Merging Outreach and Research: Lessons Learned on Balancing These Goals Using Ocean Ecosystem Health As a Focus

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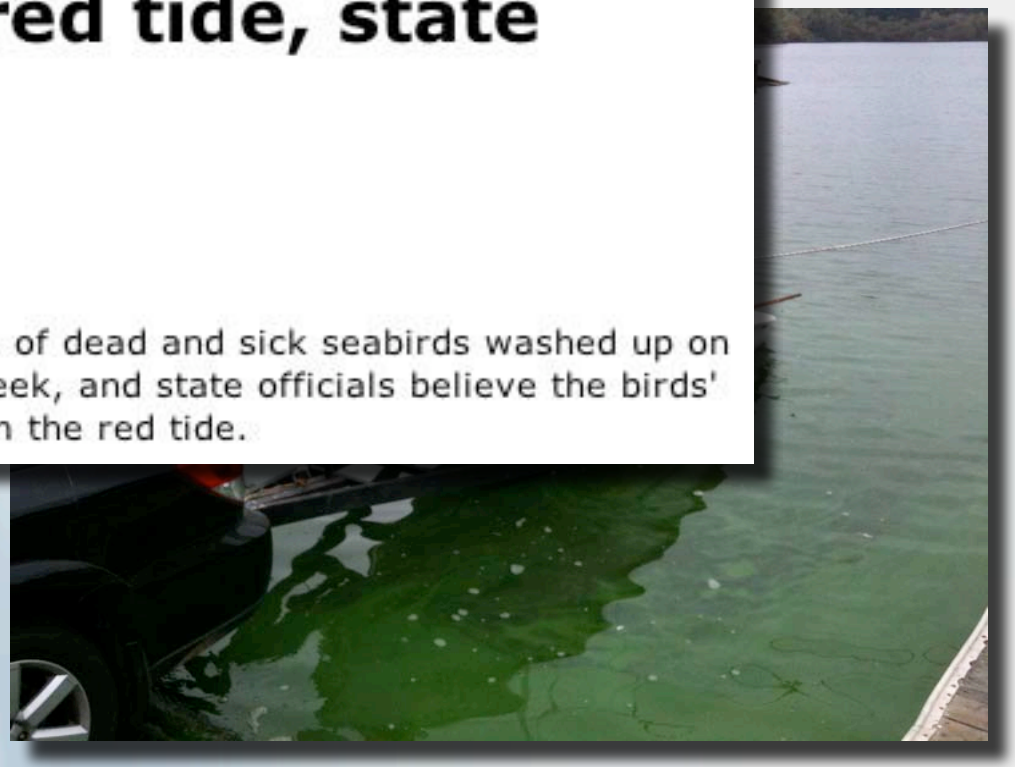
Background: Harmful Algae & Outreach

November 28, 2007

Santa Cruz County seabird die-off linked to red tide, state officials say

JENNIFER SQUIRES
SENTINEL STAFF WRITER

SANTA CRUZ -- Another wave of dead and sick seabirds washed up on Monterey Bay beaches this week, and state officials believe the birds' mysterious illness comes from the red tide.



Lesson 1: Ask the experts, but don't limit yourself!

SEYMOUR MARINE DISCOVERY CENTER
AT LONG MARINE LABORATORY
INSTITUTE OF MARINE SCIENCES
UNIVERSITY OF CALIFORNIA, SANTA CRUZ

- What is science?
- Why is science important?
- Who are scientists?
- What questions do scientists ask?

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BUT: the Seymour Center did not have the budget, time, or interest to add a module based on ecosystem health

What are our research goals?

