

# Perspectives on the Impact to Public Health from Harmful Algal Blooms (HABs)

Part 2: Summer Webinar Series to Build Awareness About Harmful Algal Blooms and Nutrient Pollution



Thursday, July 25, 2013  
1:00pm – 2:30pm ET



## Speakers:

**Lorraine C. Backer, PhD, MPH** Senior Scientist and Environmental Epidemiologist, National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC)

**Andrew Reich, MS, MSPH** Program Coordinator, Aquatic Toxins Disease Prevention Program  
Public Health Toxicology Section, Florida Department of Health

Moderated by: **Lesley Vázquez-Coriano, Dr.PH, MEH**, Office of Science and Technology, US EPA

# Today's Schedule

- **Introduction and GoToWebinar Logistics**
- **Lorrie Backer**
  - **Means of exposure**
  - **Data collection**
  - **Public health response**
- **Andy Reich**
  - **HAB-related illnesses**
  - **Communication resources**
- **Polling Questions**
- **Q&As**
- **Final Announcements**

# Webinar Logistics

- **To ask a question** – Type your question in the “Questions” tool box on the right side of your screen and click “Send.” Our panelists and moderator will respond to the entire audience.
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# Today's Topic and Speakers

## Epidemiologic Studies and Surveillance

Lorrie Backer, PhD, MPH

- Team Leader and Senior Environmental Epidemiologist
  - National Center for Environmental Health, **Centers for Disease Control and Prevention**

## HAB Illnesses and Public Communication

Andy Reich, MS, MSPH

- Aquatic Toxins Disease Prevention Program Coordinator
  - Public Health Toxicology Section, **Florida Department of Health**

# Harmful Algal Blooms and Public Health

Lorraine C. Backer, PhD, MPH

Health Studies Branch

Division of Environmental Hazards and Health Effects

National Center for Environmental Health

Centers for Disease Control and Prevention

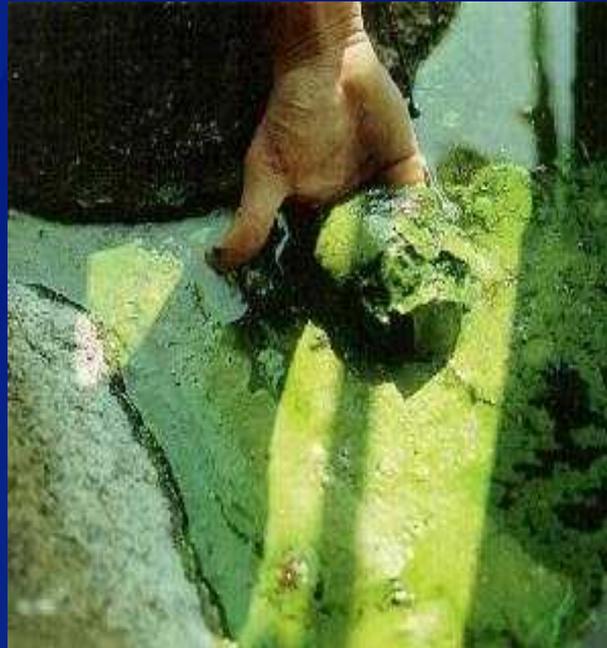
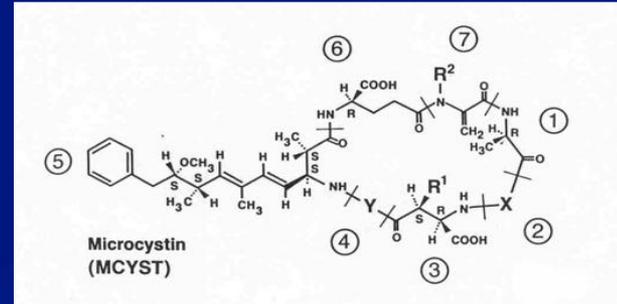
HAB Awareness Webinar, July 25, 2013

# HABS – a Public Health Problem?

- Hazard definition
- Exposure routes
- Completed exposure pathways
- Health outcomes
- Public health response

# Hazard Identification

## Organisms and toxins in the environment



*Karenia brevis*

# Exposure Routes and Completed Exposure Pathways

- Possible exposure routes
  - Food
  - Drinking water
  - Recreational waters
  - Aerosols
- Completed exposure pathways



# Health Outcomes

- Food-born illness
- Dermatologic effects
- Respiratory effects



Photo courtesy of Andy Reich

# HABs: What is our public health response?

- Epidemiologic studies
  - Outbreak investigations
  - Planned research studies
- Surveillance
- Prevention

# HABs: What is our public health response?

- **Epidemiologic studies**
  - Outbreak investigations
  - Planned research studies
- Surveillance
- Prevention

# Epidemiology

*The study of disease occurrence and its relation to the characteristics of individuals and their environment*

# HABs: Public Health Response

- Epidemiologic studies
  - Outbreak investigations
  - **Planned studies**
- Surveillance
- Prevention
- Examples of recent advances

# Planned Epidemiology Studies on HABs: Challenges

- Environmental concentrations often near the LOD
  - Need new analytic methods
- Body burdens likely to be extremely low
  - Need new biomarkers
- Biological effects occurring at the molecular level

# Environmental Epidemiology = Interdisciplinary Research

- Organisms or agents
- Exposures
- Diseases/health outcomes
- Epi study design
- New technologies
- Sentinel Species
- Biomarkers



# Target Populations

- Exposed via occupation
- Exposed via recreation
- Exposed and sensitive to environmental contaminants



# What data do we need?

- Exposure data
  - Environmental measurements
  - Monitoring data
  - Weather data
- Outcome data
  - Medical records
  - Personal interviews
  - Laboratory & clinical tests
  - Biomarkers
  - Surveillance



# Environmental Epidemiology Studies: Blue-greens and Red Tides

Klamath blue green algae impacts debated 090606



**Our Klamath Basin Water Crisis**  
Upholding rural Americans' rights to grow food,  
own property, and caretake our wildlife and natural resources.

