



prbo
PRBO Conservation Science



Climate Change and Conservation: Securing our Future

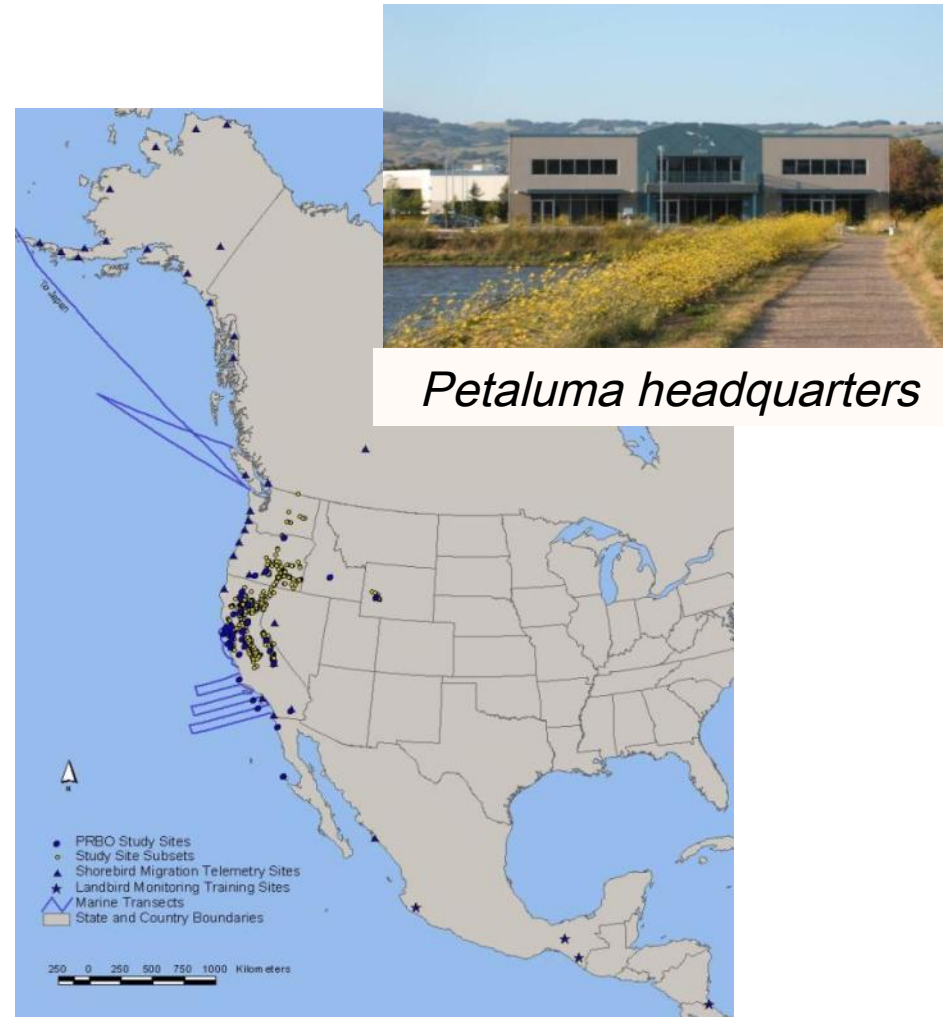
Panim el Panim

Ellie M. Cohen and PRBO Staff

January 26, 2010

Bird Science to Improve Conservation

- Founded in 1965
- 120 staff and seasonal biologists
- 2010 Budget: ~\$7m



PRIORITY: Address Rapid Environmental Change



Left: Photodisc. Right: Corbis

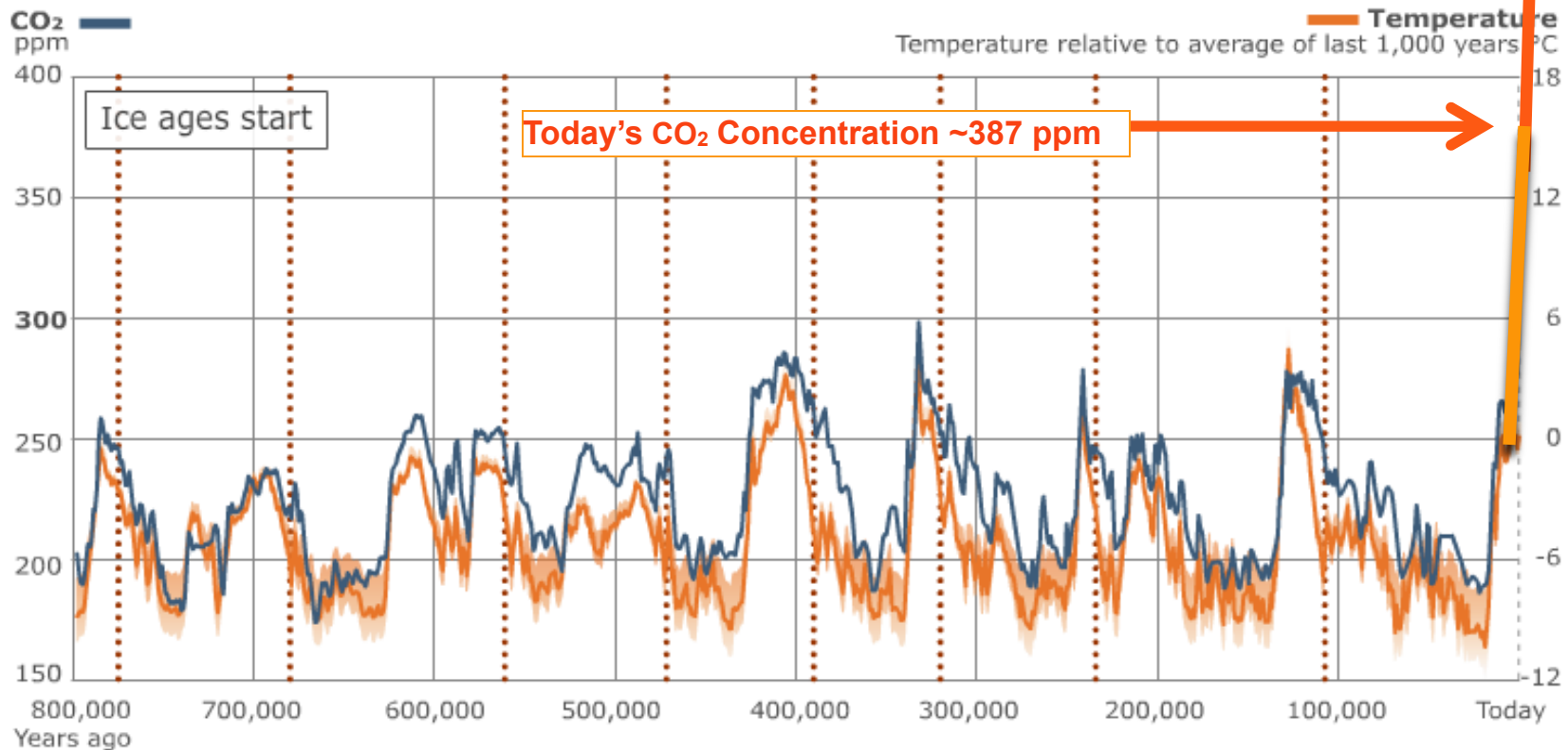


CO₂ Highest in 15 Million Years

By 2050 with "business as usual" - CO₂ at 600-700 ppm



800,000 years of change

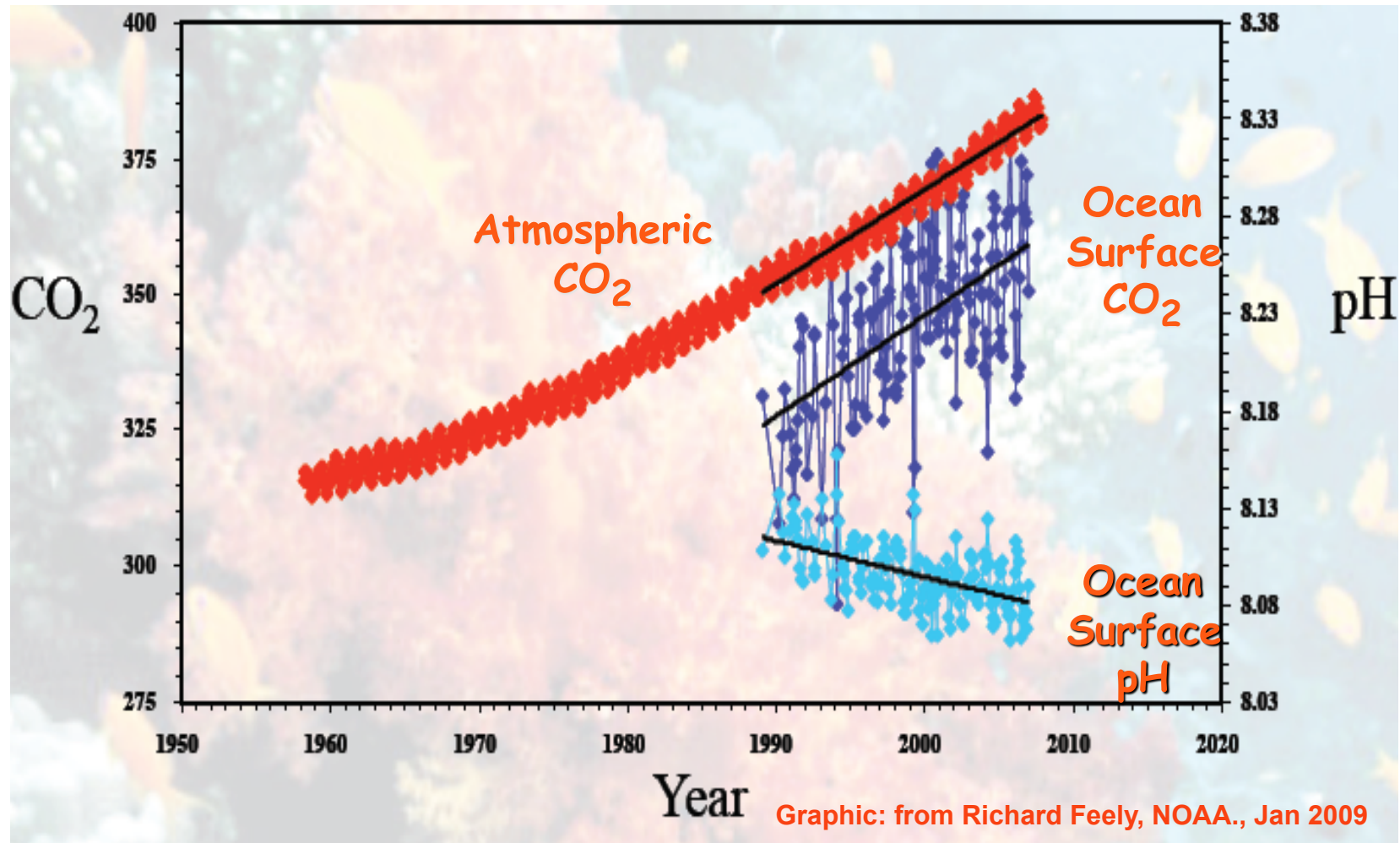


Graphic-- British Antarctic Survey, ice cores, *BBC News*, December 3, 2009

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



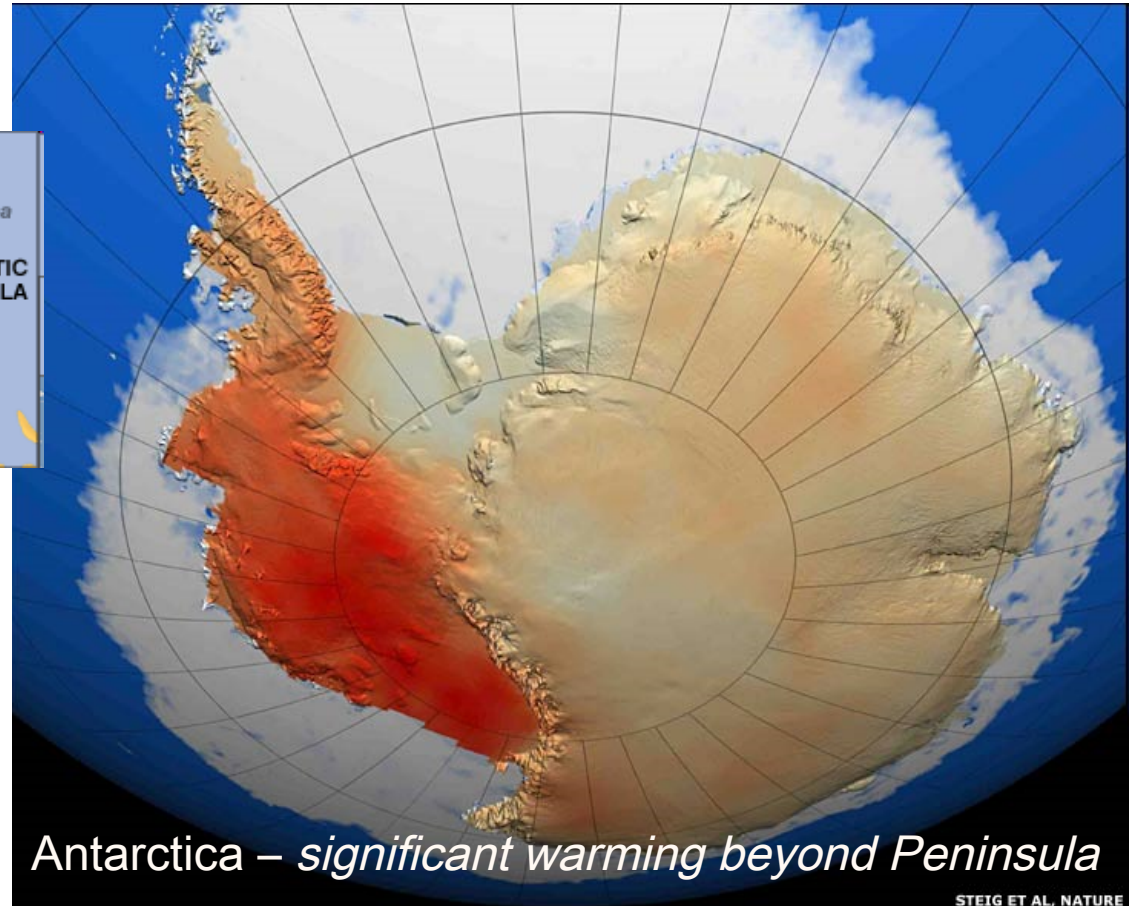
Ocean Acidification- *Fastest in 65m Years*



