



Climate Change Effects and Management Response along the North-central California Coast



Maria Brown and Kelley Higgason
Gulf of the Farallones National Marine Sanctuary

**Climate Change, Natural Resources and Coastal
Management Workshop**
January 29-30, 2009

Michael C. Carver, CBNMS



Goal: provide solutions on a local, state, and federal level through partnerships, research collaborations, education, and policy reform.

- **Ocean Climate Initiative**
- **Site Scenario**
- **Action Plan**
- **Ocean Climate Action Center**



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Working Group

- Sarah Allen, Point Reyes National Seashore
- James Cloern, USGS
- Jeffrey Dorman, University of California, Berkeley
- Brian Gaylord, University of California, Davis, Bodega Marine Lab
- Ted 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
- Raphael Kudela, University of California, Santa Cruz
- John Largier, University of California, Davis, Bodega Marine Lab
- Lance Morgan, Marine Conservation Biology Institute Dave Reynolds, National Weather Service
- Jan Roletto, Gulf of the Farallones National Marine Sanctuary
- Frank Schwing, National Marine Fisheries Service
- Bill Sydeman, Farallon Institute



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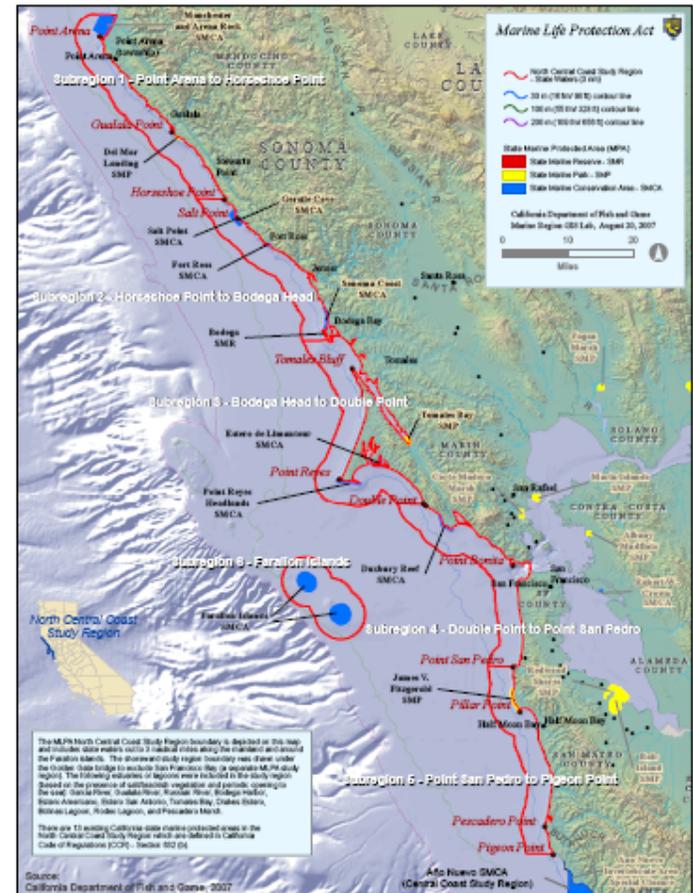
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North-Central California Coast and Ocean Climate Change Scenario

- Downsize information
- Shared understanding
- Synthesize
- Informed decision-making
- Prioritize actions
- Guide policy development
- Guide management actions



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Map 1 North Central Coast Study Region and Existing State Marine Protected Areas



Drivers of Change

- Sea Level Rise
- Ocean Circulation
- Ocean Temperature
- Ocean Chemistry
- Waves
- Winds
- Land Runoff
- Surface Heat Flux
- Incident Light



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Sea Level Rise

- 1st level: Secular trend - thermal expansion (IPCC) and glacial melt
- 2nd level – Interannual fluctuations



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Winds

- Spring transition may occur earlier
- Marine layer may get stronger
- Winter may see stronger wind events
- Lower pressure can raise sea level
- Upwelling more offshore