<http://www.siskiyoudaily.com/articles/2006-09-01/news/doc44f8cb00fca692280607.txt>

## Blue-green algae impacts debated

By TIM RIOS and BRAD SMITH Daily News Staff Writers September 1, 2006

## Something's Amuck

Algae blooms return to Michigan shores

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NEWS & PUBLICATIONS

### New York's Toxic Algae Blooms

#### ESF Leads New Study

SYRACUSE, N.Y. In the northeastern United States, August brings ripe corn, shorter days and blue-green algae blooms toxic enough to kill humans.

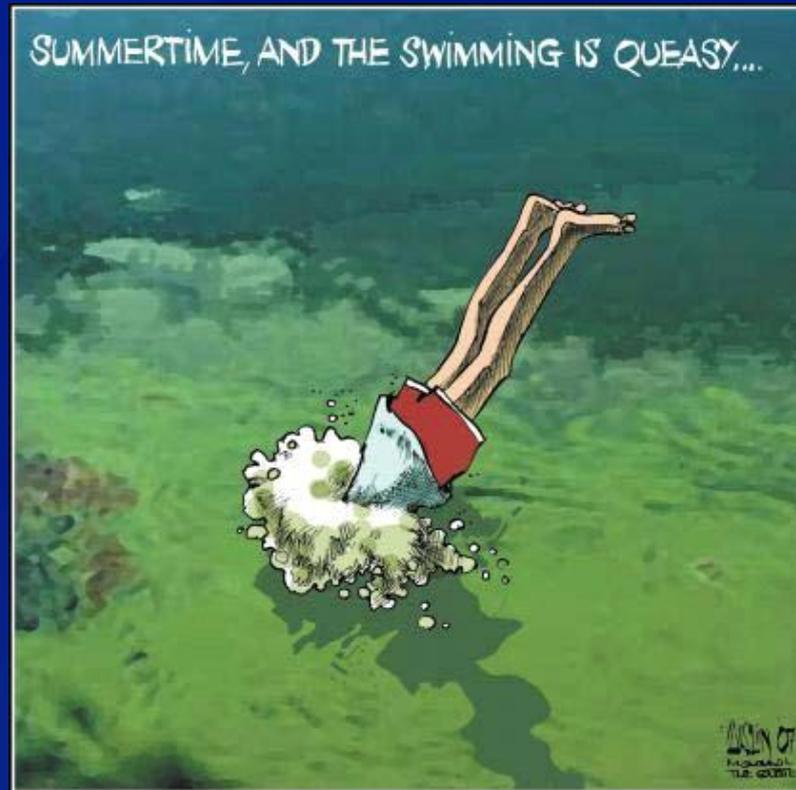
**JOURNAL in the NEWS**  
COVER STORY | GARDEN | PREVIEW | THE HUM | CALENDAR

August 5, 2004

**ALGAE ALERT:** A Jack Russell terrier died July 25 after swimming through some blue-green algae in the South Fork of the Eel River near Piercy, the Environmental Division of the Humboldt Department of Health and Human Services reported. Like three other dogs who died in the river in 2002, the terrier vomited some green material, had a seizure and died within 10 to 15 minutes of exiting the water. No cases of human illness caused by algae contact have been reported, but signs have been posted warning swimmers to



# Exposure to Microcystins in Recreational Waters



# Collaborators

- National Center for Environmental Health, CDC
- National Center for Infectious Diseases, CDC
- Mote Marine Laboratory
- Greenwater Laboratory
- Lovelace Respiratory Research Institute
- Wright State University
- Other Federal Agencies (NOAA)
- State and local public health agencies
- Officials or others at study site

# Field Study

- 13 study personnel
  - 2 local phlebotomists
  - Epidemic Intelligence Service Officer
- 3 boats
- 1 RV



# Epidemiology Study Design

- Study population
  - Planning aerosol-generating recreational activities in lake with a HAB (exposed)
  - Planning recreational activities in lake with no HAB (control)
- Recruited in person



# Environmental Data Collection

- Water samples
  - Water quality
  - Algal taxonomy
  - Microcystins
  - Viruses



# Environmental Data Collection: Air Samples & New Methods

- Air samples
  - 3 High-volume
    - Particle size
    - Microcystins
- 50 personal air samples
  - Microcystins



# Health-related Data Collection

- Recruited 104 people
- Questionnaires
  - Pre-exposure
  - Post-exposure
  - Follow-up (7-10 days later)
- Post-exposure plasma samples
  - Microcystins



# Outcome Measures

- Compare plasma levels of microcystins in control and exposed groups
- Compare symptom reports



# Results

Parameter	Unexposed N = 7	Exposed N = 97
Microcystin in water ( $\mu\text{g/L}$ )	< LOD LOD = 0.15	3-5
Microcystins in air ( $\text{ng/m}^3$ )	NA	< LOD – 0.14 LOD = 0.0037
Microcystins in blood ( $\mu\text{g/L}$ )	<LOD LOD = 0.147 $\mu\text{g/L}$	< LOD
Symptoms	No change	No change

# Exposure to Microcystins in Recreational Waters: Part 2



# Collaborators

- National Center for Environmental Health, CDC
- California Department of Health
- Siskiyou County
- Mote Marine Laboratory
- Greenwater Laboratory
- National Center for Infectious Diseases, CDC
- Lovelace Respiratory Research Institute
- Karuk Tribe
- Pacific Corporation

# Health-Related Data Collection

- Added nasal swabs
  - Microcystins



# Results

Parameter	Unexposed N = 7	Exposed N = 88
Microcystin in water ( $\mu\text{g/L}$ ) (total microcystins)	< LOD	23 – 357
Microcystins in air ( $\text{ng/m}^3$ )	NA	0.2 – 0.4
Microcystins in blood	<LOD	<LOD
<b>Microcystins on nasal swabs</b>	<b>NA</b>	<b>&lt; LOD - 0.4 ng</b>
Symptoms	No change	No change

# What have we learned about microcystin exposure?

- Aerosols generated in lakes with blue-green blooms producing microcystins contain measurable concentrations of this toxin
- Potential for exposure
- Potential for public health impact

# Epi Studies: Florida Red Tide



*K. brevis*, Charlotte Harbor, Charlotte Sun Herald, Paul Schmidt

ST. PETERSBURG TIMES-TRIPLEX  
TUESDAY, 4/19/10

## Red Tide dumps its catch on beach

...the shore with most of the fish that died.