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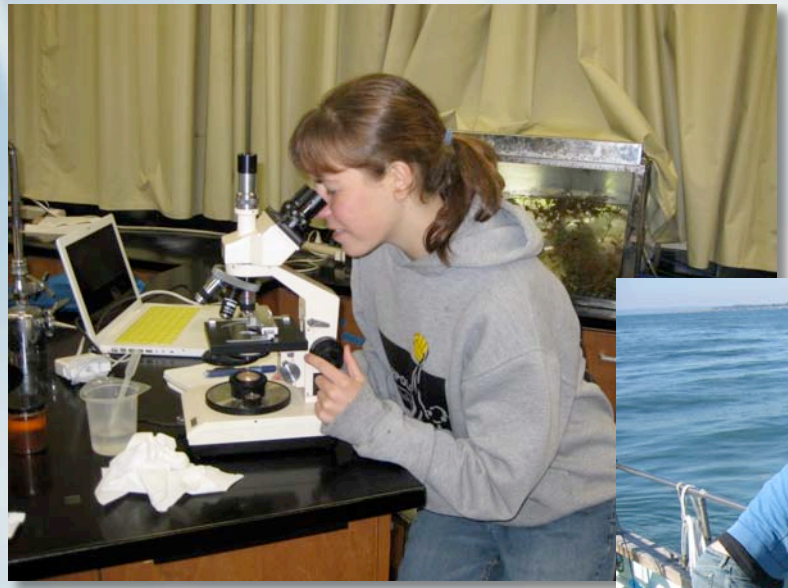
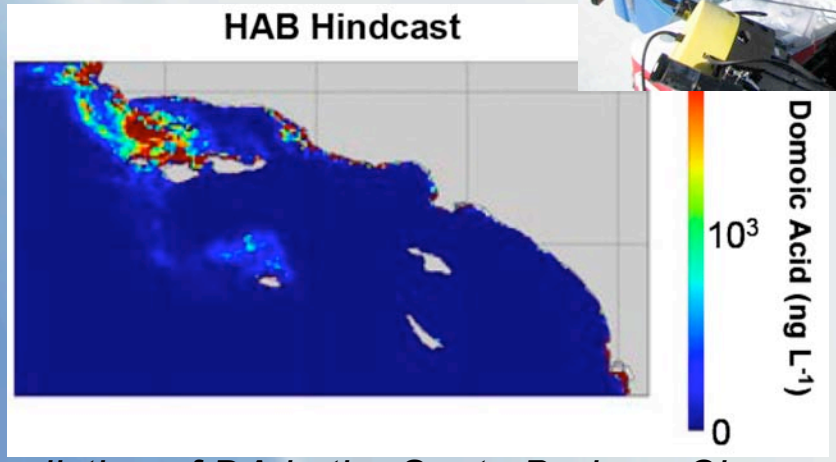


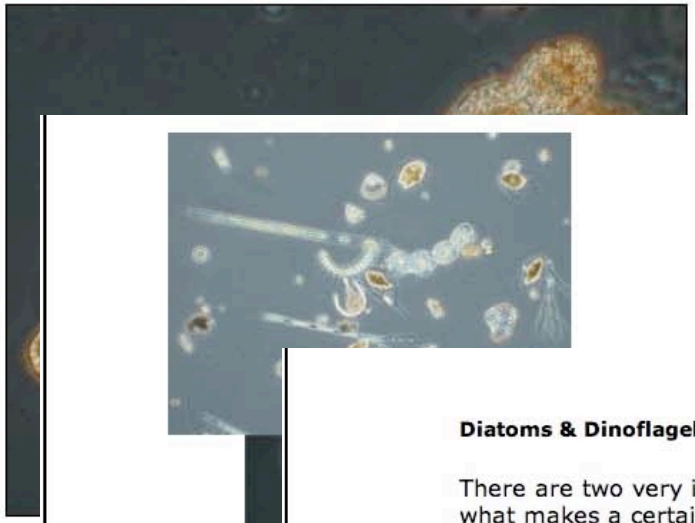


Prediction of DA in the Santa Barbara Channel

What are our research goals?

