Climate-Smart Adaptation for the North-Central California Coast: Planning, Lessons Learned, and Adaptation Outcomes

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Restore America’s Estuaries
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Greater Farallones National Marine Sanctuary

Office of National Marine Sanctuaries (NOAA)

3,295 square miles

Open ocean, tidal flats, rocky intertidal, estuarine wetlands, subtidal reefs, and beaches

Breeding/feeding grounds for:
• 25 E&T species
• 36 marine mammal species
• > 1/4 million breeding seabirds
• Significant white shark population
The Sanctuary Advisory Council: A Critical Boundary “Organization”

Community-based advisory groups established to provide advice and recommendations to sanctuary superintendents.

Conservation  Research  Youth
Tourism  Fishing  Community-at-large
Education  Boating/shipping
Harbors  Recreation  Government

Councils are supported by working groups composed of outside experts to tackle specific issues.
The Sanctuary Advisory Council: A Critical Boundary “Organization”

- Effectively bridging the gap between various community members, including scientific community and the federal government
- Ensuring community voices are heard and represented
- Vector for sharing climate information with diverse audience and management
- Forum for local to federal collaboration
- Leverage regional expertise
The Council and Climate Change
The Council and Climate Change

Mitigation

Green Operations
Working Group
The Council and Climate Change

Mitigation
- Green Operations Working Group

Science
- Climate Impacts Working Group
The Council and Climate Change

**Mitigation**
- Green Operations Working Group

**Monitoring**
- Climate Indicators Working Group

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Adaptation
- Climate-Smart Adaptation Working Group
Climate-Smart Adaptation Working Group

Goal: Develop collaborative, multi-benefit adaptive management actions in response to climate vulnerability assessments by regional experts.
Science Information: Climate Vulnerabilities

Two Decision-Support Workshops with regional scientists:
1. Define focal resources
2. Assess resource vulnerability
Focal Resources Workshop

Workshop Goal:
Recommend North-central California coast and ocean focal resources (species, habitats and ecosystem services) for use in vulnerability assessments.

Recommendations produced in habitat break-out groups
- 53 species
- 9 services
- 10 habitats
Workshop Goal:
Assess the vulnerability of selected focal resources to climate change impacts

Resources assessed:
- 8 habitats
- 18 species, 10 post-workshop
- 6 ecosystem services
Climate Change Vulnerability Assessment for the North-central California Coast and Ocean
Blue Rockfish (*Sebastes mystinus*)

**Executive Summary**

Blue rockfish is a medium-sized, midwater rockfish important in both the recreational and commercial catches in California, and is the most abundant rockfish in central California kelp forests (CDFG 2010). The species occurs from Alaska to Baja California, from surface waters to a maximum depth of 600 meters. Key climate sensitivities identified by workshop participants for the blue rockfish include dissolved oxygen, pH, salinity, and the Pacific Decadal Oscillation, and key non-climate sensitivities include harvest, energy production, and oil spills. Blue rockfish exhibit a transcontinental geographic extent and a stable, continuous population that is at abundant levels. The species has a relatively high dispersal capability for both the larval and adult stages, and exhibits relatively moderate-high diversity in life history strategies, genetics, and phenotypic/behavioral plasticity. The societal value for blue rockfish is moderate-high due to its value for harvest, recreational diving and tourism, but managers may have difficulty in managing this species due to the inability to control the impacts expected from climate change, which will likely outweigh any manageable impacts such as harvest and pollution.

<table>
<thead>
<tr>
<th>Blue Rockfish</th>
<th>Score</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Exposure</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Adaptive Capacity</td>
<td>4</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>3</td>
<td>High</td>
</tr>
</tbody>
</table>

**Sensitivity**

I. Sensitivity to climate and climate driven changes

Climate and climate-driven changes identified (score, confidence): dissolved oxygen (DO) levels (5, high), ocean pH (4, low), salinity (4, moderate), Pacific Decadal Oscillation (PDO) (4, high), sea surface temperature (3, moderate), dynamic ocean conditions (currents/mixing/stratification) (2, moderate-high)

Climate and climate-driven changes that may benefit the species: sea surface temperature

Description of benefit: Increased sea surface temperatures may promote more jellyfish production, which are prey for blue rockfish, increasing food supplies. Increasing sea surface temperatures may also result in increased distribution of blue rockfish.

