Welcome to the C-CAN Ocean Acidification Roundtable!

We will begin at 1:00 pm PST using the free VOIP (Voice Over Internet Protocol).

If you need technical assistance, please type your questions into the Question box in in the control panel on the right hand side of your screen.
If you are unable to connect using VOIP, dial Toll: +1 (213)929-4212
Access code: 673-760-476
You will be charged for this call.
To connect you MUST HAVE the audio pin number shown after joining the webinar

Today's Webinar:

A state-level policy, management and science approach to build support to address ocean acidification: lessons learned after 5+ years of stakeholder collaboration in Washington State.

Hosted by:

Today's Moderator:

Dr. Jan Newton

Co-Director of the Washington Ocean Acidification Center at the University of Washington, Executive Director of the Northwest Association of Networked Ocean Observing Systems, NANOOS and a C-CAN steering committee member.

Introducing our Featured Speakers

Martha Kongsgaard

Chair of the Marine Resource Advisory Council.

Introducing our Featured Speakers

Bill Dewey

Director of Public Affairs for Taylor Shellfish Farms, the largest producer of farmed shellfish in the United States and owns and operates his own shellfish farm in Samish Bay.

Introducing our Featured Speakers

Dr. Kirsten Feifel

Ocean Acidification Science and Policy Advisor for the Washington State Department of Natural Resources Aquatics Division.

Introducing our Featured Speakers

Dr. Richard Feely

NOAA Senior Fellow at the NOAA Pacific Marine Environmental Laboratory in Seattle., Washington.

Introducing our Featured Speakers

Dr. Terrie Klinger

Barer Professor of Sustainability Science and Director of the School of Marine and Environmental Affairs at the University of Washington, and is Co-Director of the Washington Ocean Acidification Center.

Today's format:

Jan, Martha, Bill, Kirsten, Richard and Terrie will co-present on:

A state-level policy, management and science approach to build support to address ocean acidification: lessons learned after 5+ years of stakeholder collaboration in Washington State.

Q&A

Adjourn

Special thanks to Dr. Shallin Busch at NOAA for her technical assistance behind the scenes.

Overview of MRAC

How it all started

Photo credit: Benjamin Drummond / benjandsara.com

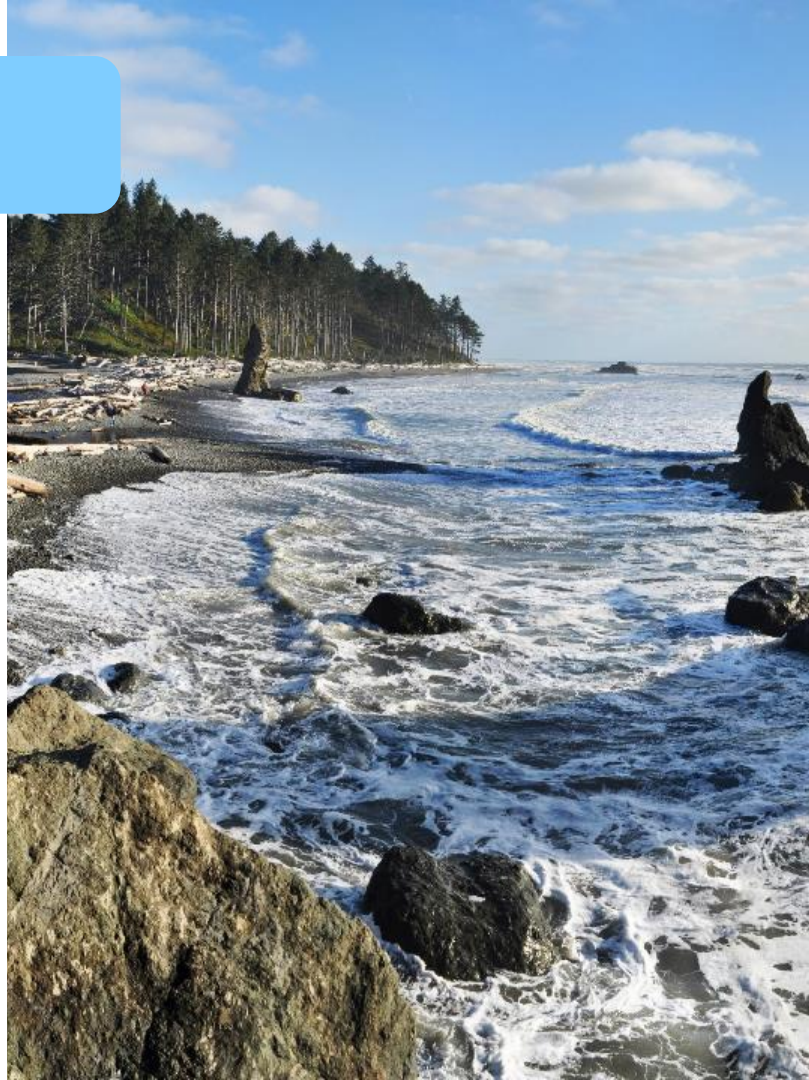
Between 2005 and 2009, billions of oyster larvae mysteriously died at major commercial Pacific Northwest oyster hatcheries.

How it all started

In response, Governor Gregoire and the Washington State Legislature established:

- 2012: Washington State Blue Ribbon Panel on Ocean Acidification
- 2013: Washington Ocean Acidification Center (WOAC)
- 2013: Marine Resources Advisory Council (MRAC)

….to ensure Washington state addresses **ocean acidification** in a strategic and comprehensive way



MRAC basics

- Acts as a state body to maintain a sustainable coordination focus on ocean acidification
- Membership includes:
  - Legislative, executive, and elected officials
  - NGOs
  - Private sector
- Participation also from academic institutions and federal agencies
- Meets quarterly

Who we are

MRAC Chair: Martha Kongsgaard

Current Members:

Brian Allison, Puget Sound Commercial Crab Assoc.
Maia Bellon, Ecology
Mike Cassinelli, City of Ilwaco
Mark Clark, WA State Conservation Commission
Rich Childers, WDFW
Mindy Roberts, Washington Environmental Council
Garrett Dalan, WCMAC
Tom Davis, Washington State Farm Bureau
Bill Dewey, Taylor Shellfish Farms
Norm Dicks, Van Ness Feldman LLP
Tony Floor, Northwest Marine Trade Association
Hilary Franz, DNR
Gus Gates, Surfrider Foundation
Lisa Graumlich, UW College of the Environment
The Honorable Dave Hayes, WA State House of Representatives
Libby Jewett, NOAA
Jay Manning, Puget Sound Partnership
Nan McKay, Northwest Straits Commission
Erika McPhee-Shaw, Western Washington Univ.
The Honorable Kevin Ranker, WA State Senate
Marilyn Sheldon, Coastal Shellfish Grower
Douglas Steding, Assoc. of WA Business
Terry Williams, Tulalip Tribes of Washington

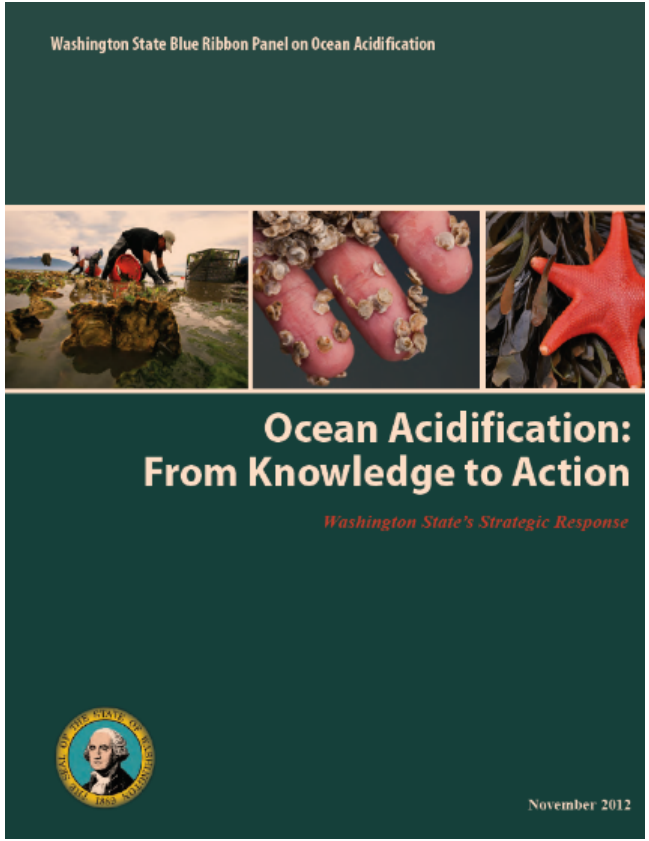
What we do

- Ensure OA work is efficient, leveraged, and integrated into key programs across the state
- Coordinate with WOAC to ensure science is at the heart of everything we do
- Deliver recommendations to the Governor and Legislature on OA
- Seek public and private funding to support recommendations
- Assist in conducting OA outreach activities

