Gulf of the Farallones National Marine Sanctuary

Climate Smart Conservation

Kelley Higgason, Ocean Climate Initiative Coordinator
GFNMS Advisory Council Meeting, November 20, 2013

What is Climate Smart Conservation?

Strategies and actions specifically address impacts of climate change in concert with existing threats and promote nature-based solutions to:

1) Reduce greenhouse gas emissions and enhance carbon sinks

2) Reduce climate change impacts on wildlife and people and enhance ability to adapt

3) Sustain vibrant, diverse ecosystems

Climate Smart Conservation, Point Blue Conservation Science

What is Climate Smart Conservation?

Key Characteristics of Climate-Smart Conservation

1. Actions Linked to Climate Impacts

Conservation strategies and actions are designed specifically to address the impact of climate change in concert with existing threats; actions are supported by an explicit scientific rationale.

2. Forward-Looking Goals

Conservation goals focus on future, rather than past, climatic and ecological conditions; strategies take a long view (decades to centuries) but account for near-term conservation challenges and needed transition strategies.

3. Broader Landscape Context

On-the-ground actions are designed in the context of broader geographic scales to account for likely shifts in species distributions, to sustain ecological processes, and to promote collaboration.

4. Robust in an Uncertain Future

Strategies and actions provide benefit across a range of possible future conditions to account for uncertainties in future climatic conditions, and in ecological and human responses to climate shifts.

5. Agile and Informed Management

Conservation planning and resource management is capable of continuous learning and dynamic adjustment to accommodate uncertainty, take advantage of new knowledge, and cope with rapid shifts in climatic, ecological, and socio-economic conditions.

6. Minimizes Carbon Footprint

Strategies and projects minimize energy use and greenhouse gas emissions, and sustain the natural ability of ecosystems to cycle and sequester carbon and other greenhouse gases.

7. Climate Influence on Project Success

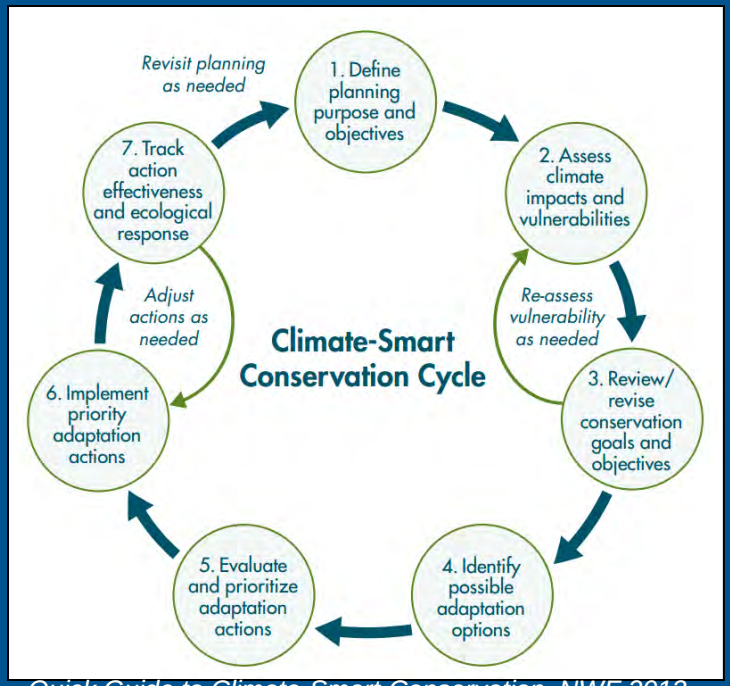
Considers how foreseeable climate impacts may compromise project success; generally avoids investing in efforts likely to be undermined by climate-related changes unless part of an intentional strategy.

8. Safeguards People and Wildlife

Strategies and actions enhance the capacity of ecosystems to protect human communities from climate change impacts in ways that also sustain and benefit fish, wildlife, and plants.

9. Avoids Maladaptation

Actions taken to address climate change impacts on human communities or natural systems do not exacerbate other climate-related vulnerabilities or undermine conservation goals and broader ecosystem sustainability.



Quick Guide to Climate-Smart Conservation, NWF 2013

Guidance (CA Climate Commons):

Point Blue Conservation Science

National Wildlife Federation

Resources Legacy Fund

EcoAdapt

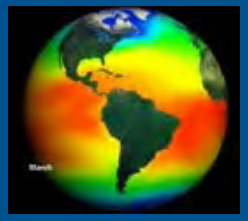
Bay Area Ecosystems Climate Change Consortium

GFNMS Climate Smart Conservation

Integrating climate change adaptation, monitoring, mitigation, and communication into sanctuary management.

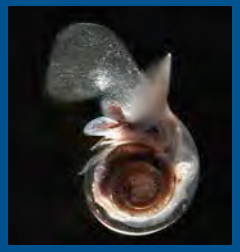
✓**Green Operations: Reducing Our Carbon Footprint**

Working group developed over 130 strategies and annual emissions audits are conducted



✓**Climate Change Impacts Report**

Joint CB/GF working group determined observed and predicted climate change impacts, foundation to guide future monitoring and inform outreach and management actions



✓**Ocean Climate Indicators Monitoring Plan**

Regional scientific consensus on physical and biological indicators, working group developed comprehensive monitoring inventory and plan

GFNMS Climate Smart Conservation

Integrating climate change adaptation, monitoring, mitigation, and communication into sanctuary management.

Climate Smart Adaptation

Currently in vulnerability assessment phase, working group will be convened in 2014 to develop adaptation actions, sanctuary will develop implementation plan, design Green Resilient Shoreline projects

Communication

Initiate in 2014 to outline current and prioritize new climate change education programs for youth and adults and develop project-specific communication strategies

Ocean Climate Indicators:

A Monitoring Inventory and Plan for Tracking Climate Change in the North-central California Coast and Ocean Region

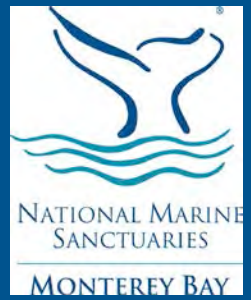
Report to the GFNMS SAC from the Ocean Climate Indicators Working Group

Benét Duncan, Ph.D.
Kelley Higgason, MSc
Tom Suchanek, Ph.D.

