post testing occurred 10 days after final lesson, and were used to measure outcomes and information retention by students.
- Three main findings were presented: 1) Student knowledge increased and remained elevated post testing; 2) Post testing showed no significant long-term change in attitudes; 3) Short-term impacts of learning about ways to address ocean acidification faded with time in post testing.

- Council members made parallels with other environmental education/messaging topics (e.g., protecting ozone, acid rain reduction), with how simple/positive messaging can result in long lasting change in action and perceptions

8:40am **Review and Discussion of DRAFT Focus Statements (Group Leader Shelby Walker)**

WG4: Increasing public awareness (Broad Theme):

Vision: Oregon residents and visitors are aware of the causes, extent, and impacts of ocean acidification and hypoxia, and work collectively to promote strategies to mitigate OAH.

Mission: Targeted strategies reflecting different audiences are developed and implemented to expand public awareness and implement local and regional mitigation efforts.

WG4-specific working group activities:

Vision: Opportunities to educate and inform students, industry, media, and decision-makers are identified and advanced for the next 10 years.

Mission: Working with Oregon stakeholders to develop K-12 curricula and work with K-12 educators; engage with media and informal educators to promote stories; and educate the public and local, state, and federal decision-makers on ocean acidification science, impacts, and mitigation options.

9:00am **Review and Discussion of Prioritization Document (Group Leader Shelby Walker)**

9:30am **Information/Data needs to support further WG discussion**

- Leverage surveys conducted in other regions (e.g., Capstick et al 2016 – England; Frisch et al 2015 – Alaska)
- Washington State OAH survey methods and questions

9:40am **Adjourn**

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

Working Group 3 Meeting #2 - Tuesday, May 22nd, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Building Adaptation and Resilience – *Meeting Summary Draft*
Location: Remote

OAH Council membership: Dr. Caren Braby, Frank Barcellos, Fran Recht, and Dr. Aaron Galloway

Guest Presentation: Dr. Steve Rumrill (ODFW)

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

2:00pm **Getting Started (Council Co-chair Caren Braby)**

2:09pm **Review and Discussion of DRAFT Focus Statement (Caren Braby)**
Propose activities and initiatives that aid Oregon coastal communities and ecosystems to adapt to changes in OAH conditions and build resilience strategies into management to stabilize Oregon's socio-economic and ecosystem assets in the face of future OAH conditions.

2:20pm **Review and Discussion of Prioritization Document (Caren Braby)**

3:20pm **Oregon Aquatic vegetation and Shellfish update (Steve Rumrill – ODFW)**
- Eelgrass beds are considered carbon "sinks" in most scientific literature, and experience daily and annual fluctuations in carbon capture.
- Regionally, Coos Bay and Netarts Bay have been studies for site specific vulnerability in eel grass carbon capture

3:30pm **Information/Data needs to support further WG discussion**
- Hofmann et al 2011 – High frequency dynamics of Ocean pH: A Multi-ecosystem Comparison

- Kelly and Caldwell 2013 – Harvard Environmental law review
- Lessons learned from the Shellfish Initiative

3:45pm **Adjourn**

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

OAH Council Meeting #5 - Wednesday, May 23rd, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: US Fish and Wildlife Newport Field Office

Attendees

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

Guest presenters: Dr. Shallin Busch (NOAA). Dr. Elizabeth Jewett (NOAA), Mr. Shannon Davis, Dr. Gil Sylvia

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Deanna Caracciolo (DLCD)

Meeting Materials

Copies of all powerpoint 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 (Co-chairs)**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth)
- Vote to adopt: April 17th meeting summary and revised agenda (all in favor; none opposed)

10:20am **Update on Federal OAH NOAA initiatives and Ocean Acidification Information Exchange** (Presentation from Dr. Jewett and Dr. Busch)

- Two part presentation (Federal programs and Oregon engagement) by Dr. Jewett, with supplementary information provided by Dr. Bush
- Council members then discussed increased coordination and involvement in NOAAs new Ocean Acidification Information Exchange

11:10am **Updates: Working Group 1 and Working Group 2**

- Review and vote to adopt Working Group meeting minutes (1st and 2nd meetings) (all in favor; none opposed)
- Review and discussion of WG Recommendations drafts and WG focus statement drafts

12:15pm **Working Lunch**

- Mock-up of outreach event display (for exploration, comment)
  - What is OAH one-pager, OAH Council one-pager
  - OA CO2 experiment
  - Visitor logbook/survey designs

1:10pm **Socioeconomics – Status of the Science describing coastal economies and potential needs for how OAH will impact (Presentation from Mr. Davis and Dr. Sylvia)**

- Presentation on the drivers of social and economic changes in Oregon Fisheries and Aquaculture with a focus on OAH

1:50pm **Public Comment**

- No Public Comments were received

1:50pm **Updates: Working Group 3 and Working Group 4**

- Review and vote to adopt Working Group meeting minutes (1st and 2nd meetings) (all in favor; none opposed)
- Review and discussion of WG Recommendations drafts and WG focus statement drafts

2:45pm **Report Documents Review**

- Report Outline and Crosswalk (with SB 1039)
- Report Mission/Vision Statement

2:50pm **Council Business (Co-Chairs)**

- Future Council meeting planning (schedule, locations)

3:00pm **Adjourn**

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

Working Group 3 Meeting #3 - Tuesday, June 5th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Building Adaptation and Resilience – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Fran Recht, Dr. Aaron Galloway, and Dr. Caren Braby.
Absent: Frank Barcellos

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

10:10am **Getting Started (Council Co-chair Caren Braby)**

10:15am **Discussion of Council DRAFT Work Flow Process (Caren Braby)**

10:20am **Review and Discussion of Prioritization Document (Caren Braby)**

** Due to working members travel schedules, members decided to end the meeting early and work on the following items independently, and send OAH Council staff comments and revisions before June 11th **

1) Working Group Recommendations Document: (Updated version attached)
   Timeline short-term needs vs. long-term needs?
   Ideas on any favorites/priories?

2) Diagram of OAH Council Scope/work: (Updated version attached)
   Any modifications?

Are you comfortable with including in the report?

3) WG Information/Data needs:
   Is there anything that we need PRIOR to September to make final recommendations?
   Is there any needs that can be identified to develop AFTER September?

10:35am **Adjourn**

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

Working Group 2 Meeting #3 - Wednesday, June 6th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Reducing Causes of OAH – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Caren Braby, Karen Tarnow, and John Schaefer. Absent: Dr. Kristen Sheeran, Dr. Jack Barth, Fran Recht, and Frank Barcellos
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

2:10pm **Getting Started (Council Co-chair Caren Braby)**

2:15pm **Discussion of Council DRAFT Work Flow Process (Caren Braby)**

2:20pm **Mention of DRAFT Focus Statement (Group Leader Karen Tarnow)**
Develop an understanding of work being done by others to identify and evaluate land-based drivers of OAH impacts in Oregon's estuaries and coastal waters, and make recommendations on how to assemble this information and/or address data and information gaps to support the Council's efforts to identify priority actions and initiatives to address Oregon's vulnerabilities to OAH.

- *Working Group will revisit the focus statement at the next full OAH Council meeting. Focus statement has not been adapted.*

2:25pm **Review and Discussion of Prioritization Document (Caren Braby)**

** Due to working members travel schedules, members decided to end the meeting early and work on the following items independently, and send OAH Council staff comments and revisions before June 11th **

4) Working Group Recommendations Document:
   Ideas on any favorites/priories?

5) Diagram of OAH Council Scope/work:
   Any modifications?
   Are you comfortable with including in the report?

6) WG Information/Data needs:
   Is there anything that we need PRIOR to September to make final recommendations?
   Is there any needs that can be identified to develop AFTER September?

2:40pm **Adjourn**

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

Working Group 4 Meeting #3 - Thursday, June 7th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Expand Public Awareness – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Shelby Walker and Andy Lanier. Absent: Dr. Jack Barth, Al Pazar, Karen Tarnow, and John Schaefer.

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

1:00pm **Getting Started (Charlotte Whitefield)**

1:10pm **Discussion of Council DRAFT Work Flow Process (Charlotte Whitefield)**

- Suggestions were made to use a professional graphic designer to help the Council with overall document design and reducing "linear" aspects of the document figure to be more representative of the interconnection of working groups.