...the beach on Monday morning as a result of Red Tide, and prepared it for a final trip to the dump.

## Algae bloom keeps rolling in

...the water with most of the fish that died.

...the beach on Monday morning as a result of Red Tide, and prepared it for a final trip to the dump.

...the water with most of the fish that died.

...the beach on Monday morning as a result of Red Tide, and prepared it for a final trip to the dump.

# Science

## Red tide spreads distress by air

### Fish-killing algae causing human breathing problems

By Elizabeth Weise  
USA TODAY

A toxic algae bloom that has been lingering along the southwest coast of Florida since December has poisoned large numbers of fish, killed as many as 45 endangered manatees and may turn out to be more hazardous to people than previously believed.

Because they are frequently reddish-brown, red tide is the colloquial name for several types of microscopic algae that sometimes bloom near coasts.

These blooms are age-old. Some believe the first of the 10 plagues of Egypt described in the Bible was a red tide. "... and all the waters that were in the river died, and the water stank."

The algae, called *Karenia brevis*, produces a poison called a brevetoxin. Though not deadly, it can cause neurotoxic shellfish poisoning in people who eat contaminated fish and asthma-like symptoms in those who breathe in the odorless toxic particles that can blow off the waves up to 1 mile inland.

Once a year, the *K. brevis* population undergoes an explosion for reasons scientists can't explain. The number of the creatures can go from 1,000 in a liter of ocean water to more than 1 million.

"At times you go to the beach and you just open the door of the car in the parking lot and you start coughing," says Barbara Kirkpatrick, a scientist at the Mote Marine Laboratory in Sarasota, Fla. Brevetoxin can cause watery eyes, congestion and coughing in healthy people up to 1 mile from shore.

Kirkpatrick has found that it's more dangerous to those with asthma and obstructive lung diseases, causing slightly lowered lung capacity.

Still, no warning is generally given to beachgoers when a red tide is present. Florida's West Coast is a popular tourist destination. "For a while it was (covering) a good part of southwest Florida. It wasn't like people could drive to another location. It's dissipating now," says Allison Bozarth of the Florida Fish and Wildlife Research Institute.

Red-tide updates can be found at the group's website, [www.floridamarine.org](http://www.floridamarine.org).



Breathing uneasy: Barbara Kirkpatrick tests Sarasota lifeguard Scott Ruberg to learn if the red-tide toxin is having an effect on his lungs.

Science now

HELP SUBSCRIPTIONS FEEDBACK SIGN IN

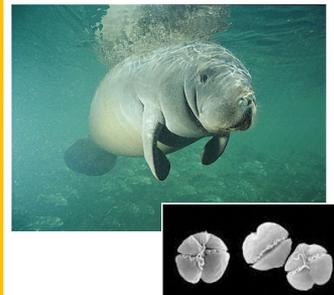
NEWS TIPS FIRSTHAND

SEARCH ARCHIVES

8 June 2005

## Algal Toxin Linked to Marine Mammal Deaths

When toxins from common microscopic algae build up in fish and seagrass, they can kill large numbers of dolphins and manatees, according to new research. The findings may help explain the recent deaths of these creatures in Florida waters, even when harmful algal blooms were no longer present.



Poison pill. Toxic algae (inset) from red tides can accumulate in seagrass and kill the manatees that graze on it.

University of Maine, Orono. Already facing danger need any more help dying."

--AMITABH AVASTHI

Florida is no stranger to harmful algal blooms, also known as red tides. The phenomenon occurs when populations of toxic microscopic algae explode, turning the sea red, brown, green, or yellow. The organism responsible for red tides (*Karenia brevis*) produces a potent poison called brevetoxin that kills fish and sickens people when they eat filter-feeding organisms such as clams and oysters. Scientists suspected that the same toxin was causing the deaths of dolphins and manatees, but they couldn't understand why the creatures continued to die long after the bloom had passed.

The search to find the cause of the deaths gained greater urgency in 2002 when 34 manatees turned up dead in southwest Florida. Two years later, 107 dolphins died. Although a test of the waters showed relatively low concentrations of *K. brevis*, marine biologist Jerome Nair of the University of North Carolina, Wilmington, and colleagues found that the stomach tissues from the dead animals contained high levels of brevetoxin, suggesting the poison was introduced through food. Further testing showed that seagrass in the manatee stomachs was loaded with the toxin, as were the menhaden fish inside the dolphins.

Since even small amounts of brevetoxin can kill fish, Nair wondered if live toxic clams and red tide algae with low levels of the toxin, his fish stayed healthy but accumulated the toxin in their tissues. The findings indicate that fish can remain a potent source of algal toxin long after a red tide has disappeared, says Nair, whose team publishes its findings in the 9 July issue of *Nature*.

## What is killing the manatees?

In 1990, previously Florida's worst year for manatees, 2016 died. Already this year, 210 are dead.



Manatee deaths

...the water with most of the fish that died.

...the beach on Monday morning as a result of Red Tide, and prepared it for a final trip to the dump.

# The Boston Globe

MONDAY, MARCH 28, 2005

## Tide's toxins trouble lungs ashore



BY BETH DALEY  
Globe Staff

SARASOTA, Fla. — A massive red tide off the beaches of southwest Florida is causing an outbreak of wheezing and coughing among beachgoers, and new evidence suggests that the effects of an airborne neurotoxin the tide produces may be more harmful than health officials previously thought.

