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PRBO Conservation Science

Climate Change and Ecosystems: Securing our Future in the Bay Area

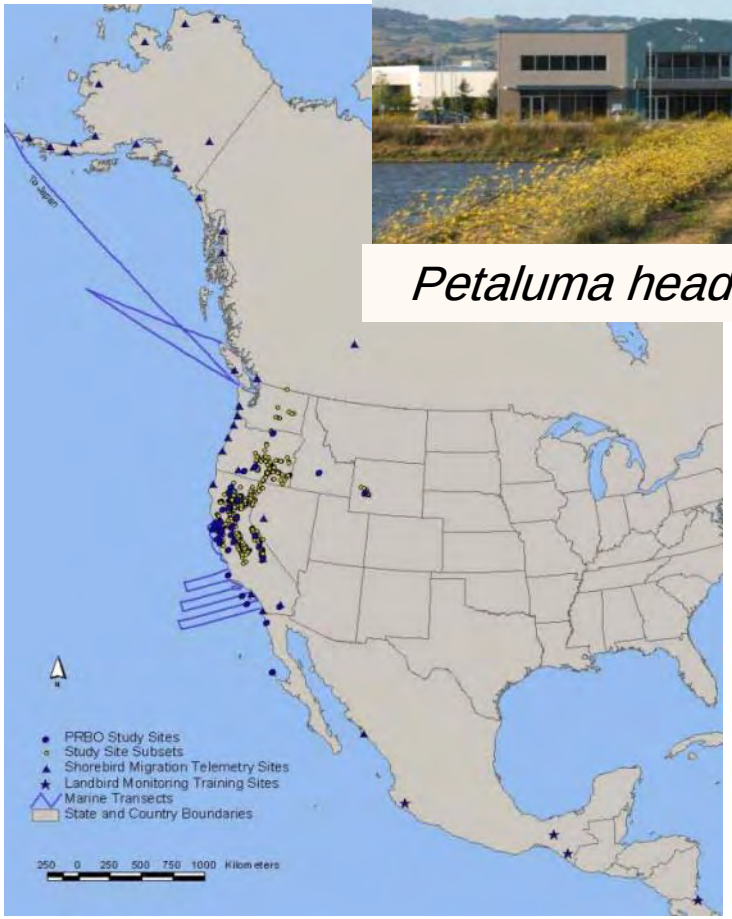
BCDC

Ellie M. Cohen and PRBO Staff September 2, 2010

Bird Ecology to Improve Conservation

- Founded in 1965
- 120+ staff and seasonal biologists
- 2010 Budget: ~$7.3m

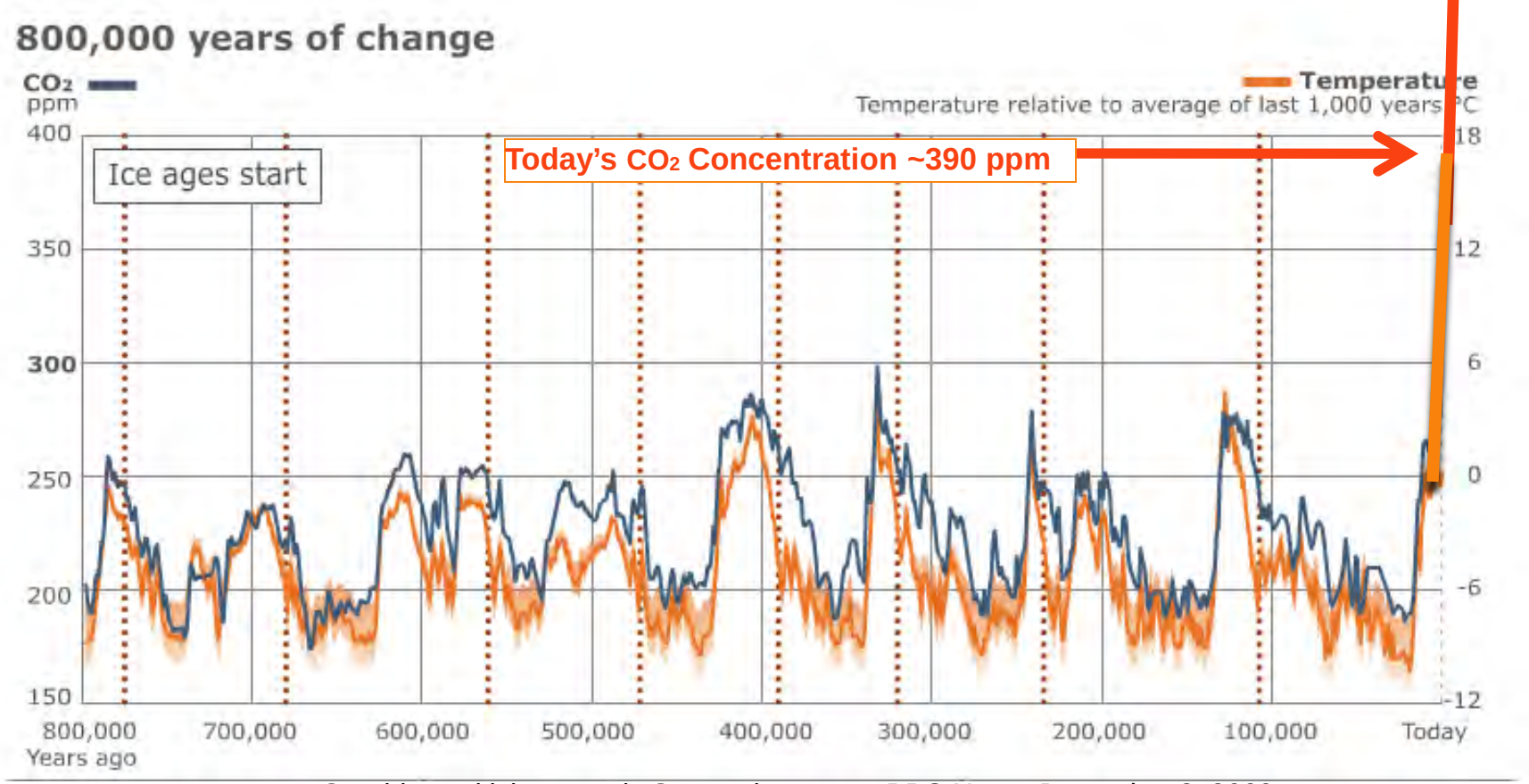
Petaluma headquarters



PRIORITY: Address Rapid Environmental Change

CO_2 Highest in15-20 Million Yrs

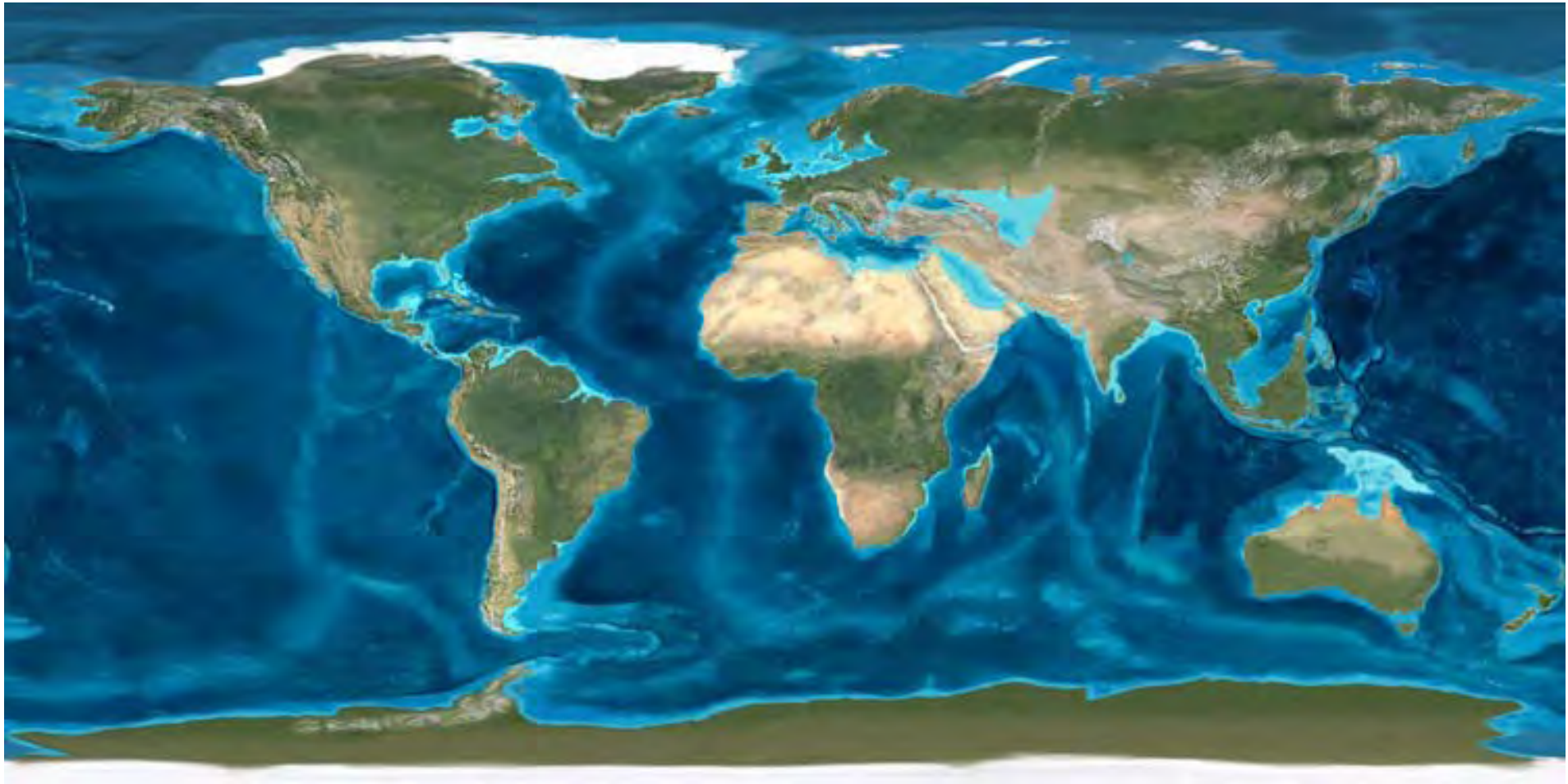
By 2050 with "business as usual" - **CO_2** at 600-700 ppm"



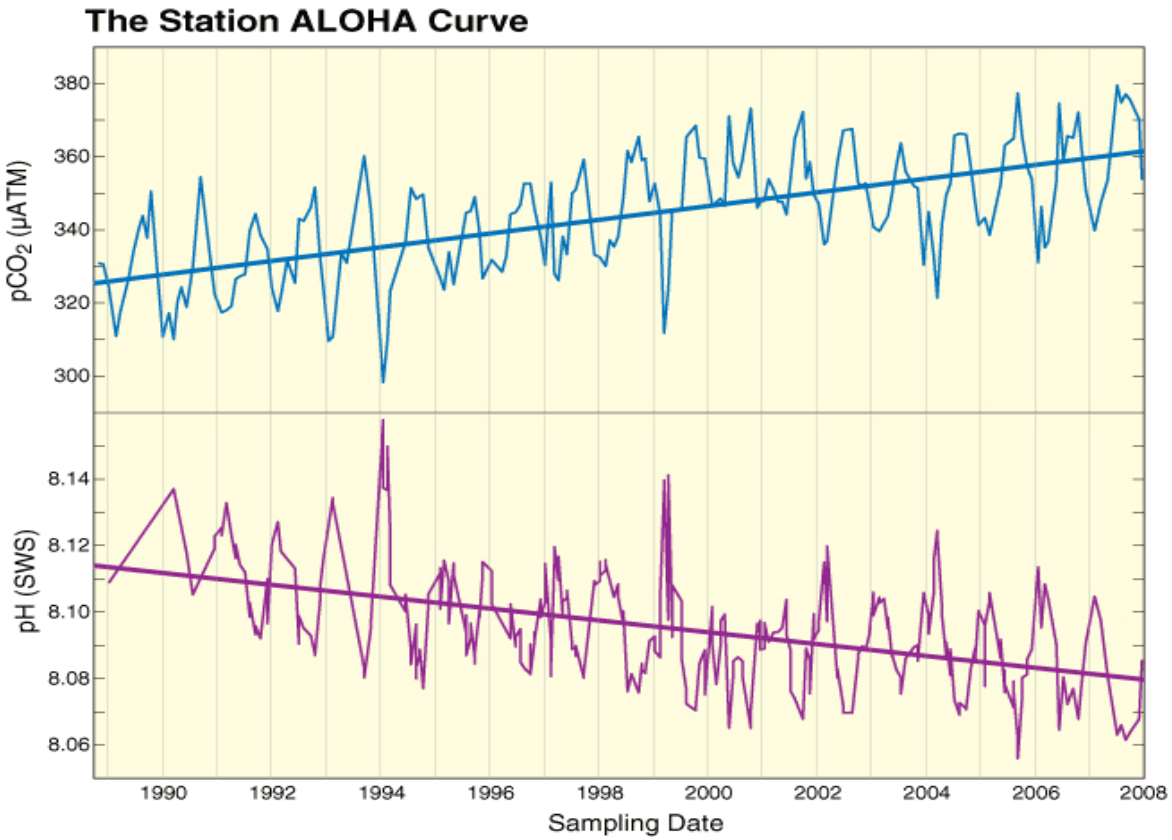
Graphic-- British Antarctic Survey, ice cores, *BBC News, December 3, 2009*