- changes in the carbonate chemistry of the deep ocean may exceed anything seen in the past 65 million years.
- predicts much higher rates of change at ocean's surface , potentially exceeding rate at which plankton can adapt.
- Ridgwell & Schmidt Feb 14 2010 Nature Geoscience**



↑ Ice Sheets Melting Faster— *both polar regions*



- **+0.6° C or 1.5° 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

Russian
Steppes

Western China

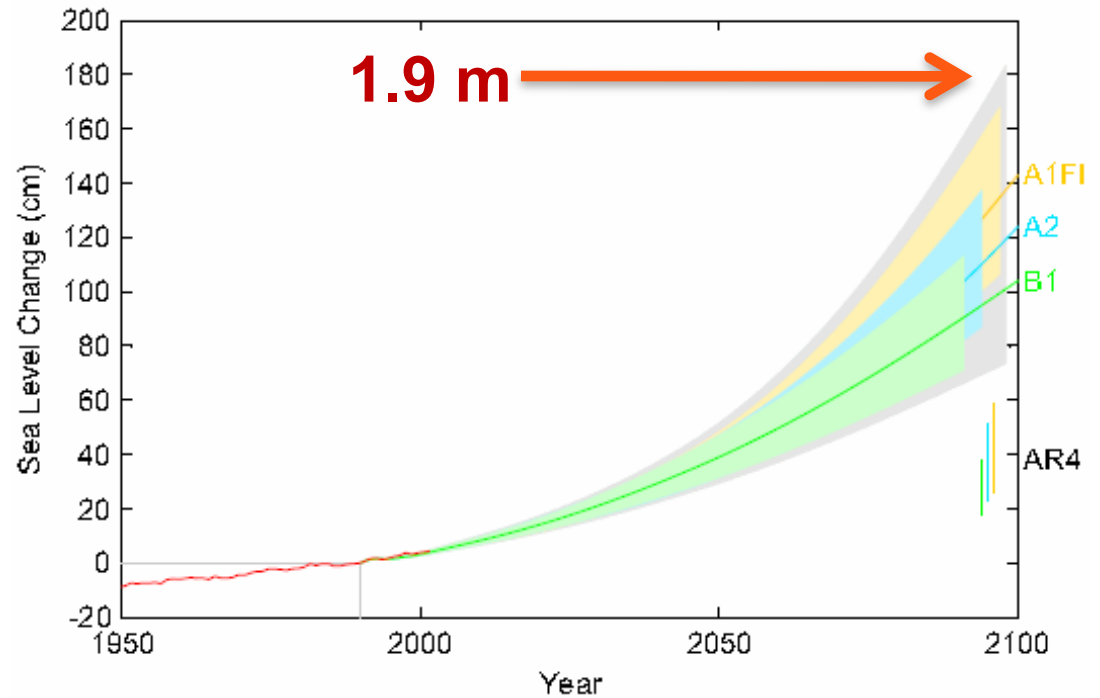
Tibetan Plateau Glaciers – 2/3 gone by 2050?



↑ Sea Level Rise— up to 6 ft by 2100

**-Rate of global SLR already
>2x faster than 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



Photo: Tom Van Sant- The Climate Project

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↑ Extreme, Unpredictable, Deadly Weather Events



CA Climate Change Center
www.climatechange.ca.gov

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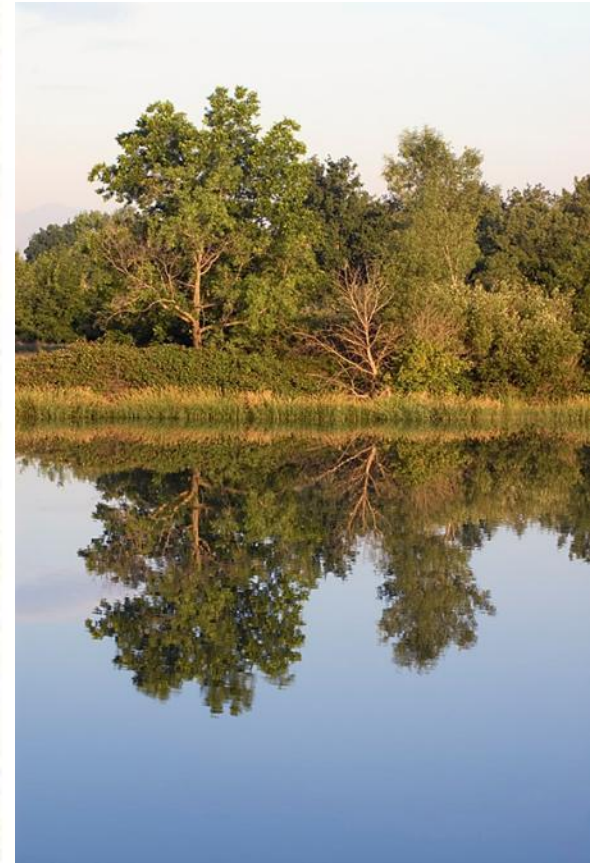


Water Shortages



Water Storage

Left: Photodisc. Right: Corbis



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

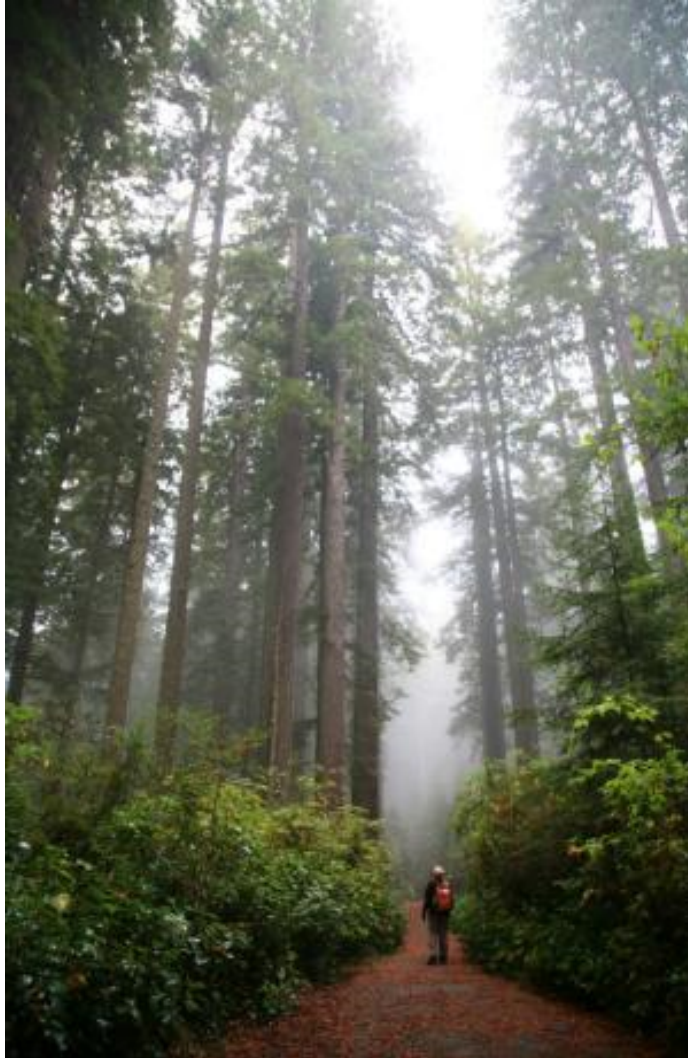


Impacts potentially greater than sea level rise

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

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↓ Fog on West Coast



National Park Service



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

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Climate Impacts on Wildlife



Edith's Bay Checkerspot



Pika or Rock Rabbit

Changes in Migration Dates

- Climate related changes for > 50% of Central CA songbirds
- Mismatch in timing between birds and food?



