

# California HABs, Monitoring, Research

*With Thanks to:*

Dave Caron

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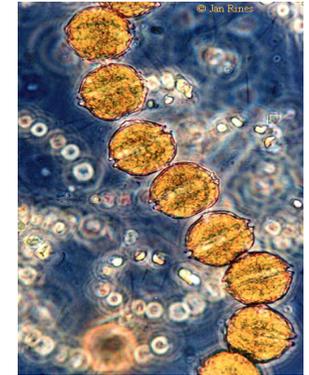
Chris Scholin

HABMAP

# The Rogue's Gallery-- Regulated

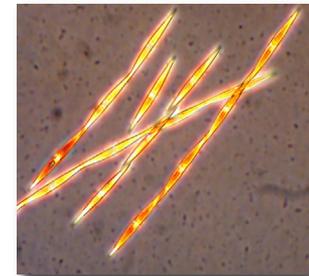
## ***Alexandrium catenella***

- Dinoflagellate
- causes Paralytic Shellfish Poisoning



## ***Pseudo-nitzschia spp.***

- Cosmopolitan
- Causes Amnesic Shellfish Poisoning



## ***Microcystis (blue-green algae)***

- Previously a freshwater problem
- Recently monitored in coastal waters



# The Rogue's Gallery-- Not Regulated

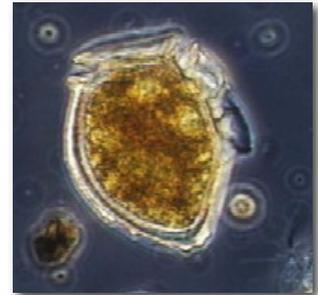
## *Heterosigma akashiwo*

- Raphidophyte
- Found in embayments and in aquaculture



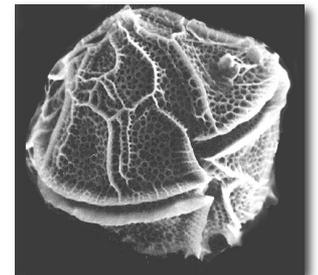
## *Dinophysis*

- recently identified in California
- causes diarrhetic shellfish poisoning



## *Lingulodinium polyedrum*

- Red Tide forming dinoflagellate
- Previously thought to be “harmless”



# The Rogue's Gallery- Emerging

## ***Cochlodinium fulvescens*\***

- Fish/shellfish killer

***\*Red Tide producers***

## ***Lingulodinium polyedrum* \***

- Produces yessotoxin (Howard 2006, 2007)

## ***Akashiwo sanguinea* \***

- “Harmless” red tide (produces peroxides?)

## ***Dinophysis spp.***

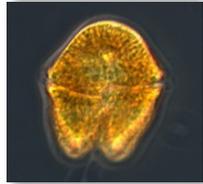
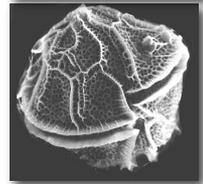
- Diarrhetic Shellfish Poisoning

## ***Ceratium spp.* \***

- Generally harmless

## ***Heterosigma akashiwo***

- Bays and estuaries—causes fish kills



# Discovery of Saxitoxin

- 1927, contamination of mussels in San Francisco
- 102 illnesses and 6 deaths
- *Alexandrium* determined to be responsible
- Regulatory limit established as  $80\mu\text{g}/100\text{g}$  of tissue
- Lethal (human) dose is 1-4 mg toxin



# HAB Timeline

1987: Domoic Acid first identified, but linked to previous events



1987

1990

1992

1994

1996

1998

2000

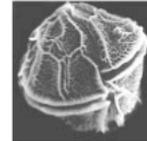


1991: DA discovered in Monterey Bay, Major bird mortality event

1995: *L. polyedrum* Red Tide (extending from Baja to Monterey, CA)

1998: *P-n* bloom along much of the US West Coast  
Severe bird and marine mammal mortality

2002: More than 500  
Seizures in Southern California



2000: Highest recorded DA values in Monterey Bay  
Relatively few impacts on higher trophic levels

2001

1998: *P-n* bloom along much of the US West Coast  
Severe bird and marine mammal mortality



2002: More than 500 sea lion, 20 dolphin  
Seizures in Southern California

2006: Pelicans poisoned in Southern California;  
Linked to contaminated shellfish



AP Photo/Krista Niles

2007: Highest ever recorded  
DA in shellfish, Santa Barbara;  
DA poisoning from Los Angeles  
to Monterey

1998

2000

2002

2004

2006

2008

2000: Highest recorded DA values in Monterey Bay  
Relatively few impacts on higher trophic levels

2006: Massive red tides in Monterey--shift  
to "Age of Dinoflagellates?"

2003: *Pseudo-nitzschia* bloom in Santa Barbara,  
Massive DA concentrations



# California HAB events

- 2002--first evidence for shift to Southern California
- more than 500 sealion, 31 dolphin seizures in Southern California
- 2003: Pseudo-nitzschia bloom in Santa Barbara Channel exceeded 30  $\mu\text{g}/\text{L}$  chl, massive DA concentrations

