

Media Activity

Created by Sara Heintzelman, Interdepartmental Graduate Program in Marine Science
University of California Santa Barbara

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Santa Barbara Coastal Long Term Ecological Research Project



The National Science Foundation



California Department of Education Science Standards

6th Grade

- Investigation and Experimentation
 7. Scientific progress is made by asking meaningful questions and conducting careful investigations.
 - e. Recognize whether evidence is consistent with a proposed explanation.

7th Grade

- Investigation and Experimentation
 7. Scientific progress is made by asking meaningful questions and conducting careful investigations.
 - b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.
 - c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.

8th Grade

- Investigation and Experimentation
 9. Scientific progress is made by asking meaningful questions and conducting careful investigations.

Media Coverage Activity

This lesson explores the ideas of biases and the differences between fact and opinion while helping the students to better understand when material that they are reading, listening to or watching is reliable. Students discuss the normality of having biases and the importance of being able to recognize your own biases as well as those of other people. They will practice identifying statements as fact or opinion and will apply these skills to a critical reading of an article. Being able to identify credible sources is crucial to good research skills; and with the increasing access to the internet, knowing which material to trust is more important than ever. Students will gain skills that will help them throughout this unit as well as in the rest of their subjects.

Objectives:

- * The students will be able to read a newspaper, magazine, or internet article critically.
- * The students will discuss biases and understand that everyone has them. The students will learn to identify the interests of the different people involved in an issue.

Specification: At the end of this lesson, the students should be able to:

- a. Identify who the author is (what is their job, qualifications, company, etc).
- b. Identify what the author's position on the subject is.
- c. Pick out which parts of the article are facts and which are opinions.
- d. Explain what bias is.
- e. Describe the possible biases of two authors or people involved in the topic of an article that they read.

Introduction:

I'm not biased!

Actually, most people have certain biases; a bias is "an attitude that always favors one way of feeling or acting over any other". In other words, if you have ever felt partial to something, had a preconceived notion, or played favorites- you have probably experienced what it is like to feel a bias towards something. It is normal that people will favor a certain way of acting or feeling; it may be what you have learned at home, at school, or through different experiences in your life. For example, if you have had a science class that you didn't like in the past, you may have come into this one expecting not to like it. That would be a preconceived notion, or a bias towards science! It is important to figure out what your own biases are so that you can be aware of them and realize when they are and aren't appropriate. In recognizing your own biases, you will become better at picking out other people's biases as well.

Fact or Opinion?

When you are reading a newspaper article, a magazine article, information on the internet, or even a book; how do you know what is fact and what is opinion? Can you tell from reading one of these if the author has any biases or if they are being completely

objective? It is good for people to express their own opinions, but they need to make it clear what is opinion and what is actual fact. So how do you tell?

One way may be the language that they use. For example, if I were to say “everyone loves the ocean, the ocean is great” would that be a fact or an opinion? It would be an opinion; not everyone loves the ocean and not everyone thinks the ocean is great. I love the ocean and am therefore a little biased towards it and may not understand how anyone wouldn’t like it. Alternatively, if I were to say “many people enjoy the ocean and think that it is great” that would be a fact. It would be even more accurate if I gave proof of my fact and said “I conducted a survey of all of the students in my class and found that 25 of 30 students enjoy the ocean and think its great”.

Another way would be to look at the author’s credentials, what qualifies the author to make certain statements? This can be a little difficult sometimes, especially with all of the information that we can access so easily through the internet- how do you know what to trust? Usually the information that you get from big, well-known agencies is reliable (for example, information from a museum or a city office). If you are ever in doubt, try to double check the information by looking at another source or ask someone! When you are reading an article, it usually tells you who the author is, it may say that the author is a researcher at UCSB, or a government official, or it may not say much. You can also look at the company that the author, or the people who are quoted in the article, work for. If you read something in the LA Times it’s a safe bet that it will be more reliable than something you read in the National Enquirer. You need to learn how to judge when you are reading information from a reliable source, and when you may not be. This takes practice.