http://cimt.ucsc.edu/habid/habhome.html

Phytoplankton Identification



Genus: *Cochlodinium* | Dinoflagellate

HOME | PHYTOPLANKTON | GLOSSARY

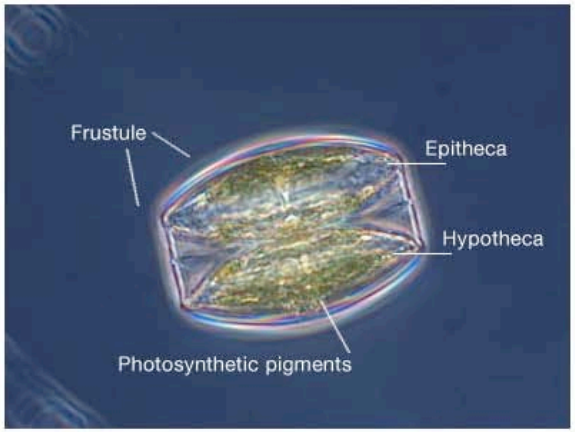
Glossary

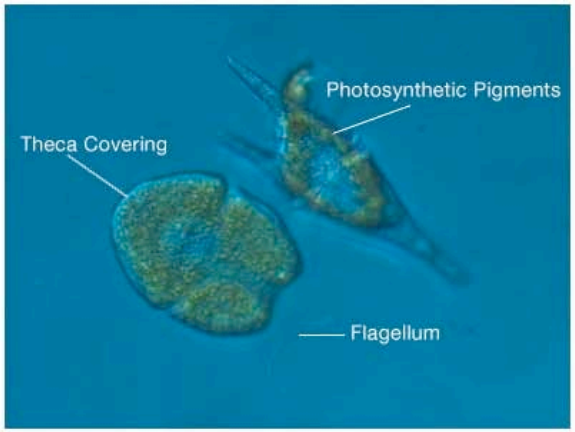
Auxospore: Specialized cells that function to re-establish the normal size of a diatom following multiple mitotic cell divisions, which leads to a decrease in cell size. They may also be formed as a response to non-favorable conditions in which

HOME | PHYTOPLANKTON | GLOSSARY

Diatoms & Dinoflagellates

There are two very important groups of phytoplankton species: diatoms and dinoflagellates...so what makes a certain kind of plankton either a diatom or a dinoflagellate?





Diatoms

- Single-celled algae that possess a distinct nucleus (eukaryotic).
- They are represented by two major groups based on the structure and shape of the valves. These are the Centrics (Order: Biddulphiales) and the

Dinoflagellates

- Single-celled eukaryotic micro-organisms.
- They possess a distinctive nucleus where they maintain continually condensed chromosomes.
- Characteristically have two flagellae which afford them some mobility.

Santa Cruz Plankton Weekly Updates

A CalPReEMPT project in partnership with CeNCOOS

About | Disclaimer | Plankton Species of the Month

Week of February 15, 2010

Posted by: **cimt2007plankton** | February 18, 2010

Sample description by Jenny Lane
Sample date: **Wednesday, February 17, 2010**

Quick phyto report:
Pseudo-nitzschia spp.: Present (this reflects relative abundance in a sparse sample; very few cells were observed).
Alexandrium spp.: None observed.

Full report:
Sampler: Jenny Lane
Sampling time: 8:40 am

SCW local conditions
Water color: Green (NOAA color: 10GY 2/4)
Water temperature: 12.9 C
Water visibility: 4 ft
Water conditions: Calm
Tide: Low at 6:11 am (1.52 ft)