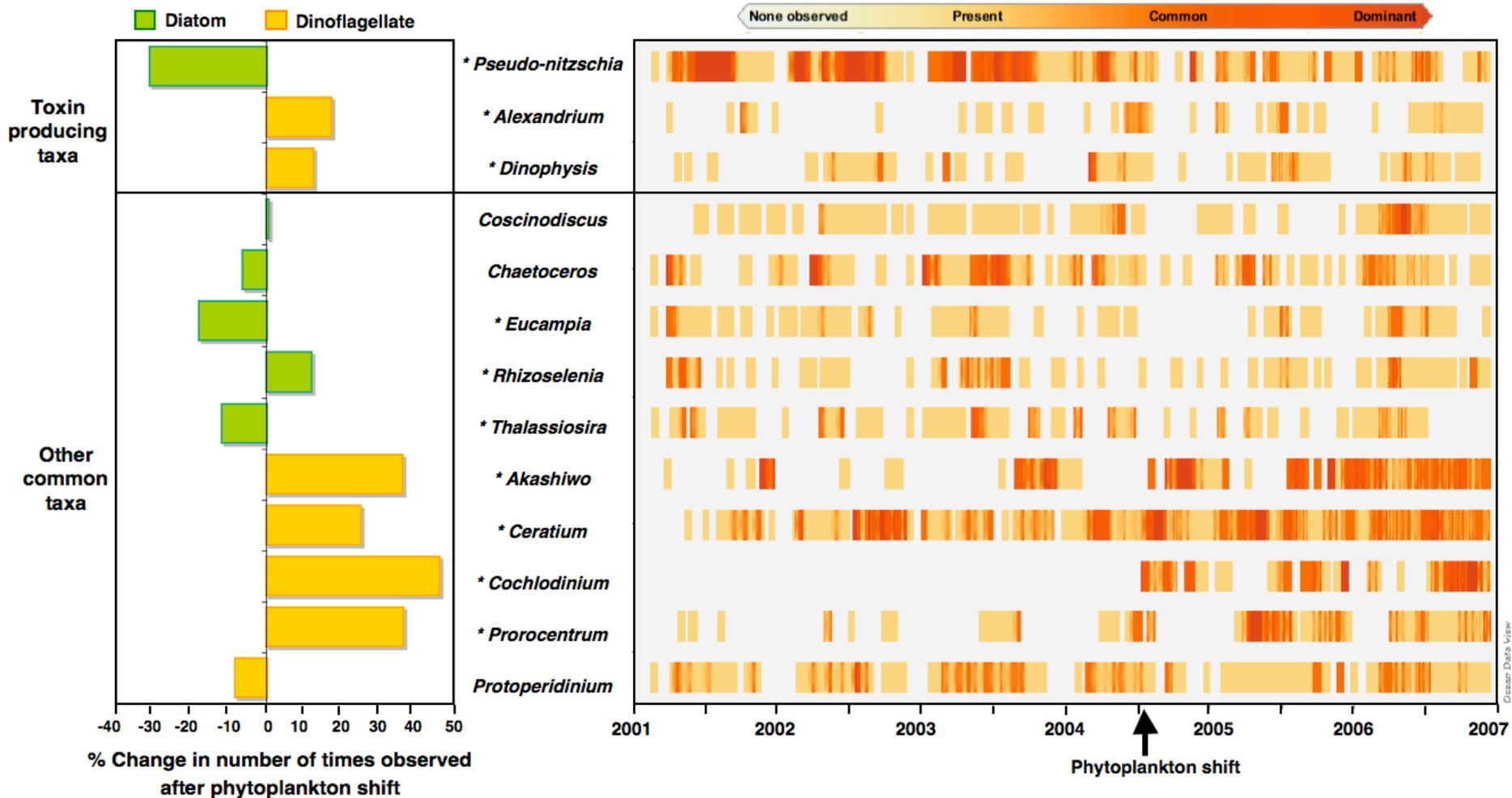
AP Photo/Krista Niles



## ***Toxic Algae Poisoning Los Angeles Pelicans***

**LOS ANGELES Apr 13, 2006 (AP)** Pelicans are falling ill and dying from the same toxic algae bloom that is sickening sea lions and making shellfish unsafe for human consumption, wildlife rescuers said.