1:25pm **Review and Discussion of Prioritization Document (Charlotte Whitefield)**

** Due to working Group members travel schedules, the meeting ended early and work on the following items independently, and send OAH Council staff comments and revisions before June 11th **

7) Working Group Recommendations Document: (Updated version attached)
   Ideas on any favorites/priories?

8) Diagram of OAH Council Scope/work: (Updated version attached)
   Any modifications?
   Are you comfortable with including in the report?

9) WG Information/Data needs:
   Is there anything that we need PRIOR to September to make final recommendations?
   Is there any needs that can be identified to develop AFTER September?

1:35pm **Working Group General Updates**

- Suggestions were made that the OAH Council reaches out to OPAC at OPAC's July 2018 meeting to request time on the November OPAC meeting schedule to discuss the September 2018 OAH Council legislative report.
- Questions were address concerning the OSU professional level workshop focused on ocean acidification and measuring the marine carbonate system that will be delivered at Hatfield Marine Science Center in Newport at the end of summer (August 2018). Council staff agreed to reach out to the workshop coordinator to request more information on behalf of the Council, and provide an update at the June OAH Council meeting.

1:40pm **Adjourn**

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

Working Group 1 Meeting #3 - Friday, June 8th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Scientific Understanding and Data Gaps – Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Andy Lanier, Dr. Jim Sumich, Dr. Shelby Walker, and Dr. Caren Braby. Absent: Liu Xin and Al Pazar.

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

9:00am **Getting Started (Group Leader Liu Xin and Council Co-chair Caren Braby)**

9:10am **Discussion of Council DRAFT Work Flow Process (Caren Braby)**

9:30am **Review and Discussion of Prioritization Document (Caren Braby)**

** Due to working members travel schedules, members decided to end the meeting early and work on the following items independently, and send OAH Council staff comments and revisions before June 11th **

10) Working Group Recommendations Document:
   - Ideas on any favorites/priories?
   - Timeline for actions? Short term and long term?

11) Diagram of OAH Council Scope/work:
    - Any modifications?
    - Are you comfortable with including in the report?

12) WG Information/Data needs:
    - Is there anything that we need PRIOR to September to make final recommendations?
    - Is there any needs that can be identified to develop AFTER September?

9:45am **Adjourn**

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 #6 - Monday, June 25th 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

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

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Dr. Steven Rumrill (ODFW), Stacey Jochimsen (U.S. Senator Merkley), Tom Calvanese (Port of Port Orford), Deanna Caracciolo (DLCD).

Meeting Materials

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

Meeting Agenda (Actual) Summary

10:05am **Getting Started (Co-chairs)**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth)
- Vote to adopt: May 23rd meeting summary and revised agenda, Working Group meeting minutes (3rd meetings) (all in favor; none opposed)

10:10am **Council Updates on ongoing initiatives in Oregon relevant to OAH**

- Summary of current OAH community outreach events
- Appointment of new Oregon coast STEM Hub director
- Oregon Legislature Coastal Caucus – Economic Summit (August 2019)

10:25am **Report Theme Review**
(Overarching comments)

- Comments were made that the recommendations were broad and encompassing of all major components of OAH mitigation and adaptation planning.
- Comments were made on improving the interconnection between the themes, by cross-referencing themes to each other and to SB 1039.
- Comments were made on the level of detail of recommendations, actions, and processes in each theme, agreed on considering consolidating some sections to improve report flow and consistency.
- Comments were made on the creation of theme 5, further discussion will be needed as this section continues to be developed.

12:25pm **Public Comment**

- No Public Comments were received

12:30pm **Council Business (Co-Chairs)**

- Future Council meeting planning (July 18th, August 17th)

12:45pm **Adjourn**

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

Working Groups 2 & 3 Meeting #4 - Thursday, July 12th 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Caren Braby, Dr. Jack Barth, Karen Tarrnow, Frank Barcellos, John Schaefer and Fran Recht. Absent: Dr. Kristen Sheeran.

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: None

** Working group members focused on their respective sections (themes 2 and 3); However, all 5 themes were discussed. **

To access a recording of this conversation please visit:
https://www.oregonocean.info/index.php/working-groups

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

Working Groups 1 & 4 Meeting #4 - Friday, July 13th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

OAH Council members: Dr. Caren Braby, Dr. Jack Barth, Karen Tarrnow, Dr. Shelby Walker, James Sumich, and John Schaefer. Absent: Andy Lanier, Al Pazar, and Liu Xin.

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: None

** Working group members focused on their respective sections (themes 1 and 4); However, all 5 themes were discussed. **

To access a recording of this conversation please visit:
https://www.oregonocean.info/index.php/working-groups

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 #7 - Wednesday, July 17th 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Oregon State University, Main Campus, Strand Building

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Attendees

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

Guest presenters: Dr. George Waldbusser (OSU)

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: Jim Carlson, Chuck Willer, Deanna Caracciolo (DLCD).

Meeting Materials

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

Meeting Agenda (Actual) Summary

10:15am **Getting Started (Co-chairs)**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth)
- Vote to adopt: June 25th meeting summary (all in favor; none opposed)
- Last date for OAH Council member edits on report will be August 17th

10:40am **Council Updates on ongoing initiatives in Oregon relevant to OAH**

- OAH DEQ council seat will be replaced in September 2018
- OAH Council co-chairs had a phone meeting with the Oregon Global Warming Commission chair on July 17th 2018
- Oregon Legislature Coastal Caucus – Legislative days (September 2018)
- Oregon Forest management updates and concerns

11:05am **Report Theme Review (Theme 1)**

12:15pm **Prioritization of Recommendations/Actions Discussion**

- Council discussed choosing 5 primary recommendation to highlight in the executive summary, one per theme.
- Council discussed that recommendation/action importance will be a balance of steps/processes that can be completed in the short term, and those steps/processes that will make the largest impact on our understanding/adaptation/mitigation of OAH in the state.

12:30pm **Lunch**

12:45pm **Presentations from Dr. Waldbusser**

"Vulnerability and Adaptation to Ocean Acidification among Pacific Northwest Mussel and Oyster Stakeholders"

1:30pm **Report Theme Review (Theme 2)**

2:25pm **Public Comment**

- No Public Comments were received

2:30pm **Report Theme Review (Theme 3)**

3:00pm **Council Business (Co-Chairs)**

- Future Council meeting planning, a full council meeting phone meeting was agreed upon to occur before August 17th

3:20pm **Adjourn**

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

Working Groups 1 – 4 Meeting #5 - Tuesday, July 31st, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

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

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: None

((Revisions on Themes 1 – 5 were discussed as well as design formatting))

To access a recording of this conversation please visit:
https://www.oregonocean.info/index.php/working-groups

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 #8 - Friday, August 18th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

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

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: None

Meeting Materials

Copies of all PowerPoint 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 (Co-chairs)**

- Formal greetings provided by Co-Chairs (Caren Braby and Jack Barth)
- Vote to adopt: July 17th meeting summary (all in favor; none opposed)

10:10am **Council Updates on ongoing initiatives in Oregon relevant to OAH**

- Oregon Legislature Coastal Caucus – Legislative days (September 2018)

10:20am **Report Themes 1 – 4 were discussed in detail by the Council**
(For more information please see meeting recordings)

12:45pm **Public Comment**

- No Public Comments were received

1:00pm **Council Business (Co-Chairs)**

- Theme 5 was not discussed by the Council due to lack of time.
- Periodization summary was not discussed by the Council due to lack of time.
- Future Council meeting planning, one last full Council phone meeting will be scheduled.

1:05pm **Adjourn**

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 #9 - Friday, August 24th, 2018
Oregon Coordinating Council on Ocean Acidification and Hypoxia

Meeting Summary Draft
Location: Remote

Attendees

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

Guest presenters: None

OAH Council Staff: Dr. Charlotte Regula Whitefield

Audience attendees: None

** Council members focused on Theme 5 and the prioritization document. **

(Meeting time from 11:00am – 12:30pm)

To access a recording of this conversation please visit:
https://www.oregonocean.info/index.php/working-groups

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 F: Communication and Outreach

As part of the OAH Council process, Council Members and staff have focused on sharing OAH messaging and engaging in regional OAH mitigation and adaptation actions. Provided in this appendix are lists of collaborations, presentations and outreach that the OAH Council and/or Council Staff have been involved in.

