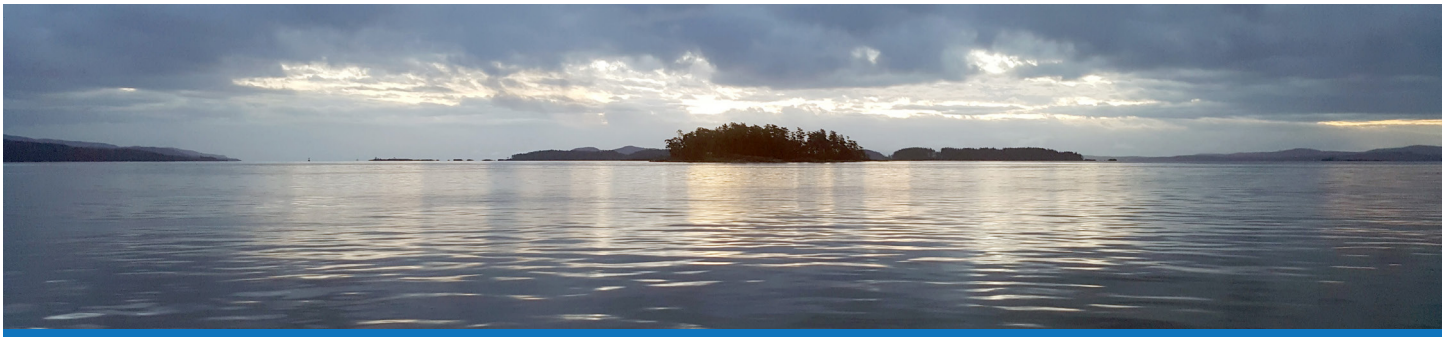
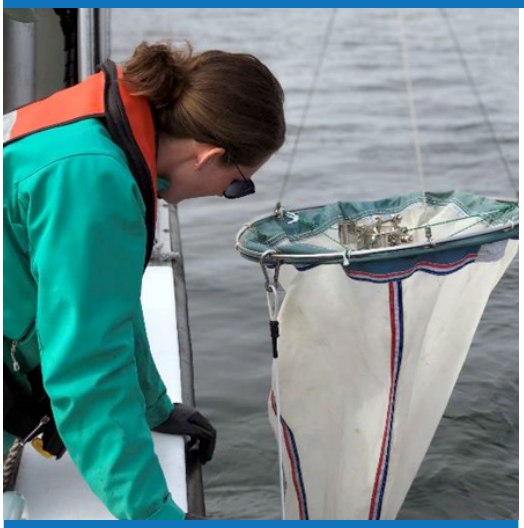


Understanding and Advancing Natural Resource Management in the Context of Changing Ocean Conditions



Resource managers consistently expressed a need for long-term monitoring of plankton and other ecologically important species to help illuminate sensitivity to changing ocean conditions.

Project Background

Ocean acidification, ocean warming, and hypoxia are changing Washington's marine waters, posing a variety of immediate and future challenges for natural resource managers and industries. To address this challenge, the University of Washington Program on Climate Change collaborated in 2018 with the Washington Department of Fish and Wildlife and Washington Department of Natural Resources to solicit input and guidance from resource managers and industry representatives to identify means to enhance resource management strategies in light of changing ocean conditions and improve coordination between managers and researchers.

Key Data and Research Priorities

Survey respondents identified the top five priorities that would be most beneficial for addressing the impacts of changing ocean conditions on the resource(s) they work with:

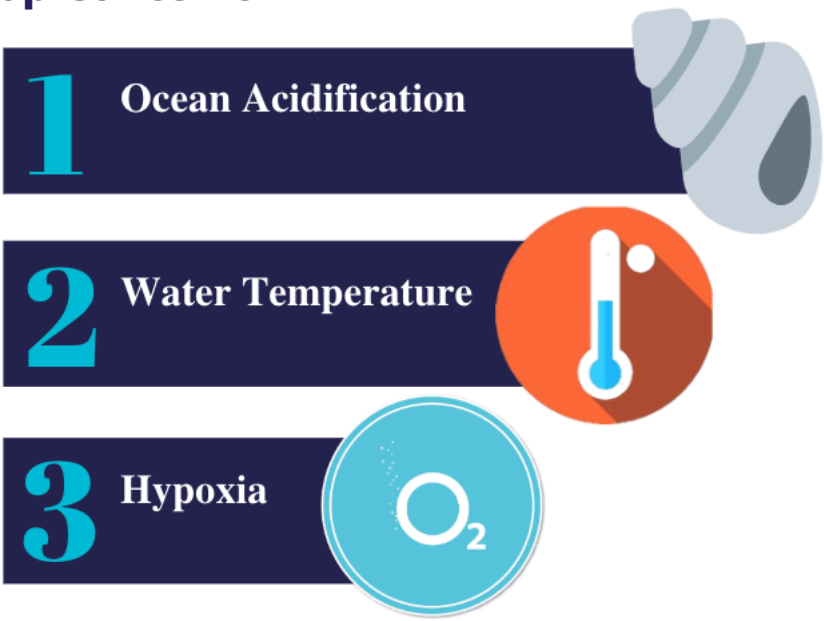
1. **Biological responses of species to changing ocean conditions**
   Over 75% of respondents chose species tolerance and survival thresholds as one of their top priorities.
2. **Increased monitoring in nearshore environments**
   Over 60% of survey respondents identified increased monitoring in the nearshore as a priority.
3. **Map or summary of most vulnerable locations**
   Identifying which areas and habitats are considered most vulnerable was a priority of 100% of resource managers.
4. **Improved data sharing and collaboration**
   Lack of coordination and data sharing was repeatedly cited as a barrier to effectively addressing the challenge of changing ocean conditions.
5. **Resource abundance data gaps**
   Better knowledge of historical and current shellfish and fish populations is needed to differentiate long term cycles from recent anthropogenically caused changes.