# Are HAB events more common?



Greener Data View

Source: R. Jester, G. Langlois, M. Silver

# *Are they related to humans?*

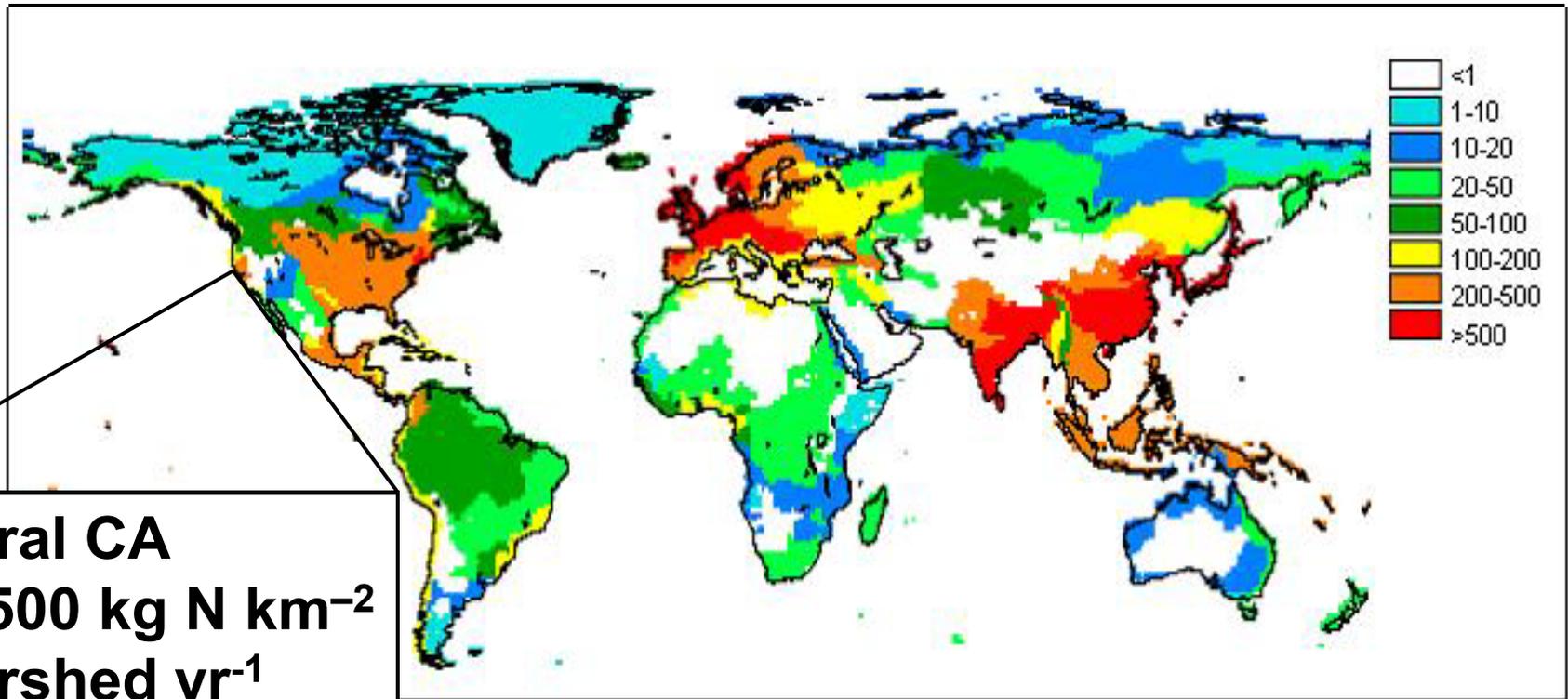
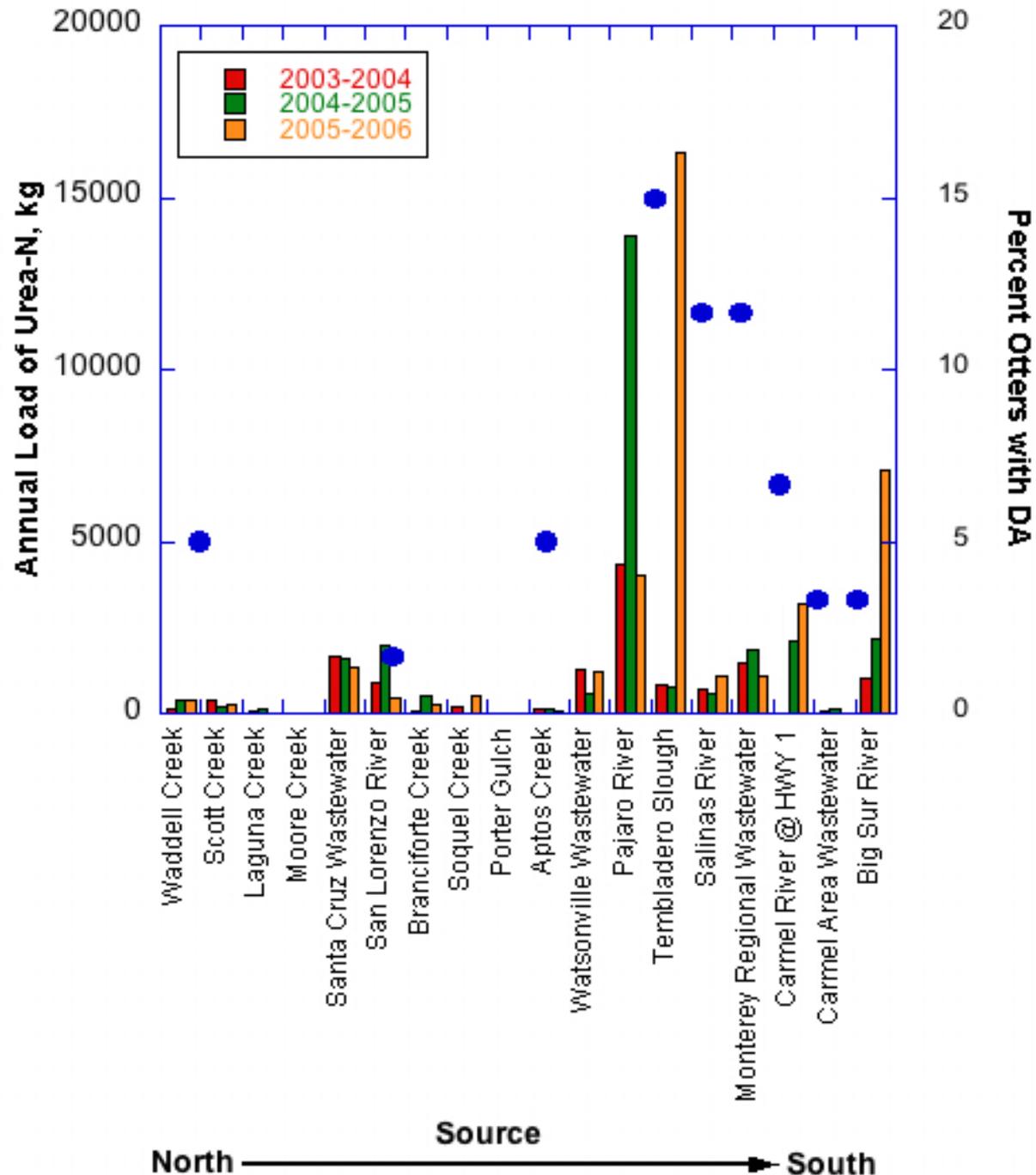


Figure courtesy of Dr. Patricia Glibert, adapted from Seitzinger & Kroeze, 1998 and Glibert & Burkholder, 2006.