Swainson's Thrush

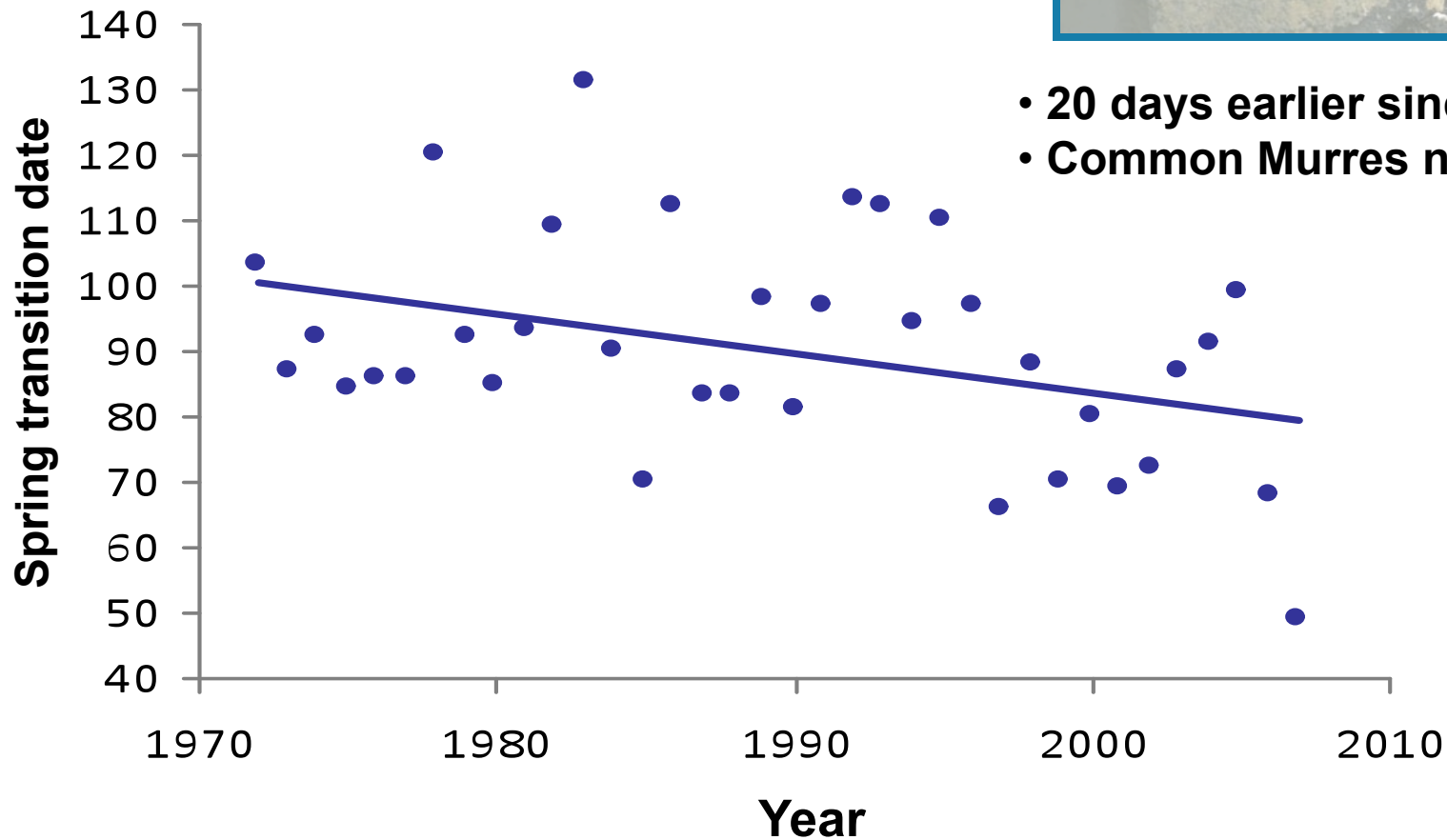


Black-headed Grosbeak



Barn Swallow

Earlier Onset of Upwelling



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



Extreme Weather Events... *Breeding Failure*

Brandt's Cormorant



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



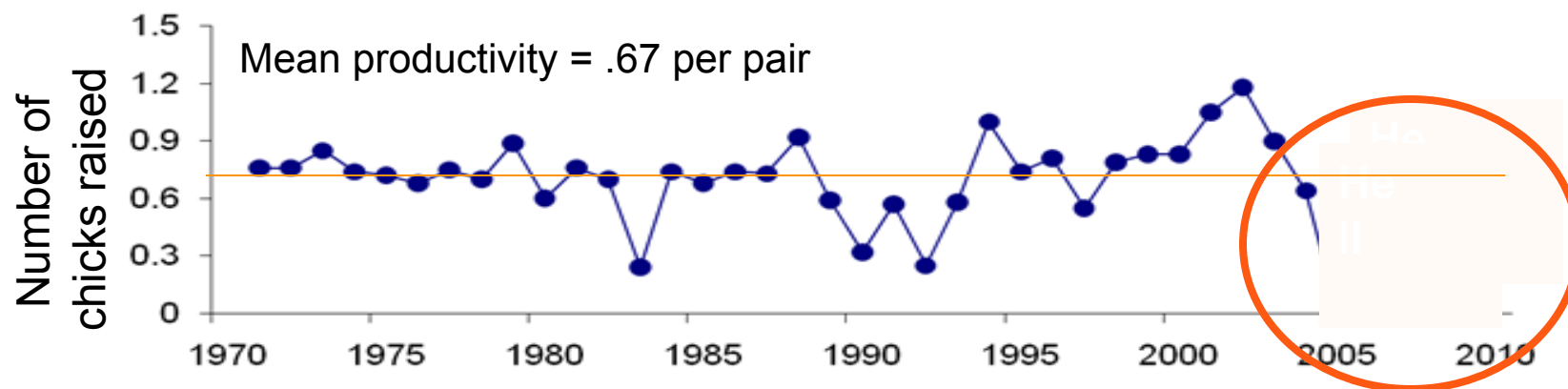
Ocean Variability– Marine Wildlife Impacts



Farallon National Wildlife Refuge



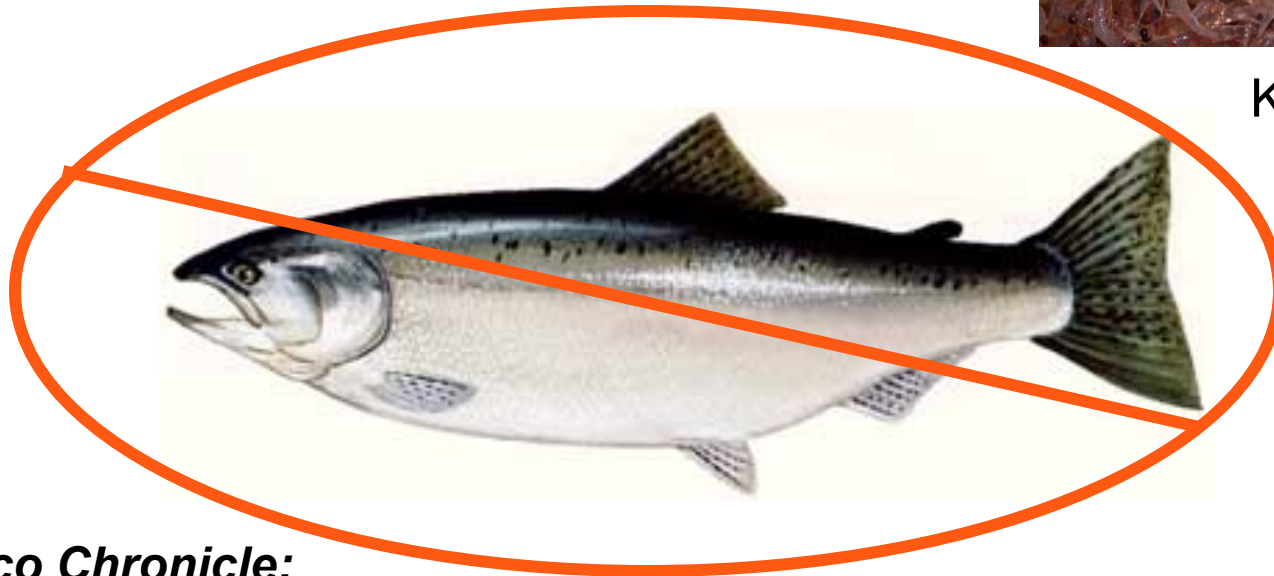
Cassin's Auklet- krill dependent



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”

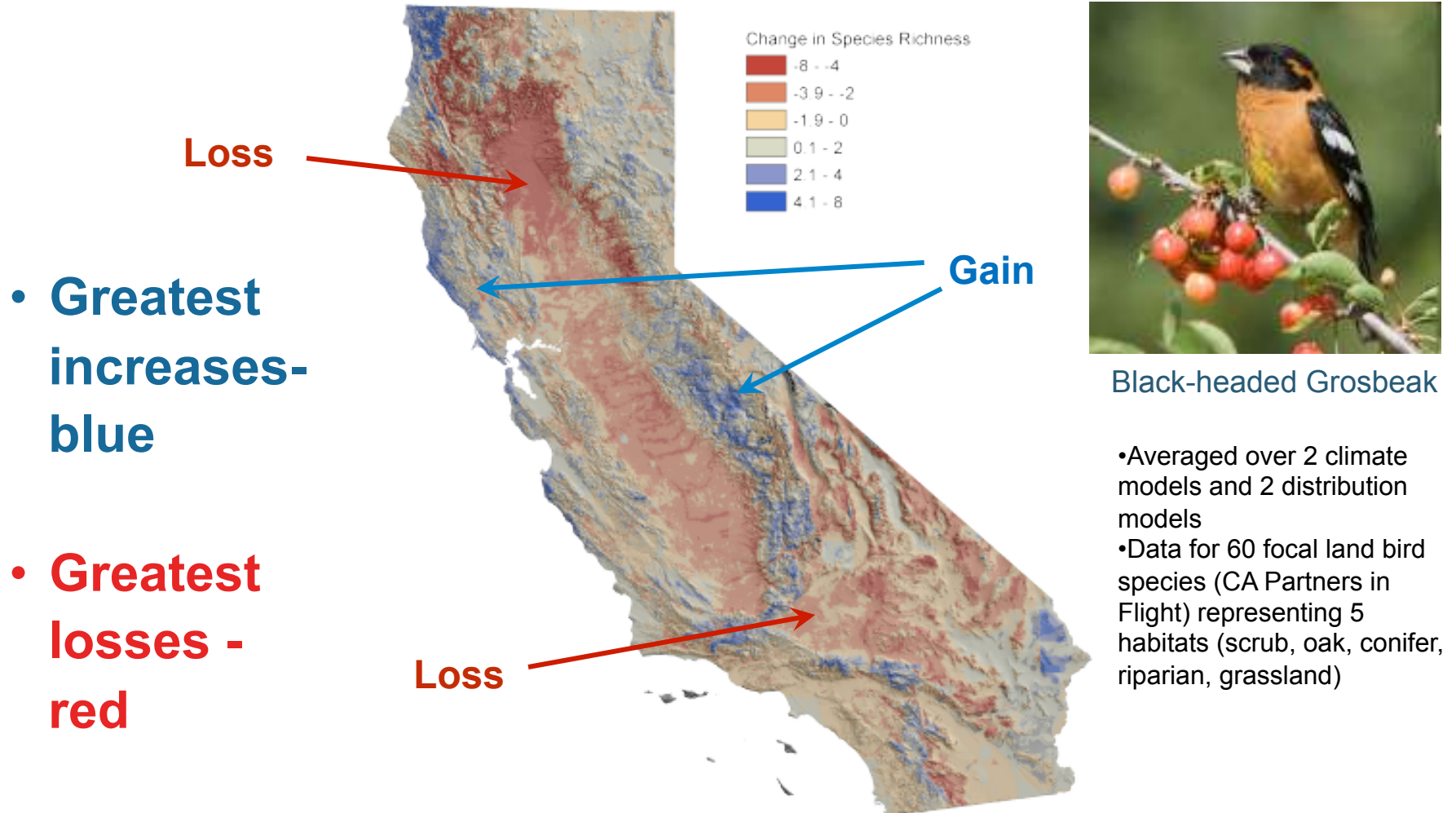
February 19, 2009

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

February 11, 2010



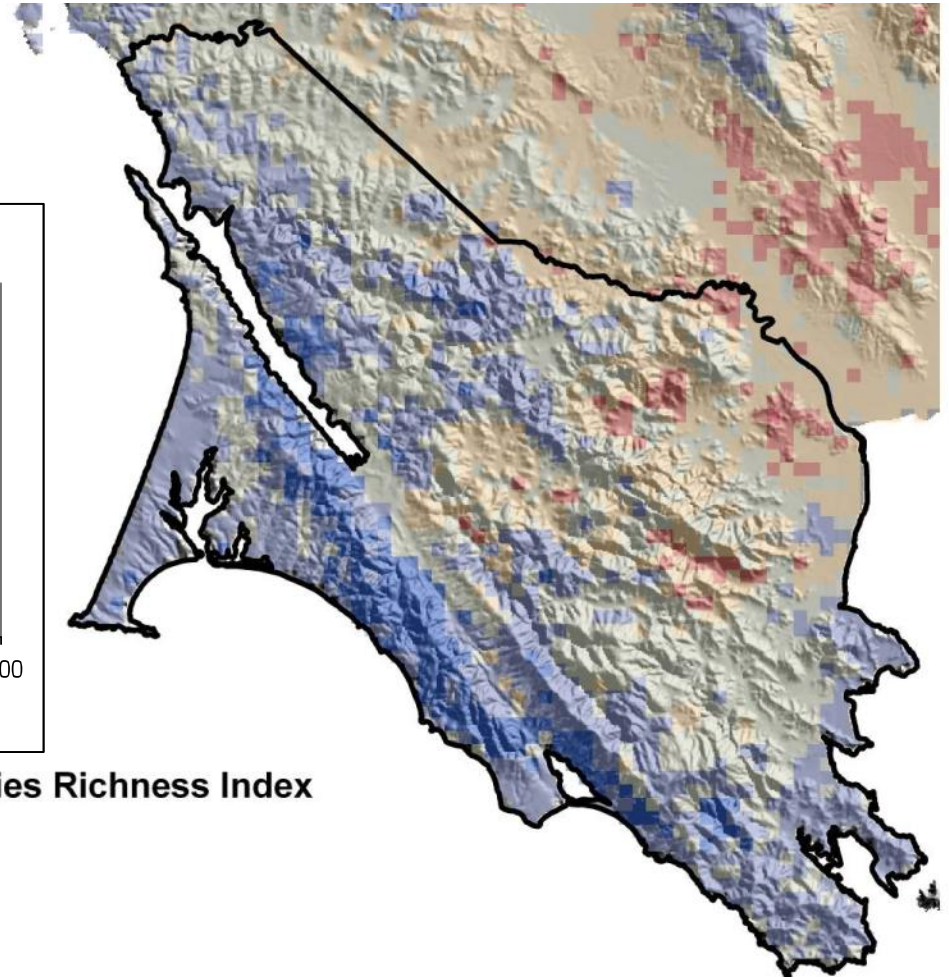
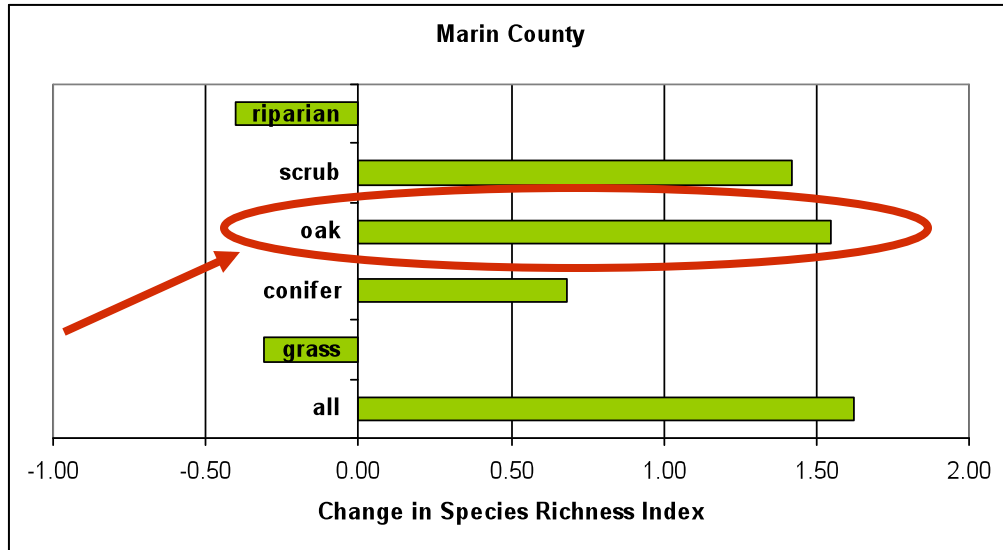
Hotspots of Change: Species Diversity by 2070



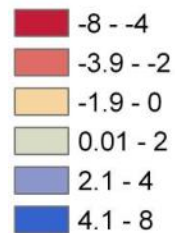
Source: PRBO, Wiens, et al, PNAS, Oct. 2009
www.prbo.org

of Bird Spp. to Increase in Marin

Oak, conifer and scrub associated bird spp. projected to increase but... which ones?