15m yrs ago- ~400 ppm, SL 25-40 m (75-120 ft) higher, 3-6C (5-10 F) warmer*;*
used ratios of boron to calcium in foraminifera - marine algae
Tripati et al, Science, Vol 326, no. 5958, December 2009

Earth 15-23m years ago– Miocene– sea level was 25-40 m (75-120 ft) higher, 3-6 C (5-10 F) warmer



Ocean Acidification- *Fastest in 65m Years*

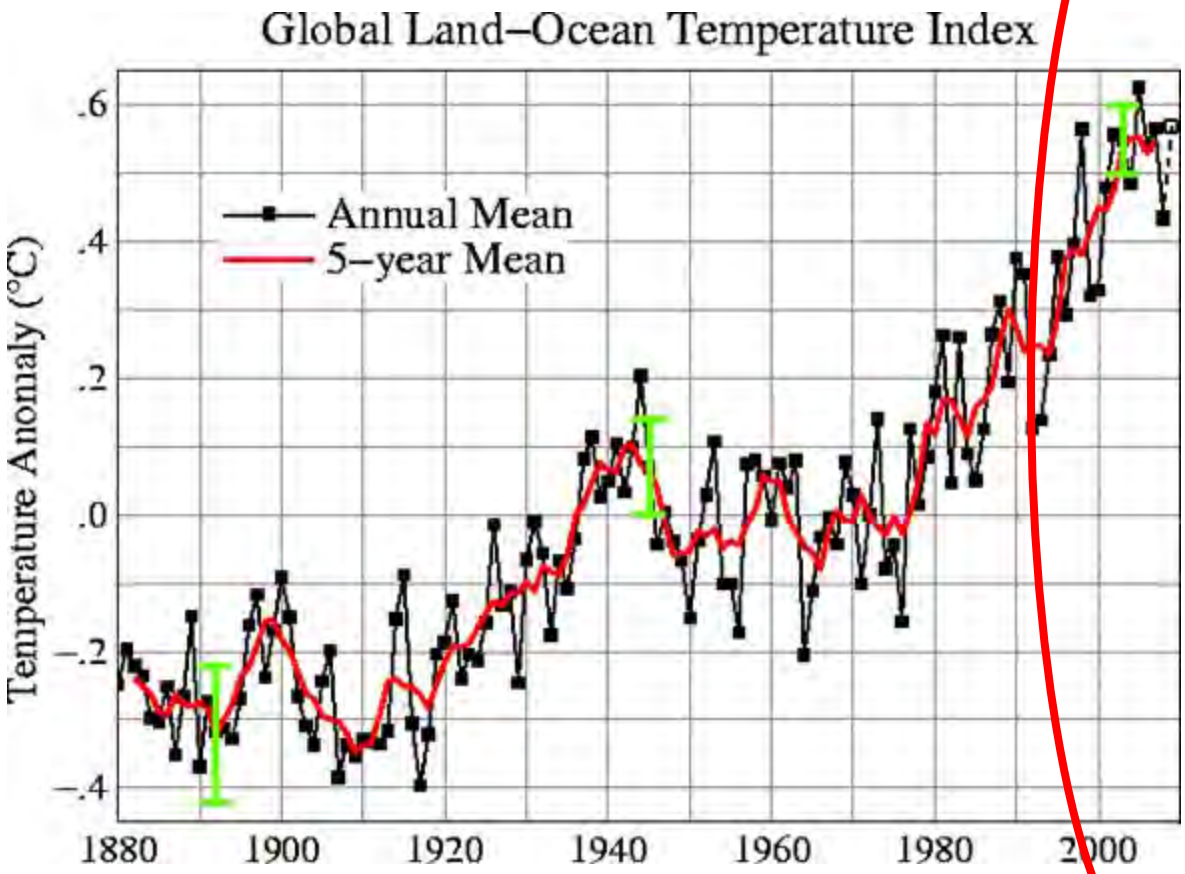


•*Ridgwell & Schmidt Feb 14 2010 Nature Geoscience*

- **lower ph in past = mass extinctions**; **tipping point is pH of 7.8 at which calcified organisms begin to disappear, jellies & algae take over**

Dias, Hart, et al Journal of the Geological Society; September 2010; v. 167

2000-2009 Warmest Decade on Record



Avg. global surface temp 0.54°C (0.96°F) above 20th century avg.; shattered 1990s value of 0.36°C (0.65°F).
NOAA, Natl Climatic Data Center, Global Analysis, State of the Climate Dec. 2009
World Meteorological Association Dec. 2009

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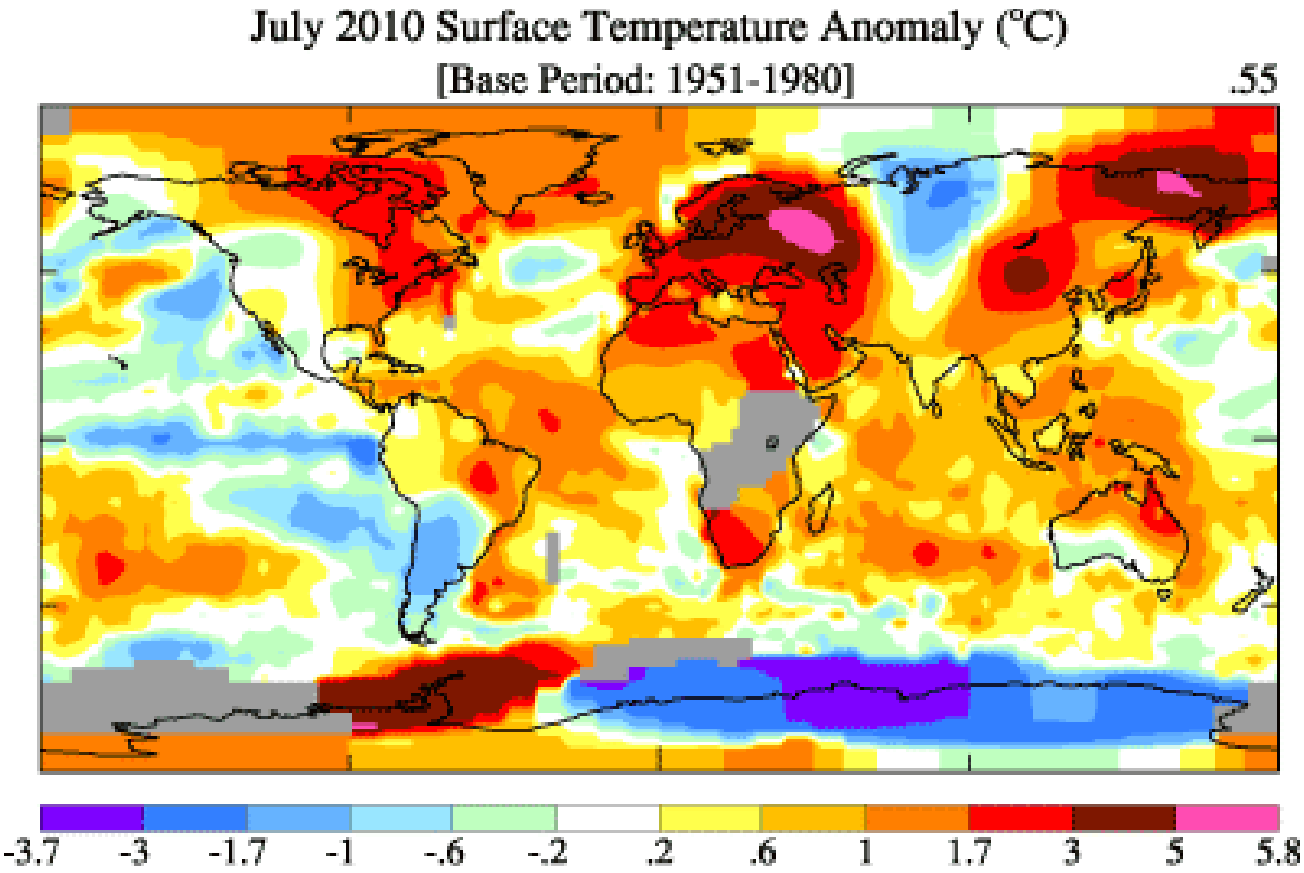
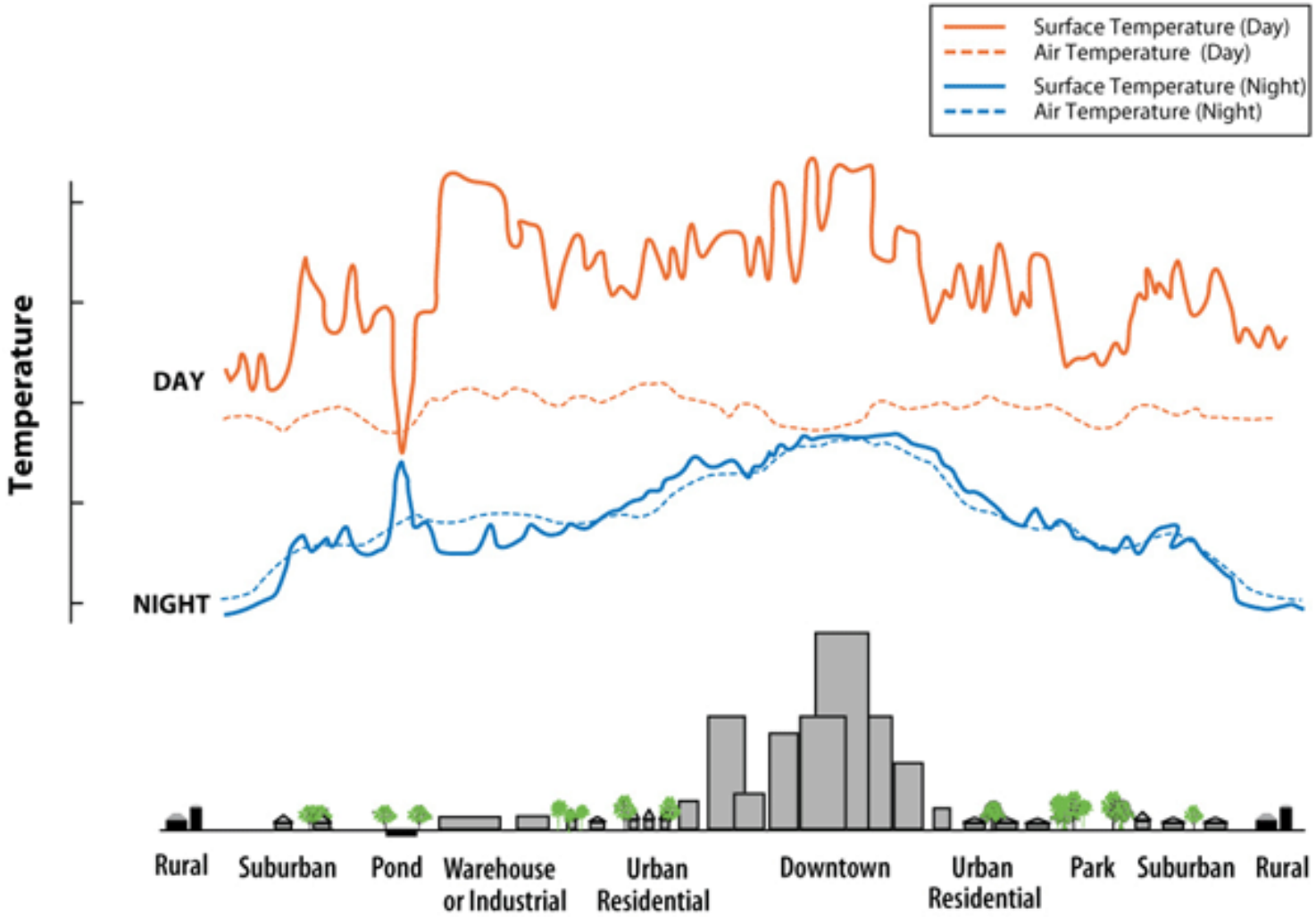
2010- Warmest Year To Date on Record
NASA: "July is What Global Warming Looks Like"



NASA's Goddard Institute for Space Studies http://data.giss.nasa.gov/gistemp/2010july/

Urban Heat Island Effect– adds to warming globally?