Since early January, a large algae bloom stretching from the mouth of Tampa Bay to Sanibel Island has been

problems have reduced lung capacity after even a short exposure to red tide, although it's unclear how long the problems last.

"For years we've had anecdotal information this is happening, but you can't decide public policy on anecdotes," said Barbara Kirkpatrick, staff scientist at Mote Marine Laboratory in Sarasota and one of the lead researchers of the study, which will be published in a series of seven papers in *Environmental Health Perspectives*. She wants state and local officials to develop a visible warning system to alert beach visitors to red tides.

Still, healthy people appear to be affected only temporarily; their watery eyes and scratchy throats can be cured by simply going inside an air-conditioned room or leaving the beach.

Florida's version of red tide — actually more green-brown in appearance than red — is a different organism from the one blamed for the red tide that appears off the New England coast, which doesn't produce an airborne toxin and is most dangerous to humans if they eat contaminated

occur on Florida's East Coast.

This year's outbreak has killed thousands of fish, many of which could be seen last week speckling the shoreline along the Siesta Key and Lido beaches. At least 44 endangered manatees are believed to have died from exposure to the algae, according to wildlife officials. People who eat seafood contaminated by the neurotoxin can become ill. Still, swimming is allowed and most people report few adverse reactions.

Whether the blooms have been getting worse or are persisting longer are matters of debate among environmental researchers in this state, whose tourism is a major industry. Some studies have suggested sewage and other runoff might be to blame. Florida wildlife officials say no evidence exists to show that the blooms are increasing in frequency or lasting longer. "We haven't seen an increase in the duration or frequency of red tides," said Cynthia Heil, a scientist with the Florida Fish and Wildlife Research Institute.

State officials also say it's unclear whether this year's bloom has caused more medical problems.

tively short-lived."

How best to warn the public about red tide's respiratory effects is a delicate subject in southwest Florida, where so many people's livelihoods rely on tourism. Although Florida public health officials have stepped up awareness campaigns in recent years with pamphlets and public service messages that warn people with respiratory problems to stay away from beaches during a red tide bloom, several first-time tourists to the area said they were unaware why they were coughing during a particularly gusty Wednesday night last week on Lido Beach.

Because Florida does not close beaches during red tide events, lifeguards often educate beachgoers. State public health officials say they and Kirkpatrick are developing a log program to place beach signs warning about the dangers.

"We do tell people to bring an inhaler if they are asthmatic," said Tamara Pigott, beach and shoreline project manager for Lee County Visitor and Convention Bureau in Fort Myers. "For most people, it's a nuisance. It's not going to rain their va-

# Beaches littered with dead fish

## Red tide may be behind Franklin fish kill

By Bruce Ritchie  
Democrat Staff Writer

Tens of thousands of dead fish Tuesday were strewn along some beaches in Franklin County, further raising concerns about red tide in the area.

Red tide is a toxic algae that has killed fish and other sea life in the Tampa area since January. The tide was confirmed off the Taylor County coast last week and suspected in fish kills as far west as Port St. Joe.

There were reports Tuesday of dead fish at St. George Island, Bald Point, Alligator Point and

St. Teresa. State wildlife officials said they were collecting water samples from the area to determine whether red tide was to blame.

The dead fish strewn along St. George Island were accompanied by an odor that stung the eyes, nose and throat, island resident Steve Harris said.

"It seems there is a red tide," Harris said. "There is a lot of odor and irritation. And a lot of dead fish."

He said he couldn't tell what species of fish were killed because they apparently had been

TO REPORT A FISH KILL

Florida Fish and Wildlife Conservation Commission fish kill hot line: (800) 636-0511



decomposing for days.

At Alligator Point, Mary Conley said she saw tens of thousands of dead fish including large redfish and other tiny fish.

"There are dead redfish everywhere just scattered all over the beach," she said. "I've never seen anything like it before in my life."

The Florida Fish and Wildlife Conservation Commission on Tuesday was collecting more

Please see RED TIDE, 2B

JOHN ROBERGE/Democrat

# Collaborators

- Centers for Disease Control and Prevention
- Florida Department of Health
- Florida Department of Env Protection
- Florida Marine Research Institute
- Harbor Branch
- Lovelace Respiratory Research Institute
- Mote Marine Lab
- NIEHS
- South Florida Poison Information
- University of Miami School of Medicine
- University of North Carolina (Wilmington)



