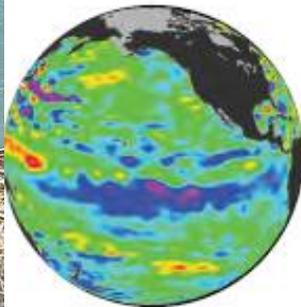




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PRBO Conservation Science



# Managing for Rapid Change: Adaptive Conservation Strategies

Ellie M. Cohen and PRBO Staff

January 30, 2009

USFWS/USGS Climate Symposium, San Francisco, CA

# Study birds and ecosystems to improve conservation outcomes

- Founded in 1965 as Pt Reyes Bird Observatory
- 120 staff and seasonal biologists



SF Bay Research Center/Headquarters

Petaluma Wetlands, Petaluma, CA. [www.prbo.org](http://www.prbo.org)



# Birds: Nature's "S&P 500"

## Indicators of Ecosystem Health



Brown Pelicans

# Talk Outline

- 1. Update on latest climate change findings**
- 2. Adaptive management strategies to address rapid change**
- 3. Riparian, tidal wetland and marine examples**
- 4. Thoughts for our future**

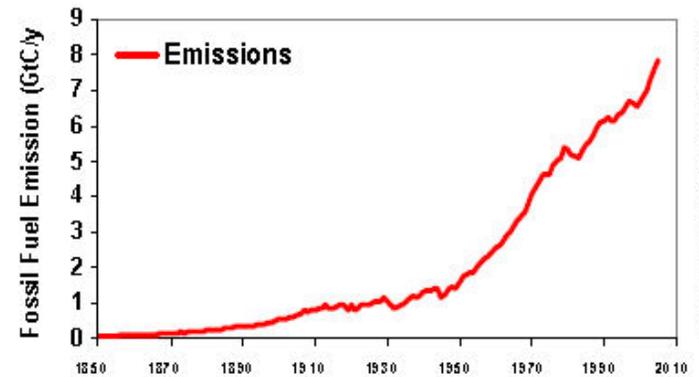
↑ CO<sub>2</sub> into atmosphere



- ~4x greater rate of emissions than 1990s
- Exceeds IPCC worst case



2007 Fossil Fuel: 8.5 Pg C



1990 - 1999: 0.9% y<sup>-1</sup>

2000 - 2007: 3.5% y<sup>-1</sup>



# Ability of nature to absorb excess CO<sub>2</sub>

- **1955-2000: ~57%**
- **2007: ~ 54%**

Land



Ocean



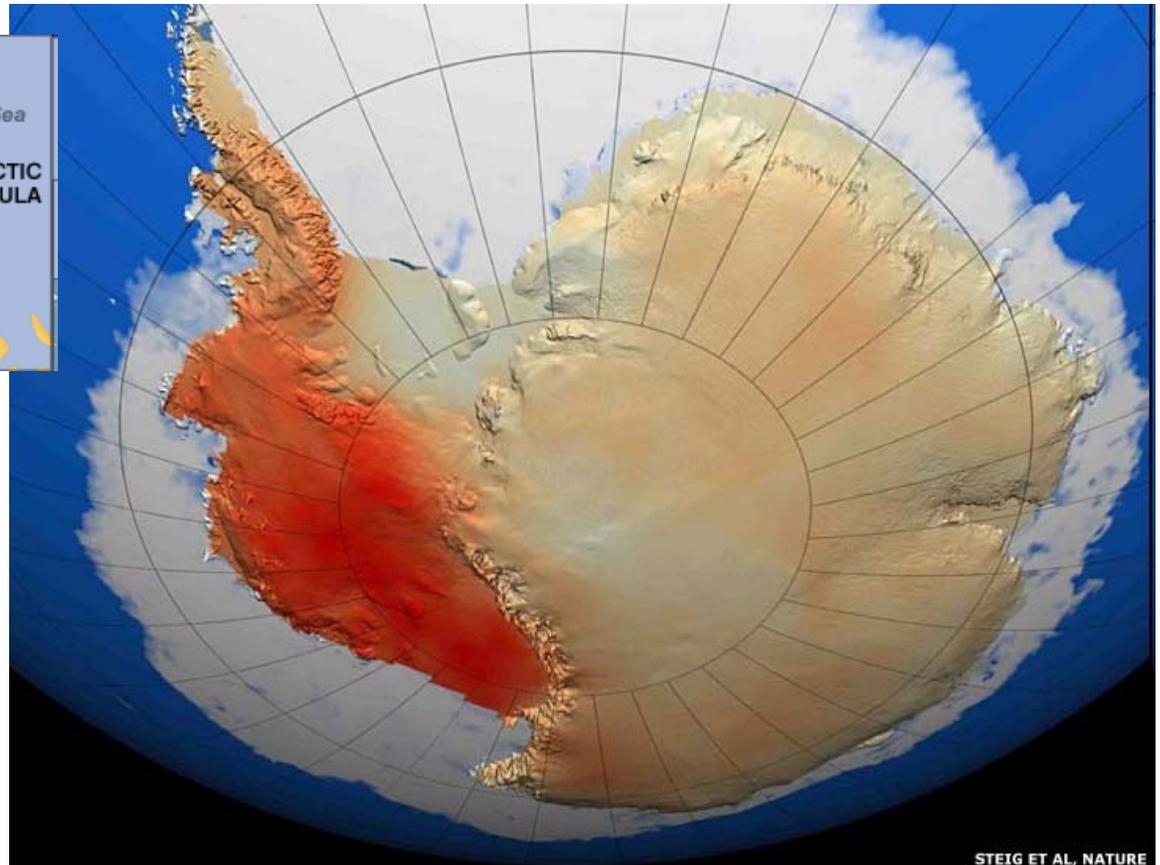
# Jet streams moving poleward 1979-2001 = major $\Delta$ 's storm, precipitation patterns





# Rate of ice sheets melting

## Antarctica – *significant warming beyond Peninsula*



STEIG ET AL, NATURE

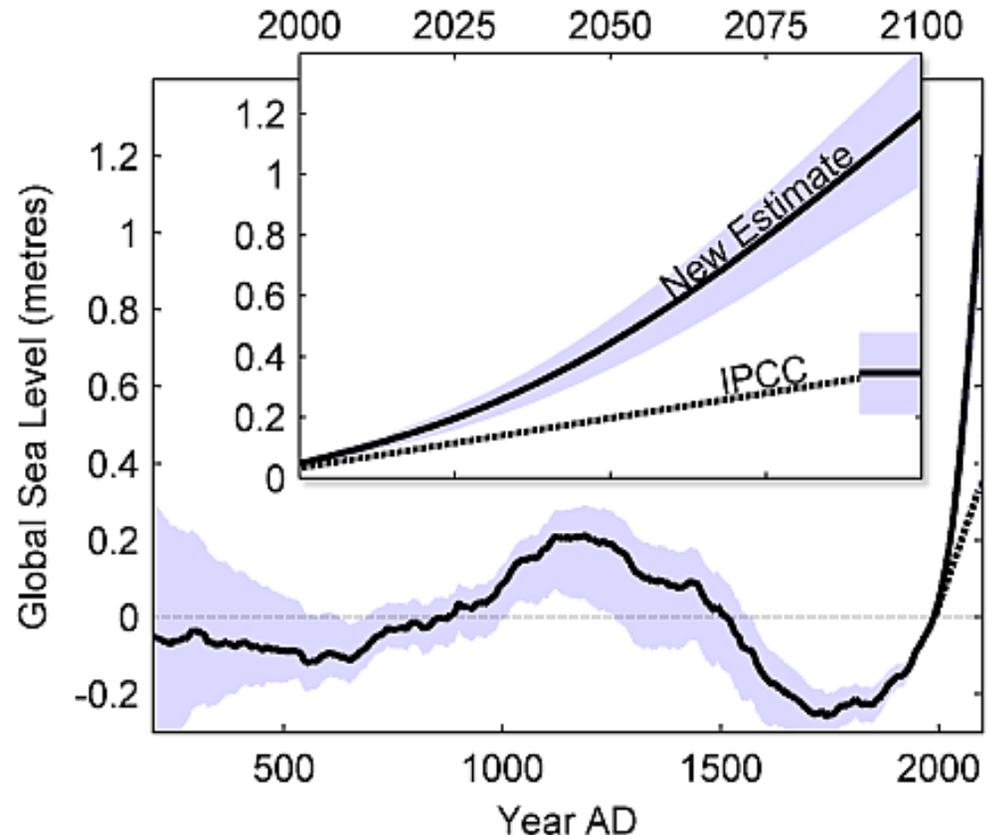
- **+0.6° C past 50 yrs**
- **Wilkin's Ice Shelf breaking up now**



# Rate of sea level rise

**-Already >2x faster  
than IPCC 2007 predictions**  
([www.climateinstitute.org.au](http://www.climateinstitute.org.au))

**-New estimate: Up to 1.3  
m (4.3 ft) by 2100** (A1B  
scenario- middle of road)



Grinsted, A., J. C. Moore, and S. Jevrejeva  
*Climate Dynamics*, Jan. 6, 2009

[www.glaciology.net/Home](http://www.glaciology.net/Home)

# Trees in West dying 2x faster



*over recent decades*

Mantgem, et al, Science, Vol. 323. no. 5913, Jan. 23, 2009



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

([www.rockymountainclimate.org](http://www.rockymountainclimate.org), March 2008)

Photo: Tom Van Sant- The Climate Project

# Mega-drought, other abrupt change projected

**“...models project a permanent drying by the mid-21st century... a quarter of the projections may reach this level of aridity much earlier. “**

**“Slight changes in climate may trigger major abrupt ecosystem responses ... including insect outbreaks, wildfire, and forest dieback.”**

