

Are we in a new era of marine mammal mortality events associated with harmful algal blooms in California?

Clarissa Anderson, PhD
Director, SCCOOS + CIMEAS

Marine Mammal Commission 2025
Annual Meeting, September 11



SOUTHERN CALIFORNIA
**COASTAL OCEAN
OBSERVING SYSTEM**



SCRIPPS INSTITUTION OF
OCEANOGRAPHY

UC San Diego



IOOS
Integrated Ocean
Observing System





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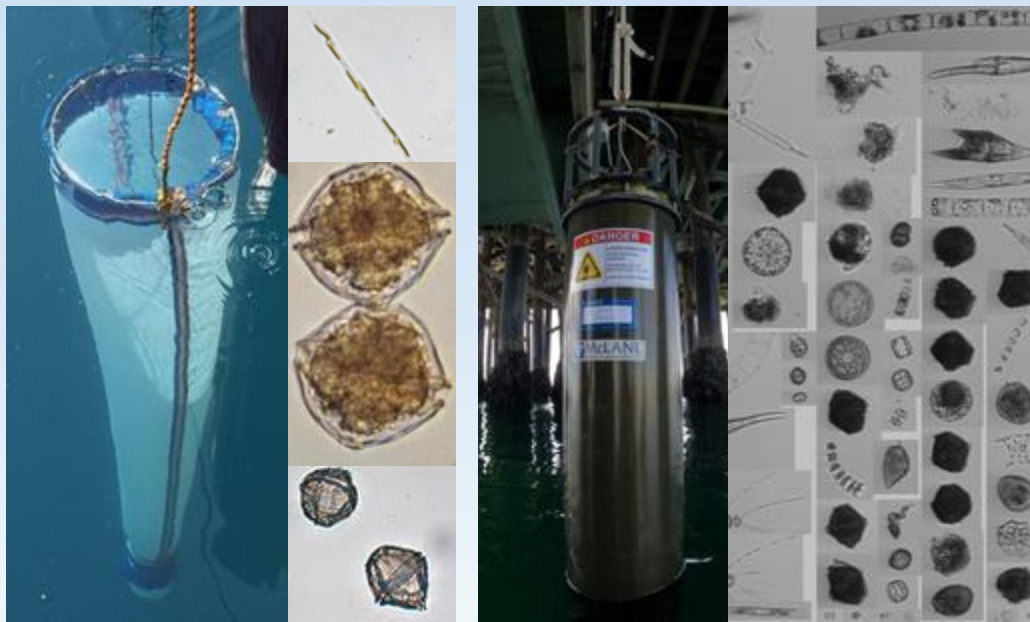
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HAB Early Warning System



CA HAB Monitoring Alert Program (CalHABMAP) -
Weekly net tows & water samples since 2008

CA Imaging FlowCytobot Network (CA IFCB Network) -
Real-time automated *in situ* microscopic imaging



Harmful Algal Bloom Monitoring & Implementation of an Early Warning System

*Operate, sustain, and expand HAB monitoring in support of a National HAB Observing Network.
PI: Anderson/Carter (SIO), Caron (USC), Brzezinski (UCSB), Pasulka (Cal Poly SLO)*

Weekly measurements:

- Chl-a, Temp, Salinity, Nutrients
- HAB species (8-9 taxa)
- Domoic Acid + SPATT toxins
- Weekly alerts to HABMAP listserv
- Monthly QC'd data
- Synthesis with models: CA HAB Bulletin