# Occupational Exposure to Aerosolized Brevetoxins

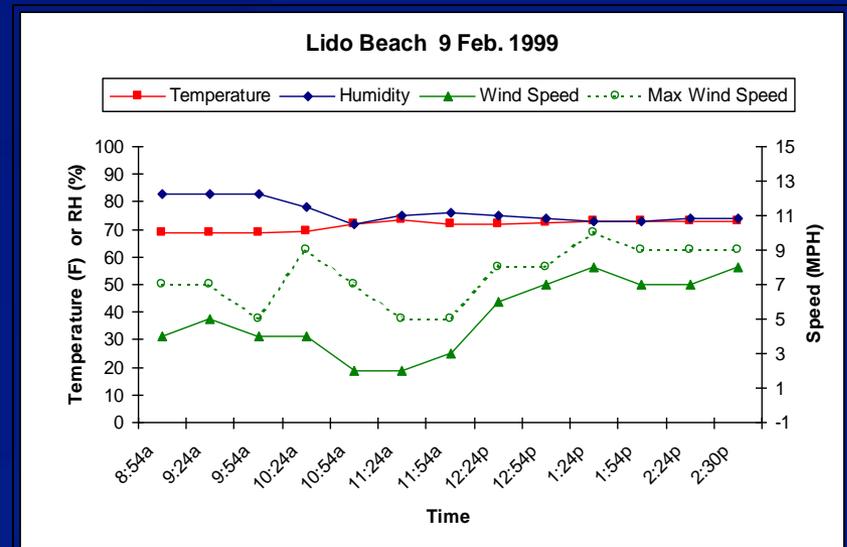
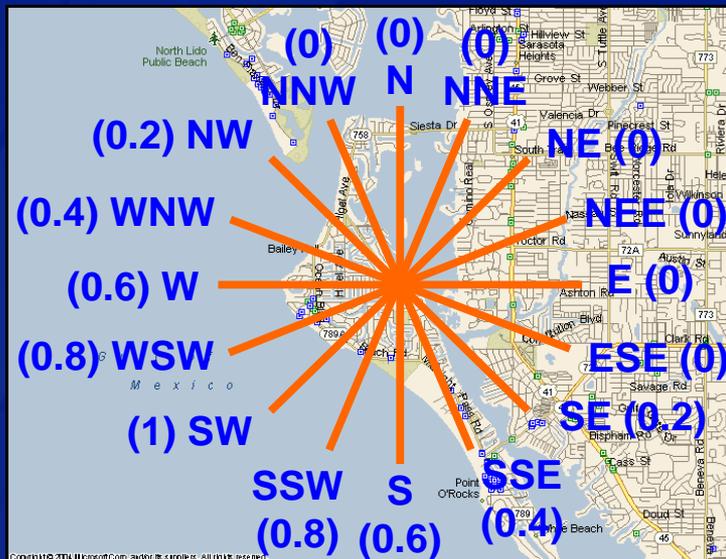
Objective: To determine if occupational exposure to aerosolized brevetoxins induces acute adverse health effects.



# Epidemiology Study Design: Occupational Exposure

- Recruit a study population: lifeguards
- On study days:
  - Conducted exposure assessments (environmental data)
  - Conducted symptom surveys
    - Before and after spending time on the beach when there is no red tide (unexposed) and again when there is a red tide (exposed)
- Compared results for unexposed and exposed periods

# Data: Environmental Conditions



# Air Samples

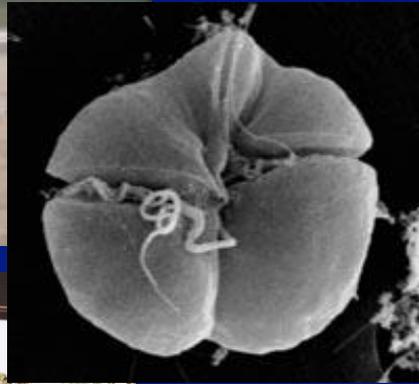


- Airborne particles captured on filters
- Brevetoxins extracted and analyzed using HPLC

# Personal Air Samples



# Water Samples



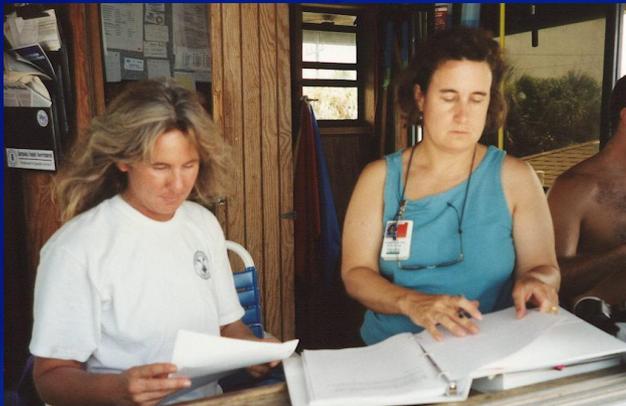
- Seawater samples collected from the beach
  - *Karenia brevis* cell counts
  - Brevetoxins extracted and analyzed using HPLC

# Health Outcome: Lung Function



- Spirometry testing
  - Used American Thoracic Society Guidelines for data collection and interpretation

# Individual Data Collection: Questionnaires



- Demographics
- Pulmonary health history
- Time spent on beach
- Symptoms



# Lifeguards—Health Effects?

Parameter	Unexposed	Exposure 1	Exposure 2
Respiratory symptoms	None	Eye irritation, congestion, cough, headache	Eye & throat irritation, cough
Lung function (spirometry)	No changes	Slight decrease in some parameters	No changes
Personal air samplers (ng/m <sup>3</sup> )	< LOD LOD = 1	< 10 ng/m <sup>3</sup>	> 10 ng/m <sup>3</sup>
Wind	1-4% onshore	0-58% onshore	0 -58% onshore

# What have we learned about Florida red tide?

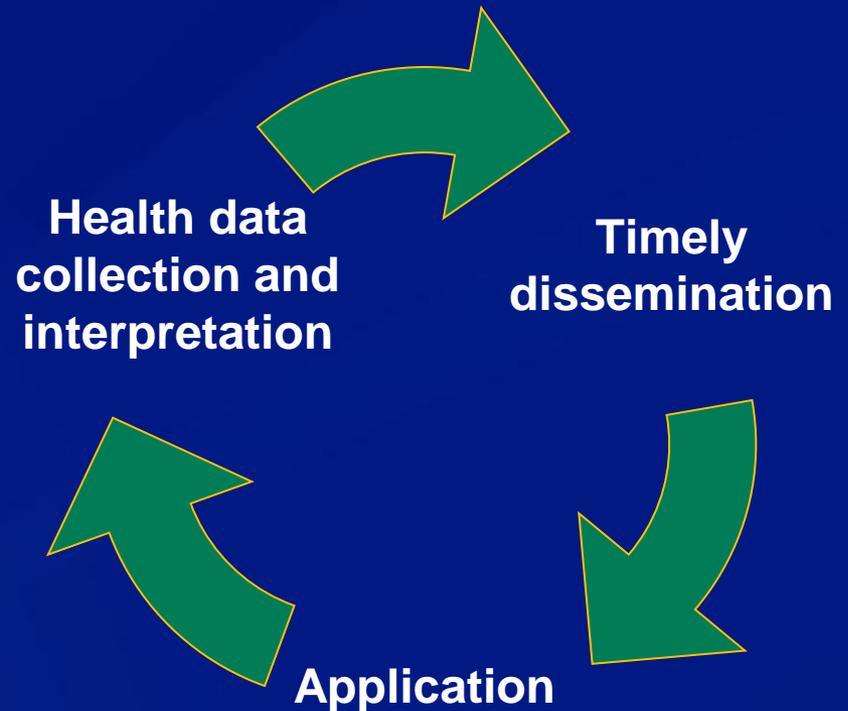
- Aerosols from Florida red tides have a public health impact
  - Acute symptoms and pulmonary effects
- Local conditions, particularly wind, critical in determining exposure