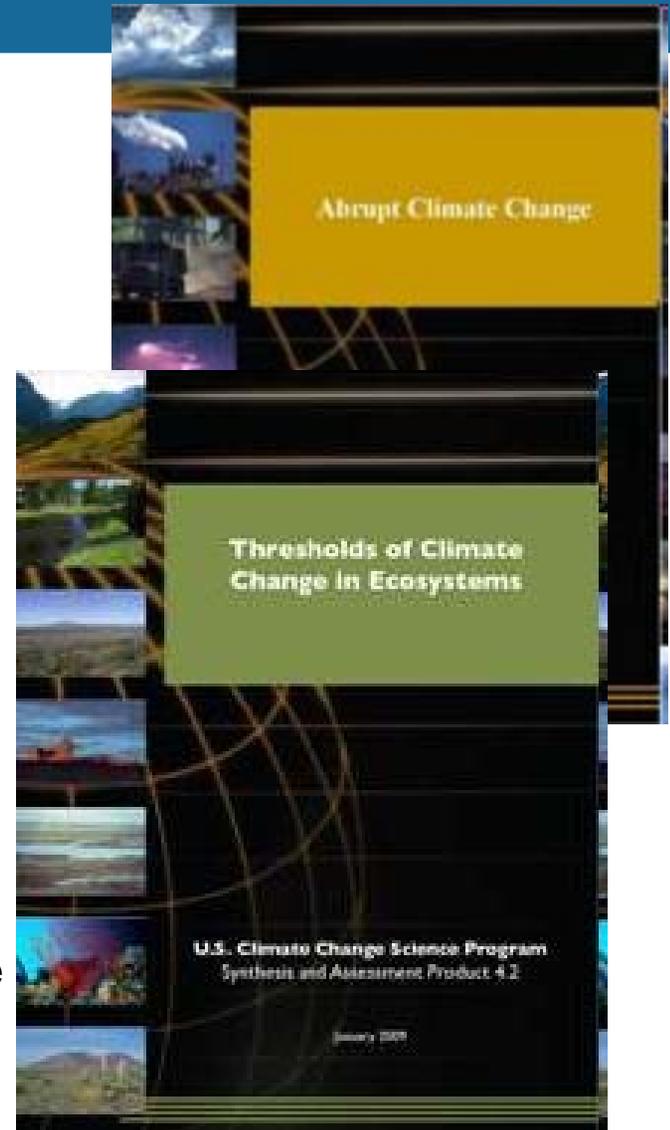
**“[need to] predict and understand early warning signals of impending ecological thresholds.”**

Abrupt Climate Change  
Final Report, Dec. 2008

Thresholds of Climate Change  
in Ecosystems, Jan. 2009

**US Climate Change Science Program**

[www.climatechange.gov](http://www.climatechange.gov)

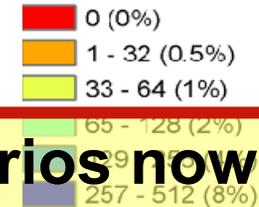




# Future: no-analog bird communities

GFDL / Maxent

Number (%) of Modern Analogs  
(2.5% Similarity Cut-off)



**Exceeding IPCC worst-case scenarios now**  
**More climate change impacts in pipeline**  
**Signs of mega-drought**  
**Species extinctions inevitable**  
**Economic outlook is gloomy**

Projected by 2070

Data from 60 land bird focal species

Assumes all exist 60 years from now combined  
with temperature, precipitation variables