NASA/Goddard Space Flight Center (2010, January 5). Ecosystem, vegetation affect intensity of urban heat island effect.; additional info at www.epa.gov/heatisld/about ;

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40% Decline in Phytoplankton Since 1950- Due to Warming

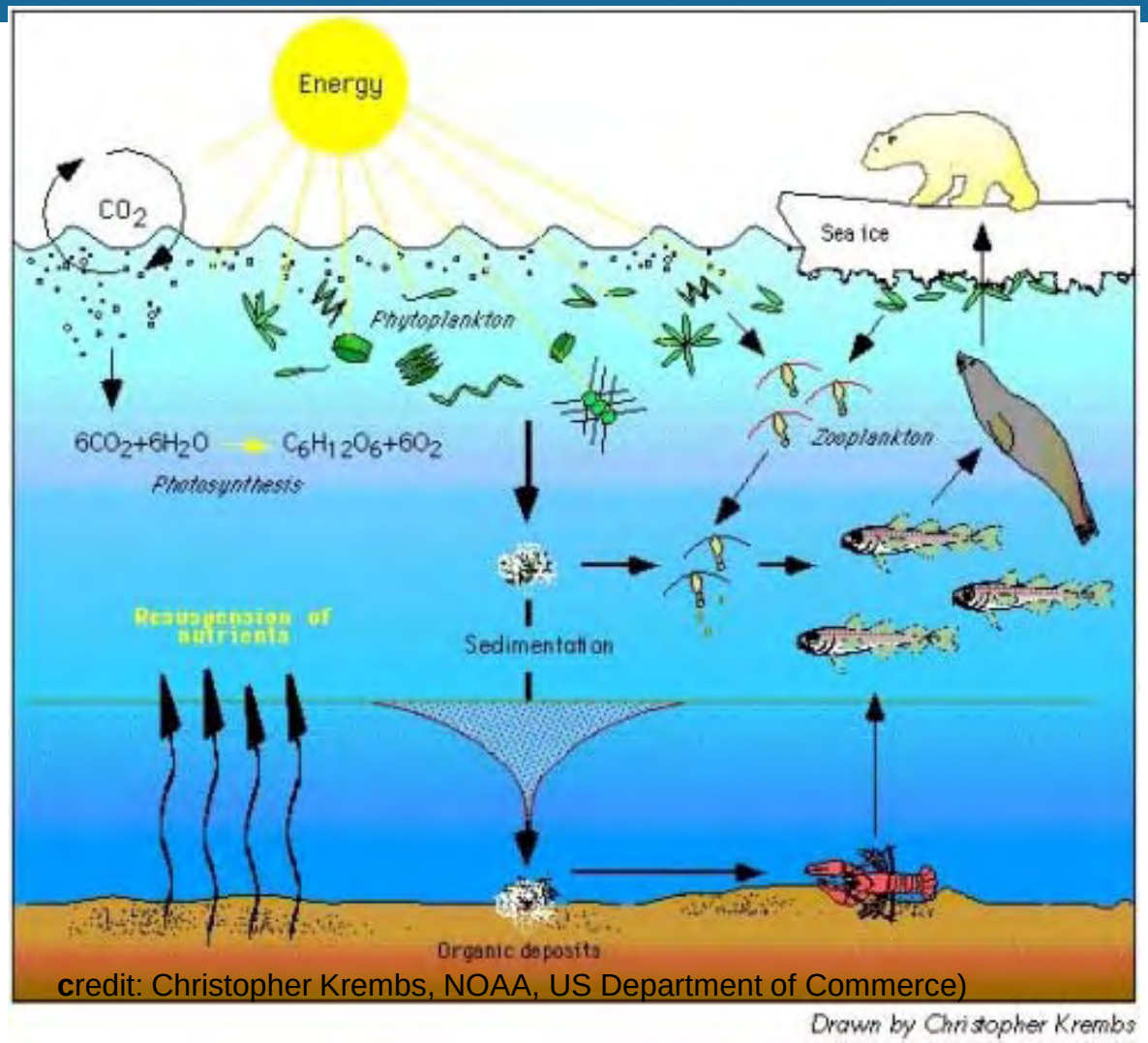
"Plant plankton… crucial to life on Earth–

•foundation of marine food web

•produce half world's O2

• sucks up… CO2"

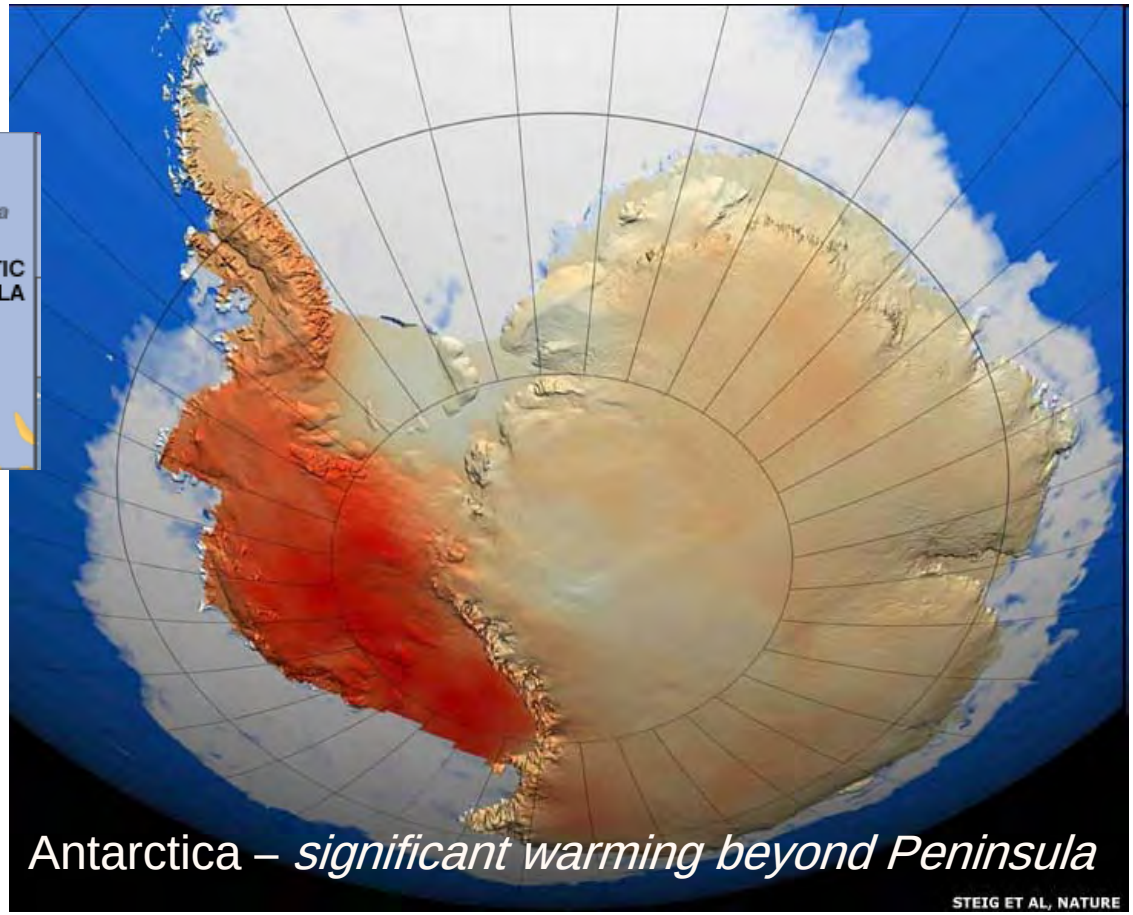
AP, July 29, 2010



credit: Christopher Krembs, NOAA, US Department of Commerce)

Global phytoplankton decline Boyce et al Nature : 466, Pages: 591–596 (29 July 2010)

Ice Sheets Melting Faster– *both polar regions*



- **+0.6º C or 1.5º F over past few decades**
- **Wilkin's Ice Shelf breaking up now**

Steig, et al, *Nature* 457, 459-462 Jan 22 2009; "State of Polar Research" Feb 25, 2009 World Meteorological Organization (WMO) and Intl. Council for Science (ICSU) "Ice Shelves Disappearing on Antarctic Peninsula" USGS Feb 22, 2010

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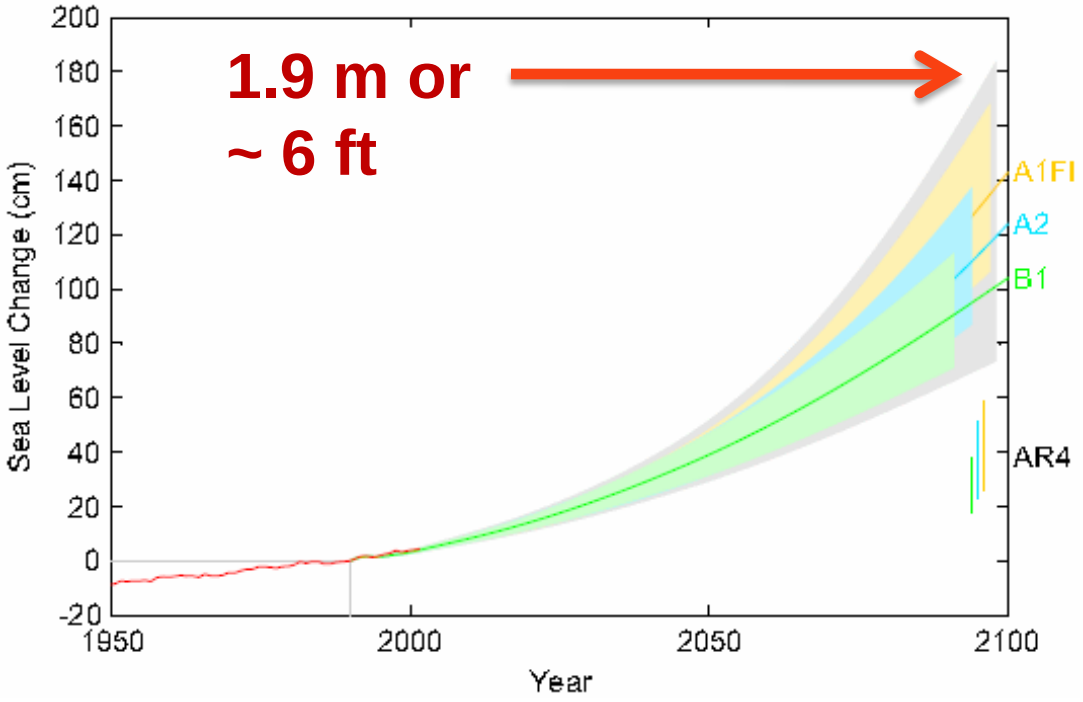
Sea Level Rise– up to 6 ft by 2100

-Rate of global SLR already >2x faster t*han IPCC 2007 predictions* (*www.climateinstitute.org.au*)



Vermeer, M., Rahmstorf, S. Global sea level linked to global temperature. Proceedings of the National Academy of Sciences, December 2009

Extreme, Unpredictable, Deadly Weather Events

US Climate Change Science Program
www.globalchange.gov

CA Climate Change Center
www.climatechange.ca.gov

Pakistan's Record Floods: ~6.5 million homeless, need food, water; ~20 million displaced, ~2000 dead

NY Times, August 15, 2010

World Meteorological Organization (WMO) –"no doubt" that higher Atlantic Ocean temperatures combined with La Nina cooler waters in Central Pacific and the jet stream stuck lower than usual, contributed to the disasters in Pakistan, Russia and China (2010)