# HABs: Public Health Response

- Epidemiologic studies
  - Outbreak investigations
  - Planned studies
- **Surveillance**
- Prevention

# Surveillance

- *The systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know...application of these data to prevention and control...*



# Harmful Algal Bloom-related Illness Surveillance System (HABISS)

- Purpose: To reduce the public health impact of HAB-related human illnesses
- Goals
  - Detection, mitigation, prevention
  - *Link cases of illness with environmental data*

# HABISS Data

- Temporally and geographically related data describing:
  - Human illnesses
  - Animal illnesses
  - Local environment



# HAB-related dog intoxications: 2007-2011

- 13 states reported
- 67 cases (suspected or confirmed)
- 58 (67%) from exposure to cyanotoxins
- 38 (54%) fatalities

# HAB-related illness surveillance is moving!

- National Outbreak Reporting System (NORS)
  - Web-based outbreak data collection
  - Managed by
    - National Center for Emerging and Zoonotic Infectious Diseases: *Waterborne Disease Prevention Branch, Enteric Diseases Epidemiology Branch*
    - National Center for Immunization and Respiratory Diseases: *Epidemiology Branch*
  - Passive surveillance for outbreaks from
    - Water, food, environmental contaminants (e.g. HABS), person-to-person transmission, animal contact

# HABs: Public Health Response

- Epidemiologic studies
  - Outbreak investigations
  - Planned studies
- Surveillance
- **Prevention**

# Prevention

- Primary prevention
  - Monitoring
- Educate target populations
  - Industries
  - Consumers
  - Health care & public health workers
  - Sensitive subpopulations



# Public Health Protection: Outreach and Education

## Florida Red Tide: Part of the Local Ecosystem

By knowing the basic facts about Florida Red Tide, you can avoid problems from this natural phenomenon and enjoy the beautiful sun, surf and seafood of Florida's Gulf Coast.

### What is Florida Red Tide?

Florida Red Tide is caused by an overgrowth of a normal micro alga called *Karenia Brevis*. This microscopic, plant-like organism can "bloom" or grow like crazy, usually late Summer to early Fall. These blooms can last for weeks or even months and shift around depending on wind and ocean currents. These blooms have been reported in Florida as far back as 1844!

### Why is Florida Red Tide a Problem?

The red tide organism releases a potent toxin that can kill fish, birds and marine mammals like manatees. This toxin can also be released into the air and carried ashore by the breeze. Boaters, beachgoers and waterfront residents can find these toxins cause them to cough, sneeze and have watery eyes. Most people feel better right away when they come indoors. People with lung disease

or asthma should be especially cautious about avoiding exposure to these toxins. It is also unsafe to eat shellfish (mollusks and bivalves) from areas with an active Red Tide. You never have to worry about fish and shellfish served in restaurants, though, because commercial seafood is only gathered from safe areas.

### How Can I find Out More About Red Tide?

To find out about current Red Tide conditions and the health effects associated with Red Tide, call the Florida Red Tide Health Hotline at 1-888-232-8635. This is a toll free hotline available 24 hours and is staffed by health professionals. To report dead fish, call the Florida Fish and Wildlife Research Institute (FWRI) at 1-800-636-0511. You can also go to [www.redtideonline.com](http://www.redtideonline.com) for information and great links.

To speak to a health professional anytime, toll free,  
call the Florida Red Tide Health Hotline **1-888-232-8635**

## Breathe Easy During a Red Tide



Solutions To Avoid Red Tide, Inc.

[www.redtideonline.com](http://www.redtideonline.com)

This informational material was funded by the Florida Department of Health with cooperation from the Centers for Disease Control and Prevention.

## HEALTH ADVISORY



### AVOID WATER CONTACT IN IRON GATE AND COPCO RESERVOIRS

Pollution has resulted in high levels of blue-green algae that can produce harmful toxins. This has resulted in violations of the State's water quality standards

- Do not use this water for drinking or cooking
- Fish from these waters previously tested positive for an algal toxin. Limit or avoid consuming fish as the risk to human health is being evaluated by public health agencies
- Do not consume fish innards, and wash fillets with drinking water

**Children and pets are at greatest risk**

For more information contact staff at:

North Coast Regional Water Quality Control Board

(707) 576-2220

From California

## Animal Safety Alert

### BLUE-GREEN ALGAE BLOOMS

When in doubt, it's best to keep out!



#### What is a blue-green algae bloom?

Cyanobacteria, sometimes called blue-green algae, are microscopic organisms found naturally in all types of water.

- Blue-green algae grow quickly, or bloom, when the water is warm, stagnant, and full of nutrients. Algae blooms usually occur during the summer and fall. However, they can occur anytime during the year.

When a bloom occurs, scum might float on the water's surface.

Blooms come in different colors, from green or blue to red or brown.

As the bloom dies off, you may smell an odor like rotting plants.

#### What is a toxic bloom?

Sometimes, blue-green algae produce toxins.

- The toxins can be present in the algae or in the water. Swallowing water with algae that are producing toxins can cause serious illness.

