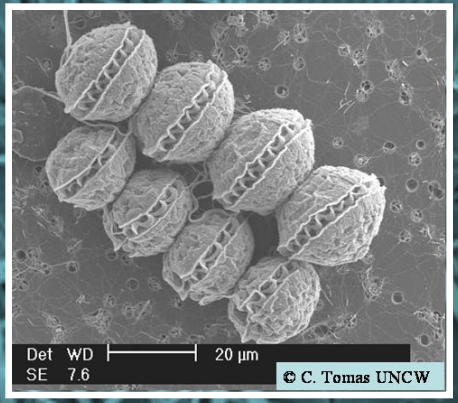
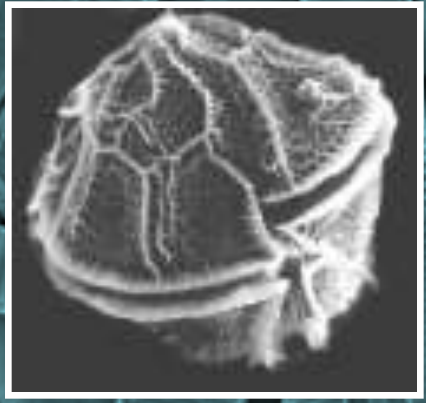
HABWatch: A Community-Based Harmful Algal Bloom Monitoring Program

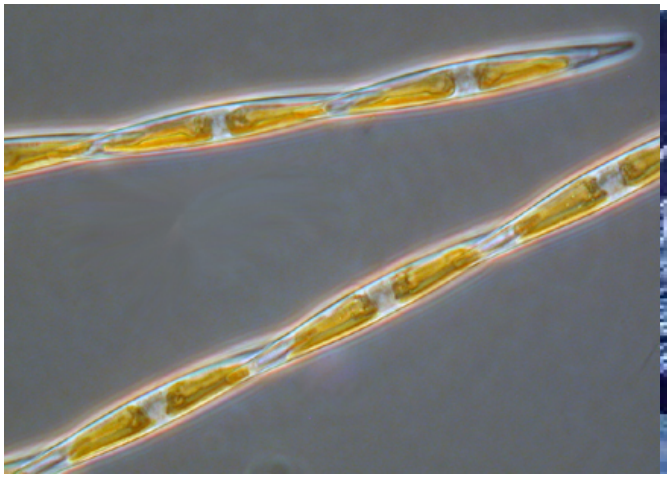
Dr. David Caron, USC
June 2015

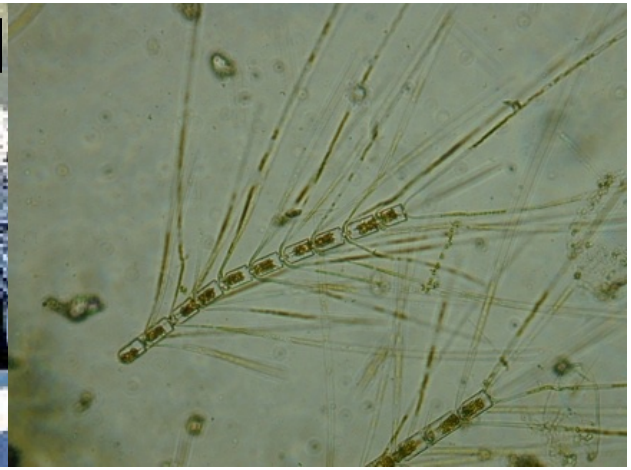




What Makes Harmful Algal Blooms Harmful?

- Production of toxins
  - Certainly important but not a necessary condition for 'harm')
- Gill Irritation and clogging, feather wetting
- Anoxia/hypoxia
- Reduced light penetration
- Food web disruption

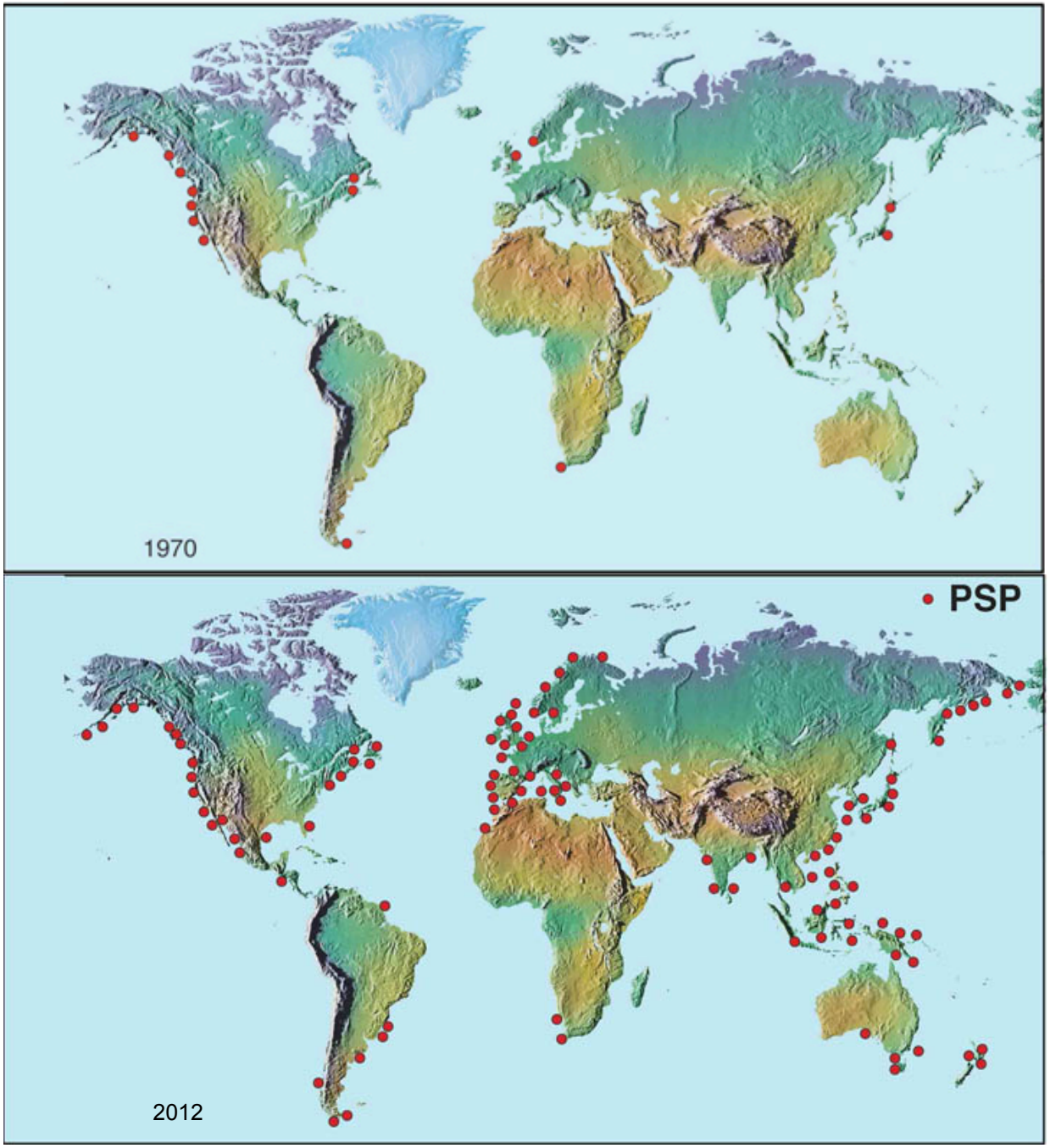




Some well known marine algal toxins

Table 3 – Summary of toxins that can be present in Southern California waters. MW: molecular weight.

Toxin	Properties	Formula	MW	Mode of action
Domoic acid (DA)	Hydrosoluble At pH 7: DA^{3-}	$C_{15}H_{21}NO_6$	311.14	Binds to glutamate receptors in the brain disrupting normal neurochemical transmission
Saxitoxins (STXs)	Hydrosoluble pH $\leq$7: Stable	$C_{10}H_{17}N_7O_4$	299.3	Bind to site 1 of voltage-sensitive sodium channels and block sodium conductance; bind to calcium and potassium channels
Brevetoxins (PbTxs)	Liposoluble			Bind to site 5 of voltage-sensitive sodium channels, shifting activation to more negative membrane potentials and block channel activation
Brevetoxin 2 (PbTx 2)		$C_{50}H_{70}O_{14}$	895.1	
Brevetoxin 3 (PbTx 3)		$C_{50}H_{72}O_{15}$	897.1	
Brevetoxin 9 (PbTx 9)		$C_{50}H_{74}O_{14}$	899.1	
Diarrhetic shellfish toxins				
Okadaic acid (OA)		$C_{44}H_{68}O_{13}$	805	Inhibits protein phosphatases, inhibits dephosphorylation of proteins
Dinophysistoxins (DTXs)				
Pectenotoxins (PTXs)	Liposoluble			High actin-depolarizaing action
Yessotoxins (YTXs)	Hydrosoluble	$C_{55}H_{80}O_{21}S_2Na_2$	1187.3	Activation of phosphodiesterase in the presence of external Ca^{2+}; Disruption of the E-cadherin–catenin system in epithelial cells and potentially disrupting its tumour suppressive functions



Global increase in detection of the class of toxins responsible for paralytic shellfish poisoning (PSP).