PAGES

- About
- Disclaimer
- Plankton Species of the Month

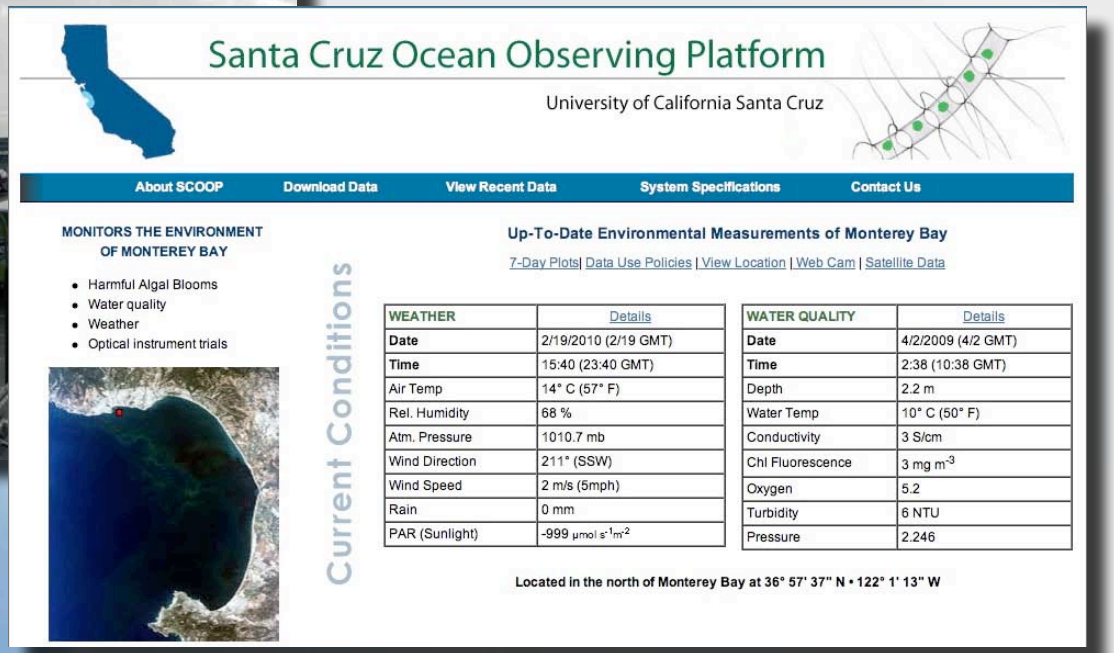
SC WEEKLY BLOG ARCHIVES

Select Month

BLOGROLL

- CalPReEMPT
- CeNCOOS
- Peter Miller Research
- Phytoplankton Online Library
- Raphe Kudela Research
- WordPress.org

Lesson 2: Ignore the experts and ask the end users….



Lesson 3: Modular additions work best

Understanding Algal Blooms

A Two Day Class

Training Academy

Algal blooms sometimes create significant water quality problems with large impacts on beneficial uses of various marine, estuarine, and freshwater bodies. The organisms responsible for these blooms are many and varied, but break down into two main groups: true green algae and cyanobacteria (formerly known as "blue-green algae").

This 2-day class will introduce students to the general topic of how algal blooms occur in nature, how different kinds of blooms generally function, how blooms may be affected by human activities, how researchers and regulators monitor blooms and/or the toxins they may produce, and how these events may affect water quality concerns such as CWA 303(d) listings of impaired waterbodies, as well as drinking water, fish and wildlife beneficial use issues. In order for the class to gain maximum practical benefit, attendees will have the opportunity to visit nearby locations areas experiencing visible algal blooms, will be provided with examples of various algae to view under microscopes, and will observe how various "rapid indicator" tests can be performed in detecting several toxins.

The final agenda and logistical details for this class will be sent as a follow-up item in the near future.

Date: June 13 & 14, 2007

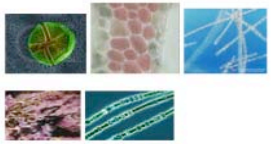
Location: University of California Santa Cruz, http://www.ucsc.edu/public/

Who can attend: Regional Board Staff. This class is by invitation only and space is limited to 18 participants.

Registration Fees: Paid through the Water Board Training Academy

To Register: RSVP to the registration invitation by May 31, 2007 to Kim Ward at (916) 341-5586. Be sure to include the names of the staff who will be attending. Due to space limitations in the UC laboratory facilities, we must limit participation to two staff per regional board. Follow the training registration requirements, obtain all required approvals. If you have questions concerning the class please contact Kim at the number above.

If you have special accommodation or language needs, please contact OEA, (916) 341-5883 or email Karen White at kwhite@waterboards.ca.gov at least 5 working days prior to the class. TTY/DD/Speech to Speech users may dial 7-1-1 for the California Relay Service.



Manager Training Classes

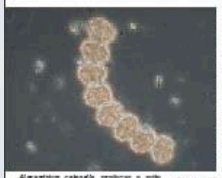
CeNCOOS

CIMT Center for Integrated Marine Technologies

Winter 2006 | A research unit of the Central and Northern California Ocean Observing System (CeNCOOS)

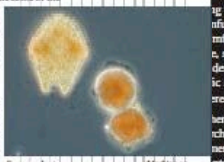
Harmful Algal Blooms (HABs)

Algal Blooms occur when environmental conditions promote the rapid growth of large numbers of single celled marine algae, either microscopic or macroscopic phytoplankton. Harmful Algal Blooms (HABs) occur when some or all of the phytoplankton in a bloom exhibit a harmful trait. The vast majority of algal species are not harmful and indeed perform an essential role as the primary producers in many aquatic ecosystems. Thus, many algal blooms are not toxic and in fact, contrary to common beliefs, discoloration of the water does not indicate whether a species is harmful. Many nontoxic species produce red tides or brown tides, while some HABs can occur without any discoloration of the water.