About 50% of stranded California Sea Otters show signs of Domoic Acid Intoxication

Stranding locations may be linked to urea discharge....



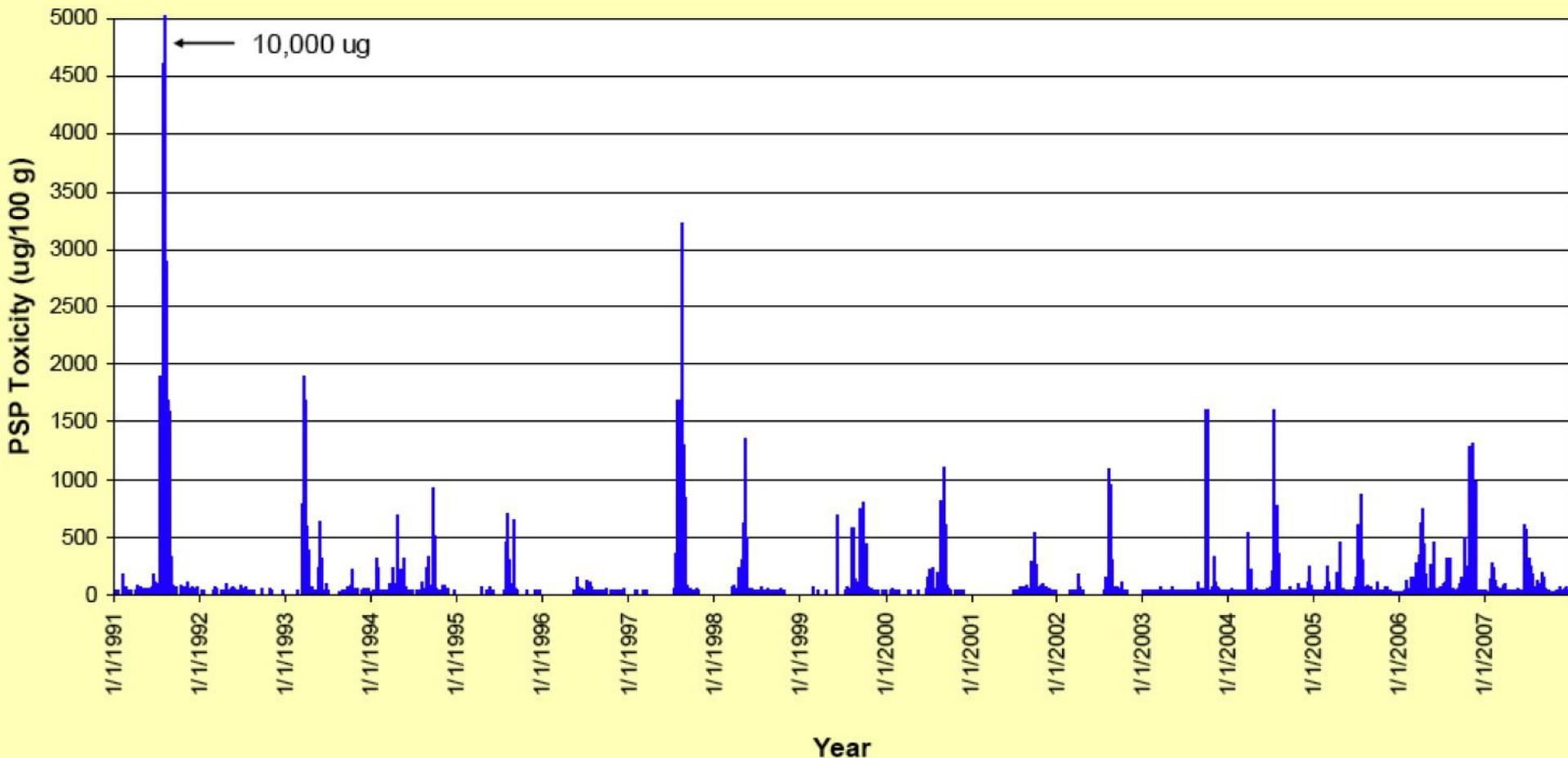
# More Red Tides = New Problems

- The increase in all dinoflagellates has resulted in an increase in saxitoxin, yessotoxin, okadaic acid, pectenotoxins, etc.
- *Cochlodinium fulvescens* appeared in Monterey at bloom concentrations in 2004--in 2007, it resulted in a \$60,000 shellfish loss to the Monterey Abalone Company
- November 2007, the “harmless” dinoflagellate *Akashiwo sanguinea* is linked to massive bird mortalities
- 2008—coldest ocean temperatures on record—switch back to *Pseudo-nitzschia*?