Increased occurrence?
or
Increased awareness?

http://www.whoi.edu/redtide

SoCal 'Local' HAB issues

(from bad-to-worst)

Fairly innocous red tides

Lingulodinium polyedrum

Prorocentrum spp. (& several other dinoflagellates)

Noxious 'foams' and 'scums'

Phaeocystis globosa, Tetraselmis

Toxic truly species

Dinophysis spp. (DSP)

Alexandrium spp. (PSP)

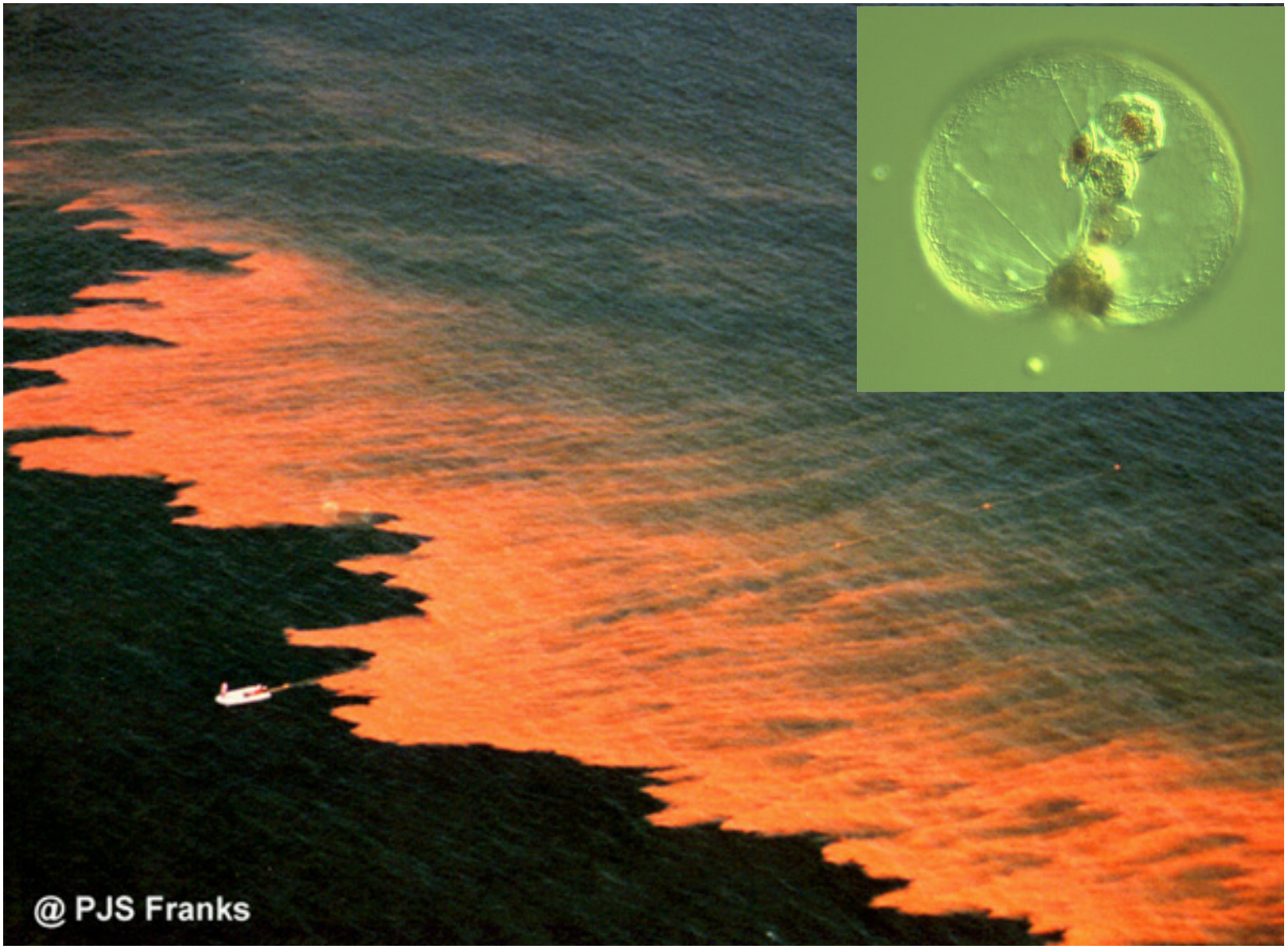
Pseudo-nitzschia spp. (ASP)

And some new players on the scene:

Cochlodinium catenatum (fish kills)

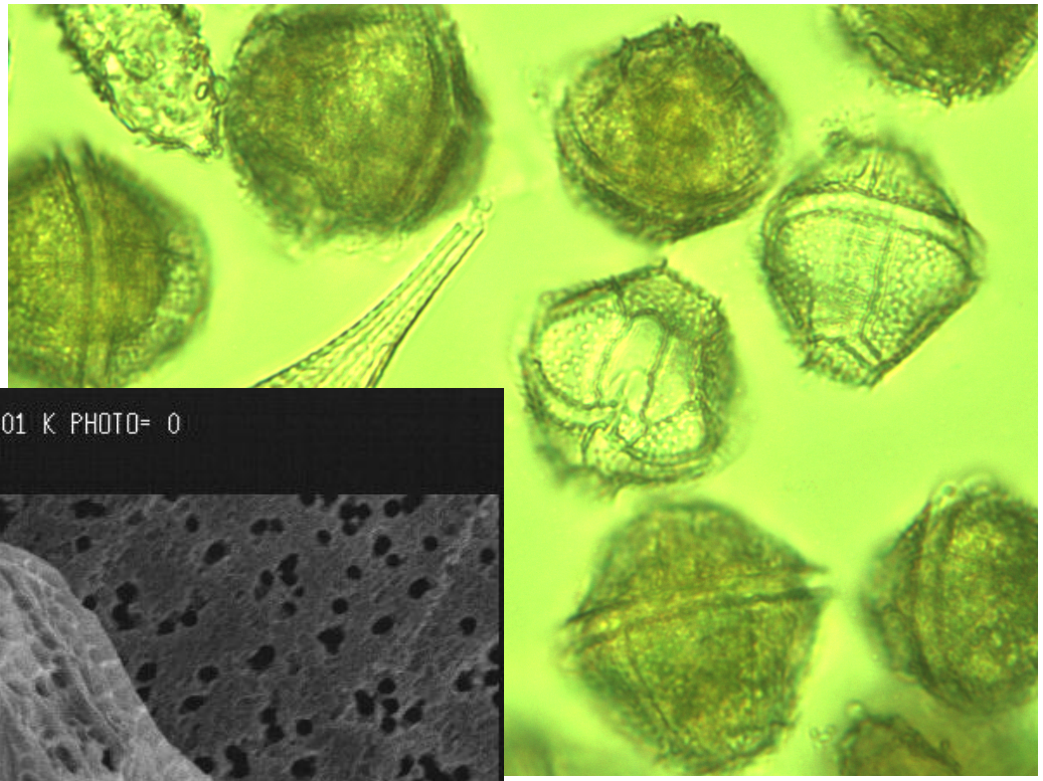
Raphidophytes (Chattonella, Heterosigma) (fish kills)

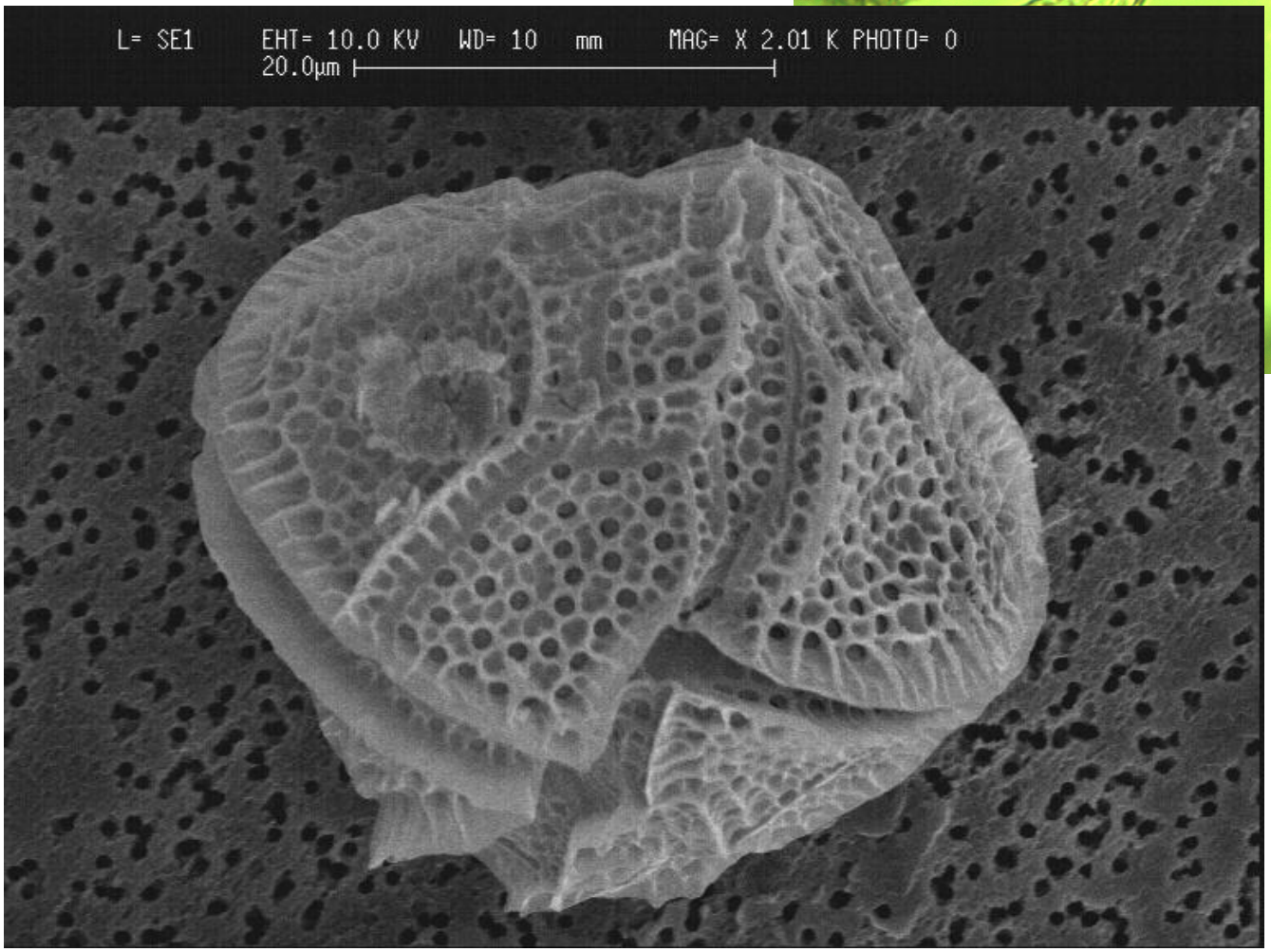
Massive ‘red tide’ off CA caused by the dinoflagellate *Noctiluca*
(colorful…but fairly innocuous)



