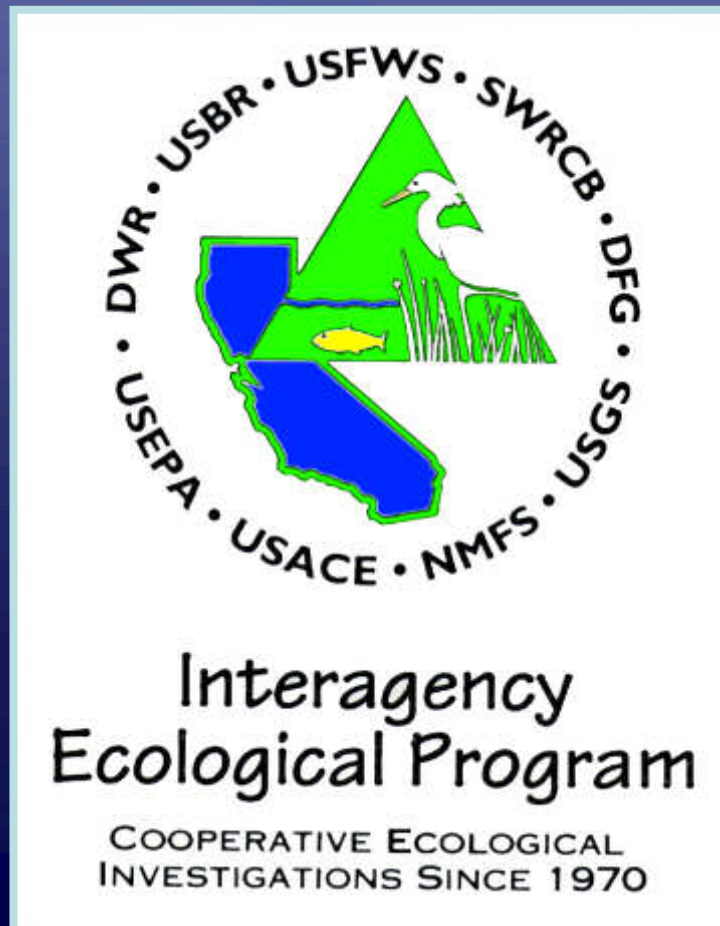


Interagency Science and Management In the California Delta: Nutrients and So Much More



Anke Mueller-Solger,
IEP Lead Scientist,
Delta Stewardship Council



DELTA STEWARDSHIP COUNCIL

SF Bay Nutrients Workshop,
June 29, 2011

Interagency Science and Management In the California Delta: Nutrients and So Much More

To understand nutrients in the Delta,
we need to first consider

Water in California

and the

History of the Delta

Water in California

- Uneven Distribution

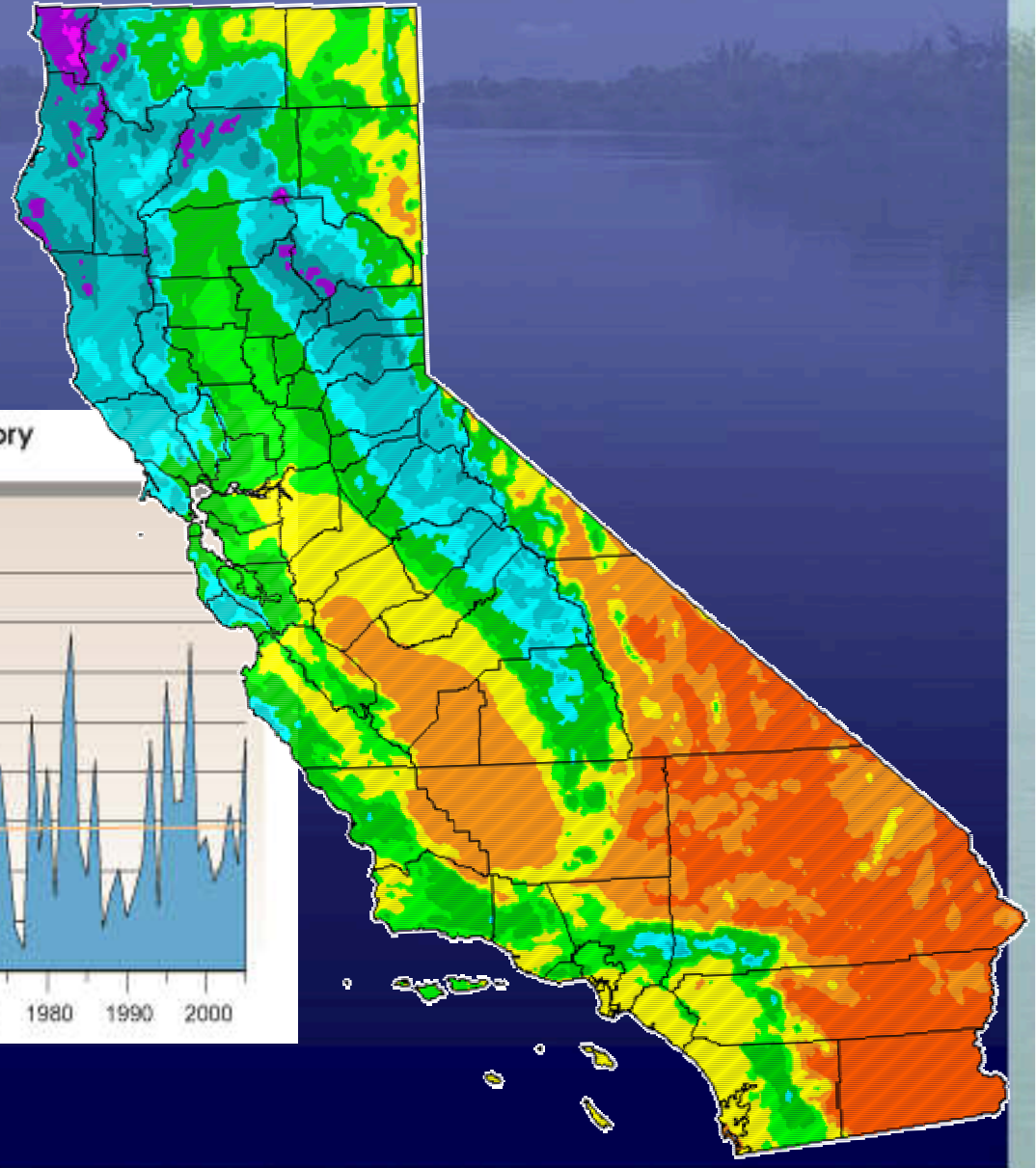
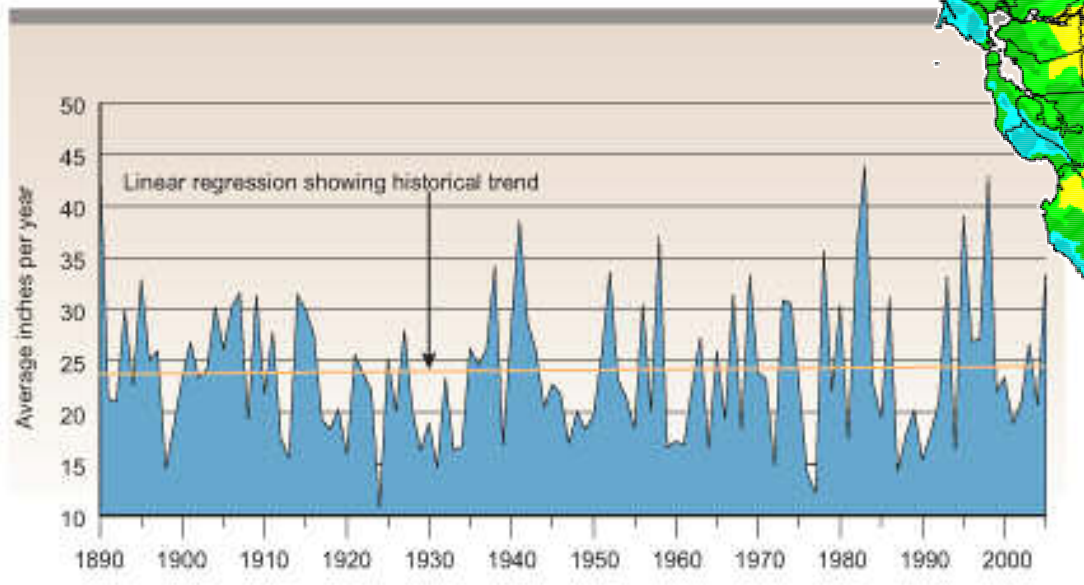
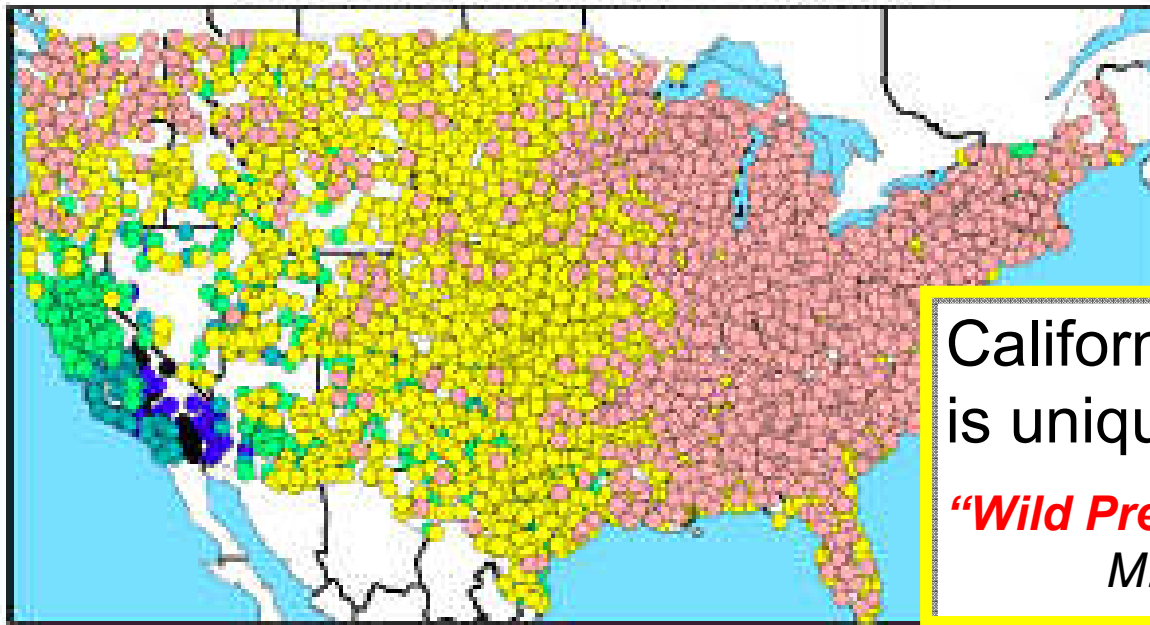