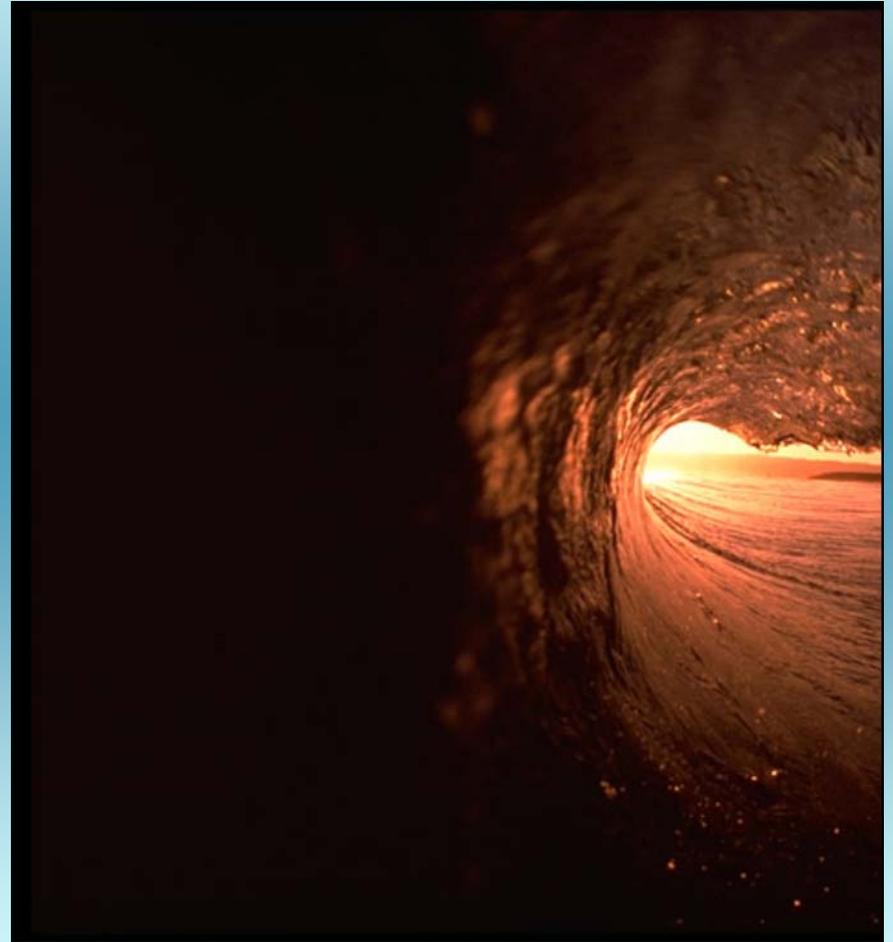


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Waves

- **More intense storms; larger swell with shorter wave period**
- **50 year increase in wave height**
- **May see increases in southerly swell**
- **Could see salinity increases driven by onshore storm surges**