Russia: Record Breaking Heat and Fires

NY Times, August 15, 2010

Mud Slides in China- 45,000 Evacuated

http://www.cnn.com/2010/WORLD/asiapcf/08/09/china.landslides/index.html

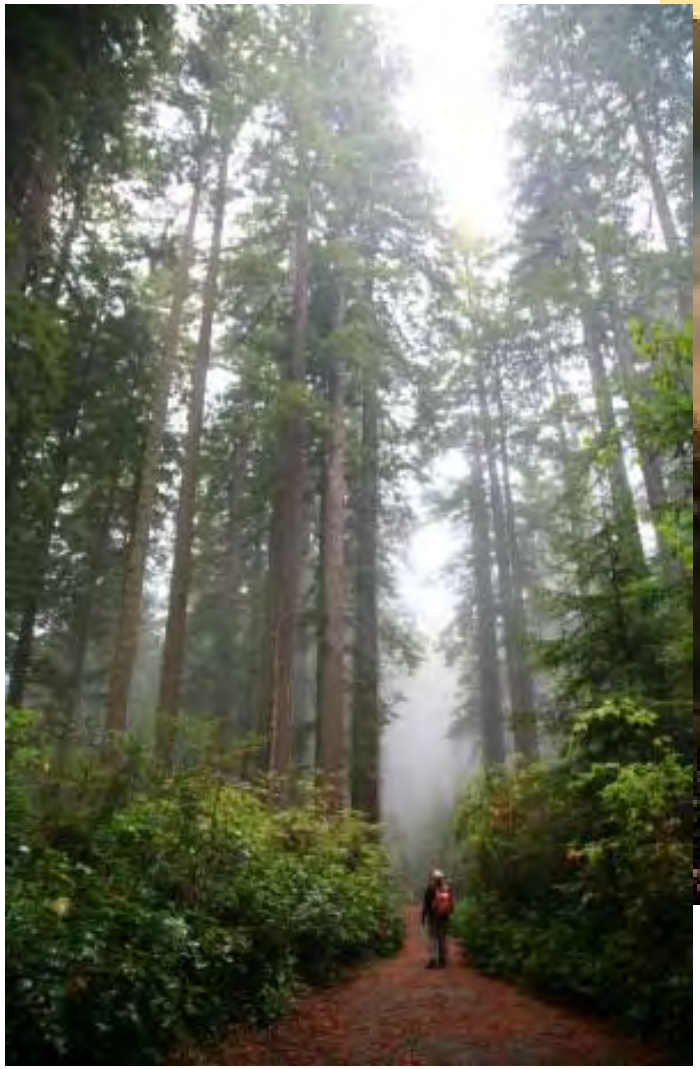
The reinsurer Munich Re reported ….that the first half of 2010 set a loss record for natural disasters; overall it estimates that the number of extreme weather events like windstorms and floods have tripled since 1980, and is expected to grow with warming……

American West temperatures – rising 2x faster than rest of world

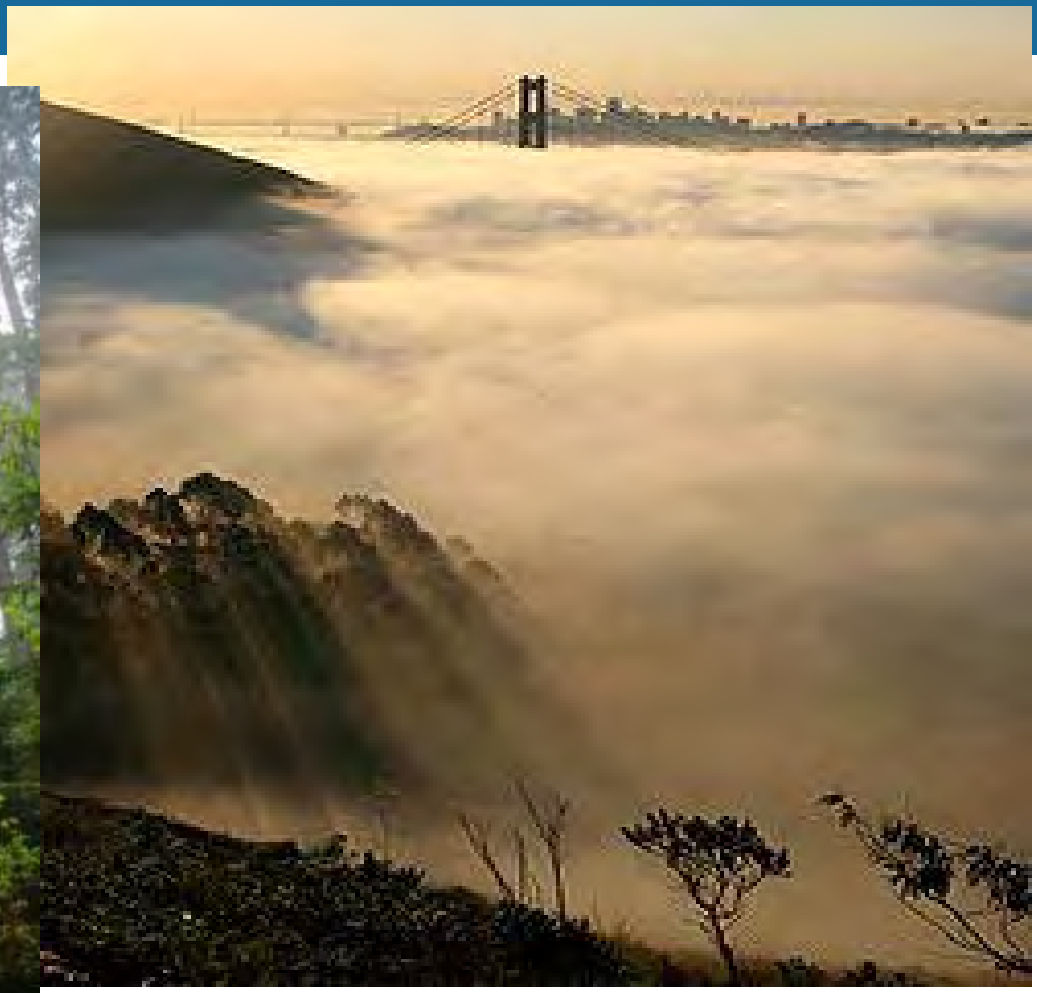
(www.rockymountainclimate.org, March 2008)

Photo: Tom Van Sant- The Climate Project

Fog on West Coast- past 100 yrs



National Park Service



Johnstone, et al, Proceedings of the National Academy of Sciences. February 2010

↑ Wave Height Extremes- up to 46 ft. in NW over next 100 years

Impacts potentially greater than sea level rise

Science Daily- Jan. 26, 2010, University of Oregon, *Coastal Engineering*

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↑ Water Shortages ↓ Water Storage

Left: Photodisc. Right: Corbis

CA Climate Change Portal www.climatechange.ca.gov

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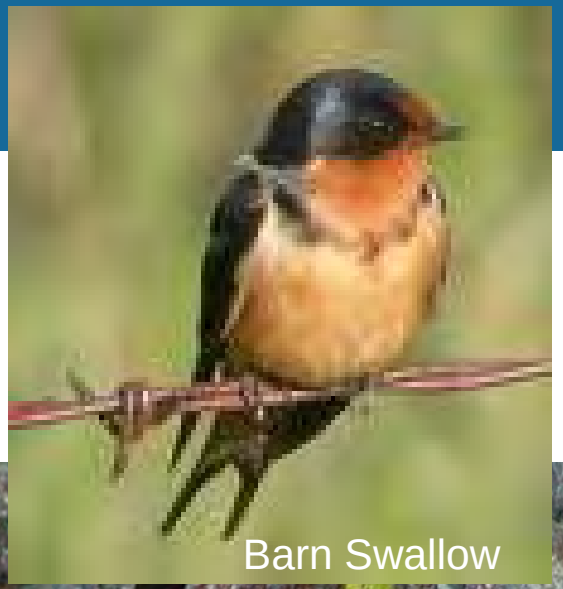
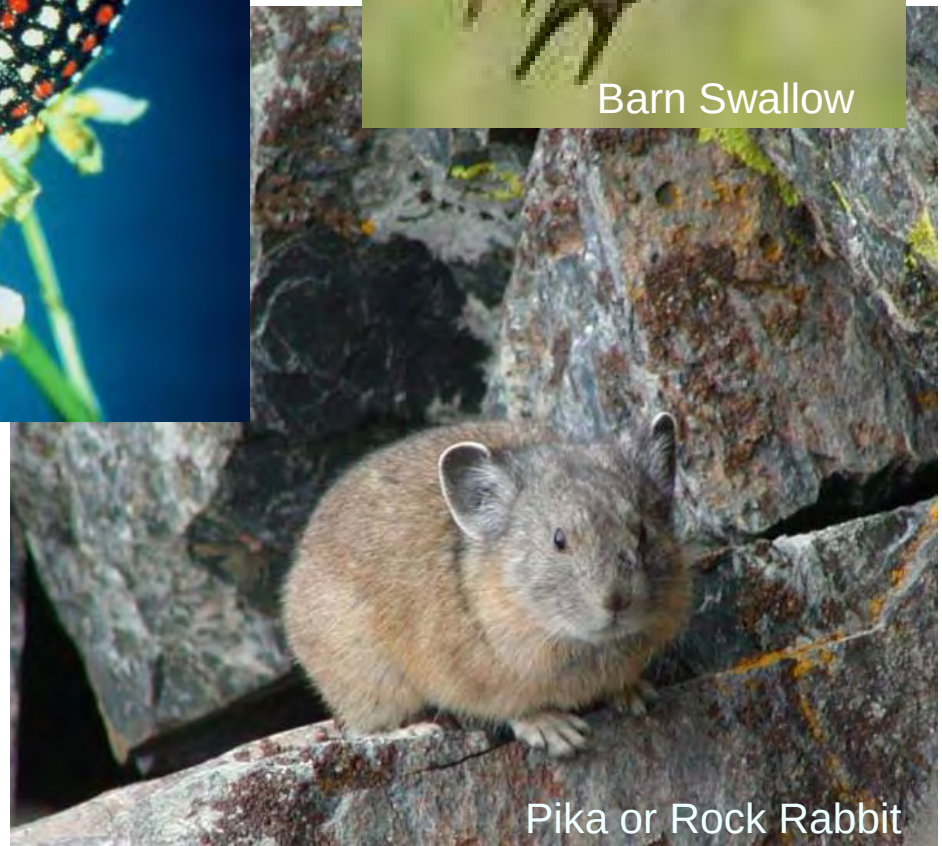
Biodiversity

Edith's Bay Checkerspot



Barn Swallow



Pika or Rock Rabbit

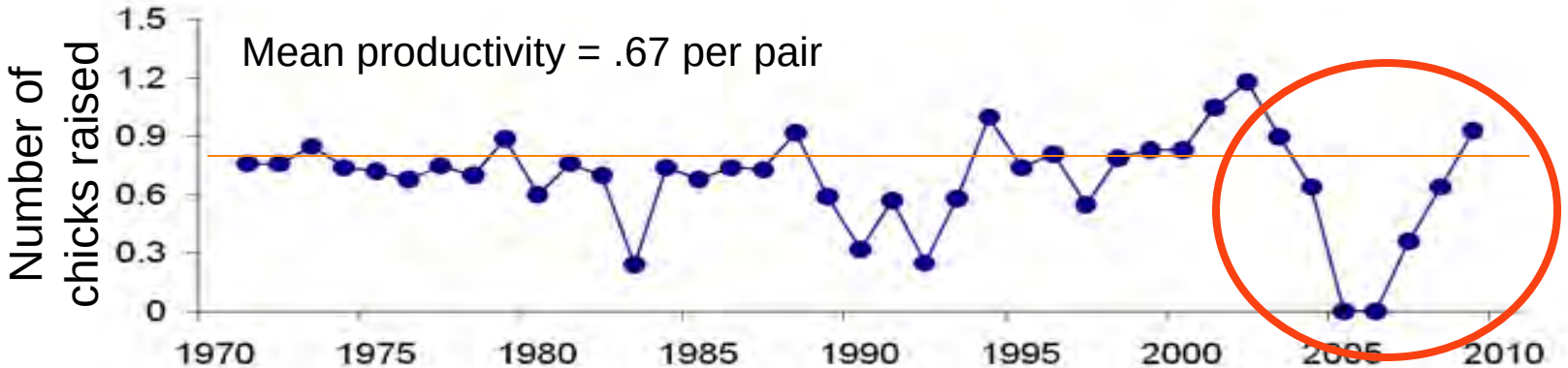
Extreme Weather Events…*Breeding Failure*

- **Record Heat- May 15-16, 2008- nest abandonment, mortality**
- **2009- lack of anchovies– almost no breeding attempts**