20 November 2013

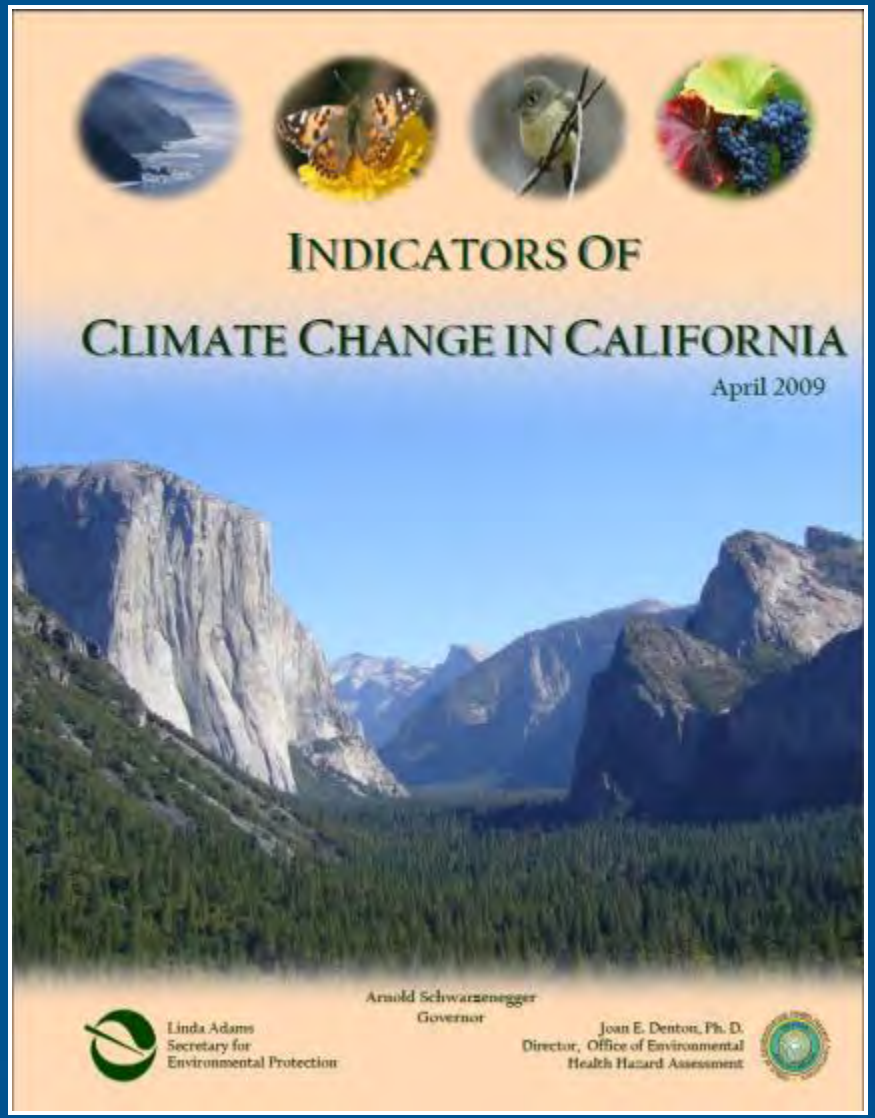
Jan Roletto, GFNMS

Interdisciplinary, Collaborative Effort



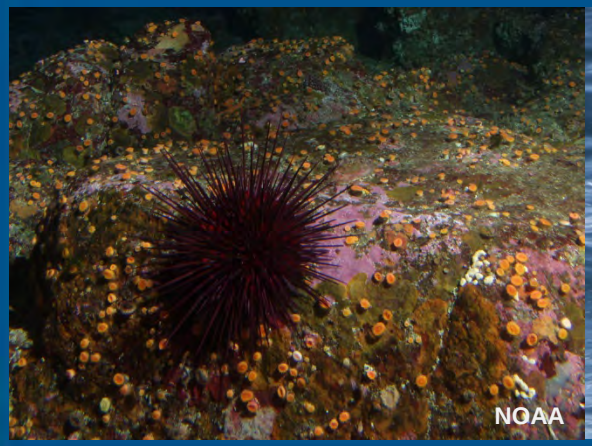
What Are Ocean Climate Indicators?

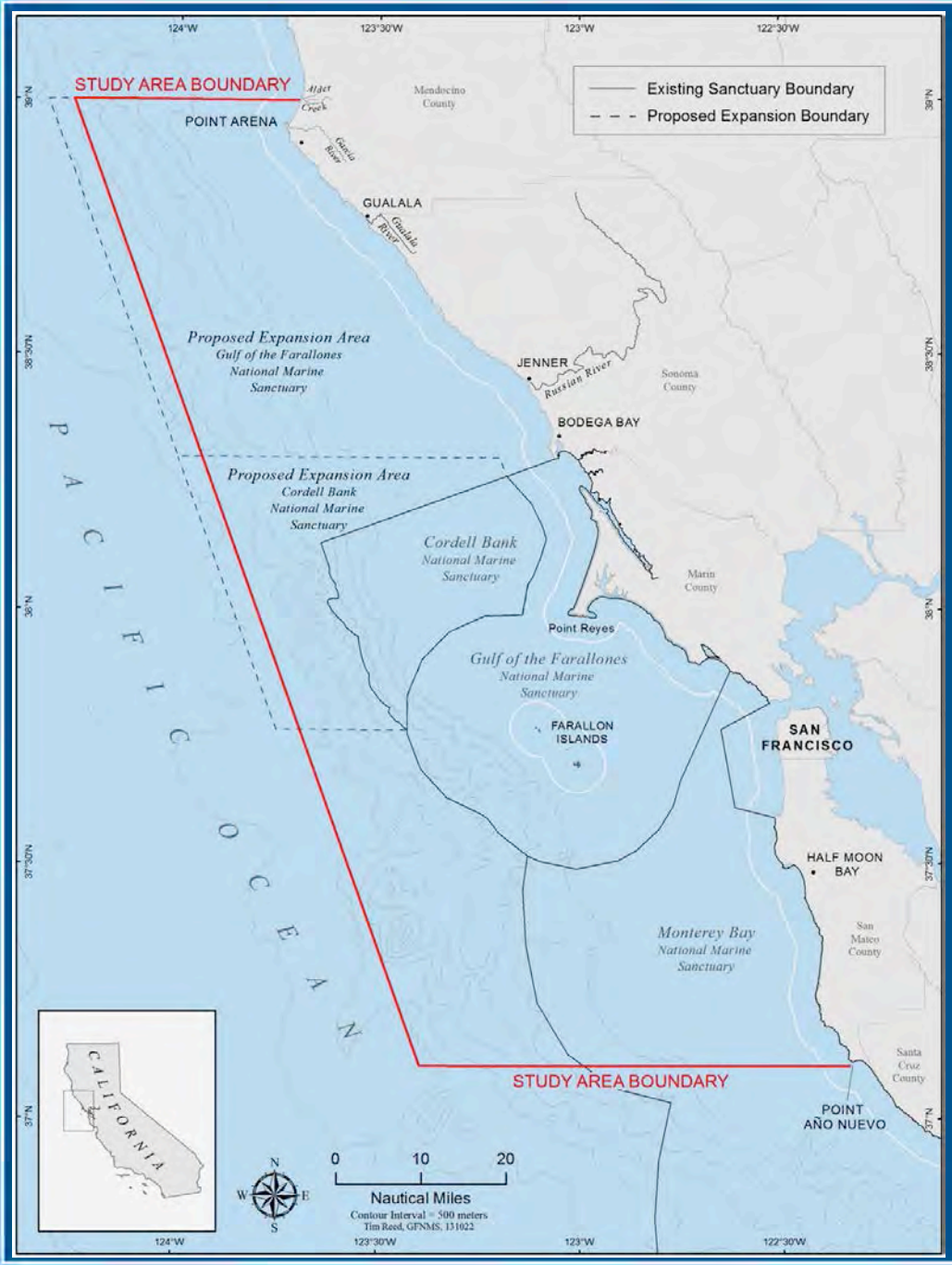
- Determine presence and impacts of climate change
- 2 Categories:
  1. Physical
  2. Biological
- Basis of many climate change monitoring and response plans



Potential Uses of Ocean Climate Indicators

- Used by:
  - Natural resource managers
  - Scientists
  - State and municipal planners
- Used to:
  - Monitor impacts of climate change
  - Develop climate change adaptation strategies
  - Mitigate impacts of climate change





Project Goals

1. Develop indicators
2. Maximize confidence in indicators with collaboration
3. Define climate change monitoring goals for study region
4. Incorporate indicators into a collaborative monitoring inventory & plan