Activity: (approximate time: 30-45 minutes)

Materials: Newspaper articles and Opinion vs. Fact Worksheet

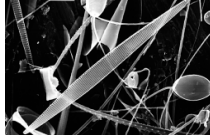
- Start by going over the information in the introduction (*on the student worksheet*) with the students. Ask the students to share (only if they feel comfortable) any of their own biases. (*Remind the students to be respectful and not to say anything that will offend other class members*). Share 1 or 2 of your own biases with the class to make them feel more comfortable. This can also be done as a journal writing activity or in small groups.
- Ask the students if they have ever read an article or book where the author seemed biased to them? How could they tell? Discuss some of the ways that you can figure out an author’s biases from their writing and how it can help you distinguish opinion from fact. (*Language, credentials, company, others?*) This can also be done as a journal writing activity or in small groups. *If you would like to give the students a real example, this one makes for a good (and funny) story. One of my college biology professors came into our class one day very excited about this great new marine biology website that he had found. The following week he came into class looking a little bit embarrassed and told us that he had researched the great new website he*

had found and he had discovered that it had been created by a 12 year old boy! It just goes to show that you really need to be careful about what information you trust; and how important it is to figure out the source of the information, especially on the internet!

- Tell the students that as a class you are going to read an article and that as you read it everyone needs to figure out what the qualifications of the author or people interviewed are, what company they work for, what possible biases the author or interviewees might have, and what clues students see that might help them distinguish facts from opinions. Are there any definite facts? Are there any definite opinions? *(Use the sample article with all of this outlined for you to guide the students)*
- Tell the students that they are each going to read an article *(you can pass out copies of the articles provided or have the students find an article on the topic on the internet, in a magazine, or in the newspaper as homework)* and that it is their job to analyze it just as you did as a class. Have them use the Opinion vs. Fact Worksheet, first to practice with selected quotations and then to guide them as they read an article. *(Tell the students that some articles are easier to analyze than others and to do their best and ask for help if they need it).* This piece could be homework instead of an in-class activity.
- After the students have read their articles, open up a class discussion. All of the articles are going to be on the same topic, but may be written from different perspectives. Ask the students to share what they found when they analyzed their article, what was the general topic of their article, what clues helped them figure out pieces of information about the author and the author's opinion? This can also be done as a journal writing activity.

Activity 1: Teacher's Sample

The 4 quotations below are taken from articles about marine mammals getting sick and, in some cases, dying. Scientists think that these illnesses and deaths may be due to a toxin that some types of algae produce called domoic acid.



This is a picture of the diatom (an algae) Psuedonitzschia, which can produce the toxin domoic acid.

For each quotation below you need to decide if it is fact or opinion. If you think that it is a fact highlight it yellow, if you think that it is an opinion, highlight it blue.

#1: “One possible reason for the large number of pregnant sea lions coming in is that during pregnancy the mothers have to eat more to sustain themselves along with their unborn pups- and by eating more, they also take more domoic acid into their systems.”

#2: “In 2002, 685 California Sea lion deaths were documented, as were the deaths of 75 dolphins”.

#3: “Common effects of domoic acid seen in animals washed ashore include head weaving and seizures, which may lead to permanent brain damage and eventual death if not treated”.

#4: “Why are domoic cases confined to coastal waters? Several researchers suspect connection with human activities.”

Activity 2:

As you read your article highlight fact in yellow and opinion in blue just like you did in activity 1. Also as you read, try and figure out (not all articles provide the following information, so just do your best!):

1. Who is the author? Jane Kay
2. What are the author's qualifications? She is the environment writer for the SF Gate.com, I can't tell anymore from the information provided.
3. What company or organization does the author work for? She works for the San Francisco Chronicle.
4. What possible biases might the author have about the topic of the article? Why? She doesn't seem to have any biases in her writing; everything she writes is pretty objective. However, because she is the environment writer, she might really like the environment and have a bias in that way, maybe she wants to protect it.
5. Does the author interview anyone? Yes/No (circle)
If yes, what are the qualifications of the person who was interviewed? She interviewed Dr. Micheal J. Murray, he is a veterinarian; Dana Micheals, who is a spokesman, and Lilian Busse, a post-doctoral researcher.
Who do they work for? Dr. Murray works for the Monterey Bay Aquarium, Micheals works for the State Department of Fish and Game, and Dr. Busse works for the Scripps Institution of Oceanography.

