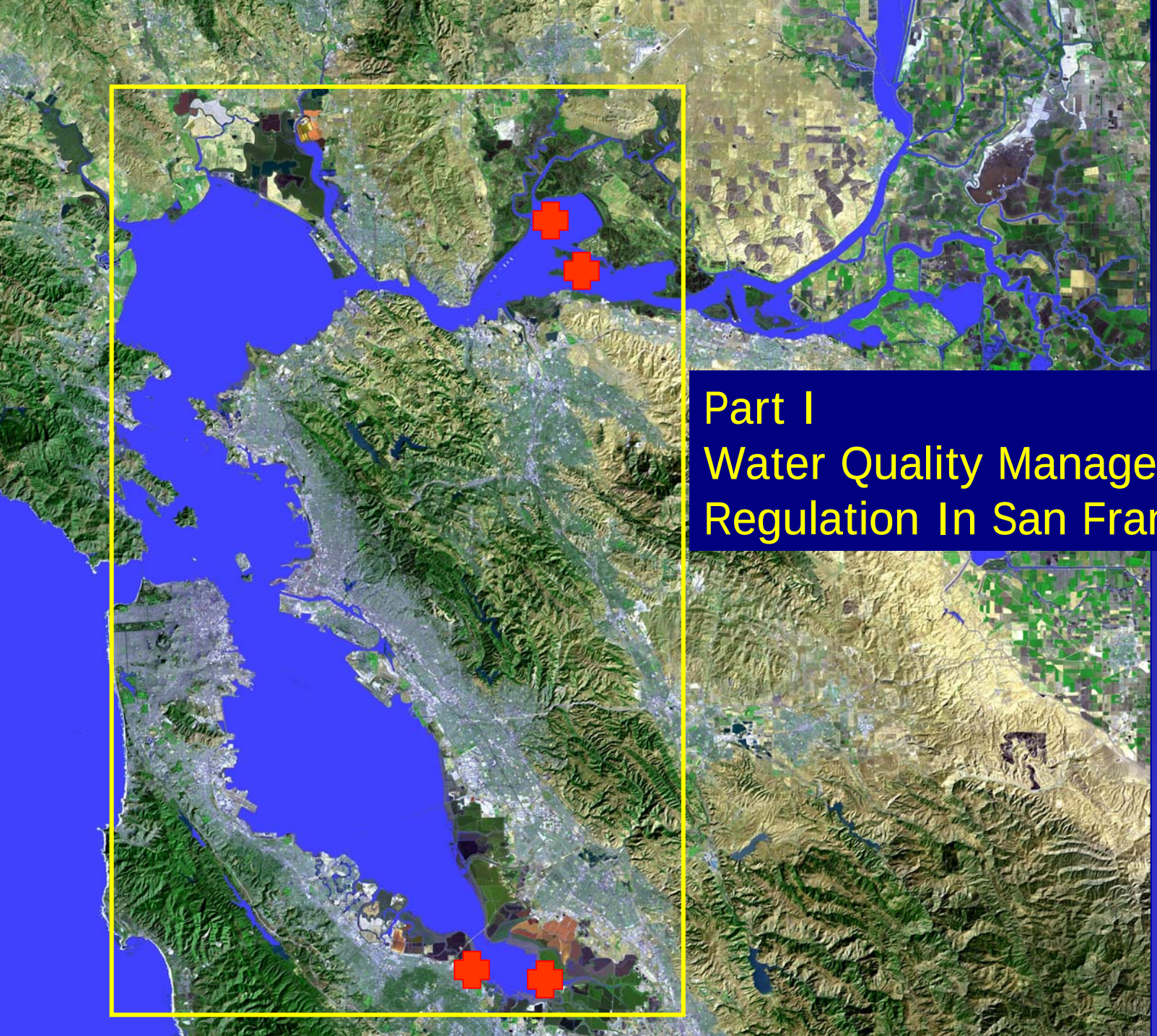
The Value of Scientific Discovery for Resource Management