Change in Species Richness Index



Oak Woodland in Marin: *Acorn Woodpecker*



www.prbo.org/data

Species Distributions

Start Over

Step 2

Select a habitat type:

Oak Woodland

Step 3

Select a species:

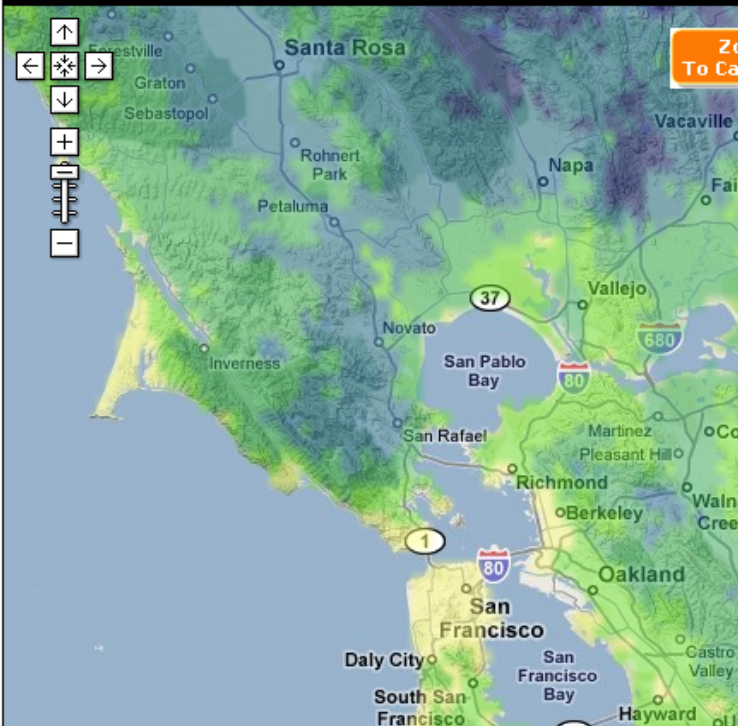
Acorn Woodpecker

Step 4 Select other data:

- Current range maps (more info)
- Show locations for this species

Probability of occurrence 0-20% 20-40% 40-60% 60-80% 80-100%

Predicted Current Distribution



Predicted Future Distribution



Species



Photo (c) Peter LaTourrette

Learn more about the **Acorn Woodpecker** at [All About Birds](#) or read the [Partners In Flight](#) species account

Variable Importance

- Annual mean temperature 47.5%
- Annual precipitation 16.8%
- Vegetation 13.5%
- Mean temperature of the warmest quarter 12.5%

Oak Woodland in Marin: *Oak Titmouse*

www.prbo.org/data

Two oak woodland associated bird species with different responses to same changing conditions....

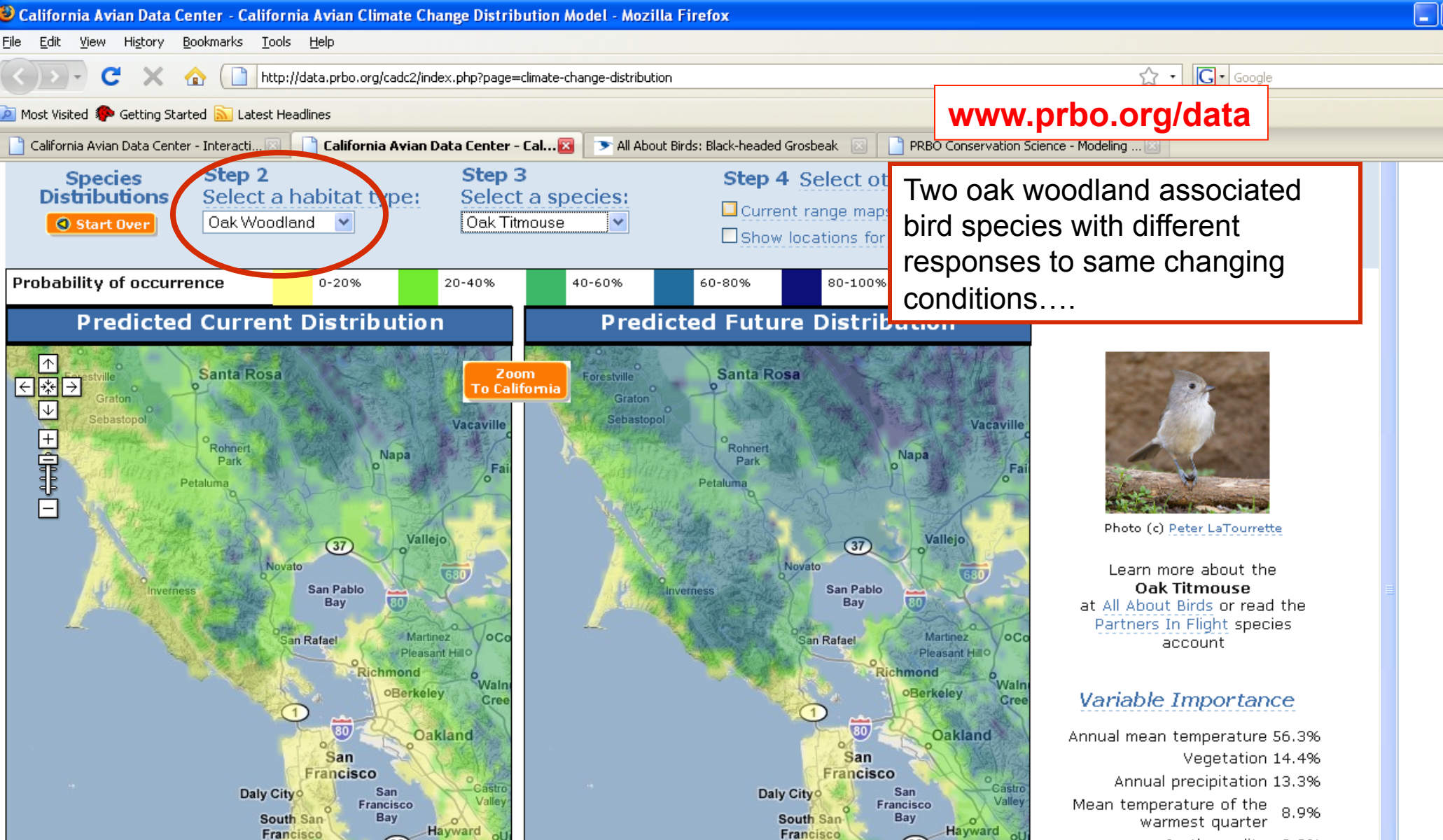


Photo (c) Peter LaTourrette

Learn more about the **Oak Titmouse** at [All About Birds](#) or read the [Partners In Flight](#) species account

Variable Importance

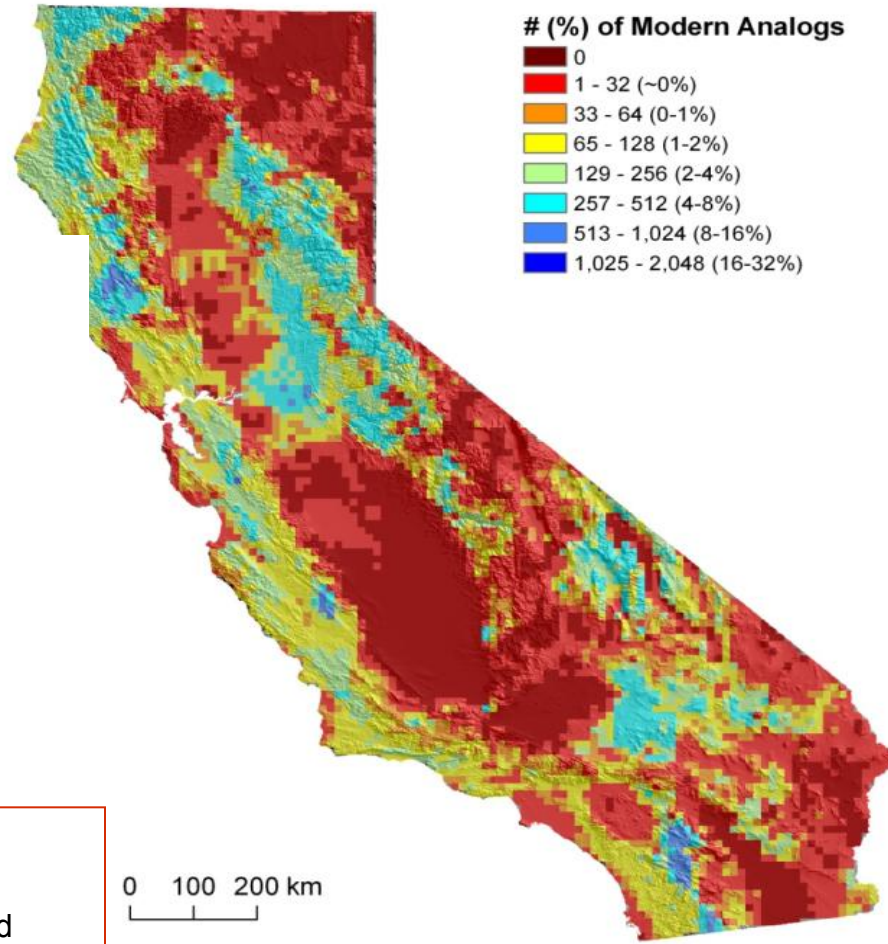
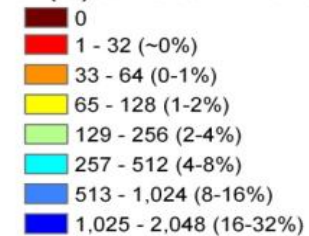
- Annual mean temperature 56.3%
- Vegetation 14.4%
- Annual precipitation 13.3%
- Mean temperature of the warmest quarter 8.9%

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

Red= Very Different

Blue= Less Different

(%) of Modern Analogs



- 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



Photo by Ellie Cohen, PRBO

Humans Rely on Healthy Ecosystems!