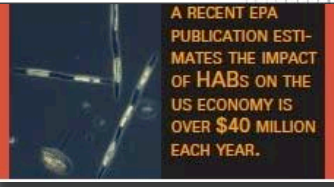
There are a number of ways in which algal blooms can have a negative impact and thus be considered harmful. Some harmful species produce toxins, which can affect humans, fish, marine mammals, and seabirds. Some species cause large fish kills by clogging up or lacerating the fish's gills; these species generally are also detrimental to crustaceans. Still others negatively impact the system indirectly: by causing other aquatic plants and animals to suffocate (by using up all the oxygen), or by blocking all the sunlight and preventing aquatic plants from accessing it.

Harmful algal blooms are naturally occurring events, but they appear to be increasing in intensity and frequency. Blooms occur when environmental conditions change to be more favorable to phytoplankton growth. This often is due to an increase in limiting nutrients, but also could be due to changing temperatures or amounts of light, or turbulence in the water column. While some of the apparent increase in HABs may be due to better monitoring programs, there is growing evidence that humans are causing the blooms to occur more frequently, be larger and last longer. Humans could potentially be influencing blooms in a number of ways: examples include increasing nutrient availability via run-off, sewage, fertilizer, etc., climate change, or merely by assisting in the transport of new species into an area.



Harmful algal blooms occur along both coasts of the United States, some species are widespread, while others appear to have a more restricted range. There are six groups of harmful algae that have a strong presence on the West Coast of the United States. Some species of *Pseudo-nitzschia*, produce domoic acid, responsible for amnesic shellfish poisoning. *Alexandrium catenella* produces a suite of toxins responsible for paralytic shellfish poisoning symptoms. Diarrhetic shellfish poisoning is due to a milder suite of toxins which are produced by some species of *Dinophysis*. In the Northeast Pacific off the coast of Washington and up into Canada, *Heterosigma* is responsible for massive finfish mortalities, and it has also been observed in San Francisco Bay and Los Angeles waters. And then there's *Cigwuera* poisoning, which occurs in tropical waters and accumulates in the viscera and fatty tissues of reef fish. Finally, *Lingulodinium polyedrum* and *Gonyaulax spinifera* have been identified in California as yessotoxin producers, which may cause problems for marine mammals and humans.

THERE IS GROWING EVIDENCE THAT HUMANS ARE CAUSING THE BLOOMS TO OCCUR MORE FREQUENTLY, BE LARGER, AND LAST LONGER.



A RECENT EPA PUBLICATION ESTIMATES THE IMPACT OF HABs ON THE US ECONOMY IS OVER $40 MILLION EACH YEAR.

Research

mid-nineties a national plan was created ordinate research on HABs. This became ti-agency research agenda that funds and laborative research between many academic ental agencies into the large scale complex iful Algal Blooms.

continuing nationwide and locally, the ecology, toxicology, and oceanographic evant to HABs. More specifically, researchers understand what physical and environmental ese algal species respond to, what causes the causes the toxin production, and how that through the food web. Projects done locally around the Monterey Bay are maintaining onitoring programs recording HABs, as well g the ecology and physiology of the locally iful algal species. There are various ways mful algal species are identified, some are e, such as having an expert visually identify der a microscope. Molecular probes that are ic allow for a more rapid identification of rest.