MRAC's guiding strategy

Blue Ribbon Panel Report *Ocean Acidification: From Knowledge to Action* from 2012

- Comprehensive strategy for addressing OA in WA
- First of its kind
- Recommends 42 actions across six focus areas



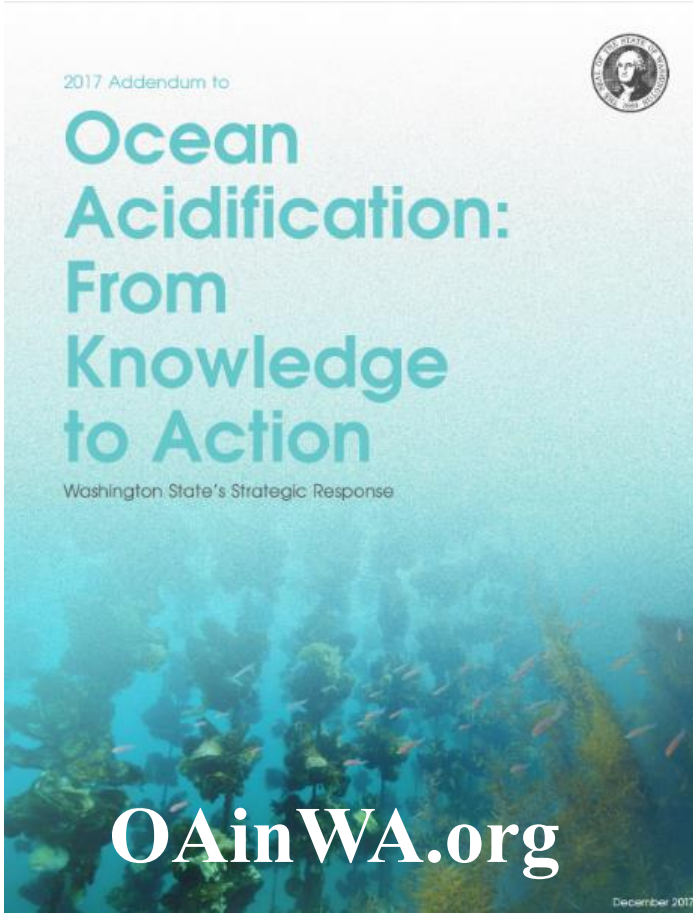
The comprehensive strategy

- Reduce carbon emissions
- Reduce local land-based contributions
- Increase our ability to adapt and to remediate impacts
- Invest in monitoring and scientific investigations
- Inform, educate, and engage stakeholders, the public, and decision makers
- Maintain a sustainable and coordinated focus

Recent update to the strategy

2017 Addendum to the Blue Ribbon Panel Report

- Learns from emerging science
- Incorporates new management needs
- Highlights opportunities for action



Partners leading efforts across the globe

Photo credits: International Alliance to Combat Ocean Acidification

What's next

Overarching priorities include:

- Biological investigations
- Bolster efforts to reduce local nutrient sources
- Build on monitoring efforts
- Build additional adaptation tools (e.g., kelp cultivation and eelgrass restoration)
- Support statewide carbon reduction efforts
- Other needs identified in natural resource managers' survey

Currently engaging members in developing budget priorities for the 2019-2021 biennium

2017 Addendum to

Ocean Acidification: From Knowledge to Action

Washington State's Strategic Response

What's New About Ocean Acidification in Washington's Coastal Waters

Richard A. Feely[1], Brendan Carter[1], Nina Bednarsek[1,2], Simone R. Alin[1] and Jan Newton[3]

[1]Pacific Marine Environmental Laboratory/NOAA
[2]Southern California Coastal Research Project
[3]University of Washington

Bill Dewey
Director of Public Affairs

Impacts of Ocean Acidification on United States West Coast Shellfish Aquaculture

C-CAN Webinar – June 20, 2018

U.S. West Coast Shellfish Products








My clam farm

me

~ 3 hectares

~ 45 metric tons/year

Bottom culture of clustered oysters for shucked oyster meats

Longline culture of clustered oysters for shucked oyster meat

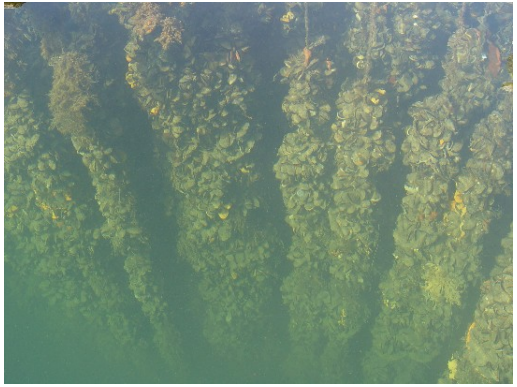
Shucking!

Shucked oyster meats

Single oyster bottom culture

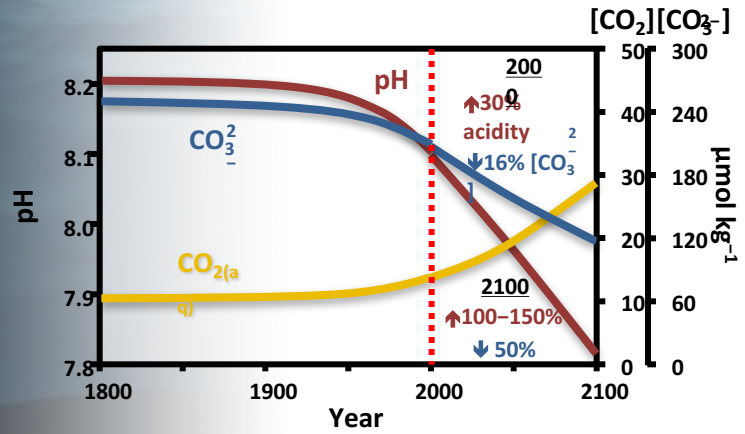
Single oyster flipping bag culture

Mussel raft culture



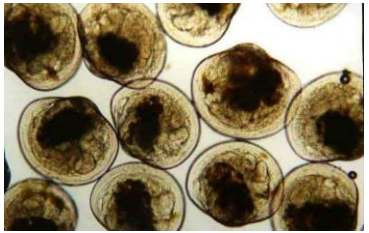
Geoduck clam culture

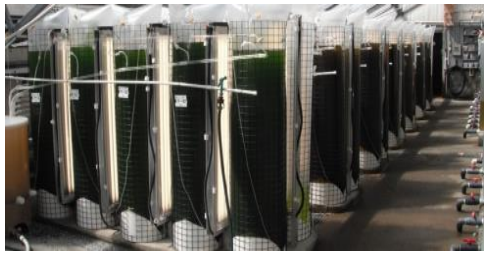
Ocean chemistry changes from anthropogenic carbon dioxide



Wolf-Gladrow et al. (1999)