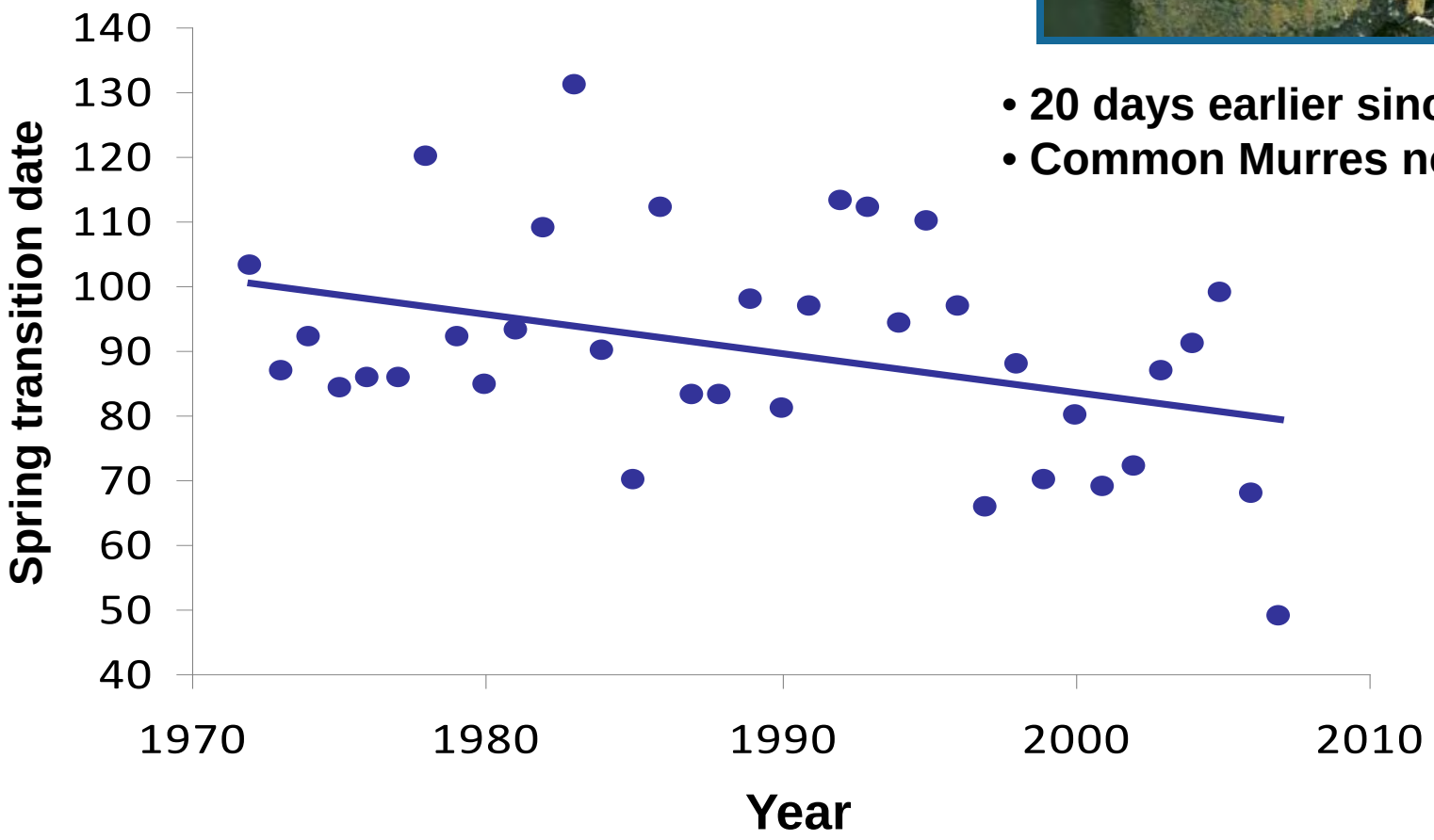
Ocean Variability– Marine Wildlife Impacts

Farallon National Wildlife Refuge

Cassin's Auklet- krill dependent



Earlier Onset of Upwelling

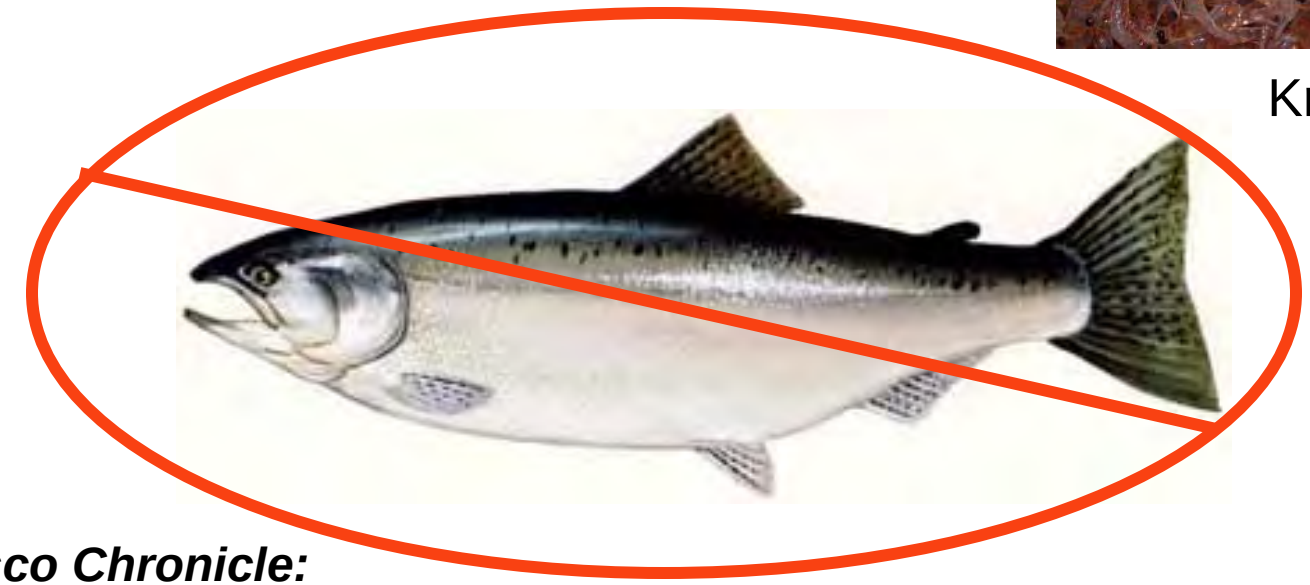


- **20 days earlier since 1970's**
- **Common Murres not adapting**

www.prbo.org Roth et al. 2009 (in prep)

Future of Salmon in CA?

Krill



San Francisco Chronicle:

“Salmon season called off in bid to save chinook”

April 11, 2008

“Smallest fall run of chinook salmon reported”

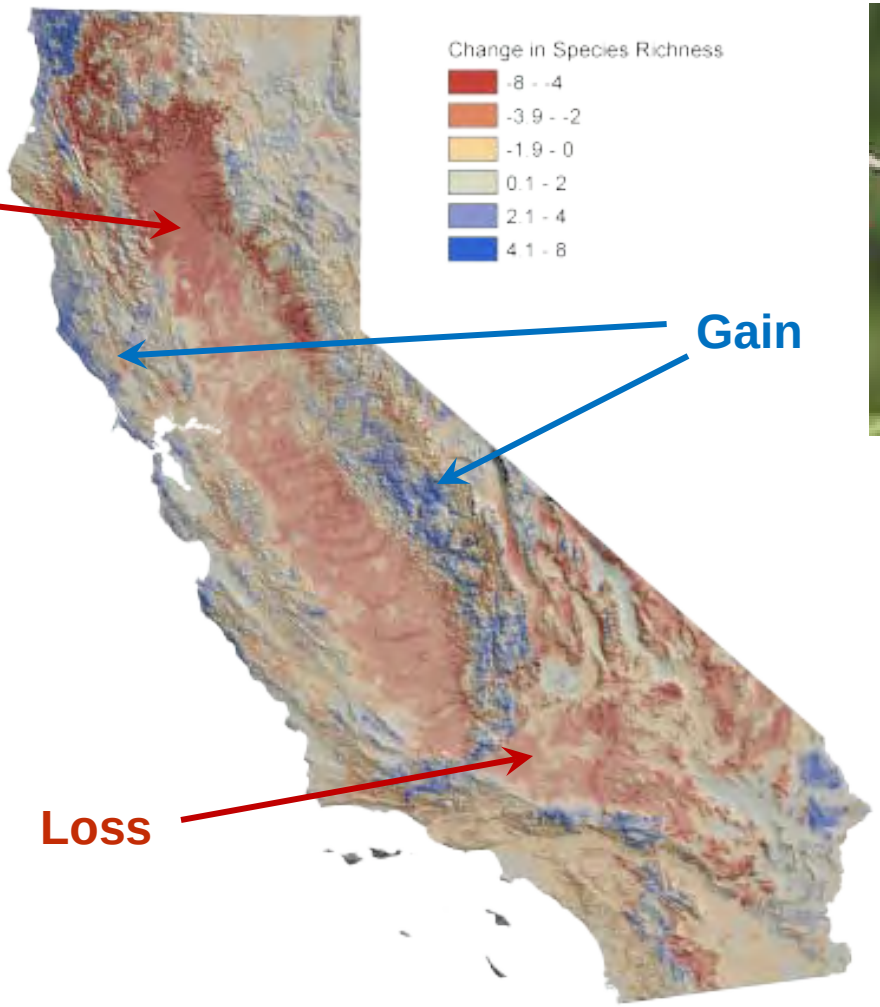
February 19, 2009

“Feds: Calif. returning chinook salmon a record low”

February 11, 2010

Winners and Losers: Species Diversity by 2070

- **Greatest increases- blue**
- **Greatest losses - red**



Black-headed Grosbeak

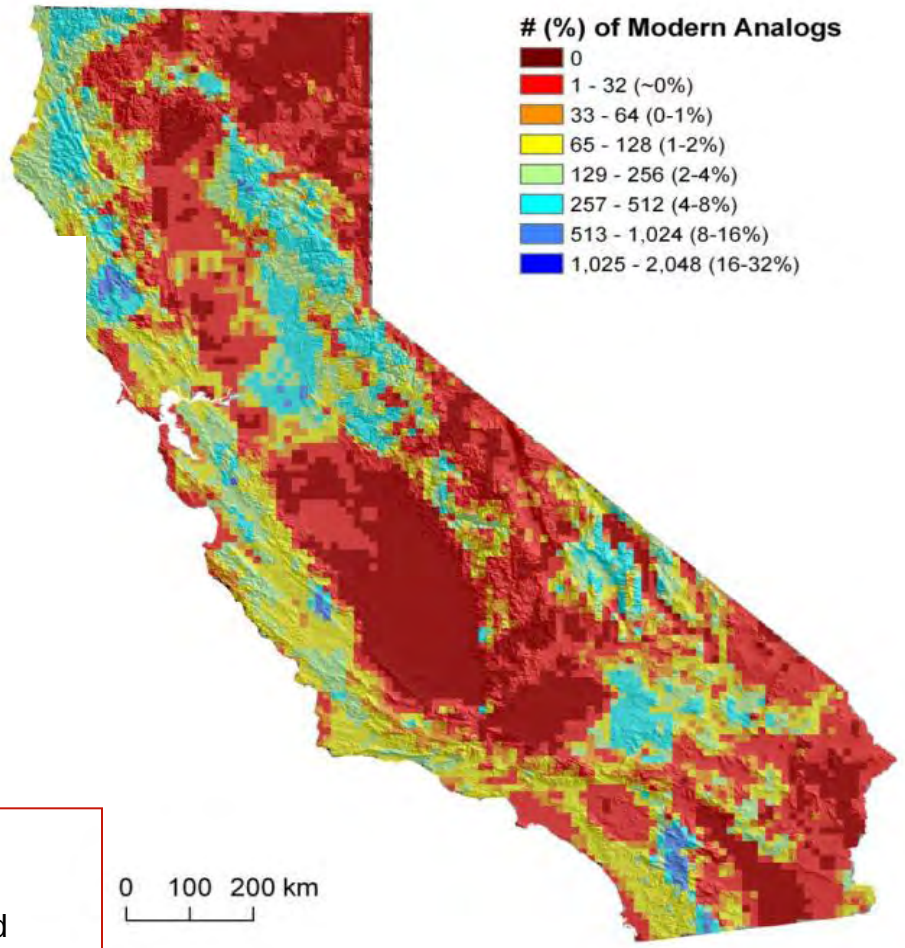
•Averaged over 2 climate models and 2 distribution models
•Data for 60 focal land bird species (PRBO, CA Partners in Flight and others) representing 5 habitats (scrub, oak, conifer, riparian, grassland)

Source: PRBO, Wiens, et al, PNAS, Oct. 2009
www.prbo.org

By 2070: Over 50% of CA will likely have very different "no-analog" ecological communities

Red= Very Different

Blue= Less Different



- Data from 60 land bird focal species
- Assumes all exist 60 years from now
- Combined with temperature, precipitation and vegetation variables
- From IPCC moderate climate scenarios

Source: PRBO, Stralberg et al., PLoS One, 2009

Humans Rely on Healthy Ecosystems!