Phase I: Information Gathering

Literature review and interviews

- 2010 GFNMS/CBNMS report, “Climate Change Impacts”
- Research published after 2010 report
- Documentation for indicator projects in other regions

Determine selection process and criteria

- Read NCA’s “Ecological Indicators for the Nation”
- Work with GFNMS management to develop priority management questions that indicators should address
- Determine regional selection process in consultation with partners

Phase II: Physical and Biological Indicators

Create list of candidate indicators

Discuss & refine candidate indicators with mentors

Determine data available for candidate indicators

Consult with experts about candidate indicators

- Written survey
- Indicator Selection Workshop

Refine list based on expert consultation

Follow-up consultation with project advisors

Finalize indicators

Phase III: Working Group & Monitoring Plan

Form GFNMS Indicators Working Group to:

- Define indicator monitoring goals
- Develop monitoring strategies for final indicators
- For each monitoring strategy, determine:
  - Implementation timelines
  - Partners involved
  - Funding requirements
- Develop the Indicators Monitoring Inventory and Plan

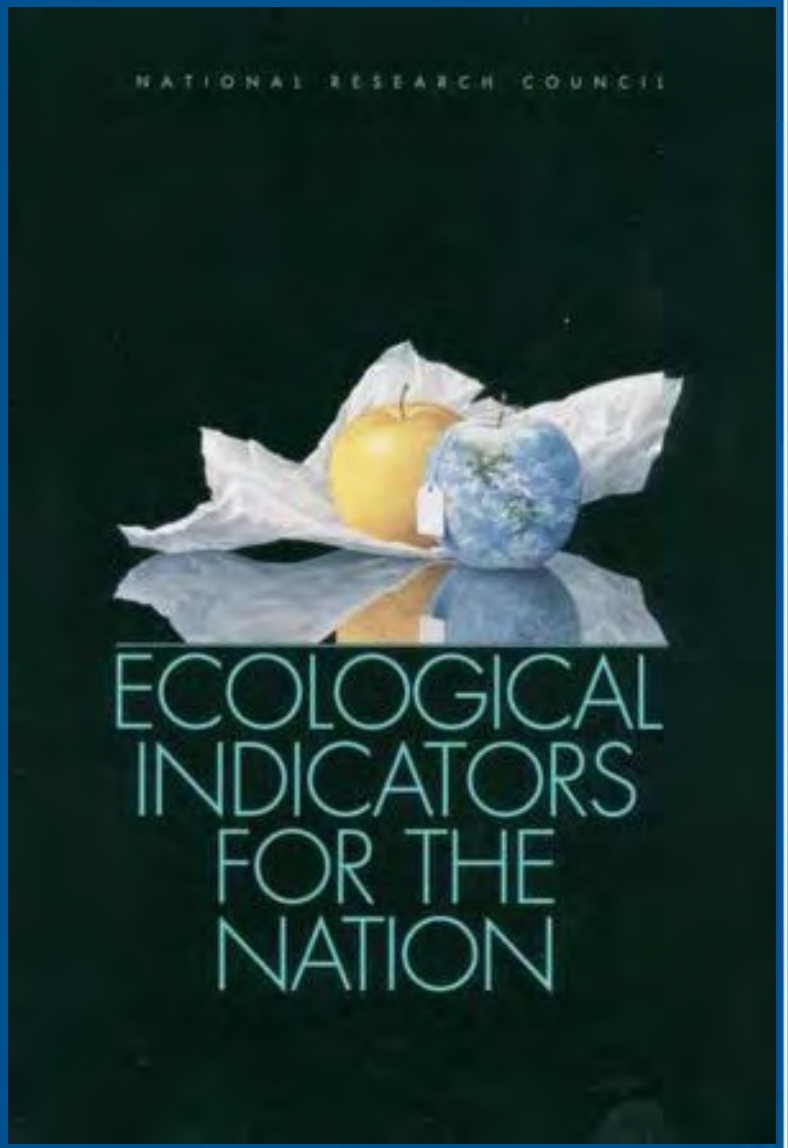
Phase IV: Indicator Report

Develop detailed indicator report for journal publication

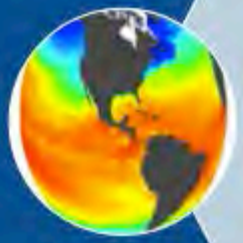
Develop outreach indicator report for management

Indicator Selection Process

1. Key indicator selection documents:
   a. Ecosystem Description
   b. Conceptual Ecological Model
   c. Priority Management Questions
   d. Indicator Selection Criteria
2. Select candidate indicators
3. Refine & finalize indicators
   a. Indicator Survey (51 of 76 respondents)
   b. Indicator Workshop (36 attendees)
   c. Follow-up Analysis & Discussions with Mentors



Physical Ocean Climate Indicators



Ocean Water Properties

Sea Surface Temperature

Indicates Changes In:

- Upwelling
- Water transport
- Habitat suitability
- Water quality

Sea Surface Salinity

Indicates Changes In:

- Runoff
- Downwelling events
- Water quality
- Nutrients

Dissolved Oxygen

Indicates Changes In:

- Habitat suitability
- Water quality
- Primary productivity

Ocean Chemistry (pH)

Indicates Changes In:

- Habitat suitability
- Water quality

Sea Level

Indicates Changes In:

- Habitat extent
- Inundation time
- Storminess
- Upwelling
- Interannual ocean state (ex: El Niño conditions)

Wave Height & Direction

Indicates Changes In:

- Habitat suitability
- Inundation time
- Storminess
- Shoreline erosion
- Beach condition
- Estuary mouth state
- Agitation of coastal bottom and shoreline biota

Atmospheric Properties

Air Temperature

Indicates Changes In:

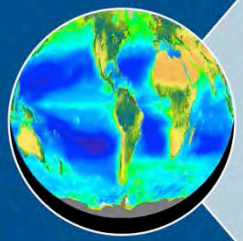
- Weather and climate patterns
- Incoming radiation
- Presence of marine layer clouds
- Intertidal habitat suitability
- El Niño Southern Oscillation

Alongshore Wind Speed

Indicates Changes In:

- Storminess
- Upwelling
- Habitat suitability

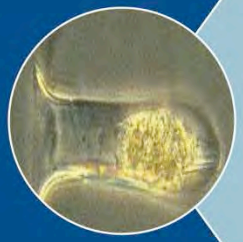
Biological Ocean Climate Indicators



Primary Productivity (Rate and Biomass of Primary Producers)

Indicates:
- Health of lowest trophic levels of food web
- Potential for harmful algal blooms

Examples:
- Chlorophyll Biomass
- Phytoplankton Assemblages



Abundance, Biomass, and/or Phenology of Mid-Trophic Level Species

Indicates:
- Health of middle trophic levels of food web

Examples:
- Mole Crabs
- California Mussels
- Gooseneck Barnacles
- Ochre Sea Stars
- Blue & Gopher Rockfish
- Copepods