Ecosystem Services

- **Food**
- **Freshwater**
- **Wood and Fiber**
- **Fuel**

- **Climate**
- **Flood**
- **Disease**
- **Water quality**

- **Recreational**
- **Educational**
- **Spiritual**



Shift to a New Conservation Paradigm

Healthy Ecosystems Act

Need new statutes, regulations to address rapid ecological change in 21st Century



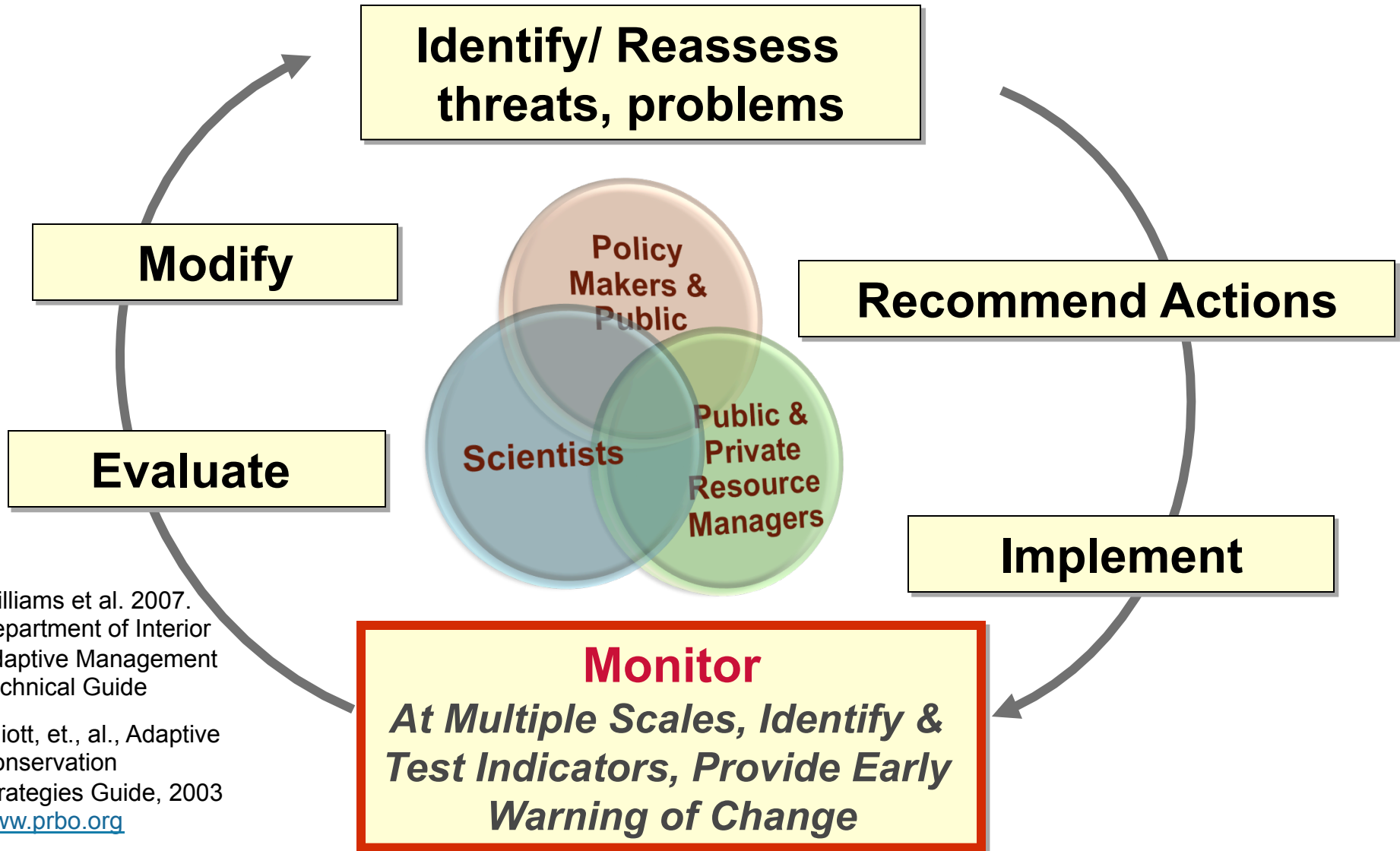
Start Managing for Rapid Change Now



MANAGE FOR ECOSYSTEM FUNCTION and SERVICES
Revise regulations, management plans, protocols as needed
Promote ecological responsiveness



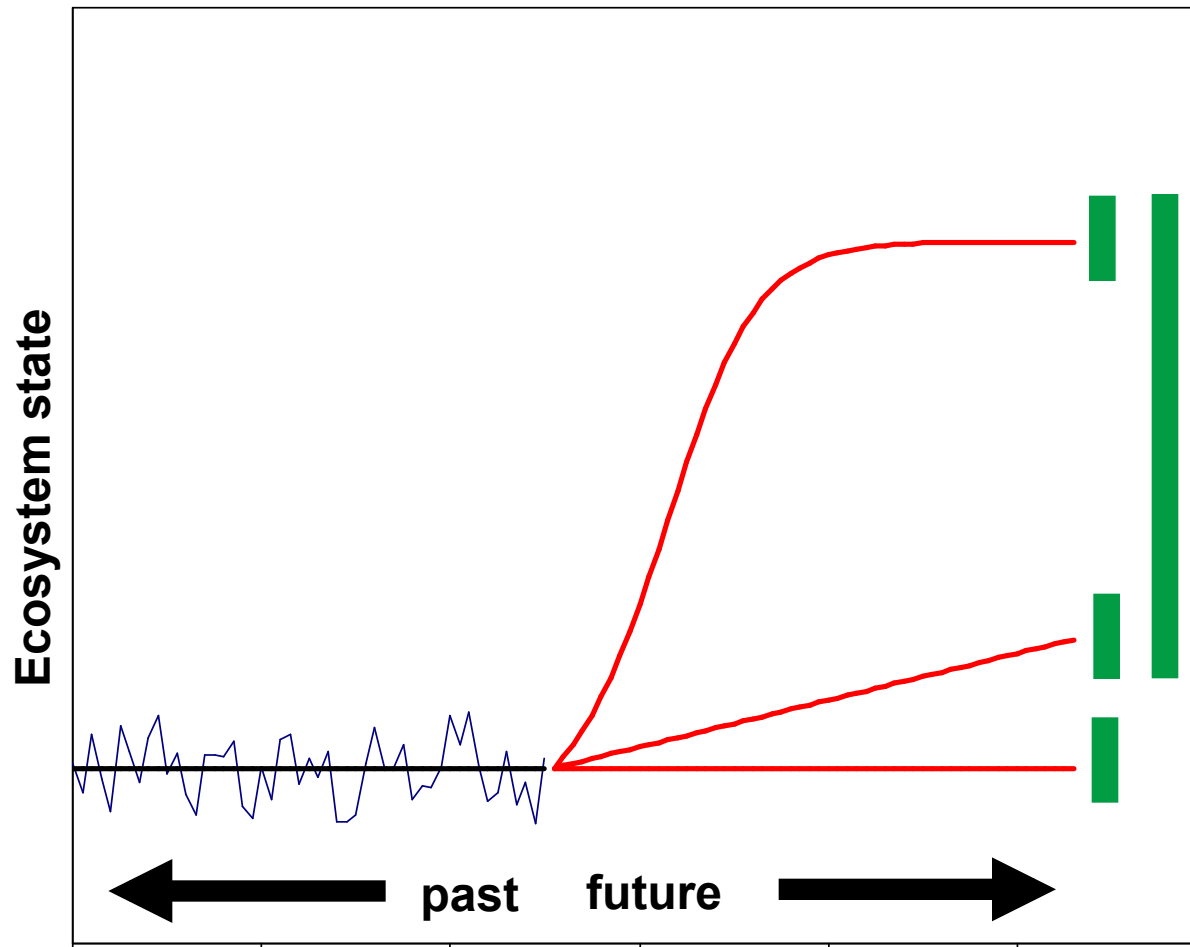
Employ Adaptive, Flexible Conservation Strategies



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

Elliott, et., al., Adaptive
Conservation
Strategies Guide, 2003
www.prbo.org

Plan for Extremes, Wider Range of Variability



--Prioritize projects that could succeed under multiple scenarios

--Protect refugia and reduce stressors to soften ecological transitions (e.g., real time ocean zoning)

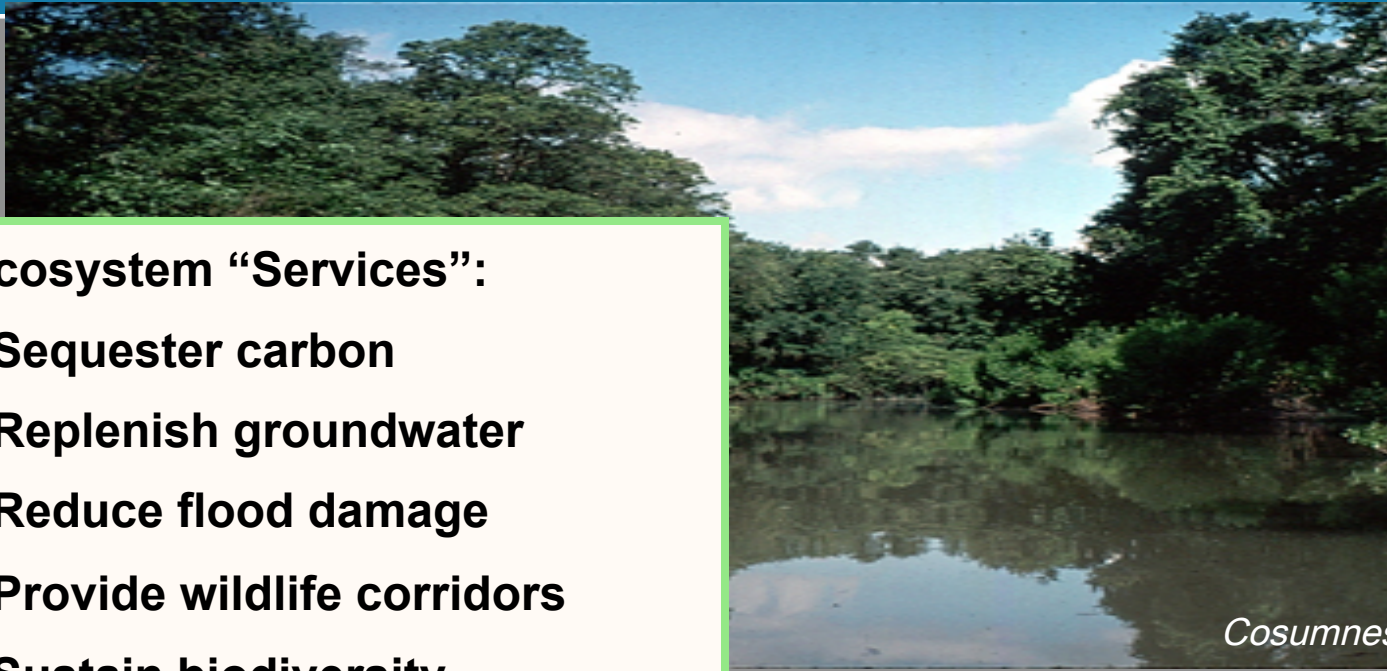
--Manage for habitat and 'climate space' heterogeneity

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

Expand Urban Creek & Wetland Restoration

Ecosystem “Services”:

- Sequester carbon
- Replenish groundwater
- Reduce flood damage
- Provide wildlife corridors
- Sustain biodiversity
- Nourish upland habitat
- Provide thermal refugia



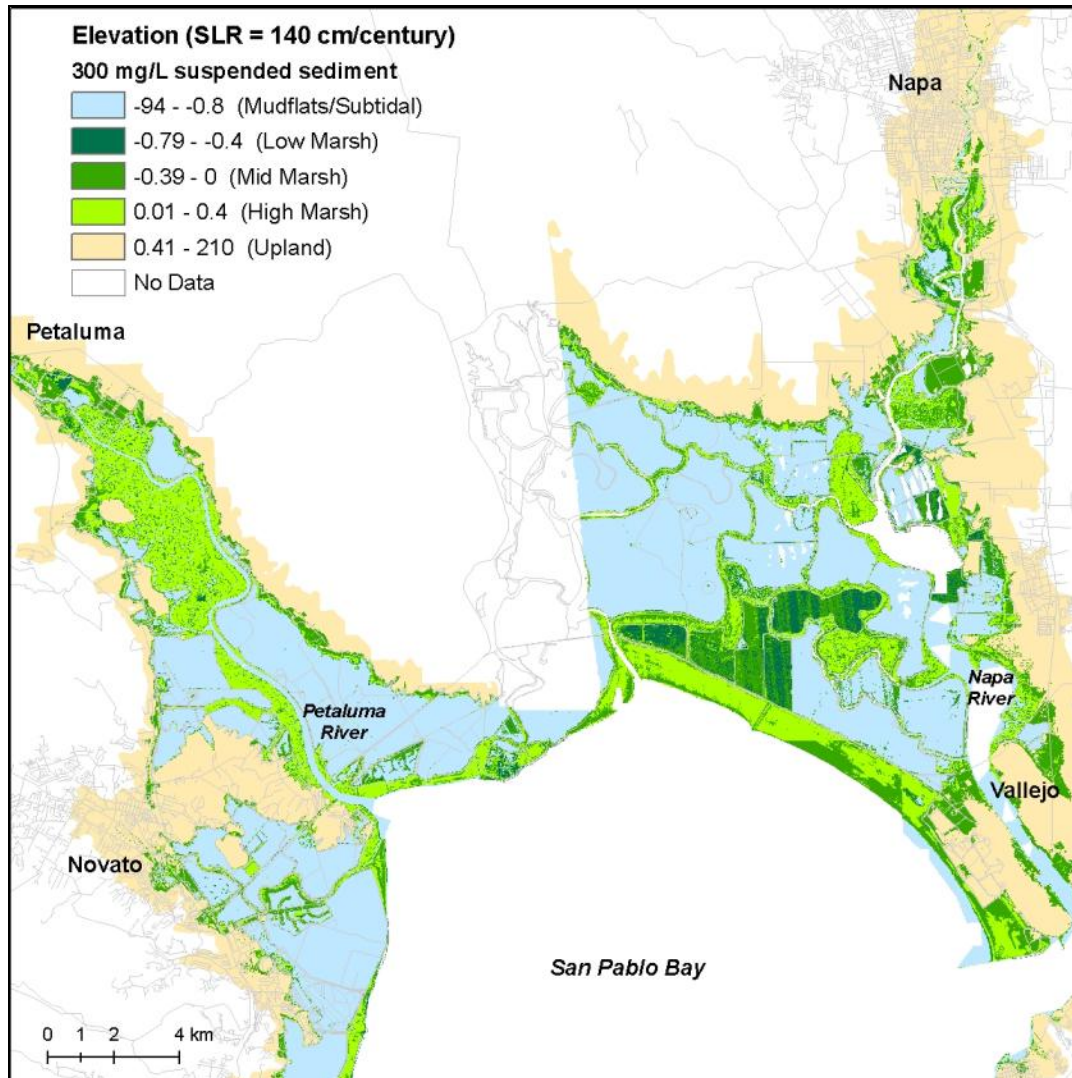
Yellow Warbler

Cosumnes Preserve



Grosholz, T., et al, UC Davis

Prioritize Tidal Wetlands for Protection--- *model SLR, sedimentation and salinity scenarios*