Ecosystem Services

- **Food**
- **Freshwater**
- **Wood and Fiber**
- **Fuel**
- **Climate**
- **Flood**
- **Disease**
- **Water quality**
- **Recreational**
- **Educational**
- **Spiritual**

www.millenniumassessment.org/en/index.aspx

No More “Business as Usual”

Photo by Ellie Cohen, PRBO

Stop greenhouse gas emissions and make ecosystem conservation an equal priority

To Sustain Human Well-Being in Bay Area: Implement Ecological and Economic Strategies Jointly

- Address sea level rise
- Plan for extreme, unpredictable weather -- e.g., heat, fire, flood, storm surge events
- Secure clean water, clean air
- Manage for ecosystem health & biodiversity– e.g., carbon sequestration, fisheries/food, nature enjoyment and much more
- Sustain economic growth, jobs

Blackwater Wildlife Refuge, Maryland, flooding, sea level rise • © 2010 Gary Braasch / WVGW

Start Managing for Rapid Change Now

INCORPORATE ECOSYSTEM FUNCTION IN URBAN PLANNING

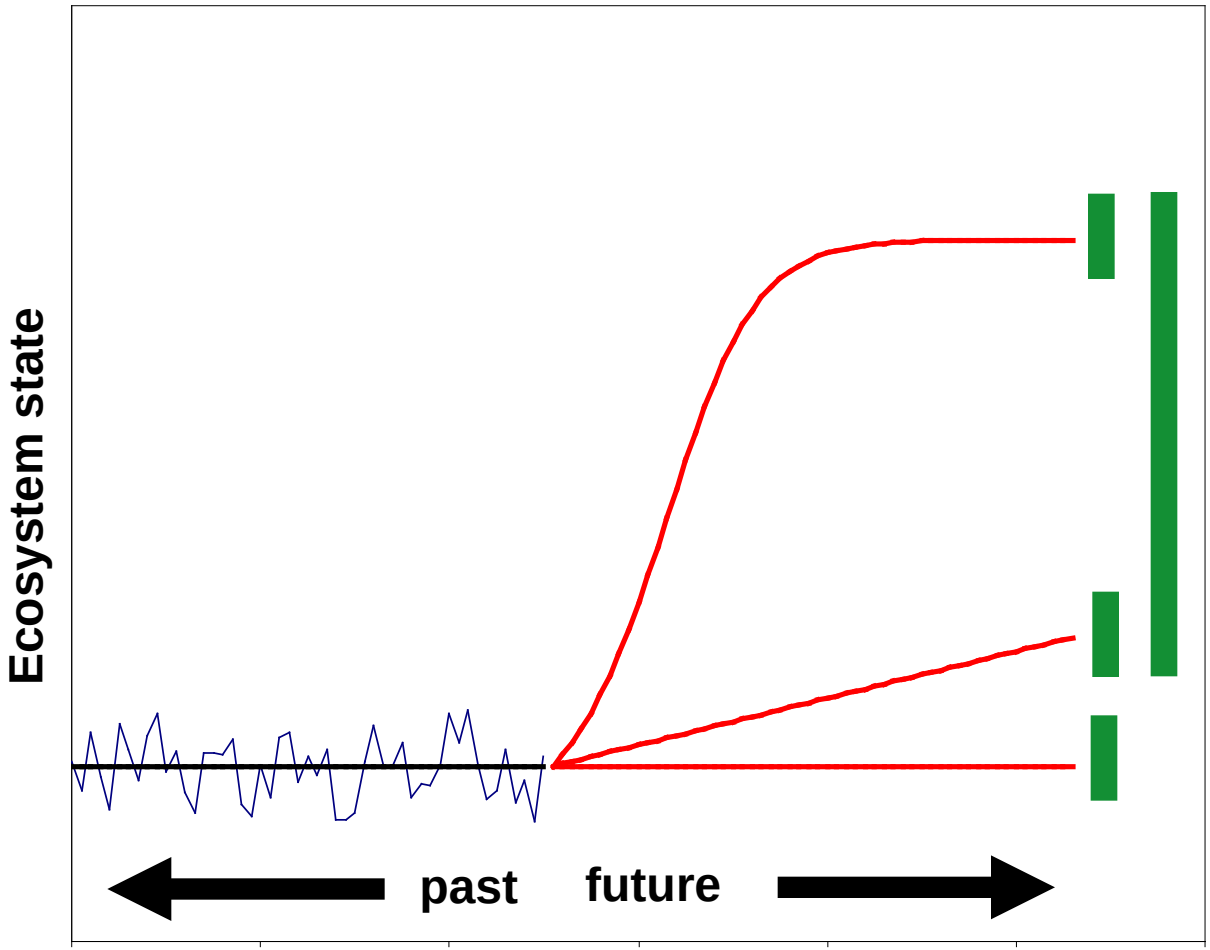
Revise regulations, management plans, protocols as needed

Prioritize ecosystem function

over endangered & invasive species

Photo by John Wiens, Tolay Creek/Tubbs Island, San Pablo NWR

Plan for Extremes, Wider Range of Variability

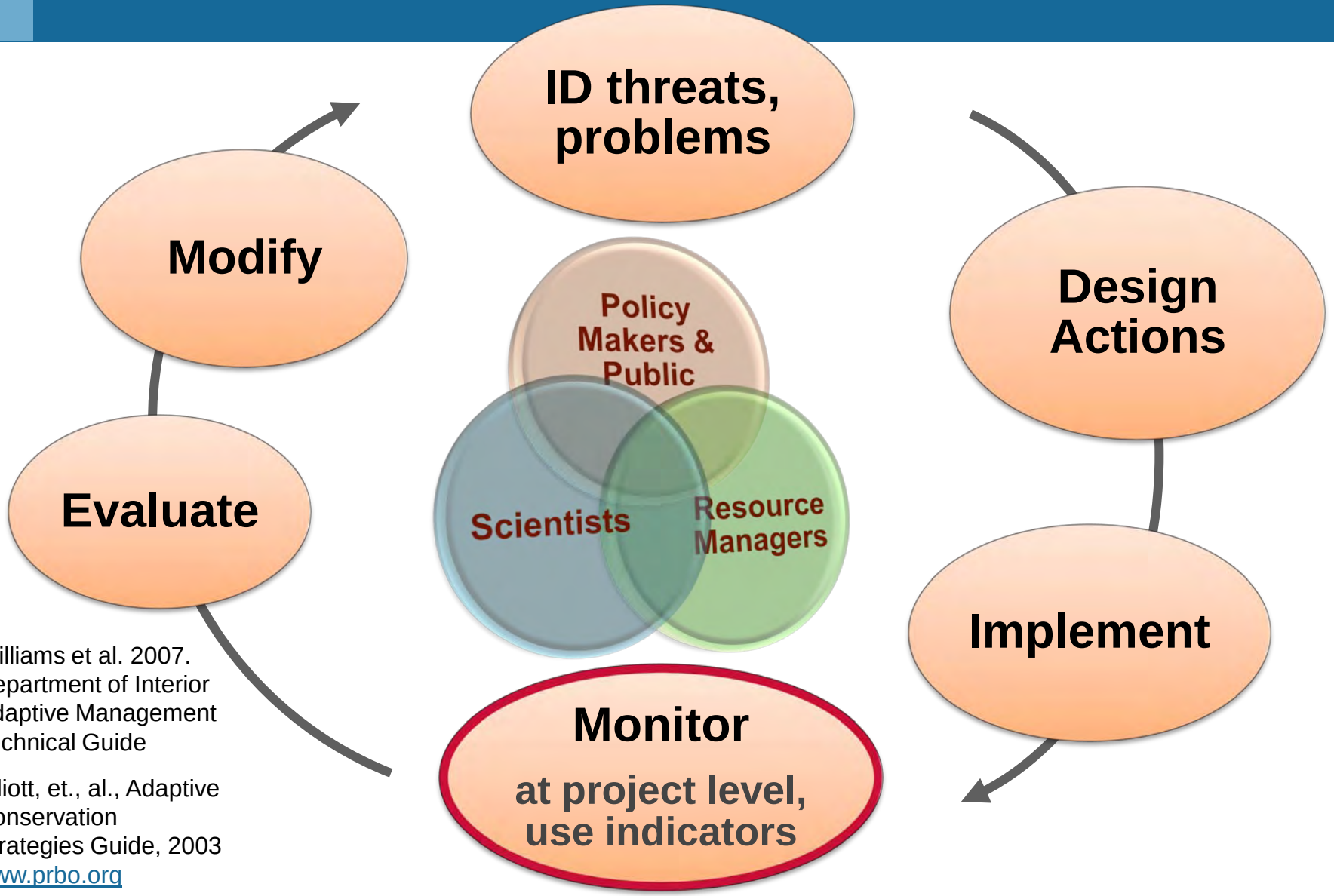


Prioritize projects that could succeed under multiple scenarios

Nat Seavy
www.prbo.org

e.g. plan for mega-drought, 1000+ yr flood , increased coastal salinity, etc.

Employ Adaptive, Flexible Conservation Strategies



Williams et al. 2007. Department of Interior Adaptive Management Technical Guide

Elliott, et., al., Adaptive Conservation Strategies Guide, 2003

www.prbo.org

Expedite Tidal Wetland & Urban Creek Restoration

Design to maximize ecosystem function and benefits to human communities

North SF Bay ~50k Acres of Wetland Restoration
Napa Sonoma Marsh Restoration, Ponds 2, 2a, 3, Larry Wyckoff, CDFG

Ecosystem “services”:

- Sequester carbon
- Reduce flood impacts
- Provide connectivity of habitats
- Reduce sea level rise impacts
- Replenish ground water
- Sustain biodiversity
- Filter out pollutants
- “Living shorelines” to reduce erosion

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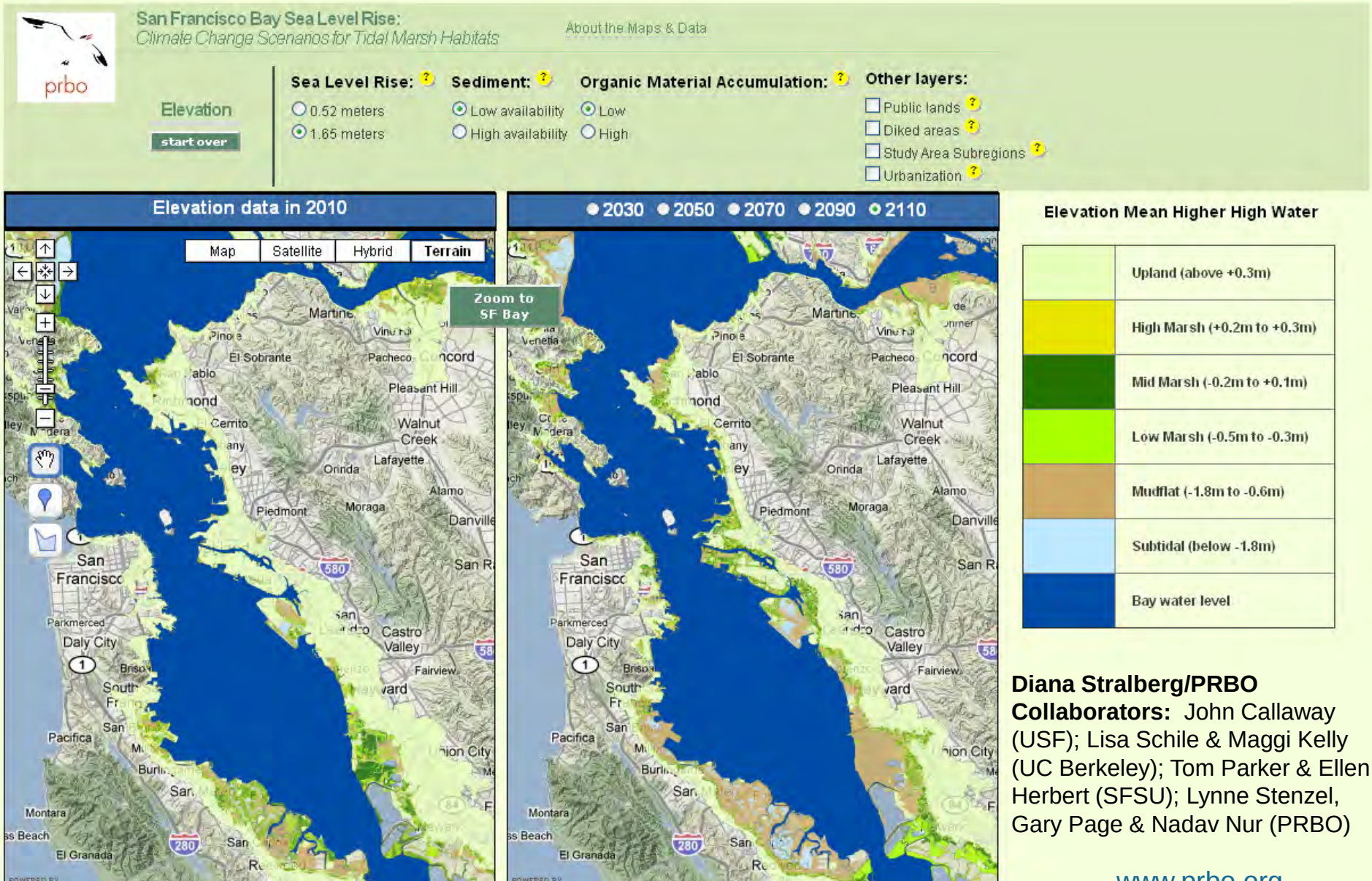
Prioritize Future Wetlands for Investment Today