Figure 5. California Precipitation History



Water in California

a) COEFFICIENTS OF VARIATION OF
TOTAL PRECIPITATION, WY 1951-2008



Atmospheric Rivers, Floods and the Water Resources of California

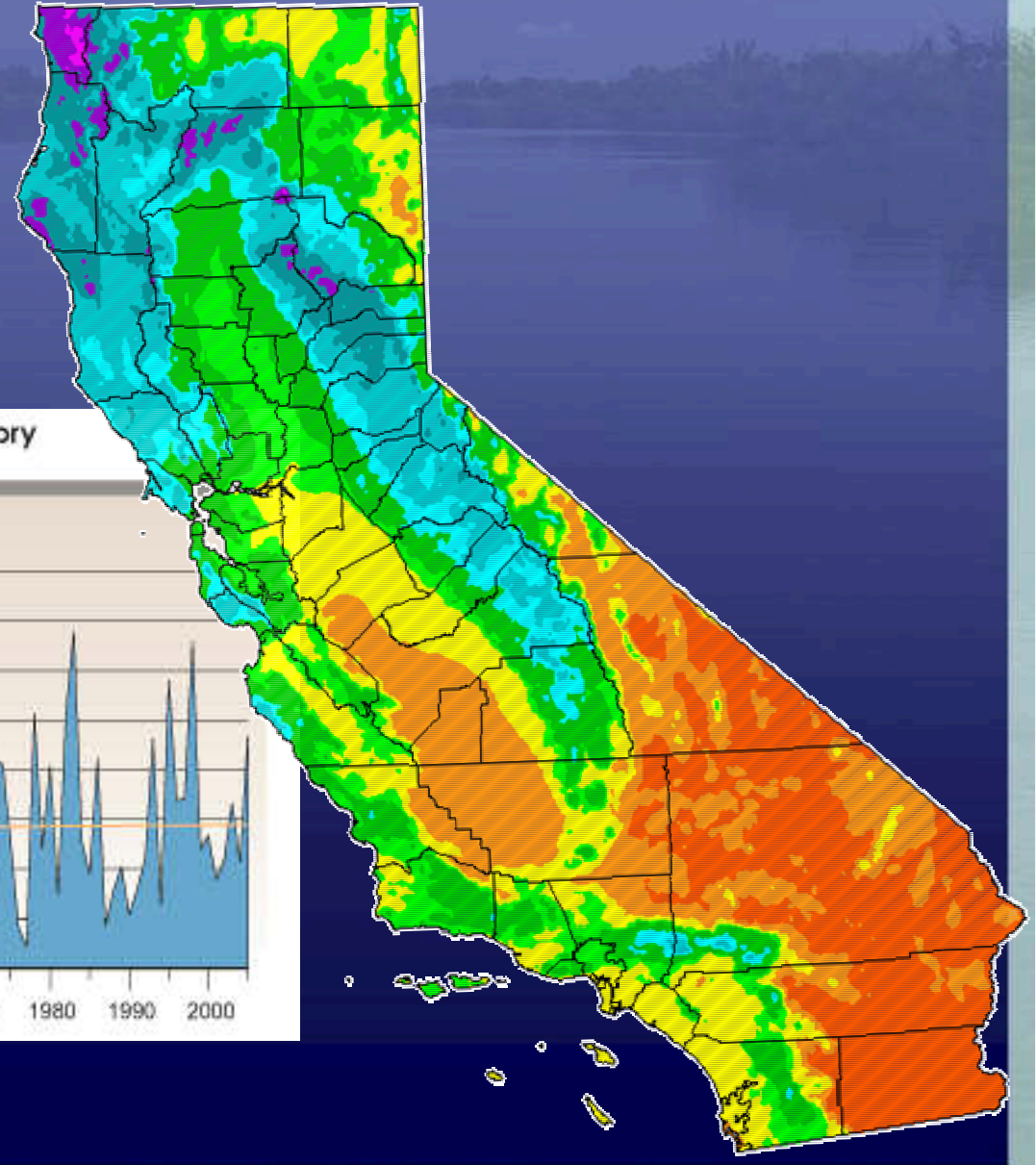
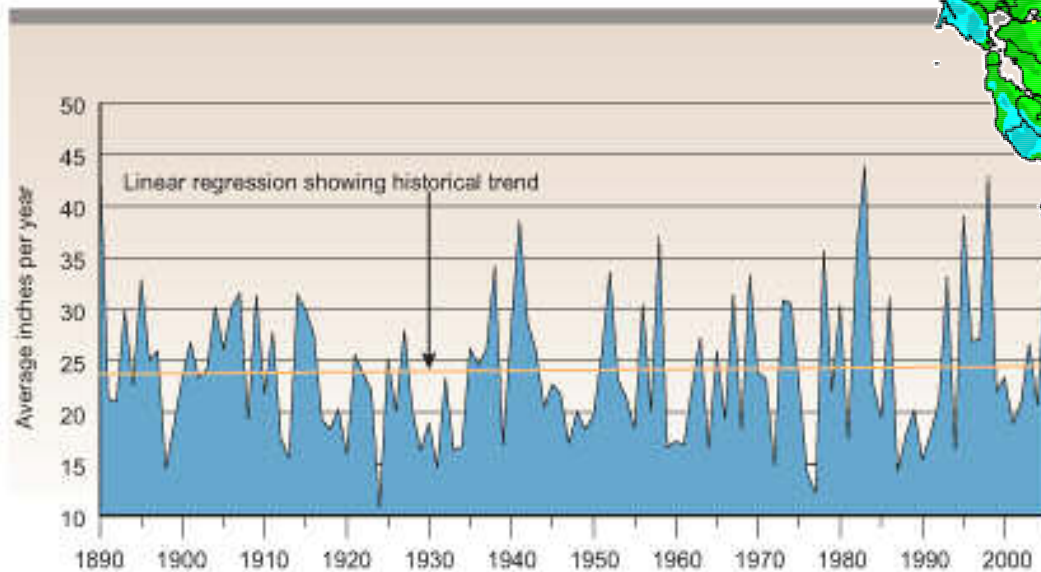
Michael D. Dettinger^{1*}, Fred Martin Ralph², Tapash Das³, Paul J. Neiman² and
Daniel R. Cayan¹

Water 2011, 3, 445-478; doi:10.3390/w3020445

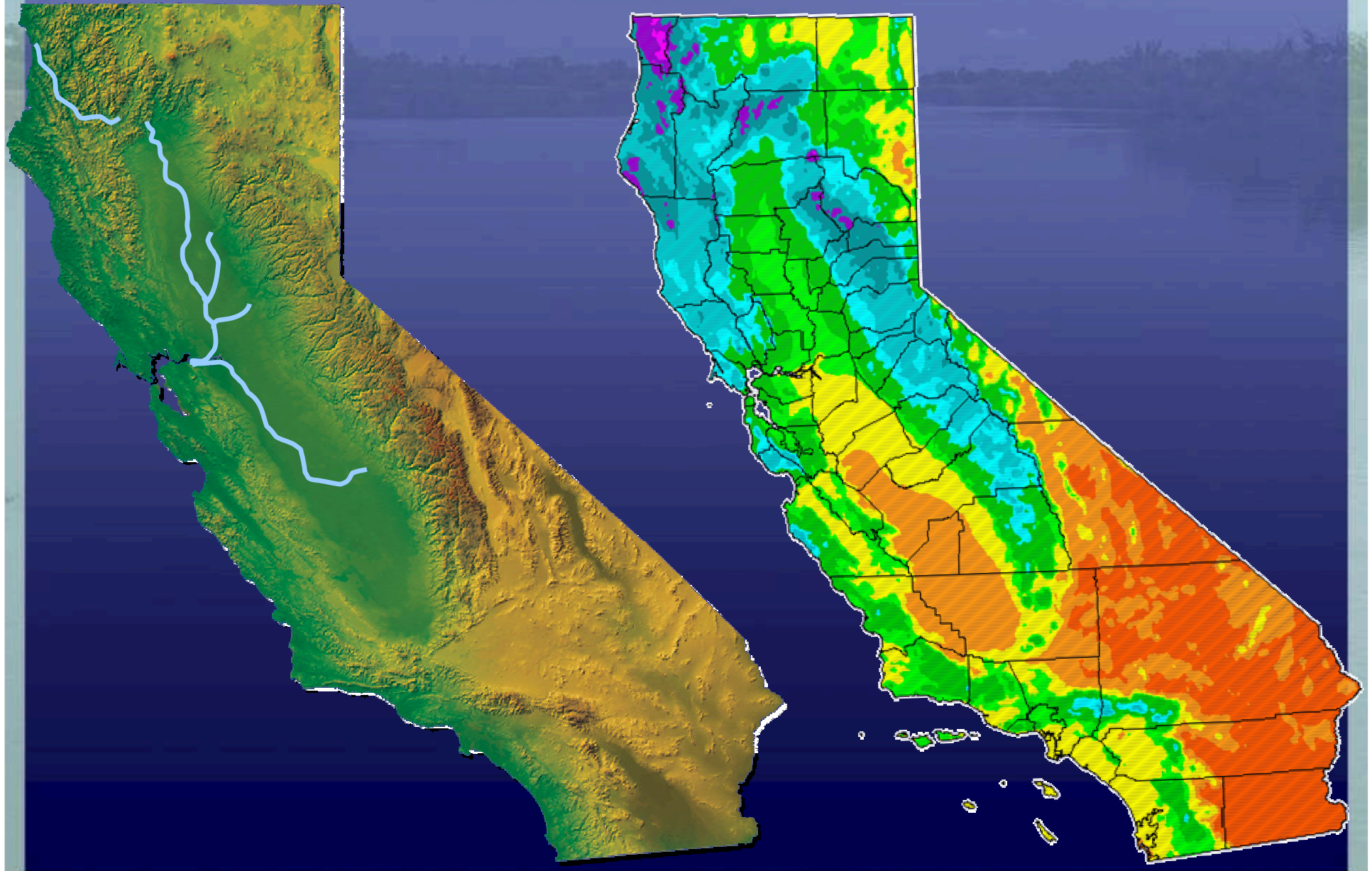
Water in California

- Uneven Distribution
- Increasing Demand
- Supply **BIG** issue
- Quality also important

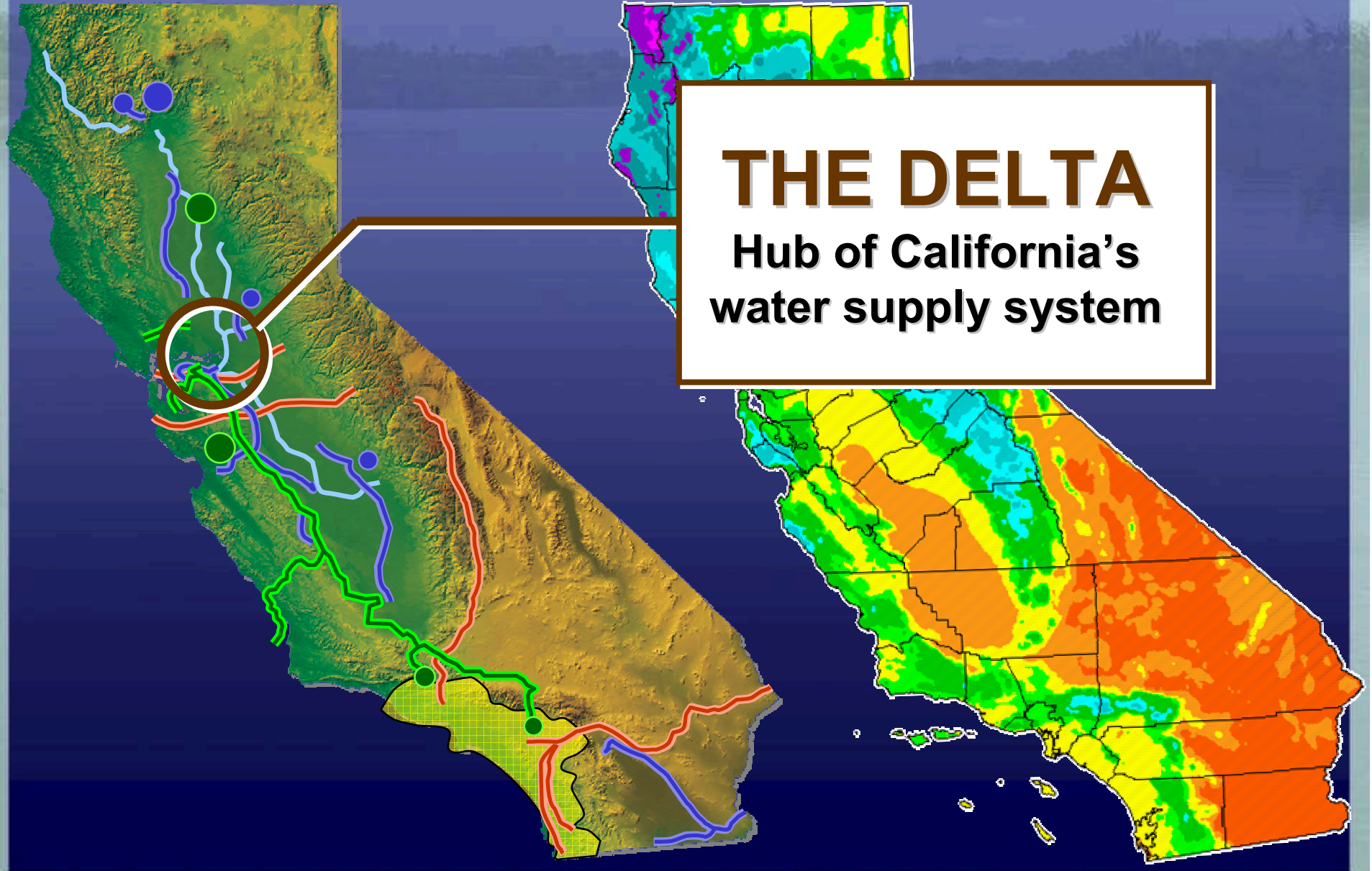
Figure 5. California Precipitation History