Noctiluca scintillans
Australia 2012

Lingulodinium polyedrum

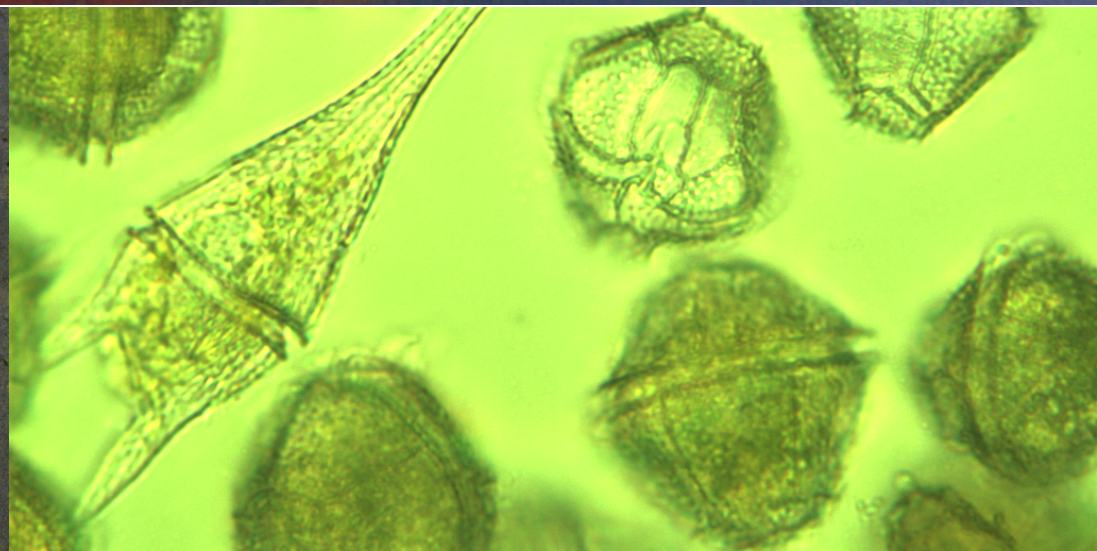




A ‘red tide’ without toxic consequences…
…so far.
(potential producer of yessotoxin)

CARON
AT 15-35

Lingulodinium polyedrum



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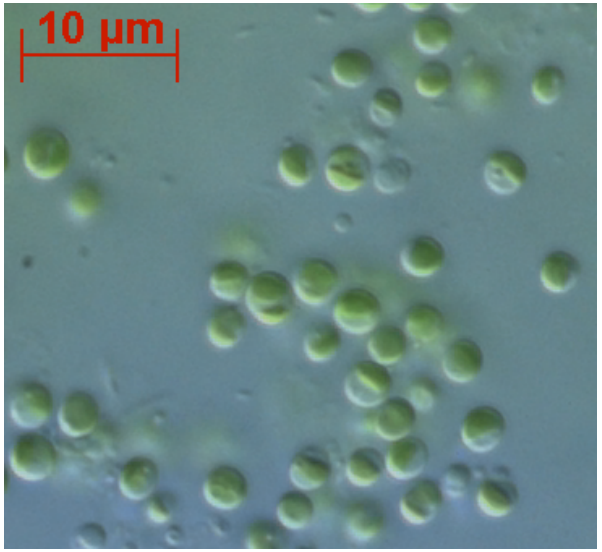
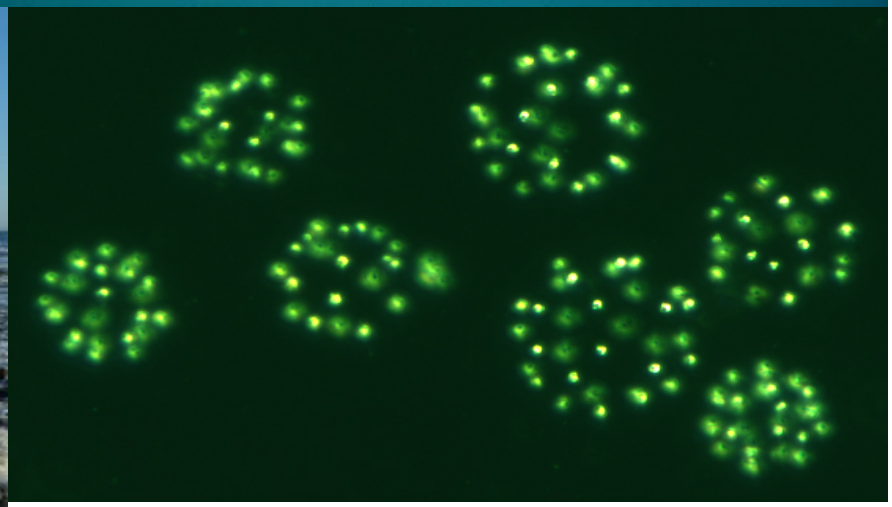
Tetraselmis : The ‘green scums’ of recent summers.

[Scientist IDs mysterious ocean scum](#)
The Orange County Register, July, 2010





Noxious species; disruption of normal food web structure and function.
Dimethyl sulfide

May, 2008
Huntington Beach, CA

January, 2008
New South Wales

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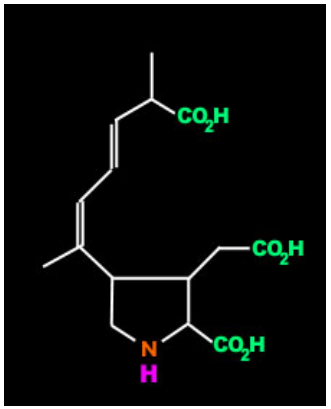
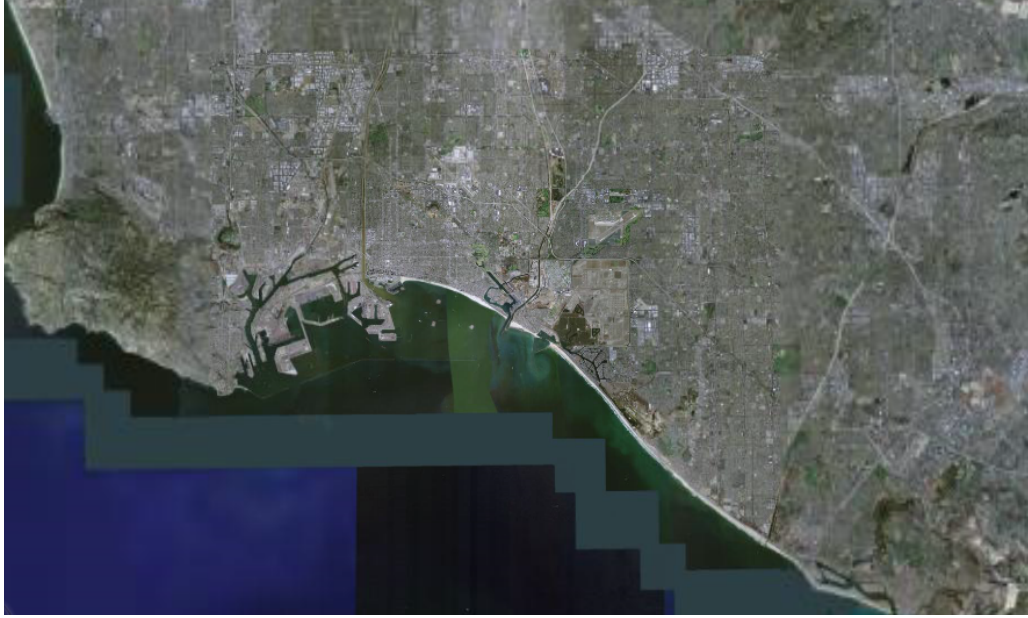
Domoic Acid

Amnesic Shellfish Poisoning (ASP)