COLLABORATIVE/ENGAGEMENT:

West Coast OAH Monitoring Inventory Task Force (winter/spring 2018):
The Task Force is reaching the completion of the Pacific Coast monitoring inventory, which includes a spatial catalog of OAH-related monitoring projects. Oregon, California, Washington, British Columbia, and Alaska data sets are in various stages of completion; current completion estimated for summer 2018. Future steps for gaps analysis and prioritization are currently being planned.

Tillamook Estuary Partnership (TEP) Grant award (January 2018):
The TEP, in collaboration with several other members of the Oregon OAH Monitoring Group, received an Oregon Watershed Enhancement Board (OWEB) grant to administer a two year OAH monitoring program in the Tillamook Estuary.

Oregon OAH Monitoring Group Quarterly Meetings (February 2018):
Oregon OAH monitoring experts from state and federal government agencies, Tribes, NGOs and academic institutions met to discuss priorities of the OAH monitoring inventory and start planning for a gaps analysis.

OA Alliance Webinars (April 2018; May 17, 2018):
Webinars for OA Alliance members and interested parties on current global activities on OAH. Presentations ranged geographically from British Columbia, Chile, Fiji, and Oregon; Presentation on NOAA's new Ocean Acidification Information Exchange (OAIE).

Global Climate Action Summit (California, September 2018):
Concurrent meeting of the OA Alliance.

EXPERT PRESENTIONS TO THE OAH COUNCIL*:*

Alan Barton (January 2018):
Hatchery manager for Whiskey Creek Shellfish Hatchery presented on the effects of OAH on shellfish hatcheries.

Dr. Francis Chan (January 2018):
Co-chair of the West coast OAH science panel as well as a researcher at Oregon State University and the Partnership of Interdisciplinary Studies for Coastal Oceans (PISCO), presented on the status of current knowledge and science of OAH.

Deborah Halberstadt (May 2018):
California Ocean Protection Council (OPC) staff presented on current status on OA report planning in CA**.**

Martha Kongsgaard (May 2018):
Washington Marine Resources Advisory Council (MRAC) staff presented on past status on OA report planning in WA**.**

Brian Erickson (June 2018):
Oregon State University graduate student presented on OA curriculum development study results from their research in Oregon.

York Johnson and David Waltz (June 2018):
Oregon Department of Environmental Quality staff presented on Water quality standards and practices related to OAH.

Dr. Shallin Busch and Dr. Elizabeth Jewett (June 2018):
National Oceanographic and Atmospheric Administration (NOAA) Ocean Acidification Group staff presented on National OA actions and communication tools.

Shannon Davis and Dr. Gil Sylvia (June 2018):
The Research Group, LLC Corvallis, Oregon and Oregon State University, Coastal Oregon Marine Experiment Station staff, respectively, presented on the effects of OA on regional fisheries economics.

Dr. George Waldbusser (July 2018):
Oregon State University researcher presented on the current OAH research in Oregon, specifically focusing on eel grasses and oyster beds.

TABLE 2 – List of outreach, extension and service activities completed by the OAH Council.

Date	Location	Event	Activity	Participation
February 12th – 16th	Portland, Oregon	Ocean Sciences Meeting	Scientific Conference	Presentation
February 18th	Newport, Oregon	Mini Marine Science Day	Community Outreach	Hands on activities table
February 24th	Salem, Oregon	Sportsman Show	Community Outreach	Printed materials (Q/A)
February 28th	Newport, Oregon	Water Monitoring Summit	Stakeholder Workshop	Presentation
March 1st	Portland, Oregon	Portland State University	Guest Lecture	Invited presentation
April 10th – 12th	Astoria, Oregon	CREC 2018	Stakeholder Workshop	Invited presentation
April 14th	Newport, Oregon	Marine Science Day	Community Outreach	Hands on activities table
April 20th	Newport, Oregon	US Rep. Schrader Meeting	Fishermen's Roundtable	Invited speaker
May 10th	Portland, Oregon	OSU Shellfish Research	Focus Group	Invited member
June 26th	Newport, Oregon	MBARI EARTH Workshop	Guest Lecture	Invited presentation
June 30th	Newport, Oregon	Oregon Coast Aquarium – World Oceans Day	Community Outreach	Hands on activities table
July 16th	Eugene, Oregon	Western Association of Fish and Wildlife Agencies	Plenary Speaker	Plenary Speaker
August 16th	Newport, Oregon	Sea Grant – Finding the Hook Teachers Workshop	Guest Lecture	Invited speaker
August 22nd - 23rd	Lincoln City, Oregon	Coastal Caucus State of the Coast Economic Summit	Panel Guest	Presentation / Discussion
September 12th -16th	San Francisco, California	Global Climate Action Summit	Panel Guest	Presentation / Discussion

Appendix G: Member Agency Management Responsibilities and OAH Nexus

Of the 13 OAH Council Members, four are State agencies: Oregon Department of Fish and Wildlife, Oregon Department of Agriculture, Department of Environmental Quality, and Department of Land Conservation and Development. These agencies each have a direct role in preparing the state for weathering OAH impacts, including various aspects of understanding, adapting to or mitigating OAH and its impacts. This section describes the overall authority of each agency and the ways that agency work spans the various aspects of OAH management. Starting with the 2017-2018 biennium, the ODFW has one staff member to support the work of the OAH Council.

Oregon Department of Fish and Wildlife

ODFW is responsible for managing and protecting Oregon's biological resources. While most of the agency's direct authority is related to fishing and hunting management, ODFW also has significant responsibility for serving as the State's authority on Oregon's diverse ecosystems, habitats, and non-harvested species. Statutory management authority for the agency is found in Chapters 496 through 513 of the Oregon Revised Statutes (ORS).

> *"The mission of the Oregon Department of Fish and Wildlife (ODFW) is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations."*

ODFW policies are set by the Fish and Wildlife Commission, a seven-member volunteer board appointed by the Governor. This Commission directly works with agency managers and biologists, and has authority and responsibility for the administration and enforcement of wildlife and commercial fishing laws; licenses and permits; hunting, angling, commercial fishing and trapping regulations; and wildlife protective measures.

Within ODFW's Fish Division, the program authority to manage for OAH impacts lies with the Marine Resources Program (MRP). MRP staff are responsible for the monitoring, sampling, research, and management of commercial and recreational marine fisheries as well as their associated marine habitats. The MRP is also engaged in a wide variety of research, management and policy issues on all aspects of sustainable ocean use and conservation. The MRP plays a critical role for the State in providing impacts analyses for human development projects and activities, which are likely to impact ocean fish and/or wildlife. These impacts analyses are included in State agency permitting processes that are run by other Oregon State agencies, for example Department of State Lands' Removal/Fill Permits, for projects that are in marine or estuarine ecosystems.

Agency Policies:

The primary statutes that govern the management of fish and wildlife resources in Oregon are the State Food Fish Management Policy and Wildlife Policy. Specialized teams of biologists focus on inland freshwater fish, terrestrial wildlife, marine wildlife (birds, mammals), and marine fish, and our conservation concerns are well-described in the Oregon Conservation Strategy and its ocean sub-component, the Oregon Nearshore Strategy.

The Oregon Nearshore Strategy provides a strategic plan for ODFW's management of nearshore marine resources, including all ocean areas from the shoreline to 60 meter water depth and encompasses Oregon's three-mile territorial sea. The Strategy, adopted in 2005, sets priorities for conservation and management of nearshore marine fish and wildlife and their habitats; an identification of current information gaps; research and monitoring needs for managing nearshore resources; and 16 actions to address current priority nearshore issues. (http://oregonconservationstrategy.org/oregon-conservation-strategy-help/#scrollNav-4)

Ocean Acidification and Hypoxia Agency Initiatives:

Our understanding of species, habitats, and ecosystem functions is critical for Oregon's ability to mitigate and adapt to larger issues of climate change in our state. Climate change presents unprecedented challenges for Oregonians and for fish and wildlife managers, but taking proactive measures to prepare for the impacts on the state's native species and habitats will make changes more manageable.

Research and monitoring:
ODFW provides data on fisheries harvest and species abundance for stock assessments, conservation, and to assess the impacts of human activities and development. As ocean acidification and hypoxia continue to worsen, we expect to see species shifts that will lead to the disappearance of some and the emergence of others in Oregon's management portfolio. Recent examples include the prevalence of marine Harmful Algal Blooms (HABs), experienced by many in the impacts of biotoxins on clam and crab harvesting activities, or in the emergence of pyrosomes (also known as "sea pickles"), washing up onto Oregon's beaches in huge numbers over the past four years. These distribution changes indicate either a temporary or longer-term shift in the food web and the presence/absence of species at a particular location.