Water in California



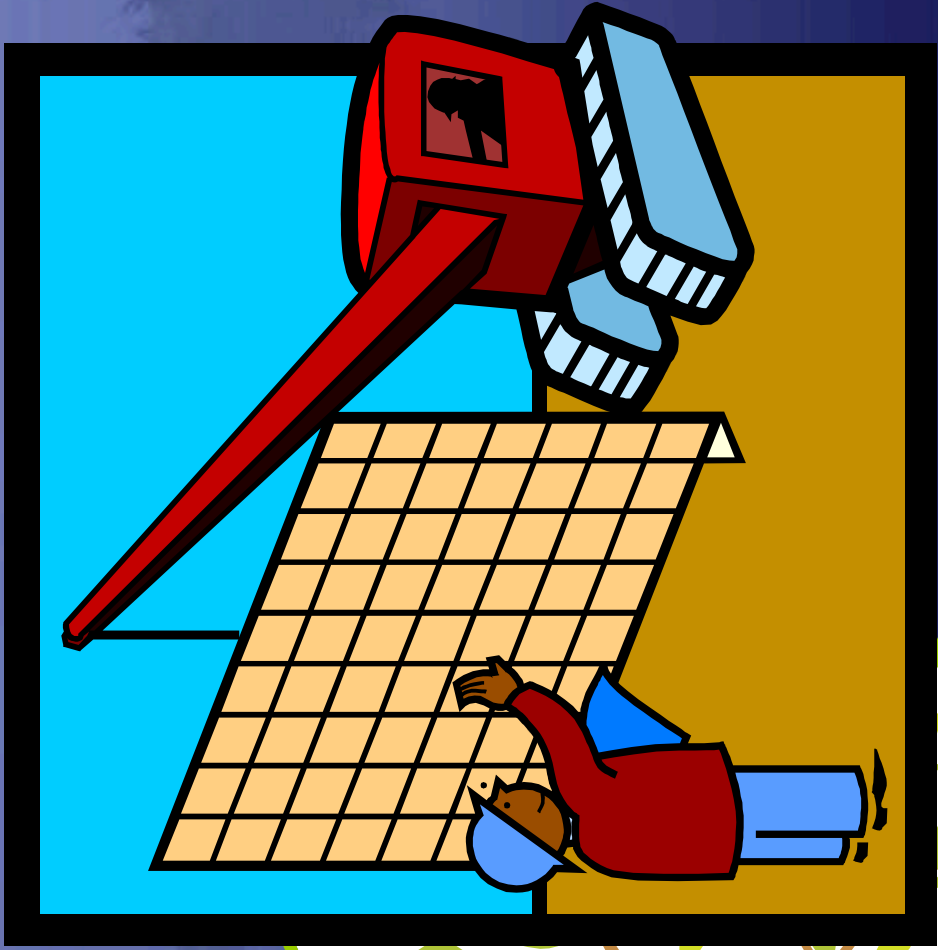
Water in California



The Delta, 1873

- Huge wetlands, dendritic channels
- Two large & many small tributaries
- Dynamic hydrograph

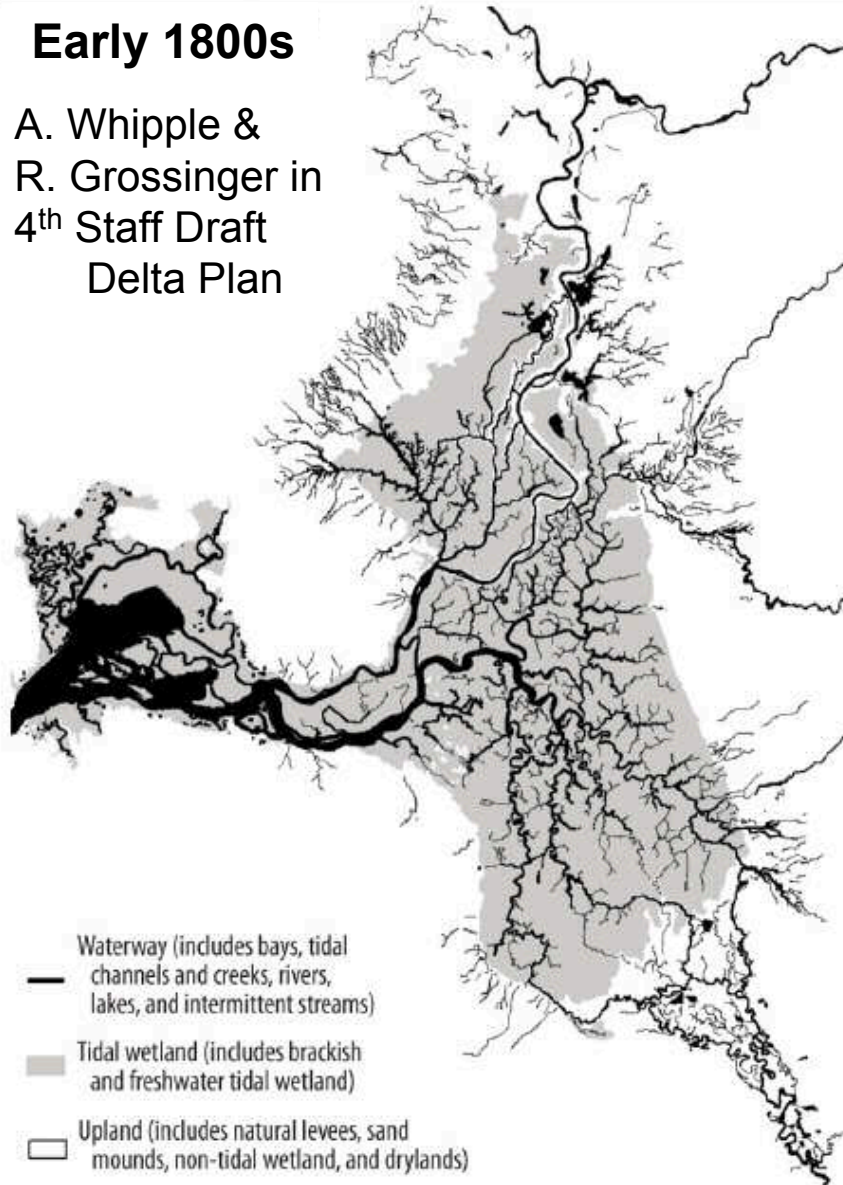




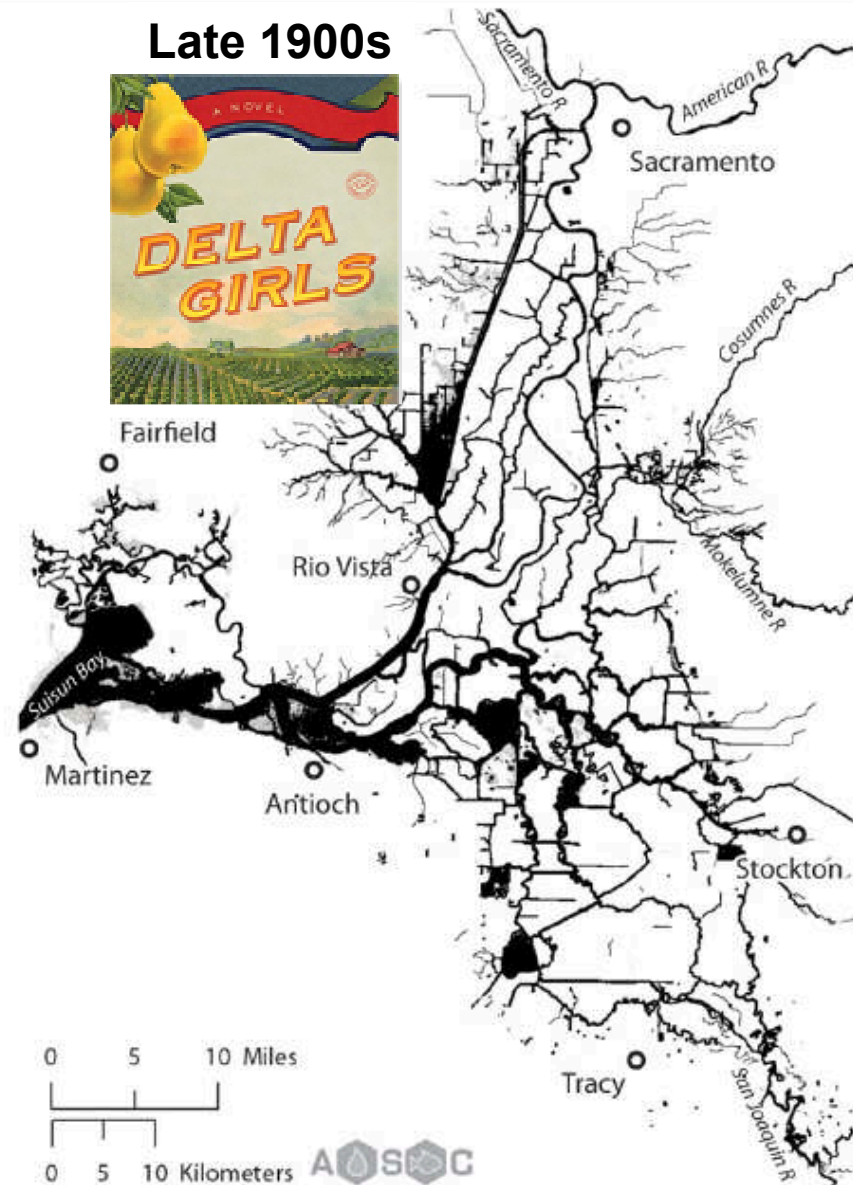
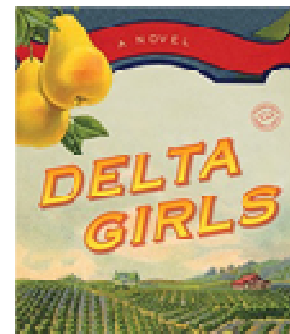
Wetland Loss (Reclamation)