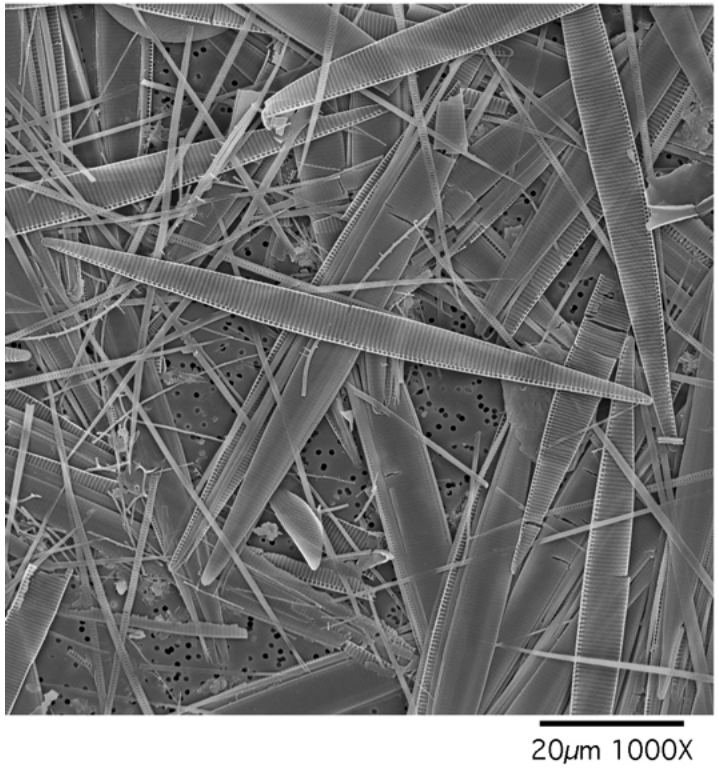
> 1500 mammal strandings in 2003



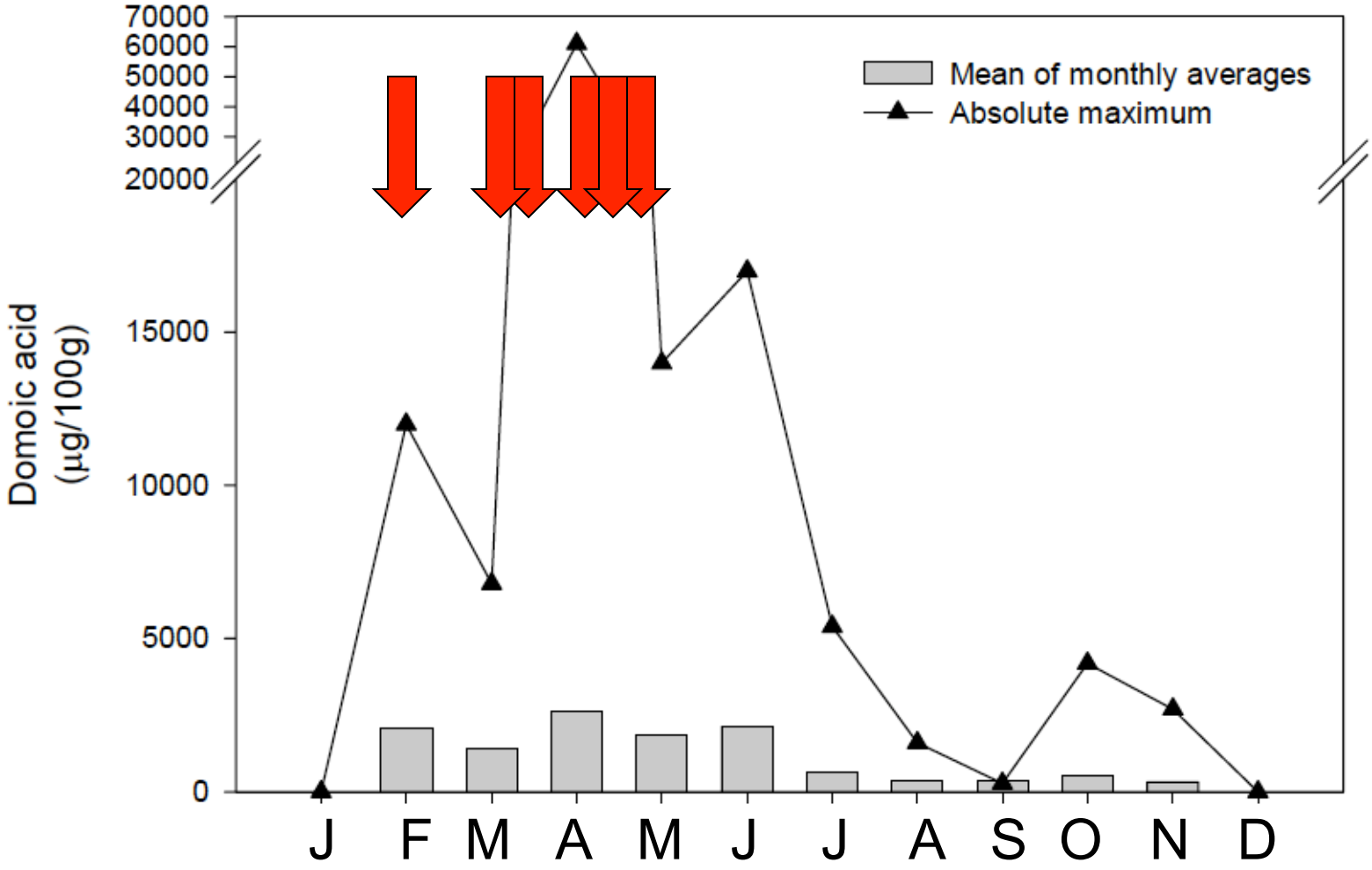


Symptoms in humans:
Nausea, vomiting, abdominal cramps, headache, dizziness, confusion, disorientation, short term memory loss
motor weakness, seizures, cardiac arrhythmia, coma, rarely death.

Around here, marine mammals and seabirds take the worst of it.

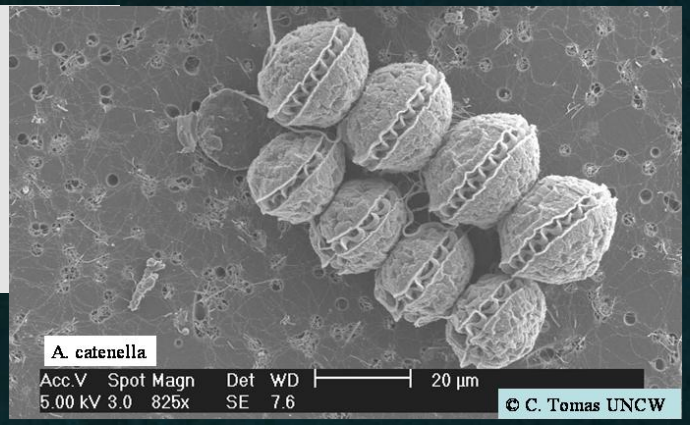


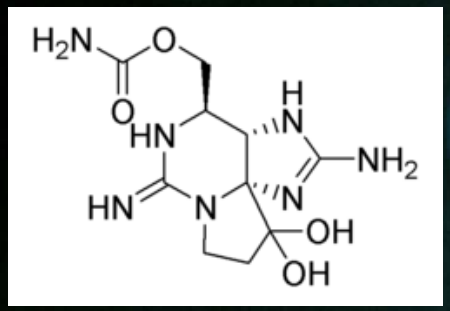
Seasonality of Domoic acid along the California Coast.

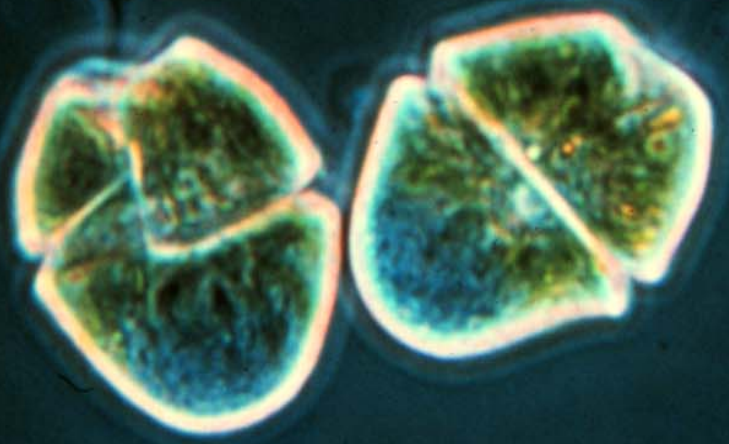


Compiled from Langlois (2007)
Shellfish tissue data (from 2002-2007)
(in Caron et al. 2010)

Saxitoxin (Paralytic Shellfish Poisoning)
And few dozen similar compounds, varying in toxicity. A selective sodium channel blocker, it blocks passage of nerve impulses.







Alexandrium spp.
Cochlodinium (Gymnodinium) catenatum
Pyrodinium bahamense var. *compressa*

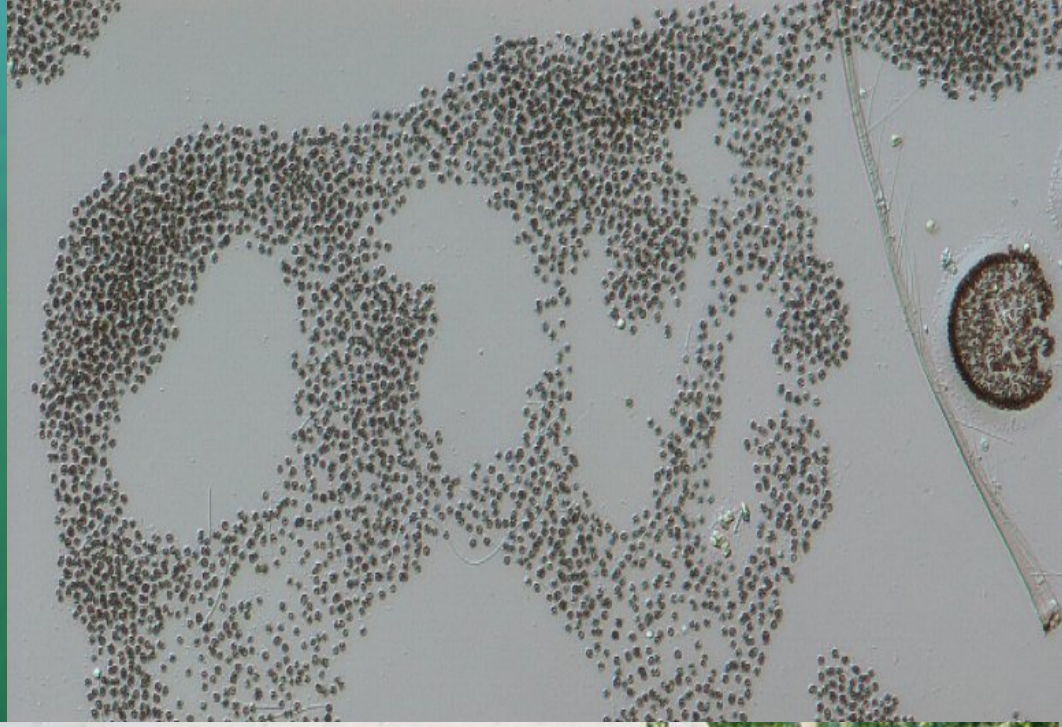
Present in SCB, but little knowledge of occurrence