What possible biases might they have? Why? Dr. Murray might be biased towards sea otters since he works with them and wants to make sure that sea animals are healthy. In the article he says how sad it is to see them dying, but some people (like fisherman who compete with the sea otters) might not think that is sad. Michaels might be biased to the issue because if people are scared to eat fish because of possible poisoning, then it would be a concern for the DFG, also depending on Micheal's background which wasn't apparent from the article, she might have a personal interest of attachment to marine life. Busse might be biased because she studies toxic algae and so an outbreak of sick animals might be exciting for her since it would provide a chance to study it and learn more about HAB's.

Teacher's Example

[Sick, dying sea otters turn up in Morro Bay](#)

[Scientists suspect naturally occurring algae bloom poison](#)

- Jane Kay, Chronicle Environment Writer

Thursday, April 15, 2004

More than 20 California sea otters, nearly 1 percent of the wild population, have turned up dead or sick around Morro Bay over the past week, most likely the victims of a natural marine toxin, scientists said Wednesday.

The animals have been discovered suffering from seizures or muscle tremors, or comatose. Wildlife experts believe they may have eaten mussels, clams and scallops contaminated with a naturally occurring toxin sometimes found in algae blooms at this time of year.

"It's really, really sad. Everybody loves the sea otters," said Dr. Michael J. Murray, staff veterinarian at the Monterey Bay Aquarium. "It's sad to read about it. It's said to hear about it. It's even sadder to see seizing and comatose sea otters, and to see them lying out on that stainless steel autopsy table."

State and federal agencies are waiting for results of post-mortem examinations on 12 otters and tests on tissue samples to confirm whether to blame the toxin, called domoic acid.

The state Department of Health Services has issued a health advisory, alerting the public not to eat sport-caught shellfish in San Luis Obispo County.

"Unfortunately, we think it's probably a naturally occurring substance, and there's nothing we can do about it," said Dana Michaels, a spokeswoman for the state Department of Fish and Game.

Other marine mammals, such as sea lions and dolphins, as well as birds and humans, are susceptible to nervous system damage from consuming shellfish and fish containing domoic acid.

The southern sea otter is protected as a threatened species under federal law. A 2003 census counted only 2,505 otters between Santa Barbara and Half Moon Bay, its current range. Biologists say the population must exceed 3,000 for the government to consider it no longer threatened.

Southern sea otters were once plentiful. But the otter has been hunted for its fur, shot by fishermen, hit by boats, snagged by nets, eaten by sharks and contaminated by PCBs, pesticides, sewage and other pollutants.

A year ago this month, 48 otters died, the highest short-term mortality rate in modern times. Those deaths were attributed to marine toxins; parasites, including one linked to cat waste; and shark bites.

But in just one week this year, the Monterey Bay Aquarium and the Marine Mammal Center have been receiving calls from upset beach-goers around Morro Bay who have found more than 20 sick or dead animals.

"The big thing that is alarming is that we're having so many animals dying in such a short time period. We're seeing in the post-mortems very similar changes, suggesting that the same thing is killing the animals," said Murray, the veterinarian.

"We suspect a marine biotoxin, but we're not sure yet. We need to get confirmation on this. We've got the best minds working on it, and we're searching for answers."

Domoic acid is produced by algae called diatoms that collect in algae blooms on the coast. Lilian Busse, a Scripps post-doctoral researcher, said it's unclear what makes algae produce domoic acid.

In recent years, domoic acid has been found in sea water in Monterey Bay, Santa Barbara and Los Angeles.

On Friday, researchers at the Scripps Institution of Oceanography in La Jolla reported that domoic acid was found in sea water as far south as San Diego. The toxin may be responsible for sea lion strandings in Southern California this year, they said.

E-mail Jane Kay at jkay@sfgate.com.

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URL: [http://sfgate.com/cgi-](http://sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2004/04/15/MNGF9651U433.DTL)

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Media Coverage Activity References

Images:

All images without a reference are from Microsoft Clipart.