**You cannot tell if a bloom is toxic just by looking at it.**



Centers for Disease  
Control and Prevention  
National Center for  
Environmental Health

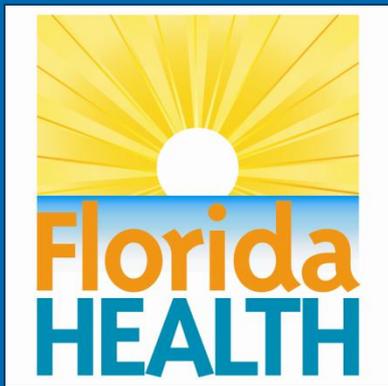
Joe Heller  
© 2000 NEA/PAF



**WARNING**  
LIFEGUARD,  
BACTERIOLOGIST,  
MICROBIOLOGIST,  
& TOXICOLOGIST  
NOT ON DUTY  
**SWIM AT YOUR  
OWN RISK**

# Questions?





*Summer Webinar Series to Build Awareness About  
Harmful Algal Blooms and Nutrient Pollution*

## **Florida Department of Health's Aquatic Toxins Program: Responding to Public Health Impacts from Harmful Algal Blooms**

Andrew Reich, MS, MSPH  
Coordinator  
Aquatic Toxins Program  
Florida Department of Health  
Tallahassee, Florida

# Public Health

Protect and Promote Safety and Health of People



# Susceptible Populations ?

- Elderly
- Immuno-suppressed
- Underlying disease: Asthma
- Pregnant women, fetus
- Children
- People with extended exposure periods