Jim Cloern
USGS, Menlo Park

San Francisco Convention & Visitors Bureau Photo

USGS
science for a changing world



Part I
Water Quality Management and Regulation In San Francisco Bay

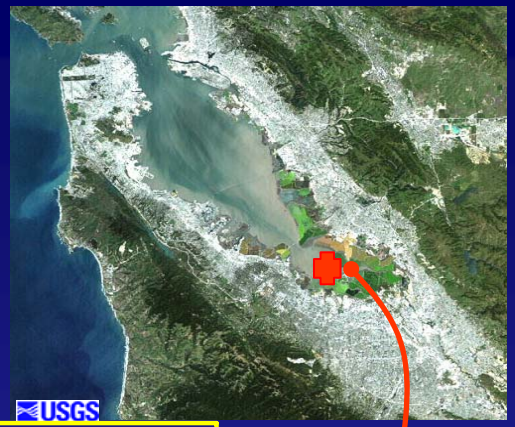
Regulatory Framework

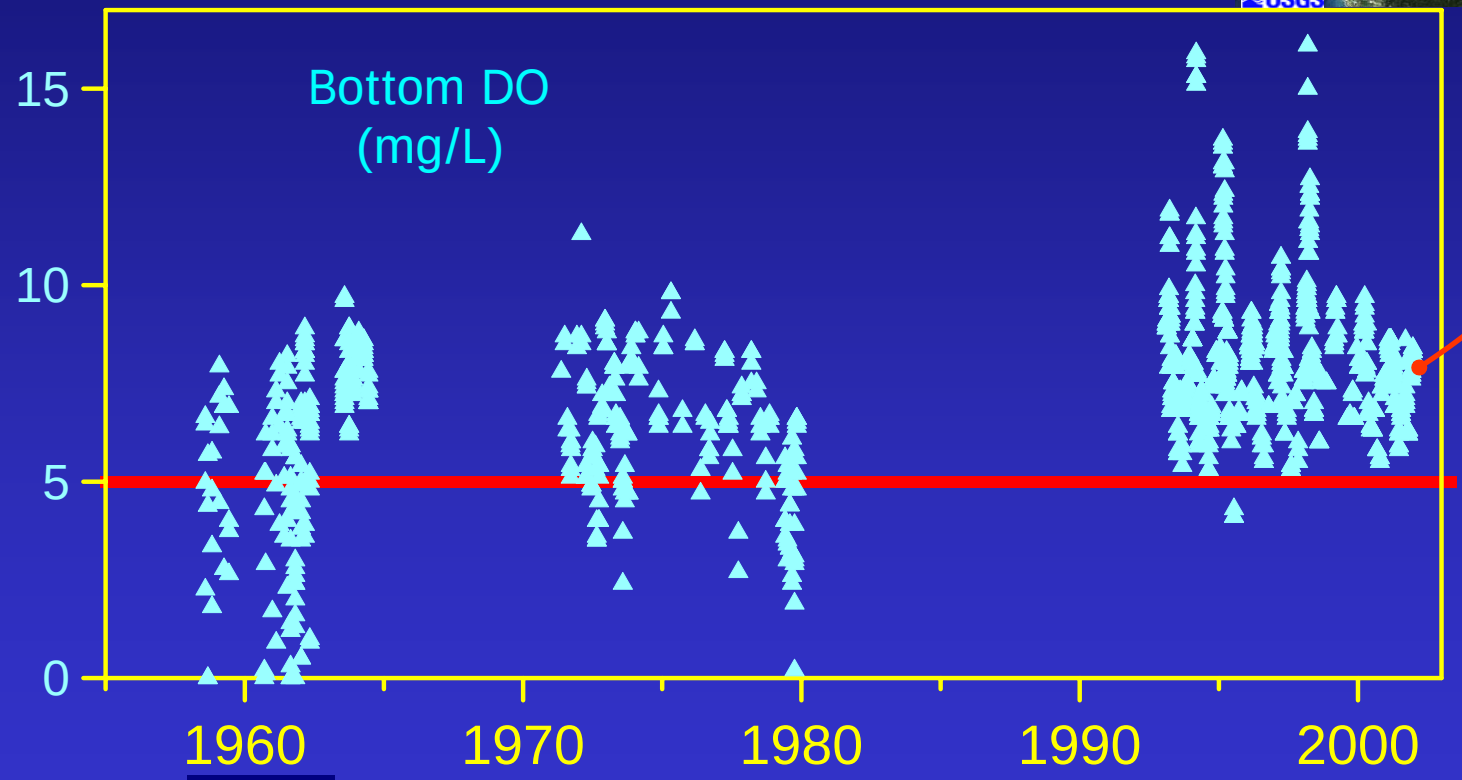
303(d) LIST

- Exotic Species
- Mercury
- Copper
- Nickel
- Diazinon
- PCB's
- Selenium

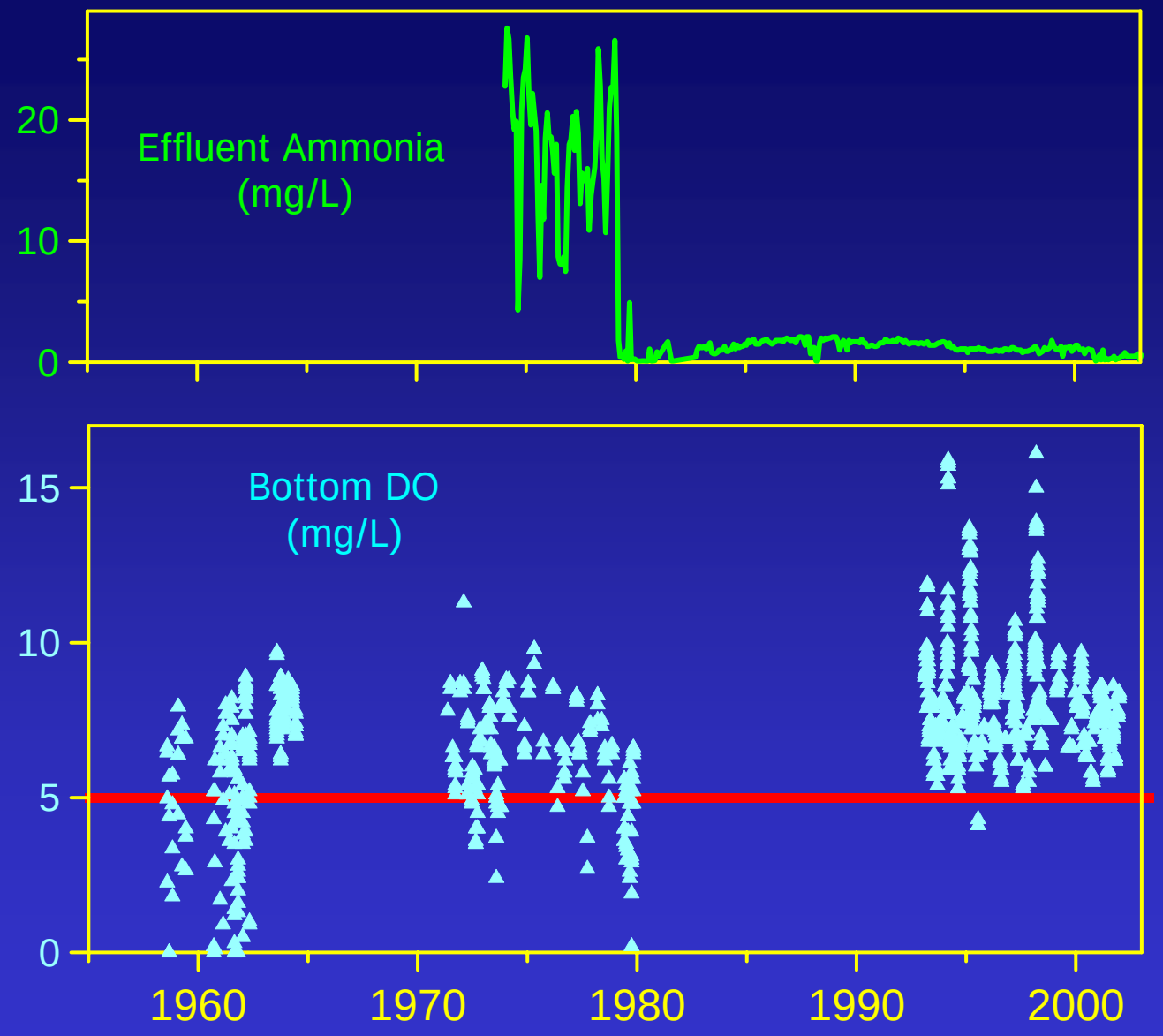
Dissolved Oxygen?

Discovery from monitoring



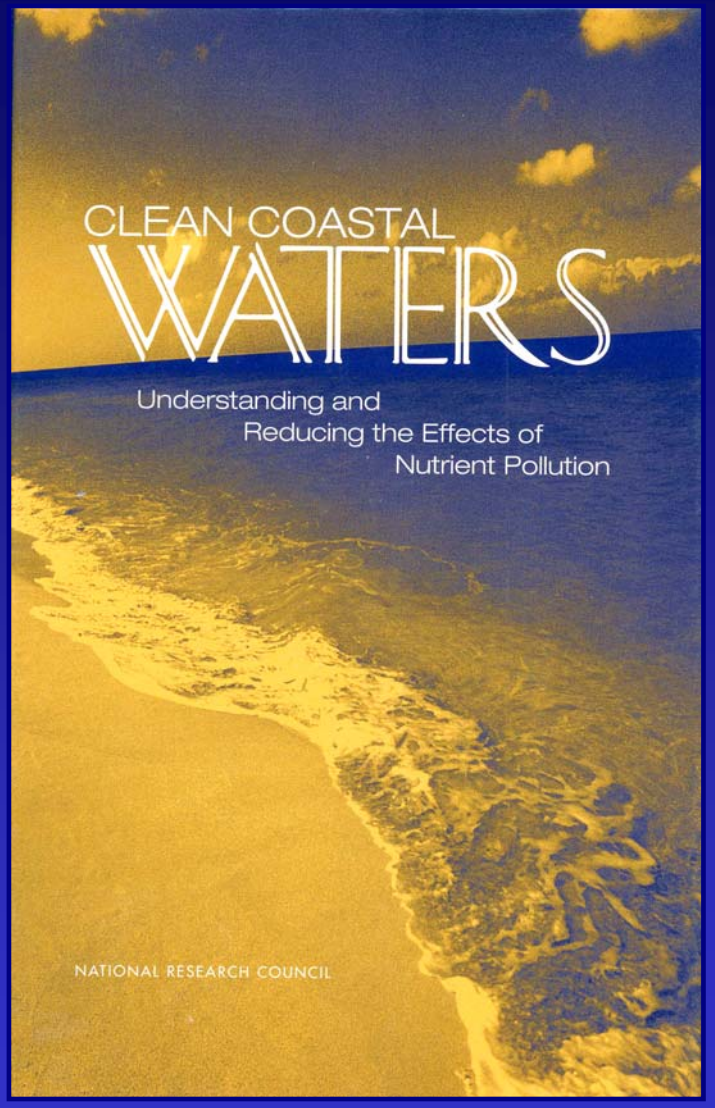


SERL



Lesson 1

Documents response to management actions



NRC (2000)

"Nutrient over-enrichment is a significant problem for the coastal regions of the United States...

Of 139 coastal sites .. 44 experiencing symptoms such as low dissolved oxygen, nuisance and toxic algal blooms..."

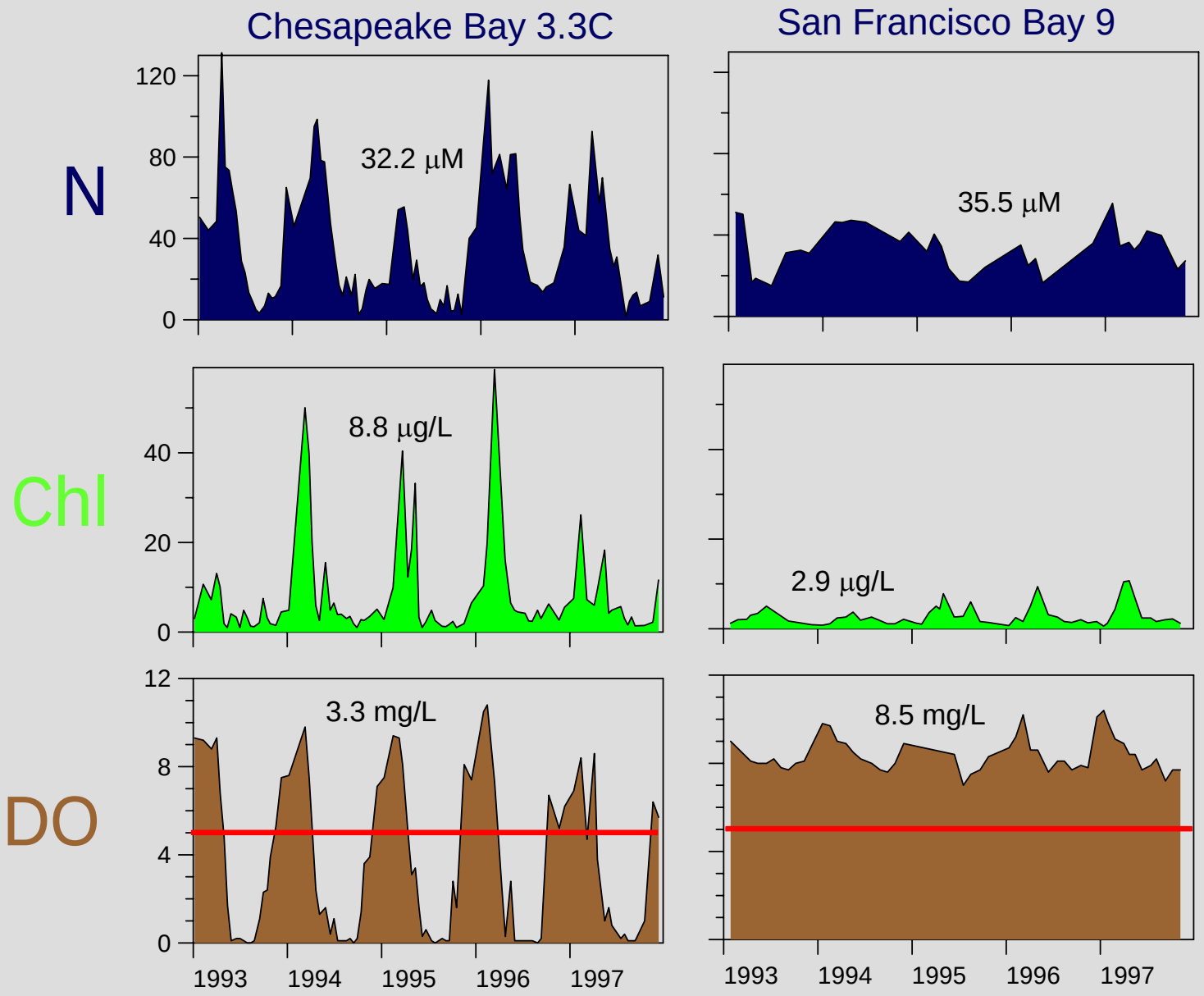
Regulatory Framework

303(d) LIST

- Exotic Species
- Mercury
- Copper
- Nickel
- Diazinon
- PCB's
- Selenium

Nutrients ?