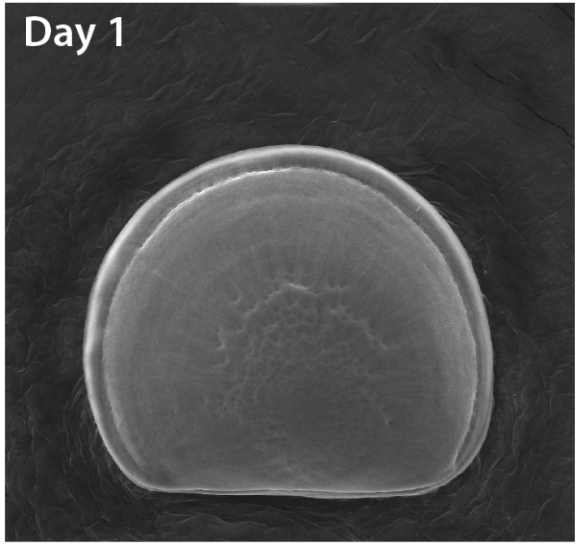
Shellfish seed production





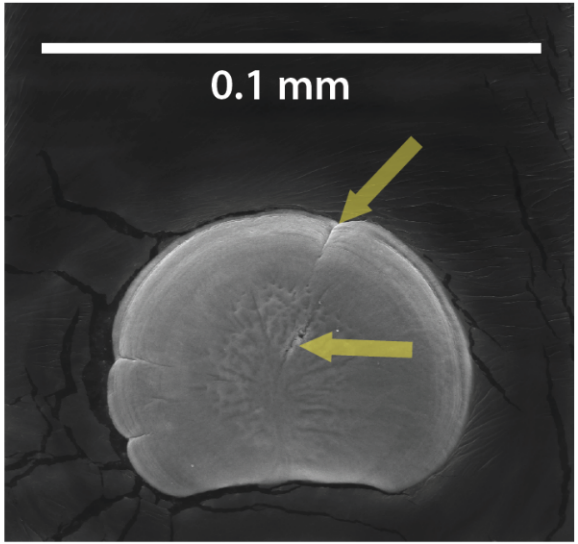
Day old oyster larvae

Abundant carbonate ions available



Healthy

Insufficient carbonate ions available



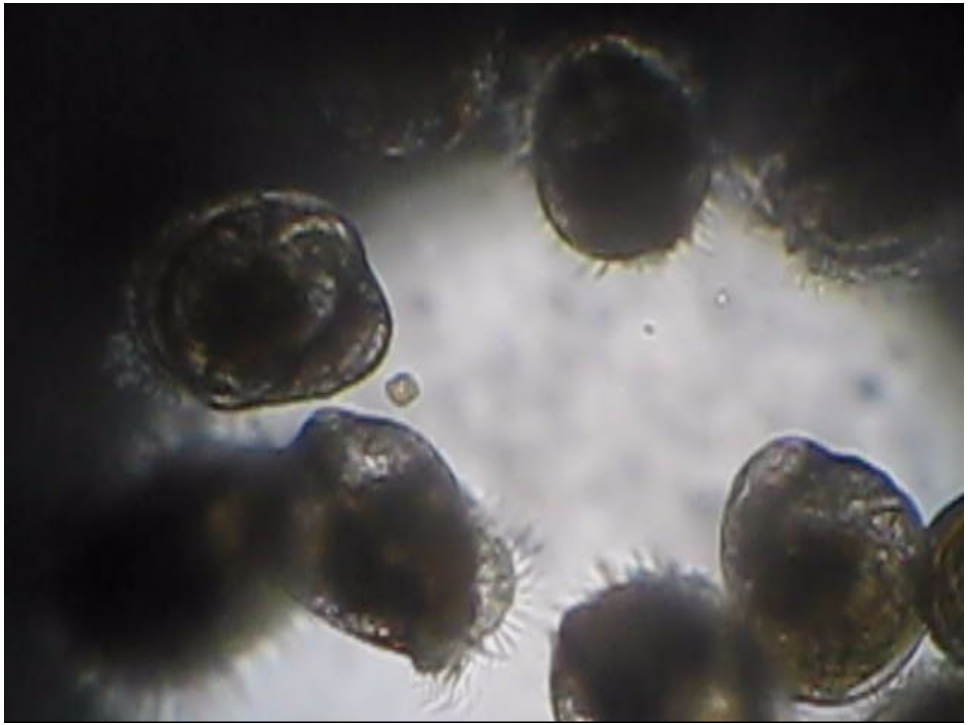
Not healthy

SEM photo: OSU Brunner/Waldbusser

~ 1 week old oyster larvae

Feeding and swimming organ (velum)

Oyster larvae

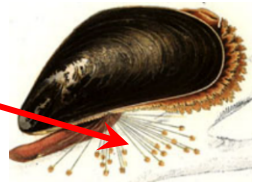


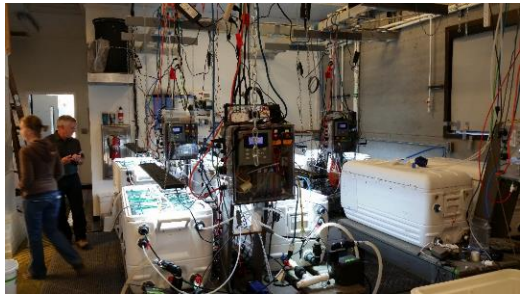
Panic/Adaptation

- Ramped up monitoring and research
- Treating hatchery rearing water
- Breeding OA resistant oysters
- Expanded seed production in Hawaii
- Experimenting w/ seaweed/seagrass refuges

Climate change impact on mussels

- University of Washington research
- Warmer/higher CO2 ocean =
  - Weaker byssal threads
  - Thinner shells





Los Angeles Times

Oceans' rising acidity a threat to shellfish — and humans

As carbon dioxide continues to build up in the atmosphere as a result of burning fossil fuels, the seas absorb much of it.The full effects have yet to be felt.

Comments 23 Email Share +1 5 Tweet 196 Recommend 160

Workers harvest oysters in Samish Bay, Wash., at low tide. Scientists have found that the rising acidity of the oceans is preventing the protective shells of some Pacific oysters from developing. (Liz O. Baylen, Los Angeles Times / June 21, 2008)

The New York Times

As Oysters Die, Climate Policy Goes on the Stump

By CORAL DAVENPORT AUG. 3, 2014

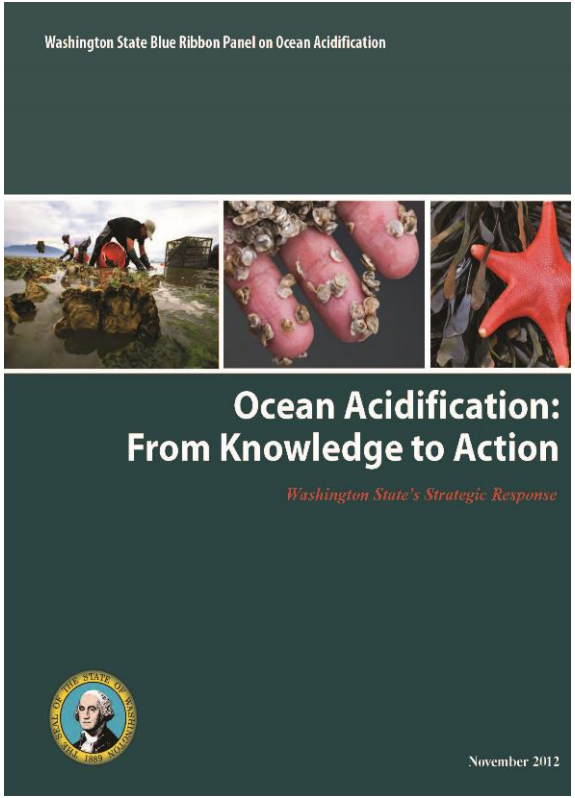
Gov. Jay Inslee, left, with Bill Dewey of Taylor Shellfish Farms during a tour of the company's Quilcene, Wash., hatchery in June. Matthew Ryan Williams for The New York Times

EMAIL
FACEBOOK
TWITTER
SAVE

OLYMPIA, Wash. — Billions of baby oysters in the Pacific inlets here are dying and Gov. Jay Inslee of Washington is busy spreading the bad news.

"It used to be the canary in the coal mine," Mr. Inslee said in a recent interview. "Now it's the oyster in the half shell. You can't overstate what this means to Washington."