Spatial Extent of Habitat-Forming Organisms

Indicates:
- Changes in habitat availability

Examples:
- Surfgrass
- Mussel Beds
- Bull Kelp
- Eelgrass
- Corals

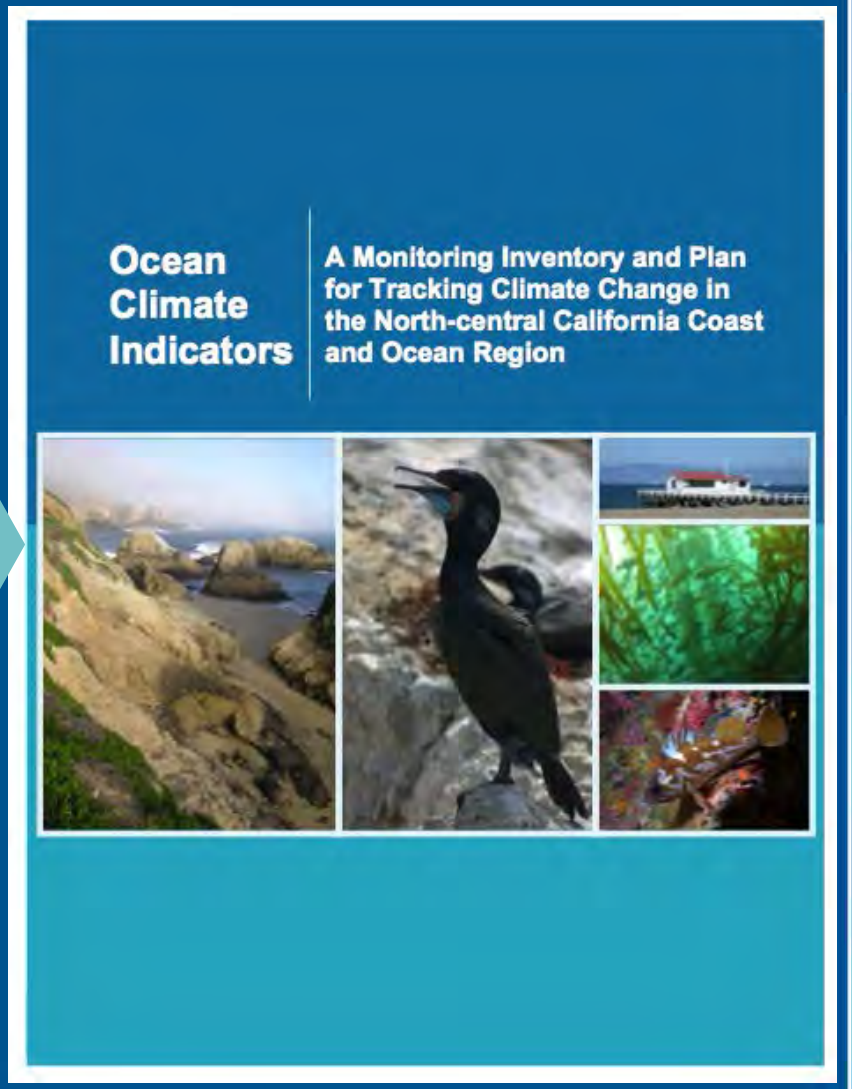
Seabird Phenology, Productivity, and/or Diet:

Indicates:
- Year-round picture of health of high trophic levels of food web
- Impacts of changes in primary productivity
- Potential for mismatches in species phenology

Examples:
- Brandt's Cormorant
- Cassin's Auklet
- Common Murre

Indicators Working Group

1. Define Indicator Monitoring Goal and Objectives
2. Determine selected species for biological indicators
3. For each indicator, develop case studies, monitoring strategies, & activities



Indicators Monitoring Goal & Objectives

Goal:

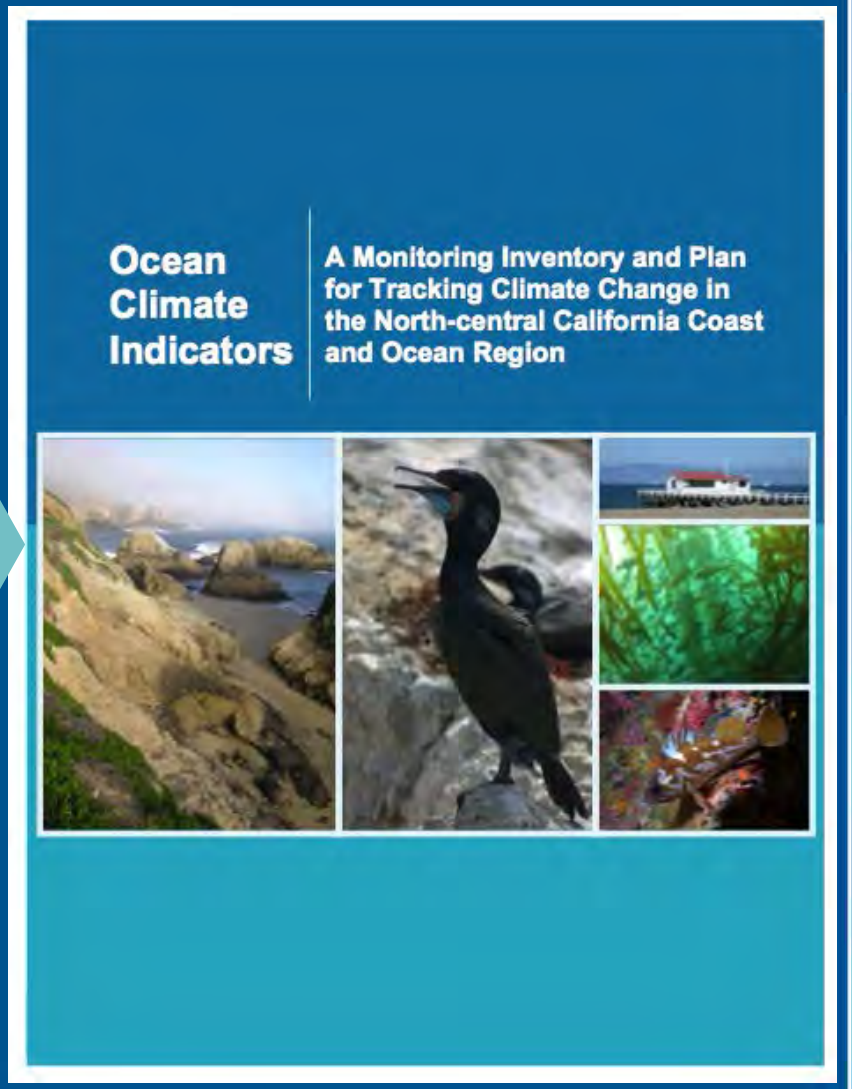
"*Provide comprehensive and coordinated management of marine resources by increasing understanding of the ecological impacts of climate change on the North-central California coast and ocean region, through the monitoring and evaluation of physical and biological ocean climate indicators*."

Objectives:

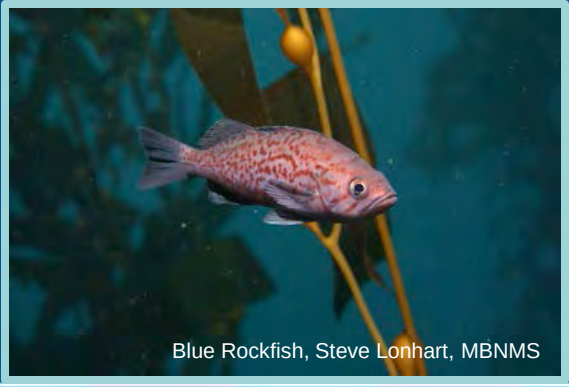
1. Determine indicator status & trends through monitoring programs and by identifying needs and opportunities for new or expanded monitoring efforts.
2. Assess the vulnerability of specific geographic areas, ecosystems, and ecosystem components to the impacts of climate change.