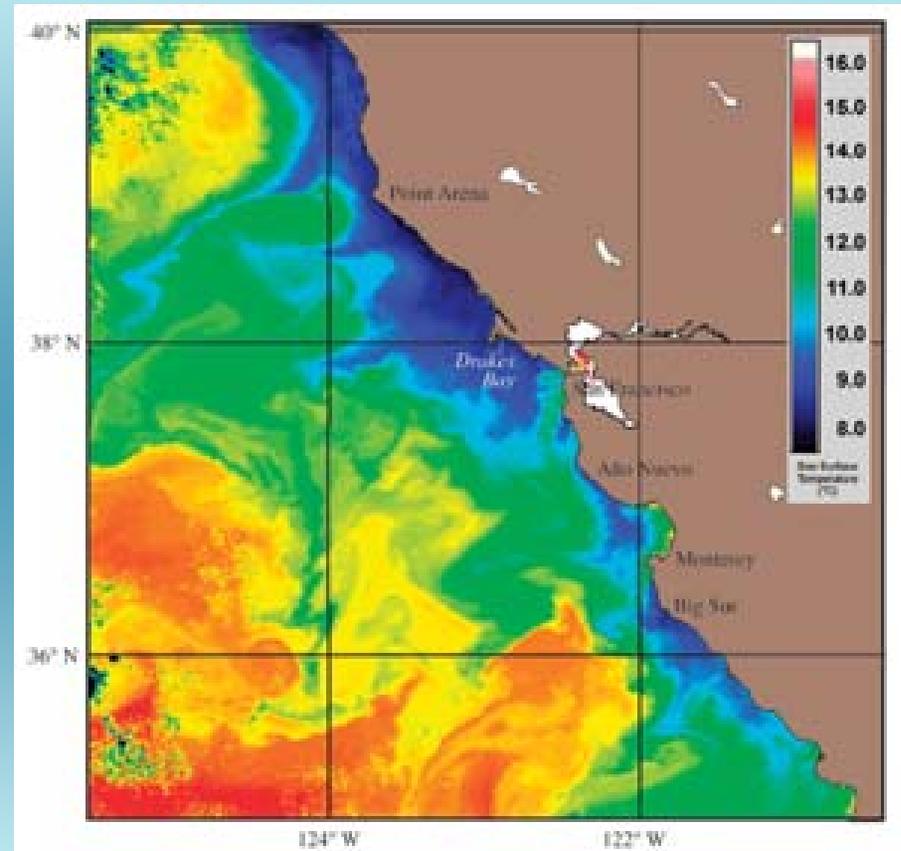


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Ocean Circulation

- Predicting large scale changes in circulation
- Resulting in change in flora and fauna
- Regime shifts: intensity and frequency of interannual/interdecadal processes

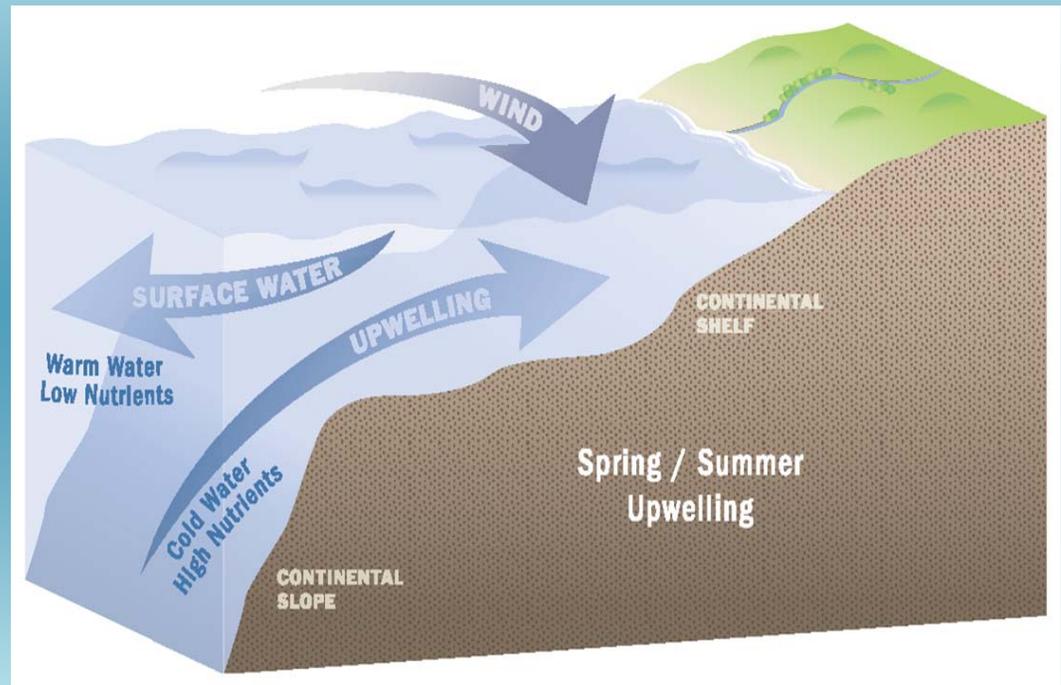


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Upwelling

- Winds will likely increase
- Upwelling process may be stronger
- Too much upwelling and too little bad



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Stratification and Mixing

- Projections → increases in winter rain, increased nearshore stratification in winter
- Potentially less stratification in spring → less snow melt, no fresh water lens from SF Bay in GFNMS