Former Washington Governor Christine Gregoire



Advocating for changing carbon policy

caption for this photo here including photographer

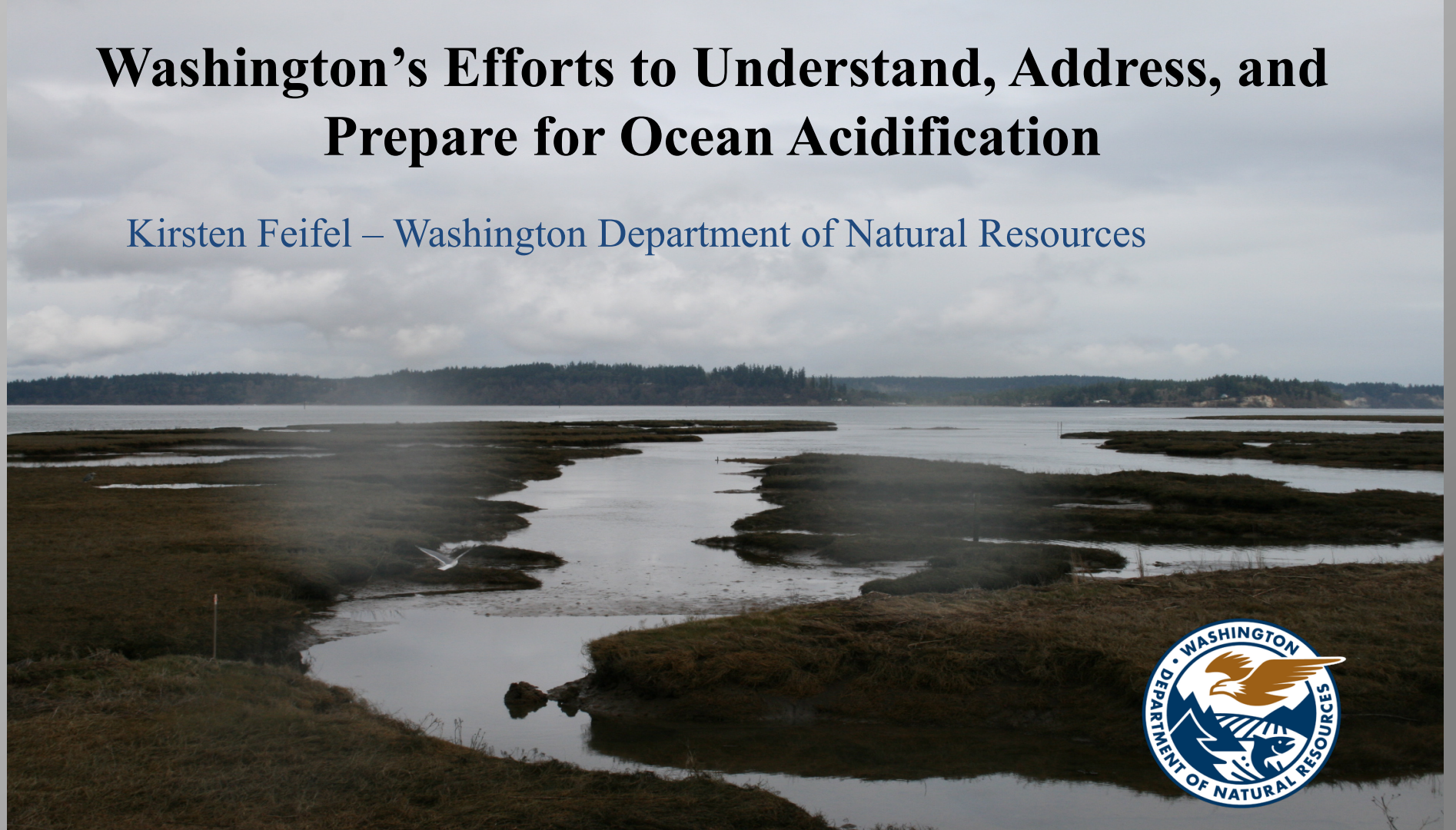
ANNOUNCING THE SHELLFISH GROWERS CLIMATE COALITION

We are pleased to announce the formation of the **Shellfish Growers Climate Coalition (SGCC)**, a partnership between shellfish growers on both the East Coast and the West Coast in collaboration with The Nature Conservancy. The Coalition is dedicated to engaging with food sector businesses, consumers, and policy makers to chart a course towards achieving climate action and securing a low carbon future.

Bill Dewey
Email: billd@taylorshellfish.com
Cell: (360) 790-2330
@BillDeweyIII
@taylorshellfish

Washington's Efforts to Understand, Address, and Prepare for Ocean Acidification

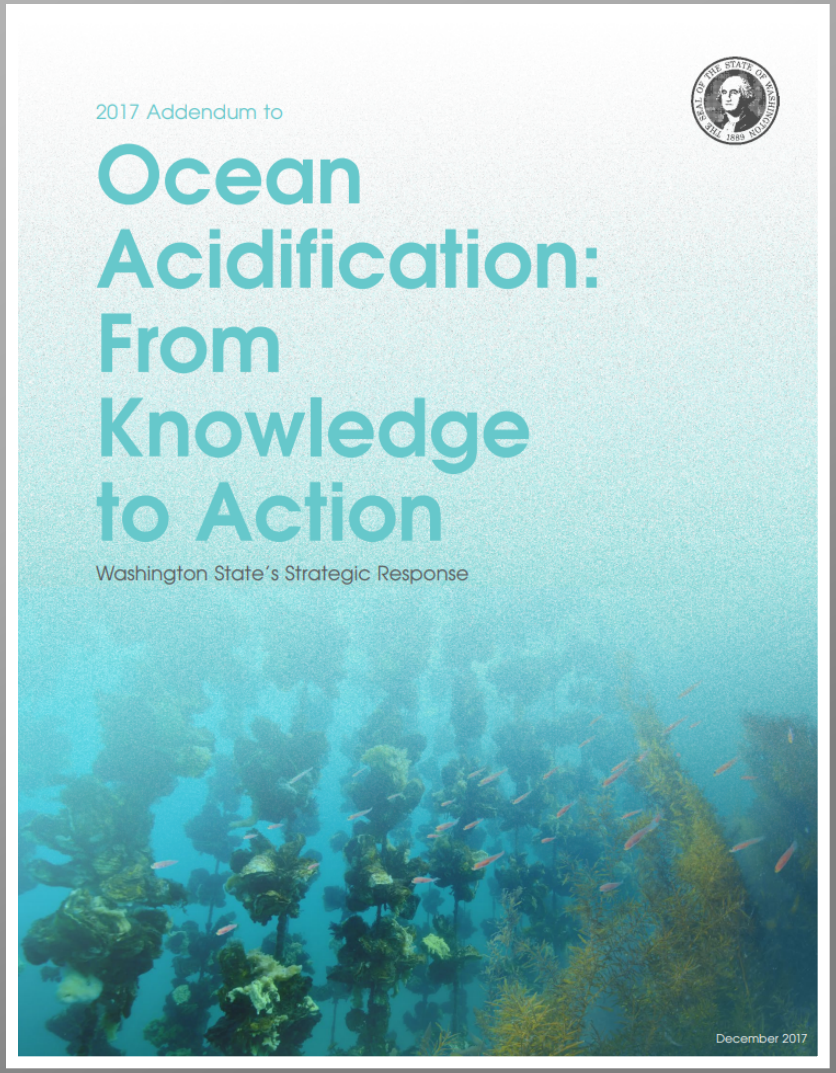
Kirsten Feifel – Washington Department of Natural Resources



Highlight Actions underway that link science to management needs

The Washington approach is a story about learning from each other, collaboration and coordination

57 Actions are identified in the report that will help Washington prepare for ocean acidification



Action 6.1.1 Develop vegetation strategies to remediate seawater

Response and adaptation

WA state agencies, WOAC, NOAA, industry, and NGO partners are working together to evaluate the efficacy of phytoremediation strategies, including use of kelp and seagrass.

Kelp demonstration site at Hood Head. Kelp may act as a buffer to acidifying conditions, and could be an important adaptation tool. Photo credit: John Mickett

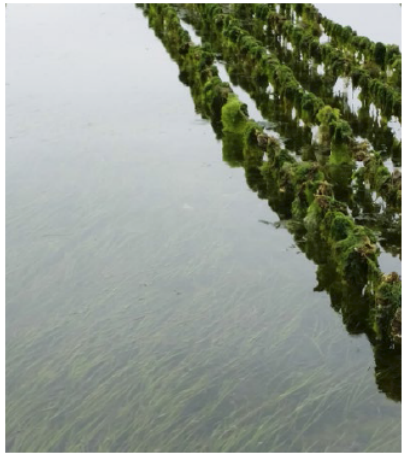


Photo credit: Bill Dewey

Brian Allen with Puget Sound Restoration Fund pictured with sugar kelp on a grow-line at Hood Head, March 20, 2017. Photo credit: Stephen Schreck

Action 6.3.1 Preserve native seagrass and kelp populations

Enhance resilience

- Kelp recovery plan
- Monitoring eelgrass populations
- Eelgrass restoration program and strategy

Photo credit: Washington State Department of Natural Resources

Action 6.3.3 Support restoration of native oysters

Enhance resilience

- Native Olympia oyster restoration projects
- Kenneth K. Chew Center for Shellfish Research and Restoration

Photo credit: Northwest Straits Commission

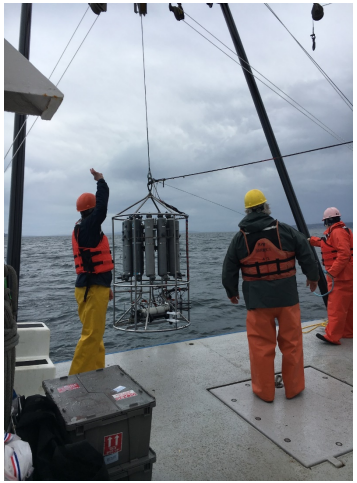
Action 7.1.1 Expand and sustain OA monitoring network

Track OA status and trends

WA state agencies and universities, WOAC, NOAA, industry, and tribes work together as partners to utilize their collective expertise to cover diverse marine habitats of Washington, spanning the open ocean to nearshore environments.

Testing marine chemistry. Photo credit: Washington State Department of Natural Resources

The NOAA research ship Ronald H. Brown taking calibration samples at the NANOOS Cha'ba monitoring mooring. Photo credit: R. Feely, Pacific Marine Environmental Laboratory/NOAA

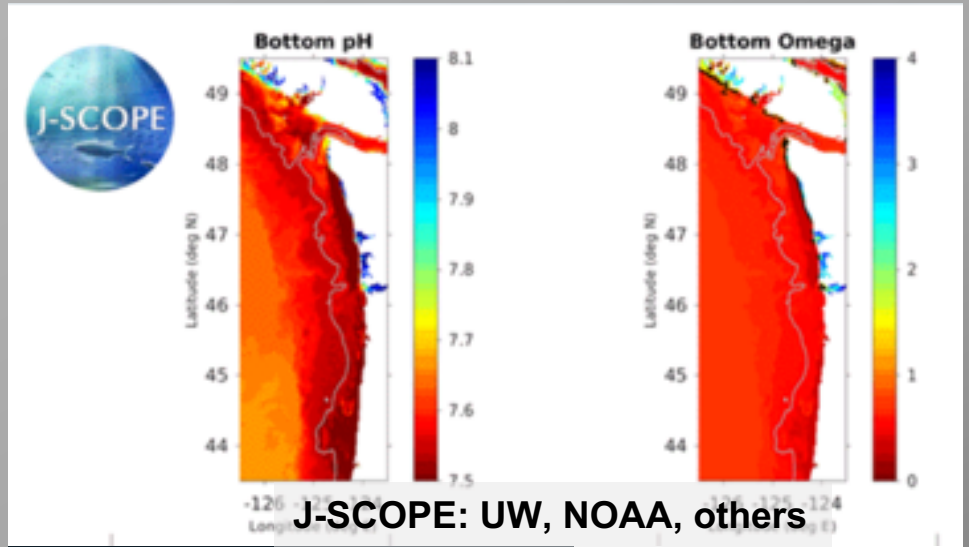


WOAC cruises sample zooplankton and water chemistry. Photo credit: J. Newton, UW/WOAC

Action 7.2.1 Quantify natural and human processes that enhance OA

Identify contributing factors

Different models have been developed, each with its own strengths and applications, by Washington state, university, and national labs. These can be used collectively to improve our understanding of OA.