ODFW also plays an important role in coordinating oceanographic information. ODFW has taken on a role as a regional leader by directing, designing, and helping coordinate efforts to inventory chemical, physical, and biological data that may inform management and adaption to OAH. This has taken shape through ODFW convening and supporting the **Oregon Ocean Acidification Monitoring Group (O-OMG),** and ODFW providing regional leadership through the Pacific Coast Collaborative (PCC) on conducting the **West Coast OAH Monitoring Inventory**, to inform future investments in OAH monitoring coastwide.

Oregon's creation of the ODFW **Marine Reserves Program** in 2009 established five reserves (and associated marine protected areas) that primarily serve as reference research sites to inform how OAH is impacting Oregon's marine resources. Marine reserves are being studied intensively by ODFW managers, as well as by academic researchers to understand how natural ecosystems and human communities (including stakeholders and regional economies) are affected by marine reserves implementation. Part of this evaluation relates to the role marine reserves are playing in Oregon's understanding of climate change impacts on marine resources.

Climate and OAH Policy:

ODFW provides technical guidance on climate and OAH policy gaps and policy development, and represents the State in regional and international arenas. In 2008, ODFW co-hosted the **Fish, Wildlife, and Habitat Subcommittee of the Oregon Global Warming Commission**, which produced "Preparing Oregon's Fish, Wildlife, and Habitats for Future Climate Change: A Guide for State Adaptation Efforts". This document outlined guiding principles to assist Oregonians in addressing climate change: (1) The maintenance and restoration of key ecosystem processes; (2) The establishment of an interconnected network of lands and waters that support fish and wildlife adaptation; (3) An acknowledgement and evaluation of the risks of proposed management actions in the context of anticipated climate conditions; (4) The need to coordinate across political and jurisdictional boundaries. This subcommittee is no longer active.

In 2010, Oregon completed a state-wide **Oregon Climate Adaptation Framework**, which describes 11 climate risks that are anticipated to affect the state in the coming decades. As part of this initiative, ODFW and partners hosted a series of expert workshops to identify climate change impacts. These workshops focused on estuaries, oak woodlands, and sagebrush habitats.

More recently, and responding to concerns voiced by scientists, the general public, and industry leaders alike, Oregon's legislature and the Governor formed the **Oregon Shellfish Task Force**, on which ODFW was a non-voting advisory member. The Task Force was asked to recommend actions the legislature could consider to support and protect Oregon's valuable shellfish industry. At its sunset in 2016, the Task Force recommended that the legislature formalize the Oregon Shellfish Initiative and pursue allocation of $2.9 million in support of research on OAH impacts, engaging with the shellfish industry to address OAH, increase monitoring of wild populations, expand chemical monitoring capabilities, and restore and protect native shellfish resilient to OAH conditions.

As co-chair of the Legislatively created **Oregon Coordinating Council on Ocean Acidification and Hypoxia** (Senate Bill 1039; 2017), ODFW now has a clear mandate to engage on OAH science, impacts and solutions with scientists, managers, stakeholders, and policy-makers. ODFW has been working collaboratively within the State and regionally, to coordinate OAH-related research and monitoring, and identify actions and initiatives to address Oregon's vulnerabilities to OAH.

ODFW**,** working on behalf of the state of Oregon, has been instrumental in the development and launching of the **International Alliance to Combat Ocean Acidification**. This international collaboration of cities, state, counties and originations that together will address ocean acidification and other threats from changing ocean conditions. As a member of this organization, Oregon has committed to developing a state-wide Ocean Acidification and Hypoxia Action Plan by June 2019.

Oregon Department of Agriculture

For more than 85 years, the Oregon Department of Agriculture has provided service and expertise to those whose livelihoods depend on agriculture. Those services extend to the Oregon consumer. We are committed to a three-fold mission of consumer protection and food safety, natural resource protection, and agricultural market development. The Oregon Department of Agriculture (ODA) has the mission of ensuring healthy natural resources, environment, and economy for Oregonians now and in the future through inspection and certification, regulation, and promotion of agriculture and food.

Our vision is to remain able to serve the changing needs of Oregon's diverse agricultural and food sectors to maintain and enhance a healthy natural resource base and strong economy in rural and urban communities across the state. ODA inspects all facets of Oregon's food distribution system (except restaurants) to ensure food is safe for consumption, protect and maintain animal health, and ensure animal feeds meet nutritional and labeling standards. https://www.oregon.gov/ODA/Pages/default.aspx

Oregon Department of Environmental Quality

DEQ monitors environmental conditions and administers many different programs regulating air, water and land pollution. *Oregon Department of Environmental Quality Mission:*

> *"Be a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water."*

The U.S. Environmental Protection Agency authorizes the agency to implement certain federal environmental programs in Oregon. This includes the federal Clean Air and Clean Water Acts, and the Resource Conservation and Recovery Act, which covers waste management and underground storage tank programs. DEQ also implements state programs including recycling, groundwater protection, air toxics, emergency response and environmental cleanup activities. DEQ has several Air Quality programs designed to monitor and control greenhouse gas emissions, which are a dominant cause of global ocean acidification conditions. Examples include:

- Greenhouse gas reporting and inventories. DEQ collects greenhouse gas emissions data from certain sectors and compiles a statewide inventory of all emissions originating within Oregon and emissions associated with electricity used in this state. The agency also compiles a second, consumption-based, inventory that measures emissions associated with the lifecycle of goods and services used by Oregonians. This work has enhanced the knowledge of greenhouse gas emissions in Oregon.
- Clean Fuels Program. The purpose of Oregon's Clean Fuels Program is to reduce the average carbon intensity of Oregon's transportation fuels. Approximately one-third of Oregon's greenhouse gases come from the transportation sector. Providing cleaner transportation fuels such as lower carbon ethanol and biodiesel, electricity, natural gas, biogas and propane will help shrink Oregon's transportation-related carbon footprint.
- Low and Zero Emissions Vehicles. The Zero Emissions Vehicle program requires that auto manufacturers sell increasing volumes of electric vehicles in Oregon, helping to curb transportation emissions by ensuring those companies offer their electric vehicles for sale in Oregon. Low emission vehicle requirements, based on California regulations, are designed to move Oregon's automotive fleet to a higher efficiency and lower emissions, including greenhouse gases.
- Financial Incentives: DEQ administers grant and rebate programs designed to reduce emissions from mobile sources of pollution, including greenhouse gas emissions. This includes: (1) Oregon's Clean Vehicle Rebate Program, which will offer rebates to Oregonians who purchase or lease electric vehicles, and (2) Oregon's Clean Diesel Program, which provides both federal funds and Volkswagen Settlement funds to reduce diesel emissions through diesel engine retrofit, replacement and repower projects.

DEQ's water quality program establishes standards to protect beneficial uses of water, such as aquatic life, fishing and recreation and then acts to protect and restore water to the standards to protect those uses. When water quality standards are not being met, the federal Clean Water Act requires states to develop a management plan to meet water quality standards. This plan is called a total maximum daily load (TMDL). TMDLs describe the maximum amount of pollutants from municipal, industrial, commercial and surface runoff sources, which includes accounting for natural background, which can enter the river or stream without violating water quality standards. Implementing a TMDL to achieve the necessary pollution reductions often results in revisions to industrial and municipal wastewater permits and working with local land owners and land managers to develop and implement pollution reduction plans.