San Pablo Bay

140 cm SLR (4.6 ft):

300 mg/L
Suspended
Sediment / Low
Organic
Accumulation
→
Some Marshes
Maintained

www.prbo.org

Stralberg, D., et al, 2010

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Innovative Partnerships

Connect Lands, Enhance Ecosystems



Gale Ranch



Gale Ranch – 3 yrs after restoration

- **Allows species to move in response to change**
 - **Promotes ecosystem health**

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Link Bay Area habitats—wildlife corridors

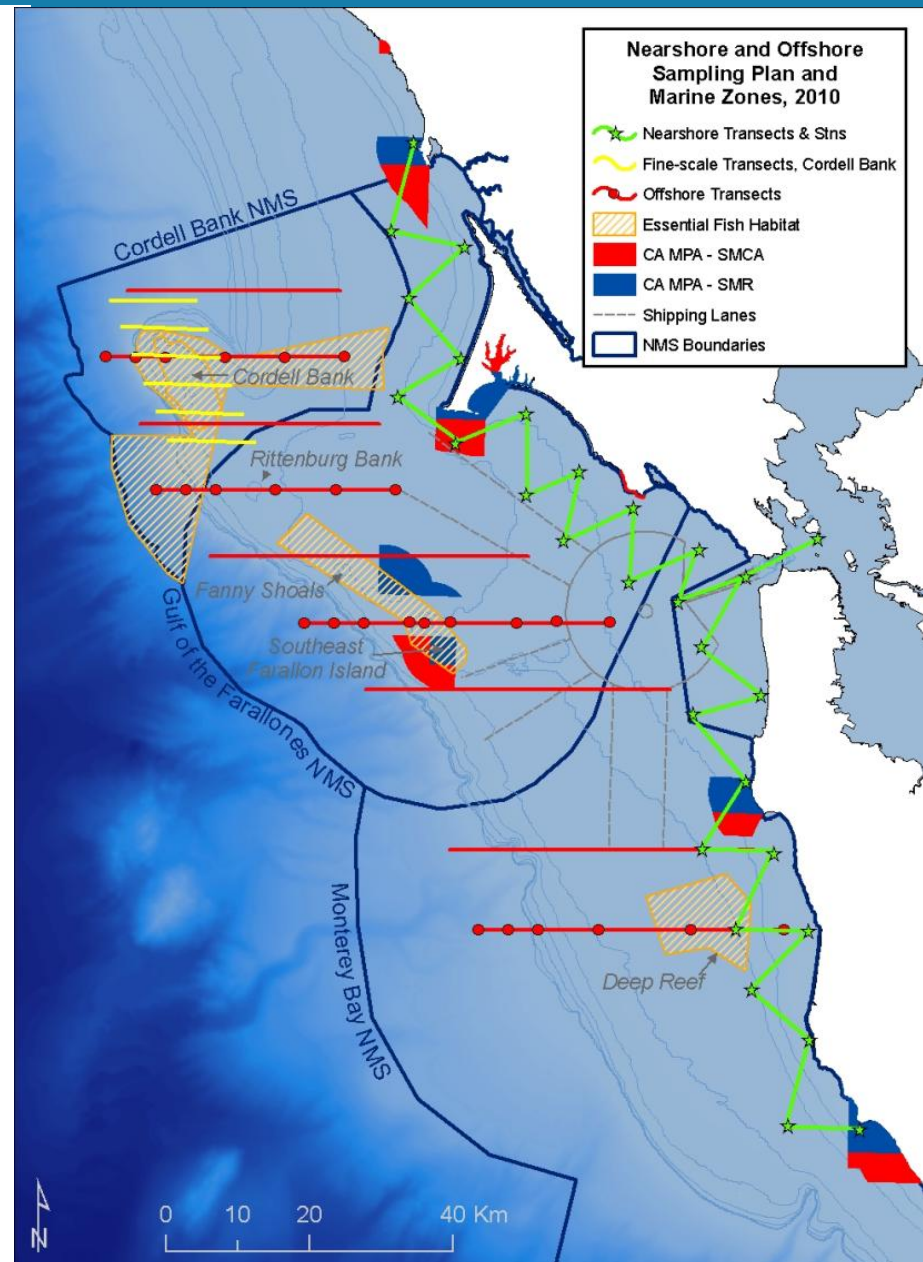


Link State and Federal Efforts



**North Central Coast Study Region
Integrated Preferred Alternative**

This marine protected area (MPA) proposal was unanimously selected on April 23, 2008 by the MLPA Blue Ribbon Task Force (BRTF) as its preferred alternative and is being submitted to the California Fish and Game Commission (CFGC) for consideration. This proposal integrates elements from three proposals developed by the North Central Coast Regional Stakeholder Group (NCCSRG) (proposals 1-3, 2-XA, and 4). These NCCSRG proposals will also be forwarded in their entirety to the CFGC for consideration. Further information on each MPA proposal can be found in the associated text document with the same MPA proposal name.



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Communicate science to policymakers and public for timely use: web-based visualizations

The screenshot displays the California Avian Data Center (CADC) website in a Mozilla Firefox browser. The main page features a header with the CADC logo and a navigation menu including Home, Research Tools, Habitat Management, and Citizen Science. Below the header, there is a brief description of the CADC's role as a regional node of the Avian Knowledge Network. Two featured sections, 'Habitat Management' and 'Research Tools', are visible, each with a small image and a brief description. The primary focus is a pop-up window titled 'Farallon Marine Bird and Mammal Distribution: Cassin's Auklet'. This window contains a map of the Farallon Islands with a distribution map overlaid. The map uses colored circles to indicate distribution levels: red for High, orange for Medium, and yellow for Low. A legend on the right side of the map defines these levels and also identifies symbols for Shelf Break, 3-nm Buffer, and Study Area. To the right of the map, there is a section for 'Southeast Farallon Island Breeders' with a dropdown menu set to 'Cassin's Auklet' and a 'Choose Species' button. Below this, there is a section for 'Migratory/Non-breeding Seabirds' with a dropdown menu set to 'Black-Footed Albatross' and a 'Choose Species' button. At the bottom, there is a section for 'Selected Marine Mammals' with a dropdown menu set to 'Blue Whale' and a 'Choose Species' button. The browser's address bar shows the URL 'http://data.prbo.org/cadc2/'.

www.prbo.org/cadc

Join Partnerships Together Regionally

Bay Area Ecosystems Climate Change Consortium- BAECCC:

**Conduct cooperative
research and adaptive
conservation to sustain
nature's benefits to our
communities in the face of
accelerating change**



Members:

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

What more might we do in SF?



- **Infill— *at higher elevations***
- **Mass transit**
- **Solar roof tops**
- **Recycling/compost**
- **Education programs**

Link back yards, plant more and plant natives, promote open space

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



Monkey Flower

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



Capture roof rainwater and greywater; require white roofs

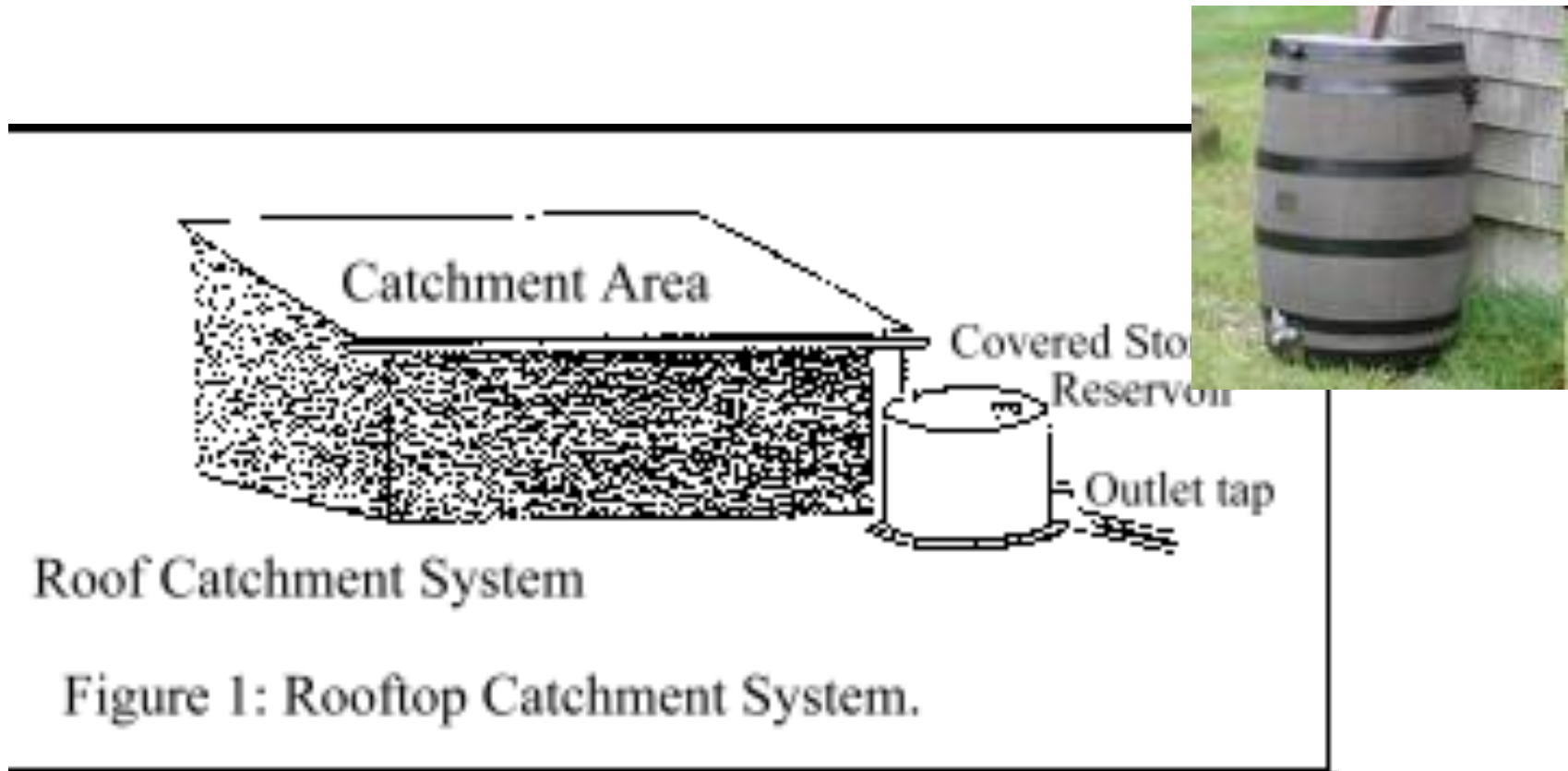
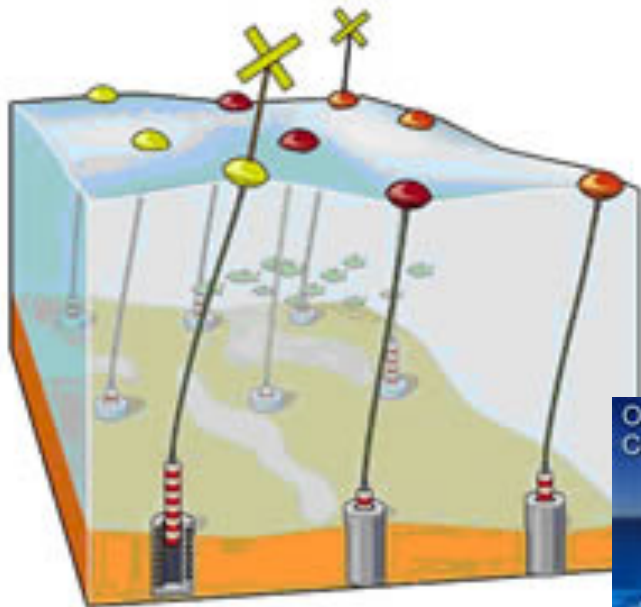


Figure 1: Rooftop Catchment System.