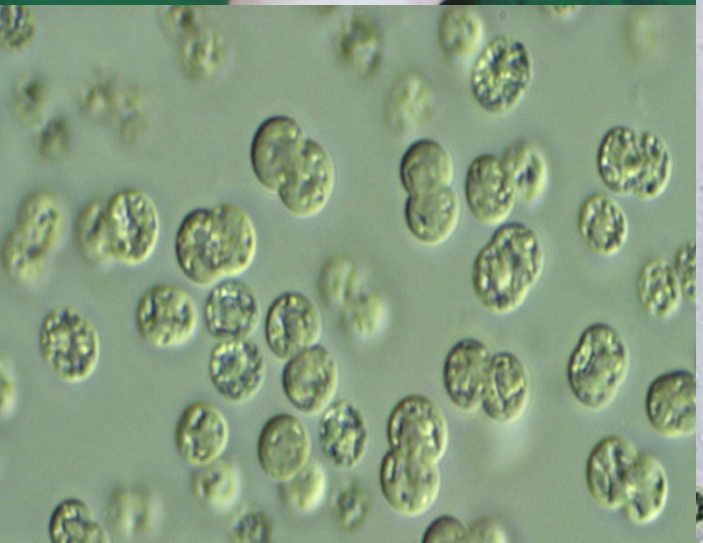
California estuaries as locations of multiple ecosystems stressors

Toxin/class detected	Mode of action in mammals	Estuary (1-33ppt)		Marine (> 33ppt)	
		Locality detected	likely producer	Locality detected	likely producer
Domoic Acid	KA/GLU receptor binding antagonist	?	*Pseudo-nitzschia* spp.	ubiquitous	*Pseudo-nitzschia* spp.
Paralytic Shellfish Poisoning Toxins (PSPs)	Na^+ channel antagonist, neurotoxins	San Elijo Lagoon, Batiquitos Lagoon	*Alexandrium* sp.*, *Aphanizomenon* sp., *Cylindrospermopsis* sp.*, *Lyngbya* sp.*, *Phormidium* sp.*	Newport Point, Ventura Harbor, Jalama	*Alexandrium* spp.*, *Lyngbya* sp.,
Diarrhetic Shellfish Poisoning Toxins (DSPs)	Protein Phosphatase inhibitor (PPi)	?	*Dinophysis* spp.	?	*Dinophysis* spp.
Microcystins	hepatotoxins, PPi	San Elijo Lagoon	*Microcystis* spp.*	?	-
Anatoxins	nAChR agonists	Lagoon at Pt. Mugu, Santa Clara River estuary	*Anabaena* spp., *Dolichospermum* sp., *Oscillatoria* spp.?	?	*Oscillatoria* spp.
Cylindrospermopsins	Potent hepatotoxins, multiple effects	upstream from lagoon at Pt. Mugu, Santa Clara River	*Cylindrospermopsis raciborskii*	?	-
Nodularin	potent PPi	Santa Clara River	*Nodularia* sp. *	?	-
Cycloimines	nAChR and mAChR antagonists, neurotoxins	?	?	Newport Point, Point Dume, Ventura Harbor	*Gymnodimium* sp., *Alexandrium* spp. *
Lyngbyatoxin A	Dermatitis, tumor promoters, other	Ventura County, Los Penasquitos Lagoon	*Lyngbya* spp.*	Ventura County	*Lyngbya* spp.*
Phormidolide	unknown	Santa Clara River estuary, Jalama creek	*Phormidium* spp.*	?	*Phormidium* spp.
Microginins	metalloprotease inhibitor	San Elijo Lagoon	*Microcystis* sp.	?	?
Microviridins	PPi, elastase inhibitor	San Elijo Lagoon	*Microcystis* sp.	?	?
Karlotoxins	cytotoxins	?	*Karlodinium veneficum*	?	*Karlodinium veneficum*

Toxin in Ohio water leaves 500,000 under state of emergency

Water at a Toledo, Ohio, treatment plant has tested positive for a toxin, and nearly 500,000 Ohio residents have been told not drink the tap water. The governor has declared a state of emergency Saturday in three counties, state officials...

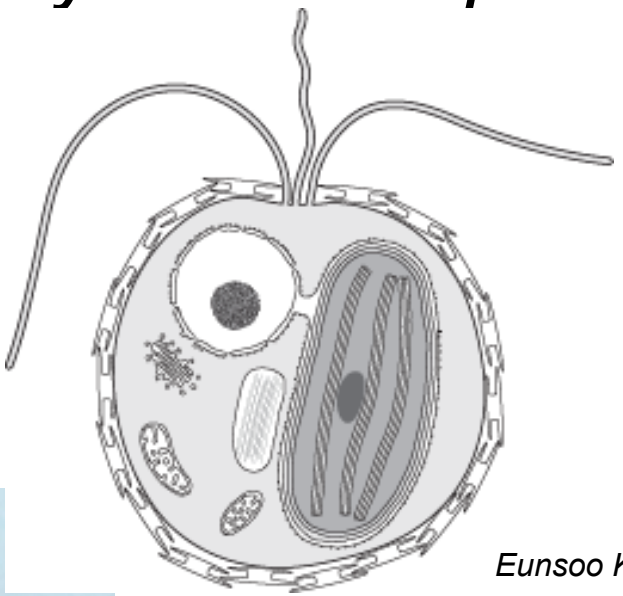




Magnification: 20x

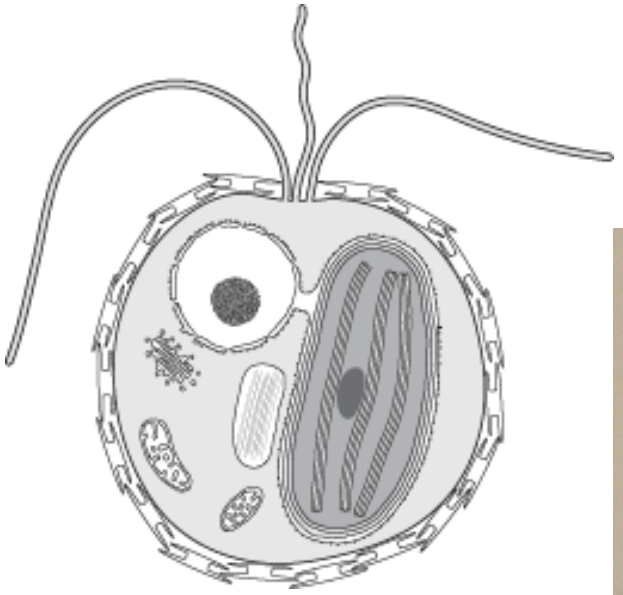
Prymnesium parvum (the ‘golden alga’)

Prymnesium parvum

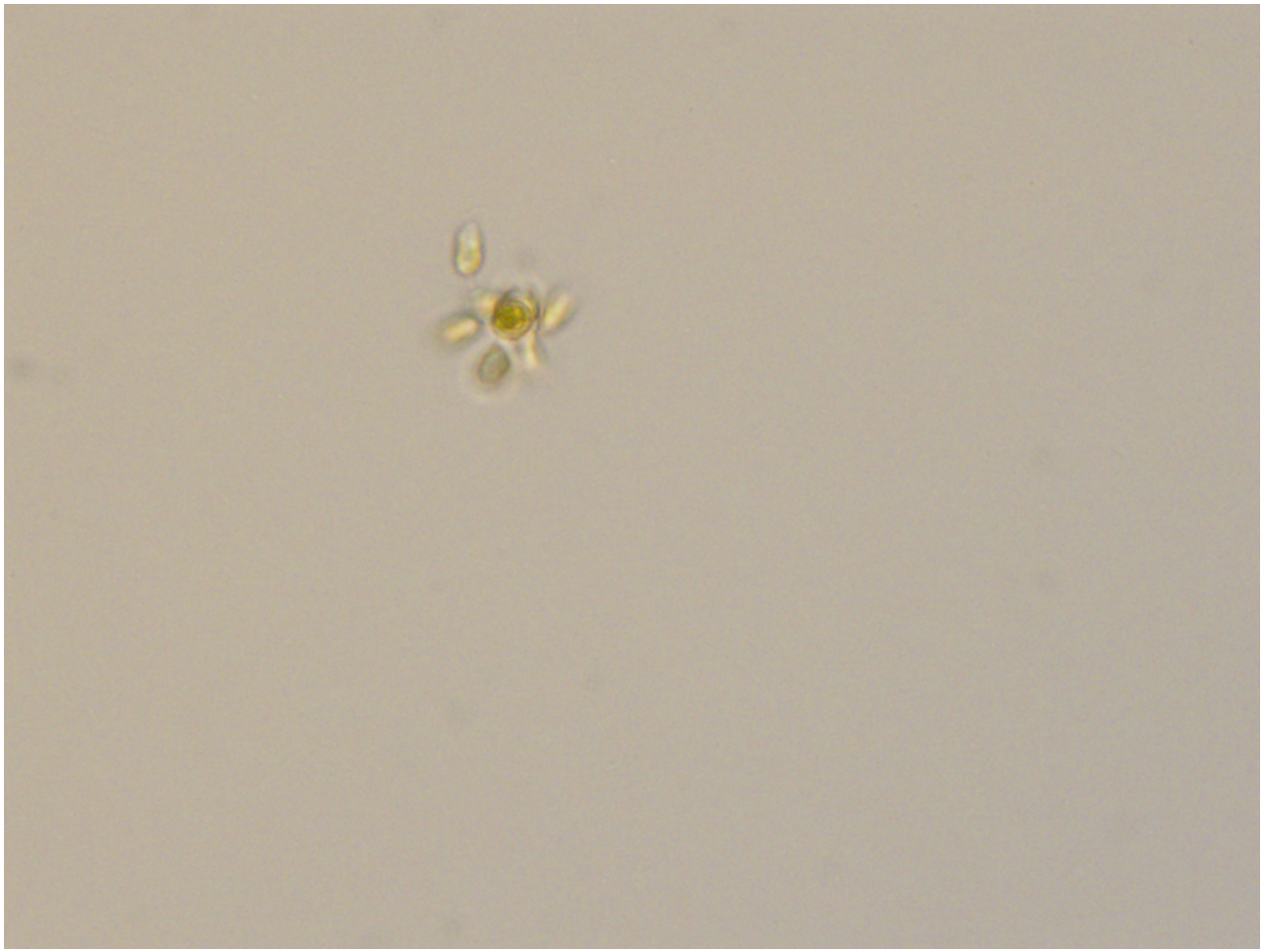


Eunsoo Kim

Prymnesium can grow easily as an axenic phototroph, but is also an excellent predator, and generally nasty bug!