Discovery from research



Lesson 2

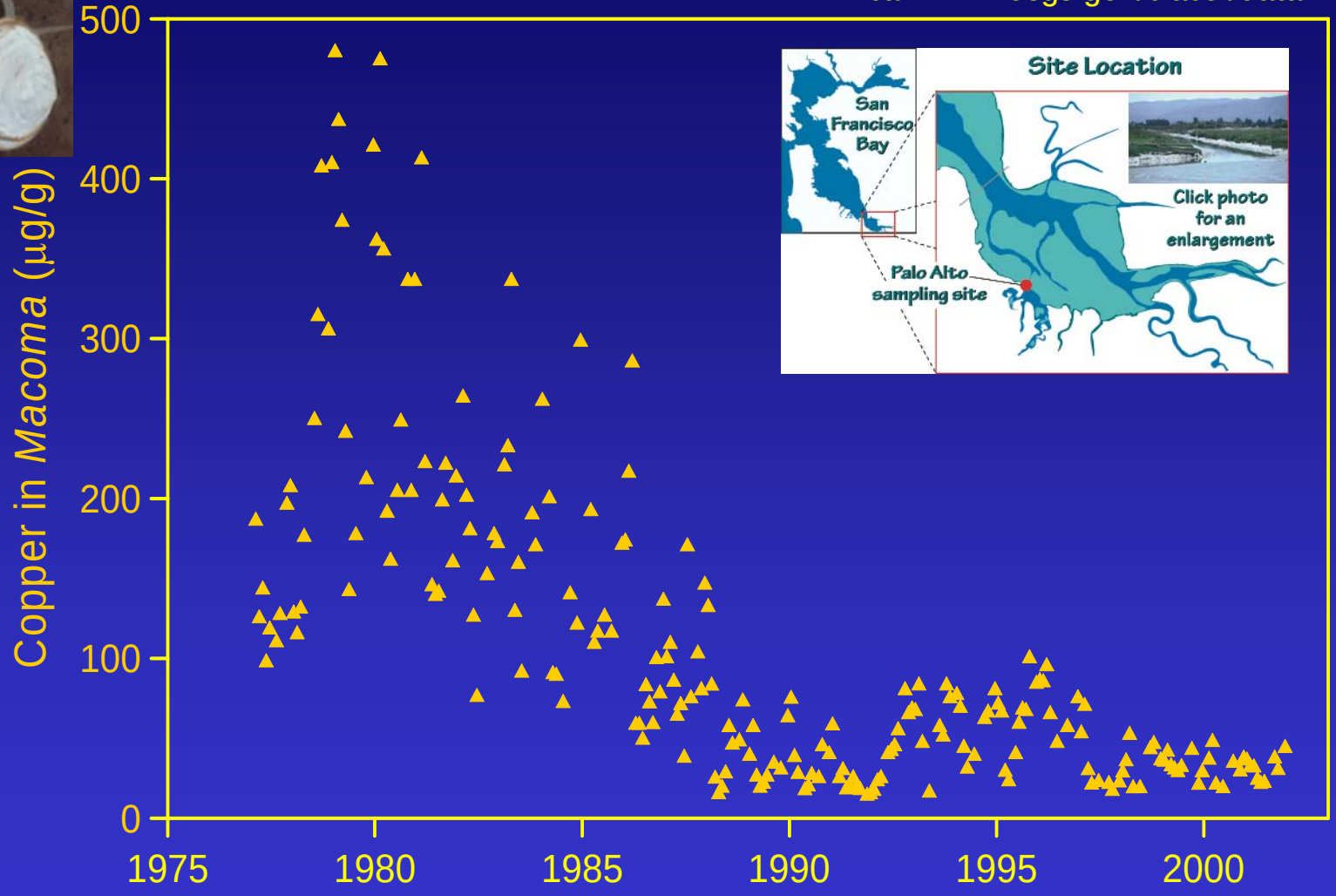
Ecosystem variability of response to stressors

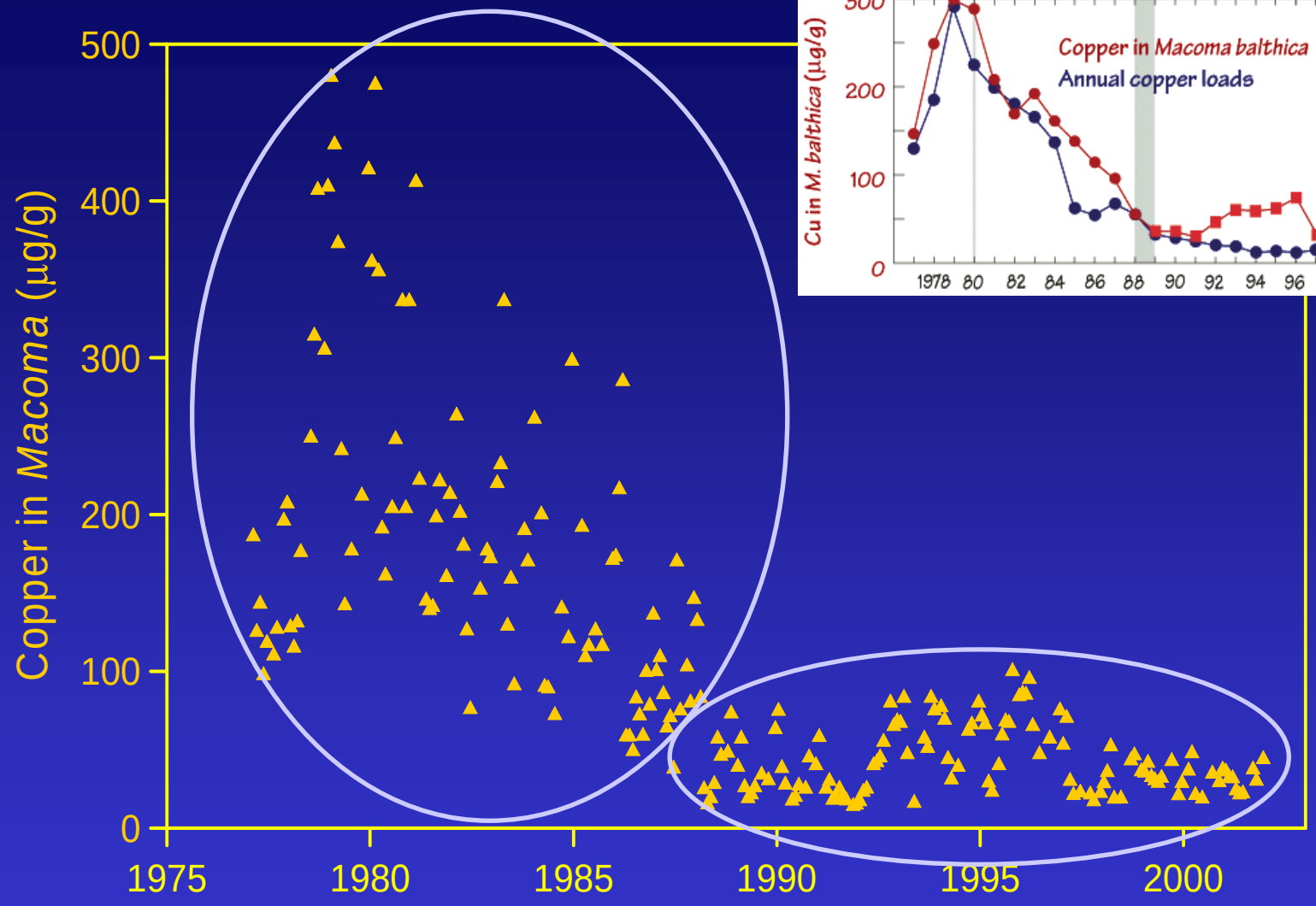
303(d) LIST

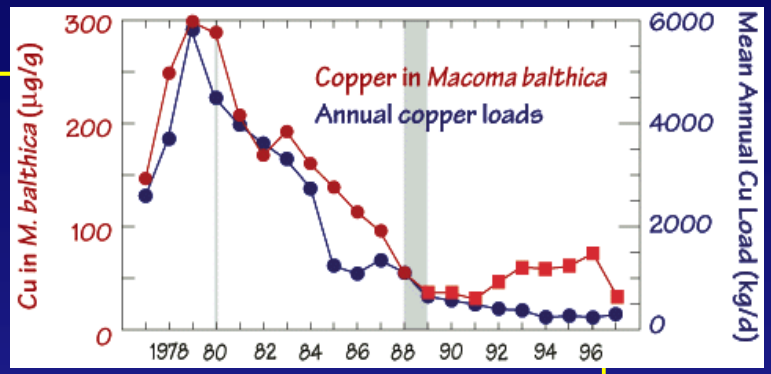
- Exotic Species
- Mercury
- Copper
- Nickel
- Diazinon
- PCB's
- Selenium

Discovery from monitoring

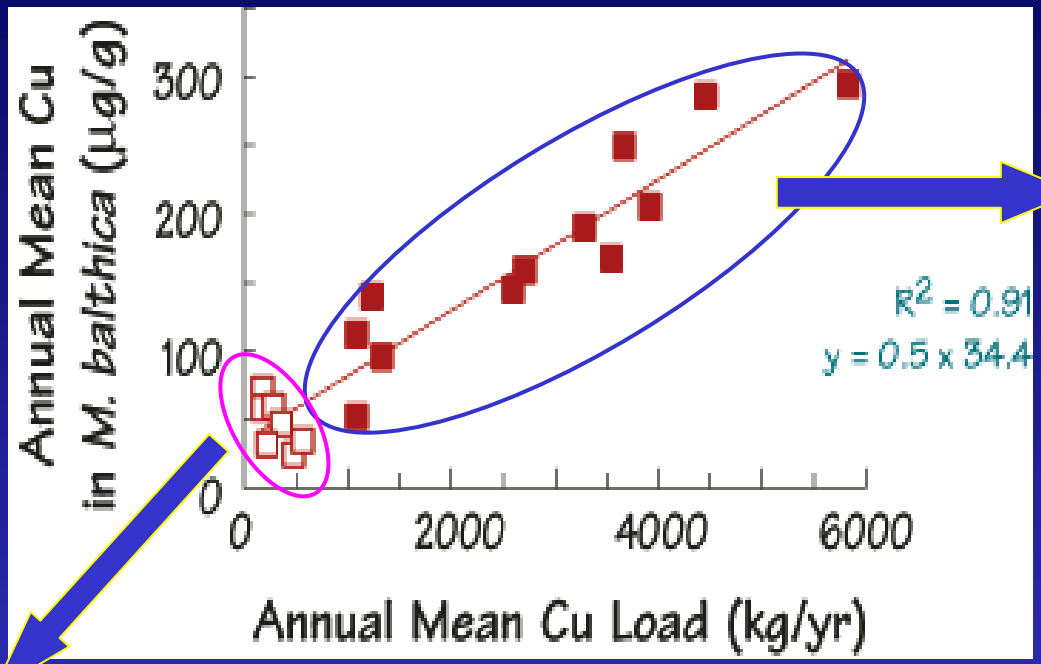
wwrcamnl.wr.usgs.gov/tracel/data




Copper in Macoma (µg/g)
500
400
300
200
100
0
1975
1980
1985
1990
1995
2000

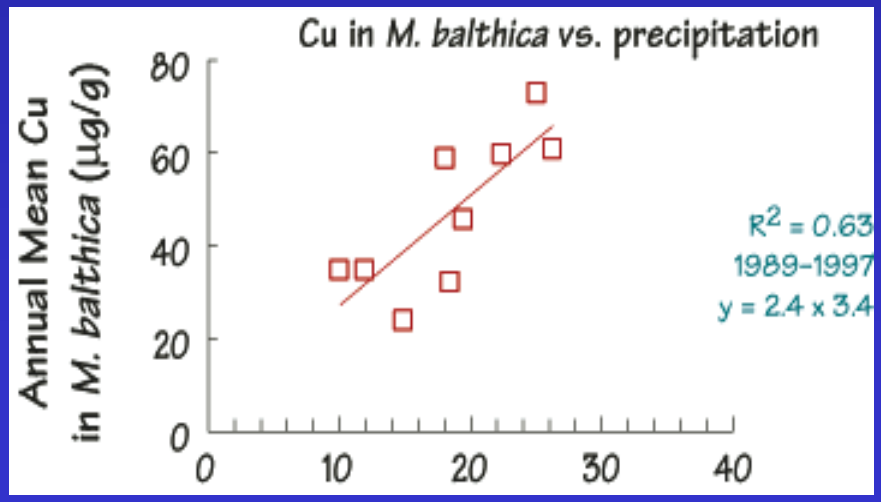

Cu in M. balthica (µg/g)
300
200
100
0
Copper in Macoma balthica
Annual copper loads
6000
4000
2000
0
Mean Annual Cu Load (kg/d)
1978
80
82
84
86
88
90
92
94
96