The water quality program is currently involved in efforts that may directly or indirectly support Oregon's overall effort to understand and address causes of OAH. For example:

- DEQ collects water quality data and maintains a water monitoring data portal – the Ambient Water Quality Monitoring System – that allows public access to water quality data for rivers and streams, lakes, estuaries, beaches and groundwater resources throughout Oregon. The portal allows users to view, query, chart, graph, and download publicly available data from DEQ and partners, including watershed councils, US EPA and USGS.
- DEQ is a member of the Oregon Ocean Monitoring Group. DEQ provides technical expertise to the group around data collection and management protocols for OAH monitoring efforts. DEQ also provides information on long-term water quality status and trend as well as other assessment information. DEQ is currently participating in a collaborative effort to establish a pilot OAH monitoring site in Tillamook Bay. DEQ is providing equipment maintenance and data storage to the group of researchers implementing the effort.
- DEQ is currently working with local stakeholders on TMDLs in several coastal watersheds to address pollutants that could potentially contribute to OAH conditions. Examples include developing a TMDL to address dissolved oxygen deficiencies in Oregon's mid-coast basins, and implementing strategies in several north coast basins to address water temperature and bacteria

To date, DEQ's water quality program has not conducted assessments or other studies aimed at understanding whether, where and to what extent local sources of water pollution are exacerbating OAH conditions. This type of information could inform state agency and local efforts to determine whether additional local actions to reduce water pollution have the potential to mitigate OAH conditions.

Oregon Department of Land Conservation and Development

The Oregon Department of Land Conservation and Development coordinates land use planning in the state, and houses Oregon's federally approved Coastal Zone Management program. The Oregon Coastal Management Program administers the Coastal Goals, including Statewide Planning Goal 19, the Ocean Resources Goal. Goal 19 provides the foundation for state policy related to Ocean Resources, clearly stating that policy related to ocean management is founded on the protection of the ecosystem, the organisms, and the ecological functions and connections that maintain the long-term ecological, economic, and cultural values and benefits for future generations of Oregonians.

Department of Land Conservation and Development Mission Statement:

> *"To help communities and citizens plan for, protect, and improve the built and natural systems that provide a high quality of life. In partnership with citizens and local governments, we foster sustainable and vibrant communities and protect our natural resources legacy."*

Oregon Coastal Management Program Mission Statement:

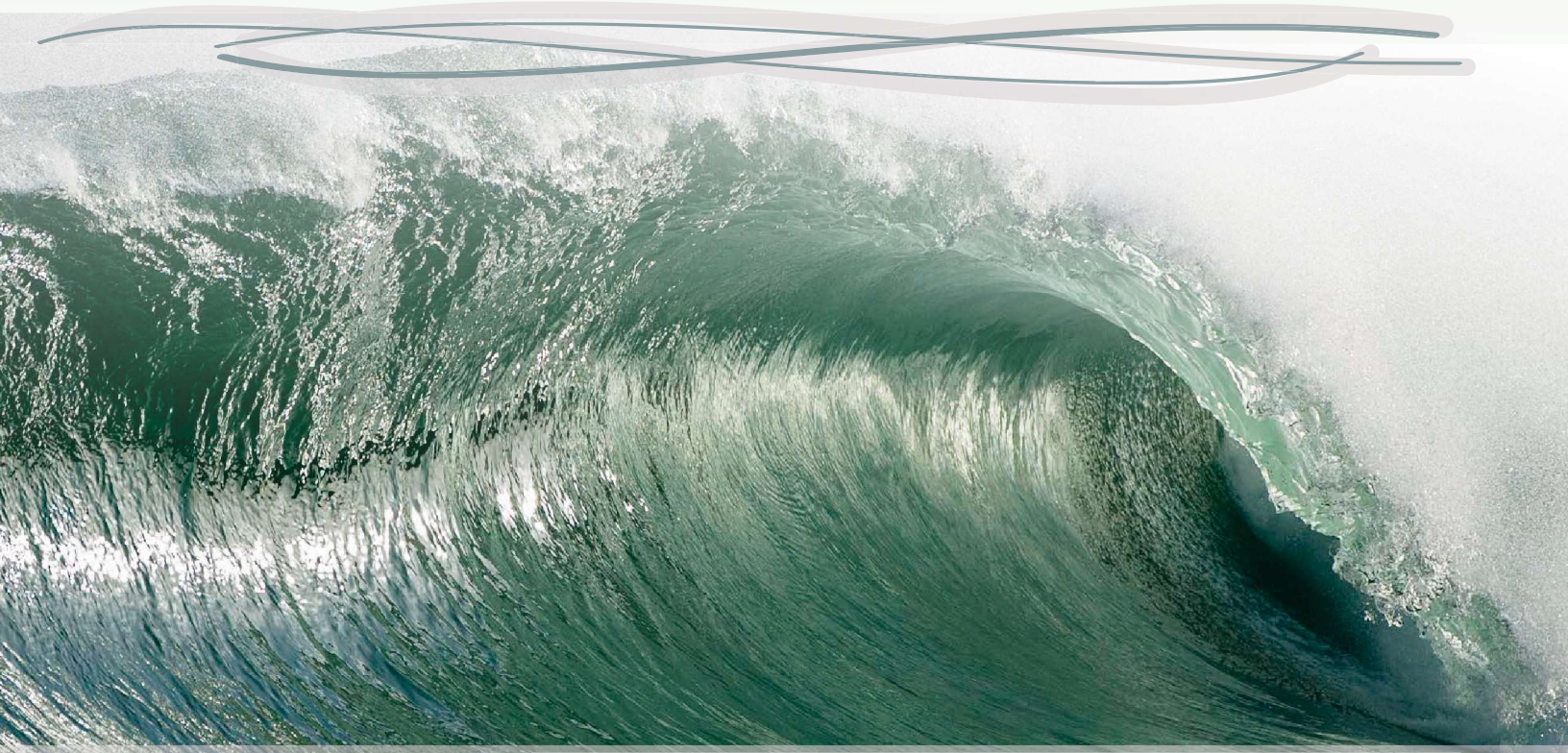
> *"To work in partnership with local governments, state and federal agencies and other stakeholders to foster livable, resilient communities by ensuring that coastal and ocean resources are managed, conserved and developed consistent with Oregon's coastal program authorities."*

Policy Development: Ocean Policy development in the state is coordinated through the implementation of the Territorial Sea Plan which was established through the Oregon Ocean Resources Management Program (ORS 196.475). The Territorial Sea Plan is administered by the Land Conservation and Development Commission in concert with the Ocean Policy Advisory Council (Oregon's legislatively established policy advisory body for ocean issues as described in ORS 196.470). The Department of Land Conservation and Development provides staffing capacity for the coordination of ocean policy development by OPAC, LCDC, and other state coordination entities that need to be consistent with Goal 19. In addition, DLCD coordinates with the agencies that are networked within the OCMP through agency authorities and regulatory programs, including the Oregon Department of Fish and Wildlife, Oregon Department of Agriculture, Oregon Department of Forestry, Oregon Department of Parks and Recreation, and the Department of State Lands.

Federal Consistency: The Oregon Coastal Management Program has the ability to use the federal consistency provisions provided in the Coastal Zone Management Act to ensure that decisions affecting ocean resources are consistent with Oregon's Territorial Sea Plan, the Oregon Ocean Resources Management Plan, and the state statutes and authorities that have been approved by the National Oceanic and Atmospheric Administration, the CZMA administering federal agency.

The West Coast Ocean Acidification and Hypoxia Science Panel

MAJOR FINDINGS, RECOMMENDATIONS, AND ACTIONS



APRIL 2016

Table of Contents

I. Introduction **4**

II. Major Findings **5**

III. Panel Recommendations **6**

IV. Appendices **13**

Appendix A: Why West Coast managers should care about ocean acidification 14

Appendix B: Why the West Coast is vulnerable to ocean acidification – and what we can learn from it 16

Appendix c: Managing for resilience to address ocean acidification and hypoxia 18

Appendix D: The cost of inaction 20

Appendix E: Using modeling to enhance understanding 22

Appendix F: Approaches to reduce CO_2 in seawater 24

Appendix G: Existing water quality criteria are inadequate to protect marine ecosystems 26

Appendix H: Establishing ocean acidification and hypoxia research priorities 28

Appendix I: Tracking changing ocean chemistry through an ocean acidification and hypoxia monitoring network 30

V. The Panelists **32**

VI. Additional Panel products supporting the "Major Findings, Recommendations, and Actions" **36**

This report was produced by the West Coast Ocean Acidification and Hypoxia Science Panel (the Panel), working in partnership with the California Ocean Science Trust. The Panel was convened by the Ocean Science Trust at the request of the California Ocean Protection Council in 2013, working in collaboration with ocean management counterparts in Oregon, Washington, and British Columbia. Ocean Science Trust and the Oregon Institute for Natural Resources served as the link between the Panel and government decision-makers. The information provided reflects the best scientific thinking of the Panel. More information on the Panel can be found at www.westcoastOAH.org.