June 2019

How Concerned are Resource Managers?

The survey queried individuals regarding their level of concern, from "not concerned" to "very concerned" on seven key ocean change issues. Respondents selected "very concerned" for ocean acidification (70%), water temperature (66%), and hypoxia (53%). Survey respondents were less apt to indicate that they were "very concerned" about the other issues surveyed: eutrophication (40%), sea level rise (34%), estuarine circulation (29%), and salinity changes (25%).

Top Concerns



What do Managers Need?

Resource managers are keenly aware that the species they work with have complex life histories that vary in both space and time. For this reason, managers indicated that they need the following information to incorporate changing ocean conditions into their decisions:

- Historical, location-specific **recruitment estimates** against which to measure species-level responses to changing ocean conditions
- Continuation, standardization, and improvement of methods and programs that assess **existing biomass** and the population size of ecologically or commercially important species seasonally or annually
- Assessments of the **vulnerability and future distributions** of different life stages, particularly the planktonic stage, of various managed species and deleterious species such as harmful algal blooms
- Highly resolved, **weekly forecasts** of the physical and chemical environment (e.g., pH, water temperature, dissolved oxygen) that are able to inform immediate management decisions
- Basin scale or finer **decadal forecasts** of how the physical and chemical environment will change with suitable interpretation able to aid in long term adaptive planning

Management Obstacles

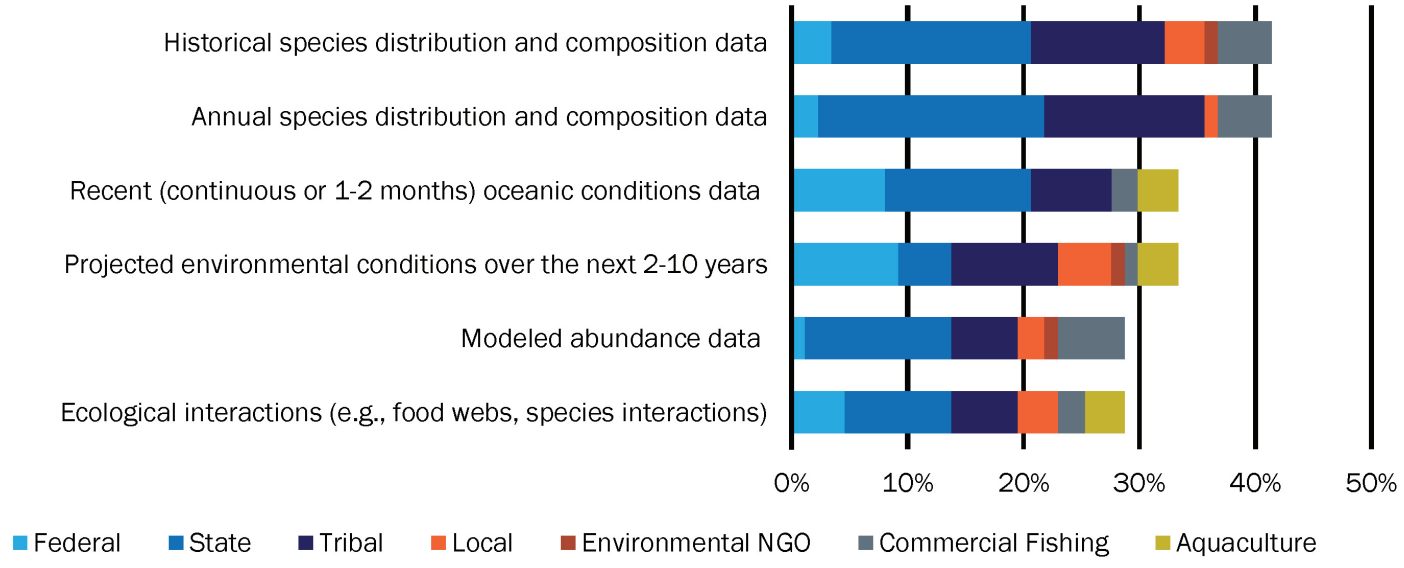
Sixty percent of survey respondents indicated that data gaps, or the lack of existing data necessary to evaluate impacts of changing ocean conditions to marine resources, is the most common management obstacle. Without data, there is limited opportunity to adjust management strategies to address current and anticipated future changes. Notably, 95% and 70% of tribal representatives surveyed indicated that data gaps and data sharing respectively were categorized as at least "noticeably problematic" obstacles. **Respondents reinforced the need for a coordinated research and monitoring data clearinghouse and routine workshops to help managers and scientists harmonize applicable science with resource management actions.**