Indicators Working Group

1. Define Indicator Monitoring Goal and Objectives
2. Determine selected species for biological indicators
3. For each indicator, develop case studies, monitoring strategies, & activities



SELECTED MID-TROPHIC LEVEL SPECIES	
SANDY BEACH	
	Mole crab (*Emerita analoga*)
ROCKY INTERTIDAL	
	California mussel (*Mytilus californianus*)
	Ochre sea star (*Pisaster ochraceus*)
	Gooseneck barnacle (*Pollicipes polymerus*)
	Giant green (*Anthopleura xanthogrammica)* & Sunburst anemone (*Anthopleura sola*)
	Volcano barnacle (*Tetraclita rubescens*)
ESTUARIES & BAYS	
	Gaper clam (*Tresus capax* and/or *Tresus nuttalli*)
	Staghorn sculpin (*Leptocottus armatus*)
	Shiner surfperch (*Cymatogaster aggregata*)
NEARSHORE SUBTIDAL	
	Blue (*Sebastes mystinus*) and Gopher (*Sebastes carnatus*) rockfish
	Cabezon (*Scorpaenichthys marmoratus*)
OFFSHORE (BENTHIC & PELAGIC)	
	Copepods (e.g., *Pseudocalanus mimus* in boreal and *Calanus pacificus* in transition zone)
	Shortbelly rockfish (*Sebastes jordani*)
	Pteropods (e.g., *Clione limacina* and *Limacina helicina*)


Blue Rockfish, Steve Lonhart, MBNMS


Ochre Sea Star & Sunburst Anemone, Steve Lonhart, MBNMS

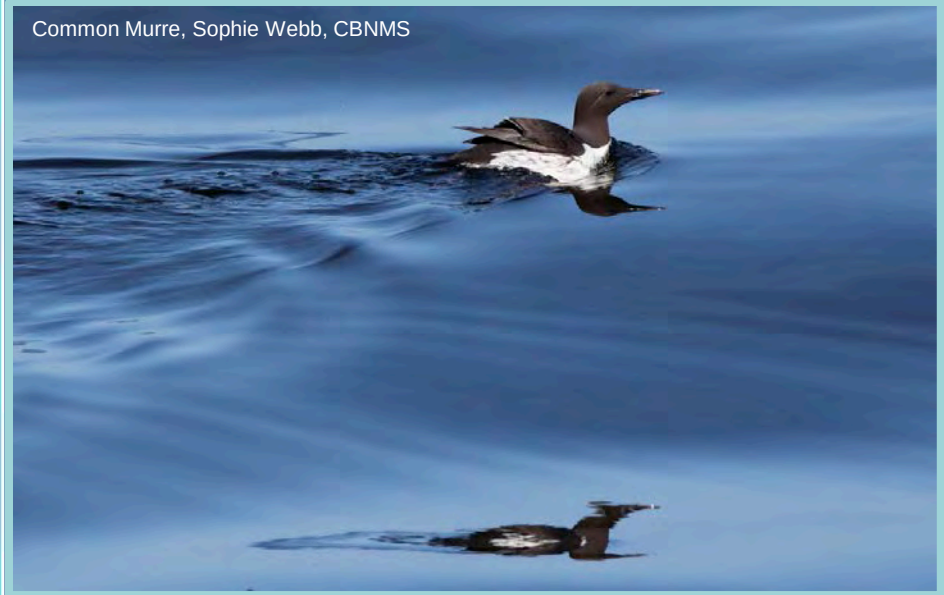

Cabezon, Chad King, MBNMS

SELECTED HABITAT-FORMING ORGANISMS	
ROCKY INTERTIDAL & ISLAND	
	Mussel beds (*Mytilus californianus*)
	Surfgrass (*Phyllospadix scouleri* and/or *Phyllospadix torreyi*)
NEARSHORE SUBTIDAL	
	Bull kelp (*Nereocystis luetkeana*)
ESTUARIES & BAYS	
	Pickleweed (*Salicornia virginica* and/or *Sarcocornia pacifica*)
	Eelgrass (*Zostera marina*)
	Cordgrass (*Spartina foliosa*)
OFFSHORE (ROCKY BENTHIC)	
	California hydrocoral (*Stylaster californicus)*


Mussel Bed, Steve Lonhart, MBNMS


Deep Sea Coral, Greg McFall, CBNMS

SELECTED SEABIRD SPECIES
Brandt's cormorant (*Phalacrocorax penicillatus*)
Cassin's auklet (*Ptychoramphus aleuticus*)
Common murre (*Uria aalge*)

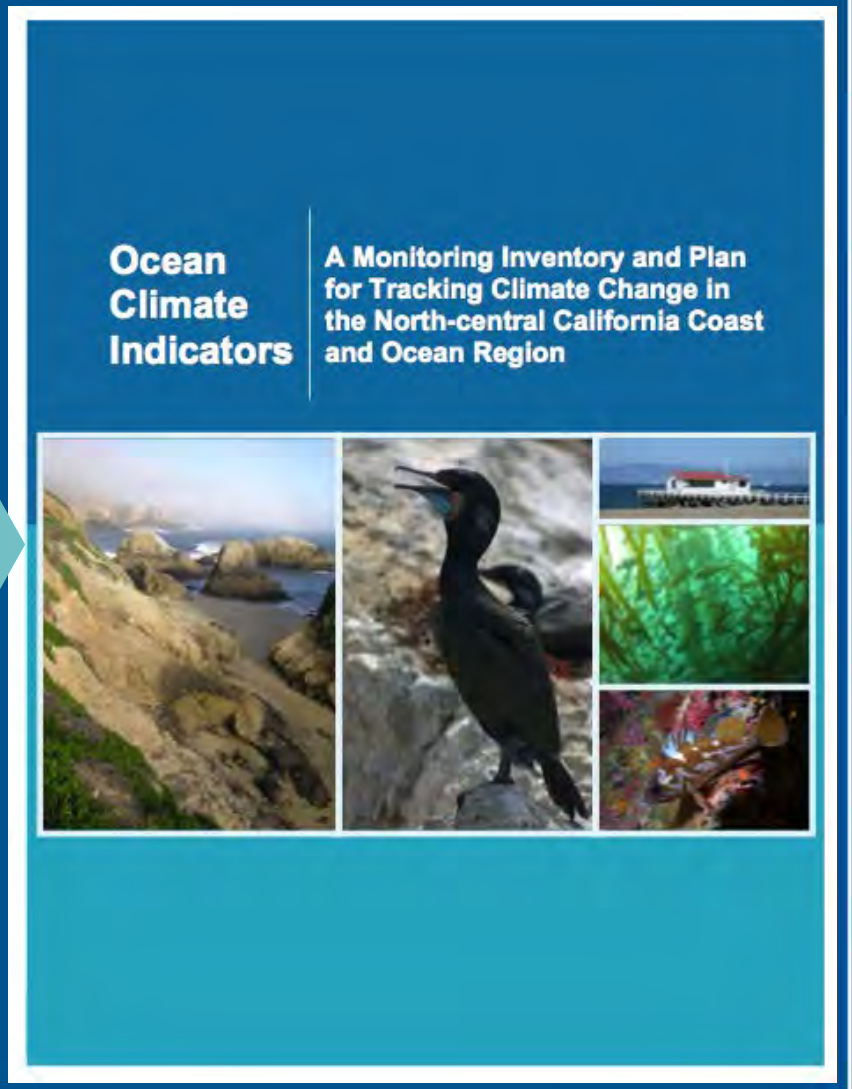


Common Murre, Sophie Webb, CBNMS

Brandt's Cormorant, Chad King, MBNMS

Indicators Working Group

1. Define Indicator Monitoring Goal and Objectives
2. Determine selected species for biological indicators
3. For each indicator, develop case studies, monitoring strategies, & activities



PRIORITY LEVEL SYMBOLS:		
★★★	★★	★
Support for this indicator monitoring activity is ***critical***, even during times of limited financial resources	Support for this indicator monitoring activity is ***very important***, even during times of limited financial resources	Support for this indicator monitoring activity is ***important***, even during times of limited financial resources
NEED FOR ADDITIONAL FUNDING & INFRASTRUCTURE SYMBOLS:		
$$$	**$$**	**$**
No existing monitoring infrastructure or equipment	Some existing monitoring infrastructure or equipment	Extensive monitoring infrastructure or equipment exists

OCEAN CHEMISTRY MONITORING STRATEGY #1:
Expand the geographic coverage of ocean chemistry monitoring.