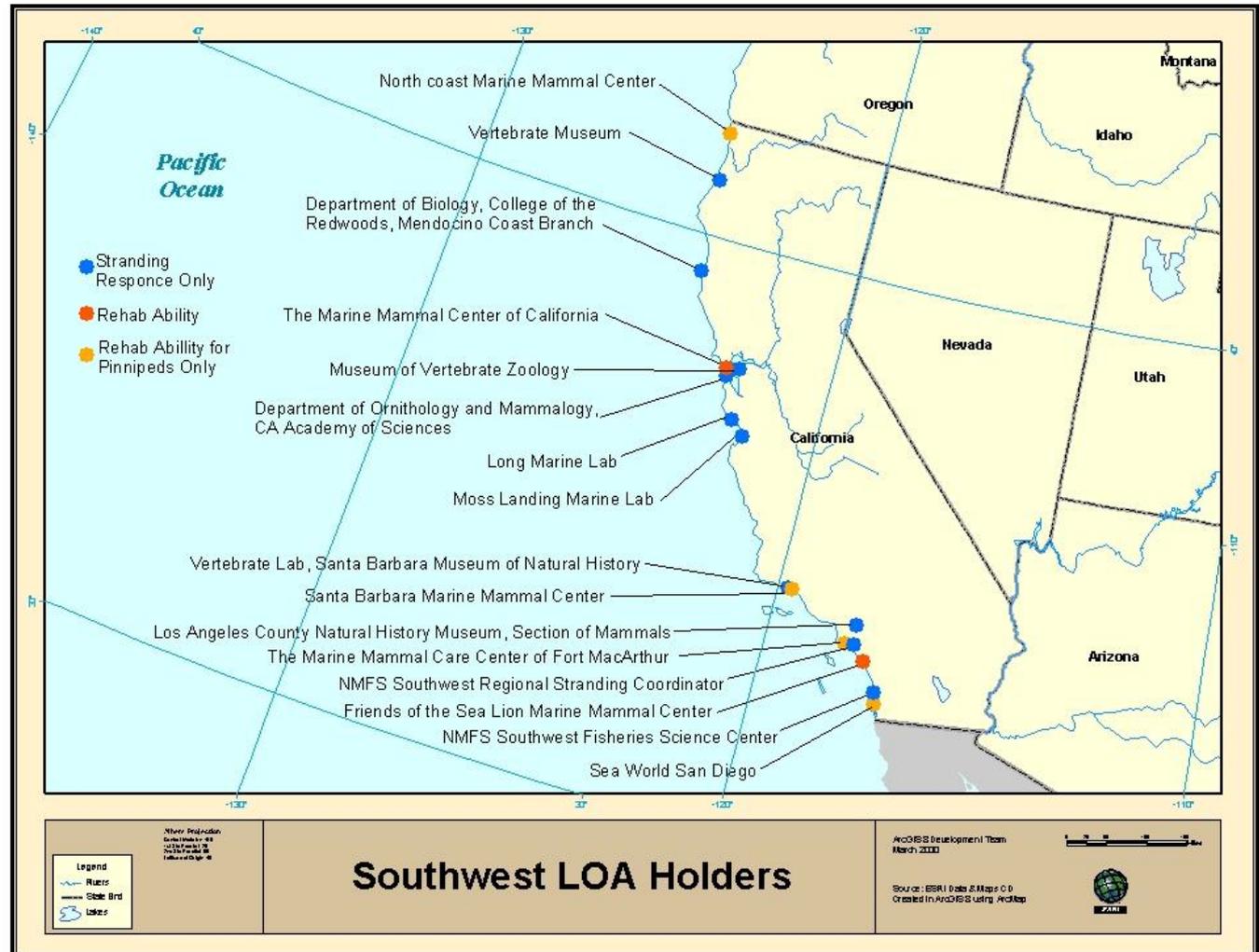
# CDPH Monitoring Program

PSP Toxicity in California: 1991 - 2007



# Marine Wildlife Monitoring

- Marine Mammal Centers
- California Dept Fish & Game
- Wetlands & Wildlife Care Center
- Other groups



# DA Indicators In Wildlife

- Mid-February, marine mammals come into rehabilitation centers with DA poisoning
- Approximately 6-weeks later, marine birds start to show signs of DA poisoning



# Index Of Suspicion

- Red Tide Occurrence
- Any sick fish-eating bird presenting with mild to severe neurological symptoms
- Within normal weight range for species
- Able to rule out other pathogens
  - Avian Influenza
  - Botulism
  - Newcastle's
- Confirmation of DA through testing



- Health warnings from the CDFG advising of a red-tide occurrence in Southern California - **RELEASE: IMMEDIATE**

**“STATE HEALTH OFFICER ADVISES CONSUMERS NOT TO EAT SOME SHELLFISH AND VISCERA OF SARDINES, ANCHOVIES AND CRAB FROM SOUTHERN CALIFORNIA COAST “**

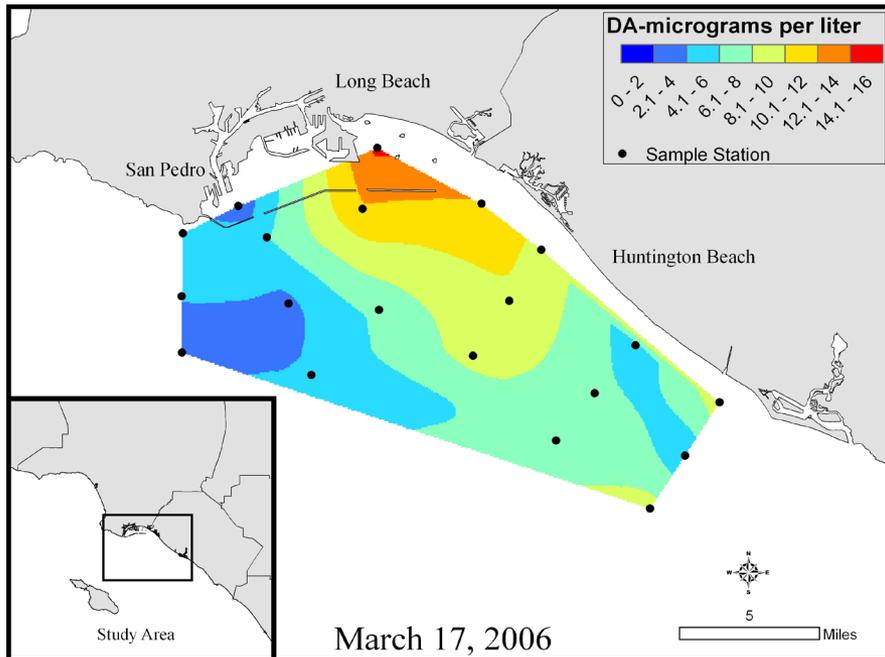
# RAPDALERT: Rapid Analysis of *Pseudo-nitzschia* & Domoic Acid, Locating Events in near-Real Time