Action 7.5.1 Support coordination of OA work at the state level

Leverage resources to address key concerns

1. Informational interviews with State and Tribal resource managers
2. Use interview information to develop an online survey for distribution to wider group

Concerns and priorities in the context of changing ocean conditions

Katie Keil, UW School of Marine and Environmental Affairs
Nyssa Baechler, UW School of Marine and Environmental Affairs
Kirsten Feifel, WA Department of Natural Resources
Rich Childers, WA Department of Fish and Wildlife

Washington Department of FISH and WILDLIFE

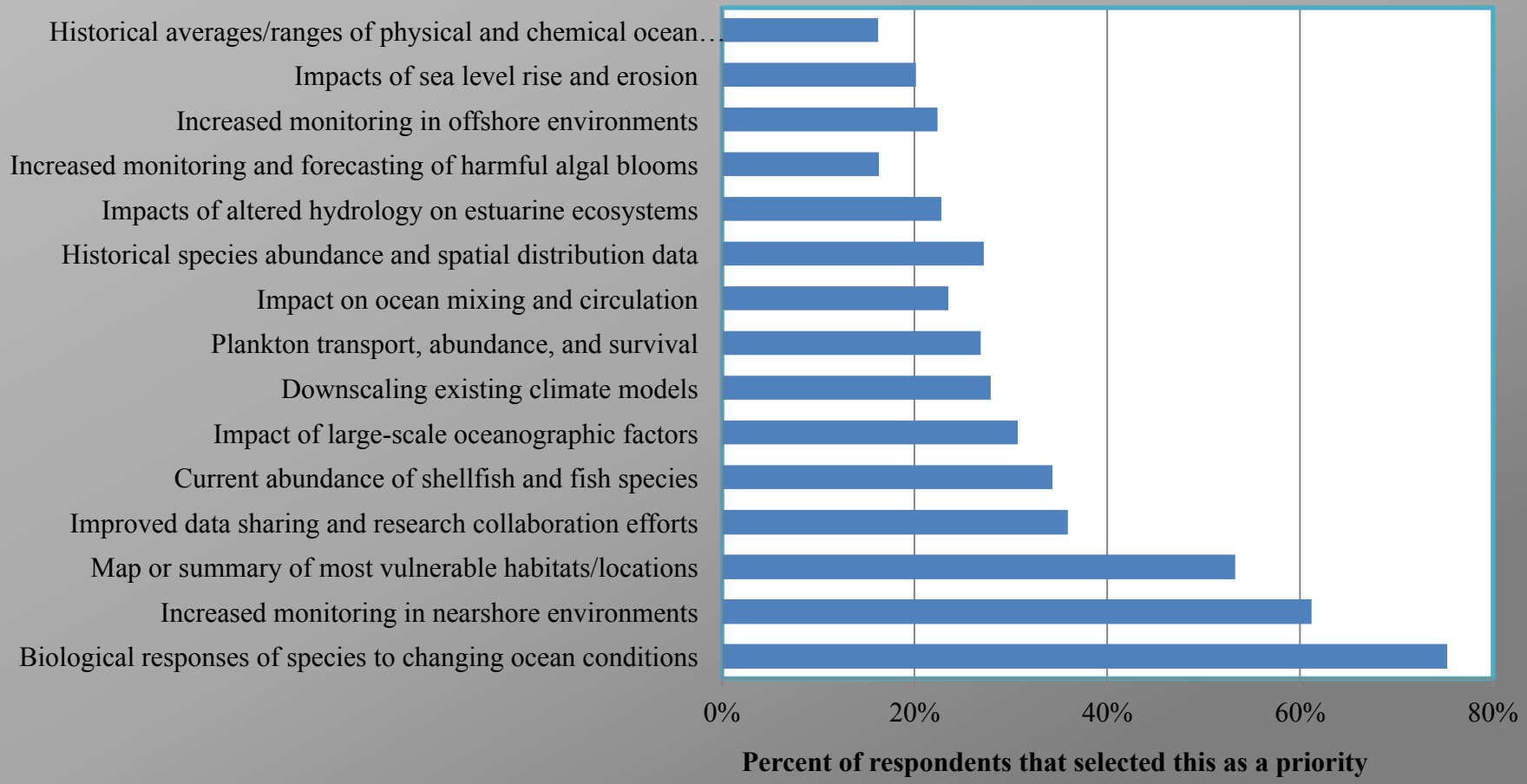
COLLEGE OF THE ENVIRONMENT
UNIVERSITY of WASHINGTON

WASHINGTON DEPARTMENT OF NATURAL RESOURCES

PROJECT GOALS:

01 | Identify concerns and information needs re: changing ocean conditions
02 | Inform future priorities based on management and policy implications
03 | Improve linkages and coordination among partners
04 | Connect results to broader efforts

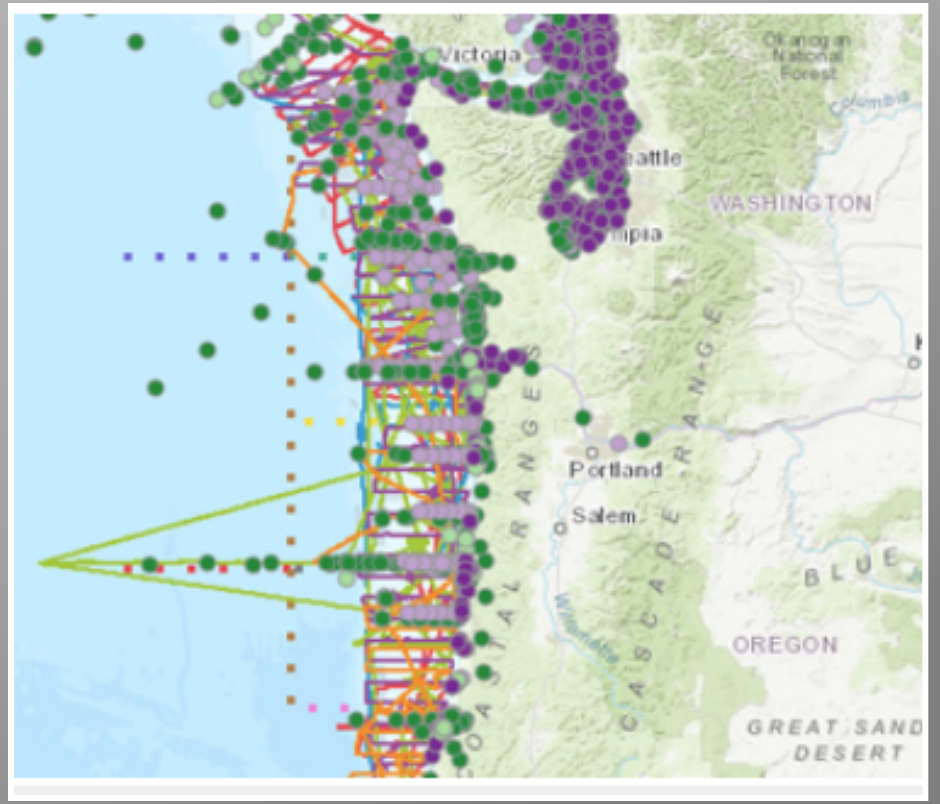
Preliminary Summary of Priorities



Action 9.1.3 Support and coordinate Washington's OA efforts regionally and internationally