From IPCC scenarios

## Shift to a new conservation paradigm

# Healthy Ecosystems Act

**Need new statutes, regulations to address rapid ecological change in 21<sup>st</sup> Century**



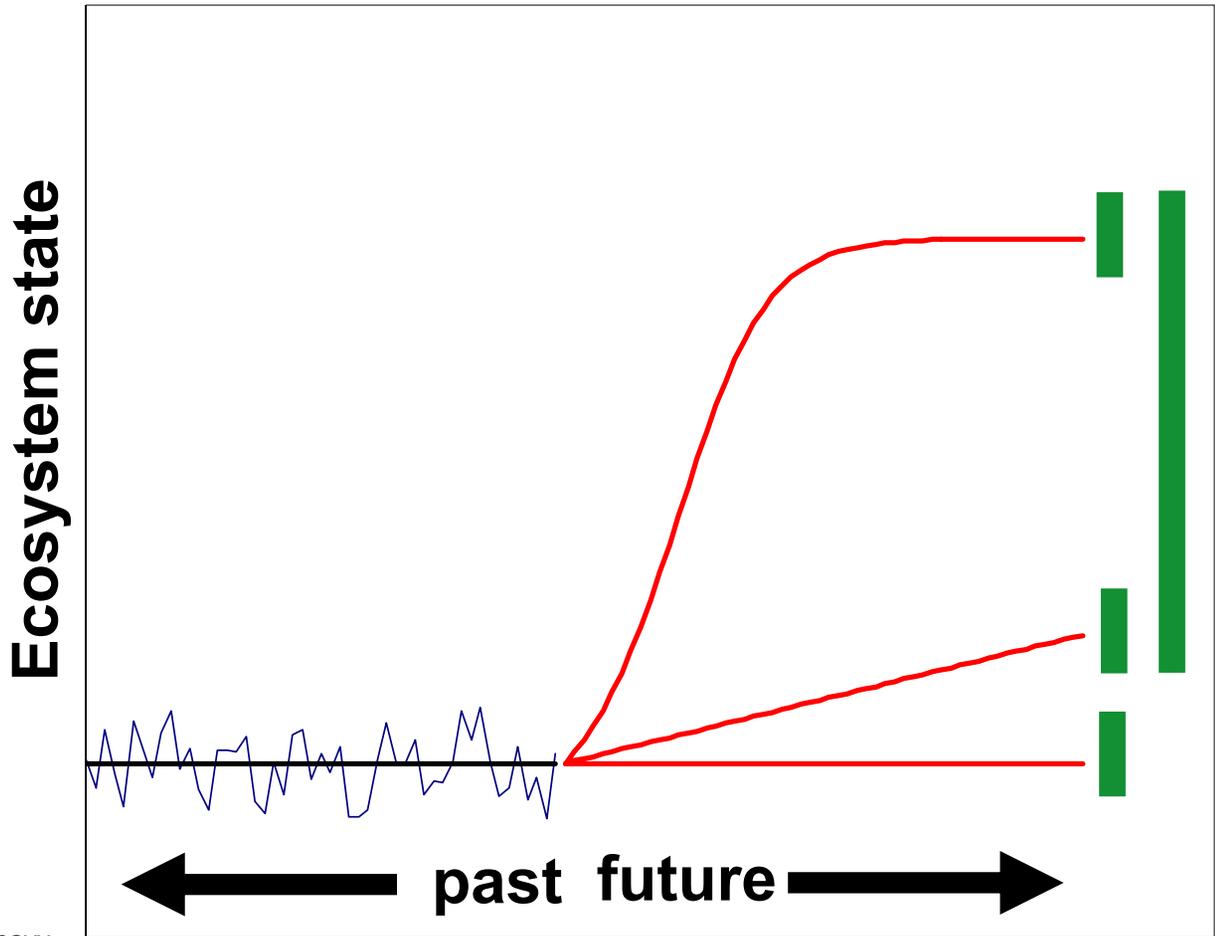
# Start managing for rapid change now



**MANAGE FOR ECOSYSTEM FUNCTION and SERVICES**  
**Revise management plans, protocols as needed**



# Plan for extremes, wider range of variability

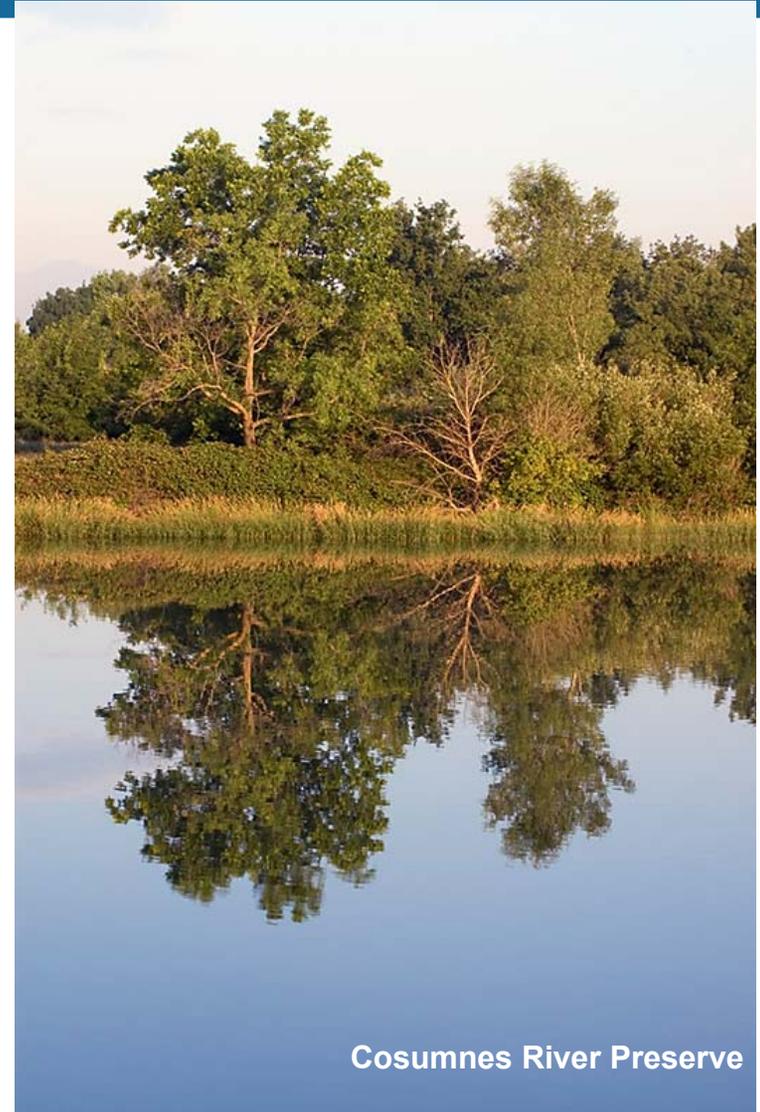


**Prioritize projects that could succeed under multiple scenarios**

# Enhance ecosystem response to change

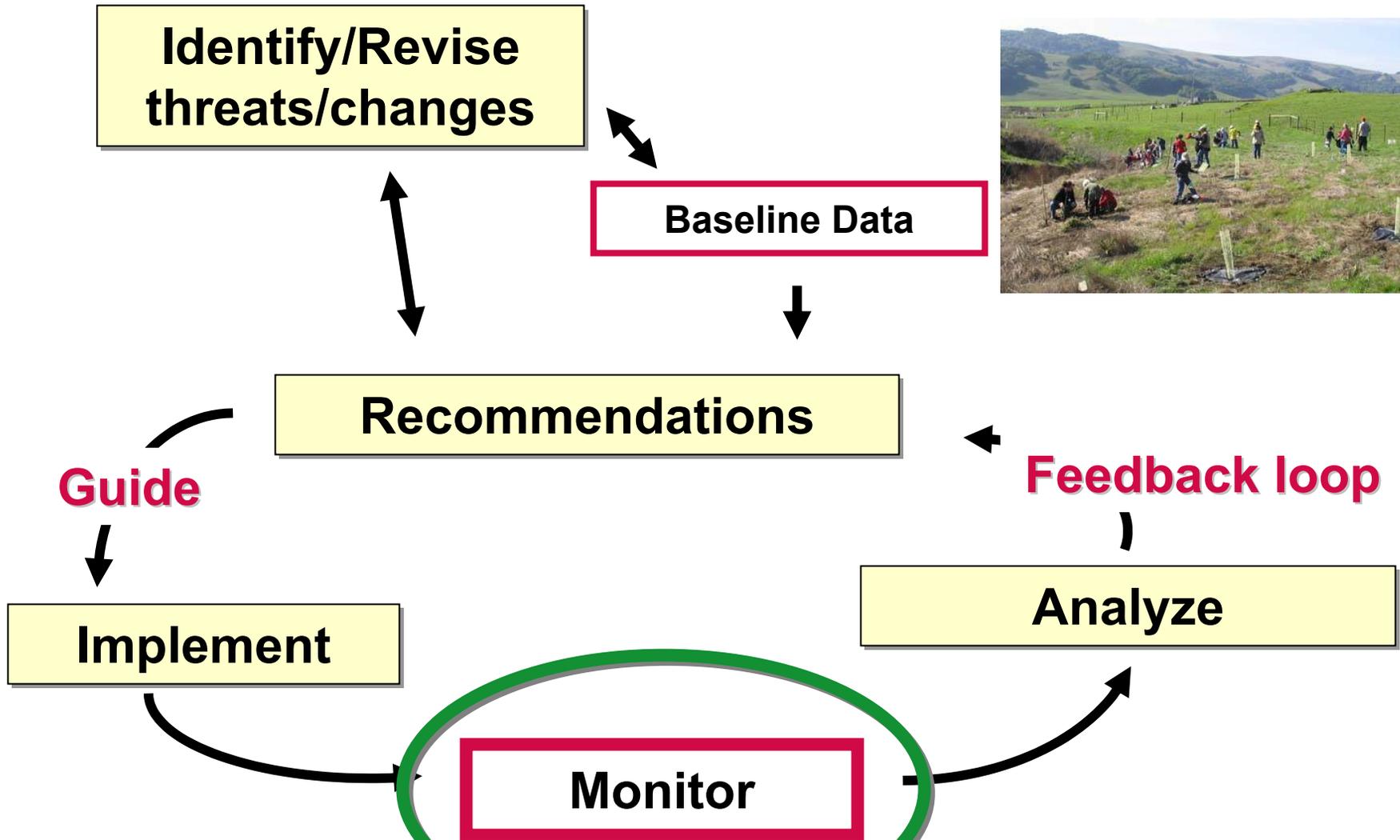
- **Promote natural processes**
  - **Flooding**
  - **Fire**
  - **Remove levees for tidal exposure**
- **Maximize heterogeneity, adaptive variation**
  - **conserve ecotones, gradients**

***Note: “Resilience” – may not be achievable anymore***



Cosumnes River Preserve

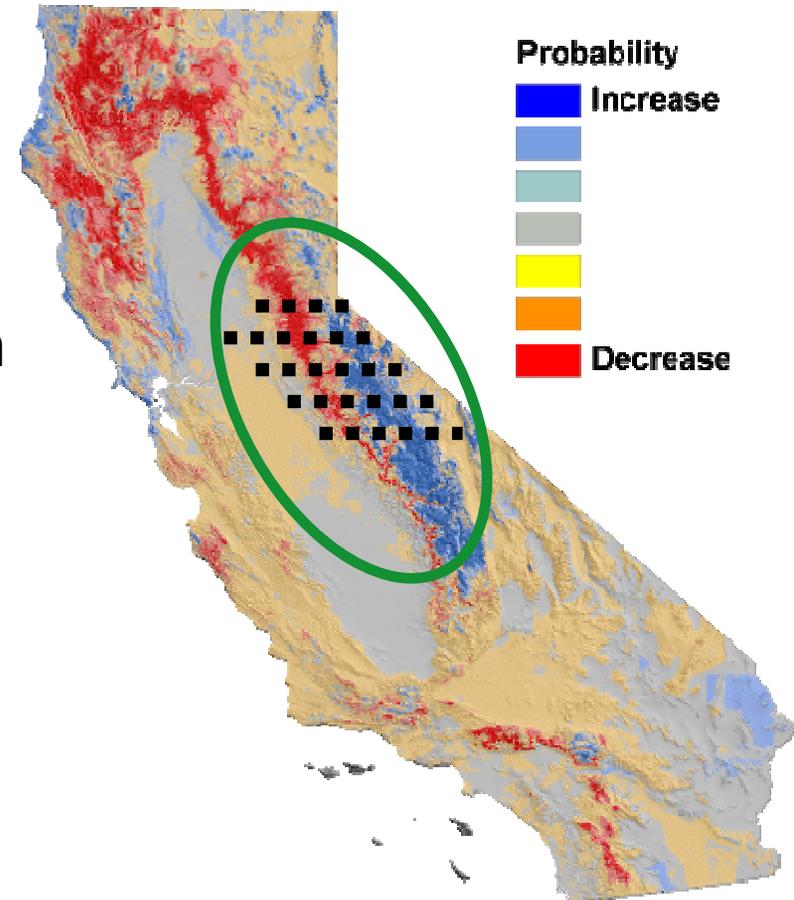
# Actively employ adaptive conservation strategies



# Establish monitoring “buoys,” new partnerships

## *“Pacific Coast Terrestrial Observing System”*

- Target areas with elevational or compositional gradients, rapid turnover projected
- Through Joint Ventures, establish new stakeholder consortiums at multiple scales to accelerate data sharing, problem solving
- Engage citizen scientists and general public