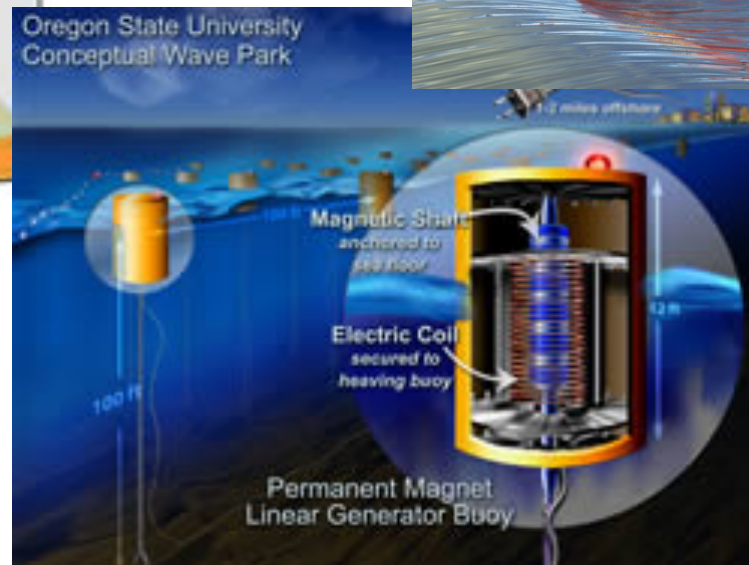
Wave Energy: Assess ecological impact , ensure science guidance for best outcomes



Point Absorber Wave Energy Farm



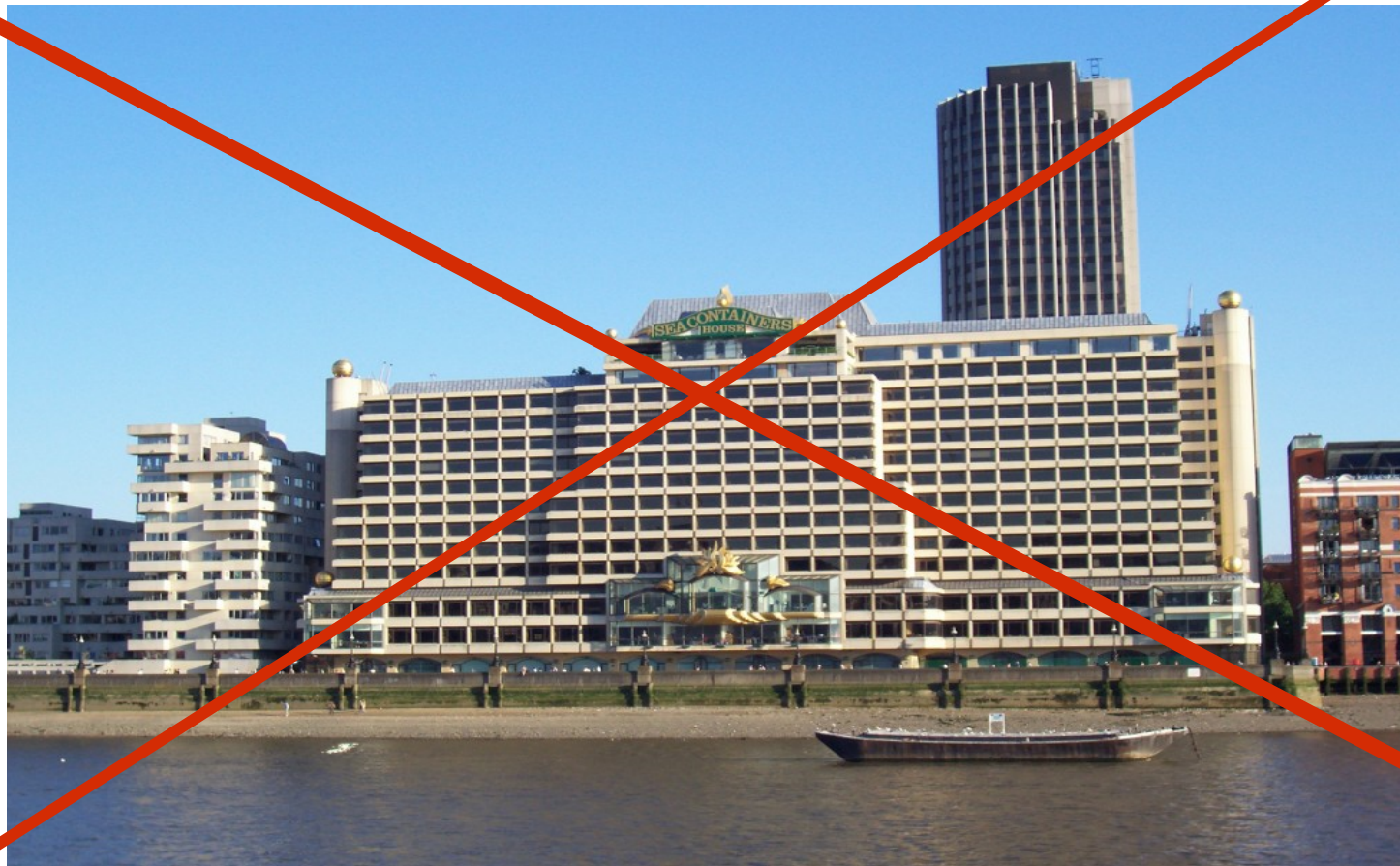
Attenuator Wave Energy Device



Wave Farm Made Up of Permanent Magnet Linear Generator Buoys

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Prohibit further building at sea level, flood plains



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Expand local restoration efforts!



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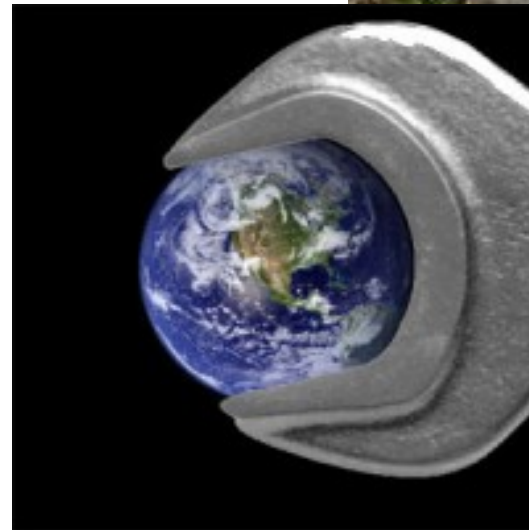
Carbon fee—e.g. Sweden's goal— end oil dependency by 2020



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

Future drivers of conservation and economy?

- **Renewable Energy**
- **Water**
- **Carbon markets**
- **Geo-engineering**
- **Other?**

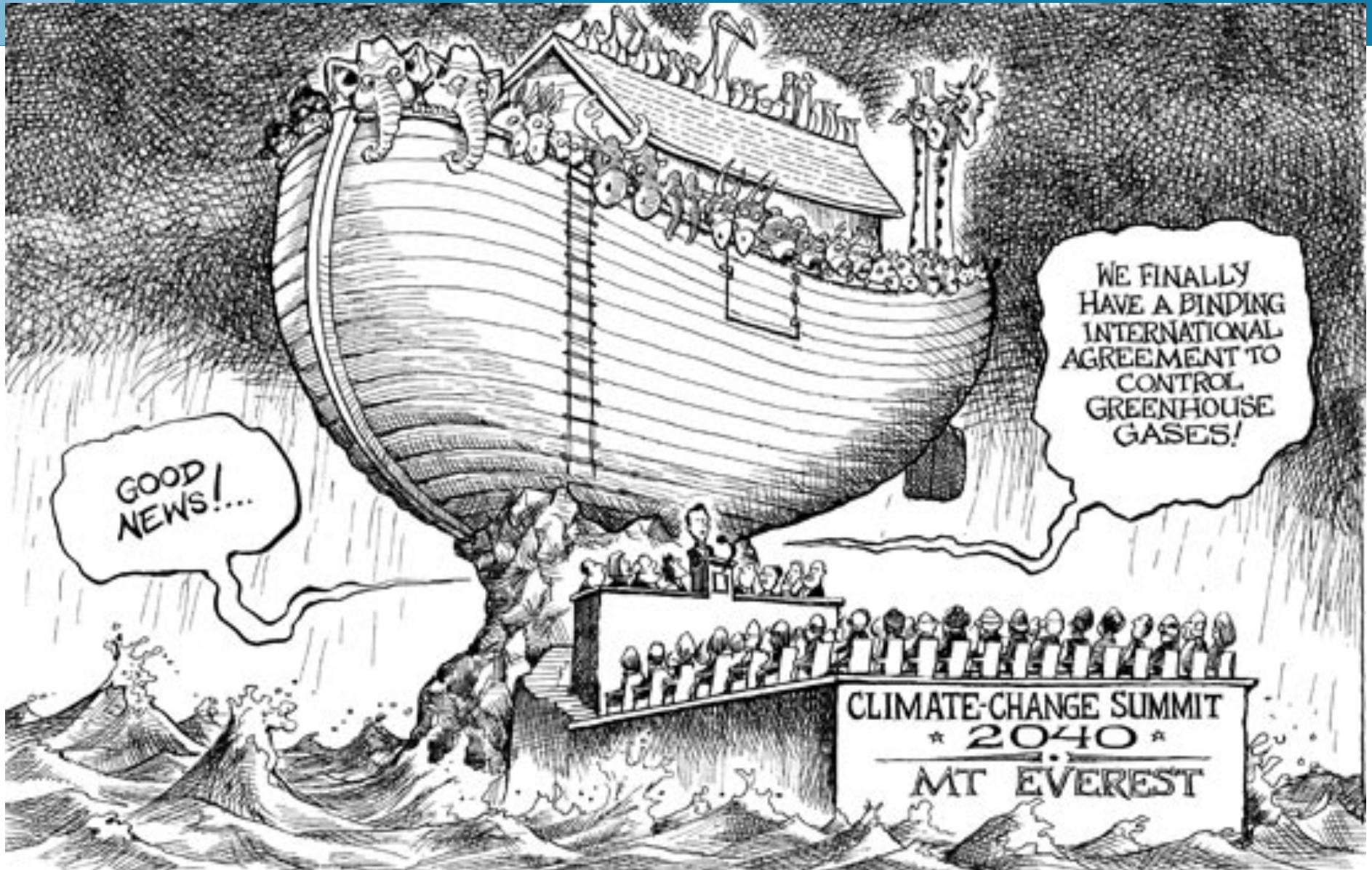


No More “Business as Usual”

**Stop greenhouse gas emissions
and
make ecosystem conservation
an equal priority now**



Our future?





Courtesy Tom Suchanek, USGS

Apply the 10% Rule



T = Test &

E = Experiment

N = Now

In Summary:



- 1. Climate change is rapidly accelerating**
- 2. Make ecosystem function & services equal priority**
- 3. Actively apply adaptive management and ongoing monitoring to address uncertainty**
- 4. Embrace change, greater flexibility- 10% Rule**
- 5. Plan for extremes, accept there will be losses**
- 6. Engage in novel partnerships**
- 7. Think out-of-the city!**



RESOURCES

www.sciencedaily.com

www.realclimate.org

Global Climate Change Impacts in the United States

www.globalchange.gov

www.climateprogress.org

www.climatechange.ca.gov

NASA's Jim Hansen

www.columbia.edu/~jeh1/

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THANK YOU!



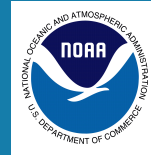
www.prbo.org
707-781-2555

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Acknowledgements

PRBO scientists, support staff, Board, members, and:

- Anonymous
- S.D. Bechtel, Jr. Foundation
- Bernice Barbour Foundation
- Bureau of Reclamation
- Bureau of Land Management
- California Coastal Conservancy
- 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



Urban wetlands --no place to go?