Need for Additional Funding & Infrastructure:
$$

Gaps in Research:

1. Do organisms respond to average carbonate chemistry conditions, and/or changes in the variability (seasonal, monthly, daily) of these parameters?
2. What is the impact of combined influence of low-pH and low oxygen waters, which may co-occur within the study region?
3. How does ocean chemistry influence local productivity and food webs, and vice versa?

Activity 1.1:	*Activity 1.2:*
Add pH and pCO_2 instruments to existing moorings and offshore cruises; support with discrete bottle samples.	Expand monitoring of ocean chemistry in critical habitats, including moorings and surveys.
Priority: ★★★	Priority: ★★
Current and Potential Partners: • GFNMS • CeNCOOS • State water agencies • Local universities • Ocean Margin Ecosystems Group for Acidification Studies (OMEGAS) partner universities • PISCO/MARINe • Pacific Marine Environmental Laboratory (PMEL) • West Coast Ocean Acidification and Hypoxia Science Panel • West Coast Governors Alliance on Ocean Health	Current and Potential Partners: • GFNMS • CeNCOOS • State water agencies • Local universities, including UC Davis and the OMEGAS program • PISCO/MARINe • PMEL • West Coast Ocean Acidification and Hypoxia Science Panel • West Coast Governors Alliance on Ocean Health
Implementation Timeline: <1 year	Implementation Timeline: ~ 1-2 years

Example Case Studies: Ocean Chemistry

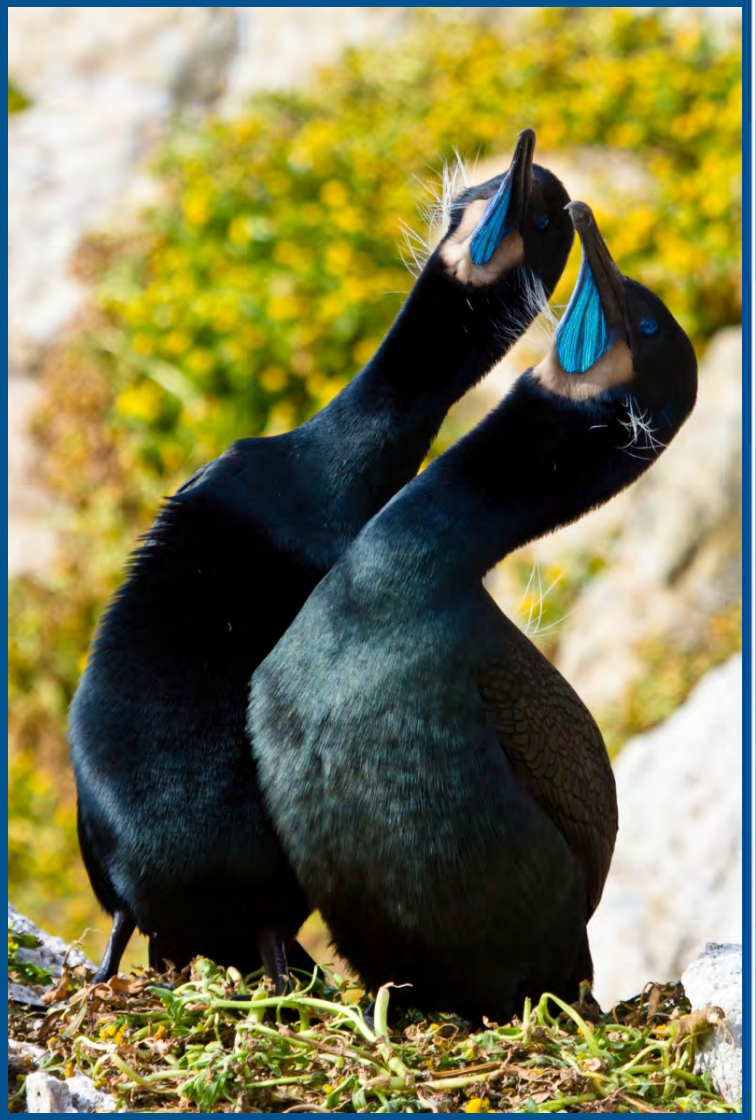
- To evaluate and predict the impact of changes in ocean chemistry, including OA, on local/regional productivity and ecosystems. For example, reproductive failure in recreationally valuable mussel species and other bivalves can impact sustainable aquaculture, with important economic and ecological effects on the region.

- To evaluate local-scale ocean acidification remediation or mitigation tactics and their efficacy, such as the restoration of seagrass beds for carbon sequestration.

- To facilitate the identification of biogenic habitats that are of the highest risk from acidification. GFNMS managers can develop additional protections for these habitats that can help to reduce or eliminate other anthropogenic impacts.

Edits Resulting from DOI Review

- Reorganized Introduction
- Reworded purpose statement
- Reworded key purposes paragraph
- Copied recommendation for updating plan to Conclusion
- Added data sources/partners to some indicators



Brandt's Cormorants – Nest Building
farallonphoto.blogspot.com

National Marine Sanctuaries
National Oceanic and Atmospheric Administration

Contact: benet.duncan@calost.org

Gulf of the Farallones National Marine Sanctuary

North-central California Coast and Ocean Climate-Smart Adaptation

Sara Hutto
Ocean Climate Initiative Specialist
GFNMS Advisory Council
November 20, 2013

Climate-Smart Adaptation Benefits Communities and Ecosystems

Conservation strategies and actions that specifically address impacts of climate change in concert with other threats.