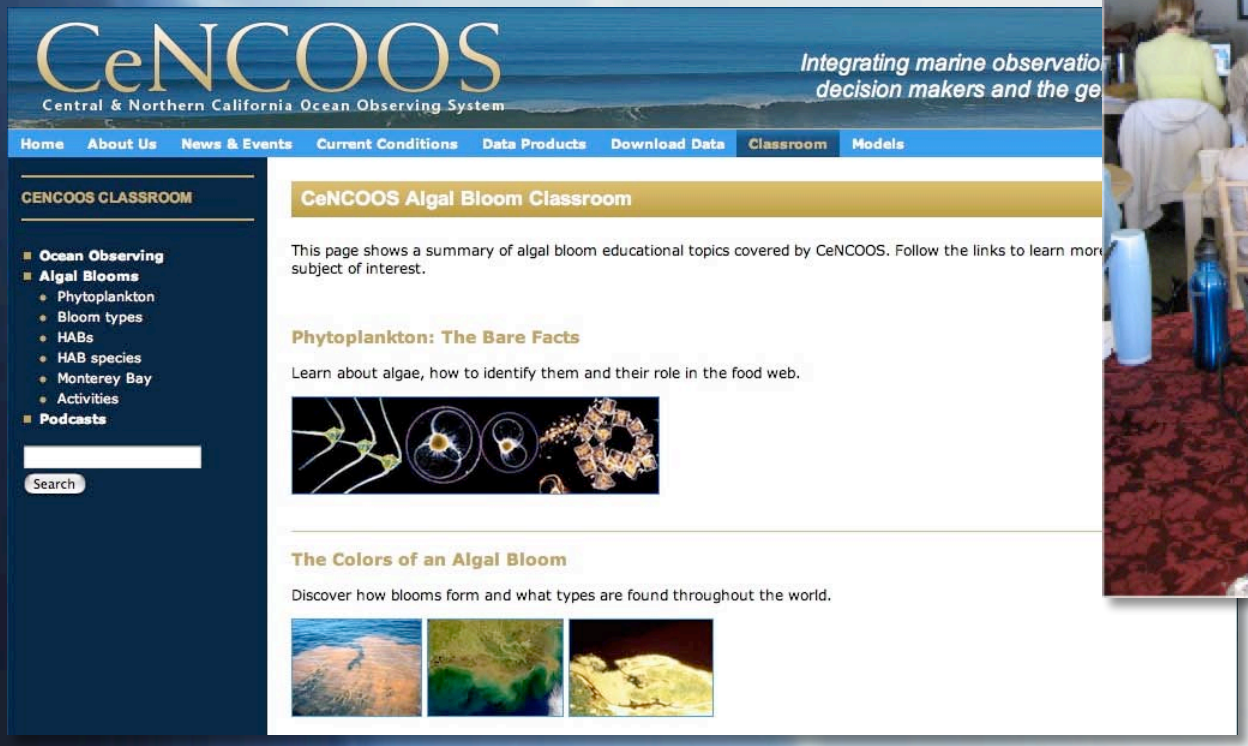
ers are also involved in another important rch to protect the public health, which is ment of rapid detection techniques and stems. The predictions of blooms is another der investigation. CIMT and other groups ogether to meet these goals for California.

HAB Fact Sheet

Lesson 3: Modular additions work best

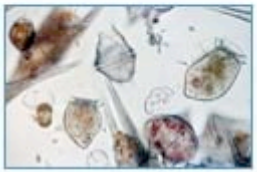
Flash Cards (docent training)

Lesson 4: Take advantage of expertise!



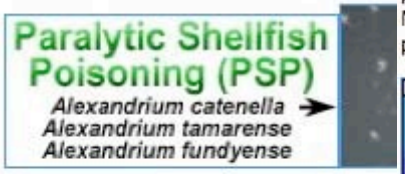
When a Bloom Turns Harmful

Find out the environmental factors that combine to produce a deadly HAB event.



California's Most Wanted

Examine the Top Nine Bad Guys

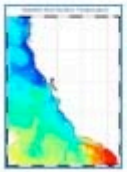


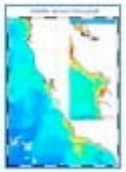
Time Traveling in Monter

Learn how studying the history c

Become a HAB Expert

Learn how to analyze actual data





Time Traveling in Monterey Bay

The physical conditions of Monterey Bay make it a "hot spot" for algal blooms. Monterey Bay has a shallow continental shelf and provides shelter from open ocean conditions, providing an ideal HAB environment because there is less disturbance. Also, the deep Monterey Submarine Canyon that splits the Bay provides nutrients to sustain phytoplankton growth in the form of a "turbid plume" (see diagram below).

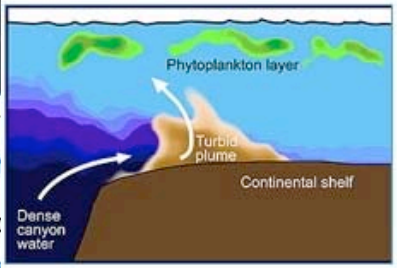
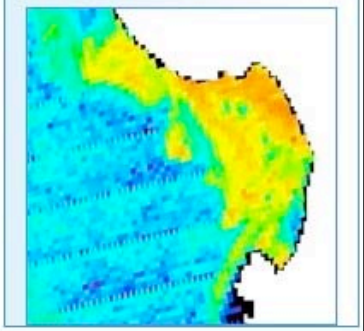


