



Climate Change Site Scenarios: Gulf of the Farallones and Cordell Bank National Marine Sanctuaries Pilot Project

Lance Morgan

April 8, 2010



GF/CB CLIMATE CHANGE SITE SCENARIO WORKING GROUP

Joint Working Group

CBNMS council approached GFNMS council to establish a joint working group and produce a joint document

Working Group Chair and other SAC members

Chaired by GFNMS Research Primary (Largier); other members include CBNMS Conservation Primary (Morgan) and Research Alternate (Jahncke), GFNMS Education Primary (Breen)

Diverse Representation

Members chosen based on areas of expertise, mix of physical/biological/ecological scientists (including NWS)

Local scientists only

Contributors

Working group members recommended other authors if specific expertise was missing

GF/CB CLIMATE CHANGE SITE SCENARIO WORKING GROUP

Extensive Collaboration

2 working group staff, 2 superintendents, 17 working group members, 36 contributors total from 16 agencies, organizations and institutions

Logistics

4 in-person meetings

3 editors (chair, coordinator, manager)

Working group and other contributors helped author and/or review sections

1.5 year process

Funding

Part time project coordinator funded through ONMS (through summer 09)

Project manager funded through GFNMS base funds

GF/CB CLIMATE CHANGE SITE SCENARIO

Goals

Identify relevant CC impacts to habitats and biological communities along the north-central California coast

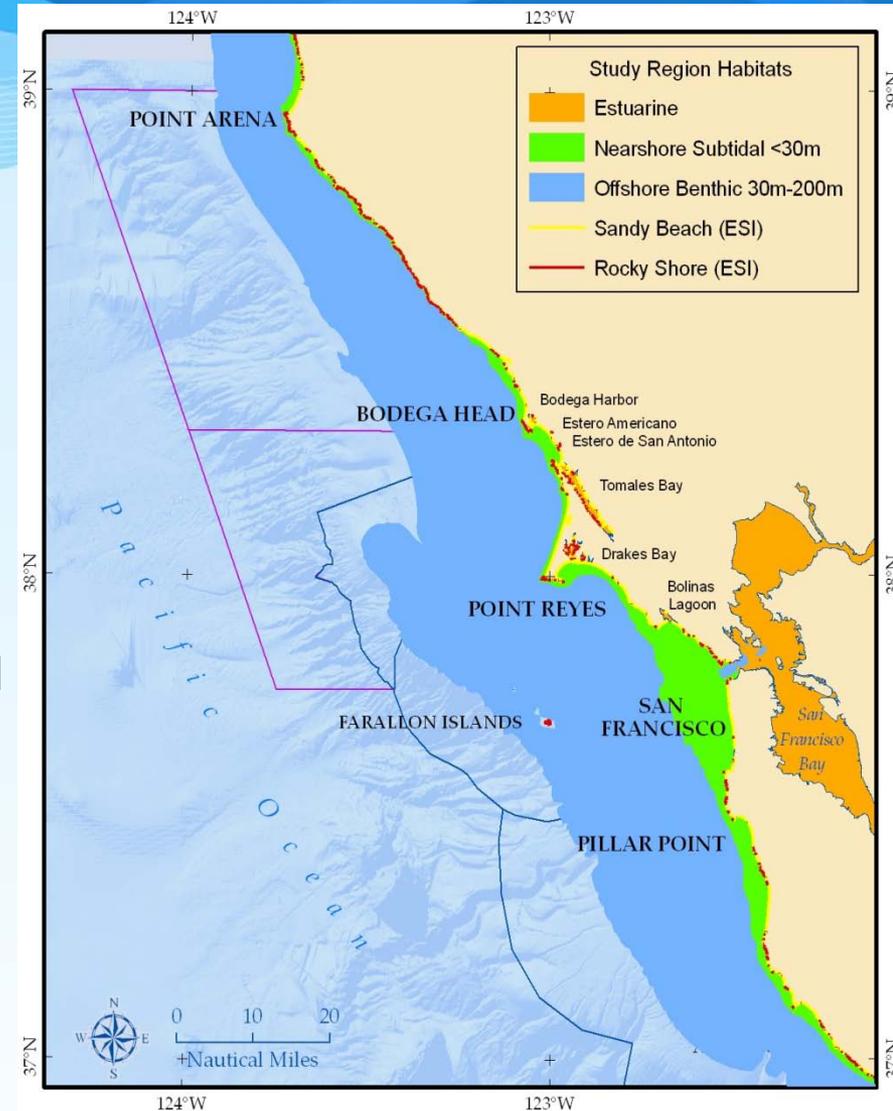
Provide a synopsis of the best available knowledge on observed and predicted physical and biological impacts from CC

Scope

Downscale global information to regional focus from Point Arena to Año Nuevo

Outcome

Foundation to guide development and prioritization of R&M activities, ultimately informing future policy/management actions



Working Group Members

Sarah Allen, Point Reyes National Seashore

Bob Breen, Gulf of the Farallones National Marine Sanctuary Advisory Council

Jenifer Dugan, Marine Science Institute, University of California, Santa Barbara

Brian Gaylord, University of California, Davis; Bodega Marine Lab

Edwin Grosholz, University of California, Davis; Bodega Marine Lab

Daphne Hatch, Golden Gate National Recreation Area

Tessa Hill, University of California, Davis; Bodega Marine Lab

Jaime Jahncke, PRBO Conservation Science; CBNMS Advisory Council

Judith Kildow, Ocean Economics Program

Raphael Kudela, University of California, Santa Cruz

John Largier (Chair), UC Davis; Bodega Marine Lab; GFNMS Advisory Council

Lance Morgan, Marine Conservation Biology Institute; CBNMS Advisory Council

David Revell, Philip Williams and Associates

David Reynolds, National Weather Service

Frank Schwing, National Marine Fisheries Service

William Sydeman, Farallon Institute

John Takekawa, United States Geological Survey

DRAFT ONMS SITE SCENARIO TEMPLATE

Main Climate Change Impact Drivers

- Sea Level Rise
- Variability in Weather Patterns
- Ocean Circulation
- Ocean Acidification