Ensure effective multi-agency collaboration

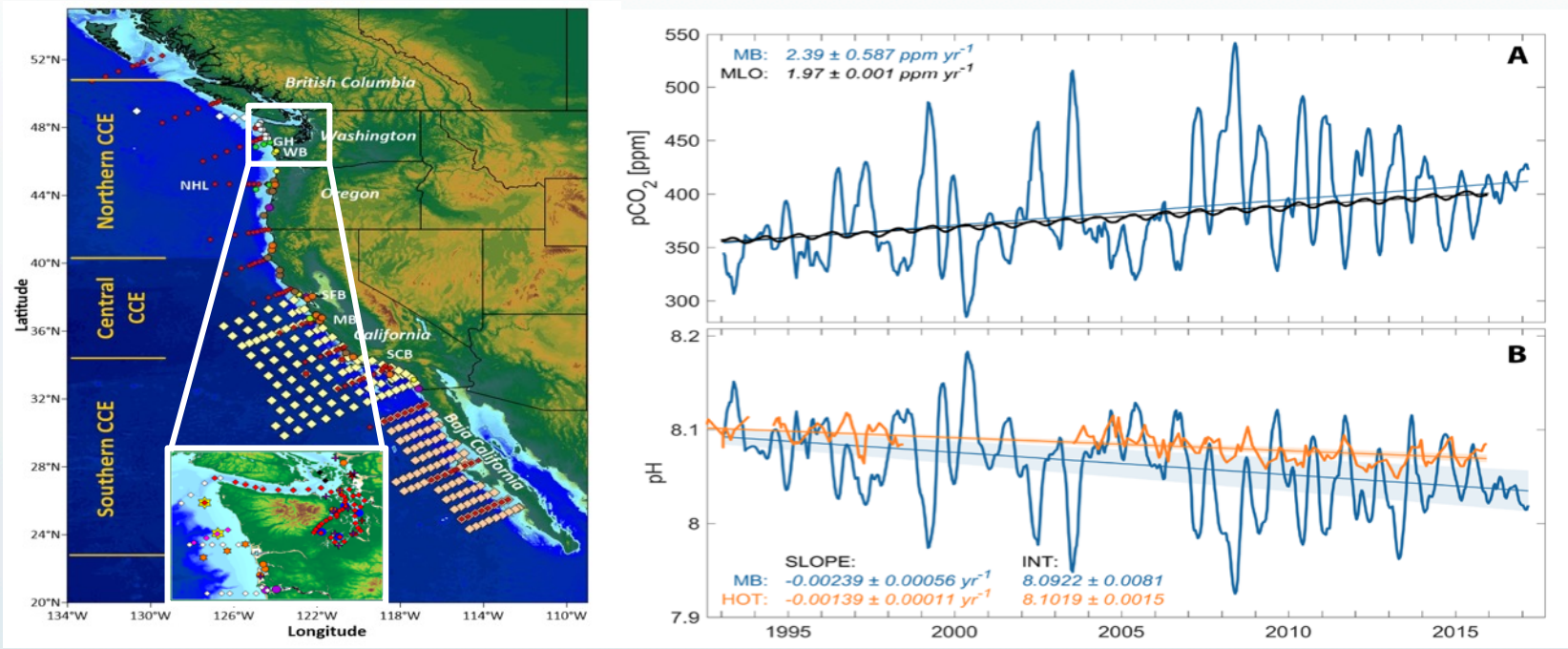
Washington state and federal partners have worked with the Joint Pacific Coast Collaborative/Interagency Working Group "***Integrated Ocean Acidification and Hypoxia Monitoring Task Force***" to inventory assets relevant to OAH and biological responses.




Thank you!
Kirsten.feifel@dnr.wa.gov

An Integrated Federal-State West Coast Ocean Acidification Observing Network

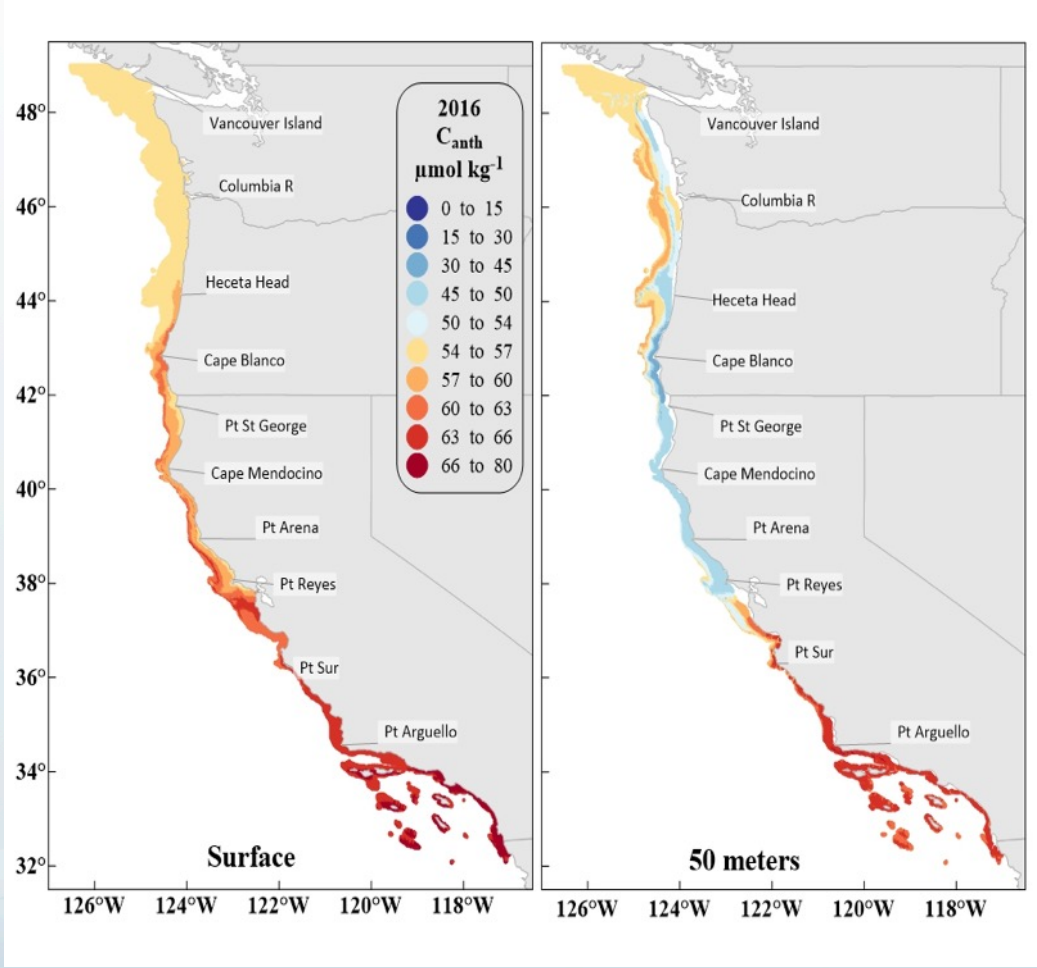
Tuned to local/regional needs and providing real-time information to stakeholders and partners via the IOOS Pacific Region Ocean Acidification Data Portal (ipacoa.org)



Alin et al. 2015, in press (L); Chavez et al. 2017 (R)

- Increasing CO_2 levels in the ocean increases its acidity (lowers its pH). These processes are faster in California coastal waters due to the combined effects of acidification, upwelling, and local carbon and nutrient sources.
- Observations and modeling studies indicate that local anthropogenic carbon and nutrient sources provide significant contributions to local acidification but vary widely depending on location.

Anthropogenic Carbon Distributions in 2016



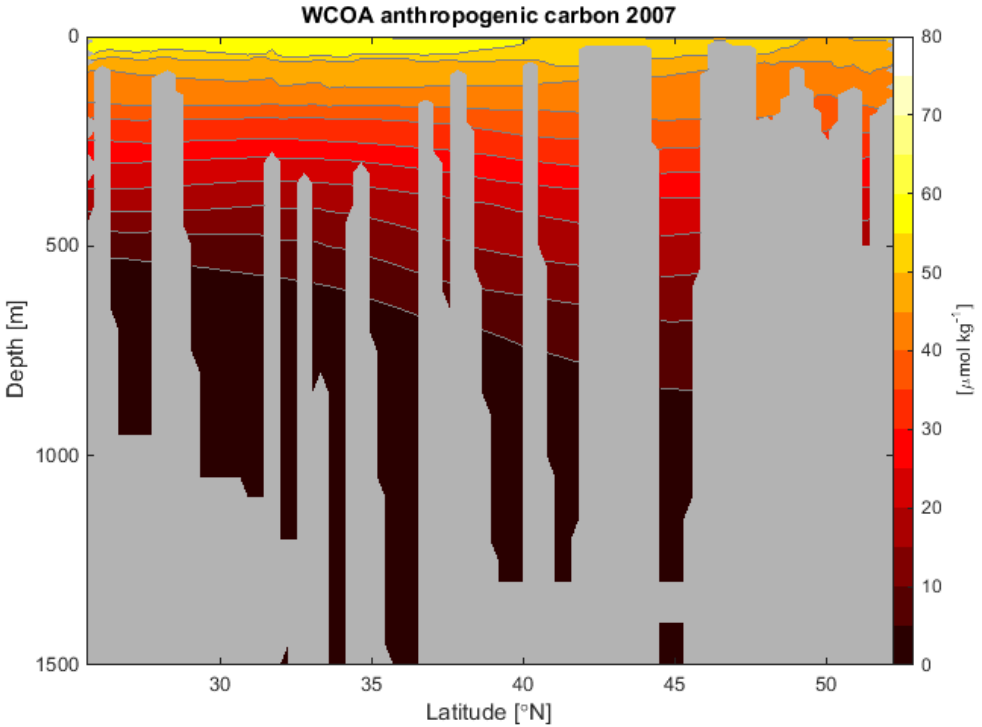
May-June 2016 C_{anth} µmolkg^{-1}

- High C_{anth} surface values (55-66 µmolkg^{-1}) offshore and to the south
- Low C_{anth} subsurface values (40-54 µmolkg^{-1}) in onshore waters from Hecata Head to Point Reyes
- Low C_{anth} waters everywhere below 100m