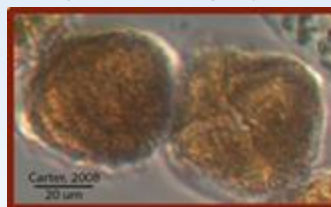
10 Institutions



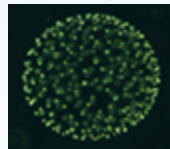
Alexandrium



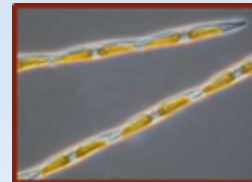
Lingulodinium polyedra



Phaeocystis



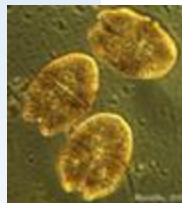
Pseudo-nitzschia



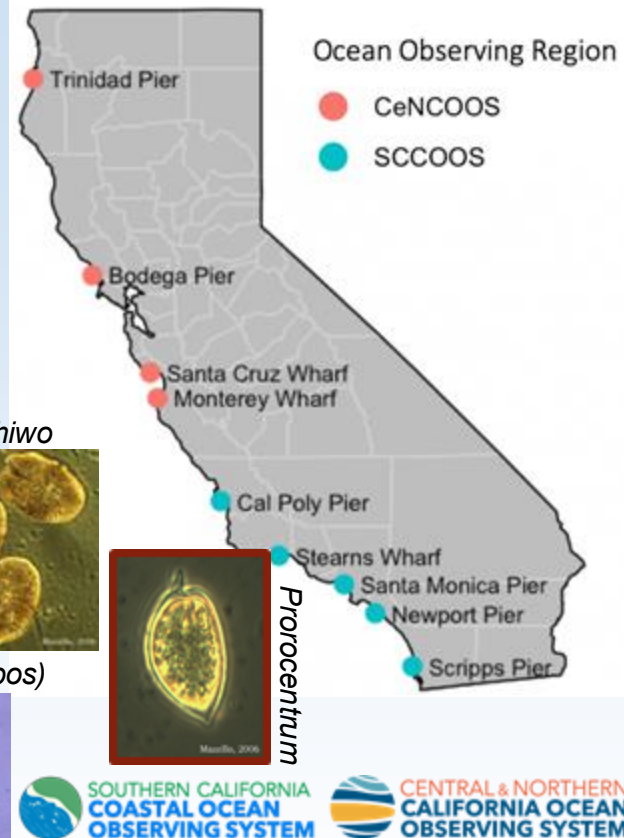
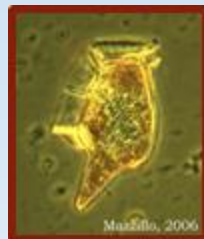
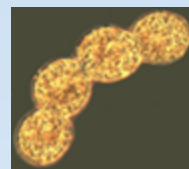
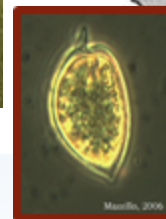
Ceratium (Tripos)



Akashiwo

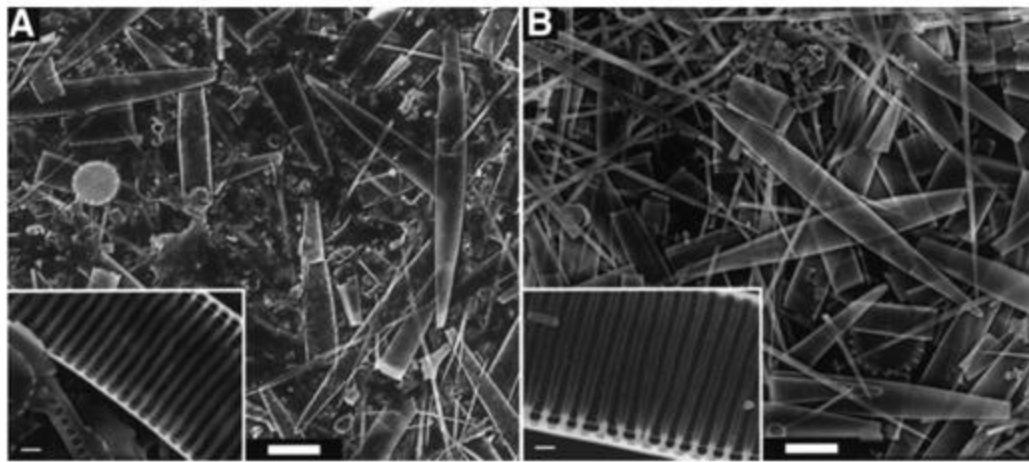


Procentrum



HAB Monitoring & Alert Program + SPATT dissolved toxins

SCCOOS PI: Anderson (UCSD), Caron (USC), Shipe (UCLA), Brzezinski (UCSB), Walter/Pasulka (Cal Poly)



Gut contents of anchovy collected during Spring 1998 bloom in Monterey Bay (Lefebvre et al. 1999 *Nature*)

Detection of Domoic Acid in Northern Anchovies and California Sea Lions Associated with an Unusual Mortality Event†

Kathi A. Lefebvre,¹ Christine L. Powell,² Mark Busman,² Gregory J. Doucet,² Peter D. R. Moeller,² Joel B. Silver,¹ Peter E. Miller,¹ Margaret P. Hughes,⁴ Sara Singaram,⁴ Mary W. Silver¹ and Ronald S. Tjeerdema³

