

# Cordell Bank National Marine Sanctuary

## Climate Change

### Management Issue

Within the region of Cordell Bank National Marine Sanctuary (CBNMS or sanctuary), there is limited information on how atmospheric and oceanographic conditions vary on multiple temporal scales and how these forcing mechanisms influence distribution and abundance patterns of sanctuary living resources. In addition to the variability surrounding typical conditions, more information is needed on how climate change will affect atmospheric and oceanographic conditions within the sanctuary and how living marine resources may be affected.

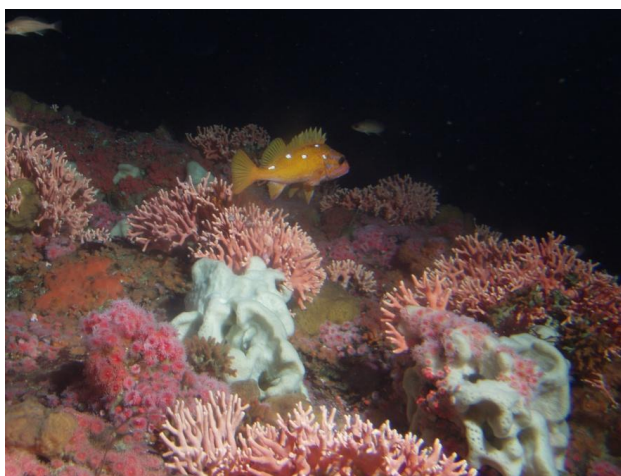
### Description

Due to its location offshore, the Sanctuary is strongly influenced by oceanic forcing as opposed to terrestrial inputs. Located within the California Current System, the Sanctuary is exposed to strong seasonal variation in atmospheric and oceanographic conditions defined by upwelling, relaxation, and winter storm conditions. Longer-term climatic phenomena influencing the region include El Niño-Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and global climate change, processes which operate on different spatial and temporal scales. Recent working groups addressed how climate change may affect regional physical processes and biological resources

(<http://farallones.noaa.gov/manage/climate/impacts.html>), and what species to monitor to detect climate change responses

(<http://farallones.noaa.gov/manage/climate/pdf/GF-NMS-Indicators-Monitoring-Plan-FINAL.pdf>).

There is a current effort to identify resources vulnerable to climate change in the region (<http://farallones.noaa.gov/manage/climate/adaptation.html>). However, there is a need to determine how physical and biological processes in situ may be altered in response to climate change.



*The hydrocoral Stylastrer californicus is one species of importance on Cordell Bank that could be strongly impacted by climate change including ocean acidification and warming ocean temperatures. Photo Credit: Rick Starr/CBNMS*

### Questions and Information Needs

- 1) What is the climatology of the sanctuary?
- 2) How will changes in upwelling intensity and timing impact krill populations and larval dispersal and recruitment of rockfishes and invertebrates?
- 3) How will changes in upwelling intensity and timing impact distribution, abundance, timing of arrival and departure, and residence times of seabirds and marine mammals?
- 4) Does species composition change in response to rising sea surface temperature?
- 5) What is the aragonite saturation horizon of CBNMS and how does it vary seasonally and in response to long term climate change?
- 6) How will ocean acidification impact the sanctuary and directly affect various species, including deep water corals, larval fish and crustaceans, krill, and other calcifying invertebrates?
- 7) What are the characteristics of the oxygen minimum zone at Cordell Bank?

*Updated: 12/3/2014*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

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- 8) What are the conditions of dissolved oxygen at surrounding Cordell Bank, what factors influence variability, and how will changes in dissolved oxygen impact Cordell Bank communities?

### **Scientific Approach and Actions**

- Create an atmospheric and oceanographic climatology report to provide a summary of how the conditions within the Sanctuary vary seasonally. This would provide a framework upon which to understand interannual variation in conditions and a baseline for climate change impacts
- Analyze oceanographic buoy data and monthly and seasonal monitoring data to provide a means to understand how conditions within the Sanctuary varied over different time scales as well as how these patterns relate to regional oceanographic dynamics
- Use regional observations to model upwelling timing and intensity and responses of larvae, krill, seabirds, and marine mammals.
- Create a model of aragonite saturation horizon including spatial and temporal variability.
- Determine what species could be affected by increasing ocean acidification (OA). Building on existing plans for benthic and pelagic monitoring, determine how to evaluate effects of OA on organisms.
- Expand initial efforts to monitor dissolved oxygen at Cordell Bank to define the oxygen minimum zone and determine the timing, duration, and extent of low oxygen events.

### **Potential Key Partners and Information Sources**

University of California-Bodega Marine Lab, San Francisco State University Romberg-Tiburon Lab, NOAA Fisheries Santa Cruz Laboratory, NOAA Pacific Marine Environmental Lab.

### **Management Support Products**

- Climatology report
- Report summarizing relationships between physical drivers and biological populations on Cordell Bank
- Models and reports to explain relationship between variability in upwelling and biological response of krill, larvae, seabirds, and marine mammals.
- Model and report explaining the status of dissolved oxygen in the CBNMS region illustrating the migration of the Oxygen Minimum Zone (OMZ) into shallower shelf waters with implications of increased hypoxic events over the Bank

### **Planned Use of Products and Actions**

- Use climatology report and bio-physical models to understand natural variability in the regional systems and evaluate climate change driven alternations.
- Document changes to species and communities experiencing climate change stress
- Reduce stressors on species and communities vulnerable to climate change
- Information from monitoring the Oxygen Minimum Zone and ocean acidification will help us to identify the presence and extent of the issue and sources responsible for changes in ocean communities
- Information will be provided to the larger ocean community to encourage ocean conservation

### **Program References**

#### CBNMS Management Plan

- Conservation Science Action Plan, strategy CS-1, CS-7, CS-8

#### CBNMS Condition Report

- Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality (question 1)
- Status of key species (question 12)
- Condition or health of key species (question 13)

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### ONMS Performance Measures

- Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved
- Number of sites in which select living marine resources, based on long-term monitoring data, are being maintained or improved

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