1. Psuedonitzschia: <http://www.who.edu/redtide/species/species/html>

Information:

Definition of Bias: <http://www.wordcentral.com/>

Articles Quoted:

Howorth, P. 2003. Deadly domoic acid still holds mysteries. *Pacific Log*. June 8th.**

Thomas-Anderson, M. 2003. Domoic acid sickens sea mammals. *Daily Nexus*. Volume 83, Issue 130, Wednesday May 21st.**

Articles Provided:

1. Student Worksheet Example:

Kay, J. 2004. Sick, dying sea otters turn up in Morro Bay: Scientists suspect naturally occurring algae bloom poison. *SFGate.com*. April 15th.**

2. Recommended:

Wallerstein, P. 2004. Domoic acid poisoning. *From the Whale Rescue Team:*
http://www.whalerescueteam.org/rescues.html#domoic_ancher

3. Others:

News Brief from California's Central Coast. 2003. *Associated Press*. June 4th.**

Sewage in urban runoff may spur growth of harmful algal blooms. 2000. *UC Santa Cruz Press Releases*. February 24th.

**These articles are available on the HAB-TrAC webpage:

<http://www.habtrac.ucsb.edu/News.html>

Opinion vs. Fact Student Worksheet

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Actually, most people have certain biases; a bias is “an attitude that always favors one way of feeling or acting over any other.” In other words, if you have ever felt partial to something, had a preconceived notion, or played favorites- you have probably experienced what it is like to feel a bias towards something. It is normal that people will favor a certain way of acting or feeling; it may be what you have learned at home, at school, or through different experiences in your life. For example, if you have had a science class that you didn't like in the past, you may have come into this one expecting not to like it. That would be a preconceived notion, or a bias towards science! It is important to figure out what your own biases are so that you can be aware of them and realize when they are and aren't appropriate. In recognizing your own biases, you will become better at picking out other people's biases as well.

Fact or Opinion?

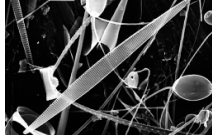
When you are reading a newspaper article, a magazine article, information on the internet, or even a book; how do you know what is fact and what is opinion? Can you tell from reading one of these if the author has any biases or if they are being completely objective? It is good for people to express their own opinions, but they need to make it clear what is opinion and what is actual fact. So how do you tell?

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Activity 1:

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#4: “Why are domoic cases confined to coastal waters? Several researchers suspect connection with human activities.”

Activity 2:

As you read your article highlight fact in yellow and opinion in blue just like you did in activity 1. Also as you read, try and figure out (not all articles provide the following information, so just do your best!):

1. Who is the author? _____

2. What are the author’s qualifications? _____

3. What company or organization does the author work for? _____

4. What possible biases might the author have about the topic of the article? Why? _____

5. Does the author interview anyone? Yes/ No (circle)

If yes, what are the qualifications of the person who was interviewed? _____

Who do they work for? _____

What possible biases might they have? Why? _____

From the Whale Rescue Team
(http://www.whalerescueteam.org/rescues.html#domoic_anchor)

Domoic Acid Poisoning

By Peter Wallerstein

LOS ANGELES COUNTY In the spring of 2002 a crisis fell upon hundreds, if not thousands, of pregnant California sea lions, dolphins and pelicans along the Pacific coast of the United States. Domoic acid, a naturally occurring marine biotoxin, produced by marine diatoms which are members of the genus *Pseudo-nitzschia*, forced pregnant sea lions to beach themselves suffering major seizures, foaming from their mouths, and the whites of their eyes bloody red. The sea lions were completely disoriented from the neurotoxin. Dozens of Common dolphins and pelicans also suffered from attacks on their brains and nervous systems by the rapid reproduction of the toxic single-cell plankton.



California sea lion suffering from domoic acid poisoning.

Photo: Jonathon Alcorn

The Marine Mammal Care Center at Fort MacArthur in San Pedro, California accepts mammals for rehabilitation from Los Angeles County and parts of Orange and Ventura Counties. The Center's staff and volunteers did an excellent job during the domoic crisis, but Fort MacArthur was overloaded for weeks which prompted the National Marine Fisheries Service (NMFS) to enact a 48 hour monitoring period before an animal may be rescued. Only “non-responsive” animals could be assisted before the 48 hour period expired. NMFS policy caused members of Whale Rescue Team (WRT) to have to triage dozens of sea lions daily leaving them unassisted on the beach.