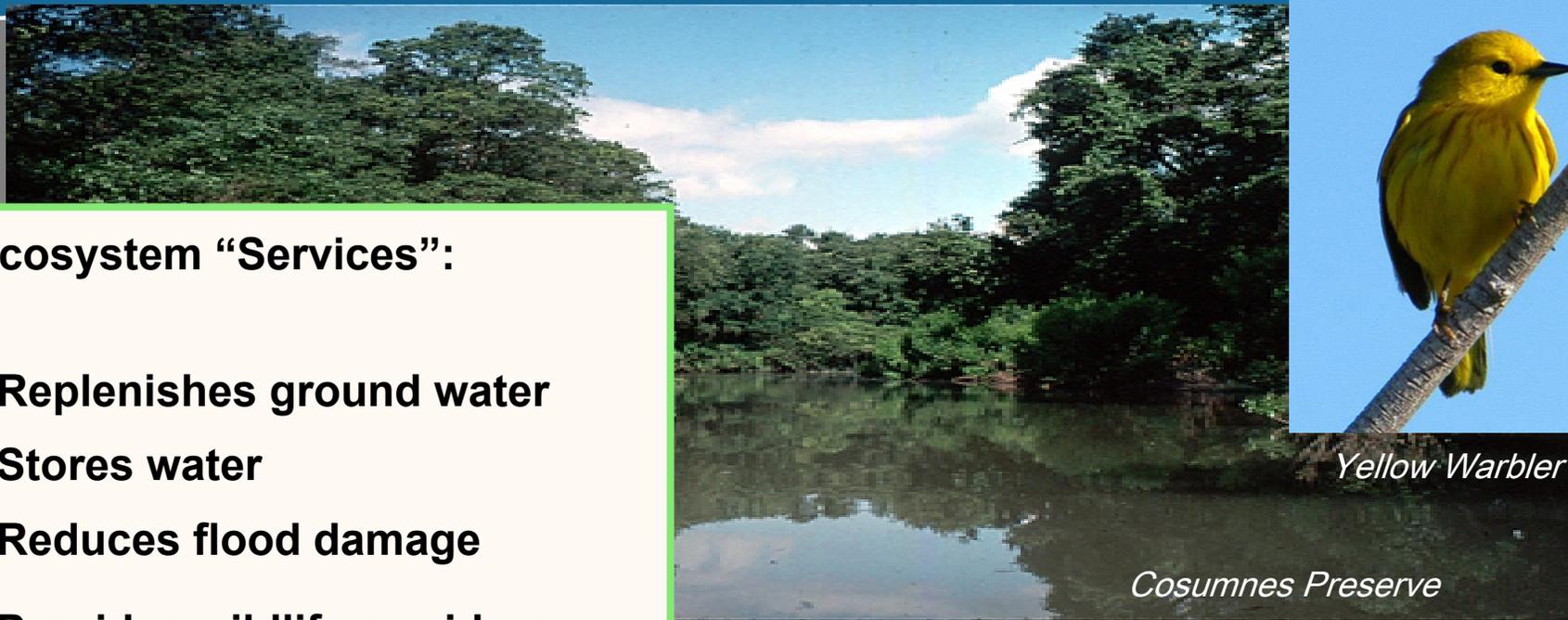


E.g., Average difference for conifer species

# Significantly expand riparian restoration

## Ecosystem “Services”:

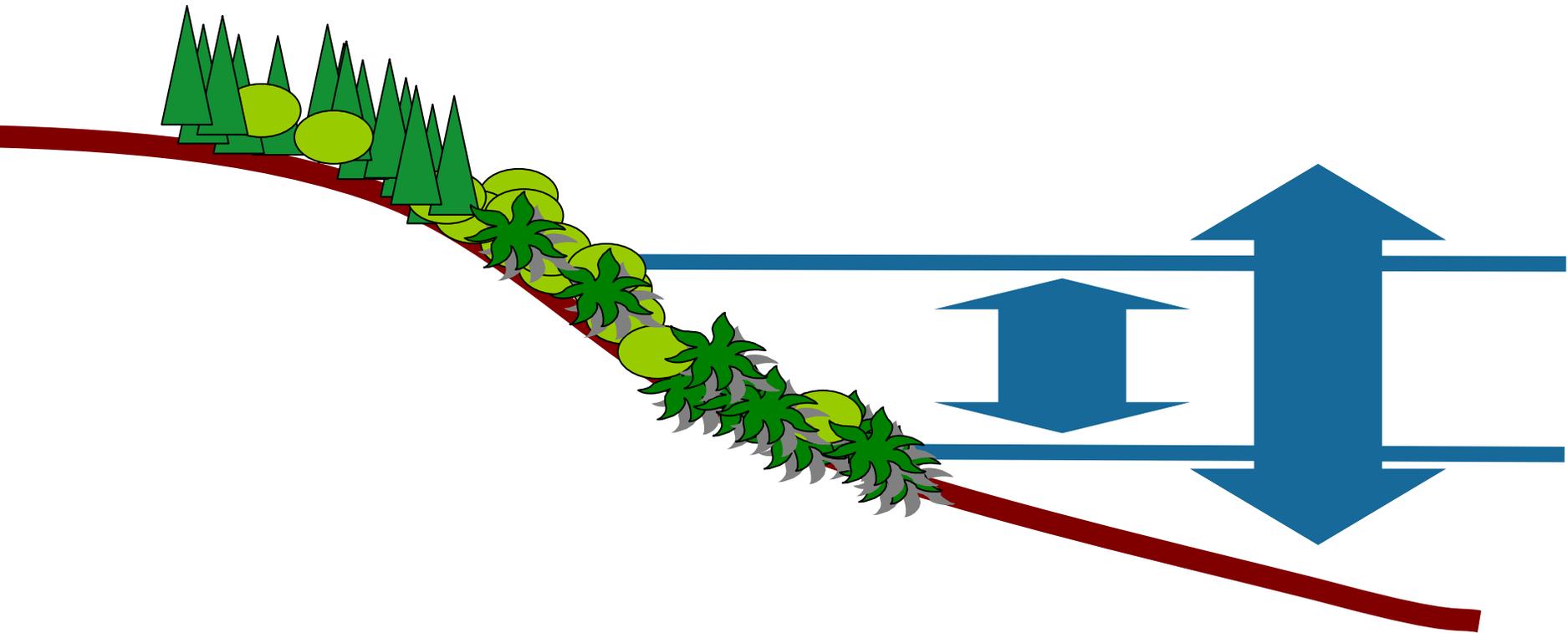
- Replenishes ground water
- Stores water
- Reduces flood damage
- Provides wildlife corridors
- Sustains biodiversity
- Nourishes upland habitat
- Provides thermal refugia