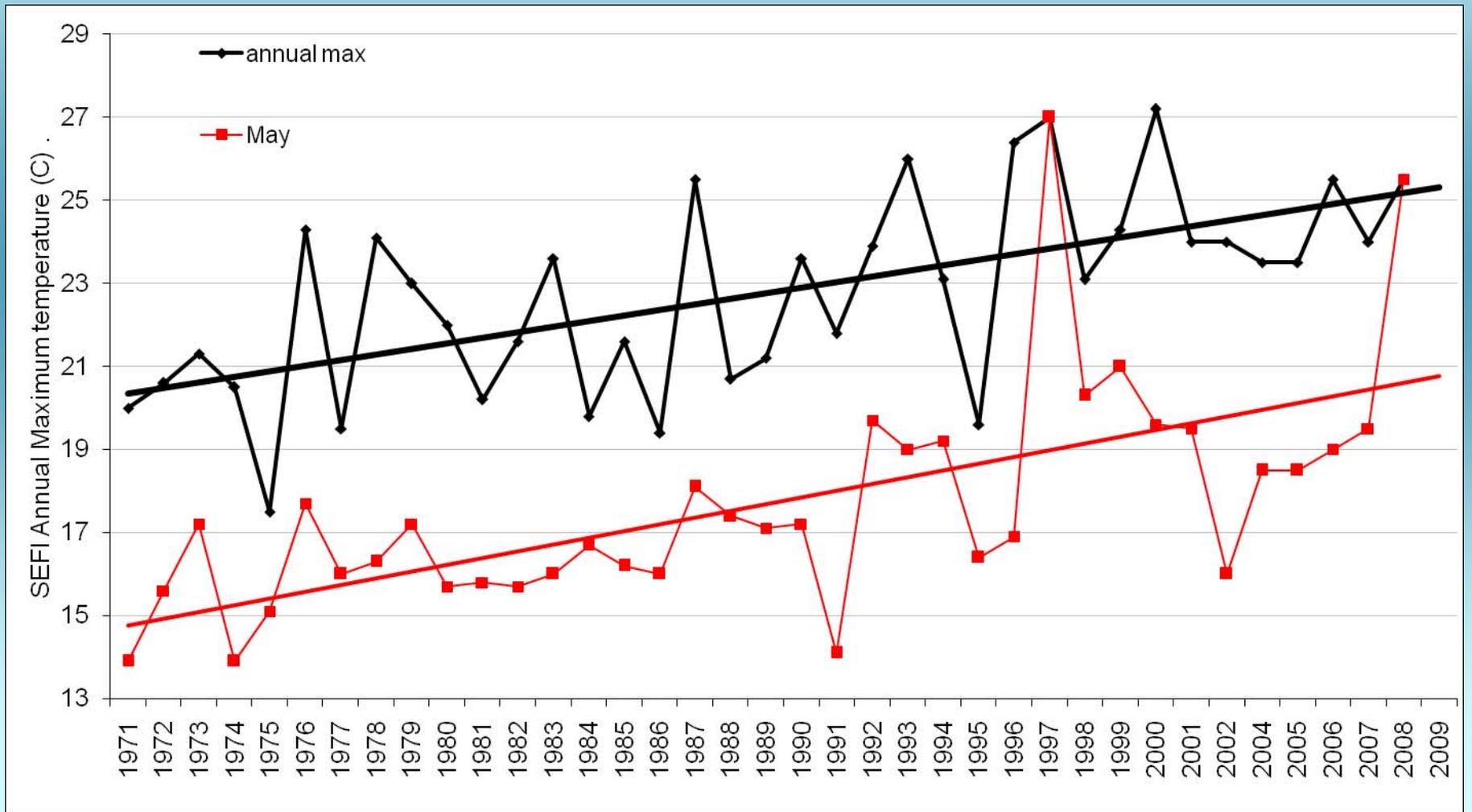


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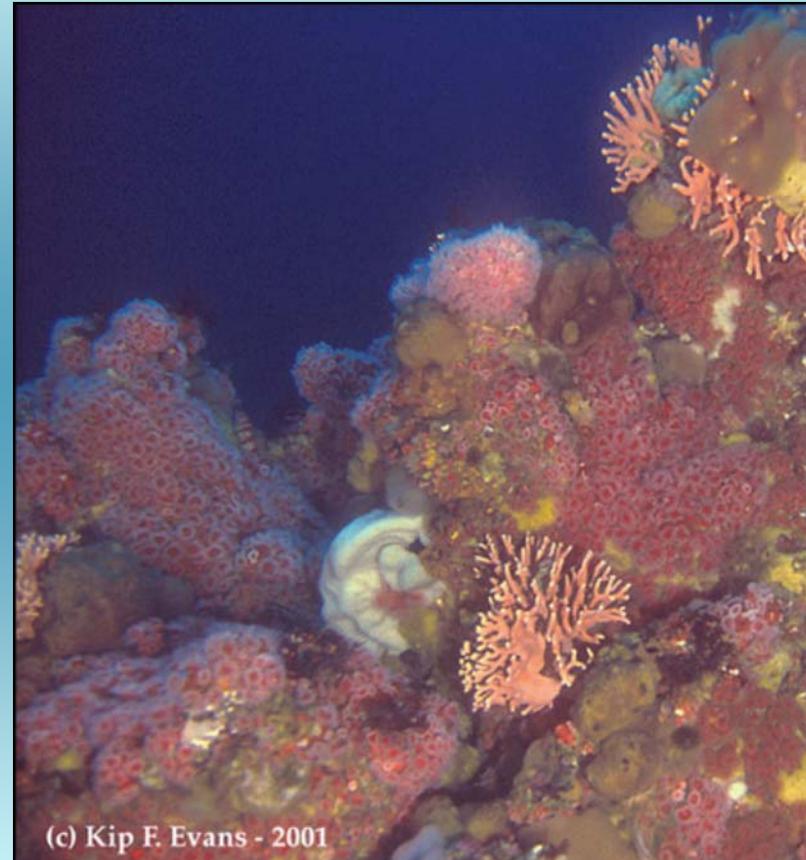
Temperature