Diana Stralberg/PRBO
Collaborators: John Callaway (USF); Lisa Schile & Maggi Kelly (UC Berkeley); Tom Parker & Ellen Herbert (SFSU); Lynne Stenzel, Gary Page & Nadav Nur (PRBO)

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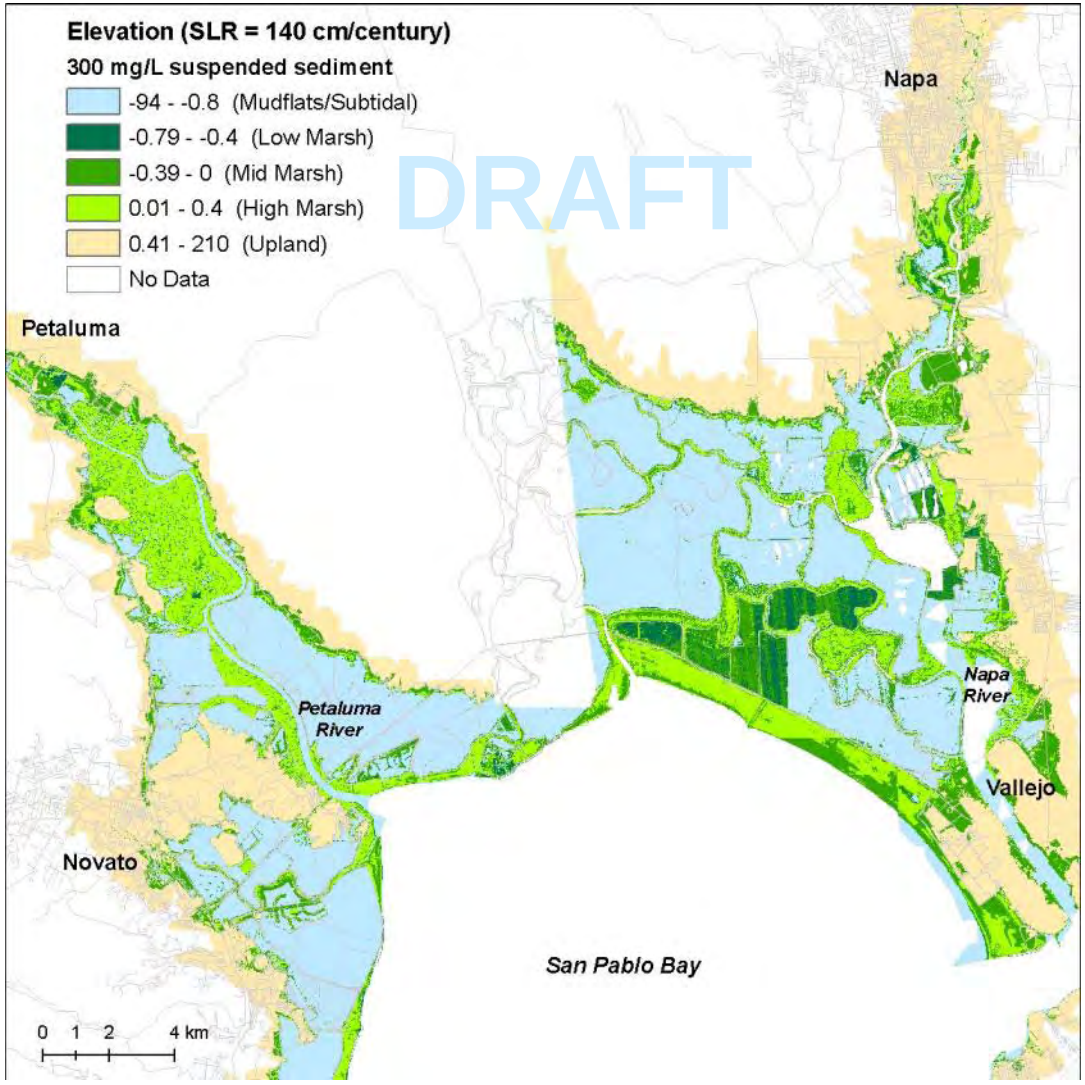
North Bay Wetlands scenario– *sea level rise, sedimentation and salinity-* preliminary results



San Pablo Bay- Sample Scenario

140 cm SLR (4.6 ft):

300 mg/L Suspended Sediment / Low Organic Accumulation

→

Some High Marshes maintained – but only with very high sediment availability

www.prbo.org

Stralberg, D., et al, 2010

Promote Innovative Partnerships: *scientists & managers working together*

Bay Area Ecosystems Climate Change Consortium- "BAECCC"

--Conducting cooperative research and adaptive natural resource management to sustain nature's benefits in the face of accelerating climate change

-- find solutions with ecological and economic benefits

www.baeccc.org

Members:

- NOAA National Marine Sanctuaries
- US Fish & Wildlife Service
- PRBO Conservation Science
- US Geological Survey
- CA Coastal Conservancy
- Bay Conservation and Development Commission
- CA Dept of Fish and Game
- National Park Service
- SF Bay Joint Venture
- SF Estuary Partnership
- Upland Goals Project
- Bay Area Open Space Council

Promote Run On--not Run Off
permeable surface parking, streets--

filter out non-point source pollutants, reduce flooding, recharge groundwater…..

Brock Dolman. Occidental Arts & Ecology Center www.oaec.org

Plant more drought resistant natives, promote open space, link back yards

- **Scale up habitats**
- **Cool micro-climate**
- **Strengthen water cycle**
- **Provide habitat for birds, butterflies, other wildlife**

Monkey Flower

www.prbo.org/cms/183

Prioritize and expand local mitigation and adaptation efforts

- **Energy efficiency**
- **Infill— *at higher elevations***
- **Mass transit**
- **Solar roof tops/brownfields**
- **Recycling/composting**
- **Public Education**

Efficiency Works, Aug 31 2010
http://www.americanprogress.org/issues/2010/08/good_jobs_new_markets.html

Capture roof rainwater and greywater; Require white roofs, roads

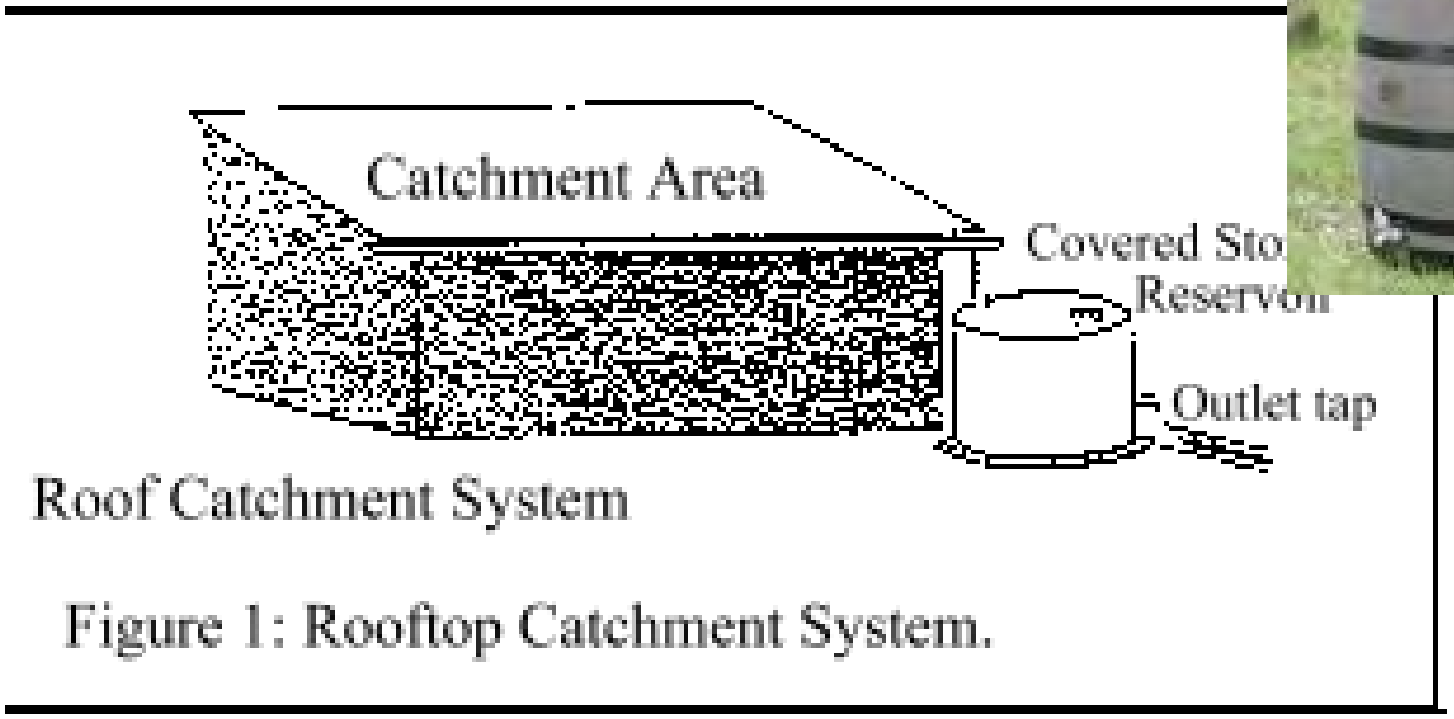
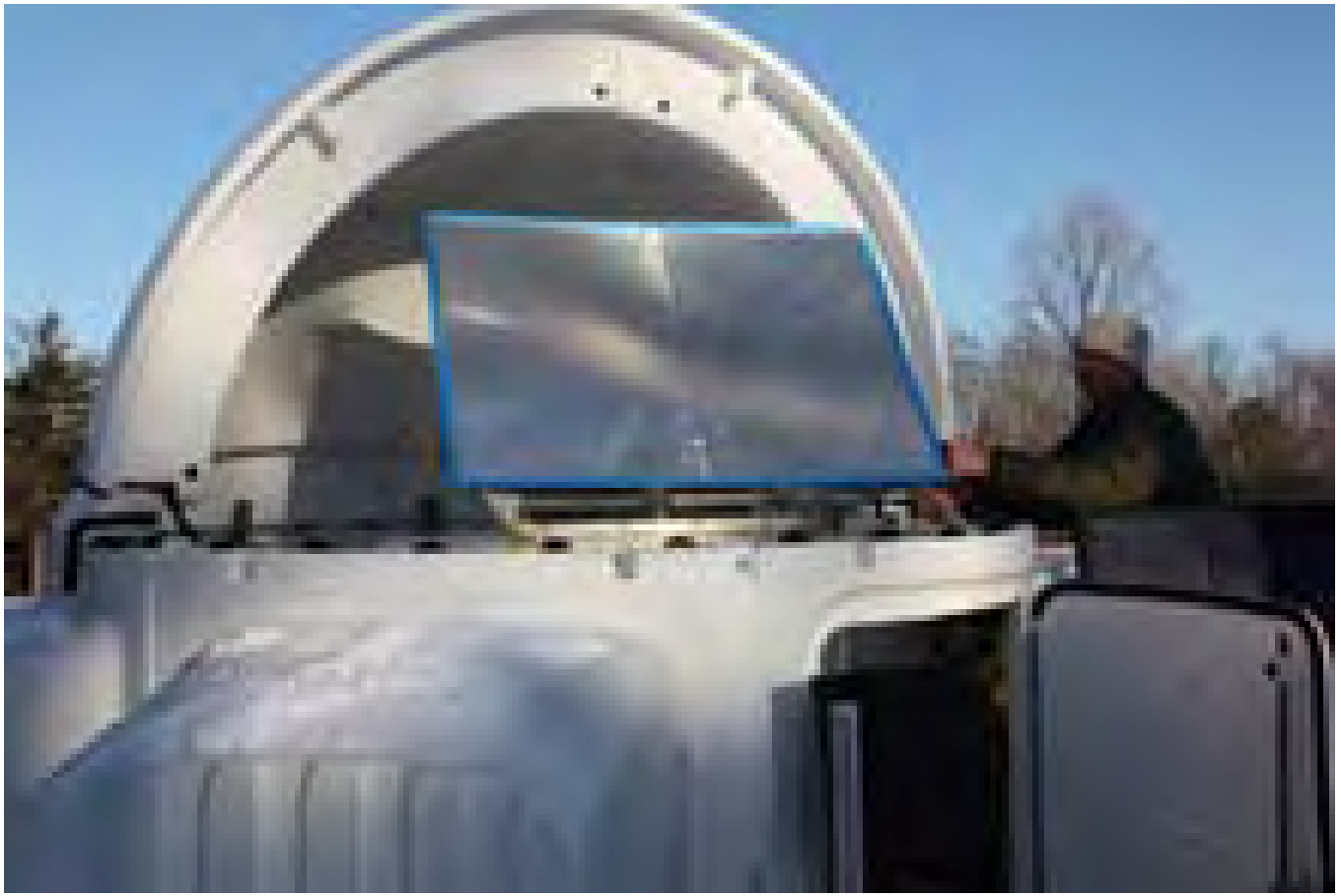