Caron, Jones, Sukhatme, Schnetzer (USC), Estrin (UCLA), Miller (UCSC; SCCWRP), Weisberg (SCCWRP)

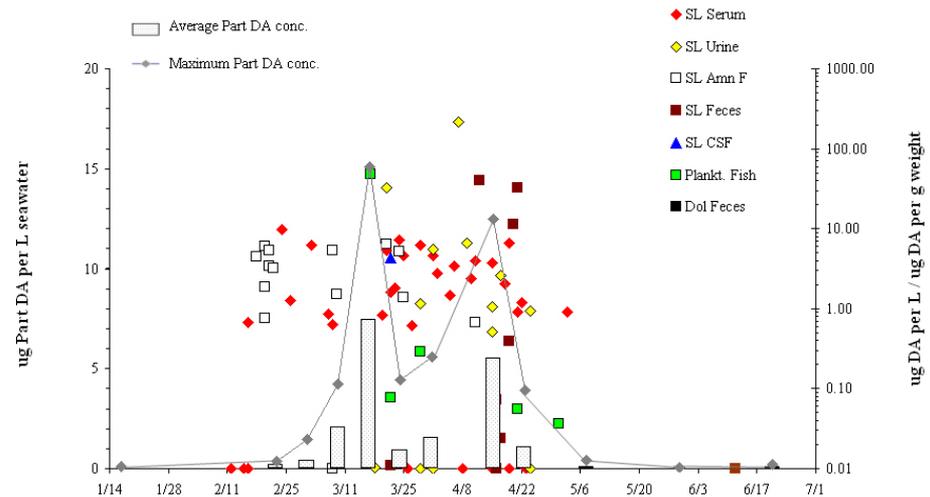
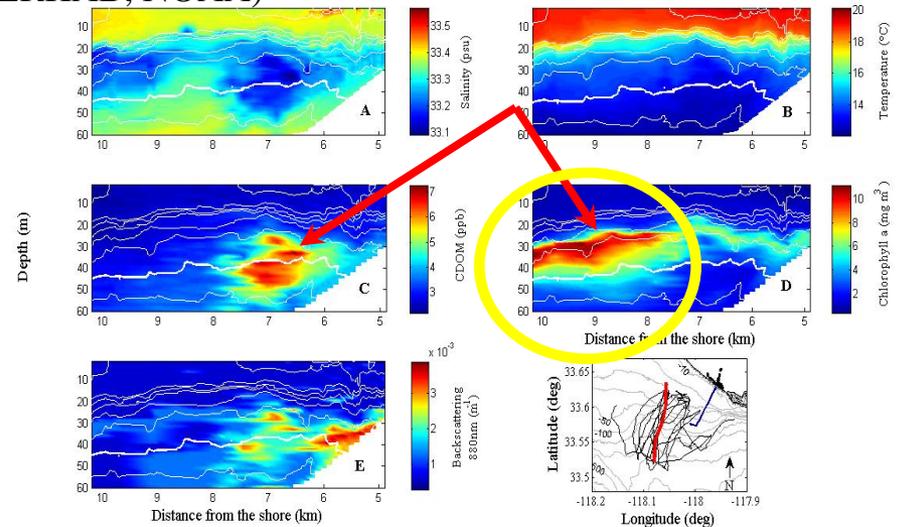
(supported through MERHAB, NOAA)

Partnerships with state & regional health agencies, animal rescue agencies  
Focus on San Pedro Shelf region.