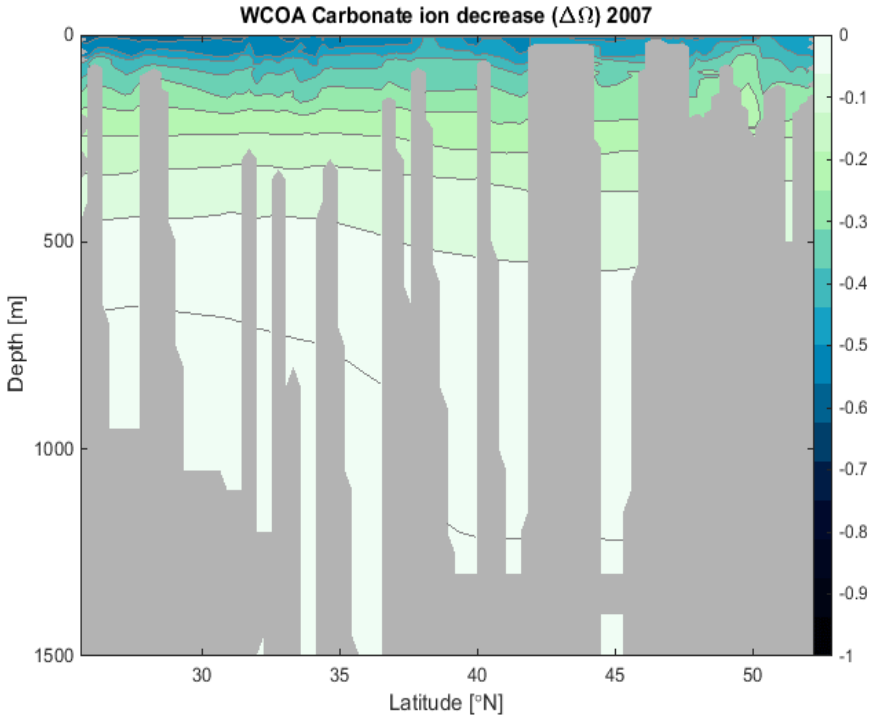
Feely et al., in prep

Evolution of chemical conditions in the California Current Ecosystem

Decadal trend in anthropogenic carbon concentration and aragonite saturation changes from the preindustrial to present

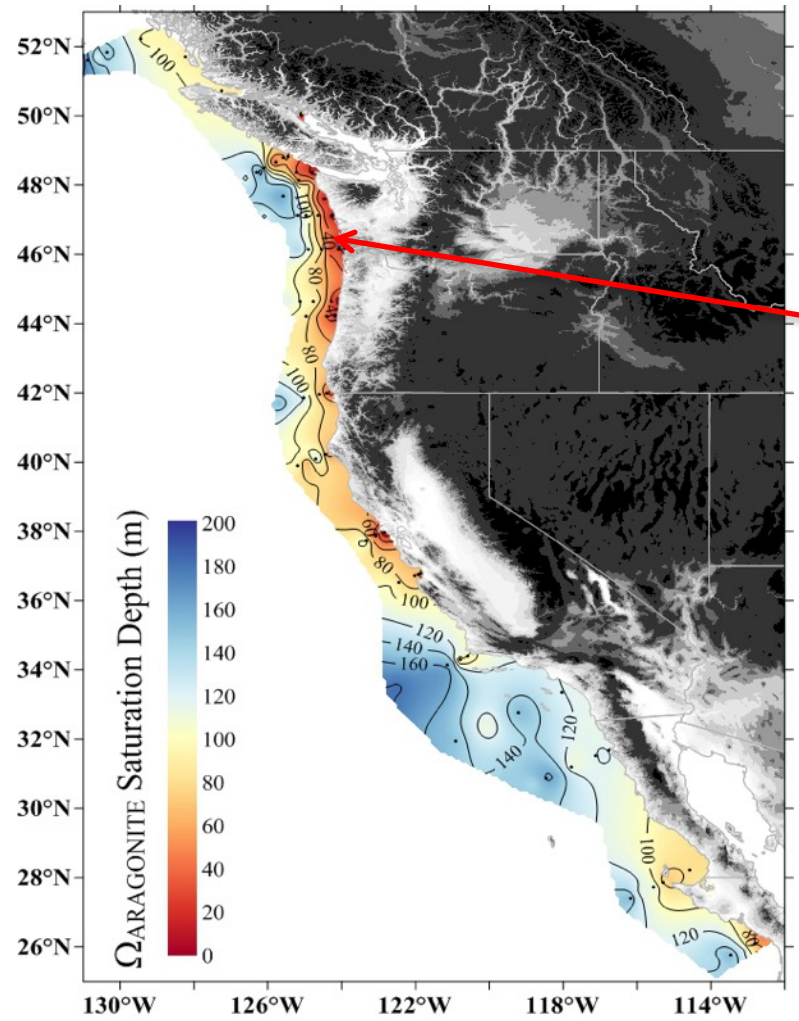


Anthropogenic CO_2 (µmol/kg)

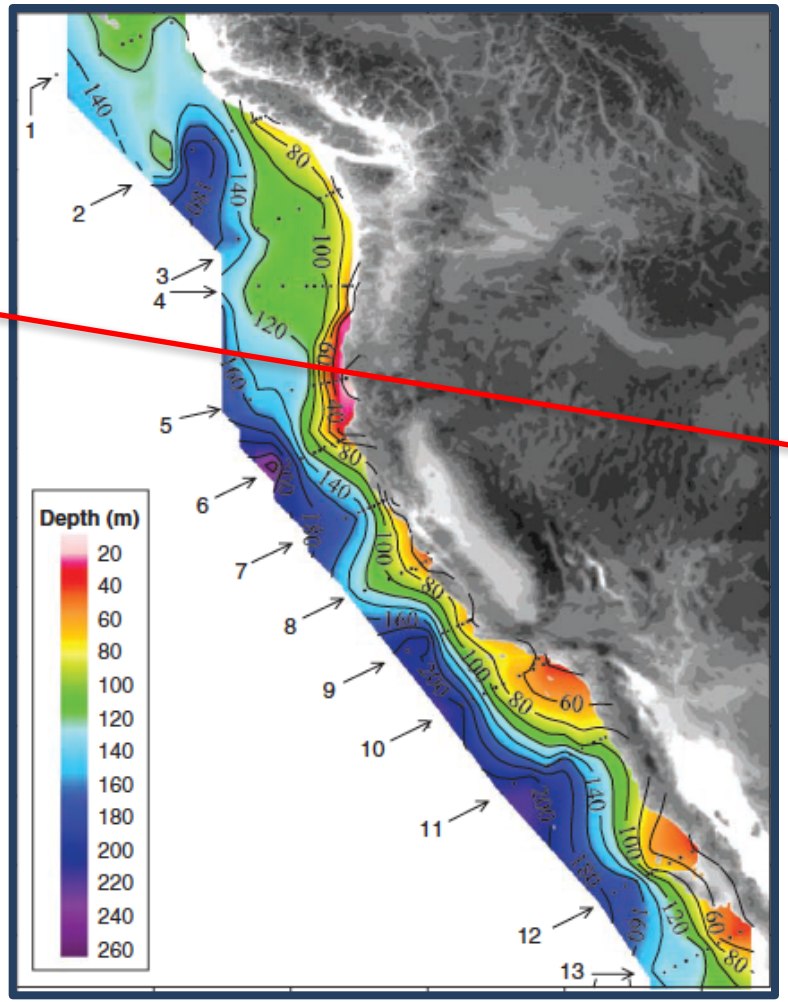


Change in aragonite saturation state

Aragonite Saturation Depth (m) (2016)



Aragonite Saturation Depth (m) (2007)



NOAA West Coast Cruise 8 May – 6 June 2016 compared with May-June 2007

Aragonite saturation depth indicates strong upwelling near the coast from northern California to Vancouver Island.