¹Biology Department, University of California at Santa Cruz (UCSC), CA, USA

²Marine Biotoxins Program, NOAA/National Ocean Service, Charleston, SC, USA

³Monterey Bay Aquarium Research Institute, Moss Landing, CA, USA

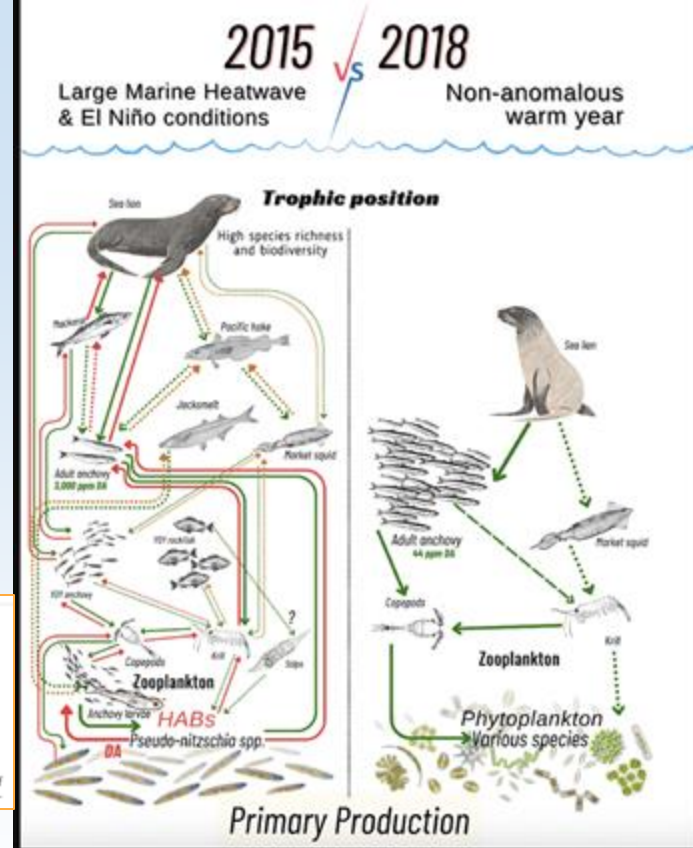
⁴Institute of Marine Science, UCSC, Santa Cruz, CA, USA

[†]Department of Environmental Toxicology, University of California at Davis, CA, USA

Perturbations in a pelagic food web during the NE Pacific large marine heatwave and persistent harmful diatom blooms

Rocio I. Ruiz-Cooley^{a,b}, Clarissa Anderson^c, Raphael Kudela^d, Robin Dunkin^e, John Field^f

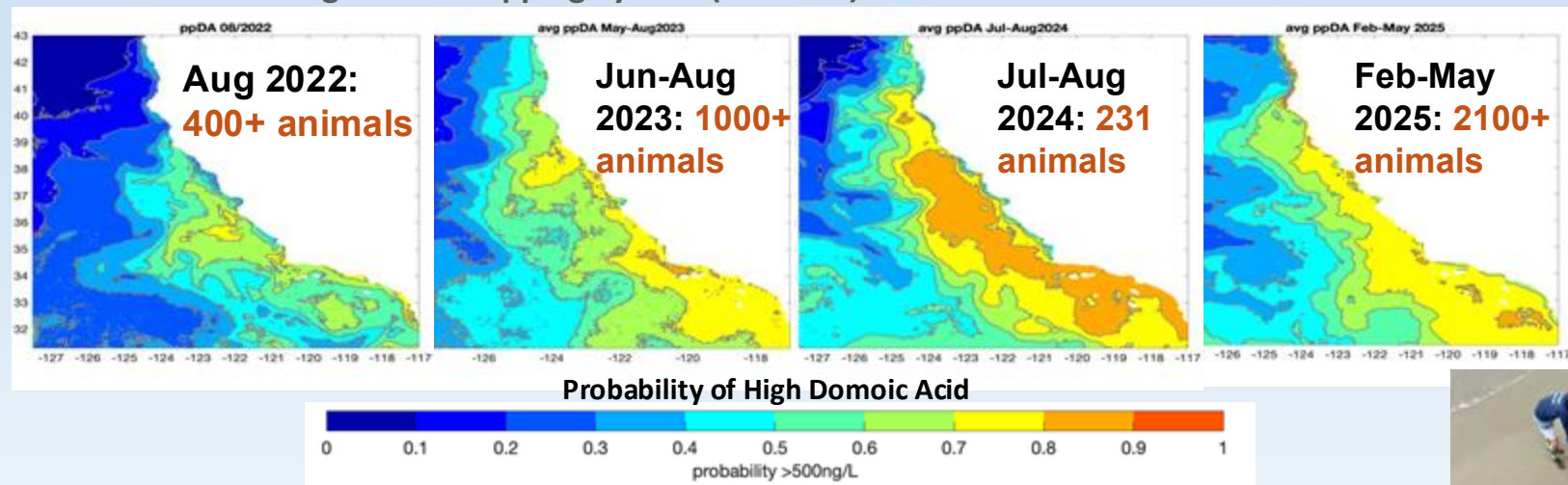
Ruiz-Cooley et al. 2024 *Harmful Algae*



Bottom-up transfer of DA leading to mortality events

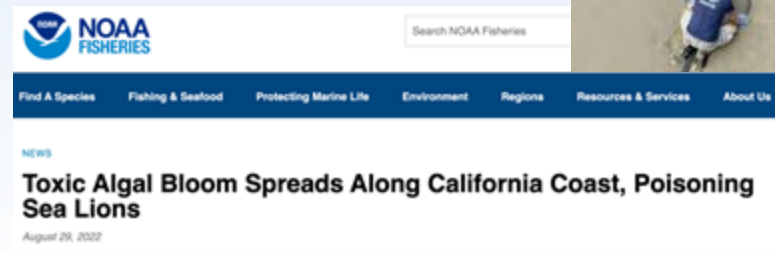
Anchovy are an ideal vector for DA into marine food webs (others = zooplankton/sardine/squid)