Overall species sensitivity to climate and climate-driven factors: Moderate-High

- Confidence of workshop participants: Moderate

**Supporting literature**

1 Refer to the “Introduction to Assessment Summaries” section for an explanation of the format, layout and content of this summary report.

2 For scoring methodology, see methods section. Factors were scored on a scale of 1-5, with 5 indicating high sensitivity and 1 indicating low sensitivity.

3 Confidence level indicated by workshop participants.

II. Sensitivity to disturbance regimes

Disturbance regimes identified: disease and storms

- Overall species sensitivity to disturbance regimes: Moderate-High
- Confidence of workshop participants: High

**Additional participant comments**

Storms may cause loss of prime habitat (kelp forests) which will impact blue rockfish recruitment and survival, and increase turbulence that exacerbates kelp dislodgment and sedimentation that may reduce the recovery of storm-damaged forests.

**Supporting literature**

Disease

Disease is projected to increase with warming water temperatures, due to enhanced development and survival, as well as host susceptibility (Harvell et al. 2002). Blue rockfish has no known diseases, but may be indirectly impacted by disease through their dependence on kelp forest habitat.

III. Dependencies

Species dependence on one or more sensitive habitat types: Moderate-High

- Confidence of workshop participants: High
- Sensitive habitats species is dependent upon: kelp forest and nearshore habitats

Species dependence on specific prey or forage species: Low-Moderate

- Confidence of workshop participants: High

Other critical dependencies: oceanographic conditions

- Degree of dependence: Low-Moderate
- Confidence of workshop participants: High

Spectrum of species (1-generalist; 5-specialist): 3

- Confidence of workshop participants: High

**Additional participant comments**

Blue rockfish are dependent on productive oceanographic conditions, including cool surface waters for reproductive success. This species does not recruit well during periods of reduced upwelling and during El Niño events.
ADAPTIVE CAPACITY  

SENSITIVITY & EXPOSURE

Low (1)  Low-Mod (2)  Mod (3)  Mod-High (4)  High (5)

Low Vulnerability

Offshore Rocky Reefs

Kelp Forest

Pelagic Water Column

Cliffs

Nearshore

Beaches & Dunes

Rocky Intertidal

Estuaries

Habitats

High Vulnerability
Key stressors

Climate-driven
1. Wave action
2. Coastal erosion
3. Sea level rise

Non-climate
1. Roads/coastal armoring
2. Invasive/problematic species
3. Land use change
Climate-Smart Adaptation Working Group

Federal: USFWS, CA LCC, National Park Service, GGNRA, NMFS, BLM, USGS

State: Coastal Commission, State Parks, State Coastal Conservancy, CDFW

Local: San Mateo and Marin Counties

NGOs: Point Blue, BAECCC, Greater Farallones Association

Academia: Bodega Marine Lab, Stanford University
Adaptation Options

Over 200 adaptation responses proposed
Climate-Smart Adaptation for North-central California Coastal Habitats

Report of the Climate-Smart Adaptation Working Group of the Greater Farallones National Marine Sanctuary Advisory Council

Editor: Sara Hutto

March 2016
Some examples…
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Investigate the use of vegetation to locally mitigate ocean acidification
Some examples…

- Remove/redesign roads to allow for coastal habitats to migrate inland in response to sea level rise
- Restore living shorelines (kelp beds, seagrass beds, beaches/dunes) to buffer from storms
- Manage invasive species – keep track of species range shifts
- Enhance tidepool and marsh education and interpretation
- Investigate the use of vegetation to locally mitigate ocean acidification
- Remove sediment supply inhibitors and structures that cause erosion (jetties)
Benefits:
• More robust outcomes; leverage regional expertise
• Investment and buy-in from partners and community

Challenges:
• External process, staff cannot intervene
• Partners, partners, partners

Lessons learned:
• Involve as many partners as possible – whomever shows up gets the say
• Provide necessary resources
• Consider current management activities when developing adaptation responses
Thank you!

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http://farallones.noaa.gov/manage/climate/