Hoop netting a sea lion during a rescue on Pacific Palisades beach.

Photo: Rich Schmitt

It was very difficult to leave a suffering animal on the beach that we would normally rescue immediately. From 7 o'clock in the morning to 10 o'clock at night we located the animals, gave each of them multiple evaluations throughout the day, rescued as many of the animals as possible and evaluated the new ones that arrived daily. The WRT hotline was receiving over 60 calls a day. We would receive calls at 2 o'clock in the morning from irate citizens wanting to know why we weren't helping the animal they were calling us about. But most citizens after hearing what was truly going on understood and were sympathetic. Some citizens even assisted WRT with the safer parts of our rescues.

In April, some of the sea lions began birthing their pups prematurely. Some were stillborn, others alive. We were advised that at this point the pup's lungs were so under developed that they wouldn't survive no matter what anyone did. We decided to keep those pups with their moms for the few hours they had to live. It was heartbreaking. We did observe that many of the pregnant sea lions that gave birth prematurely, were gaining strength and returning to the water with added vigor on their own.

The mis-education people receive from captive display facilities was very obvious during this crisis. A sea lion beached on a busy day in Venice, California and was quickly surrounded by 200 people trying to pet the frightened and distressed sea lion. I am amazed that more people weren't bitten. Luckily for the citizens the domoic caused most of the sea lions to be very incoherent to their surroundings. We saw people attempting to bounce balls off a sea lions nose or take family photos next to the suffering and unpredictable sea lions. Other well intentioned, but misguided citizens tried to pull the sea lions back into the water not knowing how dangerous this could be and also that their actions might cause death to the sea lion. Some people would even hold the head of a sea lion while it was suffering a seizure. One out of ten sea lions awoke from their seizures looking for something to attack. In one incident, in Venice Beach, a woman got too close to a sea lion as it awoke from a seizure. She got bit severely and the sea lion, up on all fours charged at anything near it. It was very sad to see these normally non-aggressive animals act so violently and out of control. They were scared and sick. The sea lion charged the Lifeguards upon their arrival and also charged WRT volunteers when we arrived. Due to her aggressiveness and her location we received permission to rescue her. With assistance from County Lifeguards we rescued the sea lion and brought her in for treatment at Fort McArthur

We've seen and rescued many animals suffering from gill net entanglement and gun shot wounds. But, in 20 years of Southern California rescue experience, I have never seen anything on our local beaches that compares to the horrific and heartbreaking suffering caused by the toxic algae bloom in the spring of 2002. WRT volunteers gave each and every animal our very best efforts.

[Sick, dying sea otters turn up in Morro Bay](#)
[Scientists suspect naturally occurring algae bloom poison](#)

- Jane Kay, Chronicle Environment Writer
Thursday, April 15, 2004

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The animals have been discovered suffering from seizures or muscle tremors, or comatose. Wildlife experts believe they may have eaten mussels, clams and scallops contaminated with a naturally occurring toxin sometimes found in algae blooms at this time of year.

"It's really, really sad. Everybody loves the sea otters," said Dr. Michael J. Murray, staff veterinarian at the Monterey Bay Aquarium. "It's sad to read about it. It's said to hear about it. It's even sadder to see seizing and comatose sea otters, and to see them lying out on that stainless steel autopsy table."

State and federal agencies are waiting for results of post-mortem examinations on 12 otters and tests on tissue samples to confirm whether to blame the toxin, called domoic acid.

The state Department of Health Services has issued a health advisory, alerting the public not to eat sport-caught shellfish in San Luis Obispo County.

"Unfortunately, we think it's probably a naturally occurring substance, and there's nothing we can do about it," said Dana Michaels, a spokeswoman for the state Department of Fish and Game.

Other marine mammals, such as sea lions and dolphins, as well as birds and humans, are susceptible to nervous system damage from consuming shellfish and fish containing domoic acid.