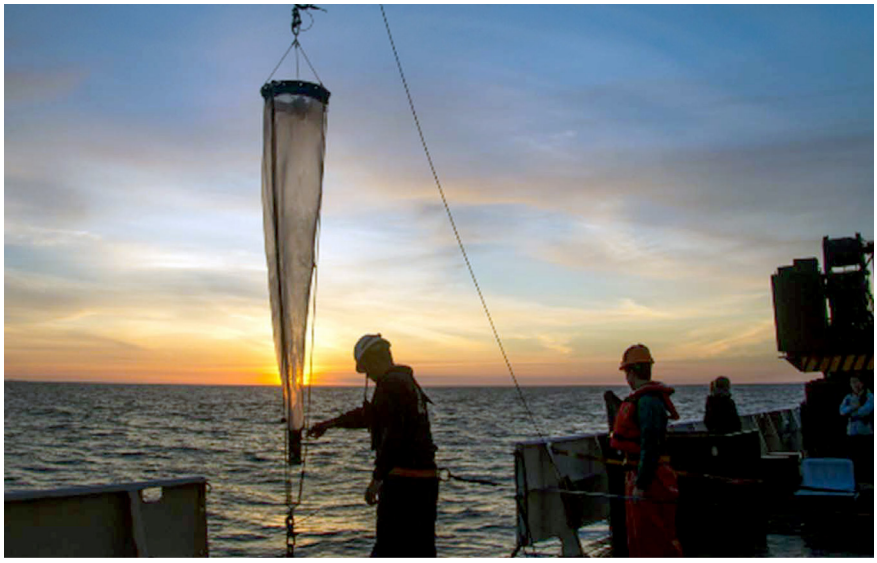
Survey results further demonstrated that, although data sharing is an obstacle, the lack of interpretive summary products remains a large barrier for respondents. There was a perception that funds exist to generate the data, but funds are not dedicated to analyze and summarize status and trends in the data. **If the data collected are not processed, summarized, and interpreted in the context of resource impacts, it is functionally irrelevant to many resource managers.**

> *"There's no way of exactly identifying the type of consequences when the rubber hits the road - the on the ground consequences for the fishermen in 5 years, 20 years . . . **but what's causing the anxiety is the unknown.** We don't know the type of impact or magnitude."*

Information Used in Decision Making

When asked what information was used to inform their management decisions, survey respondents highlighted the importance of historical and annual species distribution and composition data.





"How do you absorb growing population in a way that does not harm ecosystems that are remaining? We need to protect remaining, intact ecosystems . . . ***It's easier to protect than rebuild.*** *"*

PROJECT METHOD

Conduct Interviews

27 resource managers (19 state, 8 tribal)
3 state agencies
5 tribes

→ Distill themes and structure survey questions

Distribute Survey

Marine Resources Advisory Council members distributed to constituents
90 responses from 45 entities were returned

→ Analyze responses and provide top recommendations

Conclusion

The survey results highlight a need for sound science, interpretive products, and effective communication between partners before changing ocean conditions can be effectively incorporated into resource management and policy decisions. Resource managers are relatively unified in their concerns and recognition of the potential negative impacts that changing ocean conditions pose to Washington's marine resources. Currently, they are struggling to effectively manage around the unknown effects of these changes. Moving forward, respondents emphasized the need for Washington to maintain its investments in monitoring programs essential to establishing long-lived data sets, and suggested that funds be added to support the development of interpretive products. **The societal value of information is only realized if interpreted in ways that it can be acted upon.** Managers indicated a preference for forecast models and associated interpretative products with a spatial resolution at the basin-scale or finer and a temporal resolution of weeks-to-decades depending upon the management question at hand.

Incorporating changing ocean conditions into management decisions will require commitment of funds and staff time, political leadership, interdisciplinary collaboration, and an alliance between scientists and resource managers, state and federal agencies, tribal governments, and industry representatives. To keep Washington State resilient to the impacts of changing ocean conditions, we must continue to invest in the necessary research, monitoring programs, collaborations, and communication networks that have been established. Although the challenges are many, participants in this study communicated a marked willingness and commitment to find solutions for the benefit of all.

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