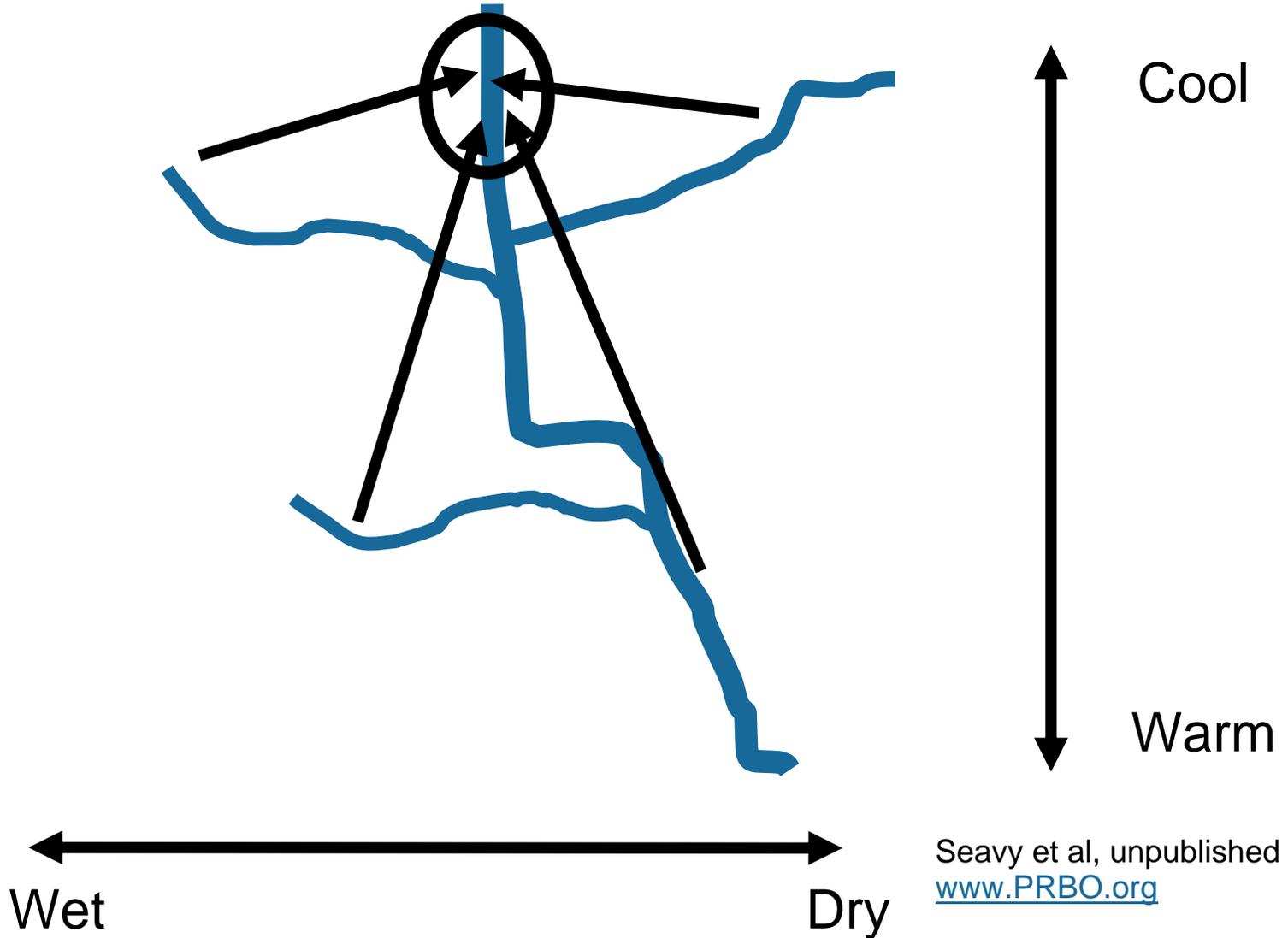
*Yellow Warbler*

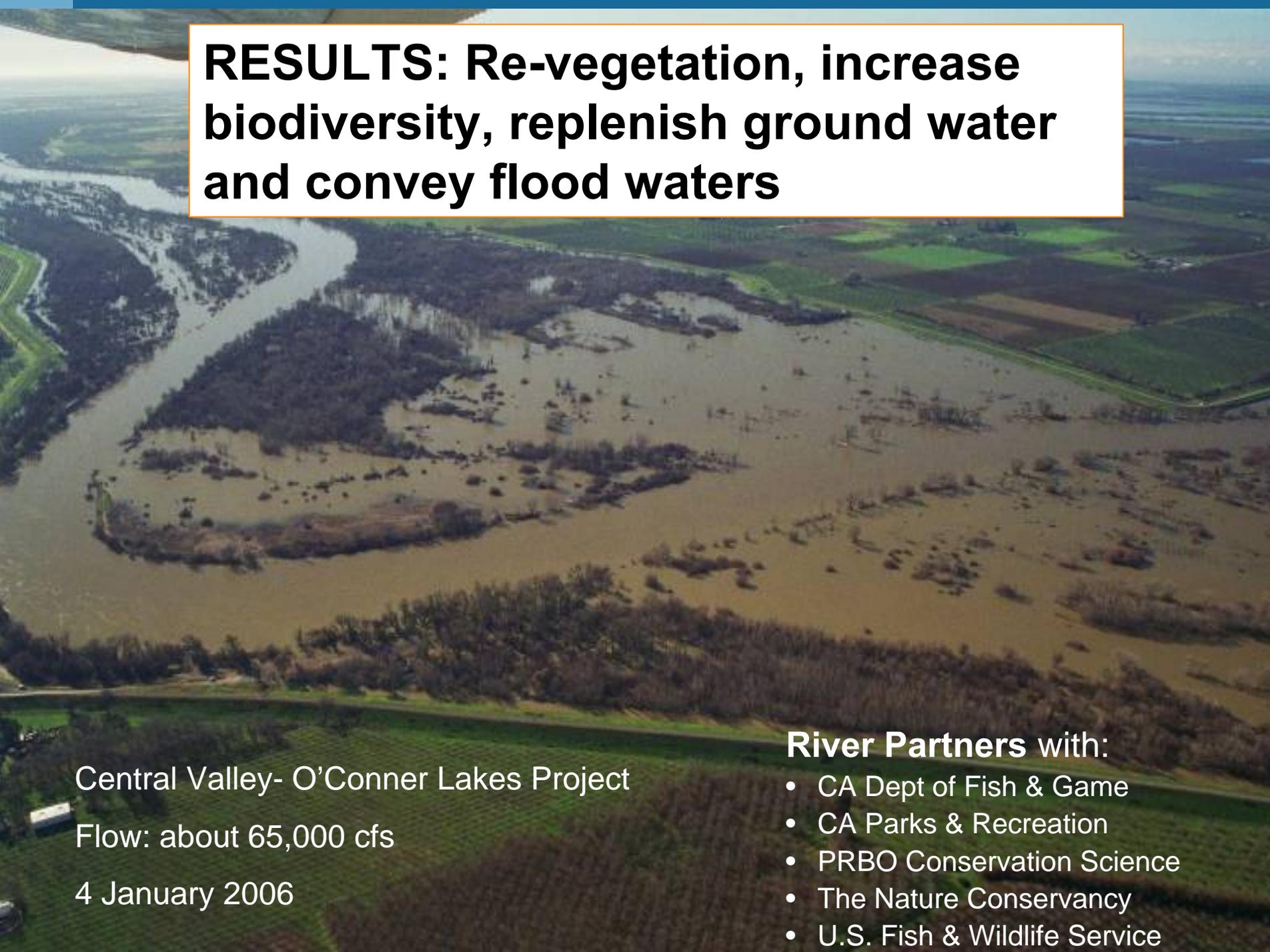
*Cosumnes Preserve*

# Plan restorations for an unpredictable hydrograph



# Plant for genetic diversity in restoration



An aerial photograph showing a wide, muddy river with a large loop or meander. The river is surrounded by a mix of green agricultural fields and dark, wooded areas. The sky is clear and blue. A white text box with a black border is overlaid on the top left of the image.

**RESULTS: Re-vegetation, increase biodiversity, replenish ground water and convey flood waters**

Central Valley- O'Conner Lakes Project

Flow: about 65,000 cfs

4 January 2006

**River Partners with:**

- CA Dept of Fish & Game
- CA Parks & Recreation
- PRBO Conservation Science
- The Nature Conservancy
- U.S. Fish & Wildlife Service

# Expand connectivity now: Actively partner with adjacent landowners -- public and private



10 26 '98

PRBO Conservation Science

**Results: ↑ biodiversity, ↑ response to change**



Gale Ranch, Marin County RCD

Include urban solutions ↓ flood damage, ↑ eco-health



***Integrates***

- levee management
- flood protection
- riparian conservation
- wildlife protection
- public participation

With economic and ecological benefits

**Napa River Floodplain Restoration**

Dec 31, 2005

# Expedite tidal wetland restorations and prioritize connectivity to upland habitats

Design to maximize ecosystem function and services



## Ecosystem “services”:

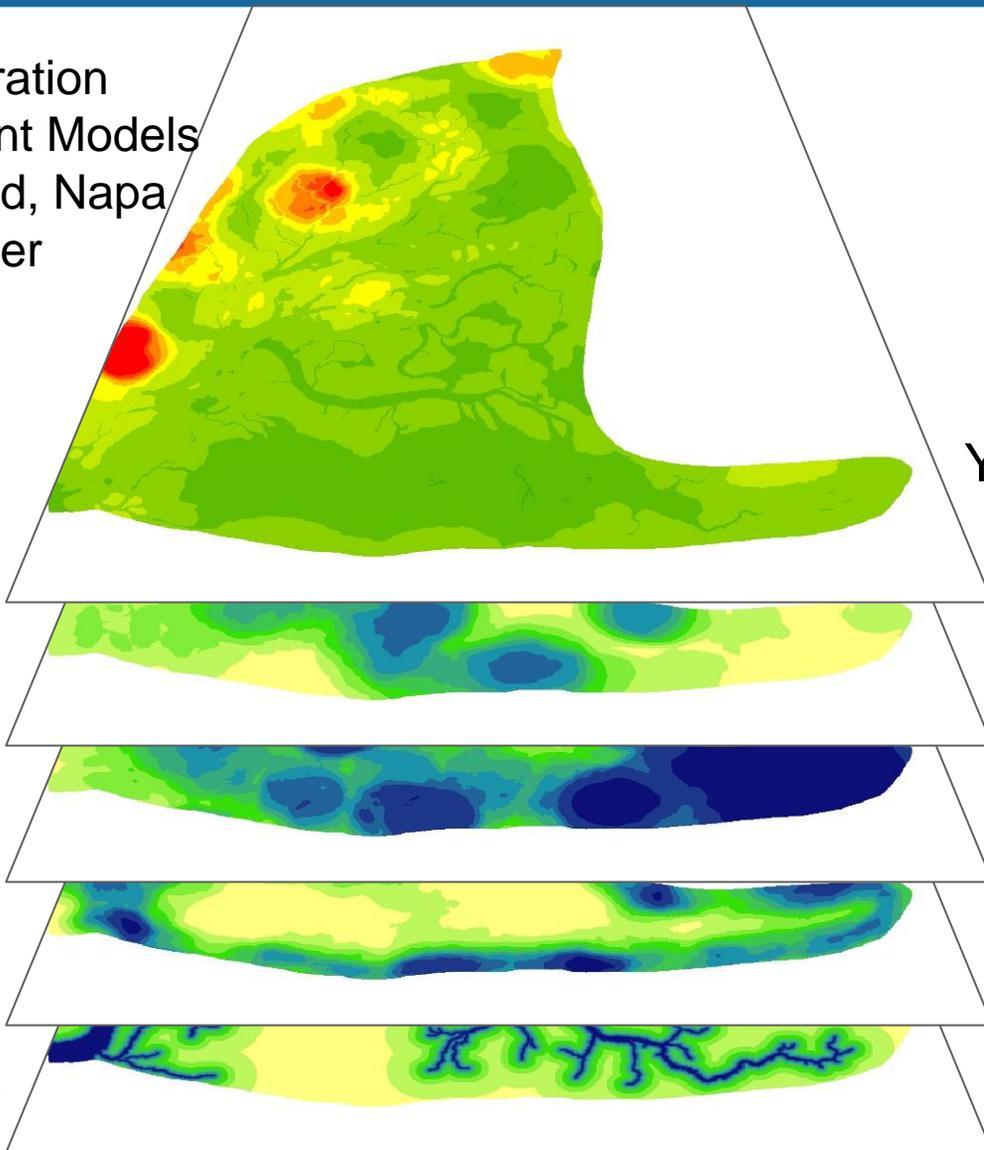
- **Sequester carbon**
- **Reduce flood impacts**
- **Reduce sea level rise impacts**
- **Sustain biodiversity**
- **Filter out pollutants**

North SF Bay ~50k Acres of Wetland Restoration

Napa Sonoma Marsh Restoration, Ponds 2, 2a, 3 photo - Larry Wyckoff, CDFG

# Expand monitoring: Not all designs created equally!

Restoration  
Assessment Models  
Bull Island, Napa  
River



$$Y = m_1x_1 + m_2x_2 + m_3x_3 + m_4x_4 + b$$

$Y$  (Common Yellowthroat density)

$X_4$  (vegetative diversity)

$X_3$  (proportion of *Scirpus*)

$X_2$  (proportion of *Typha*)

$X_1$  (distance to nearest channel)

# Enhance response: remove noxious invasives

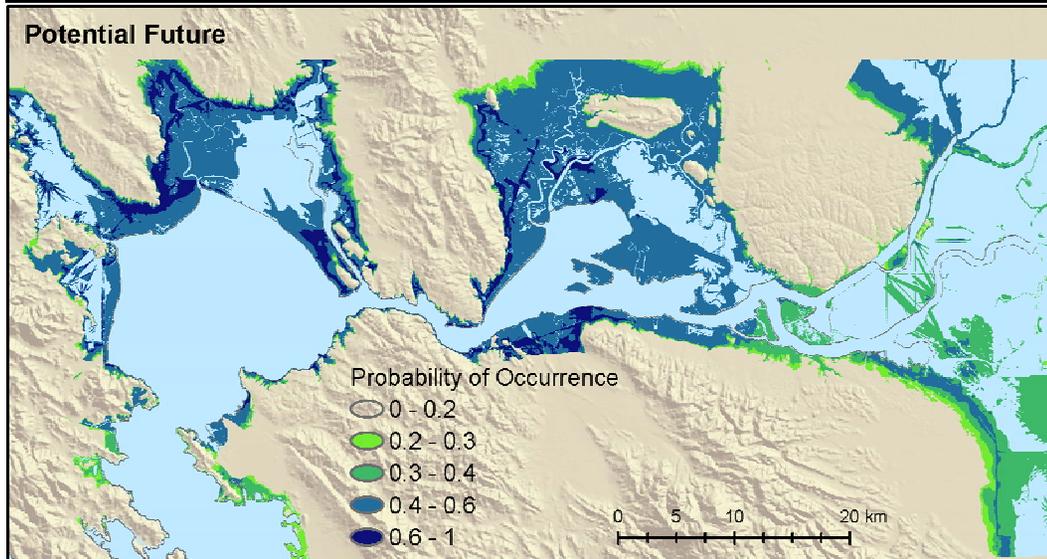
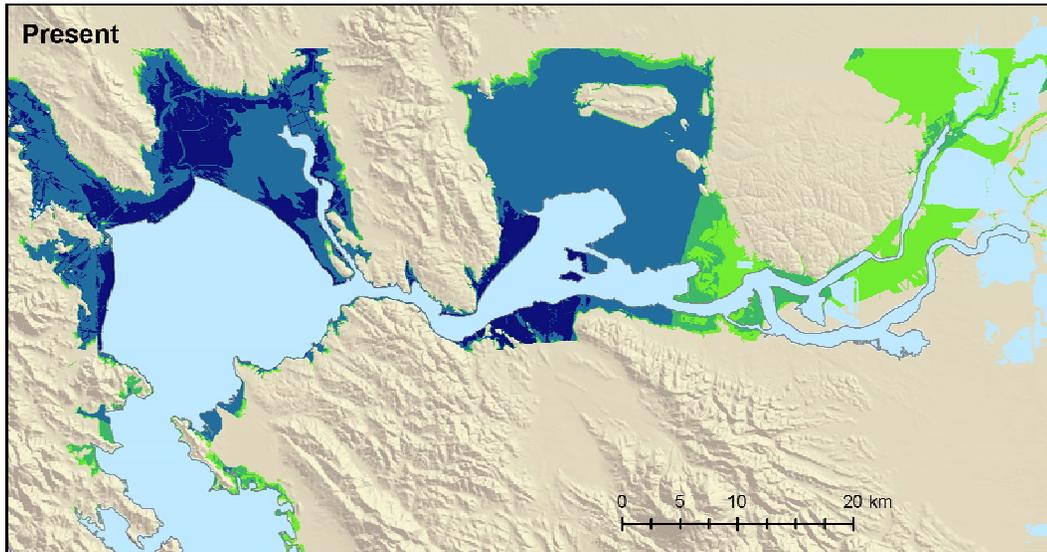