Discovery from analysis of monitoring data



Then,
point-source inputs

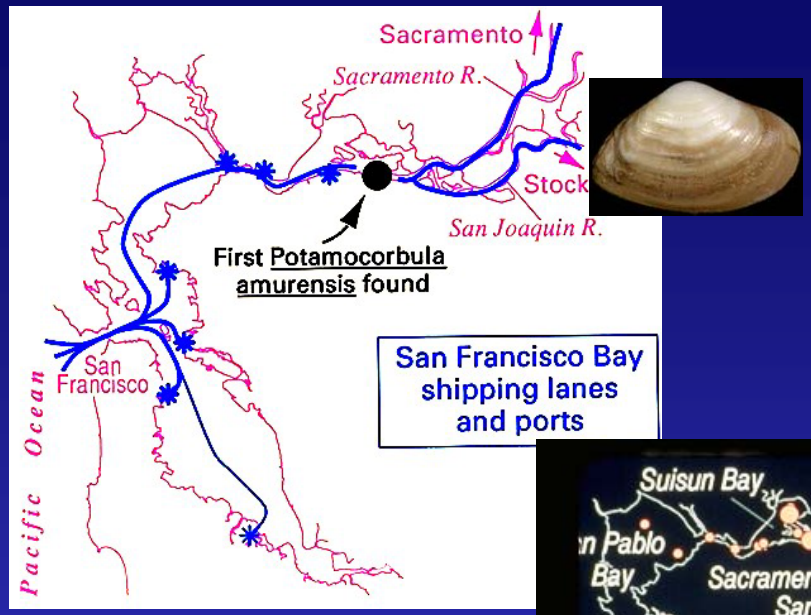
Now,
urban runoff

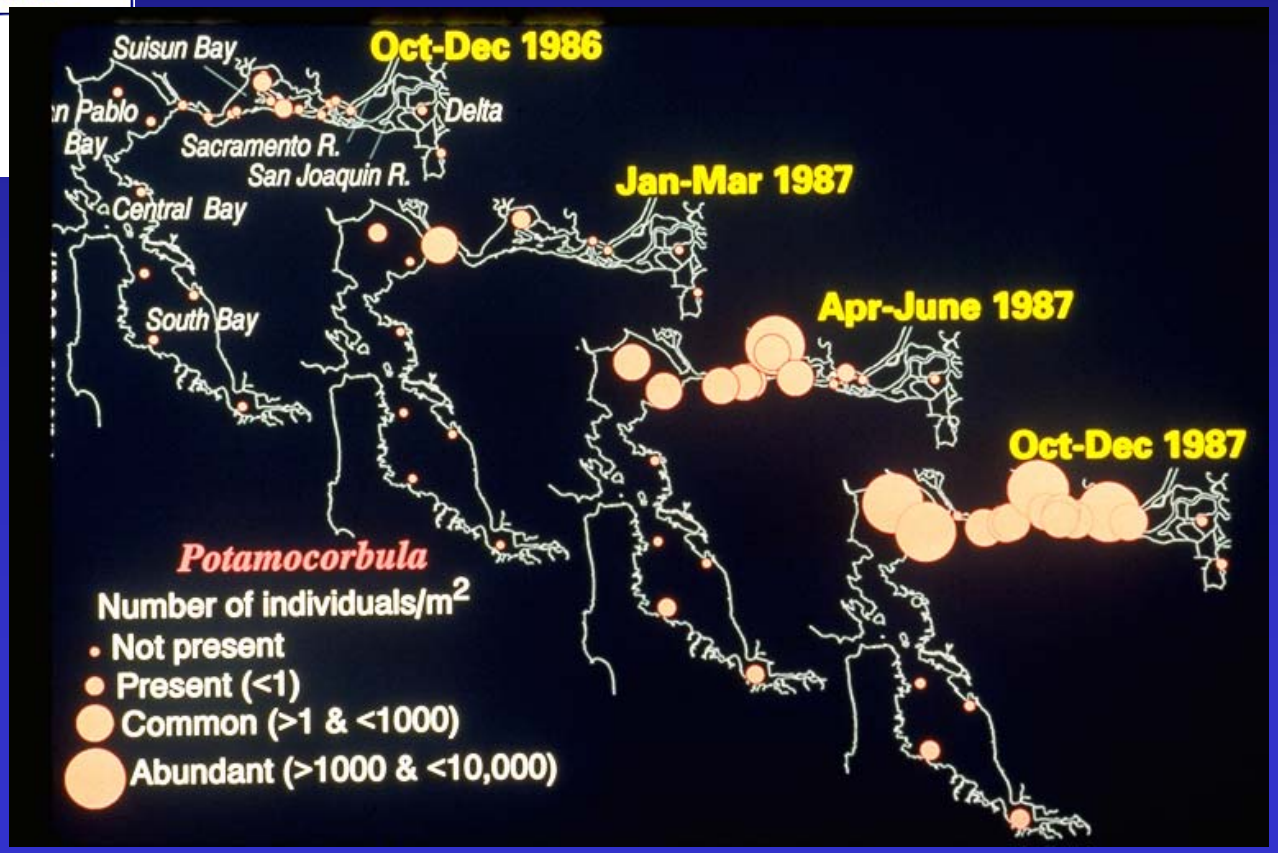


Lesson 3
Reveals changing sources of contaminants

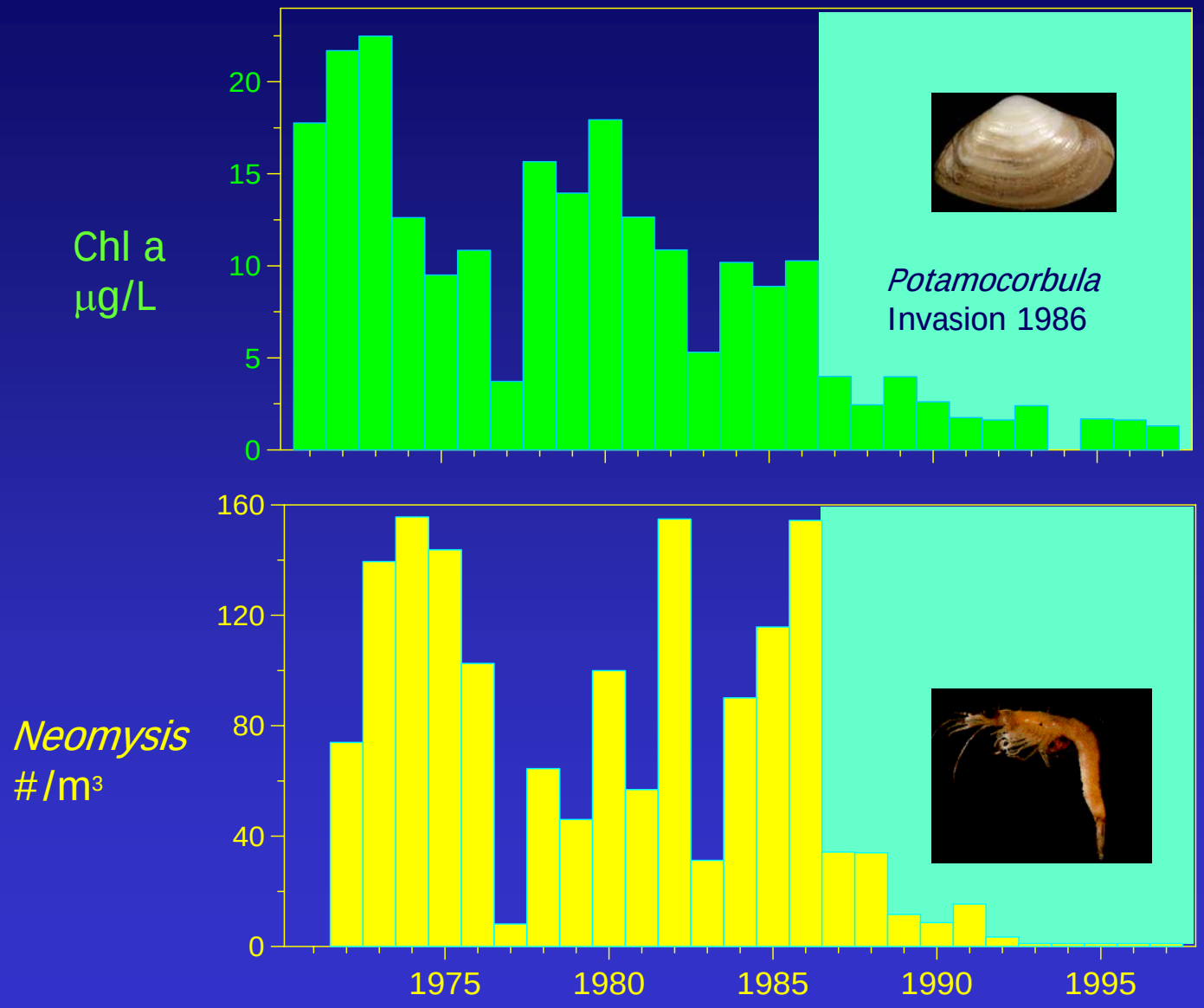
303(d) LIST
Exotic Species
Mercury
Copper
Nickel
Diazinon
PCB's
Selenium
Why ?