EDAB: Ecosystem Disruptive Algal Bloom



Didymosphenia germinata (rock snot)

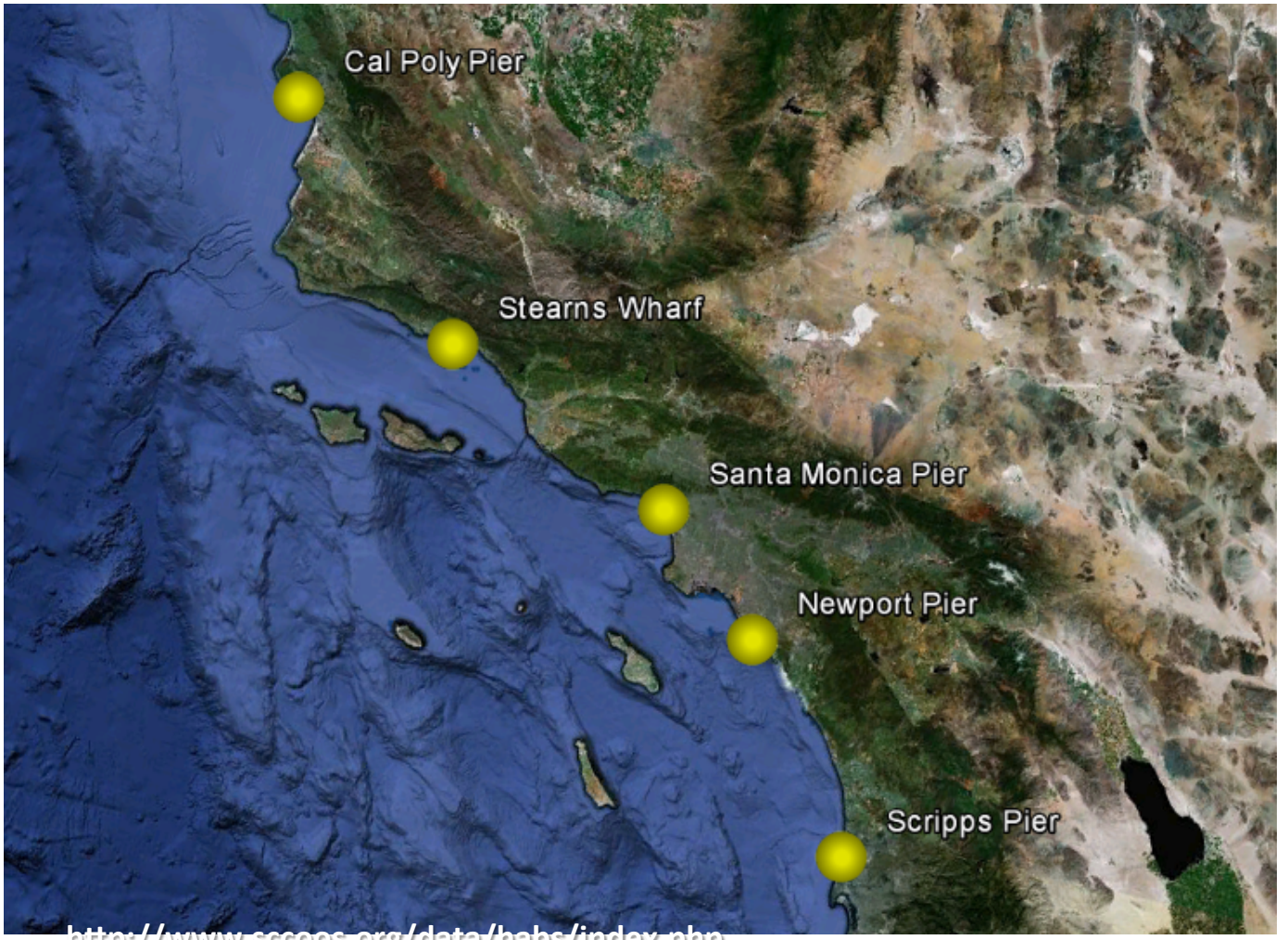
Why a Community HABWatch program?

- Improve temporal and spatial monitoring for harmful algal blooms (HABs)
  - Increase monitoring locations
  - Increase frequency of sampling
- Improve dissemination of HAB information to the general public
  - Accurate, current information
- Providing educational activities and exhibit materials

Community HABWatch

Methods based on the

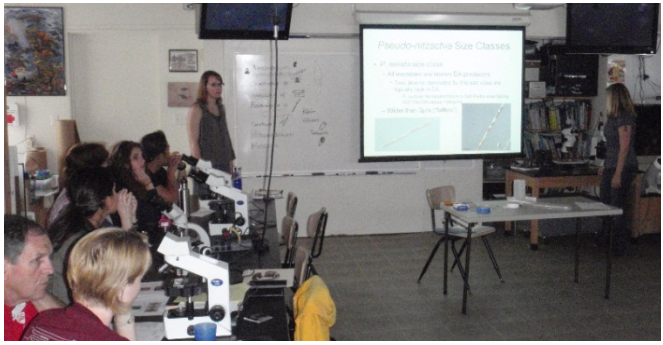
SCCOOS HAB Monitoring Program

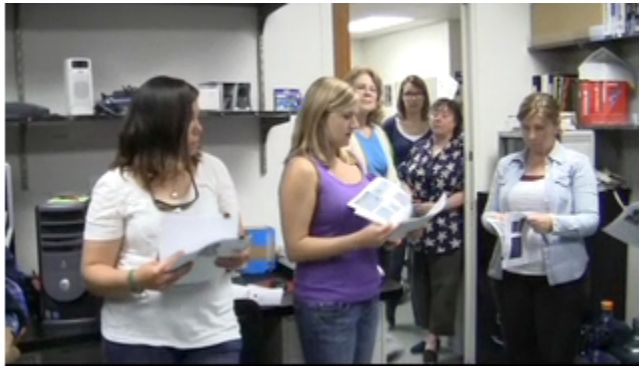


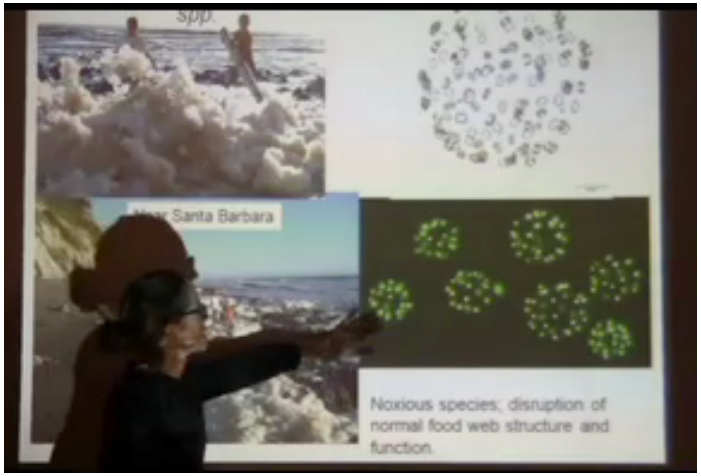
http://www.sccoos.org/data/habs/index.php

Training Design

- HAB Training (USC)
  - Introduction to phytoplankton
  - Information on HAB species known to occur in southern California
    - Identification, occurrence, impacts
- Individual site trainings
  - Tailor sampling strategy to participant's needs
  - Microscopy assistance



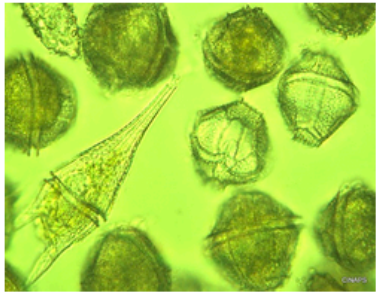




Community HABWatch Materials

- Sample collection gear
  - Bucket, rope, 20µm phytoplankton net, cod ends, thermometer
- Sample processing material
  - Petri dishes, transfer pipettes, bottles for temporary sample storage, microscope slides, coverslips
  - Log sheets, sample collection and processing protocols
  - Phytoplankton identification references

Harmful Algal Blooms



Certain algae (i.e. *Pseudo-nitzschia a* and *Alexandrium catenell*) are capable of toxic or harmful algal blooms (HABs), releasing compounds (for example, domoic acid or saxitoxin), which can accumulate up the marine food chain, causing severe illness and death in marine mammals, birds, and even humans. Another species, *Lingulodinium polyedrum*, is probably the most common dinoflagellate in the region and causes the red water often seen near the beach; when its population crashes, it consumes large amounts of oxygen in the surrounding water. This can cause hypoxia in regions with low circulation (ports, marinas, lagoons, etc.), resulting in fish kills. Scientists still do not know what conditions trigger a toxic algal species to bloom and produce toxin, but understanding complex coastal oceanographic processes is certainly a key to unraveling this mystery. It is also important for sustainably managing human use and enjoyment of the coast. USC Sea Grant focuses its research funding and outreach programs on answering these questions.