*Spartina Alterniflora*

# Identify, protect future wetlands, uplands



Salt Marsh Common Yellowthroat



## Northern SF Bay Delta

Assumptions:

- 1 m sea level rise
- no sediment accretion

Stralberg, D., et al, PRBO, 2009

# Urban wetland refuges with no place to go?

Plan for desired outcome:

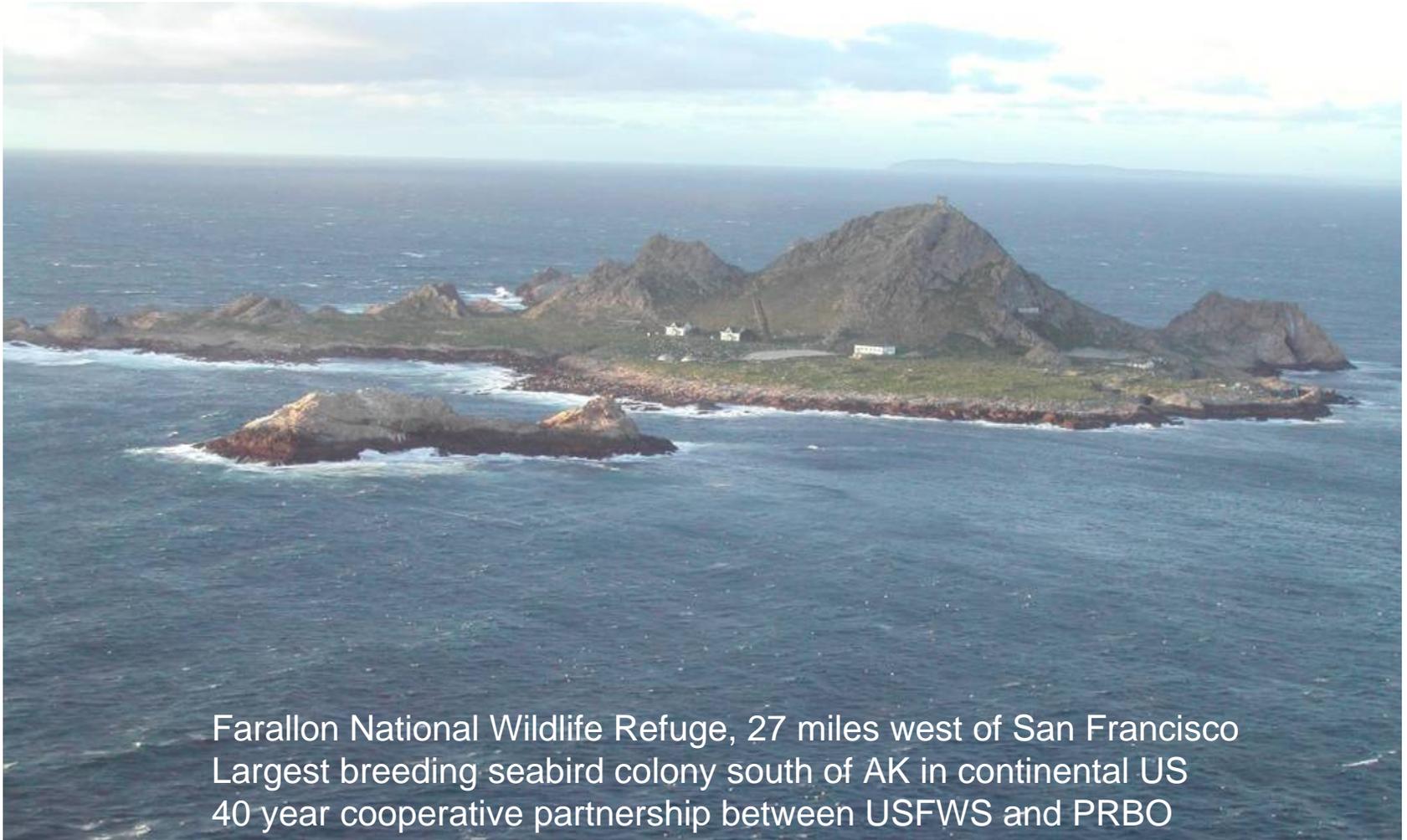
- Evaluate upland options, maintain/remove levees, ecosystem function & services, public values, etc.
- Prioritize and implement adaptively



*Rising sea levels send ripples through real estate industry*

UNION-TRIBUNE, June 24, 2007

# Managing for change in the ocean...



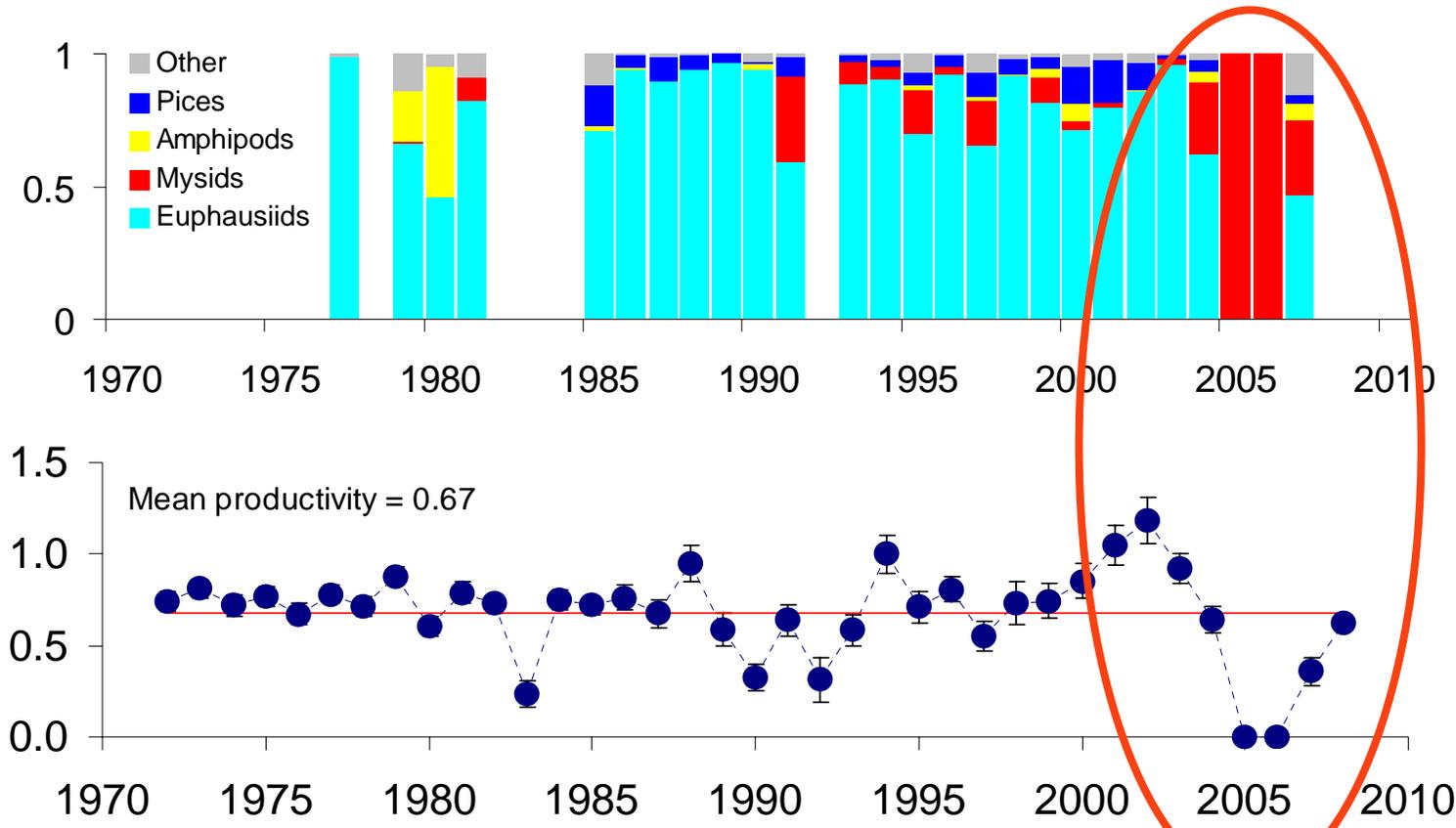
Farallon National Wildlife Refuge, 27 miles west of San Francisco  
Largest breeding seabird colony south of AK in continental US  
40 year cooperative partnership between USFWS and PRBO