California Harmful Algae Risk Mapping System (C-HARM) – NOAA NESDIS West Coast Node of CoastWatch



See CA HAB Bulletins for details:

<https://sccoos.org/california-hab-bulletin/>



Beginning in 2022, a streak of DA events has been focused in Central and Southern CA

C-HARM is only synoptic view we have during bloom evolution; tracks strandings fairly well over a bloom period

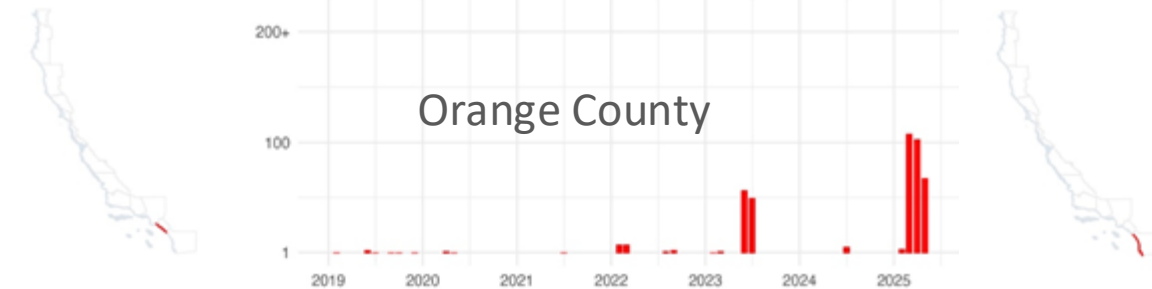
Channel Islands Marine Wildlife Institute



Marine Mammal Care Center LA



Pacific Marine Mammal Center

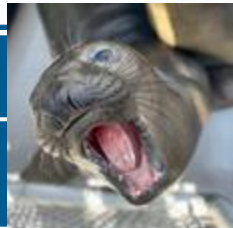


SeaWorld



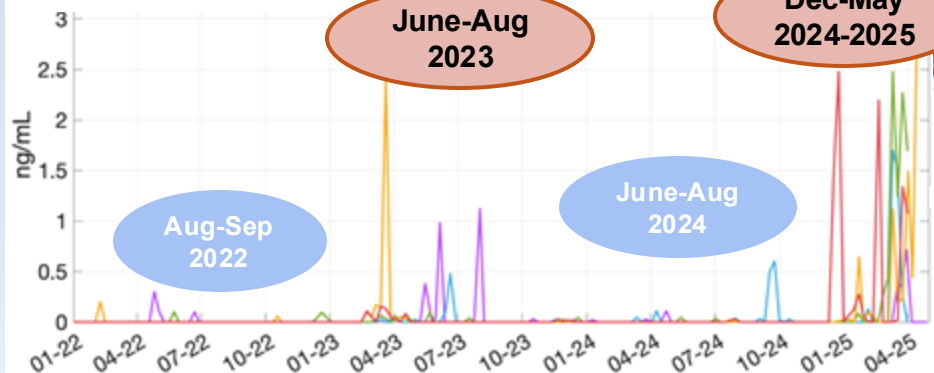
Collating monthly reports from the Marine Mammal Stranding Network

2,100+ suspected DA intoxication cases between Feb-May 2025
Abnormal number of violent encounters with humans due to erratic behavior

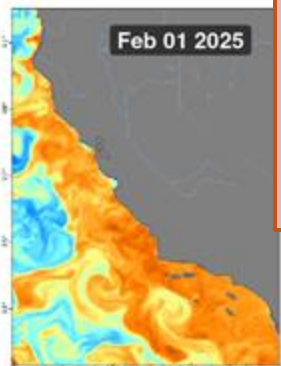


CalPoly — Stearns Wharf — Santa Monica — Newport Beach Pier — Scripps Pier — threshold of concern

2022-2025 HABMAP Particulate Domoic Acid



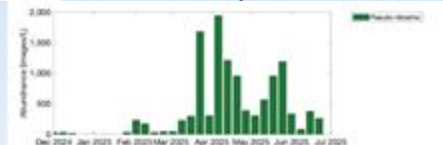
IFCBs captured
La Niña pattern of bloom



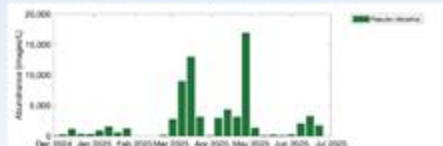
Beginning in Dec. 2025, nearshore monitoring detected *sustained* high levels of domoic acid across southern CA