Discovery from research





Discovery from coupled monitoring & research



Lesson 4

Disturbance from biological pollution

Prevention of Exotic Species Introductions to the San Francisco Bay Estuary: A Total Maximum Daily Load Report to U.S. EPA

California Regional Water Quality Control Board
San Francisco Bay Region

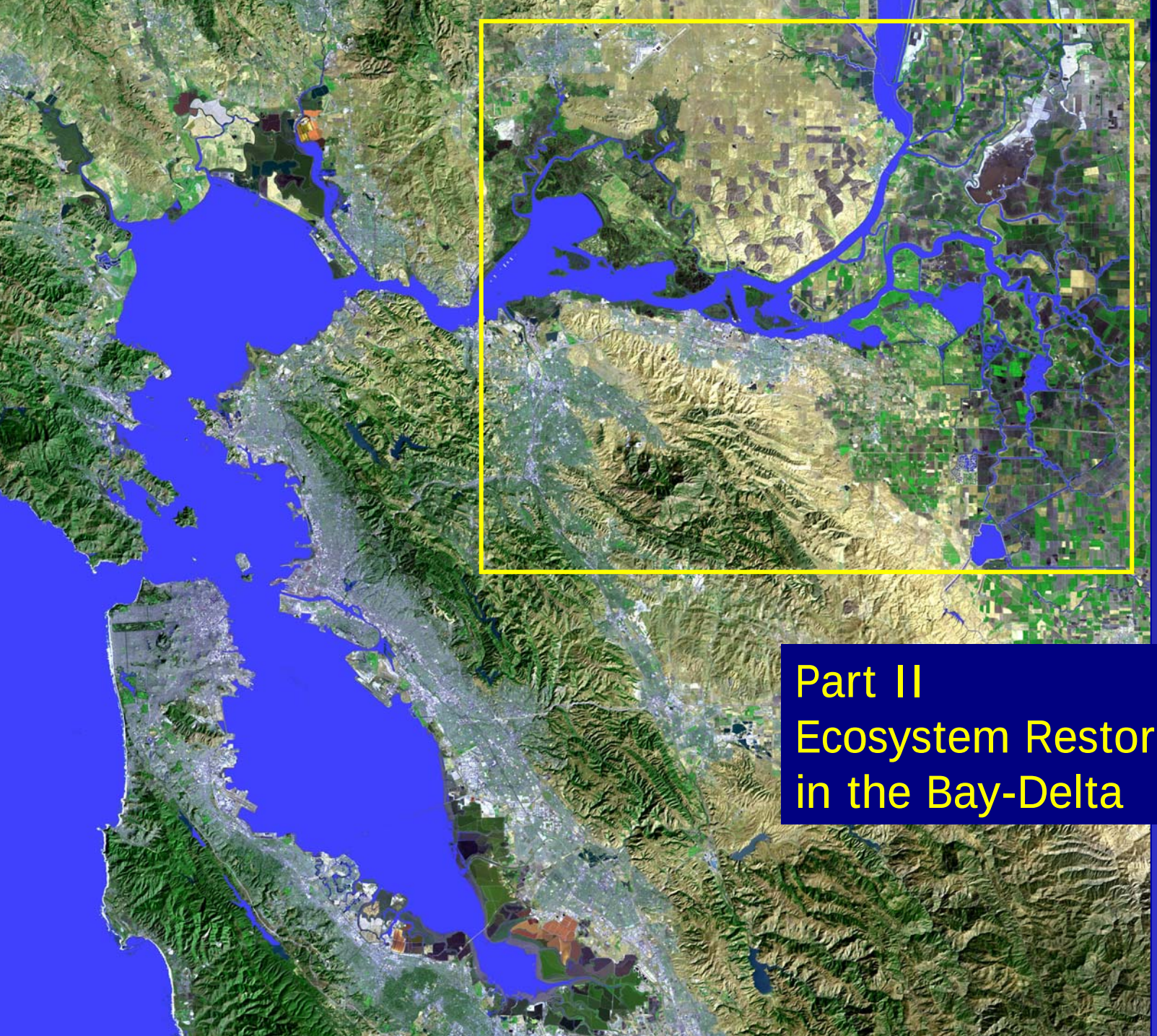
May 8, 2000

"The ecological impacts of the Potamocorbula invasion are as dramatic as any documented in the literature, and provided the impetus for the Board's 303(d) listing decision."

Scientific Discovery:

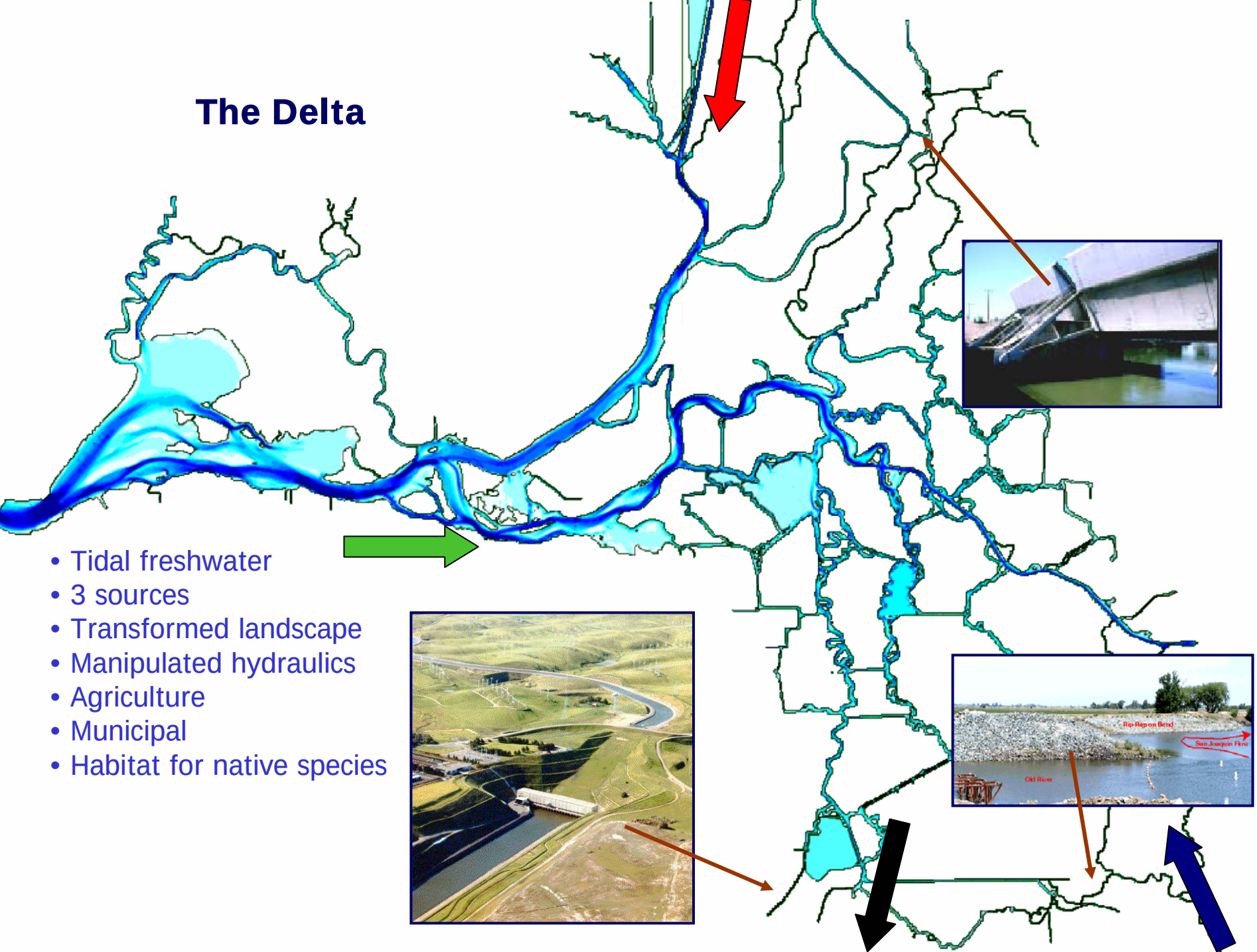
- Regulatory frameworks adapt to change
- Ecosystem-specific regulation

San Francisco Convention & Visitors Bureau Photo



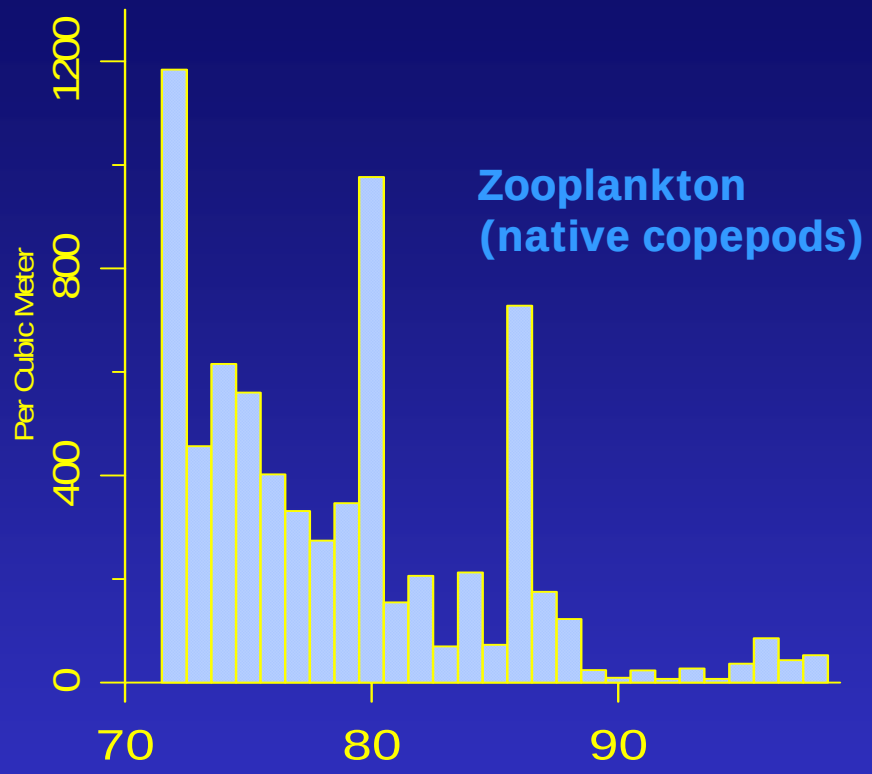
Part II
Ecosystem Restoration in the Bay-Delta