# Requires long-term, ongoing data collection



**Diet- mostly krill  
Until 2005-2006**

**Number of  
chicks per pair**



# Reduce stressors-- exposure of marine wildlife to disturbance and expected extremes when possible

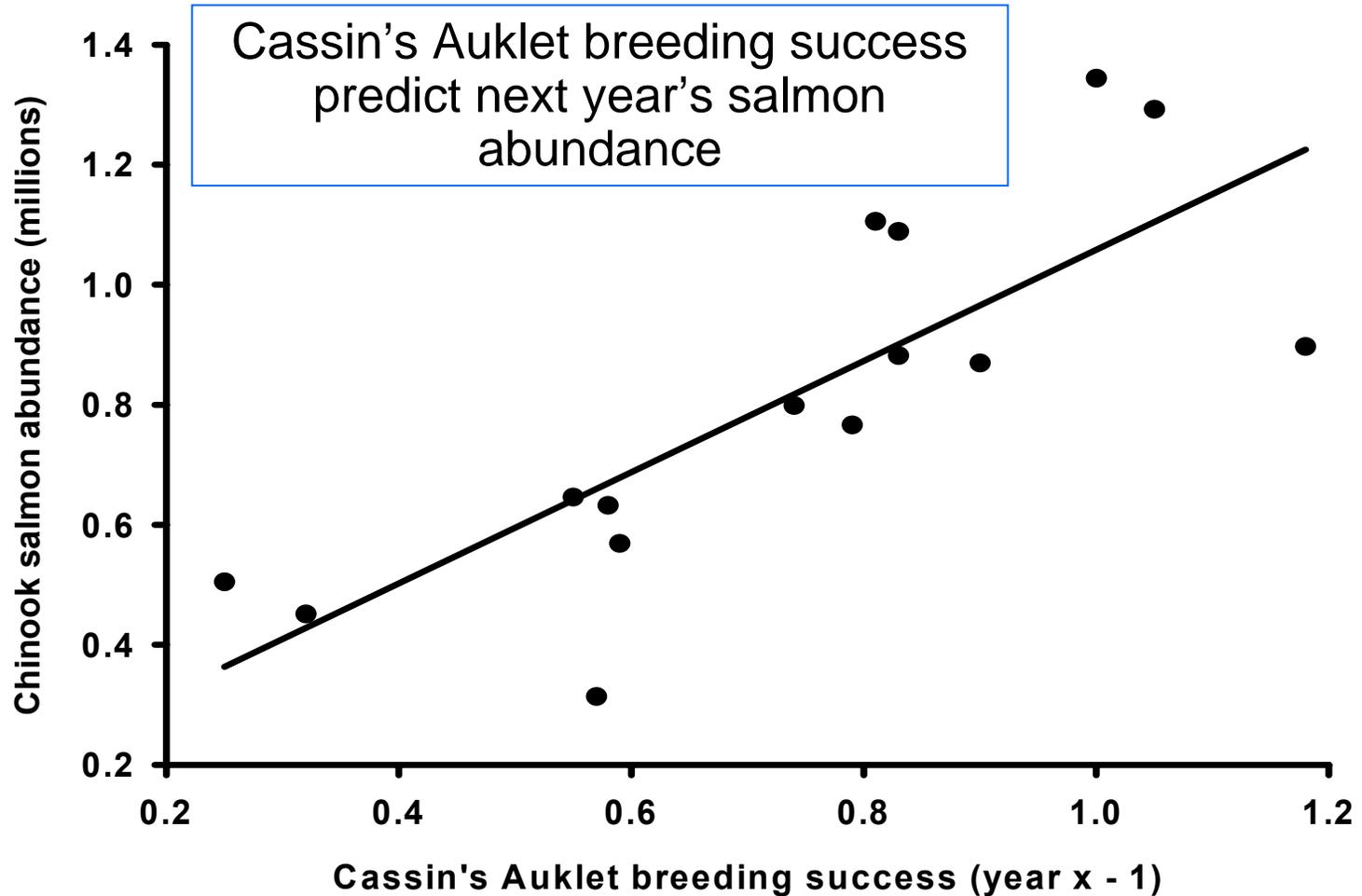
Brandt's Cormorants 2008



- **BRCO** → rockfish & anchovies → krill– lag effect- asynchronous breeding?
- **Extreme Heat- May 15-16, 2008- nest abandonment, mortality**

# Provide early warning of change

e.g., *Seabird- Fish Models*

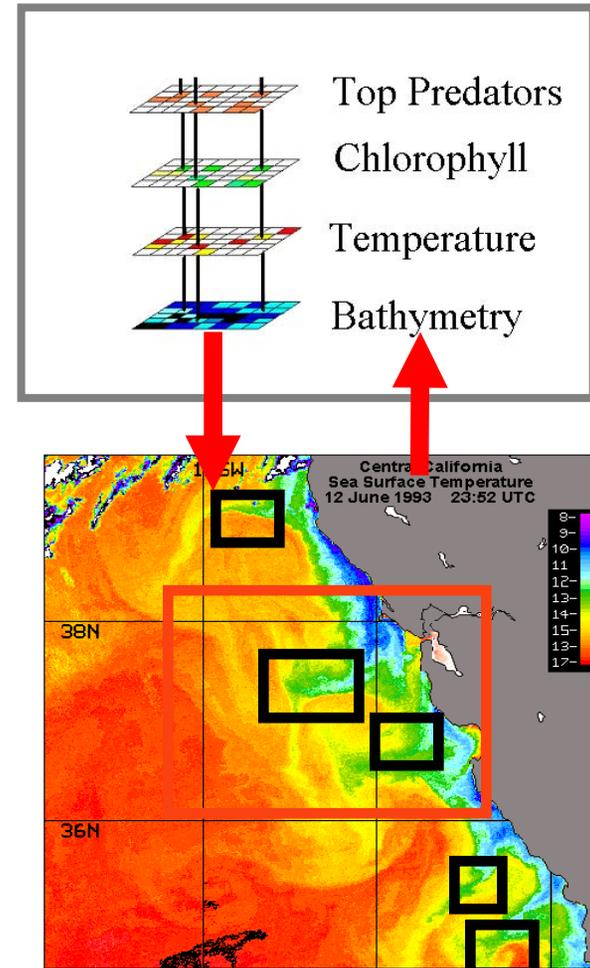


# Protect marine foodweb 'hot spots' – soften transitions

## California Current Large Marine Ecosystem

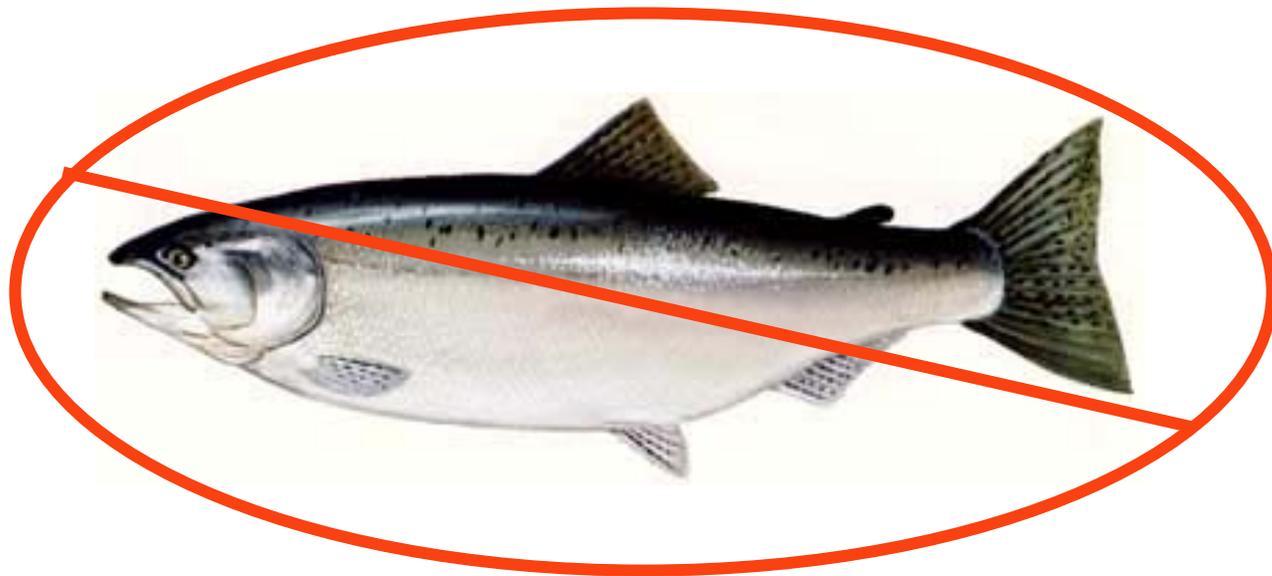
- ID relationships between top marine predators and habitat characteristics.
- Extrapolate relationships to unsurveyed areas.
- Map predicted 'hotspots' for potential marine reserves.

Nadav Nur, Jaime Jahncke, [www.prbo.org](http://www.prbo.org)



# Future of salmon? -- also dependent on krill

Does recent  
climate variability  
indicate threshold  
or natural  
variability?



**“Salmon season called off in bid to save chinook”**

April 11, 2008

San Francisco Chronicle

# May have to make the best of it....

- Jellyfish Sushi?