- Are there remaining adjacent uplands?
- Conduct cost/ benefit analyses on levees vs upland movement
- Ecosystem function advanced? Maintain for public values?
- Plan for desired outcome



Rising sea levels send ripples through real estate industry

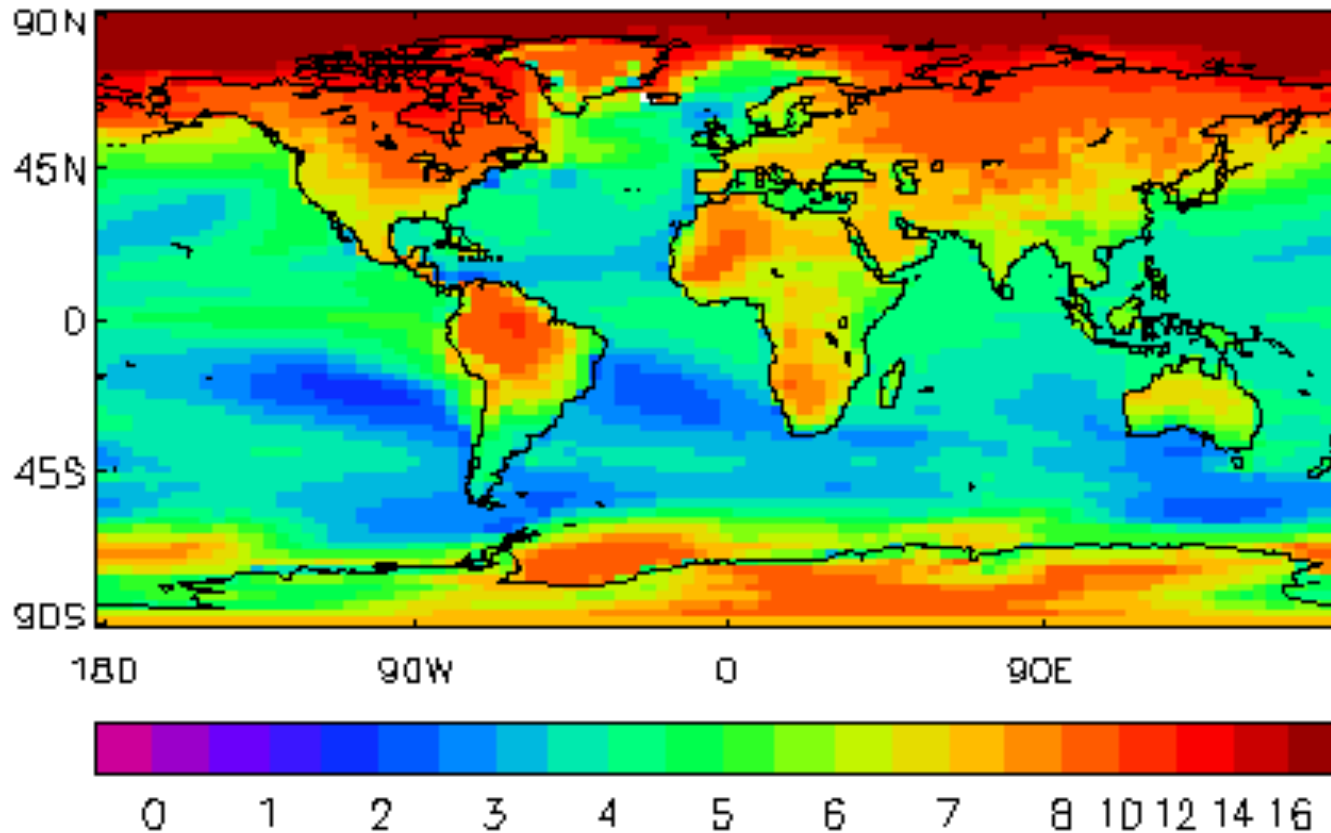
UNION-TRIBUNE

June 24, 2007



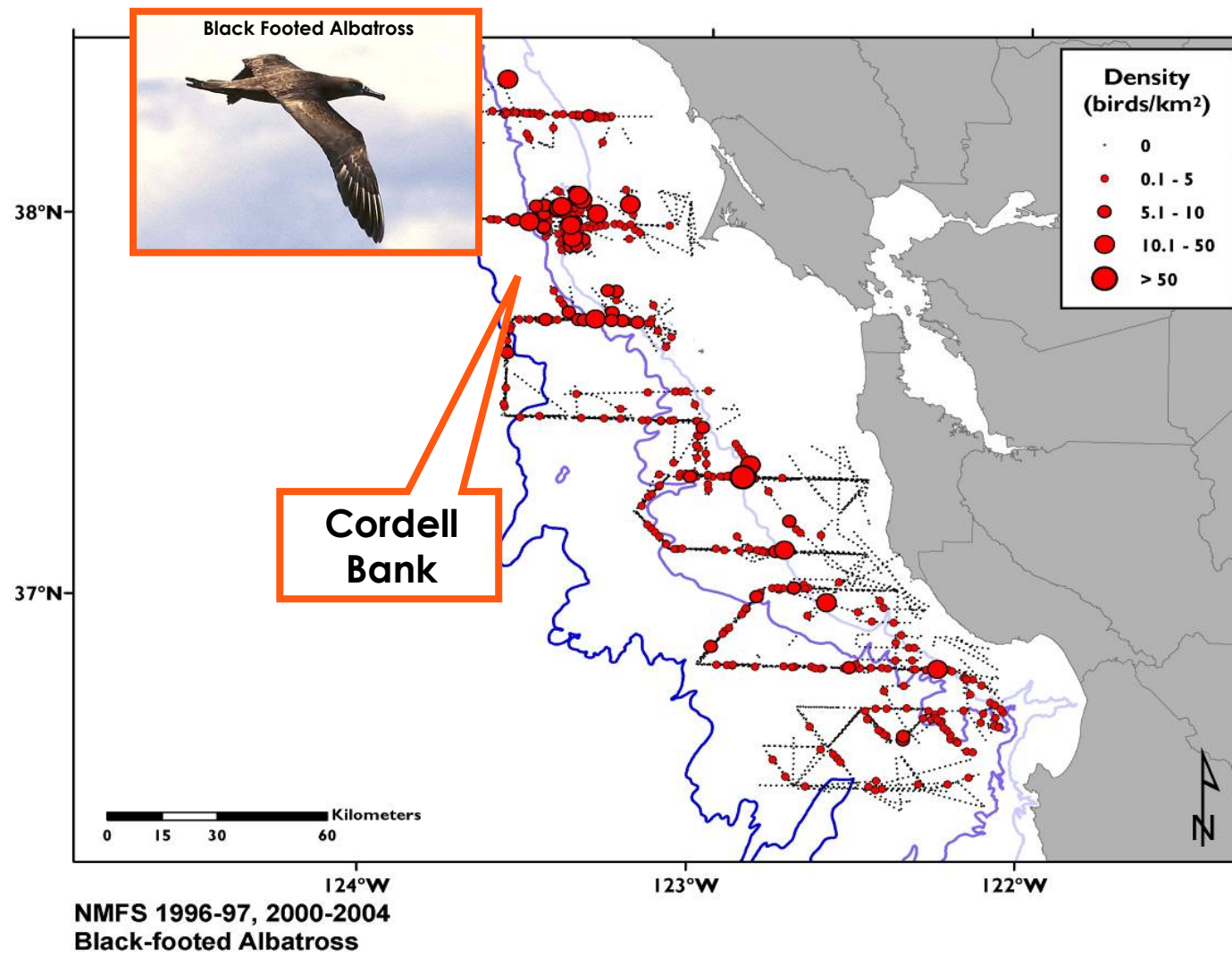
Avg. Global Surface Temp: + 7.6° F by 2060

By 2060: in Arctic up to 27° F, inland US 15°-18° F



Business as Usual CO₂ Scenario w/ Carbon Cycle Feedbacks

Protect Food Web Hotspots and Fisheries



Promote Eco-Friendly Agricultural Practices

- **Grass fed and grass finished livestock**
- **Rotational grazing**
- **Mixed farming**
- **Organic no-till**
- **Methane digesters**



Ecosystem “Services”:

- **Enhance carbon sequestration**
- **Replenish soil carbon stocks**
- **Sustain biodiversity**
- **Retain moisture**
- **Reduce emissions**

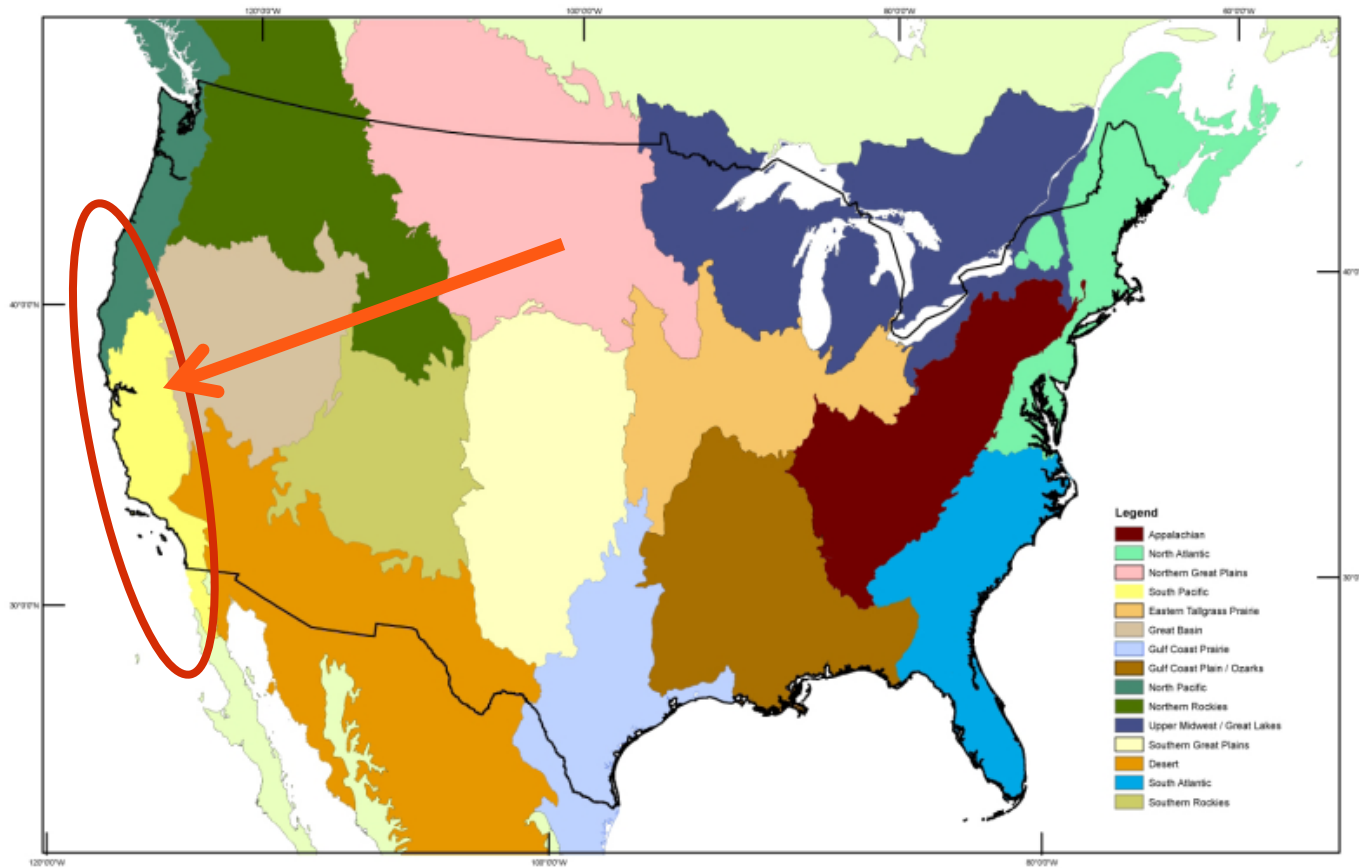
Landscape Conservation Cooperatives- USFWS



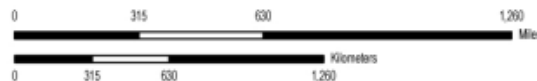
U.S. Fish & Wildlife Service

Landscape Conservation Regions
Conterminous United States

Recommendations from the National Geographic Framework
Rapid Prototyping Workshop



PRODUCED IN THE DIVISION OF REALTY
ARLINGTON, VA
MAP DATE: 8/16/2009
BASEMAP: ESRI
MERIDIAN: NAD
FILE: LCRs.mxd



Drought = Reduced or No Breeding



Chrissal Thrasher

— *Sonoran Desert*
Longest drought
On record
2006, 2007



Phainopepla

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↑ Innovative Public-Private Partnerships: *Connect Lands, Enhance Habitats*



- **Allows species to move in response to change**
 - **Promotes ecosystem health**