Related Research

- Trophic transfer of domoic acid in food webs of the future greenhouse coastal ocean (Hutchins and Fu)
- Will a warmer, more acidic ocean lead to increased Pseudo-Nitzschia bloom toxicity in the Southern California bight? (Hutchins and Fu)
- Resolving the annual pattern of algal toxins in coastal waters off Los Angeles (Schnetzer, Caron)
- Impacts of Algal Toxins on Species Composition of Coastal Plankton Communities (Schnetzer, Caron)
- High Resolution Remote Sensing of Coastal Discharge Plumes and Algal Blooms in the Southern California Bight (Jones, Fuhrman)

Outreach & Education Projects

- Community HAB Watch volunteer monitoring

Related Links

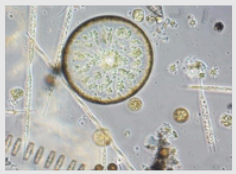
- CINAPS (Center for Integrated Networked Aquatic Platforms)
- SCCOOS (Southern California Coastal Ocean Observing System)

For More Information

Juliette Finzi Hart | 424.241.2457

Sea Grant
University of Southern California
SCIENCE SERVING THE URBAN COASTS

Harmful Algal Bloom Watch



Interest and awareness of harmful algal blooms (HABs) has brought together scientists and informal educators in the Southern California Bight to form a volunteer harmful algal bloom monitoring network called HABWatch. This effort increases the number of eyes on the ocean for early detection and sets into place a method for rapid response.

This project was funded by Southern California Coastal Ocean Observing System with support from USC Sea Grant and COSEE West. The next steps include development of educational resources to use in outreach to visitors at each of the centers.

HABWatch Program Resources

Sampling and Reporting Protocols

- Protocol for HAB Sample Collection
- Protocol for New Tow Relative Abundance
- HABWatch Log Sheet
- Access HABWatch Data Portal
- Tips & tricks for Collecting a Net Tow

Plankton ID Guides

- Southern California Bight HAB Phytoplankton ID Guide
- Phytoplankton Size Scale Guide
- Guide to Common Inshore Plankton of Southern California and Supplemental Color Guide to Identifying Dinoflagellates

HABWatch Partners

- Santa Barbara Natural History Museum
- Channel Islands National Park
- National Marine Sanctuary
- Santa Monica Pier Aquarium
- Los Angeles Conservation Corps SEA Lab
- Cabrillo Marine Aquarium
- Los Angeles Maritime Institute
- Aquarium of the Pacific
- Back Bay Science Center
- Port of Los Angeles High School
- Ocean Institute

Related Resources

- SCCOOS - Southern California Coastal Ocean Observing System Harmful algae and Red tides
- MERHAB - Monitoring and Event Response for Harmful Algal Blooms
- The California Harmful Algal Bloom Monitoring and Alert Program (CalHABMAP)

For more information

- Linda Chilton (Director of Education Programs)

LIQUID

Features

HABWatch-Marine

Duplicate

jahart

- Overview
- Charts
- Responses
- Collaborators
- Export

Dataset Overview

Welcome to the Community HABWatch data portal!

You will upload your weekly monitoring data here as well as be able to view past data collected at your location and by other participating groups. We have volunteers sampling at many different Southern California locations, from Dana Point in the south to Santa Barbara in the north.

Sample Collection

Follow the procedure laid forth in the HABWatch sampling protocol. Remember to record the time of sampling and the name of the collector. Be sure to store your sample in a cool, dark place with the top of the sampling jar loosened if there is to be any significant passage of time between sample collection and sample processing.

Sample Processing

Record the time of observation and the name of the observer on your log sheet. Please use the Southern California Bight HAB Phytoplankton ID Guide and the Phytoplankton Size Scale Guide to help you identify organisms in your sample.

Uploading Your Data

Once you have finished your sample observations, the information from the log sheet can be entered into the database. Click on the blue "+Add Response" button at the top of this page. Information that is required for successful submission of data is starred (*). If you have any comments/questions or concerns about your sample, you can add them at the end of the form and one of the scientists will get back to you shortly. Click on the blue "Submit Response" button at the end of the form when you are done.

Training Refreshers/Additional Information

Do you have a new member of your team interested in assisting in HAB sampling or possibly you need a refresher on HAB science? Stay tuned for training, lesson plans and videos in a few months.

You may also visit the HABWatch home page for more information.

10
Collaborators

2
Responses

1mo ago
Since Last Response

Harmful Algal Bloom Watch

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Community HABwatch partners(PPT)

Community HABWatch Training Video

Community HABWatch Lab Training Video

Email your questions to our research team

HAB overview

Plankton id guides

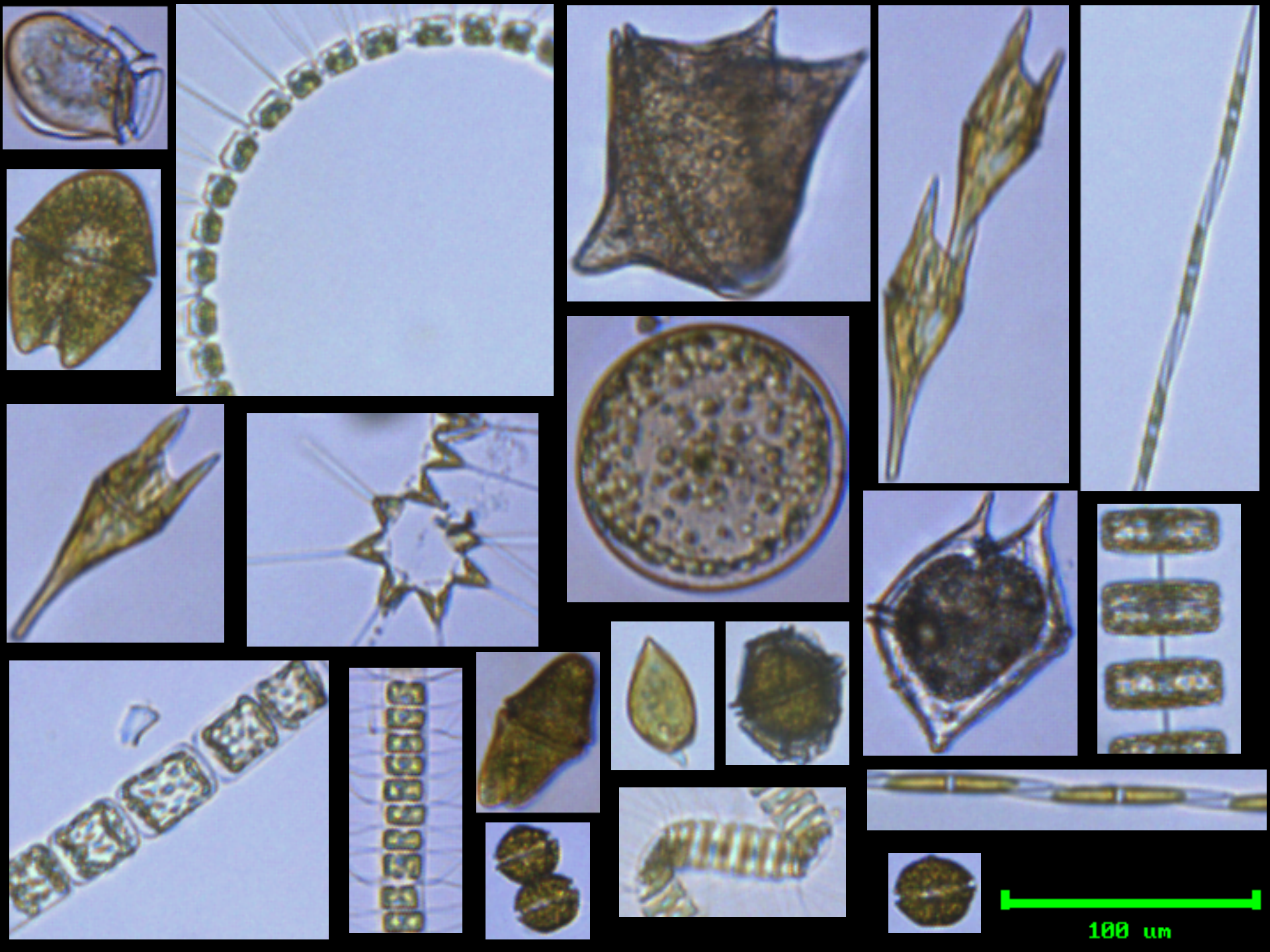
- Guide to Common Inshore Plankton of Southern California and Supplemental Color Guide to Identifying the Dinoflagellates
- Southern California Bight HAB Phytoplankton ID guide
- Phytoplankton size scale guide

Data collection sheet

Sampling and reporting protocols

- Tips and tricks for collecting a net tow
- Protocol for HAB sample collection
- Protocol for net tow relative abundance
- HabWatch data sheet

http://www.usc.edu/org/cosee-west/habwatch.html


100 um

Protocol for Net Tow Relative Abundance Determination

Materials

- Net Tow sample
- Pipette
- Microscope
- Petri dishes
- Microscope slides
- Cover slips
- Vaseline
- Tape
- Razor blade