Diagram of turbid plume effect

SATELLITE IMAGE OF A MONTEREY BAY ALGAL BLOOM



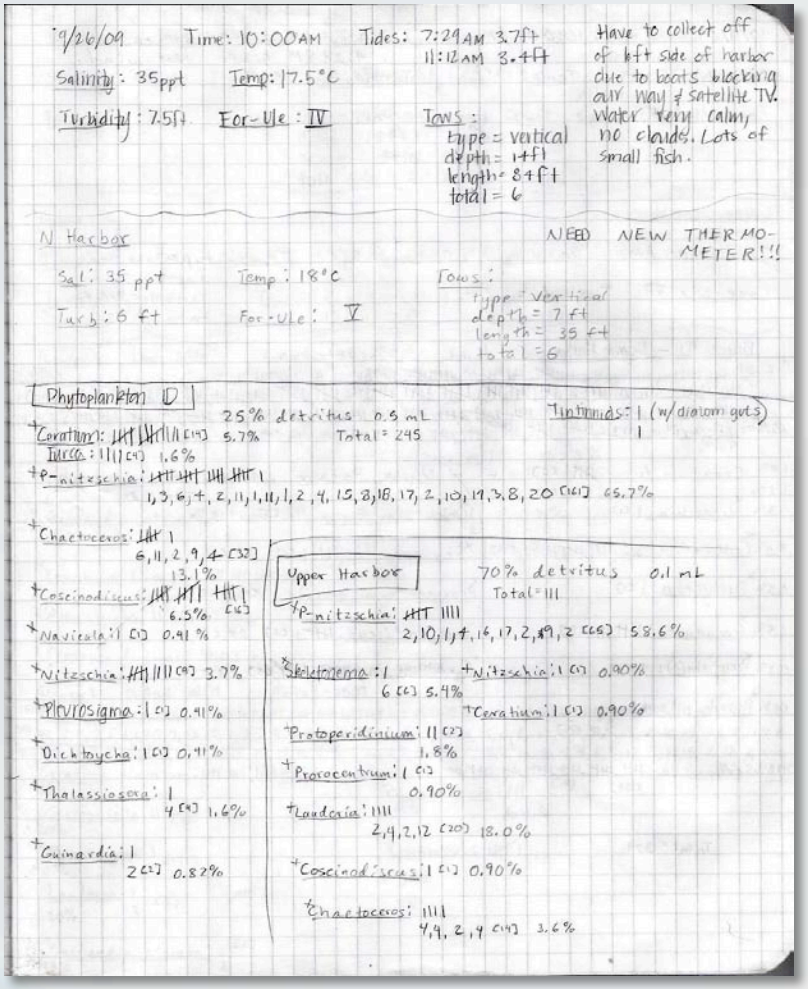
In 1991, the U.S. experienced its first recognized toxic algal bloom involving *Pseudo-nitzschia* and domoic acid in Monterey Bay. This outbreak resulted in the unusual deaths of many pelicans and cormorants that ate sardines and anchovies contaminated with high levels of domoic acid.

After the 1997-98 El Niño Another large ***Pseudo-nitzschia*** bloom was detected in Monterey Bay . Over 400 sea lion carcasses washed up on shore, appearing to have suffered neurological damage that later was connected to eating infected anchovies. Since then a series of environmental changes and regime shifts have occurred in the area.

After the 2003 El Niño, researchers noticed a strange shift in phytoplankton species. Diatoms, which are usually the more dominant phytoplankton species in upwelling systems, became less abundant. Even though diatoms grow faster and out-compete other phytoplankton species, the dinoflagellates proved to be better swimmers and were able to obtain more nutrients at lower depths.

CeNCOOS Harmful Algae K-12 module

Merging Outreach & Research



Joanna Coker & Kelly Chesus
San Lorenzo Valley HS

What did we learn?

The Good:

• Don't assume you need a formal program to be effective!

• Do focus on your research—it keeps it fresh and exciting, and means minimal additional effort

The Not So Good:

• Doing it on your own only goes so far—the professional groups can help with educational standards, national programs, and evaluation.

The Surprise (to us):

• "If you build it, they will come" and can contribute to your own research….

Acknowledgements

Partners:
- The Central and Northern California Ocean Observing System
- MBARI (particularly George Matsumoto)
- The City of Santa Cruz
- California Harmful Algal Bloom Monitoring & Alert Program
- Many educational institutions (including UCSC) around the Bay

Funding:
- Center for Integrated Marine Technology, NOAA
- National Science Foundation
- NOAA MERHAB Program
- California Water Boards
- California Sea Grant