Maximum Air Temps, Farallon Islands, 1971-2008



Water Chemistry

- Ocean Acidification
- Surface pH and pH of upwelled water
- Hypoxic Events



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Land Runoff

- **Changes in freshwater influx**
- **More freshwater in winter**
- **Less freshwater in spring and summer**



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Changing Habitats & Biotic Response

- Loss of habitat
- Change of community structure
- Species distribution shifts
- Demography
- Phenology
- Population connectivity



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Ocean Climate Change Action Plan for North-Central California

- Conservation Science
- Community Action
- Ecosystem Resilience and Protection
- Carbon Footprint Reduction



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Marine Sanctuaries Conservation Series NMSA (ONMS-08-05)

First Biennial Ocean Climate Summit: Finding Solutions for San Francisco Bay Area's Coast and Ocean



Proceedings of the Summit:
April 29, 2008
Golden Gate Club, The Presidio
San Francisco, California

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Ocean and Coastal Resource Management
Office of National Marine Sanctuaries



August 2008



Conservation Science Actions

- Sentinel Site: Establish the region as an indicator for ecosystem health and climate change in a temperate environment
- Coordinate the development of a cohesive research and monitoring plan to fill information gaps
- Use SIMoN web site as a portal to share information
<http://sanctuarysimon.org>
- Make connections/synthesize information
- Use scientific findings to develop policy



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Ocean Climate Action Center

To bring together agencies, non-profit organizations, scientists, policy advisors, educators, and private businesses to:

- 1) Promote partnerships to address climate change in the Bay Area coast and ocean environment
- 2) Facilitate implementation of Action Plan strategies
- 3) Serve as a regional ocean climate change communication center



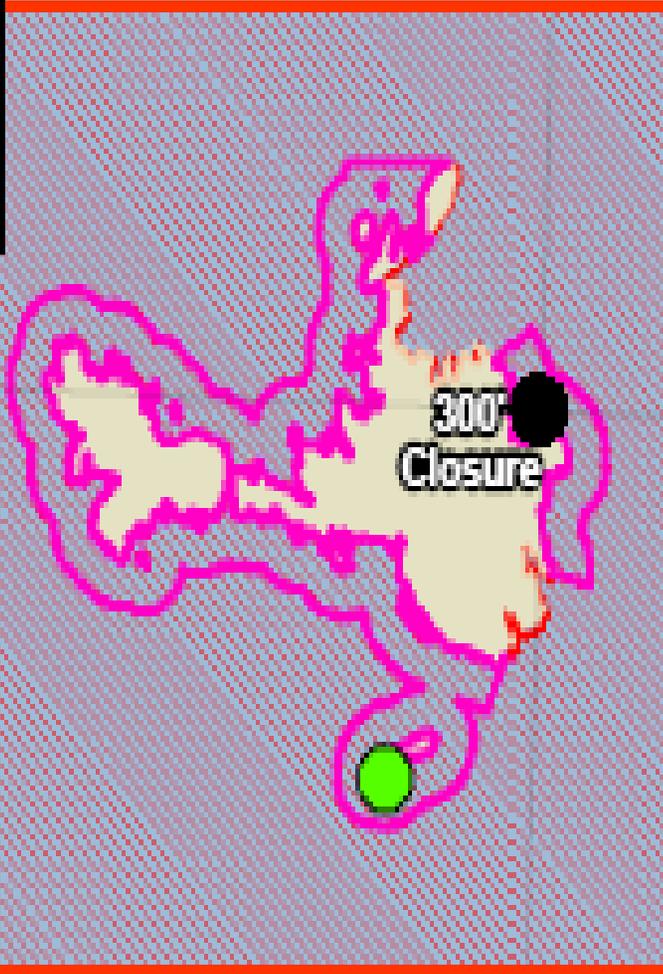
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Ecosystem Resilience and Protection