The southern sea otter is protected as a threatened species under federal law. A 2003 census counted only 2,505 otters between Santa Barbara and Half Moon Bay, its current range. Biologists say the population must exceed 3,000 for the government to consider it no longer threatened.

Southern sea otters were once plentiful. But the otter has been hunted for its fur, shot by fishermen, hit by boats, snagged by nets, eaten by sharks and contaminated by PCBs, pesticides, sewage and other pollutants.

A year ago this month, 48 otters died, the highest short-term mortality rate in modern times. Those deaths were attributed to marine toxins; parasites, including one linked to cat waste; and shark bites.

But in just one week this year, the Monterey Bay Aquarium and the Marine Mammal Center have been receiving calls from upset beach-goers around Morro Bay who have found more than 20 sick or dead animals.

"The big thing that is alarming is that we're having so many animals dying in such a short time period. We're seeing in the post-mortems very similar changes, suggesting that the same thing is killing the animals," said Murray, the veterinarian.

"We suspect a marine biotoxin, but we're not sure yet. We need to get confirmation on this. We've got the best minds working on it, and we're searching for answers."

Domoic acid is produced by algae called diatoms that collect in algae blooms on the coast. Lilian Busse, a Scripps post-doctoral researcher, said it's unclear what makes algae produce domoic acid.

In recent years, domoic acid has been found in sea water in Monterey Bay, Santa Barbara and Los Angeles.

On Friday, researchers at the Scripps Institution of Oceanography in La Jolla reported that domoic acid was found in sea water as far south as San Diego. The toxin may be responsible for sea lion strandings in Southern California this year, they said.

E-mail Jane Kay at jkay@sfgate.com.

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Local News -----

Posted on Wed, Jun. 04, 2003

News briefs from California's Central Coast

Associated Press

SANTA BARBARA, Calif. (AP) – Federal officials want the county to provide details on the dead sea lions and dolphins found along beaches.

With carcasses rotting on beaches for days at a time, most coastal residents are well aware of the toll taken by domoic acid on local sea mammals. But the federal government hasn't been in the loop.

For the past decade, Santa Barbara County hasn't shared that information with the National Marine Fisheries Service, a violation of federal law that could put efforts to fight the outbreak at risk.

A directive from the federal agency - prompted by last week's strangling of a dying sea lion by a county worker - requests the county Public Works Department submit a monthly report on the local death toll by July 10.

The Marine Mammal Protection Act of 1972, in addition to protecting the sea lion killed on May 27, requires state and municipal officials to provide a monthly report on the beached mammals they bury.

"We need to know how many animals are coming in dead in a certain area," said Joe Cordero, a wildlife biologist with the Fisheries Service office in Long Beach, which is investigating the strangling incident. "If we know the timeline, we can establish a pattern.

"Right now, we have no idea how many are dying in Santa Barbara County."

Cordero said his office has sent several letters to the county requesting reports since the mid-1990s, but there has been little response.

Public Works director Phillip Demery said, however, that he's never received any letter. County Administrator Mike Brown also said he couldn't recall seeing a letter.

Santa Barbara County is last behind other counties in submitting reports about deaths due to domoic acid, Cordero said.

The domoic acid outbreaks began in Southern California in 1998, but until last year had not hit the waters off Santa Barbara County.

Domoic acid is carried by a common algae that blooms in early summer. Most of the sea lions and dolphins, and even some pelicans who fall victim to the illness, are pregnant. Symptoms of domoic acid poisoning include seizures, shaking and head-waving.

Last year, domoic acid killed 685 sea lions in Santa Barbara and Ventura counties, and stranded another 518, Cordero said. Since April, about 104 sea lions have died and another 177 have fallen ill in Santa Barbara and Ventura counties.