Figure 1: Rooftop Catchment System.

www.oaec.org/water-institute/
www.greywateralliance.org, www.watersprout.org

Plan for Eco-friendly Desalination Plants



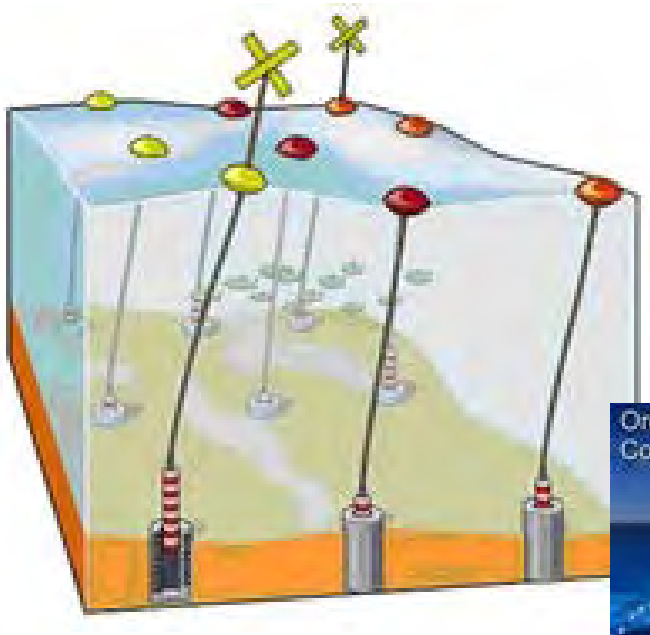
Solar Powered Desalination plant- Saudi Arabia--
http://www.technologyreview.com/energy/25010/?a=f

Promote Eco-friendly Renewables- within Urban Areas (*not in areas of high ecological value*)

Wind farm planned city of Masdar in Abu Dhabi, the Windstalk

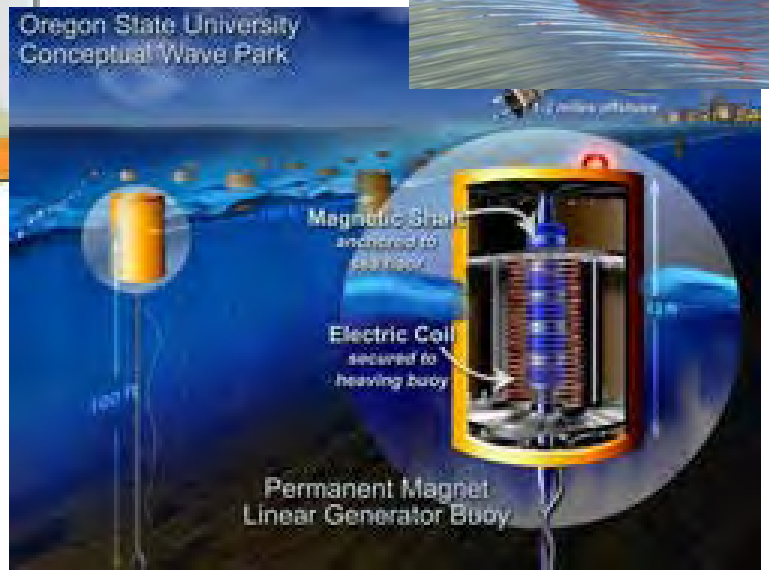
http://inhabitat.com/2010/08/18/kinetic-windstalk-field-harvests-energy-from-the-breeze/

Wave Energy: integrate science guidance for best outcomes, minimize negative ecological impacts



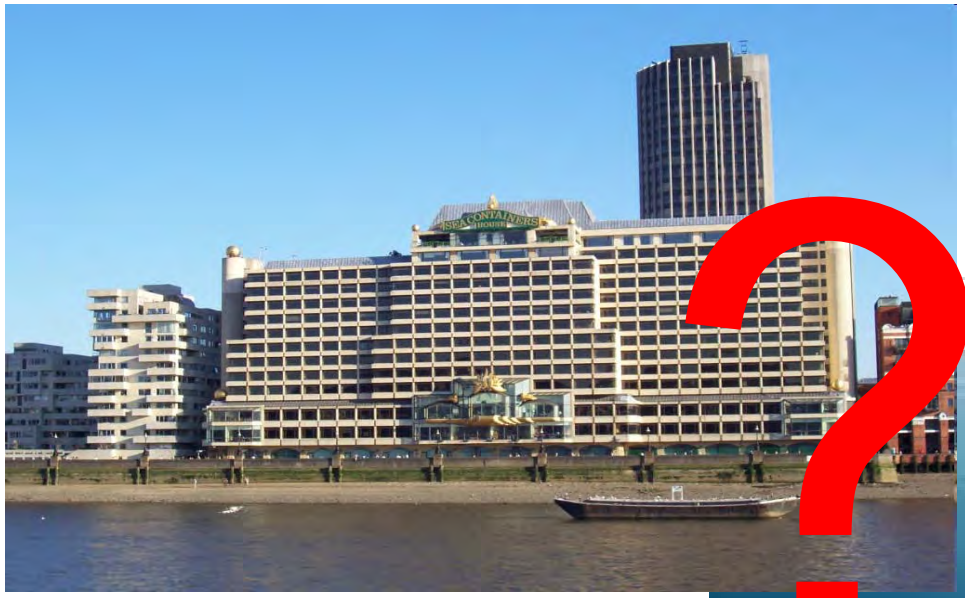
Point Absorber Wave Energy Farm

Attenuator Wave Energy Device



Wave Farm Made Up of Permanent Magnet Linear Generator Buoys

Prohibit further building at sea level, flood plains- create jobs in more sustainable way?



Artist's impression of an aerial view of the new Treasure Island development

Institute carbon fee? Sweden's goal– end oil dependency by 2020

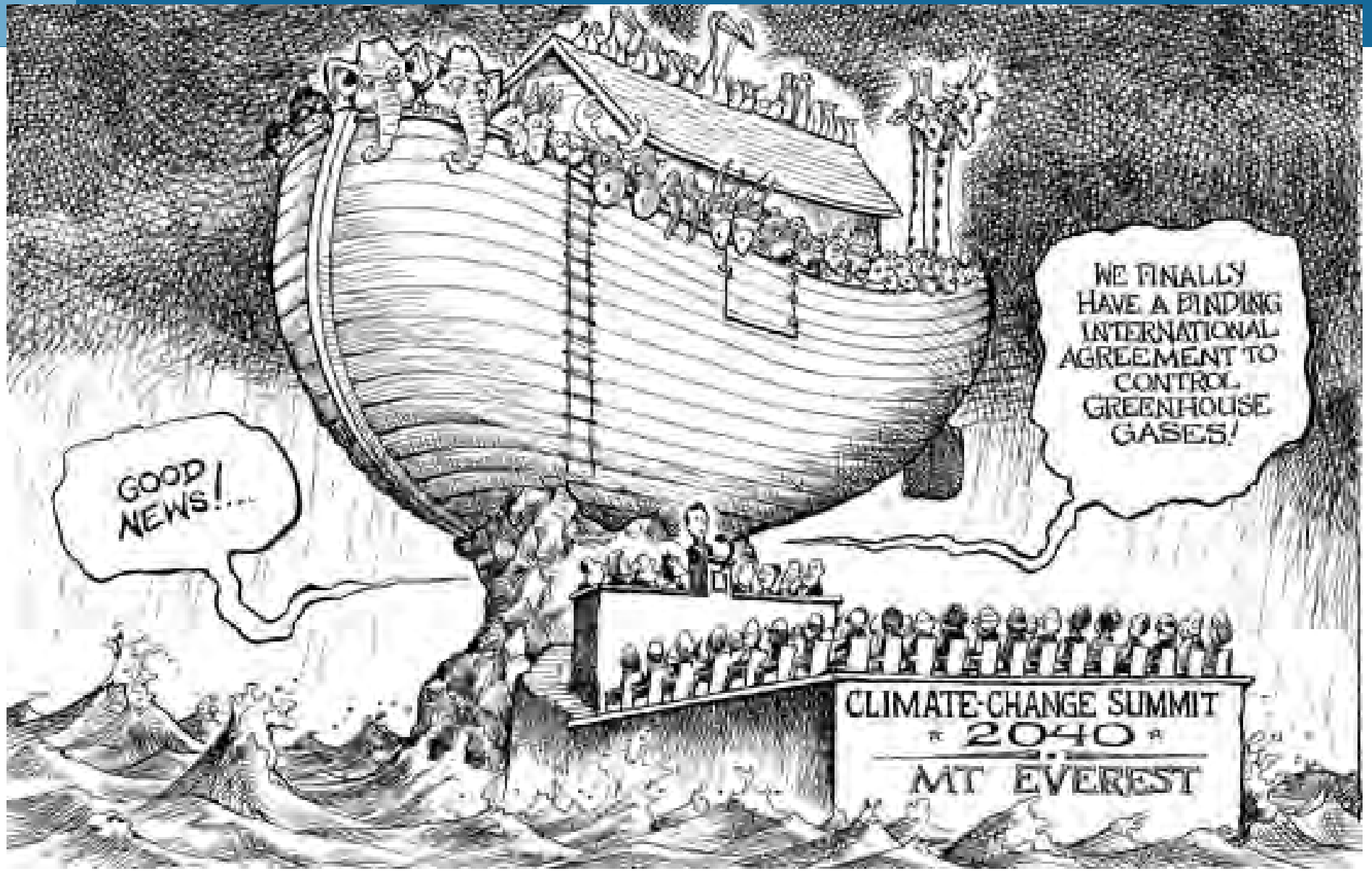
- E85- 85% renewable ethanol in Vaxjo "climate cities network"
- Carbon tax- 80 cents/liter or ~$3.20 per gallon

Engage young people in restoration efforts!

Drivers for a Sustainable Future

- **Water**
- **Carbon**
- **Biodiversity**

Our future?


GOOD NEWS!...
WE FINALLY HAVE A BINDING INTERNATIONAL AGREEMENT TO CONTROL GREENHOUSE GASES!
CLIMATE-CHANGE SUMMIT
* 2040 *
MT EVEREST


Courtesy Tom Suchanek, USGS

In Summary:

1. **Climate change rapidly accelerating**
2. **Ecosystem health must be equal priority to greenhouse gas reduction**
3. **Use nature to slow impacts of climate change; allow more time for nature and human communities to adapt**
4. **Plan for extremes, accept there will be losses**
5. **Engage in novel partnerships**
6. **Think out-of-the city!**

THANK YOU, BCDC!

San Francisco Bay Conservation and Development Commission

www.prbo.org
707-781-2555

Acknowledgements

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California Department of Fish and Game
California Department of Water Resources
California Bay Delta Authority
California Audubon
California Seagrant
Central Valley Joint Venture
Cornell Lab of Ornithology
DMARLOU Foundation
Richard Grand Foundation
Marin Community Foundation
Marin Municipal Water District
Giles Mead Foundation
Moore Family Foundation/Gordon & Betty Moore Foundation
David and Lucile Packard Foundation
National Fish and Wildlife Foundation
National Park Service
National Science Foundation
NOAA National Marine Sanctuaries, Fisheries
Natural Resource Conservation Service
Resources Law Group/Resources Legacy Fund Foundation
Riparian Habitat Joint Venture
San Francisco Foundation
San Francisco Bay Joint Venture
The Climate Project
The Nature Conservancy
U.S. Fish and Wildlife Service
USDA Forest Service