See the 2025 CA HAB Bulletins for details:
<https://sccoos.org/california-hab-bulletin/>

Santa Cruz



Stearns Wharf



Del Mar



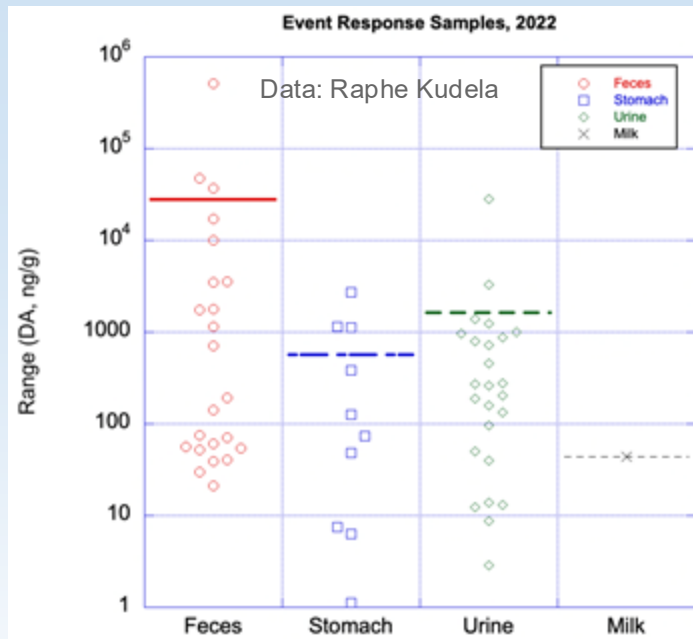
SIO



Pseudo-nitzschia bloom
developed South to North

HAB Early Warning System – very useful in 2023 and 2025

California Sea Lions as sentinels in 2022 and 2024



Thanks to NOAA Event Response Funds



Marine Mammal Tissue from 3 Rescue Centers 2022

- N = 45 animals
- 59 samples processed across 4 possible matrices
- Highest *known* recorded animal DA ~ **507,608 ng/g** in feces of **California Sea Lion** CIMWI-SB-22-124-CU-001 from Channel Islands Marine Wildlife Institute (CIMWI)

Highest *known* recorded DA in dolphins
296,538 ng/g in feces collected from a dolphin in Ventura on June 19, 2023



Data: Michelle Berman-Kowalewski and Kathi Lefebvre



Highest DA measured in animals in 2022 and 2023 (other years TBD)

Mammal tissue A levels keep breaking records, more dolphins + cetaceans seem to be stranding, and STX identified in 2025 in some animals!

Data Sharing Public Health Warnings HAB Monitoring Outreach



- Unprecedented multiple-toxin event
- Significant bloom with high DA toxicity
- Severe marine mammal + seabird strandings
- PSP impacts on seafood + public health



Above: Stranded Common bottlenose dolphin, as a photo from LA Lifeguards.
Below: CA sea lion being treated for DA poisoning.

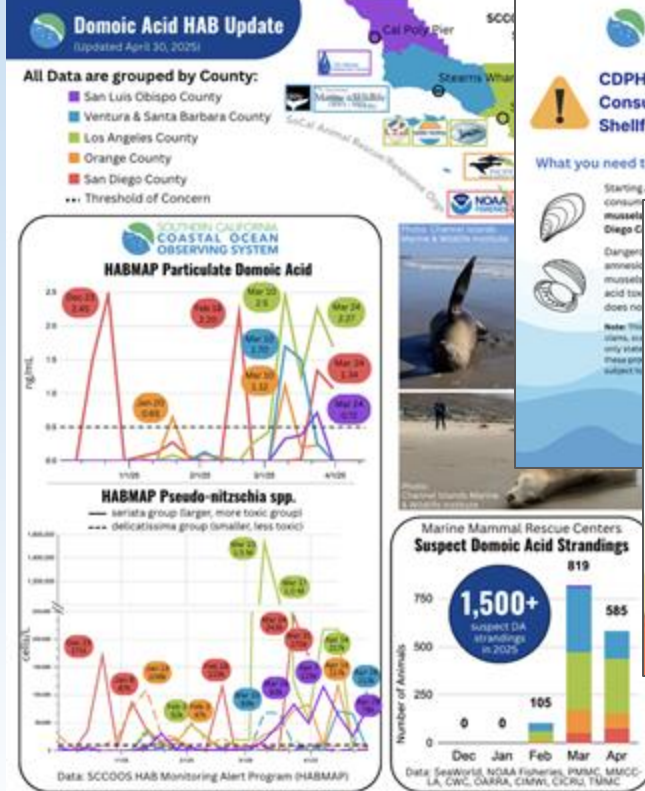


CA HAB Bulletin
SCCOOS publishes a bimonthly online bulletin that summarizes CA HAB events & forecasts.
See <https://www.sccoos.org>



