Special Study Proposal: Ocean Acidification Strategy Development

Summary:

Ocean acidification has the potential to cause widespread impacts to marine ecosystems by reducing calcification in key marine organisms and altering the impacts of other water quality contaminants on wildlife. However, the current status and impacts of ocean acidification on the San Francisco Bay are largely unknown. This study will convene ocean acidification researchers, managers, and monitoring entities to assess whether ocean acidification is a likely concern in the Bay, and to identify its potential impacts of beneficial uses, cost-effective monitoring strategies, and potential management actions.

Estimated Cost: $30,000

Oversight Group: RMP Exposure and Effects Work Group

Proposed by: Jennifer Sun and Phil Trowbridge (PI)

Background

Ocean acidification (OA), the process of declining pH in marine waters due to atmospheric exchange of CO2, has caused declines in commercially important shellfish fisheries, and has the potential to cause widespread changes to marine ecosystems. The most direct impact of OA is the reduced saturation of important calcium carbonate minerals in seawater, making it difficult for calcifying marine organisms -- mussels, oysters, clams, coral, calcareous plankton -- to build or maintain their shells (Fabry et al. 2008, Doney et al. 2008). OA has been linked to declines in commercially important shellfish fisheries in the Pacific Northwest, causing the Center for Biological Diversity to file a lawsuit against the US Environmental Protection Agency in 2013 for failing to adequately address OA and protect these fisheries, and pushing for OA to be formally regulated under the Clean Water Act (Center for Biological Diversity 2013). These calcareous grazers also play an important role in preventing algal blooms and maintaining ecosystem balance; population declines in these grazers due to OA could potentially cause cascading trophic effects.

OA may also alter the impacts of other water quality constituents of concern that are currently regulated in Bay sediment and discharges, and monitored by the RMP. Decreases in pH can increase the bioavailability of certain toxic metals, changing their impacts on a broad range of marine life (Millero et al. 2009, Pascal et al. 2010, Campbell et al. 2014), potentially necessitating revisions of contaminant water quality objectives (Roberts et al. 2012). An understanding of how and where OA will most impact these contaminants and associated wildlife will help guide any necessary changes to the management of these pollutants in the Bay.

The effects of ocean acidification can also be magnified and accelerated in nutrient-rich areas, where increased production and organic matter decay in algal blooms can contribute a significant local source of CO_2 in addition to atmospheric deposition (Sunda & Cai 2012, Wallace et al. 2014). The impacts of organic matter decay can be heightened in estuaries, where longer residence times and lower flushing rates allow for more CO_2 accumulation relative to open ocean areas. Diurnal fluctuations in CO_2 caused by photosynthesis and respiration can also contribute to large short-term fluctuations in pH that can affect the ability of a wide range of species to survive in an increasingly harsh environment (Wallace et al. 2014). Future management strategies to mitigate the impacts of ocean acidification could focus on reducing or preventing algal blooms. Again, an understanding of where the synergistic impacts of nutrient pollution and atmospheric CO_2 deposition are greatest can help inform the management of nutrients to reduce OA impacts most effectively.

Although pH is commonly measured as an ancillary parameter, the traditional measurement techniques are inaccurate. Therefore, data to document baseline conditions and OA trends in the San Francisco Bay are limited. Constituents that are strong indicators of OA, such as pH, alkalinity, total carbon, and pCO_2 can be highly variable, fluctuating on diurnal, seasonal, and decadal time scales. A robust understanding of OA status and trends will require long-term, high-frequency monitoring using newer instruments and techniques than are currently used by the RMP.

The growing body of research indicates that OA might affect water quality in the Bay, but it is not clear where this problem should sit on the priority list for water quality managers. Advice from Bay Area and West Coast experts is needed to understand the likely impacts of OA in the Bay and develop cost-effective monitoring strategies. Should acidity become regulated as a water quality pollutant under the Clean Water Act, a strong monitoring program and understanding of baseline acidity levels in the Bay will be critical for identifying regulatory targets and opportunities for the most effective management actions.

Study Objectives and Applicable RMP Management Questions

This Special Study would fund a workshop to identify the likely impacts of OA on beneficial uses in San Francisco Bay, cost-effective monitoring strategies, and potential management actions. This Special Study will primarily address the level one RMP management question:

1. Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?

Approach
SFEI will invite OA researchers, managers, and monitoring entities to contribute to a workshop. The workshop will be guided by the following questions:

Technical Questions

- Is OA a potential concern in the Bay and are adverse impacts likely?
  - Where is the potential impact of OA likely to be the greatest both in terms of location and the species affected?
  - Are there long-term datasets that should be analyzed to look for *current* impacts consistent with OA?
- What new monitoring methods can be used in the Bay to accurately track OA and support management actions?
- How might OA affect other water quality management strategies for the Bay, such as nutrients management, toxic metals management, and habitat restoration for carbon sequestration?

Management Questions

- What level of effort should the RMP expend in the short- and long-term to answer technical questions about OA?
- What role should the RMP play within the local OA science community?

The RMP will invite local OA scientists and the San Francisco Estuary Partnership to participate in the workshop. These entities may include, but will not be limited to:

- Romberg Tiburon Center
- Bodega Bay Marine Laboratory
- Monterey Bay Aquarium Research Institute
- San Francisco National Estuarine Research Reserve
- USGS
- UC Santa Cruz
- Stanford University, Hopkins Marine Station

RMP funding will also support the invitation of OA experts outside of the Bay Area to contribute to the workshop. These advisors will be able to provide new technical advice and perspectives on the management impacts of OA, and allow the RMP to learn from the experiences of scientists and managers that have gone through similar strategic planning processes for analogous systems. These entities may include, but will not be limited to:

- Scripps Institute of Oceanography
- Southern California Coastal Water Research Project
- Oregon State University
- University of Washington
- NOAA

Budget
The proposed base-level budget for this Special Study is $30,000. This includes staff time to invite scientific advisors, coordinate, prepare for, and run the OA workshop, and write a meeting summary and initial strategy document.

The budget also funds the inclusion of at least 3 scientific advisors located outside the Bay Area, including honoraria and travel costs.

Table 1. Budget for Ocean Acidification Workshop

Task	Estimated Cost
Labor	
Meeting Preparation and Coordination	$9,700
Deliverable: OA White Paper	$10,000
Direct Costs	
Food & Materials	$300
Honoraria for external advisors	6,000
Travel for external advisors	4,000
Grand Total	$30,000

*Project management and contract management costs will be included in the RMP base funding

Reporting
A white paper documenting the information resources and recommendations from the fall 2016 workshop will be prepared by the end of calendar year 2016. The white paper will be reviewed by the workshop participants, the EEWG, and the TRC as a draft by November 30, 2016 and will be finalized by January 15, 2017.

References

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