Interaction of Drivers with Other Stressors

Potential Changes, Impacts and Vulnerabilities

- Ecosystem Resilience
- Maritime Heritage/Cultural Resources
- Community Adaptation and Natural Hazards

Potential Changes/Impacts to Society and Economic Sectors

GF/CB CLIMATE CHANGE SITE SCENARIO

Executive Summary

1. Introduction

2. Background

3. Physical Effects of Climate Change

3.1 Atmosphere

3.2 Precipitation and Land Runoff

3.3 Ocean Currents and Waves

3.3.1 Ocean Circulation

3.3.2 Waves

3.3.3 Coastal Upwelling

3.3.4 Estuarine Circulation

3.4 Sea Level Rise

3.5 Coastal Erosion

3.6 Ocean Water Properties

3.6.1 Temperature

3.6.2 Ocean Acidification

3.6.3 Salinity

3.6.4 Nutrients

3.6.5 Dissolved Oxygen

4. Responses in Biological Processes

4.1 Physiology

4.2 Range Shifts

4.3 Phenology

4.4 Population Connectivity

5. Responses in Marine Organisms

5.1 Plankton

5.2 Macroalgae and Plants

5.3 Invertebrates

5.4 Fish

5.5 Seabirds

5.6 Marine Mammals

6. Responses in Marine Habitats

6.1 Pelagic Habitat

6.2 Offshore Benthic Habitat

6.3 Island Habitat

6.4 Sandy Beach Habitat

6.5 Rocky Intertidal Habitat

6.6 Nearshore Subtidal Habitat

6.7 Estuarine Habitat

7. Parallel Ecosystem Stressors

8. Direct Impacts on Humans

9. Conclusion

9.1 Priority Issues

9.2 Working Group Recommendations

“...should not be considered an assessment of current conditions, or a prediction of future; instead it is a scoping document that discusses potential issues as they relate to a changing climate through both observation and science-based expectations.”

WORKING GROUP KEY ISSUES

Key Issues

- ⇒ Observed increase in sea level (100 year record at mouth of San Francisco Bay)
- ⇒ Expected increase in coastal erosion associated with changes in sea level and storm waves
- ⇒ Observed decrease in spring runoff of freshwater through San Francisco Bay, due to decreased snowpack
- ⇒ Observed increase in precipitation variability (drier dry years, wetter wet years)
- ⇒ Observed increase in surface ocean temperature offshore (50 year record)
- ⇒ Observed increase in winds driving the upwelling of cold, nutrient-rich waters (30 year record at offshore buoys)
- ⇒ Observed increase in extreme weather events (winds, waves, storms)
- ⇒ Expected decrease in pH, due to uptake of CO₂ by the ocean
- ⇒ Observed northward shift of key species (including Humboldt squid, volcano barnacle, gray whales, bottlenose dolphins)
- ⇒ Possible shift in dominant phytoplankton (from diatom to dinoflagellate blooms)
- ⇒ Potential for effects of climate change to be compounded by parallel environmental changes associated with local human activities

WORKING GROUP RECOMMENDATIONS

Recommendations

- ⇒ *Educate society – inform people to allow for optimum decisions*
- ⇒ *Put ecosystems in context – link greenhouse gas emissions with marine ecosystem health*
- ⇒ *Anticipate change – obtain best available information on changing and future conditions*
- ⇒ *Mitigate impacts on the system – reduce manageable stressors that compromise system resiliency*
- ⇒ *Adapt to change – create policies and management strategies that are flexible to future changes*

WORKING GROUP RECOMMENDATIONS

- 1. Educate** – inform people (public and decision makers) to allow optimum decisions to be made
 - **Promote stewardship, including citizen science and monitoring**
 - **Conduct outreach through exhibits and lectures**
 - **Conduct outreach through web sites and portals**

WORKING GROUP RECOMMENDATIONS

2. Put Ecosystems in Context – link greenhouse gas emissions with marine ecosystem health.

- **Work to understand and elucidate links between global climate assessments and threats to local ecosystems**
- **Work with partners regionally and globally to address the increase in greenhouse gas concentrations**
- **Educate the public on the link between greenhouse gases and marine ecosystem health**

WORKING GROUP RECOMMENDATIONS

3. Anticipate Change – create policies and management strategies that are flexible to future changes

- **Identify priority concerns and develop expectations of change in order to direct monitoring efforts and identify opportunities to reduce risk**
- **Monitor the environment**
- **Monitor populations**
- **Produce regular assessments**
- **Use models to anticipate future changes**
- **Pursue funding and collaboration**

WORKING GROUP RECOMMENDATIONS

4. Mitigate impacts – reduce manageable stressors that compromise system resiliency

- **Develop an assessment of ecological goods and services**
- **Develop an assessment of stressors that are constraining the “breathing room” of ecosystems**
- **Identify strategic opportunities to reduce manageable stressors and motivate action to reduce risk**
- **Work with regional partners to develop ecosystem-based management**

WORKING GROUP RECOMMENDATIONS

5. Adapt to change – create policies and management strategies that are flexible to future changes.

- **Adaptive management**
- **Develop and strengthen partnerships**
- **Develop funding and resources to engage partnerships**

GF/CB CLIMATE CHANGE SITE SCENARIO

Next Steps

Public/media release (June 3)

Formation of R&M working group (funding dependent; survey of CC research activities/gap analysis; action plan strategies built from WG recommendations)