- Why is this event so severe?**
- Two different types of marine algae were present. Each produce a unique neurotoxin that can cause illness & death in marine mammals/seabirds, and can also harm humans:
 - Domoic Acid (DA) → Amnesic Shellfish Poisoning
 - Saxitoxin → Paralytic Shellfish Poisoning (PSP)
 - This is the 4th consecutive year of major DA-related marine mammal mortality events in Southern CA.
 - High DA levels were detected at our shore stations and in animal samples. High toxin levels lead to larger numbers of strandings, deaths, and more severe neurological effects, which have led to inadvertent alterations with humans.
 - This year's HAB severity may be exacerbated by La Niña conditions, and potentially ash from the recent LA fires.
 - CA rescue centers report this DA event has caused more dolphin and seabird strandings than the past 3 years, as well as affecting CA Sea Lions; Mammal stranding numbers have surpassed the last three years of HAB events.
 - CDPH has issued shellfish harvest advisories in Southern CA due to DA + PSP surpassing the critical safety threshold.

Report a stranded animal (West Coast)
Marine Mammal Stranding Network 1-866-767-6714



CDPH Warns Public Not to Consume Sport-Harvested Bivalve Shellfish from San Diego County

What you need to know:

Starting April 2, 2025 CDPH is advising the public not to consume sport-harvested bivalve shellfish from San Diego County.

CDPH Warns Public Not to Consume Sport-Harvested Bivalve Shellfish from Ventura, Orange, and San Diego Counties

What you need to know:

Starting April 2, 2025 CDPH is advising the public not to consume sport-harvested bivalve shellfish from Ventura, Orange, and San Diego Counties.

Southern California Pacific Sardine Take Restrictions in Place Due to Public Health Hazard

What you need to know:

May 9, 2025: State health agencies determined that Pacific sardine sampled off Southern California contained elevated levels of domoic acid. This naturally occurring toxin can cause illness or death in humans. Cooking does not destroy the toxin.

The California Department of Fish and Wildlife (CDFW) has enacted a restriction for the commercial and recreational take of Pacific sardine for human consumption in the area south of Point Conception (34° 27'00" N lat.) to the California/Mexico border. Take of Pacific sardine for live bait is still allowed.

Note: The current fishery restrictions only apply to Pacific sardine. This restriction does not apply to other fishery products, including sea bass, yellowtail, tuna, and others. It is always recommended to consume only the cleaned, skinned, fillets of fish when there are restrictions or advisories for other species.

SCCOOS helps coordinate HAB event response

Rapid dissemination of public health advisories (DA + STX this year!), stranding maps, monitoring data

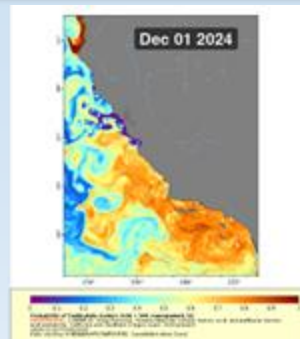
California HAB Bulletin

March-April 2025

Summary written by Dr. Clarissa Anderson and Dr. Kasia Kenitz, May 5th

SUMMARY: The ecological impacts observed during this period have surpassed those of the past four years, with toxins affecting CA sea lions and other pinnipeds, dolphins, sea birds, larger cetaceans, and producing shellfish advisories from Santa Barbara to San Diego. Very high levels of DA detected in sardine tissue prompted state agencies to recommend recreational fishery restrictions in Southern California. The biological toll of this multifaceted toxic event has been staggering, with more than 1,670 reported to date, far exceeding those reported in any of the toxic events over the past four years. Over 1250 of which were in Los Angeles, Ventura, and Santa Barbara counties. The origin of this bloom appears to be linked to the longest, nearshore cold water episode since the La Niña year of 2011, which began as early as December 2024 in Baja and at Scripps Pier and sustained it through February to April. The cold water brought elevated nutrient levels – silicic acid and nitrate – setting the stage for a major bloom of toxic *Pseudo-nitzschia*. This was followed by the emergence of several other HAB taxa, most notably an extensive toxic *Alexandrium* bloom that caused the first known prolonged saxitoxin advisories in shellfish for southern California areas such as San Diego. Blooms of *Akashiwo* and *Margalefidinium* also crept in at shore stations with no known impacts.