Pier Monitoring Sites  
Autonomous vehicles  
Shipboard sampling



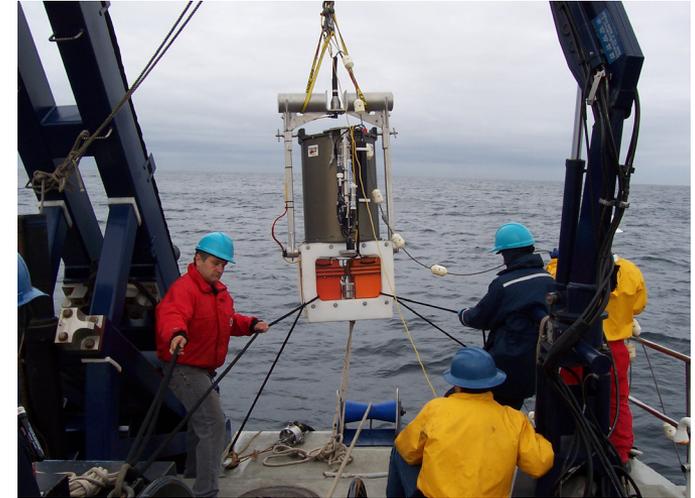
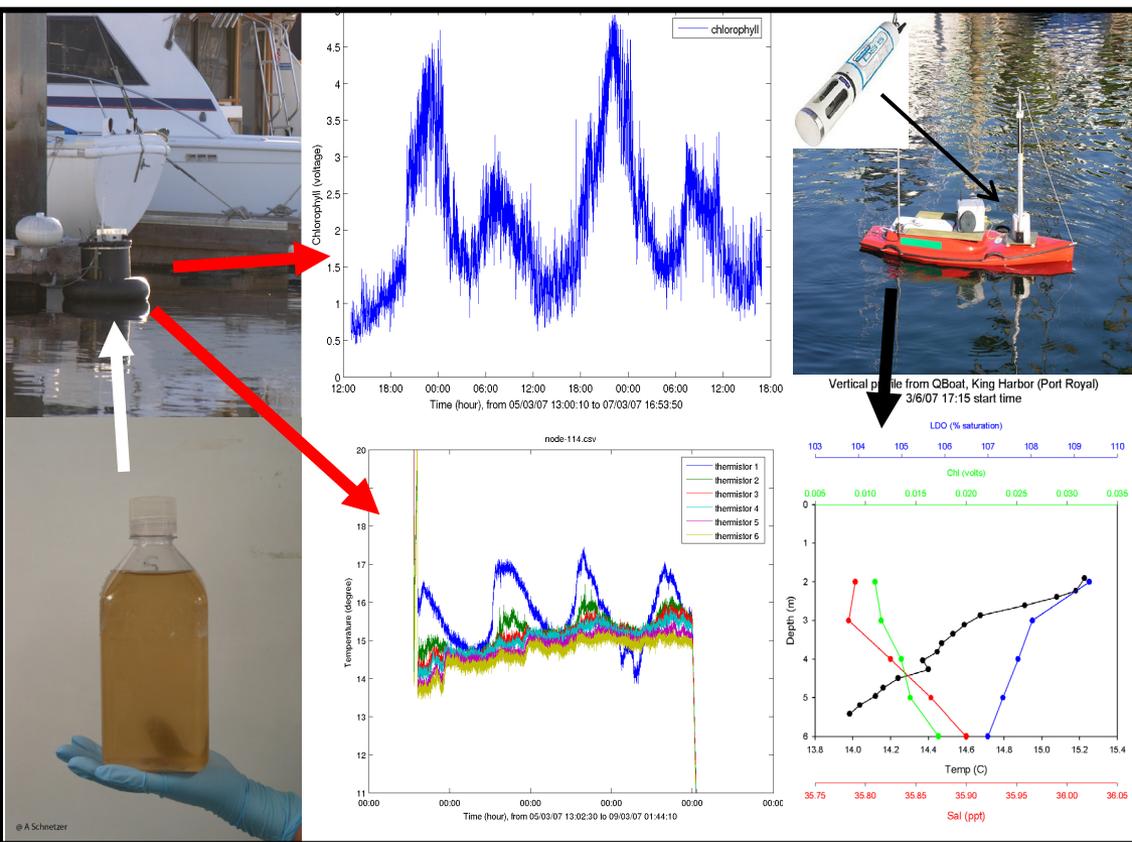
Raphael Kudela



West Coast Regional HAB Summit, February 2009



# Research Examples

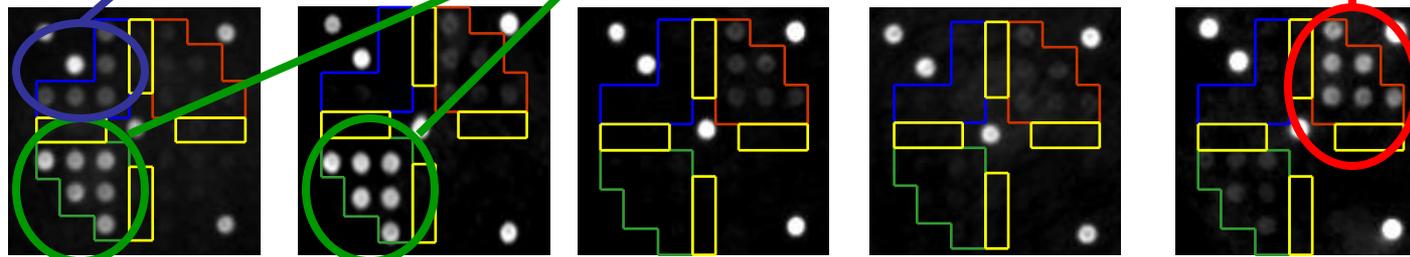
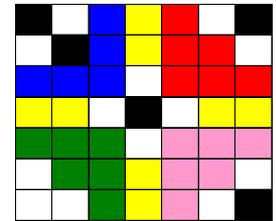
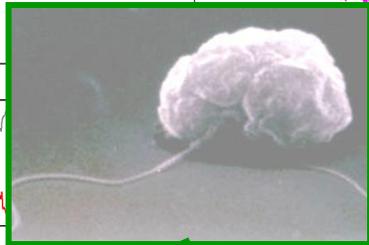
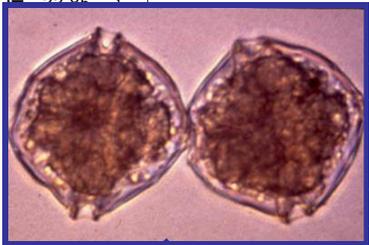
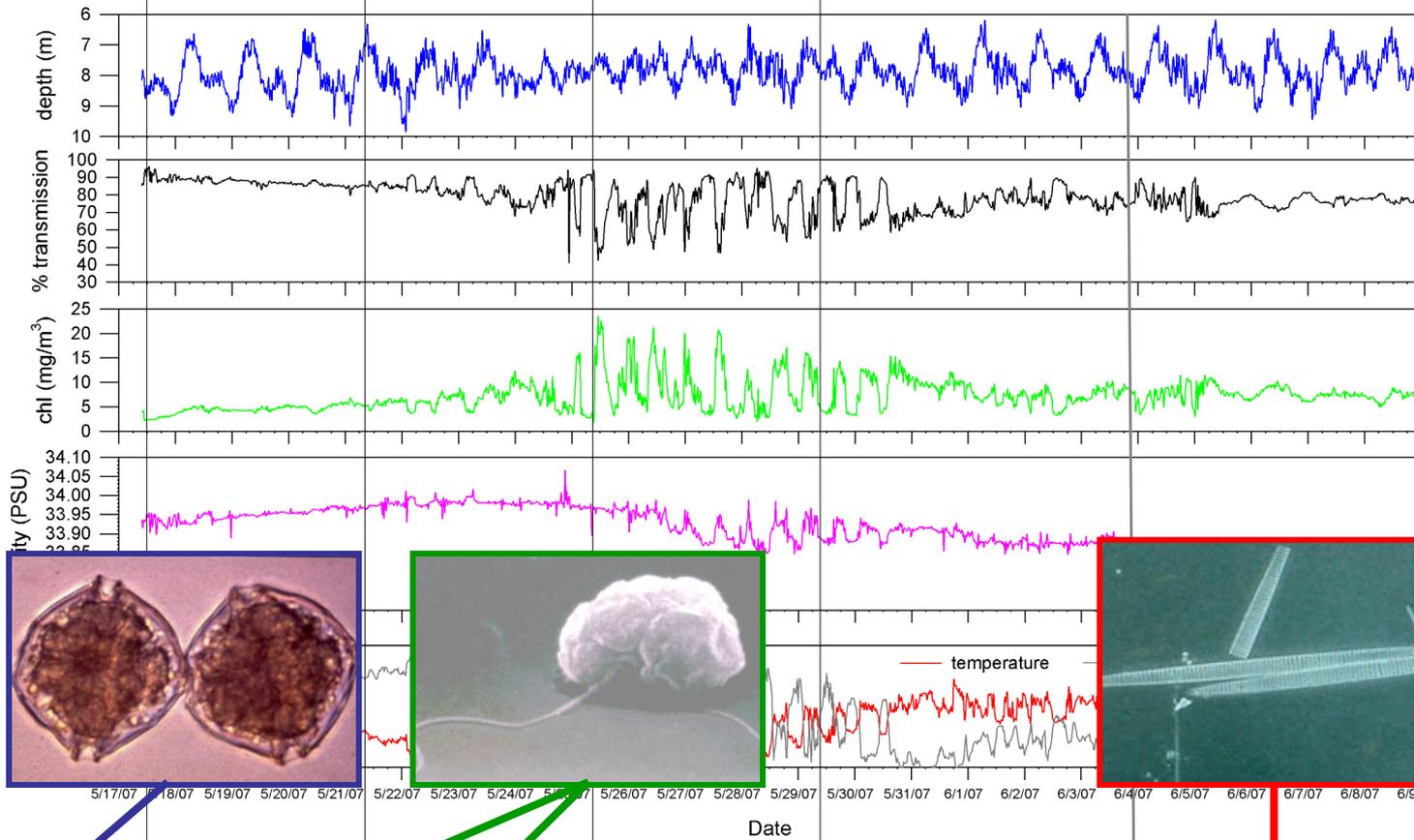