Early 1800s

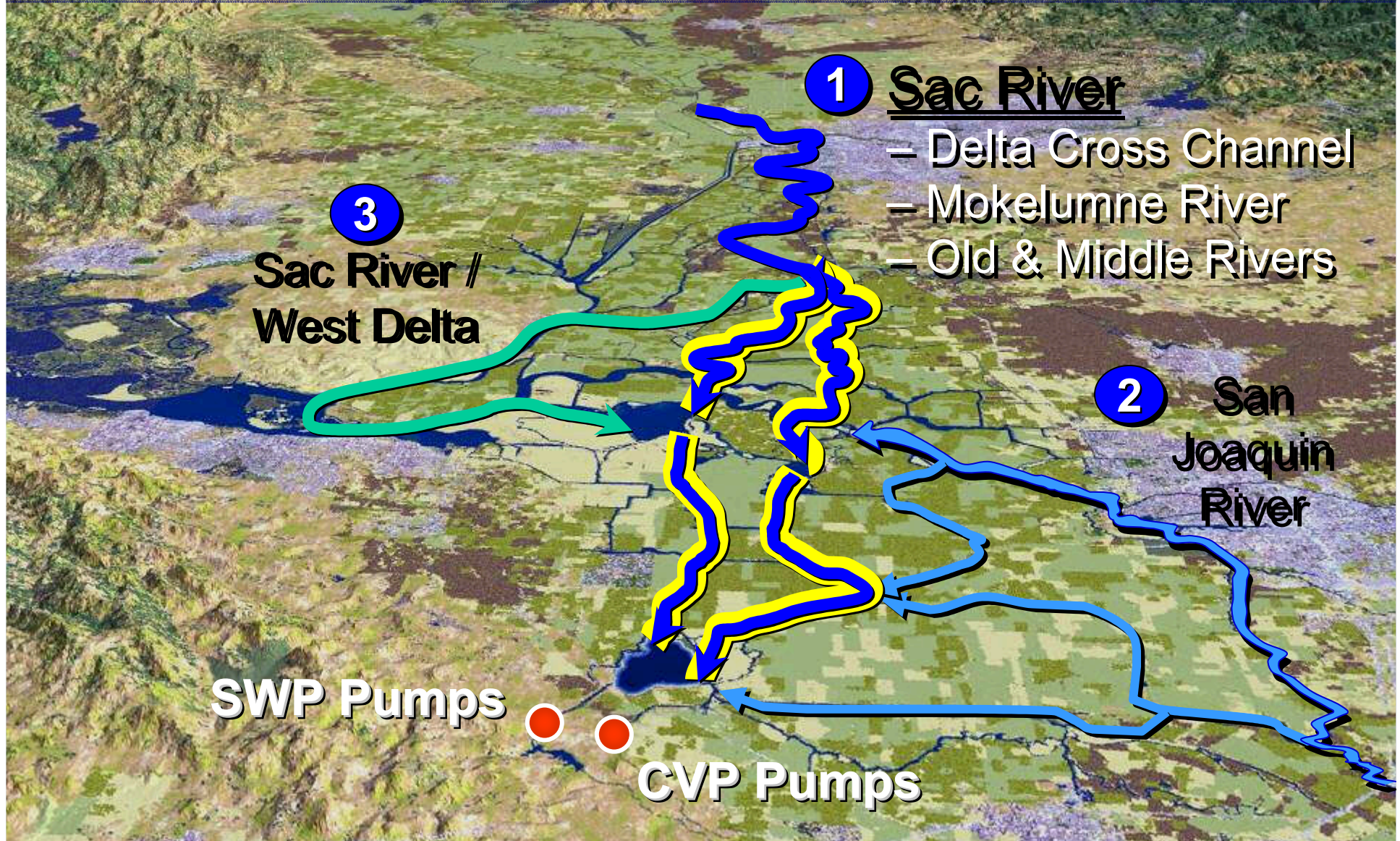
A. Whipple &
R. Grossinger in
4th Staff Draft
Delta Plan



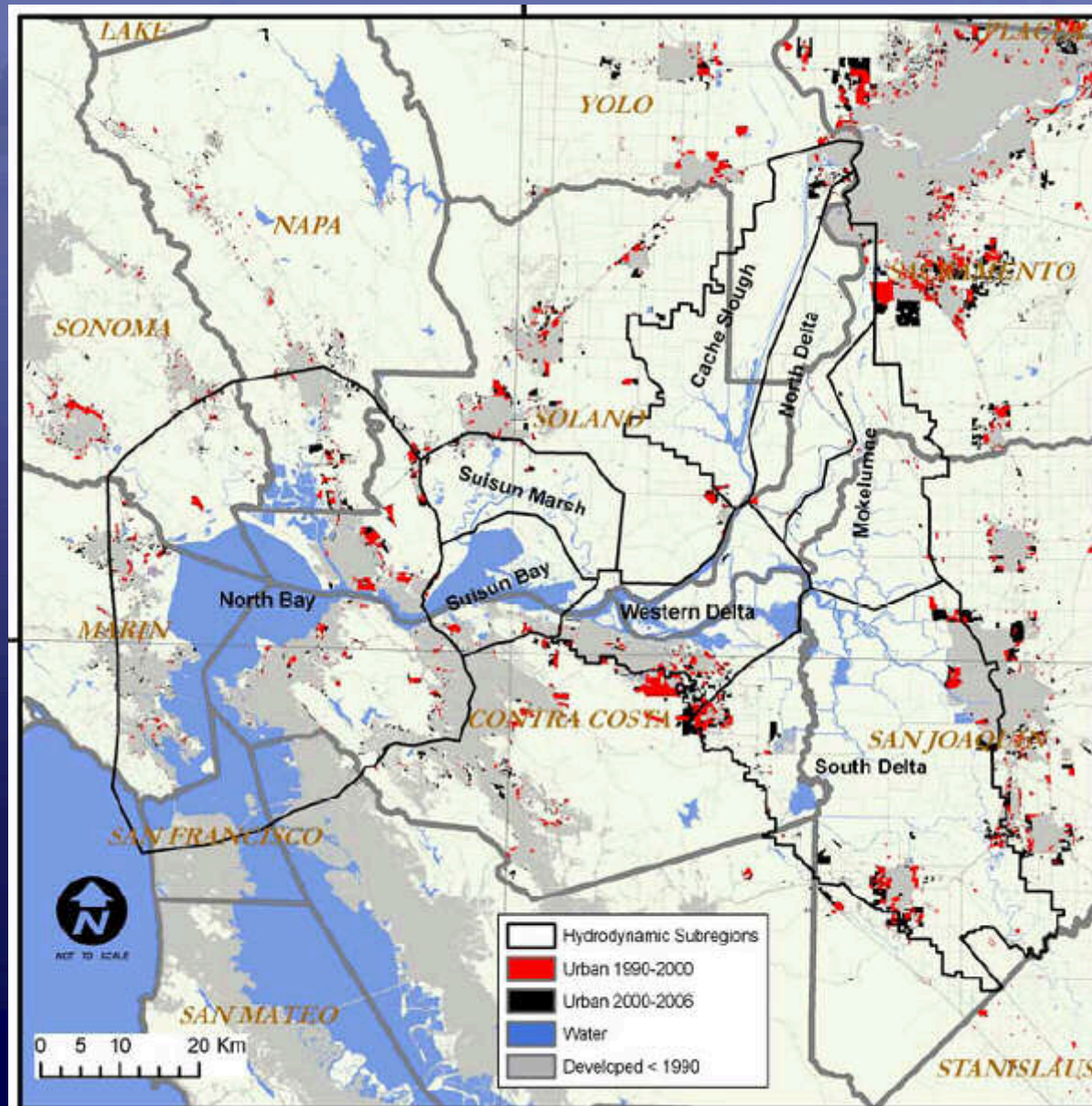
Late 1900s



Water Rerouting (Conveyance)



Urbanization (Margins)

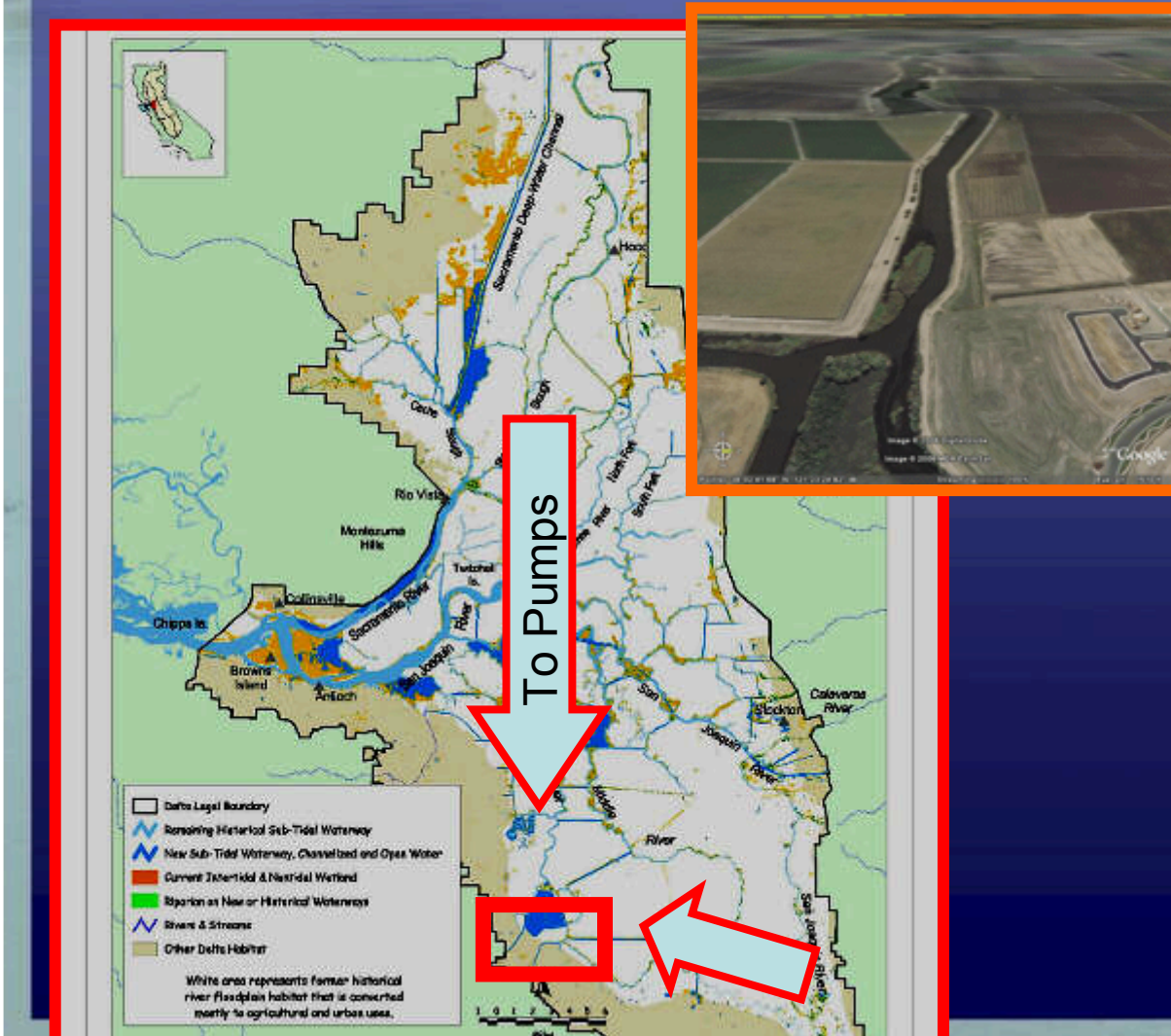


Stoms,
SFEWS 2010

The Delta, 2000s

- Grid of channels with subsiding farmed “islands”
- Urbanized margins
- Hub of California’s water infrastructure