The Delta

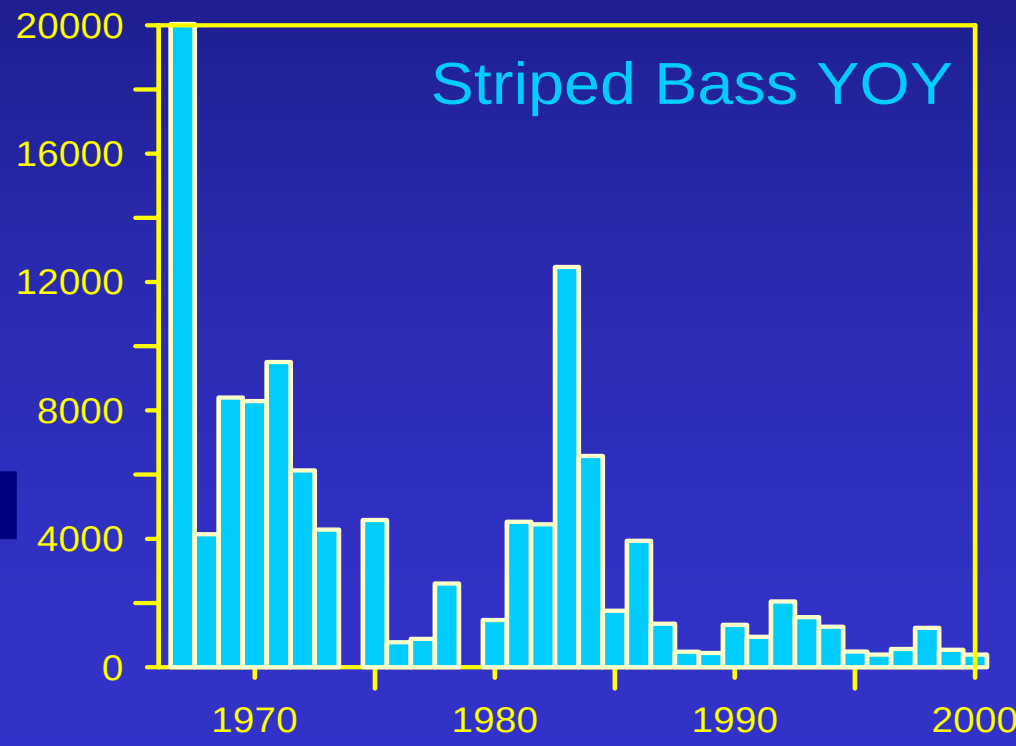


- Tidal freshwater
- 3 sources
- Transformed landscape
- Manipulated hydraulics
- Agriculture
- Municipal
- Habitat for native species

PROBLEM: Declines of living resources



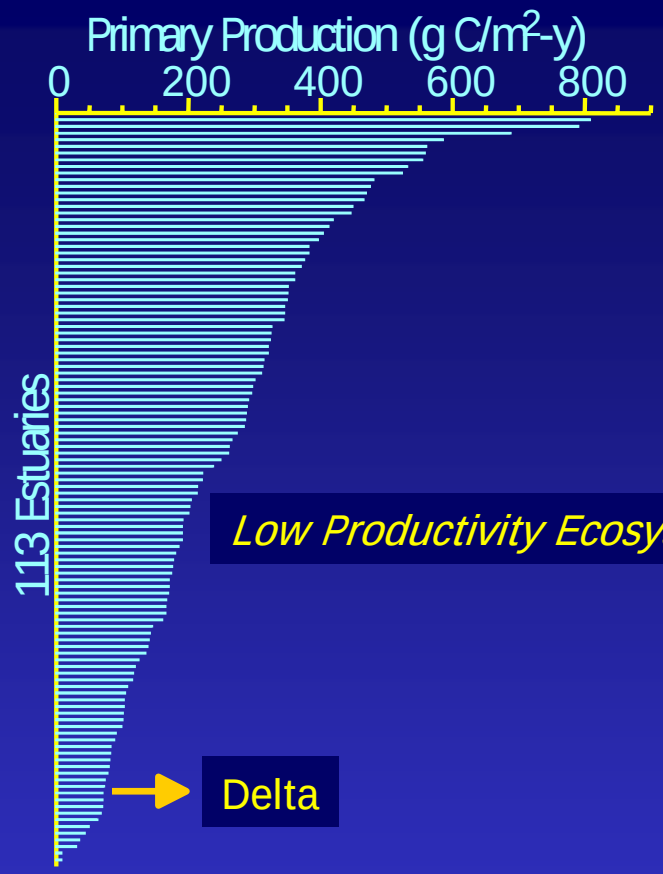
Data from California Department of Fish and Game



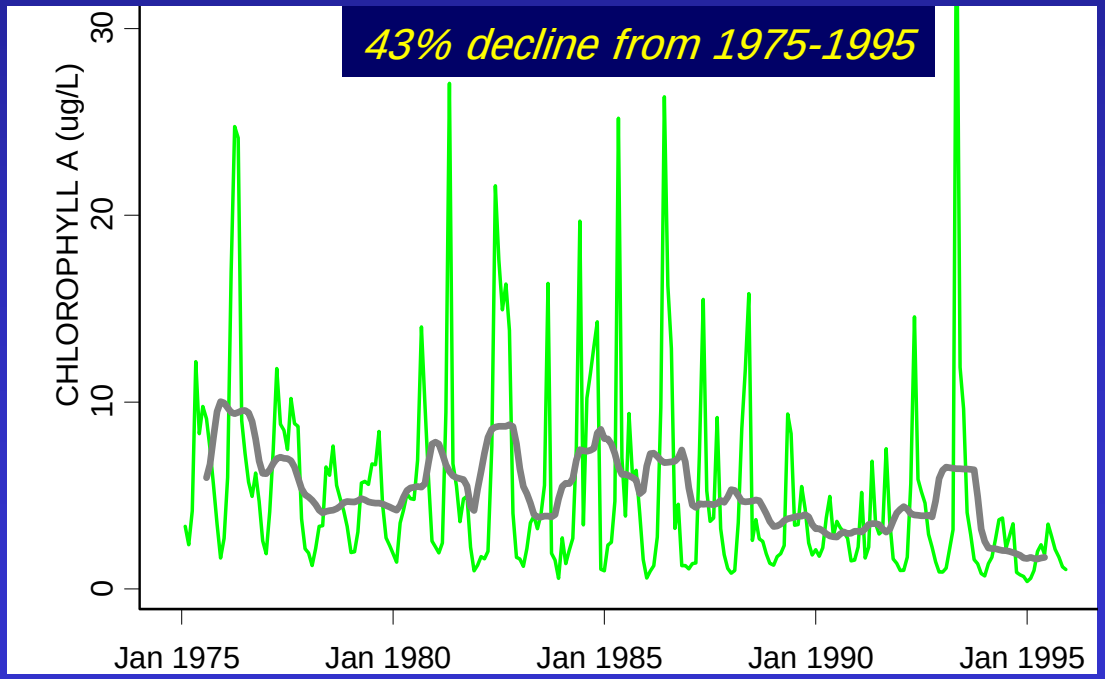
California Bay-Delta Authority

The mission of the California Bay-Delta Program is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta.