C-HARM



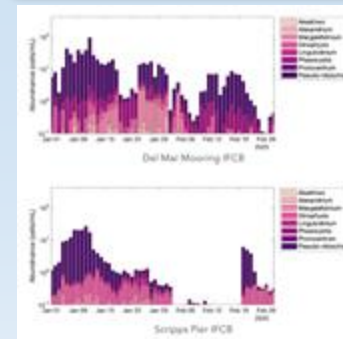
CDPH



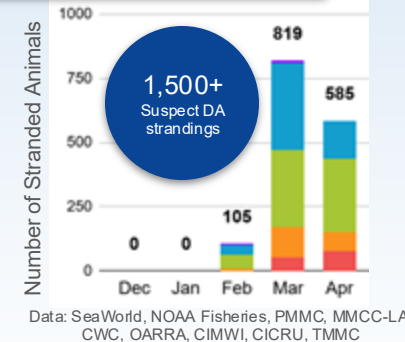
HABMAP



IFCB Network



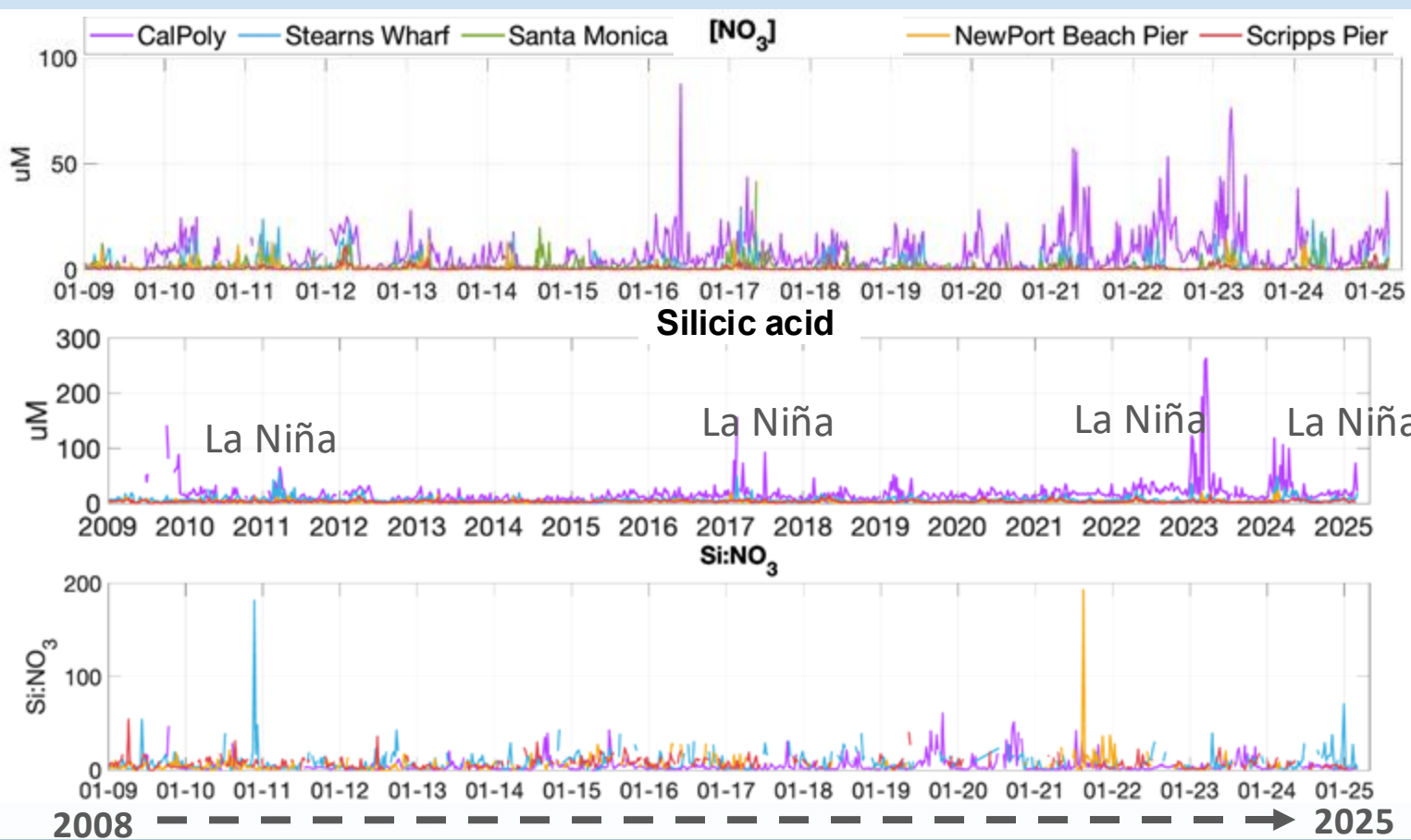
Stranding Data & Tracker



SCCOOS Publishes Bimonthly CA HAB Bulletin

Retrospective synthesis of observations, predictions, advisories, and mammal strandings — sccoos.org/california-hab-bulletin





Nitrate max in May 2016 at Cal Poly Pier (SLO) - no precip that month; El Nino conditions likely present in CCS