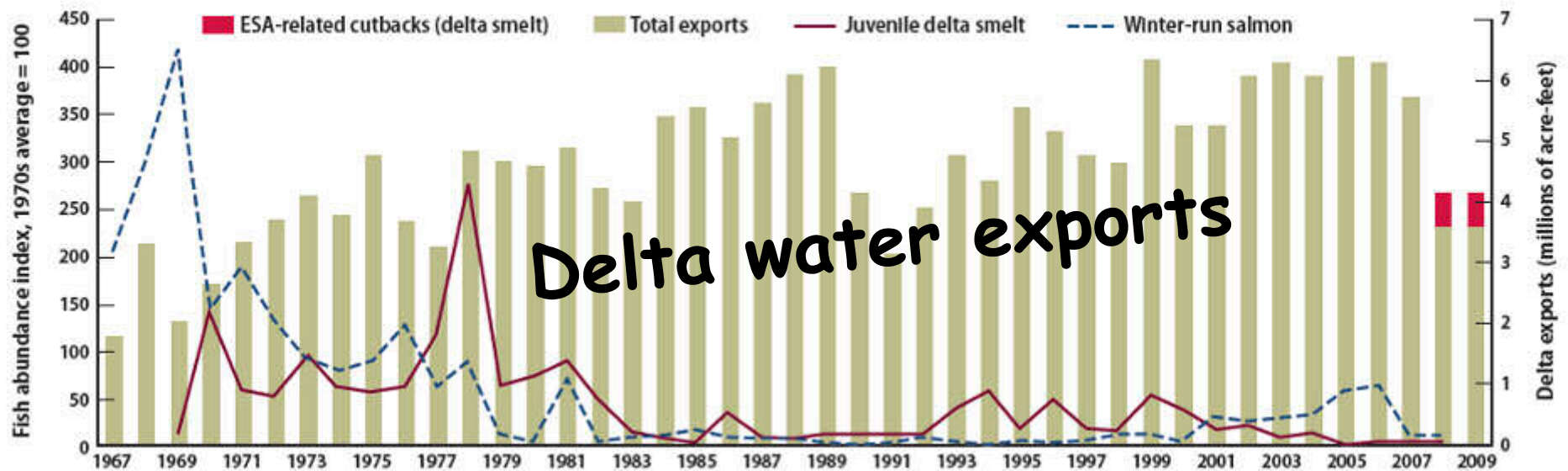
In Distress!



Water supply ^{un-}reliability

Hanak et al, PPIC 2009

Figure 4. Environmental restrictions account for 15–20 percent of recent Delta cutbacks

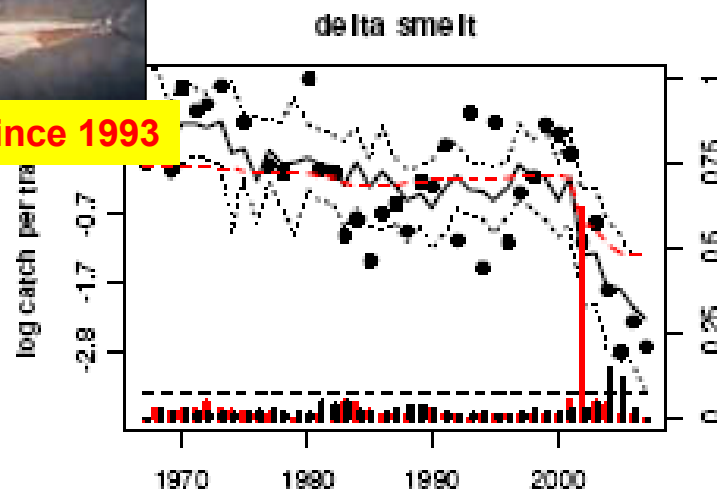


Long-term IEP Monitoring Shows Fish Declines

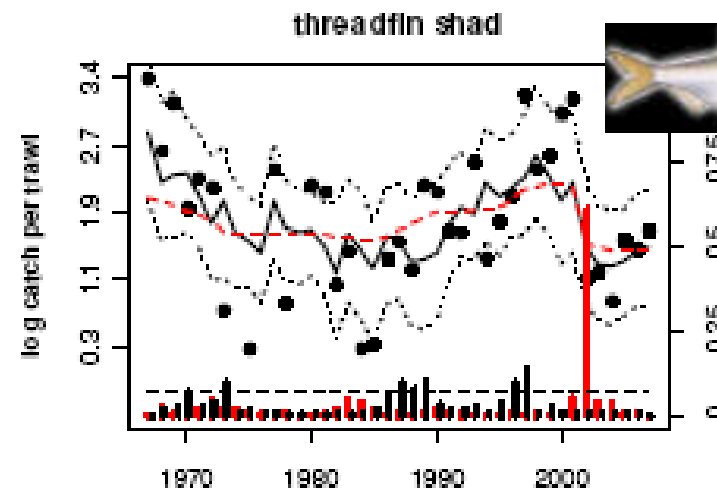
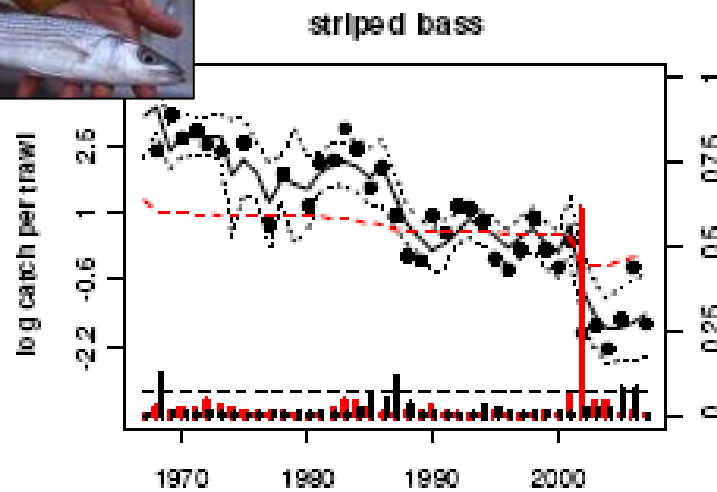
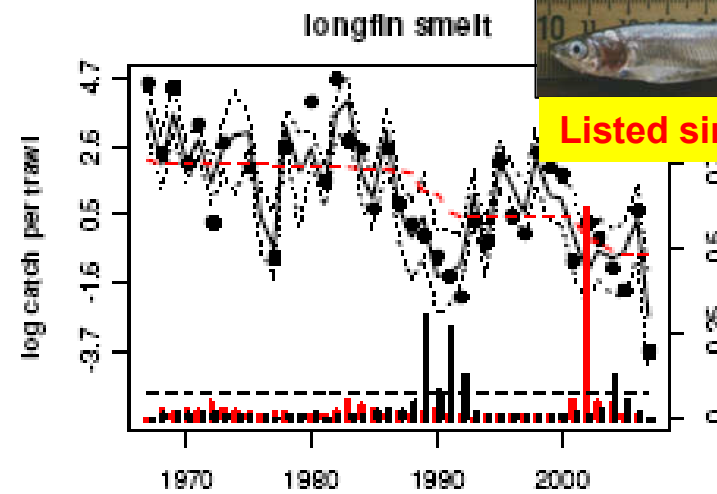
Pelagic Organism Decline (POD) Change Point in 2002