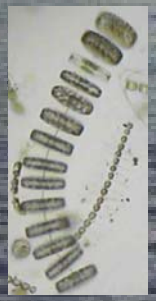
Discoveries from exploratory science



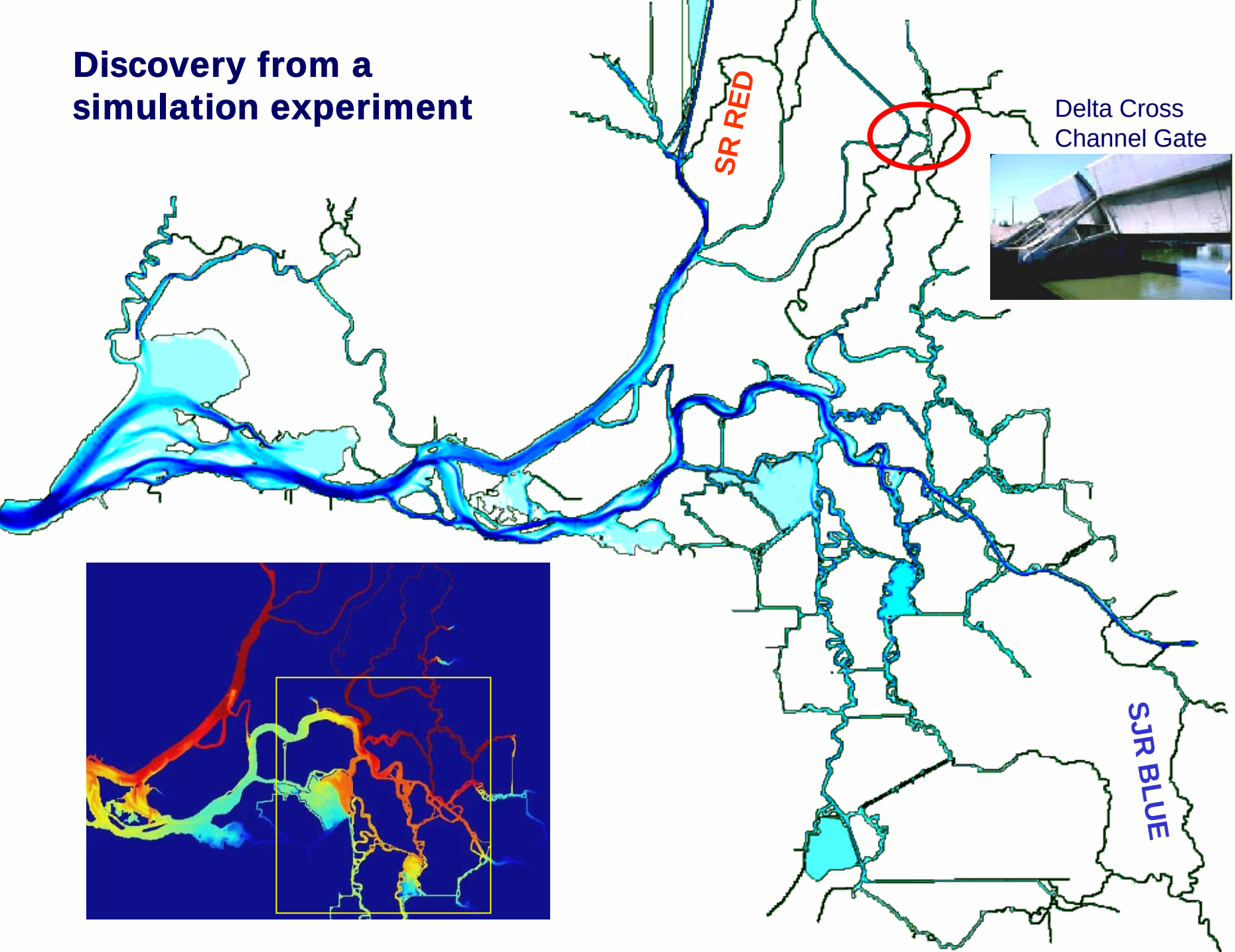
Zooplankton are food limited



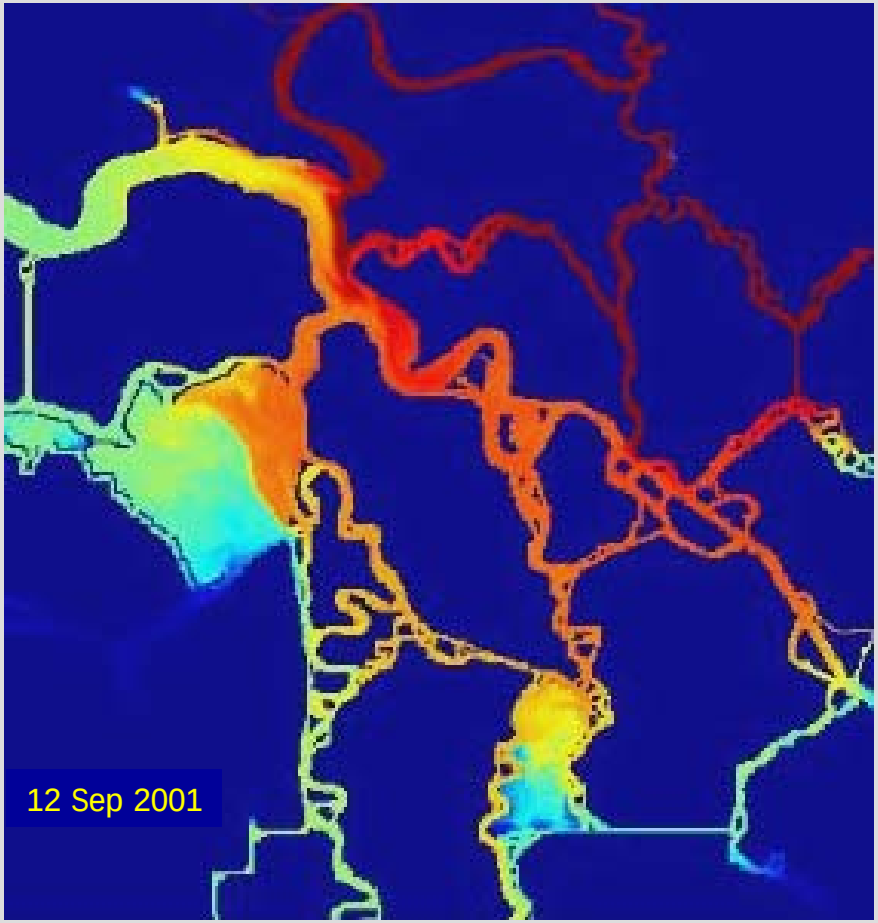
Lesson 5: identify limiting factors



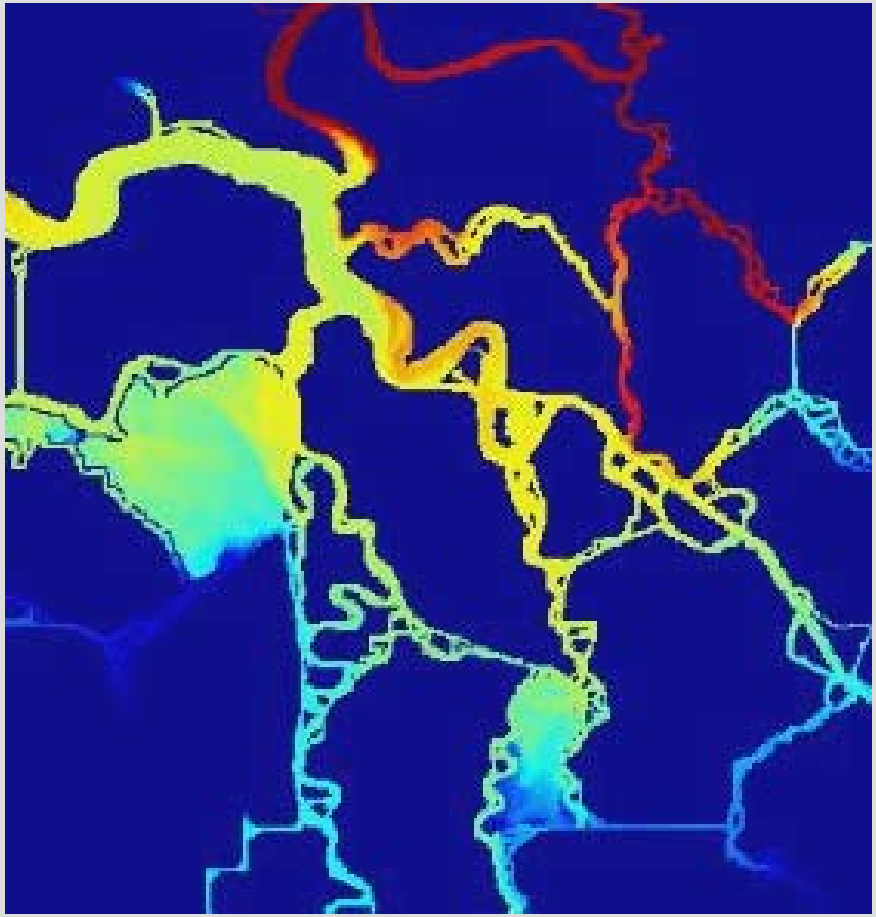
Discovery from a simulation experiment



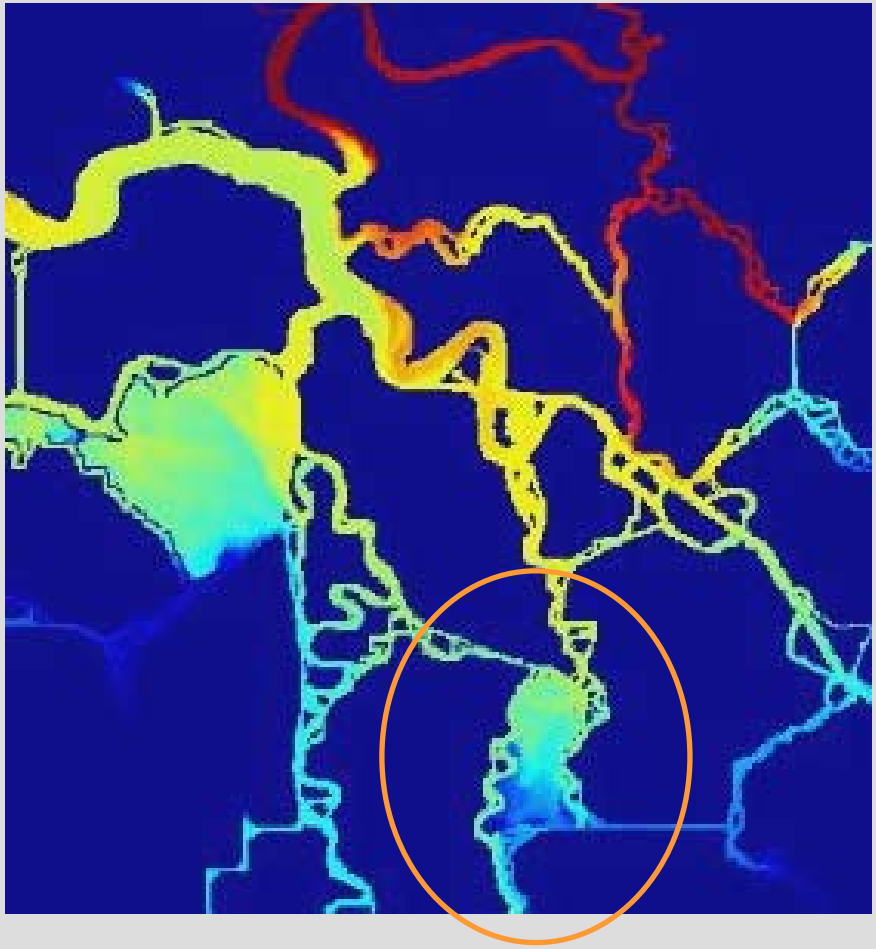
Gate Open



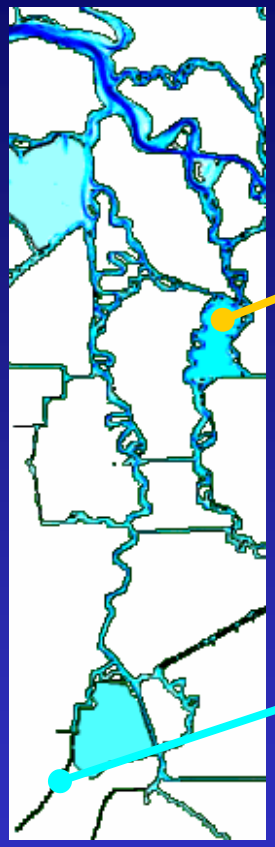
Gate Closed

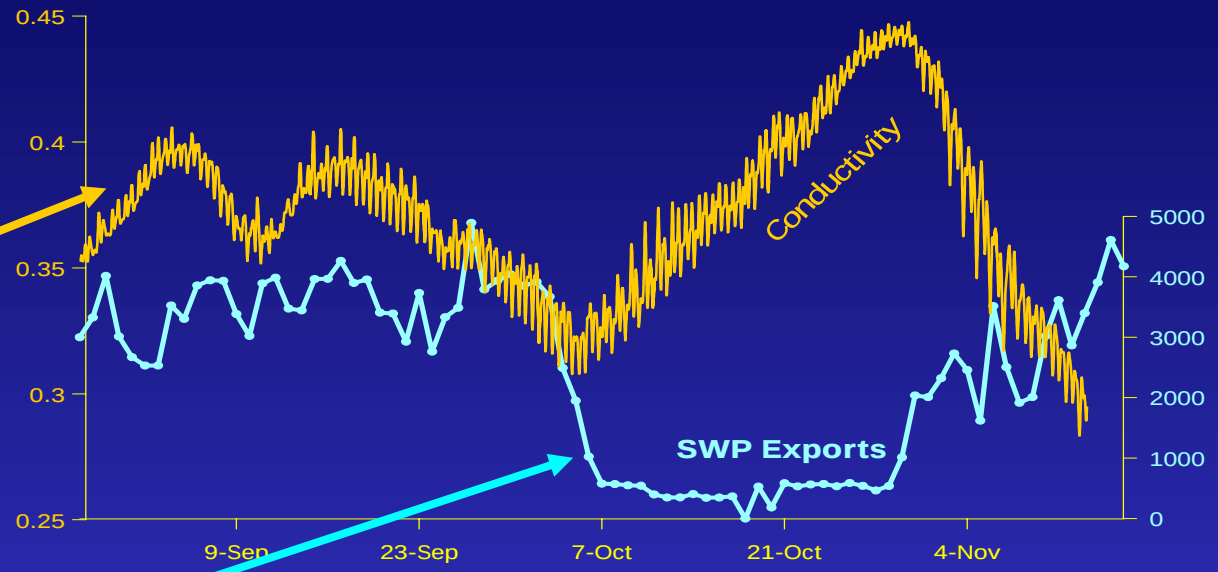


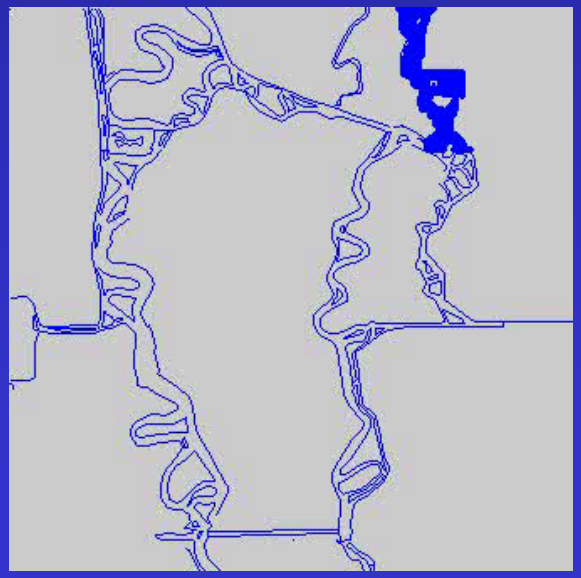
Lesson 6: local manipulations affect regional transport