Moorings: Addressing temporal variation & drivers

- Water quality
- Carbon variables

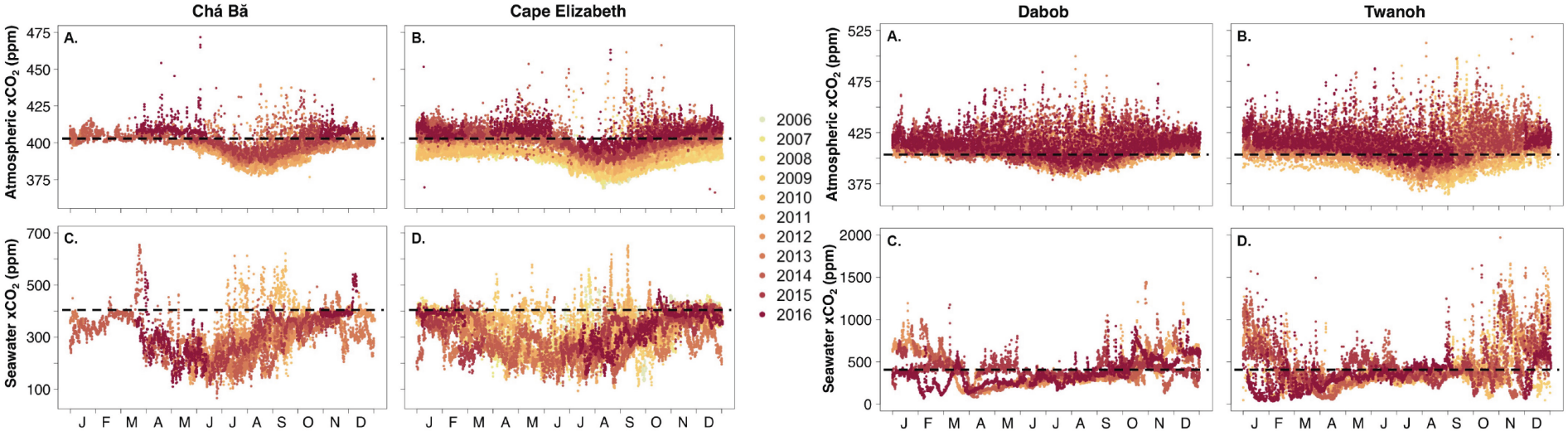
- High-frequency sampling (>1x/day)

- First data 2006 (CE); 2009 (Tw)

Mooring analyses: Coast versus Hood Canal

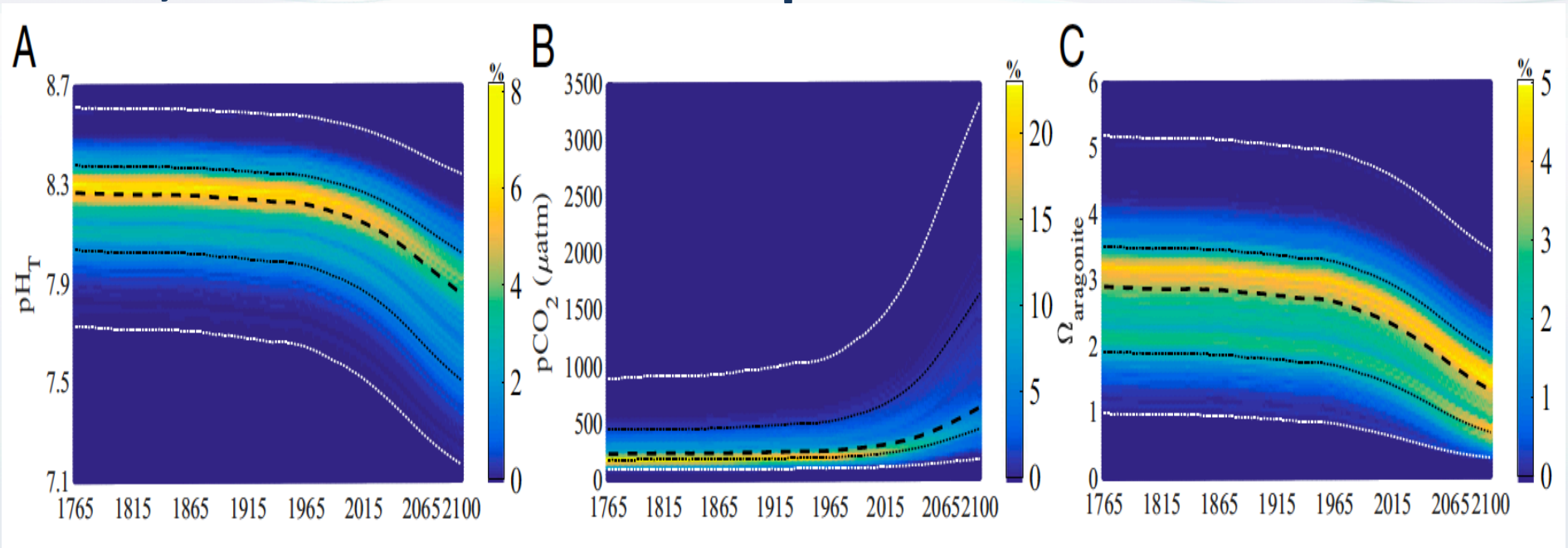
Range of variation in xCO_2 is less off coast than in Hood Canal; moreover, the seasonal timing of highest variability differs:

- Coast highest variation **during summer**: associated with upwelling
- Hood Canal highest variation **during winter**: associated with mixing/storms



Alin et al., 2017 PSEMP

Past, Present and Future Impacts of Ocean Acidification



In coastal environments the increasing anthropogenic carbon reduces the ability of the system to buffer natural variations in CO_2. This reduced buffering capacity leads to preferential amplification of naturally extreme low pH and high $pCO_{2(s.w.)}$ events above changes in average conditions, which outpace rates published for atmospheric and open-ocean CO_2 change. -Pacella et al., PNAS 2018

Six things we know about ocean acidification in Pacific Northwest coastal waters

WOAC
WASHINGTON OCEAN ACIDIFICATION CENTER

- **Rising atmospheric CO_2 changes ocean chemistry and negatively impacts shelled organisms.**
- **Pacific Northwest shellfish are sensitive to reduced calcium carbonate saturation state within the current range of conditions.**
- **Natural and anthropogenic contributions are additive.**
- **Anthropogenic contributions to ocean acidification are detectable and have increased the frequency, intensity, and duration of harmful conditions.**
- **The changes in ocean chemistry will increase over the next several decades.**
- **Some local species are already affected.**

www.coenv.uw.edu/oacenter

Biological effects occur across critical life processes, multiple trophic levels, and habitats [Kroeker et al. 2013, Haigh et al. 2015, Sunday et al. 2016]

Responses are mediated via diverse physiological pathways [Somero et al. 2016]

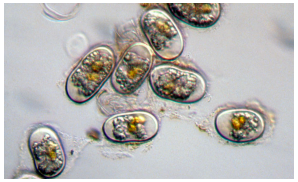
Among calcifiers: energetic demands increase, calcification rates decline, shells are thinner [Waldbusser et al. 2015; Gaylord et al. 2011, Sanford et al. 2014]

Among chitinous species: mortality increases among Dungeness crab larvae and juveniles [Miller et al. 2016, Marshall et al. 2017]; larval development and survival are reduced in krill [McLaskey et al. 2016]

Among fish species: predator detection is affected in juvenile Coho salmon [Williams et al. in prep.]; critical life-history and behavioral traits are affected in pink salmon [Haigh et al. 2015, Ou et al. 2015]; behavioral changes are exhibited by copper rockfish [Hamilton et al. 2017]

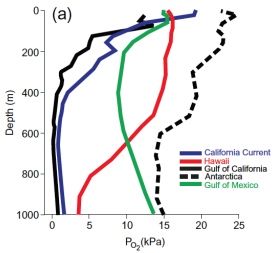
Images (top to bottom): public domain, NOAA, J. Weinberg

Surprising effects are emerging



Harmful algal species can grow more quickly and produce more toxin under OA conditions; response is observed in both diatom and dinoflagellate taxa
[Tatters et al. 2015, Cochlan et al. 2016, Eberlein et al. 2016, Ou et al. 2017]

Synergistic interactions with other climate stressors occur



Increasing temperature, declining oxygen are two common co-occuring stressors
[Somero et al. 2016]

Complexities will influence management options and alternatives

Images: top: D. Anderson, Woods Hole Center for Oceans and Human Health; bottom: Somero et al. 2016

Management responses require enforcement of existing laws and regulations [Kelly and Caldwell 2013]

Holistic, systems-based approaches offer means of addressing inherent complexity [Klinger and Newton 2016]

Creative interdisciplinary and cross-sectoral approaches will be required to address rapid ocean change

Questions?

Please type questions into the question box located in the control panel on the right side of your screen.

A video archive of this webinar will available on the C-CAN website on the "workshop/webinars" page

- http://c-can.info/workshopswebinars/

Please contact Diane Pleschner-Steele at dplesch@gmail.com with any questions about C-CAN.

Our Roundtable Discussion series will resume in the Fall of 2018.

If you have an idea for a discussion topic, please let us know!

Registration and more info will be distributed via the C-CAN listserv and the Ocean Acidification Information Exchange. You can sign up by visiting the C-CAN News page
http://c-can.info/category/news/