10/10/2014





Carbon Footprint Reduction

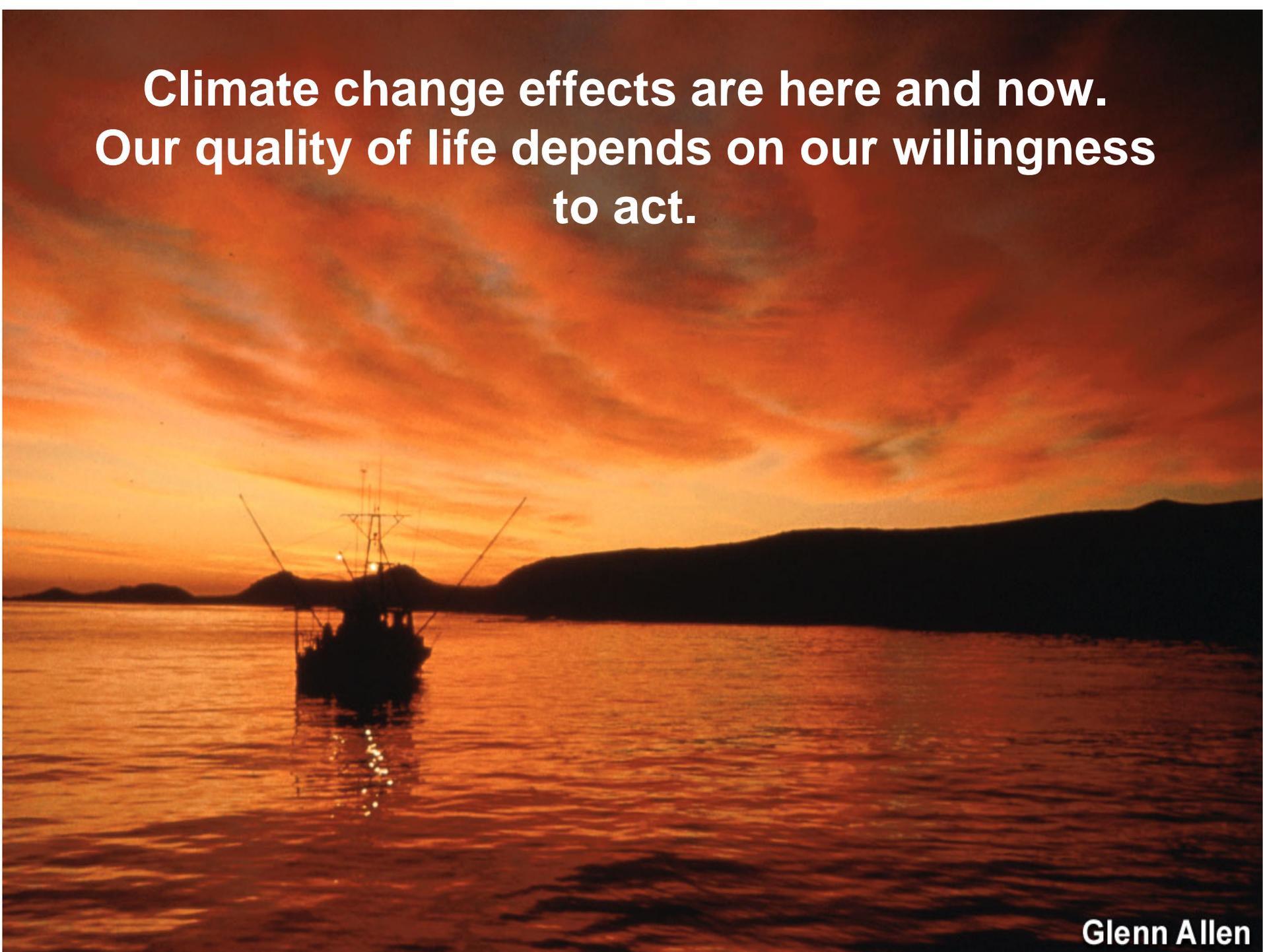
- Emissions Audit
- Model Green Corporate Behavior
- Protect Carbon Sink Habitat
- National Energy Policy



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**Climate change effects are here and now.
Our quality of life depends on our willingness
to act.**



Glenn Allen