*echizen kurage*

<http://www.timesonline.co.uk/tol/news/world/asia/article749446.ece>

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



**Home** | **Research Tools** | **Habitat Management** | **Citizen Science**

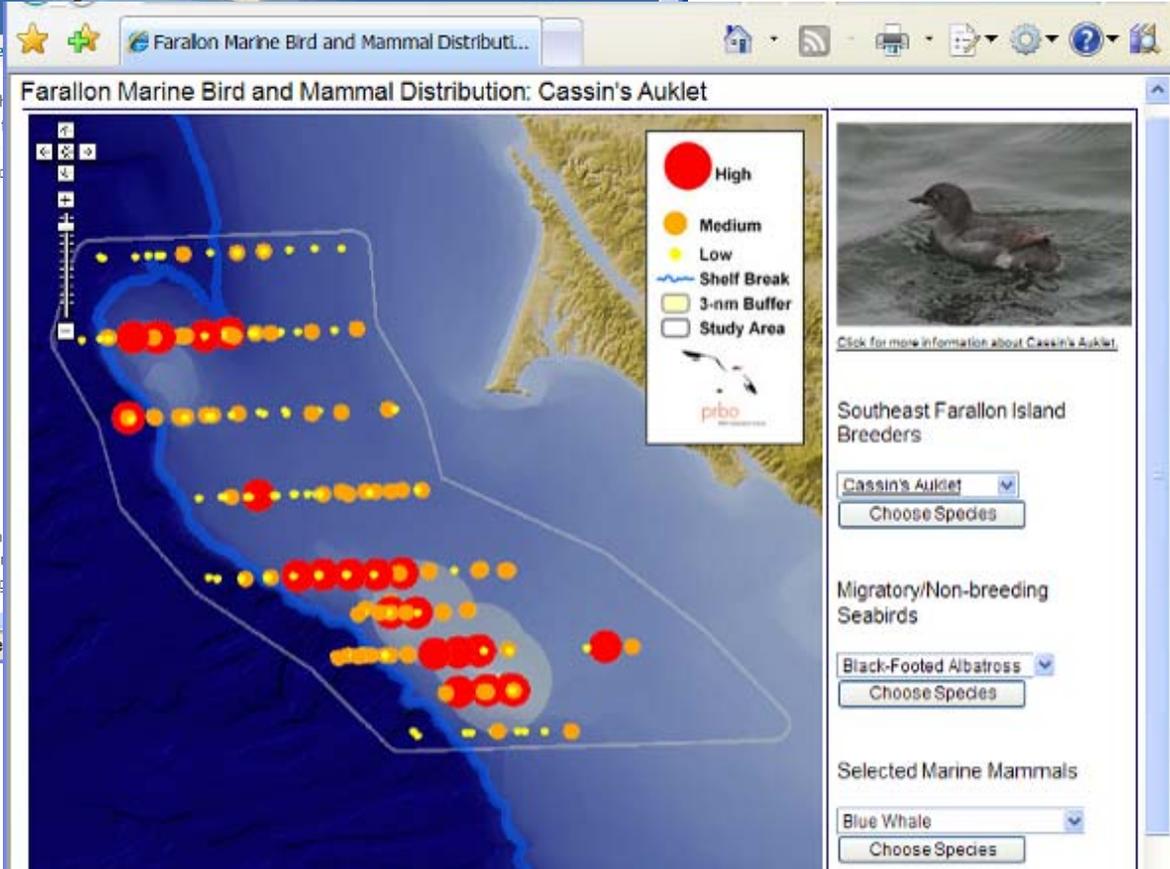
The California Avian Data Center (CADC), a regional node to the Avian Knowledge Network, serves as a repository of data, analysis tools and information to help researchers understand their habitats throughout California. CADC contains resources for researchers, managers involved in habitat management, and interested public in California. [more>>](#)

**Habitat Management**

For people involved in habitat restoration, protection, and conservation.

**Research Tools**

For scientists and researchers who are conducting avian research and performing original investigations.



# Talk Outline

1. Update on latest climate change findings
2. Adaptive management strategies to address rapid change
3. Riparian, tidal wetland and marine examples
4. **Thoughts for our future**

# What will be the key drivers of conservation in the future?

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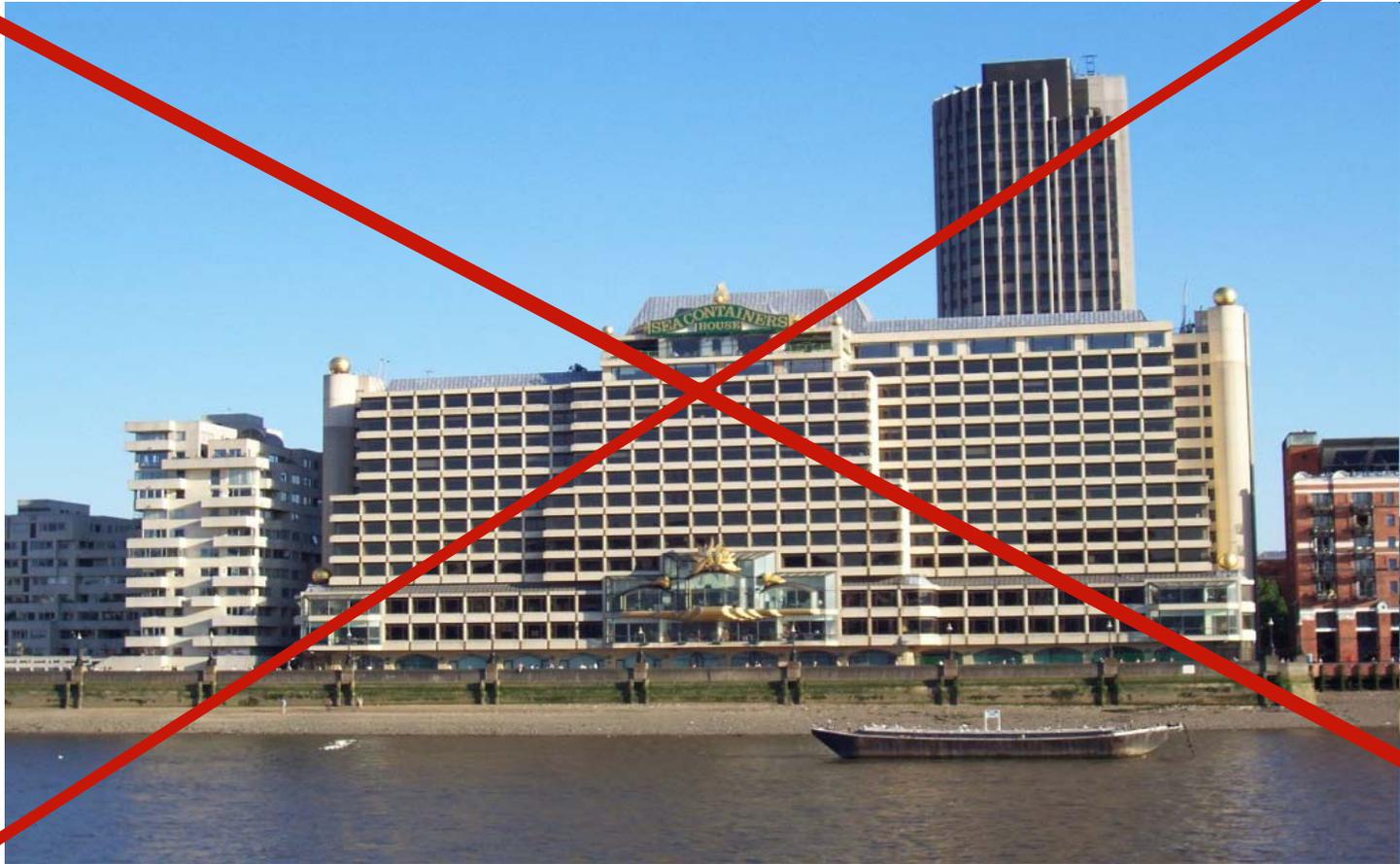
- **WATER...**
- **CARBON-** e.g., balance carbon reduction schemes with ecological function
- **Energy-** mitigation?
- **Ocean acidification?**
- **Other?**



# Large scale solar, wind, wave energy– must assess ecological impact, guide for net benefits



# Prohibit building at sea level, flood plains -- enhance ecosystem response to rapid change, reduce future costs to society



**Require Run On-- not Run Off**  
**permeable surface parking, streets--**  
filter out non-point source pollutants, replenish  
groundwater, buffer drought, reduce flood damage....

Brock Dolman. Occidental Arts & Ecology Center [www.oaec.org](http://www.oaec.org)



# No Time to Lose

**“The longer action is delayed, the more  
it will cost.”**

*IPCC 4<sup>th</sup> Assessment Final report, November, 2007*

-----  
**Stop greenhouse gas pollution  
*and*  
make adaptive ecosystem conservation  
an equal priority now!**

# A new era... full of opportunity

Mike Keefe, The Denver Post, 1-18-09



# In Summary:

- 1. Climate change is rapidly accelerating**
- 2. Requires a new conservation paradigm at all levels**
- 3. Prioritize ecosystem function and services**
- 4. Plan for extremes, anticipate abrupt changes, accept there will be losses**
- 5. Actively apply adaptive management, ongoing monitoring to best address rapid ecological change**
- 6. Broaden non-traditional partnerships**
- 7. Think out-of-the refuge!**

THANK YOU!



# Additional background material

Available at:

<http://www.fws.gov/pacific/Climatechange/meetings/presenter.cfm?id=1>

- US Climate Change Science Program [www.climate-science.gov](http://www.climate-science.gov) – for recent reports on adaptation, abrupt change and ecological thresholds.
- Unquiet Ice Speaks Volumes on Global Warming. Robin Bell. Scientific American, Feb. 2008 <http://www.sciam.com/article.cfm?id=the-unquiet-ice>
- Climate Change and Wetland Restoration, SF Bay Joint Venture, Nov. 2008 [www.sfbayjv.org](http://www.sfbayjv.org)
- Before the Deluge: Coping with Floods in a Changing Climate [www.internationalrivers.org](http://www.internationalrivers.org)
- Free daily science publications and news summary [www.sciencedaily.com/](http://www.sciencedaily.com/)
- Climate science by real climate scientists [www.realclimate.org](http://www.realclimate.org)
- Association of State Wetlands Managers – climate change [http://www.aswm.org/science/climate\\_change/climate\\_change.htm#1](http://www.aswm.org/science/climate_change/climate_change.htm#1)
- Sierra Nevada Climate Change Tool Kit [www.sierranevadaalliance.org/publications/publication.shtml?type=pgm02](http://www.sierranevadaalliance.org/publications/publication.shtml?type=pgm02)

# Many thanks to:



## PRBO staff, Board, members, and:

- American Bird Conservancy
- S.D. Bechtel, Jr. 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 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 Fisheries, Marine Sanctuaries
- Natural Resource Conservation Service
- Resources Law Group/Resources Legacy Fund Foundation
- Riparian Habitat Joint Venture
- San Francisco Bay Joint Venture
- The Climate Project
- The Nature Conservancy
- U.S. Fish and Wildlife Service
- US Geological Survey
- USDA Forest Service





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