Listed since 1993



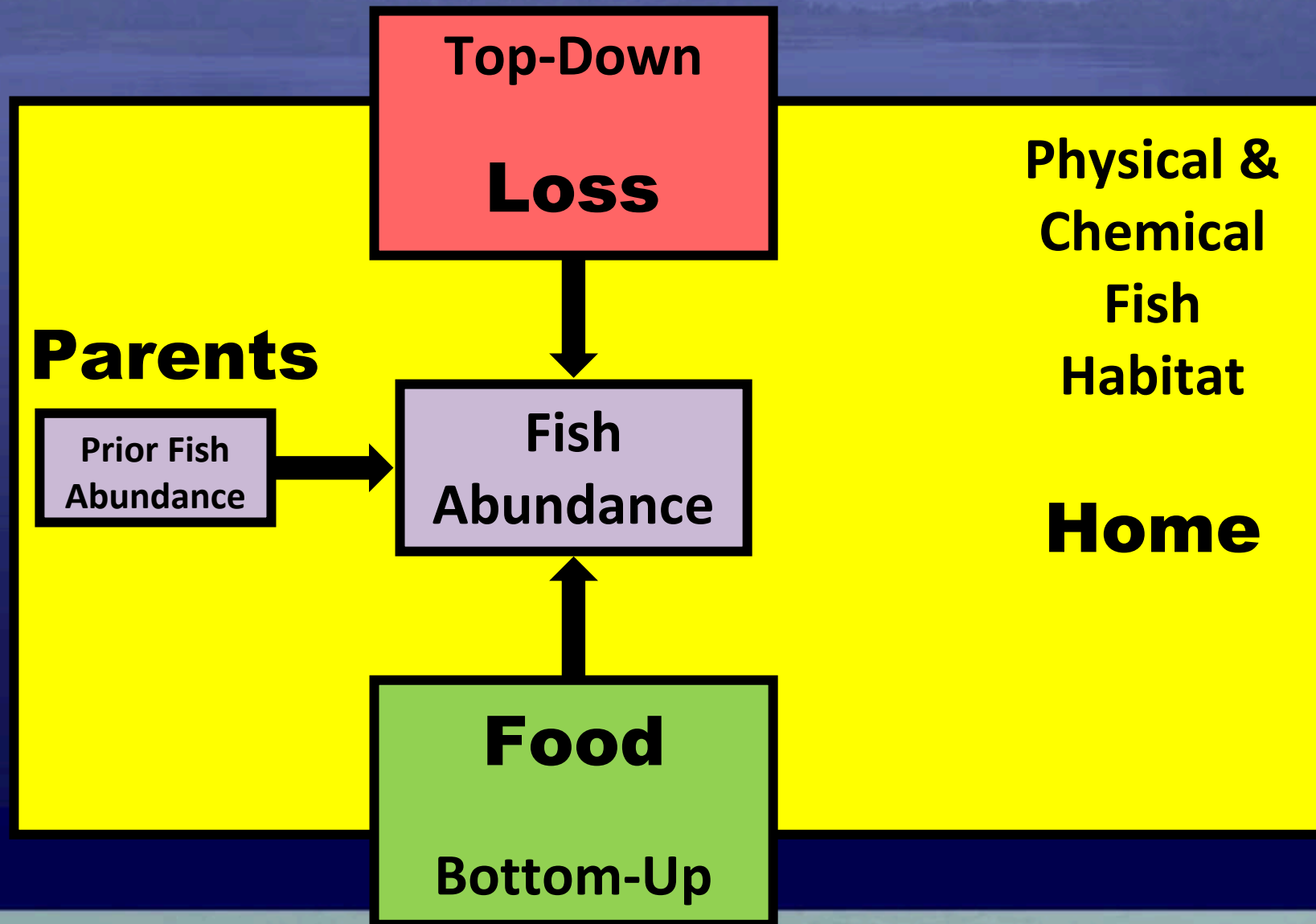
Listed since 2009



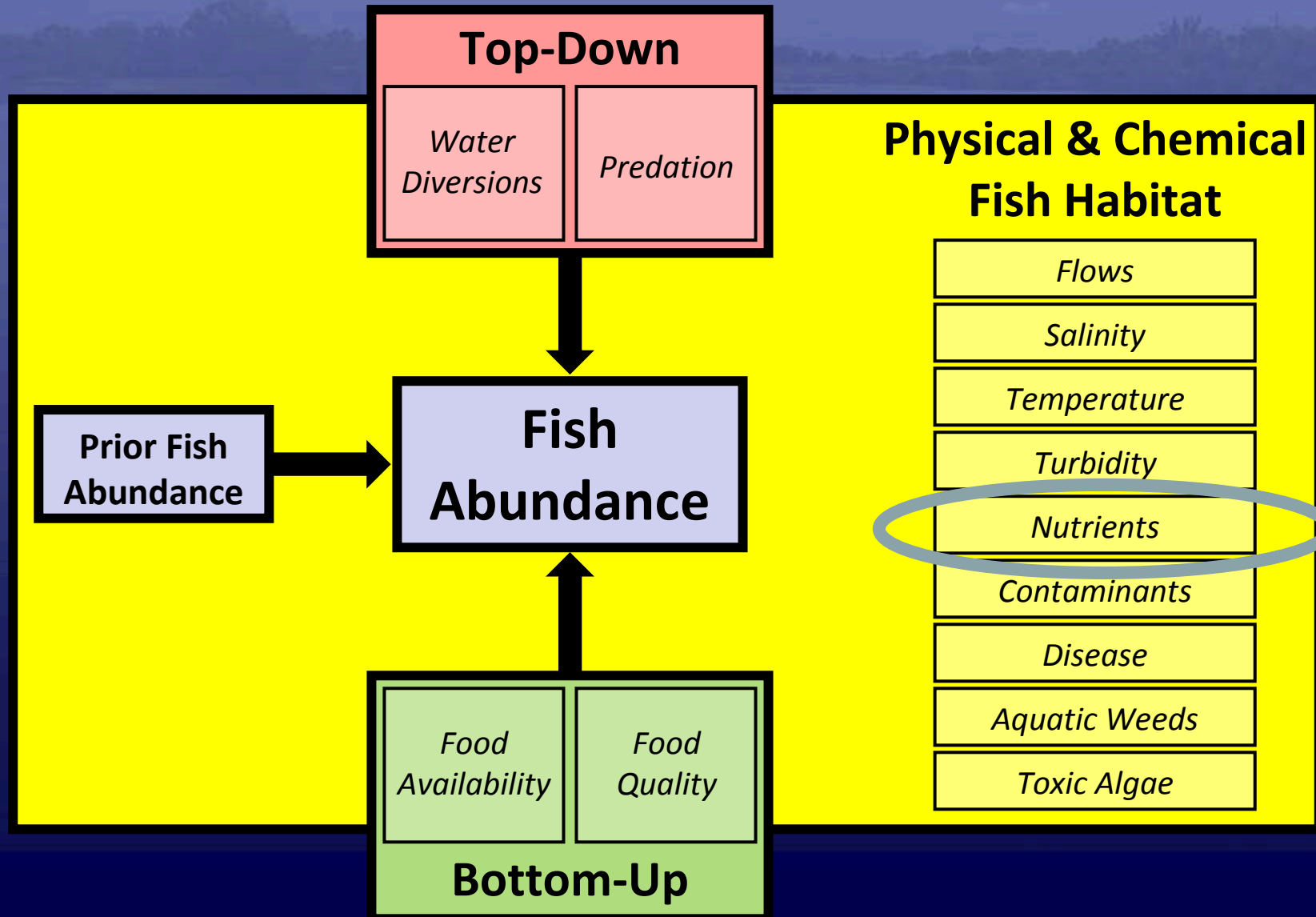
Thomson et al. 2010

Basic POD Conceptual Model (2006)

Four Groups of Drivers affecting POD Fishes, "Triage"



Multiple Drivers... in Combination!



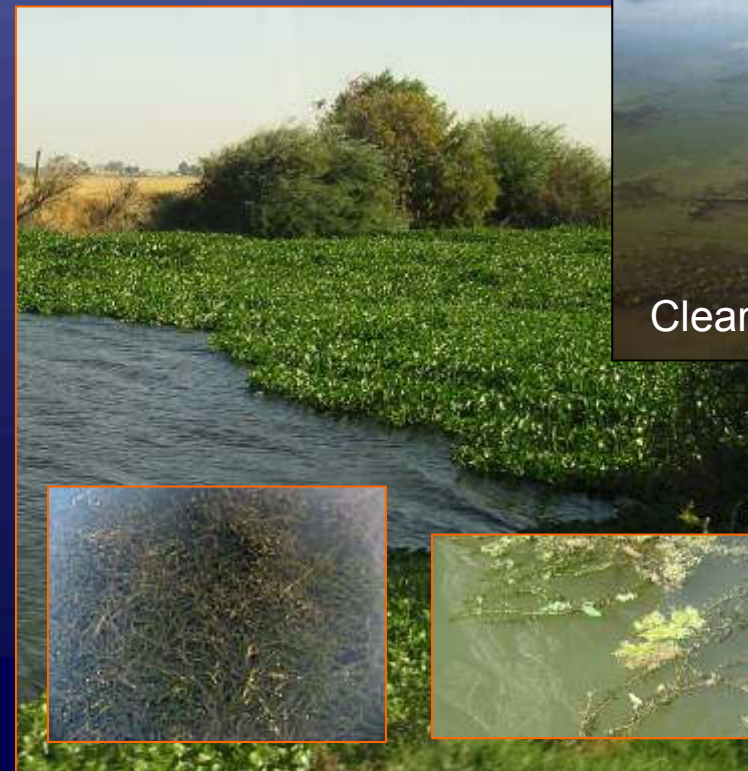
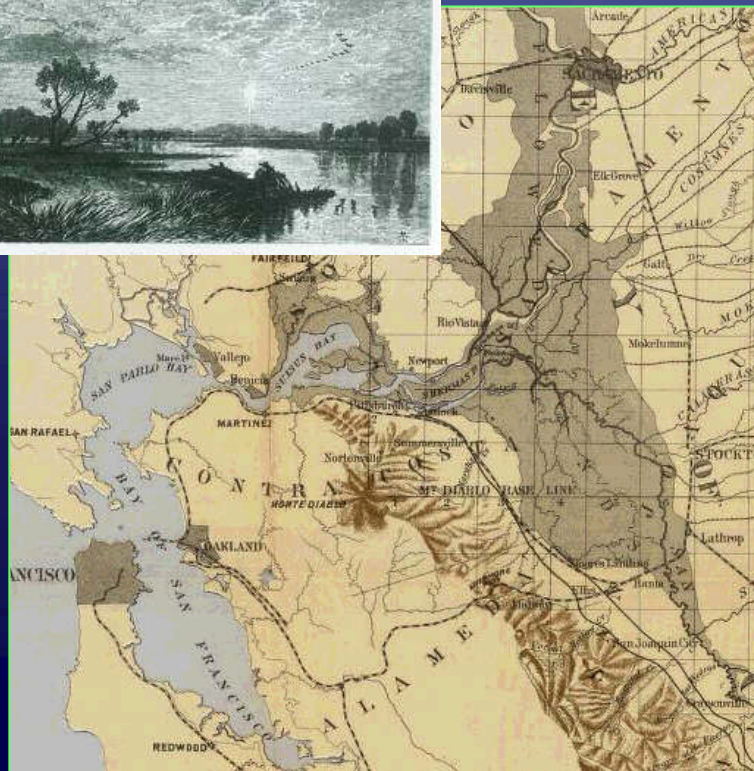
Ecological Regime Shift

“Rapid reorganization of an ecosystem from one relatively stable state to another.”

From river estuary ... to weedy “lake”



1873 → Today

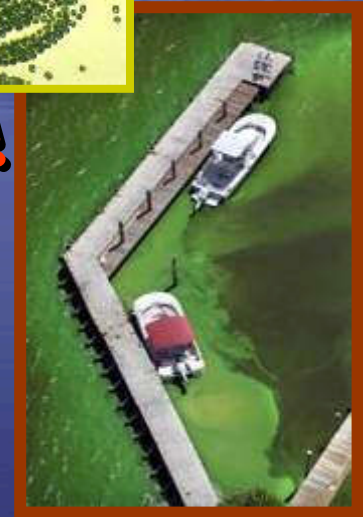


Clear Lake

On the rise / now established:
Microcystis aeruginosa blooms



Toxic!
Bad food!

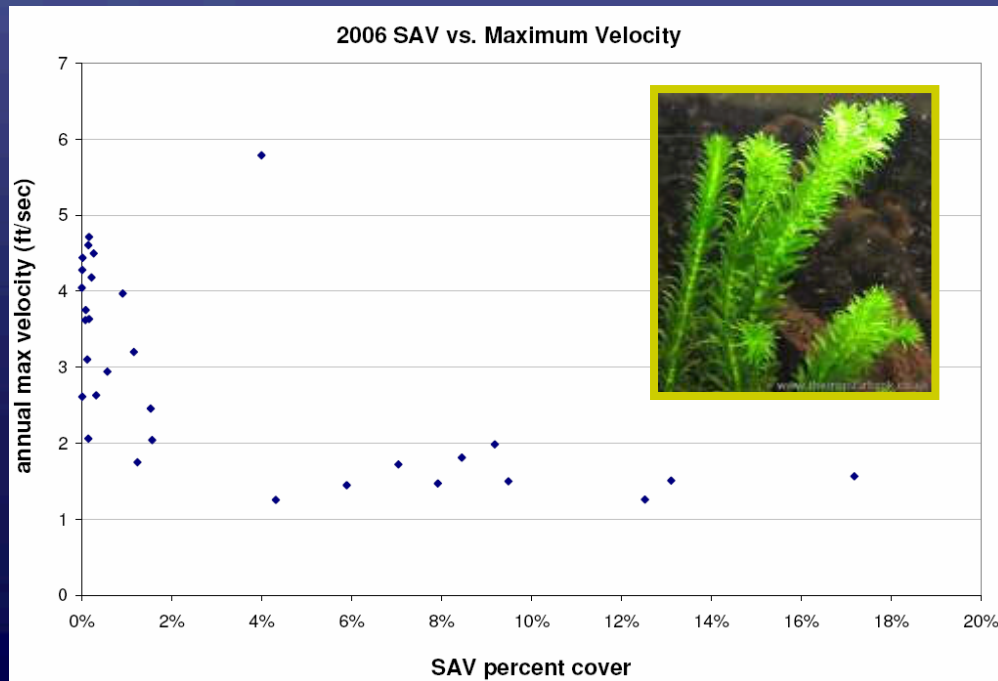


- Seasonal blooms since 1999, June-November
- Blooms peak in the central Delta in August and September ($>20^{\circ}\text{C}$)
- 2007 & 2008 worst bloom years on record

P. Lehman, Hydrobiologia, 2005 and 2008, & pers. com.

Also on the rise / established: Invasive Aquatic Plants - “Ecosystem engineers”

Water hyacinth
(*Eichhornia crassipes*)



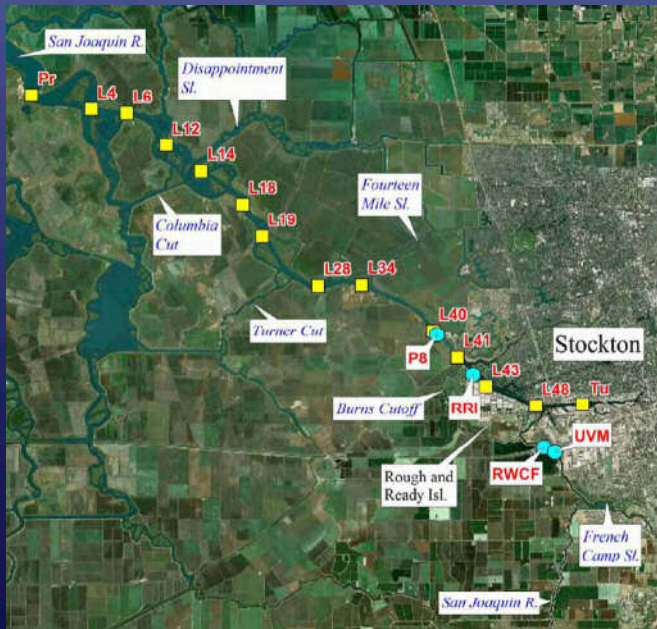
Brazilian waterweed
(*Egeria densa*)