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Panelists

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Francis Chan (co-chair), Oregon State University*
Jack Barth, Oregon State University
Elizabeth Chornesky, Independent Consultant
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*Denotes Panel Executive Committee Member

I. Introduction

Global carbon dioxide (CO_2) emissions over the past two centuries have altered the chemistry of the world's oceans, threatening the health of coastal ecosystems and industries that depend on the marine environment. This fundamental chemical alteration is known as ocean acidification (OA), a phenomenon driven by the oceans absorbing approximately one-third of atmospheric CO_2 generated through human activities. Scientists initially observed the impacts of OA on calcifying marine organisms that were having difficulty forming their shells, but additional evidence now indicates that growth, survival and behavioral effects linked to OA extend throughout food webs, threatening coastal ecosystems, and marine-dependent industries and human communities (see Appendix A).

Although OA is a global phenomenon, emerging research indicates that, among coastal zones around the world, the West Coast of North America will face some of the earliest, most severe changes in ocean carbon chemistry. The threats posed by OA's progression will be further compounded by other dimensions of global climate change, such as the intensification and expansion of low dissolved oxygen – or hypoxic – zones. In the coming decades, the impacts of ocean acidification and hypoxia (OAH), which are already being felt across West Coast systems, are projected to grow rapidly in intensity and extent. Even if atmospheric CO_2 emissions are stabilized today, many of the ongoing chemical changes to the ocean are already "locked in" and will continue to occur for the next several decades. Given these challenges, decision-makers must act decisively and in concert now.

In an effort to develop the scientific foundation necessary for West Coast managers to take informed action, the California Ocean Protection Council in 2013 asked the California Ocean Science Trust to establish and coordinate a scientific advisory panel in collaboration with California's ocean management counterparts in Oregon, Washington and British Columbia. The resulting West Coast Ocean Acidification and Hypoxia Science Panel, comprised of 20 leading scientific experts (see V. The Panelists, page 32), was charged with summarizing the current state of knowledge and developing scientific consensus about available management options to address OAH on the West Coast.

This document, "**Major Findings, Recommendations, and Actions**" of the Panel, summarizes the Panel's work and presents **Actions** that can be taken now to address OAH. The appendices to this document contain a series of two-page synopses that provide more detail on many of the key concepts that are mentioned in the main body. In addition to this document, the Panel has produced a number of longer supporting documents intended for agency program managers and technical audiences (see VI. Additional Panel Products Supporting the "Major Findings, Recommendations, and Actions," page 36).

Why ocean acidification AND hypoxia?

OA and hypoxia refer to distinct phenomena that trigger a wide range of marine ecosystem impacts. The Panel considered them together because they frequently co-occur and present a collective West Coast challenge. In particular, OA and hypoxia share a common set of drivers – increased atmospheric CO_2 levels and local nutrient and organic carbon inputs. Consequently, OA and hypoxia can be managed synergistically via an overlapping set of management strategies.

The Panel's products are more focused on OA because our understanding of the effects of OA and its interaction with hypoxia is only beginning to grow. In contrast, scientists have built a sizeable body of research on hypoxia, so its impacts on marine environments are better understood. Note that when the Panel uses the term OAH, it is a deliberate reference to both phenomena collectively; the terms OA, hypoxia and OAH cannot, however, always be used interchangeably.

II. Major Findings

The Panel's scientific experts reached consensus on six **Major Findings**:

1. OAH will have severe environmental, ecological and economic consequences for the West Coast, and requires a concerted regional management focus.

OAH is a problem that is expected to grow in intensity with far greater impacts to come, particularly along the West Coast, where regional ocean circulation patterns dramatically heighten the potentially devastating effects of OAH. Local governments alone do not have the capability to halt fundamental, widespread changes to the chemistry of coastal waters. Decision-makers need a common core of scientific information that will enable them to use limited resources in a strategic, coordinated, regional fashion to best serve the ecological and socioeconomic needs of the entire West Coast region. Appendix B provides more detail about the trajectory of OAH-triggered change, and why the West Coast is more vulnerable than other coastal regions.

2. Global carbon emissions are the dominant cause of OA.

Although this document is focused on how the West Coast is impacted by OA and the associated intensification of hypoxia, OA is a global problem that will require global solutions. Given that the dominant cause of OA is global carbon dioxide emissions, the Panel stands firmly behind multinational efforts to reduce atmospheric carbon dioxide emissions worldwide; humankind's ability to reduce the levels of CO_2 being absorbed by the world's oceans will be the single most important, effective strategy for mitigating OA. To that end, the Panel encourages West Coast leadership to develop a regional carbon management strategy, expanding on initiatives such as California's AB 32 and Washington's Climate Action Team.

3. There are actions we can take to lessen exposure to OA.

Although local actions cannot wholly undo the global impacts of OA, West Coast managers can take action to improve local conditions by managing local factors that contribute to declining water quality. In particular, opportunities exist to implement better controls on nutrients and organic matter pollution that flow from land into coastal waters, as these chemicals provide nourishment for algae and bacteria that, in turn, can trigger hypoxia and exacerbate acidification. In selecting specific areas in which to implement these controls, managers should work closely with scientists, as these actions are typically costly and will not be equally effective everywhere; monitoring and modeling results can be used to inform best options.

4. We can enhance the ability of ecosystems and organisms to cope with OA.

West Coast managers are not limited to mitigating OA; they also can take actions to reduce the negative biological and ecological impacts from OA. Fostering ecosystem resilience – that is, taking management actions intended to support an ecosystem's ability to withstand the impacts of OA – offers a near-term strategy for maintaining functional ecosystems along the West Coast as the environment changes. Managing for resilience can be achieved by expanding and adjusting approaches already in place along the West Coast, including the use of protected areas, ecosystem approaches to fisheries management, and integrated coastal management techniques. The concept of enhancing resilience is more thoroughly explored in Appendix C.

5. Accelerating OA science will expand the management options available.

The state of knowledge about OA and its interaction with hypoxia is rapidly evolving, but is still limited and thus able to inform only a limited suite of management options to date. West Coast managers should be looking for opportunities to foster rigorous, managerially relevant research, develop coordinated cost-effective monitoring programs that continue to provide information about the projected trajectories of OAH, and integrate knowledge from multiple domains into decision-making. As scientific understanding of OAH grows, so will the options available for devising effective, fiscally prudent management strategies.

6. Inaction now will reduce options and impose higher costs later.

It is becoming increasingly clear that OA will cause significant ecosystem changes, with widespread negative consequences that diminish valuable ecosystem benefits and services. Over time, OA conditions will intensify, diminishing opportunities for managers and West Coast communities to adapt to the changing marine environment. Delaying action now could render future management interventions far less effective (detailed further in Appendix D). Actions taken now based on best available science offer the possibility of forestalling at least some of the negative consequences for ecosystems and society.

III. Panel Recommendations

Consistent with these **Major Findings**, the Panel has formulated eight **Recommendations** to guide management responses. These **Recommendations** are divided among three themes:

1. Address local factors that can reduce OAH exposure;
2. Enhance the ability of biota to cope with OAH stress; and,
3. Expand and integrate knowledge about OAH.

For each **Recommendation**, the Panel provides specific **Actions** that can be implemented immediately and largely accomplished within a one-year timespan. The Panel's **Recommendations** and **Actions** highlight avenues where new science can quickly catalyze management options for addressing OAH.

By The Numbers

THREE THEMES

Eight Recommendations

Fourteen Actions

THEME 1
ADDRESS LOCAL FACTORS THAT CAN REDUCE OAH EXPOSURE

RECOMMENDATION 1

Reduce local pollutant inputs that exacerbate OAH

Action 1.1: Generate an inventory of areas where local pollutant inputs are likely to exacerbate OA.

Action 1.2: Develop robust predictive models of OAH.

Action 1.3: Develop an incentive-based strategy for reducing pollutant inputs.

RECOMMENDATION 2

Advance approaches that remove CO_2 from seawater

Action 2.1: Use demonstration projects to evaluate which locations are optimal for implementing CO_2 removal strategies.

Action 2.2: Generate an inventory of locations where conservation or restoration of aquatic vegetated habitats can be successfully applied to mitigate OA.

Action 2.3: Consider CO_2 removal during the habitat restoration planning process.

RECOMMENDATION 3

Revise water quality criteria

Action 3.1: Agree on parameters that will be part of OAH criteria.