February 24, 2000

Media Contacts: Tim Stephens, UC Santa Cruz, (831) 459-2495; stephens@cats.ucsc.edu
Merrik Bush-Pirkle, San Francisco State University, (415) 338-6747; merrik@sfsu.edu

Sewage in urban runoff may spur growth of harmful algal blooms

Researchers find that urea from urban waste, generally ignored as a pollutant by environmental agencies, contributes to growth of potentially toxic blooms of a common phytoplankton species

For Immediate Release

SANTA CRUZ, CA--In nature, there's no accounting for taste. New research shows that a common type of marine algae may prefer urea, an organic nitrogen compound found in urine and in agricultural and urban runoff, over inorganic fare such as ammonium and nitrate that occurs naturally in the ocean. When excess nutrients cross their paths, these single-celled organisms, called dinoflagellates, can grow into potentially toxic blankets of algae commonly known as red tides.

The new findings, published in the current issue of *Aquatic Microbial Ecology*, suggest that urea in urban and agricultural runoff may play a greater role than previously thought in triggering or sustaining harmful algal blooms found growing off California's coastline.

"The particular bloom we looked at, which extended from the upper Baja peninsula in Mexico to the Monterey Bay, occurred after heavy urban runoff events in the southern California region," said Raphael Kudela, assistant professor of ocean sciences at the University of California, Santa Cruz. "Our data suggests it was probably triggered by the increased concentration of urea introduced to the ocean by urban runoff," Kudela said.

Kudela and coauthor William Cochlan of San Francisco State University's Romberg Tiburon Center for Environmental Studies examined the physiology and ecology of the bloom, which occurred in 1995 and was the largest and most widespread red tide found off California's coast since 1902. Though marine scientists usually monitor marine ecosystems for high concentrations of common inorganic nutrients known to spur harmful algal blooms, urea is generally ignored, the researchers said.

Previous studies have shown that urea can nourish the growth of dinoflagellates under laboratory conditions. The new study shows for the first time, however, that the naturally occurring red-tide dinoflagellate responsible for the 1995 bloom--known scientifically as *Lingulodinium polyedrum*--can use organic urea as a nutrient source and even prefers it over traditionally measured inorganic forms of nitrogen.

"Although urea as a source of pollution is generally ignored by state and federal environmental agencies, research shows that urea represents an average of one-third of the total nitrogen uptake supporting growth of phytoplankton in regions where red tides

can occur," Cochlan said. "In some estuarine areas, such as the Chesapeake Bay, urea can represent 60 percent of the nitrogen uptake at certain times of the year."

Phytoplankton serve as the base of the marine food web, but unusually high levels of nutrients together with abundant sunlight can spur rapid growth, or blooms, of these single-celled plants, leading to dense patches of algae floating near the surface of the ocean that can double in size daily. While most blooms are not harmful, a small number of phytoplankton species can produce potent neurotoxins when they form into a bloom, sometimes poisoning or killing higher life forms such as zooplankton, shellfish, fish, birds, marine mammals, and even humans as the toxin is transferred up the food chain.

Although *Lingulodinium polyedrum* has been reported to produce yessotoxin, a compound related to the class of poisons that cause paralytic shellfish poisoning, the researchers found no evidence that the 1995 bloom was toxic. However, large algal blooms of any type pose an additional risk by lowering the available oxygen in the surrounding water when they decay, causing small marine animals, such as zooplankton and fish, to suffocate.

"Considering the role urea seems to play in spurring or sustaining growth of phytoplankton, including harmful algal blooms, this organic nitrogen source should be taken into consideration by environmental agencies that conduct bloom mitigation efforts," Cochlan said.

According to Kudela, these harmful bloom events are becoming more common off the California coastline. In addition to the dinoflagellate *Lingulodinium polyedrum*, the diatom species *Pseudo-nitzschia australis* also plagues California's coastal waters in deadly bloom form. *Pseudo-nitzschia* was recently identified as the culprit when more than 400 sea lions died and many more suffered from domoic acid poisoning on California's Central Coast in 1998. "However, there's no evidence that *Pseudo-nitzschia* responds to urea," Kudela noted.

The researchers emphasized that red-tide-causing phytoplankton species are driven to bloom by varying mechanisms and nutrients, so it's important to examine and understand each species individually. Toward that end, the researchers have been awarded a grant from the National Oceanic and Atmospheric Administration's Coastal Ocean Program to conduct a comprehensive field and lab study, along with several other groups on the West Coast, of the more deadly *Pseudo-nitzschia*.

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Note to reporters: Article reprints and images are available on request.