Hydrocoral. *Credit: Steve Lonhart, MBNMS*

Pacifica. *Credit: Jack Sutton*

Taylor's Sea Hare. *Credit: Jennifer Stock, CBNMS*

Climate-Smart Adaptation Benefits Communities and Ecosystems

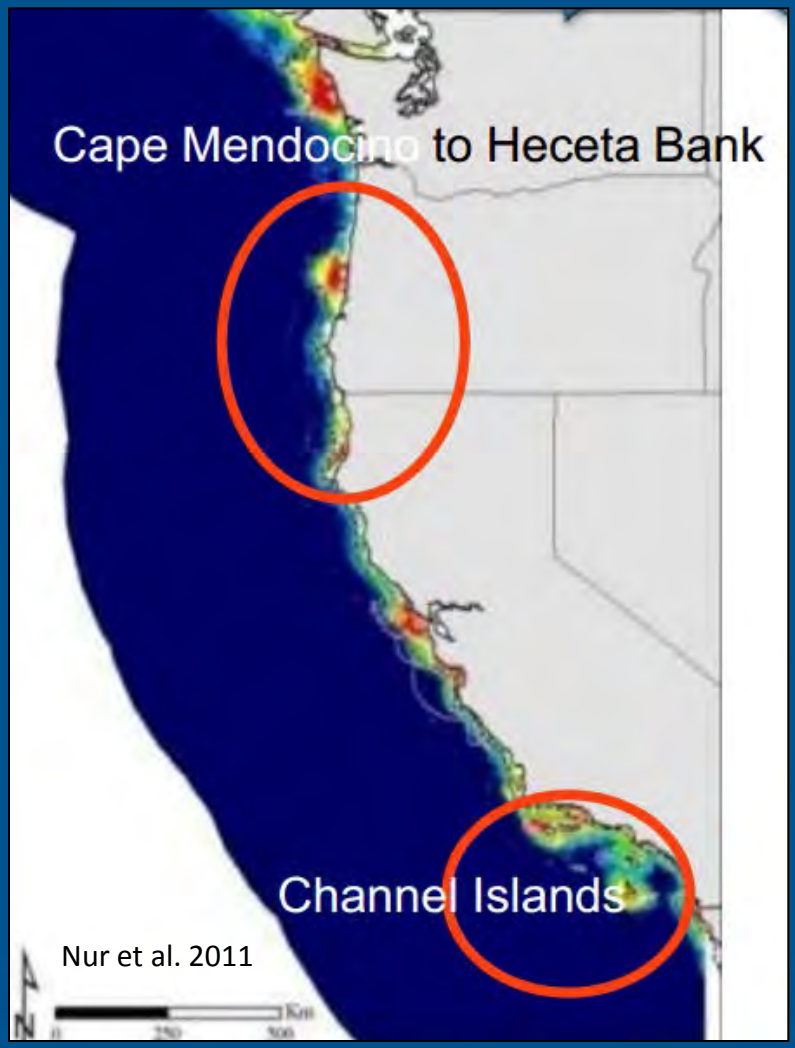
Climate-Smart Adaptation is…

- Future-focused
- Holistic (ecosystem context)
- Adaptive and Flexible

Climate-Smart Adaptation Benefits Communities and Ecosystems

Climate-Smart Adaptation is…

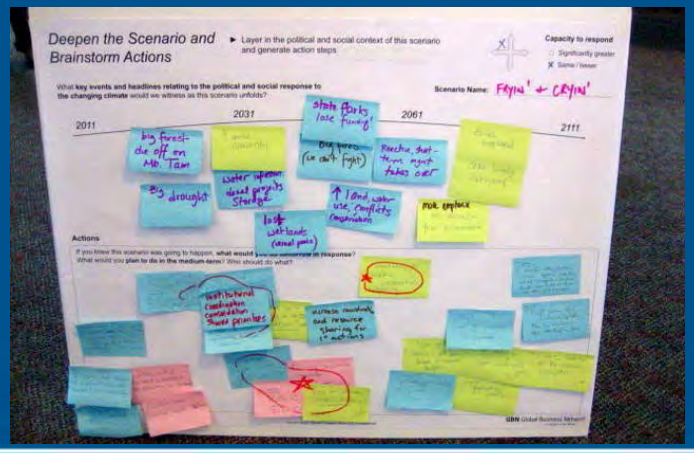
- Prioritized



Climate-Smart Adaptation Benefits Communities and Ecosystems

Climate-Smart Adaptation is…

- Collaborative
- Stakeholder-led



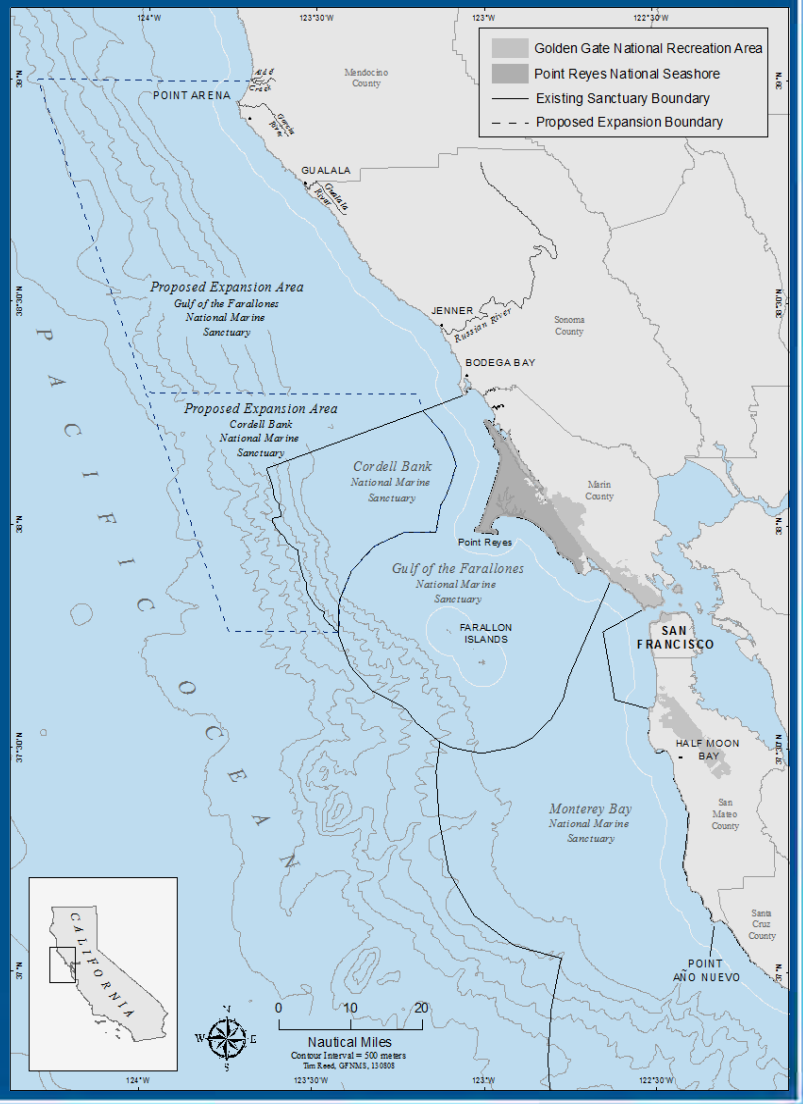
Climate-Smart Adaptation is coming to GFNMS!

Project Components – Phase 1

Establish and convene Workshop Planning Committee (complete)

Stakeholder Focal Resources Workshop (February 2014)

Stakeholder Vulnerability Assessment Workshop (April 2014)



Climate-Smart Adaptation is coming to GFNMS!