THEME 2
ENHANCE THE ABILITY OF BIOTA TO COPE WITH OAH STRESS

RECOMMENDATION 4

Reduce co-occurring stressors on ecosystems

Action 4.1: Integrate OA effects into the management of ocean and coastal ecosystems and biological resources.

RECOMMENDATION 5

Advance the adaptive capacity of marine species and ecosystems

Action 5.1: Inventory the co-location of protected areas and areas vulnerable to OAH.

Action 5.2: Evaluate the benefits and risks to active enhancement of adaptive capacity.

THEME 3
EXPAND AND INTEGRATE KNOWLEDGE ABOUT OAH

RECOMMENDATION 6

Establish a coordinated research strategy

Action 6.1: Create agreement among the multiple organizations that fund OAH research to establish joint research priorities.

RECOMMENDATION 7

Build out and sustain a West Coast monitoring program that meets management needs

Action 7.1: Define gaps between monitoring efforts and management needs.

Action 7.2: Enhance comparability of and access to OAH data.

RECOMMENDATION 8

Expand scientific engagement to meet evolving management needs

Action 8.1: Create a science task force.

THEME 1: ADDRESS LOCAL FACTORS THAT CAN REDUCE OAH EXPOSURE

Recommendation 1: Reduce local pollutant inputs that exacerbate OAH.

While elevated atmospheric CO_2 levels are a major driver of OA, local discharge of organic carbon and nutrients can exacerbate OA. Upon discharge, organic carbon is broken down by bacteria, which consume dissolved oxygen during the decomposition process, triggering hypoxic conditions, increasing CO_2 levels and lowering pH. When nutrients such as nitrogen and phosphorus are introduced to coastal waters, they can trigger proliferation of algae that, following their death, are decomposed by bacteria that further decrease dissolved-oxygen levels and increase acidity. The Panel's recommendation to reduce local inputs is tempered by the recognition that scientists do not yet have adequate information to precisely identify locations where reductions in local inputs can meaningfully mitigate OAH effects. In general, the effectiveness of local actions will be greatest in semi-enclosed water bodies, such as estuaries, where local processes dominate over oceanic forcing. Site-specific evaluations are needed to determine which local input(s) (wastewater discharges vs. non-point source pollution in river discharge or atmospheric deposition) should be the targets of nutrient reduction efforts. Because of uncertainties concerning which local-control strategies will be most effective in reducing OA, West Coast managers may find it advantageous to pursue more than a purely regulatory enforcement strategy. For example, upgrades to wastewater treatment plants or investment in water reuse could be incentivized to design facilities that reduce nutrient discharges. Regardless of whether incentive-based or regulation-based approaches are used to achieve desired outcomes, managers can support the expedited development of predictive OA models that will guide decisions about how to best implement local source controls.

- **Action 1.1: Generate an inventory of areas where local pollutant inputs are likely to exacerbate OA.**

  While local nutrient- or other discharge-related control programs will not be effective everywhere, there are a number of locations where local nutrient inputs are thought to exacerbate OA. West Coast managers should compile an inventory of those locations to focus their initial management efforts, as these locations can serve as testing grounds for understanding the relative successes that can be achieved by reducing local inputs.

- **Action 1.2: Develop robust predictive models of OAH.**

  One method to determine where reduction of local inputs will result in the greatest gains in water quality is through use of coupled physical-biogeochemical models. These models quantify to what degree various nutrient, carbon, and CO_2 inputs influence OAH, and project how these inputs will exacerbate OAH. Several research groups on the West Coast are in various stages of developing such models, but before they can be used to support OAH-related management decisions, further investment is required to enhance and coordinate modeling efforts, and to link them to managerially relevant endpoints. A more thorough discussion of how West Coast managers can enhance the usefulness of these modeling efforts appears in Appendix E. Once models are operational, model outputs should be made accessible for comparisons among models and with monitoring data.

- **Action 1.3: Develop an incentive-based strategy for reducing pollutant inputs.**

  West Coast managers can develop grants, loans and other programs to create financial incentives for both the public and private sector to work proactively toward reducing local inputs that can exacerbate OAH, as well as promote reductions in atmospheric CO_2 emissions.

In general, the effectiveness of local actions will be greatest in semi-enclosed water bodies, such as estuaries, where local processes dominate over oceanic forcings.

Recommendation 2: Advance approaches that remove CO_2 from seawater.

Seagrass and kelp beds remove CO_2 from seawater as they grow. This removal of CO_2 has the potential to offset the reductions in pH from OA. Emerging research suggests that conservation or restoration of aquatic vegetation habitats may indeed act to measurably lessen the severity of OA exposure. However, important uncertainties remain about when, where and how broadly local habitat conservation and restoration will mitigate OA exposure (see Appendix F). West Coast managers should actively explore the utility of this mitigation approach.

- **Action 2.1: Use demonstration projects to evaluate which locations are optimal for implementing CO_2 removal strategies.**

  Scientists have conducted research that demonstrates substantive positive benefits from coastal aquatic vegetation on CO_2 removal from seawater. The next step is to transition from these small-scale and short-term research efforts to larger-scale proof of concept demonstration studies across a range of habitats, providing managers with the opportunity to explicitly evaluate under which conditions protection and restoration of vegetated habitats will sufficiently remove CO_2 to meaningfully mitigate OA. These demonstration projects should be accompanied by rigorous monitoring, and physical and biogeochemical modeling to evaluate efficacy of such measures in reducing exposure to OA stress.

- **Action 2.2: Generate an inventory of locations where conservation or restoration of aquatic vegetation habitats can be successfully applied to mitigate OA.**

  The knowledge gained from demonstration projects in Action 2.1 can be used to identify and inventory locations across the West Coast where CO_2 removal strategies can be applied. This inventory can inform comprehensive planning for how local CO_2 removal approaches can be applied relative to other Actions to reduce local inputs of CO_2, non-OA stressors, and enhance ability of biota to cope with stressors.

- **Action 2.3: Consider CO_2 removal during the habitat restoration planning process.**

  A number of investments have already been made to promote aquatic habitat restoration. Carbon offset protocols are also under development in some instances to value the co-benefits from long-term carbon storage of such restoration. However, they do not incorporate the potential benefits of local reductions in OA stress. Accounting for this local ecosystem benefit will assist in better accounting for the full societal value of habitat restoration and management.

Emerging research suggests that conservation or restoration of aquatic vegetated habitats may indeed act to measurably lessen the severity of OA exposure.

Recommendation 3: Revise water quality criteria.

Water quality criteria serve as the foundation for many management activities, providing managers with thresholds to objectively determine the condition of a water body and to set targets for clean-up efforts. As such, they are an initiation point for both planning and implementation activities. However, existing water quality criteria, which were created four decades ago, are not scientifically appropriate for assessing OA conditions. Even when existing water quality criteria for seawater pH are met, a wide range of severe biological impacts of OA are observed. New criteria are needed. The Panel further recommends that OA water quality criteria be expanded to include other acidification parameters, as pH is only one of several possible parameters for describing the carbonate system. One such alternative, aragonite saturation state, has been found to be biologically relevant to a number of calcifying organisms. Appendix G provides additional insight about the need for revised water quality criteria.

- **Action 3.1: Agree on parameters that will be part of OAH criteria.**

  Water quality agencies should lead efforts among water quality and acidification experts to develop scientific consensus about which parameters are most appropriate for inclusion in new water quality criteria. In the immediate future, a scientific workshop is needed to identify appropriate biologically relevant indicators and thresholds to assess OA, and prioritize short-term research needs to support criteria development.

THEME 2: ENHANCE THE ABILITY OF BIOTA TO COPE WITH OAH STRESS

Recommendation 4: Reduce co-occurring stressors on ecosystems.

The ability of marine organisms to grow, survive, and reproduce in the face of OAH is partly dependent on the number, intensity, and interactions of other, non-OAH stresses they encounter, such as physical disturbances to nearshore habitats, warming temperatures, toxic contaminants, biological invasion, and harvest. Thus, it is important for West Coast managers to consider management plans and actions in the context of these multi-stressor effects. For example, the growing adoption of ecosystem approaches to fisheries management offers opportunities to consider the potential regional effects of OAH within the context of other ecological stressors as fisheries management plans are updated.