Using a Dissecting Microscope

- Invert the cod end containing the net tow sample several times in order to mix sample
  - Using a pipette, collect 3-5mL of sample water from below the surface of the cod end
  - Place 3-5mL in three different petri dishes
    - The desired volume of sample should completely cover the bottom of the dish but not much higher
- View all three petri dishes under the dissecting microscope
  - Identify as many organisms as possible
  - For organisms difficult to identify
    - Can you place them into a category – diatom, dinoflagellate, zooplankton, etc..?
    - Take notes on color, approximate size (i.e. – ½ Linguodinium cell), pattern of movement or lack of movement, shape
    - Can you take a picture of the organism?
    - These notes will help to identify the organism at a later date
      - Email a picture and/or description to HABWATCHHELP@USC.EDU for assistance in identification
- After identifying as many items as possible, it is time to assign relative abundances
  - Start with organisms considered RARE (<1% of the organisms in the sample)
    - These are organisms only seen once or twice
  - Continue assigning a relative abundance code (R, P, C, A or D) to all the organisms identified
    - In the comment section, you can take notes on the approximate percentage you are assigning to each organism
      - Make sure these numbers do not add up to over 100% when you are finished
    - Things to remember:
      - Move the petri dishes around and try to view as much of the sample as possible

Protocol for HAB Sample Collection

Equipment

- 20-µm mesh plankton net with cod end
- Bucket
- Thermometer
- Refractometer
- Pipette
- Rope

Sample Collection

Temperature and Salinity

- Collect water from the location where the net tow is to be taken using the bucket
  - Place thermometer in the water and allow it to equilibrate while performing the net tow
    - Keep the bucket out of direct sunlight
    - After a minimum of 5min equilibration, read temperature to the nearest ½ degree
    - Record temperature on log sheet
  - Using the pipette, collect a small volume of water from the bucket
    - Place a drop of water on the blue glass surface of the refractometer
      - Lower the clear plastic shield, hold the refractometer towards a light source and look through the eyepiece
      - The salinity value is where the blue shade ends on the scale
      - Record on log sheet
      - Clean surface thoroughly

New Tow

- Rinse the net and cod end in the water to be sampled
  - At the location(s) take a horizontal or vertical tow for the distance specified during your site training
  - Record net tow type (horizontal or vertical) and length on log sheet

Cleaning

- Rinse all sampling items thoroughly with freshwater after use
  - The net can be rinsed with a faucet or hose that has a gentle flow or it can be placed in a tub of freshwater and swished around

oom Watch

awareness of harmful algal bloo
rought together scientists and in
the Southern California Bight to
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tch. This effort increases the nu
ocean for early detection and set
od for rapid response.

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EE West. The next steps include
se in outreach to visitors at each
centers.

HABWatch Program Resources

Sampling and Reporting Protocols

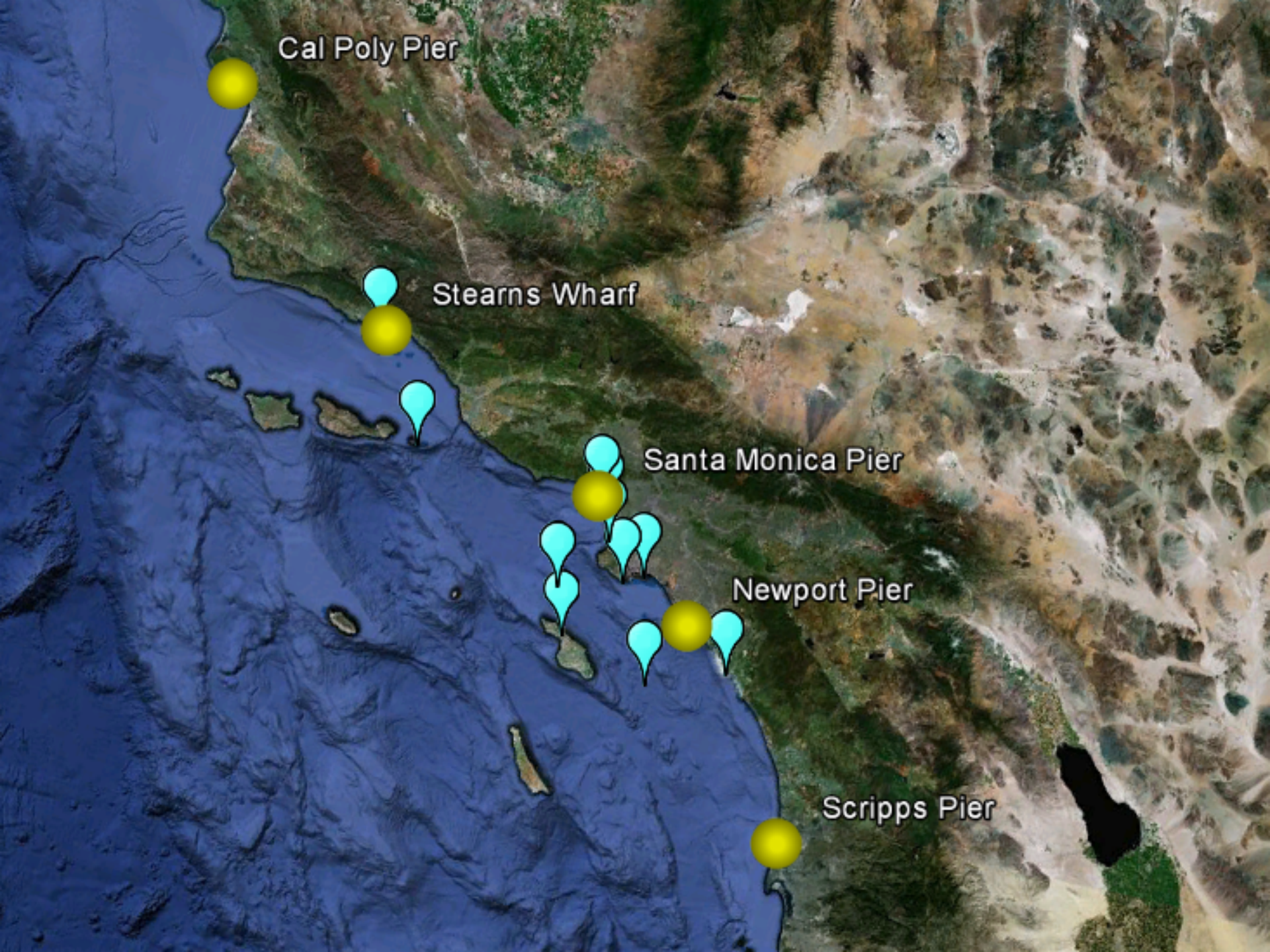
- Protocol for HAB Sample Collection
- Protocol for New Tow Relative Abundance
- HABWatch Log Sheet
- Access HABWatch Data Portal
- Tips & tricks for Collecting a Net Tow

- Back Bay Science Center
- Port of Los Angel High School
- Ocean Institute

Related Resources

- SCCOOS – Southern California Coastal Ocean Observing System Harmful algae and Red tides
- MERHAB – Monitoring and Event Response for Harmful Algal Blooms

Participants


Cal Poly Pier
Stearns Wharf
Santa Monica Pier
Newport Pier
Scripps Pier

This Location is a Member of the SoCal Community HABwatch Network

University of Southern California &
Southern California Coastal Ocean Observing System

A network of organizations supporting science, monitoring and education regarding Harmful Algal Blooms (HABs) in the southern California area.

SoCal HABwatch Participants:

For more information on the SoCal HABwatch Network
please visit us at www.usc.edu/org/cosee-west/habwatch.html

Harmful Algal Bloom Watch

Interest and awareness of harmful algal blooms has brought
informal educators in the Southern California Bight to form a
monitoring network. This effort increases the number of eyes
detection and sets into place a method for rapid response. Th
Southern California Coastal Ocean Observing System with su
next steps include development of educational resources to u
each of the centers.

Community HABwatch partners(PPT)

Community HABWatch Training Video

Community HABWatch Lab Training Video

Email your questions to our research team

HAB overview

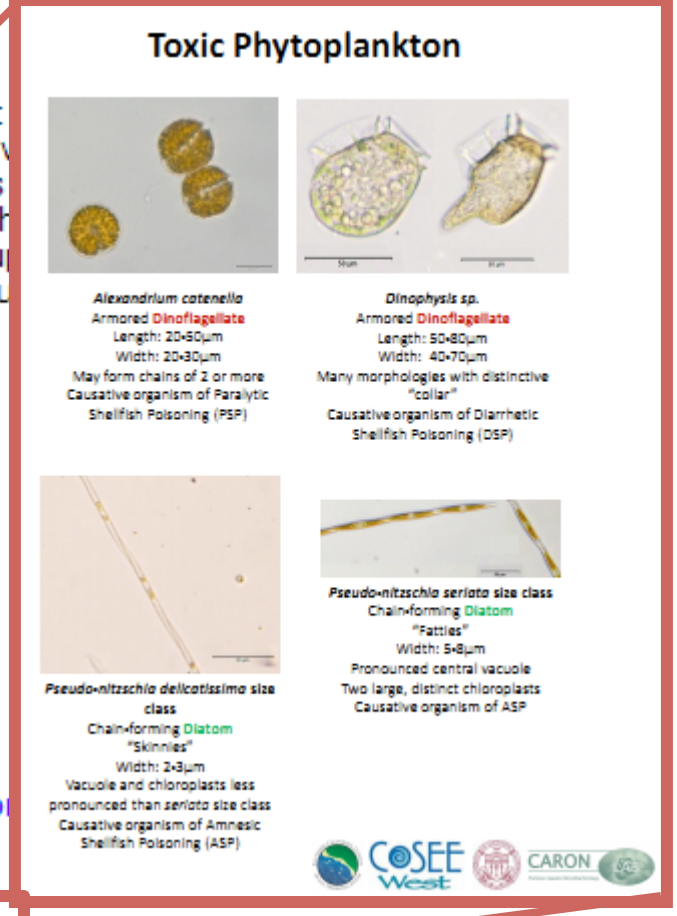
Plankton id guides

- Guide to Common Inshore Plankton of Southern Califo
- Guide to Identifying the Dinoflagellates
- Southern California Bight HAB Phytoplankton ID guide
- Phytoplankton size scale guide

Data collection sheet

Sampling and reporting protocols

- Tips and tricks for collecting a net tow
- Protocol for HAB sample collection
- Protocol for net tow relative abundance
- HabWatch data sheet



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