Project Components – Phase 2

(timeline pending funding)

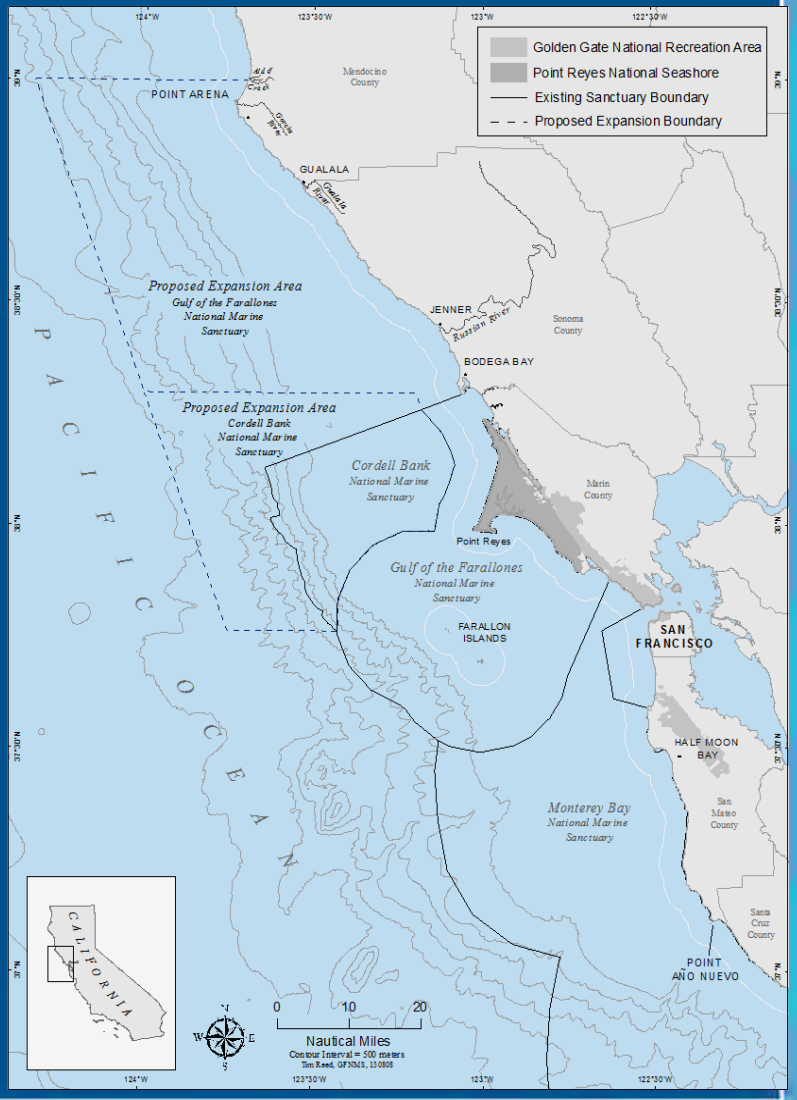
Climate Smart Adaptation Working Group (targeted Summer 2014)

Climate Scenarios

Adaptation Action Recommendations

Adaptation Implementation Plan

Green Resilient Shoreline projects



Phase 1: Workshop Planning Committee

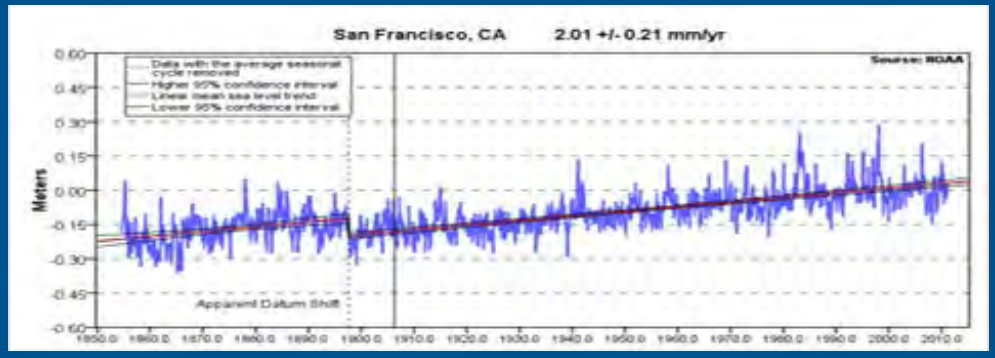
Phase 1: Climate-Smart Adaptation Workshops

Workshop 1: Define focal resources (Feb 2014)

- Species
- Habitats
- Ecosystem services

Workshop 2: Assess Vulnerability (April 2014)

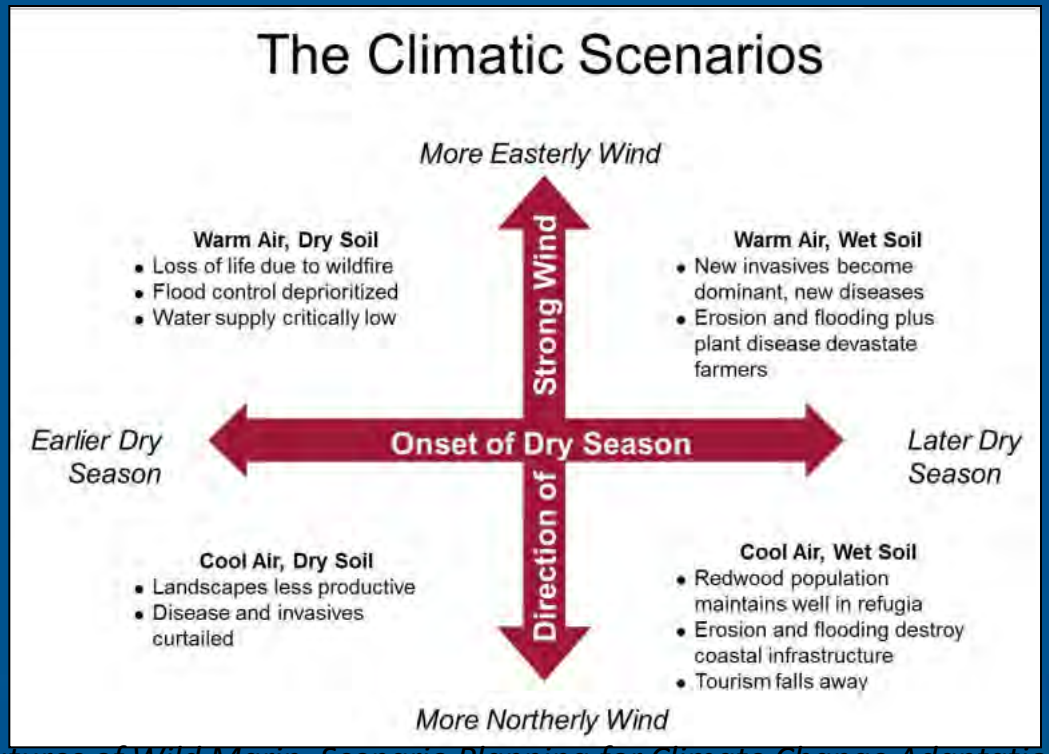
- Literature review
- Expert elicitation
- Relevant regional modeling



Phase 2: Climate-Smart Adaptation Working Group

Define distinct climate scenarios – multiple plausible futures based on:

- Most uncertain drivers of change
- Most impactful drivers of change



Futures of Wild Marin, Scenario Planning for Climate Change Adaptation

Phase 2: Climate-Smart Adaptation Working Group

Develop Adaptation Actions:

- Define criteria for prioritization (e.g. feasibility, cost-effectiveness)
- Brainstorm potential management actions for each climate scenario
- Evaluate and prioritize actions using defined criteria
- Identify specific current actions or those that may be implemented immediately as pilot adaptation responses

Phase 2: Implementation Plan and Pilot Green Resilient Shoreline Projects

Implementation Plan

- Summary of approved adaptation actions
- Implementation prioritization and schedule

Pilot Green Resilient Shorelines Projects

- Examples: restore hydrologic function in Bolinas Lagoon, seagrass restoration in Tomales Bay
- Timeline, project costs
- Monitoring Plan, Outreach Plan

Questions?

sara.hutto@noaa.gov
415-970-5251

NATIONAL MARINE SANCTUARIES
GULF OF THE FARALLONES