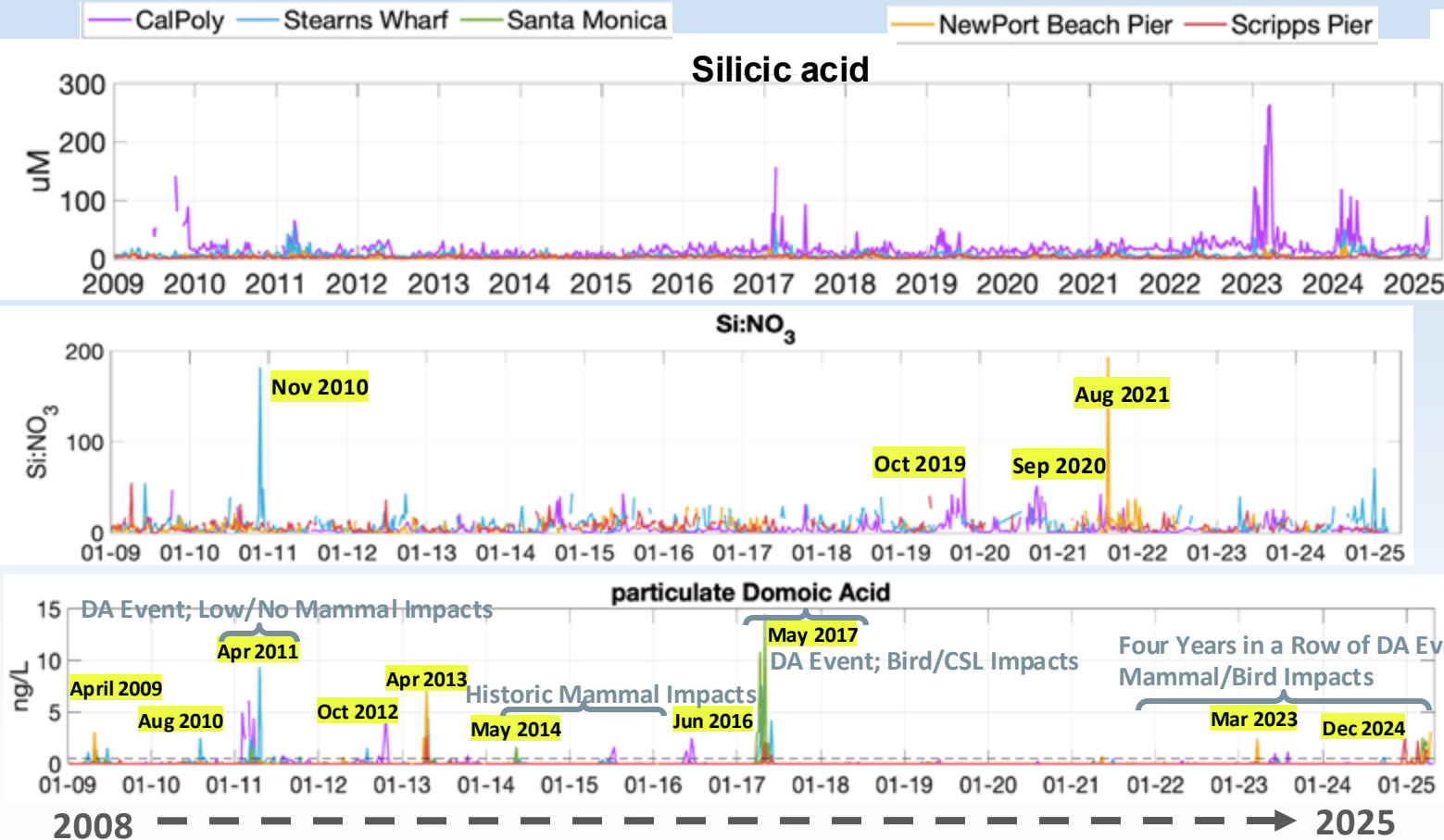
Si peaks are evident in the La Niña of 2010-2011, 2017-2018, 2020-2023, and 2025

2017 DA Event – nutrients high at all SoCal stations

Si:N signal dwarfed by a few sites: Cal Poly Pier, Stearns Wharf, and Newport Beach Pier

Drivers of Domoic Acid Events

Macronutrient Levels from HABMAP sites: 2008-2025



Runoff and Ash Deposition during the 2025 bloom may have driven local enhancement of nitrate and possibly phosphorous to stimulate additional PN and/or DA Production

Drivers of Domoic Acid Events

Silicic Acid and/or Si:NO₃ may be better predictors than nitrate for DA events

- SCCOOS is working with marine mammal rescue and research orgs to better share event-based bloom and animal stranding data and predictions
- Recent events appear anomalous in terms of frequency, magnitude, duration of tissue DA levels, aberrant animal behavior, and new toxins like STX
- Long-term SCCOOS databases useful for understanding DA event and food web impact variability