- **Action 4.1: Integrate OA effects into the management of ocean and coastal ecosystems and biological resources.**

  OA is likely to influence ecosystems along the West Coast via impacts on fish behavior, impaired calcification of shelled organisms, and fundamental changes in food web dynamics. Managers should work to understand and incorporate the probable impacts of OA into management plans for marine managed areas and fisheries. In some instances, this will require bilateral collaboration, for example, between the U.S. and Canada. For fisheries, the most promising avenue for advancing ecosystem-based fishery management along the West Coast is the Fishery Ecosystem Plan (FEP), adopted by the Pacific Fishery Management Council in 2013. The FEP is intended to improve and coordinate fishery management within the California Current Ecosystem by informing decisions made under each individual Fishery Management Plan with broader considerations about the ecosystem. Future updates of the FEP will provide an important opportunity to integrate improved OA knowledge into fishery management decisions, including ways that individual fisheries can be better managed to enhance ecosystem resilience and adaptive capacity under OA.

Recommendation 5: Advance the adaptive capacity of marine species and ecosystems.

Marine species and ecosystems have, to varying degrees, the ability to adjust and persist in the face of changing environmental conditions, a concept known as adaptive capacity. West Coast managers can support their adaptive capacity through relatively passive measures, such as use of protected areas. Managers can also undertake more proactive approaches, such as selective breeding, translocation of organisms that have shown adaptive capacity, and direct modification of genetic material. Genetic intervention efforts are already being explored as a means to improve the adaptive capacity of marine species to OA. The Panel recognizes that these more proactive approaches raise important concerns regarding their potential unintended consequences. Thus, such strategies should only be considered when other means of maintaining and promoting genetic adaptation are infeasible, and only when safety concerns have been addressed.

- **Action 5.1: Inventory the co-location of protected areas and areas vulnerable to OAH.**

  The West Coast includes five National Marine Sanctuaries, five National Estuarine Research Reserves, 15 National Wildlife Refuges, two Canadian marine protected areas, two Canadian Areas of Interest, multiple Essential Fish Habitat conservation areas created by the Pacific Fishery Management Council, 34 Areas of Special Biological Significance established by State of California, and numerous state-managed protected areas. Most protected areas, however, were designed and are being managed without regard to their vulnerability to OAH impacts, because little was known about OAH processes or impacts when most of the areas were established. Nevertheless, some of these protected areas could serve to promote adaptive capacity to OAH. Enhanced diversity and productivity of fish and invertebrate populations and preservation of ecological function within protected areas can strengthen the ability of populations and communities to cope with future OAH impacts. This may be particularly beneficial in instances where protected areas overlap with locations that are likely to face moderated exposure to OAH stress. In contrast, protected areas that are co-located with OAH hotspots offer an environment where biota that develop genetic tolerances to OAH are preserved. Both environments are important to maintaining adaptive capacity. West Coast managers should inventory the co-location of protected areas and areas vulnerable to OAH to assess the number of locations they presently have in the two categories.

...protected areas that are co-located with OAH hotspots offer an environment where biota that develop genetic tolerances to OAH are preserved.

- **Action 5.2: Evaluate the benefits and risks to active enhancement of adaptive capacity.**

  West Coast managers should facilitate the establishment of a working group of scientists and managers from relevant sectors to engage in joint fact-finding about the potential risks, benefits, and costs of active genetic intervention, such as through the selection, manipulation, and/or translocation of genetic varieties as a strategy for enhancing the persistence of species in mariculture settings and in natural ecosystems under intensifying OAH. Such intervention-based options are already being explored for OA but are occurring in the absence of deliberative guidance from the scientific and management communities. Historically, introductions of new genetic varieties and species on land and in the oceans have caused unintended harmful ecological or economic consequences that outweighed their benefits. The establishment of an active genetic intervention working group will set the stage for assessing the policy context for evaluating and regulating planned genetic interventions.

THEME 3: EXPAND AND INTEGRATE KNOWLEDGE ABOUT OAH

Recommendation 6: Establish a coordinated research strategy.

OA research is still in its infancy, with 75% of all acidification science studies published in the last five years, and only a handful of studies to date that have addressed the combined effects of OA and hypoxia, or OA and temperature, or OA and any other stressor. These constraints limit the ability to formulate options for effective management actions grounded in sound science. Generating more options will require further investment in directed research on OAH and its impacts on marine ecosystems. The research should be driven by management needs and should focus on evaluating the breadth of responses available to management, including scale and cost. The Panel has developed a comprehensive set of recommendations about which research topics are most likely to yield the greatest expansion of management options (see Appendix H), and Appendix H is supported by a separate and more extensive technical document outlining recommendations for research priorities ("*Ocean Acidification and Hypoxia Research Priorities to Inform Decisions and Develop Solutions*").

- **Action 6.1: Create agreement among the multiple organizations that fund OAH research to establish joint research priorities.**

  OAH research is taking place at multiple levels – across a range of federal, state, provincial, local and nonprofit funding sources. West Coast leadership should develop a coordinated long-term vision and funding plan to achieve a sustained, leveraged OAH research strategy for the region. West Coast managers should meet with funding entities to help unify their research around focused management goals and ensure that research efforts are effectively coordinated.

Recommendation 7: Build out and sustain a West Coast monitoring program that meets management needs.

Monitoring is a cornerstone of effective environmental management, highlighting spatial differences in OAH condition, and revealing the trajectory of conditions and providing a means for assessing effectiveness of management actions. OAH monitoring programs have often focused on measuring chemical parameters – such as pH and dissolved oxygen – but managers need a comprehensive program that assesses an array of interrelated physical oceanographic, chemical and biological variables and indices. Moreover, most West Coast monitoring is focused on addressing local issues, but these can readily be coordinated to achieve a regional-level program that addresses management needs coast-wide. A more thorough description about the need and opportunities for enhanced monitoring appears in Appendix I and in a supporting Panel technical document that describes a desired monitoring framework ("*Ocean Acidification and Hypoxia Monitoring Network: Tracking the Impacts of Changing Ocean Chemistry to Inform Decisions*").

> ...research should be driven by management needs and should focus on evaluating the breadth of responses available to management, including scale and cost.

- **Action 7.1: Define gaps between monitoring efforts and management needs.**

  West Coast managers should cultivate partnerships between monitoring practitioners and decision-makers to better define OAH information needs across ecosystem types and for diverse uses. First, they should build on existing efforts to complete a comprehensive inventory of existing oceanographic and ecological monitoring programs on the West Coast; the goal being to identify what monitoring is being conducted, what management questions these efforts address, what synergies and enhancements could be achieved, what measurements are missing, and what geographic areas have inadequate coverage to meet management needs.

- **Action 7.2: Enhance comparability of and access to OAH data.**

  Data comparability among disparate programs is necessary to achieve an understanding of OAH. West Coast managers should facilitate training and quality assurance procedures that will enhance comparability among programs. Furthermore, managers should work toward a consistent level of data discoverability, ensuring that the OAH community can make effective use of OAH data. Development of centralized portals for OAH monitoring data will allow this key information to be linked and shared, ensuring that monitoring can be used effectively to inform further research and ultimately management actions. This portal can also be used to access OAH model outputs.

Recommendation 8: Expand scientific engagement to meet evolving management needs.

Over the past two years, the Panel has not only created a set of written products outlining its "**Major Findings, Recommendations, and Actions**," but has also taken advantage of an unprecedented opportunity to network, convey relevant scientific perspectives, and build a community within a relatively nascent research area. Going forward, the region will benefit from this continued thoughtful interaction among scientists that is simultaneously focused and region-wide, and enhanced dialogue between scientists and managers. This is a rapidly evolving field, so cross-boundary communication is crucial to ensuring that new science products developed from research initiatives are appropriately vetted and communicated for use by the management community.

- **Action 8.1: Create a science task force.**

  West Coast managers will need a highly qualified body of scientists to advise them as new science develops in this rapidly evolving field. Given our West Coast-wide scientific commitment, investment, and momentum, this should remain a West Coast regional body with representation from California, Oregon, Washington, British Columbia, Alaska and Mexico as this issue will transcend state and federal geographic boundaries. The task force can evolve from the existing OAH Panel, but it should be refined to focus expertise on topic areas that align with management needs. A West Coast science task force will ensure that managers and legislators continue to be equipped with the most up-to-date information to make important decisions to protect the West Coast.

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