*New technologies such as robotic boats and in situ laboratories are being developed....*

# ESP Field Deployment

Monterey Bay, CA  
May 17-June 11, 2007

*In situ* Detection  
of Harmful Algae



- control
- *Alexandrium tamarense/catenella*
- *Pseudo-nitzschia multiseries*
- *P. multiseries/pseudodelicatissima*
- *Heterosigma akashiwo*
- *P. australis*

May 17, 2007  
1000 ml

May 21, 2007  
1000 ml

May 25, 2007  
1000 ml

May 29, 2007  
1000 ml

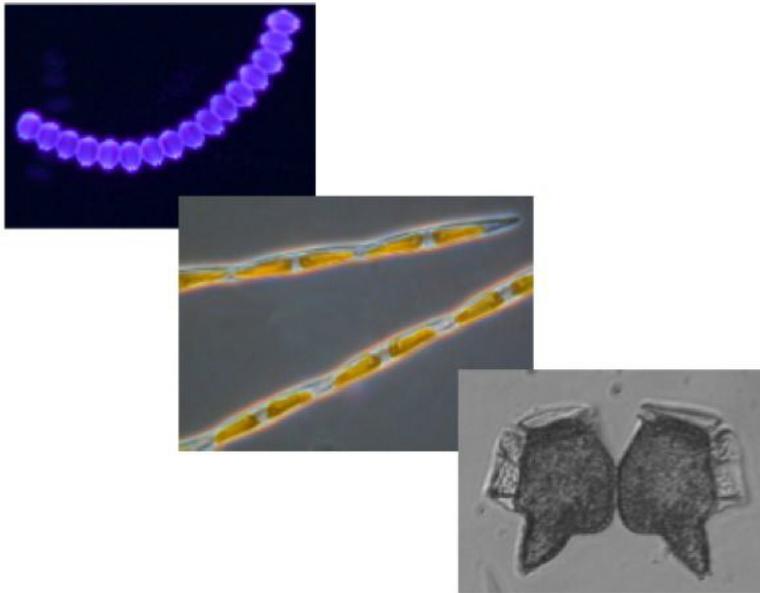
June 4, 2007  
1000 ml

Greenfield et al. *L&O Methods* (2008)

# California HABMAP

THE REGIONAL WORKSHOP FOR HARMFUL ALGAL BLOOMS (HABS) IN CALIFORNIA COASTAL WATERS

April 2-3, 2008 Workshop Proceedings



Center for Sponsored  
Coastal Ocean Research



- Voluntary participation
- No mandate or direct government backing
- Accomplishments:
  - Beginning of a standardized monitoring network
  - Cell & Toxin Detection inter-calibration planned
  - Working with CA Sea Grant, Ocean Protection Council
  - Bridges 2 OOS groups, human and wildlife health, local, state, and federal agencies, research, monitoring, and end users