Schoellhamer & Hestir, IEP
Asilomar 2008

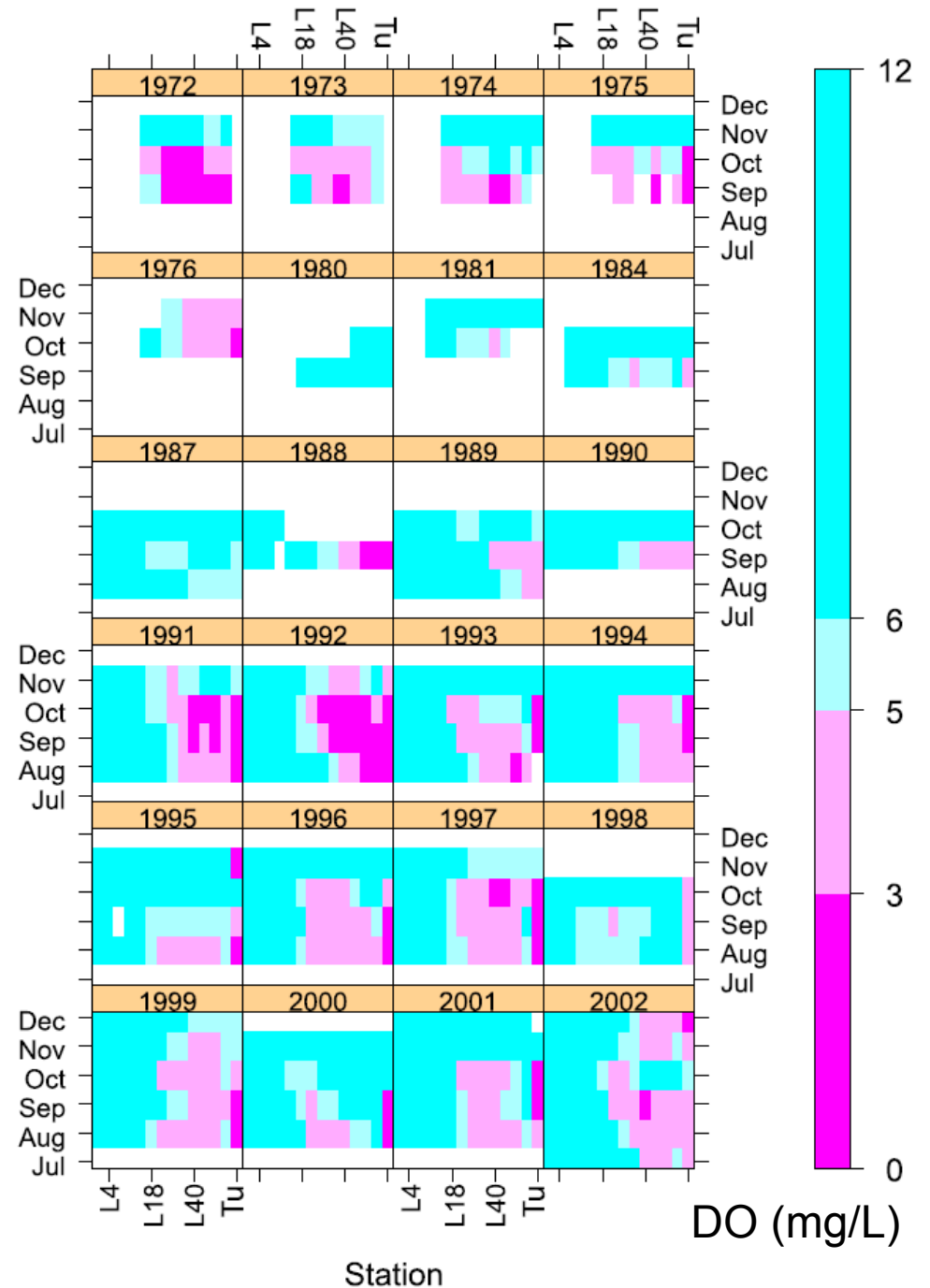
- *Egeria* cover increased by 12-13% each year from 2004-2006
- Inversely correlated to **flow**

Long-established: Oxygen Sags in the Stockton Ship Channel

“At the annual scale, ammonium loading from the Stockton WWTP has the largest identifiable effect on year-to-year DO variability.”

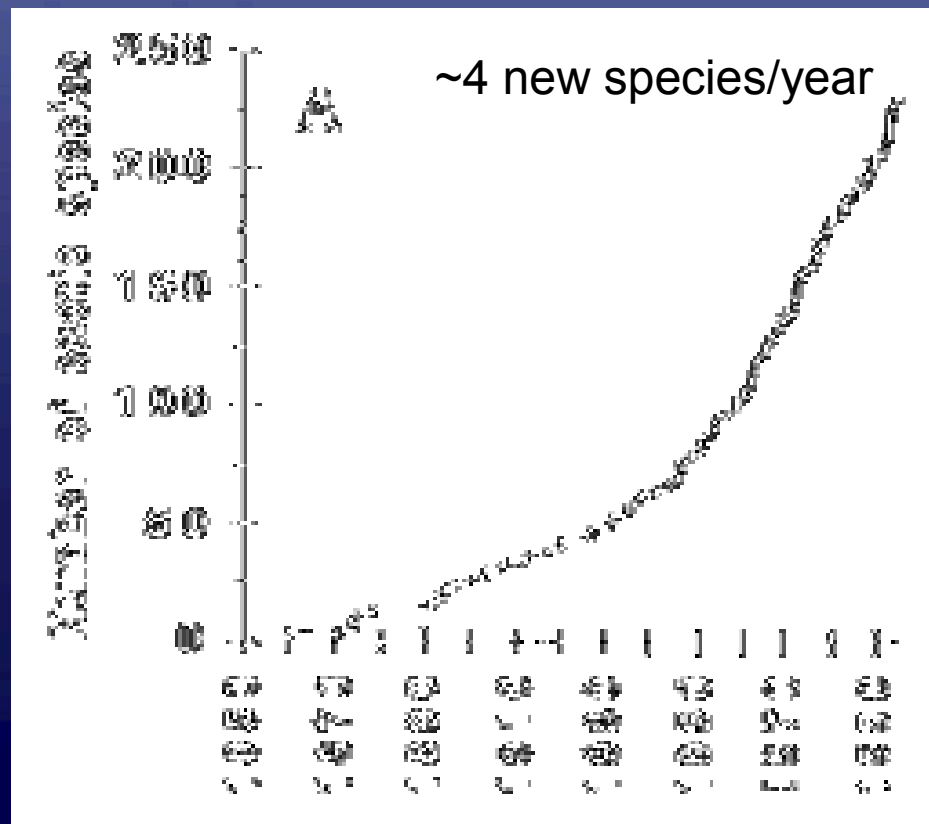


Jassby & Van Nieuwenhuysse 2005 (SFEWS)



Regime Shift Winners: Non-Native & Nuisance Species

“...the most invaded aquatic ecosystem in the world.”
(Cohen & Carlton, Science 1998)



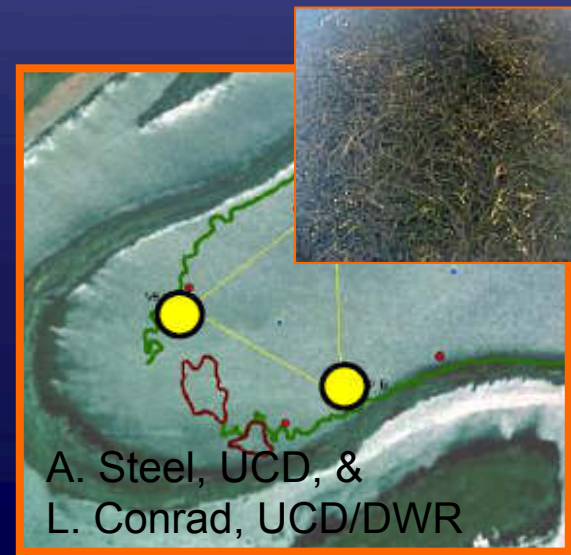
Regime Shift Winners: Non-Native & Nuisance Species

March 11-14, 2010, Bass Tournament:
Winner John Crews of Salem, VA, said he fished in
*“dead-end slough that held deep,
thick hydrilla.”*



\$100K trophy

“This is a place where monsters live.”



A. Steel, UCD, &
L. Conrad, UCD/DWR

Regime Shift Losers: Native Species, Unique Natural Heritage

Delta smelt



Listed since 1993

Longfin smelt



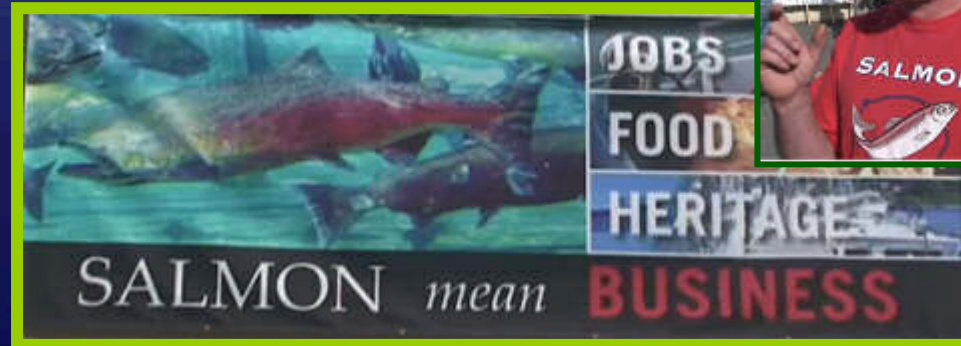
Listed since 2009

Green Sturgeon



Listed since 2006

Salmon



Listed since 1989(+)

Current POD Studies: Science Informing Solutions

Focus on Multiple Drivers of Change

Jared Diamond, 2005

Collapse - How Societies Choose to Fail or Succeed

“People often ask, “What is the single most important environmental problem facing the world today?”

The single most important problem is our misguided focus on identifying the single most important problem!

... because any of the dozen problems, if unsolved, would do us great harm and because they all interact with each other.

We have to solve them all.”

Solutions ...

*“... developed within the framework
of existing data and knowledge of
responses”*

... to multiple drivers

National Estuarine Workgroup Report 2010

Driver: Nutrients

Food Quantity & Quality, Water Quality

A Framework for Research Addressing the Role of Ammonia/Ammonium in the Sacramento-San Joaquin Delta and the San Francisco Bay Estuary Ecosystem

Submitted to:

The CALFED Science Program
650 Capitol Mall, 5th Floor
Sacramento, CA 95814

4/2009

Public IEP Workshop

August 18-19, 2009

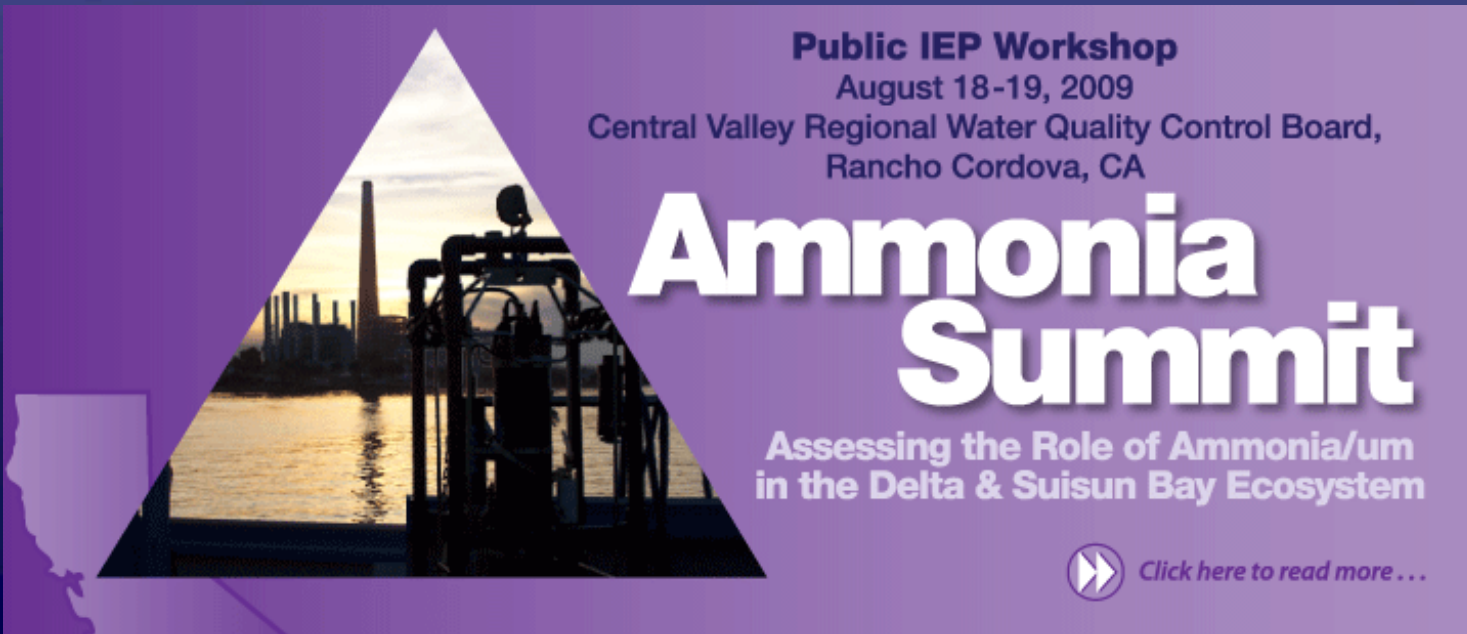
Central Valley Regional Water Quality Control Board,
Rancho Cordova, CA

Ammonia Summit

Assessing the Role of Ammonia/um
in the Delta & Suisun Bay Ecosystem



Click here to read more . . .



Driver: Nutrients

Ongoing research:

- Suisun Bay spring phytoplankton & nutrient monitoring (*Dugdale, Parker, et al*)
- Effects of flow, nutrients and light on phytoplankton in the fall (*Parker, Dugdale, et al.*)
- Nutrient sources, phytoplankton growth and species composition in Sac & SJ Rivers (*Dugdale, Mueller-Solger, et al*)
- Nutrient enrichment experiments in the Delta-Mendota Canal (*Van Nieuwenhuyse*)
- Environmental controls of the distribution of harmful algae and their toxins (*Mioni*)
- Effect of seasonal variations in flow on nutrients, organic matter and phytoplankton (*Kendall, Young*)
- Metabolic responses to variable water quality in field-acclimatized *Corbula* (*Stillman*)
- Sublethal ammonia (and other contaminant) effects on delta smelt using molecular biomarkers (*Connon*)

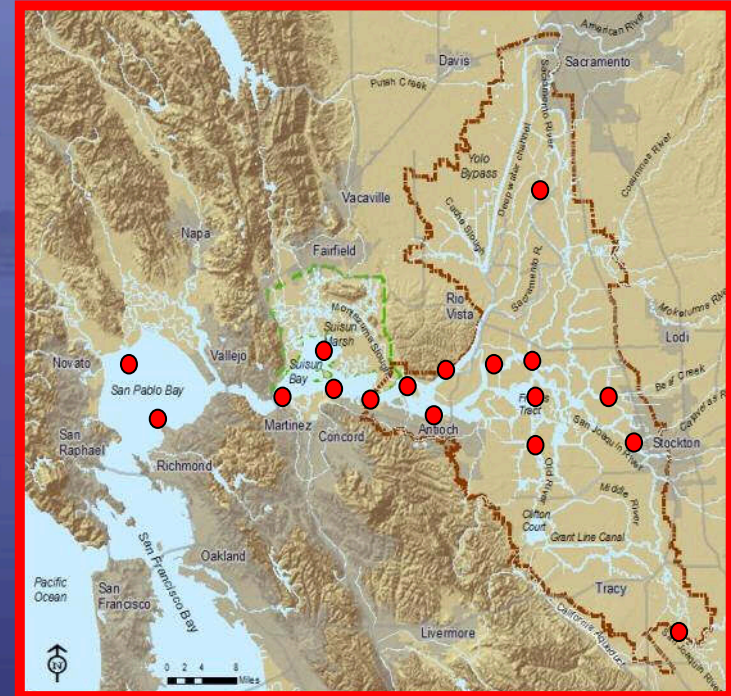
Driver: Nutrients

New research:

- Effects of nutrient forms, nutrient ratios and light availability on the lower food web of the Delta (*Glibert*)
- Environmental conditions leading to *Microcystis* blooms, their toxicity and their impact on the pelagic food web (*Parker, Kimmerer, Mioni, Ger*)
- Nutritional quality of zooplankton and phytoplankton in the Sacramento-San Joaquin Delta (*Winder*)

IEP Monitoring:

- Long-term
- Cooperative
- Consistent
- Mostly Mandated
 - SFE, Delta & Suisun focus
 - Mostly channels & bays
 - Continuous to semi-annually
 - *Variables:*
 - Fish
 - Jellyfish
 - Zooplankton
 - Benthos
 - Phytoplankton
 - **Nutrients**, D.O., pH, Turbidity
 - Salinity/EC, Temperature
 - Flow



Monthly Nutrient Sampling Sites

NOT:

- Processes, Rates
- Microbes*
- Toxicity & Contaminants* #
- Wetlands
- Plants*
- Vegetated Edges/Shore*
- Fish Condition*

* Pilots with POD

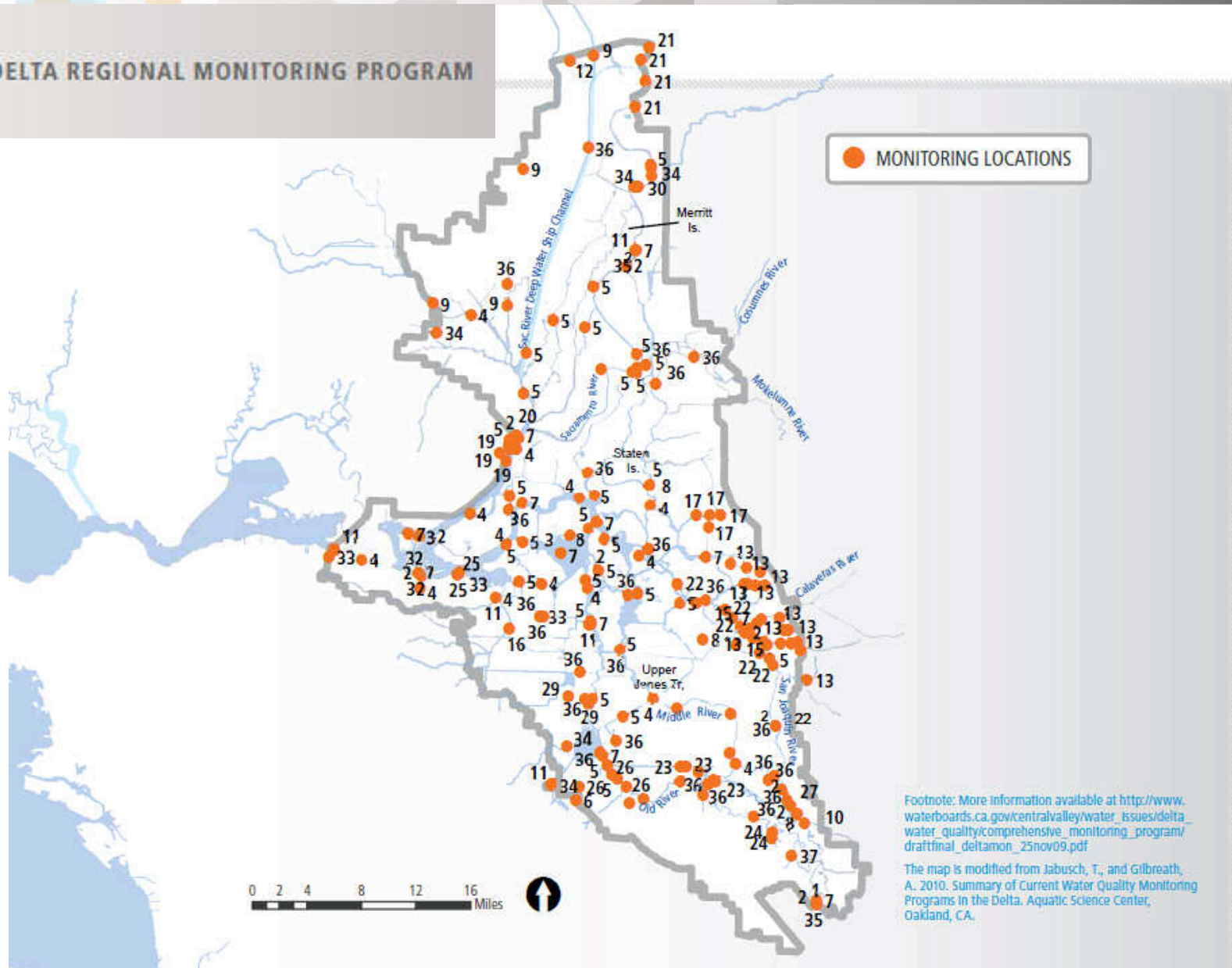
New Delta RMP

THE PULSE OF THE DELTA

2011

MONITORING AND MANAGING WATER QUALITY IN THE SACRAMENTO – SAN JOAQUIN DELTA

A REPORT OF THE DELTA REGIONAL MONITORING PROGRAM



Footnote: More information available at http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/comprehensive_monitoring_program/draftfinal_deltamon_25nov09.pdf

The map is modified from Jabusch, T., and Gilbreath, A. 2010. Summary of Current Water Quality Monitoring Programs in the Delta. Aquatic Science Center, Oakland, CA.



National Water-Quality Assessment Program

Trends in Nutrient Concentrations, Loads, and Yields in Streams in the Sacramento, San Joaquin, and Santa Ana Basins, California, 1975–2004



Scientific Investigations Report 2010–5228

C.R. Kratzer,
R.H. Kent,
D.K. Saleh,
D.L. Knifong,
P.D. Dileanis,
& J. L. Orlando
2011

<http://www.swrcb.ca.gov/mywaterquality/>



State of California
ENVIRONMENTAL PROTECTION AGENCY
NATURAL RESOURCES AGENCY
CALIFORNIA WATER QUALITY MONITORING COUNCIL

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Jerry Brown

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- > [Monitoring Programs, Data Sources & Reports](#)

Are Our Aquatic Ecosystems Healthy?

California has many types of aquatic habitats. Follow the links below to learn more ...



WETLANDS

Wetlands form along the shallow margins of deepwater ecosystems such as lakes, estuaries, and rivers. They also form in upland settings where groundwater or runoff makes the ground too wet for upland vegetation. [More >>](#)



ESTUARIES

Estuaries are unique habitats found where rivers and the ocean mix. They feature a diverse array of plants and animals adapted to life along the mixing zone. [\[Future Portal\]](#)



STREAMS, RIVERS & LAKES

California's streams and rivers flow through diverse habitats, from mountain canyons, valleys, deserts, estuaries and urban areas. Riparian woodlands develop along stream banks and floodplains, linking forest, chaparral, scrubland, grassland, and wetlands. California lakes, supporting deep water, wetlands, riparian woodlands, offer a quiet refuge for plants, animals and humans alike. [\[Future Portal\]](#)

Thank You!

Questions: amueller@deltacouncil.ca.gov
<http://www.deltacouncil.ca.gov/>
<http://www.water.ca.gov/iep/>

“Planning for the future without a sense of history is like planting cut flowers.”

Daniel Boorstin

Historian and Librarian of Congress