Discovery from time series and models

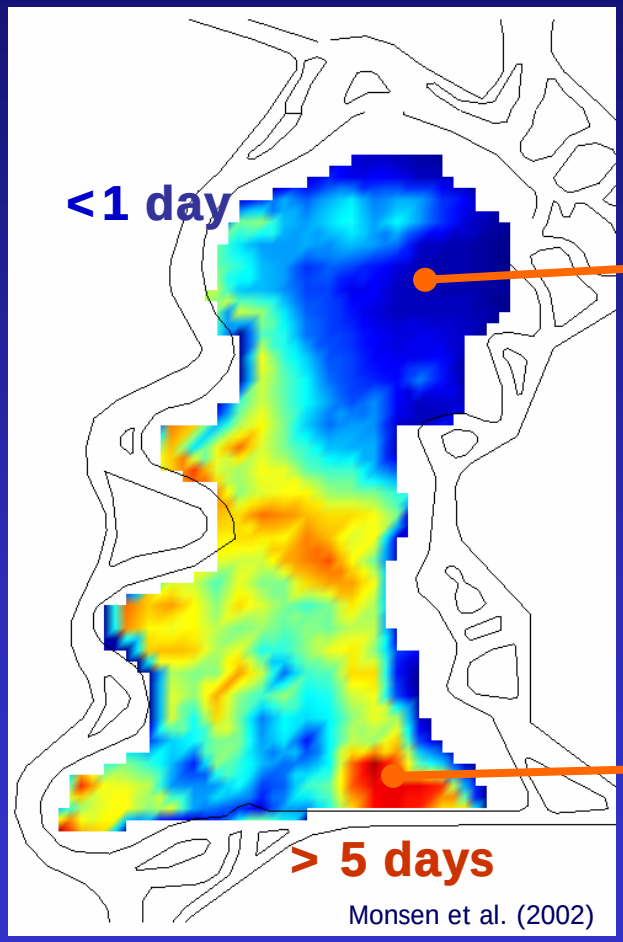






Lesson 7:
regional variability propagates into shallow habitats (fast)

Discovery from mapping and models



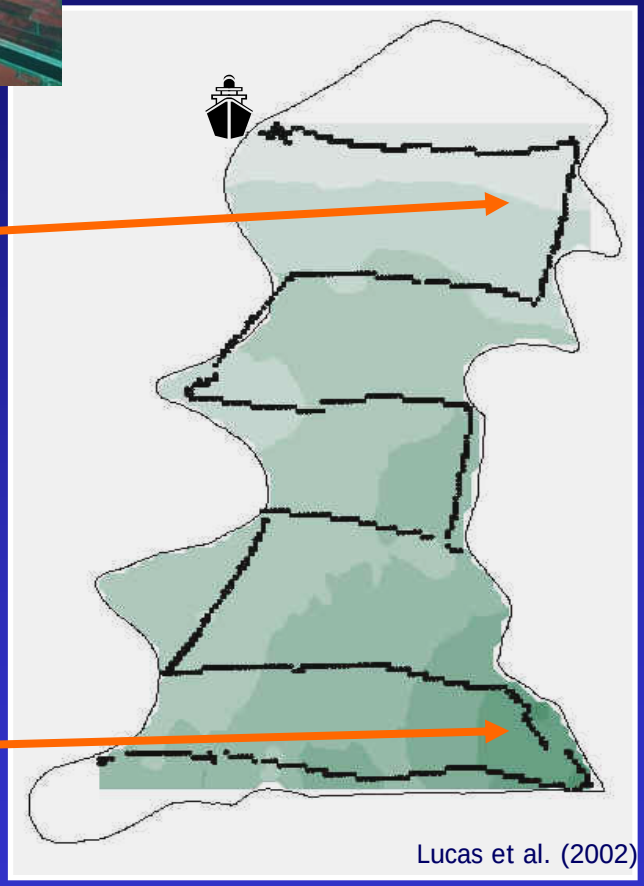
Monsen et al. (2002)

Short Residence Time

Low Chlorophyll

Long Residence Time

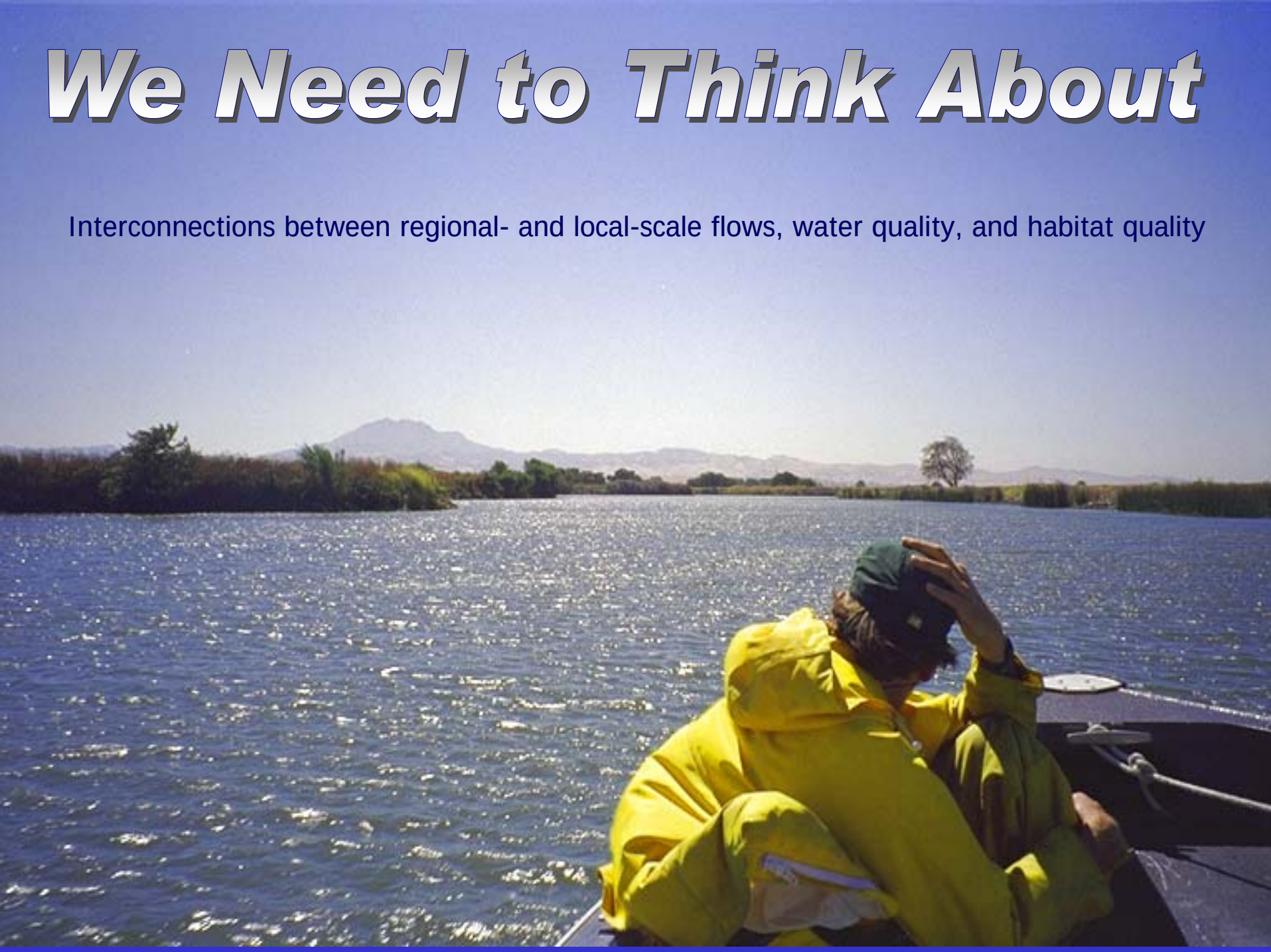
High Chlorophyll



Lucas et al. (2002)

Lesson 8:

Within-habitat variability is shaped
By tidal mixing and habitat geometry

We Need to Think About

Interconnections between regional- and local-scale flows, water quality, and habitat quality