# Harmful Algal Blooms (HABs)

Microscopic organisms, *mostly*

- Dinoflagellates
- Diatoms
- Blue-green algae

Blooms

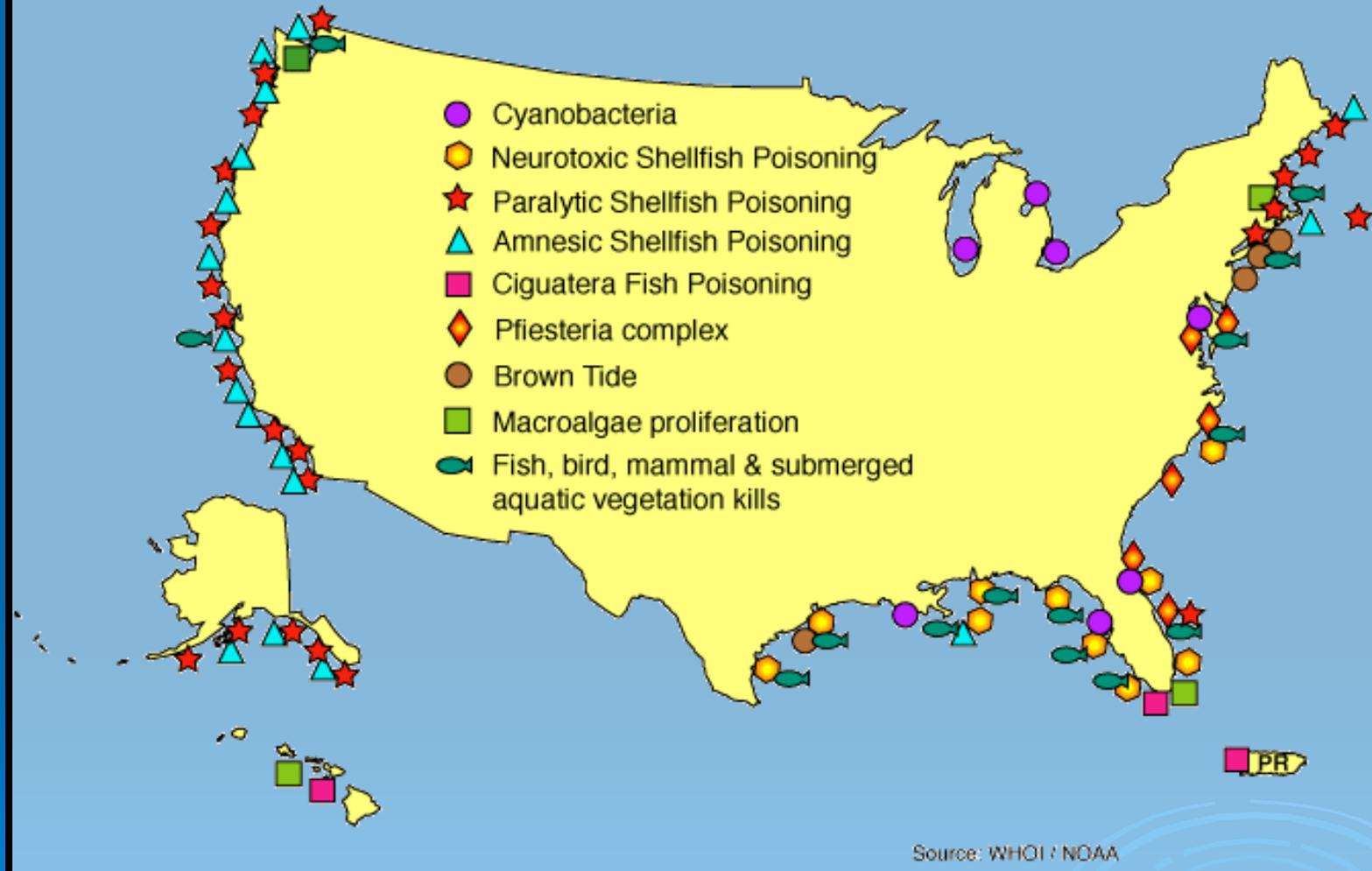
- Exuberant growth

Toxins

- No taste or smell
- Heat, Acid stable



## Major HAB-related Events in the Coastal U.S.



NOAA, WHOI

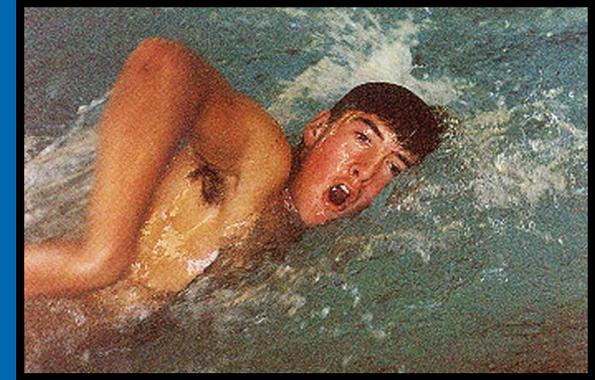
# Potential Exposure Pathways



Direct Skin Contact



Ingestion of Food



Incidental Ingestion



Drinking Water



Inhalation of Aerosols

# Marine HAB-Related Illness

- Paralytic Shellfish Poisoning (PSP)\*  
Saxitoxin (*Pyrodinium bahamense*)
- Neurotoxic Shellfish Poisoning (NSP)\*  
Brevetoxin (*Karenia brevis*)
- Diarrhetic Shellfish Poisoning (DSP)  
Okadaic Acid (*Protocentrum* spp)
- Amnesiac Shellfish Poisoning (ASP)  
Domoic Acid (*Pseudonitzschia* spp)



# Marine HAB-Related Illness



- Ciguatera Fish Poisoning  
Ciguatoxins (*Gambierdiscus toxicus*)

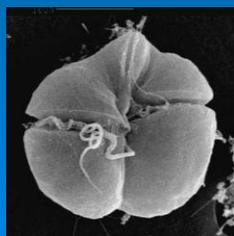
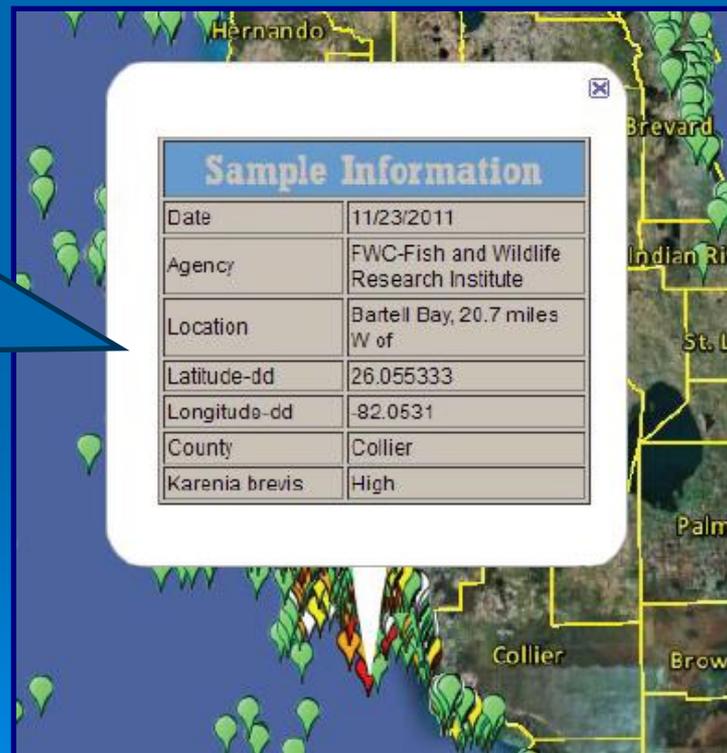
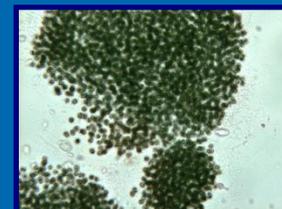


- Puffer Fish Poisoning  
Saxitoxins (*Pyrodinium bahamense*)



- Respiratory Illness  
aerosolized Brevetoxins (*Karenia brevis*)

# Fl. Fish and Wildlife HAB Data, 2011

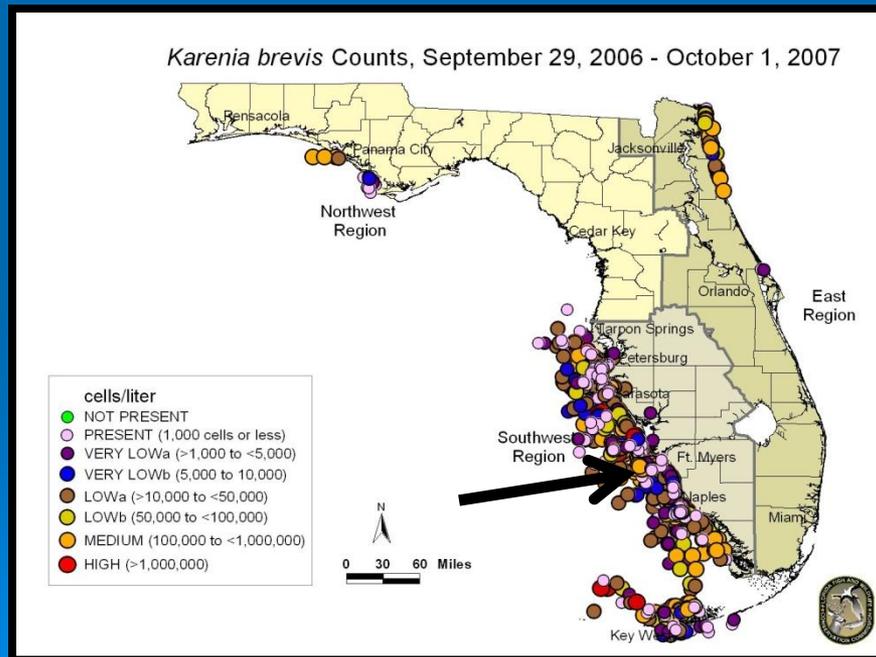


# Regulated Shellfish Harvesting Areas



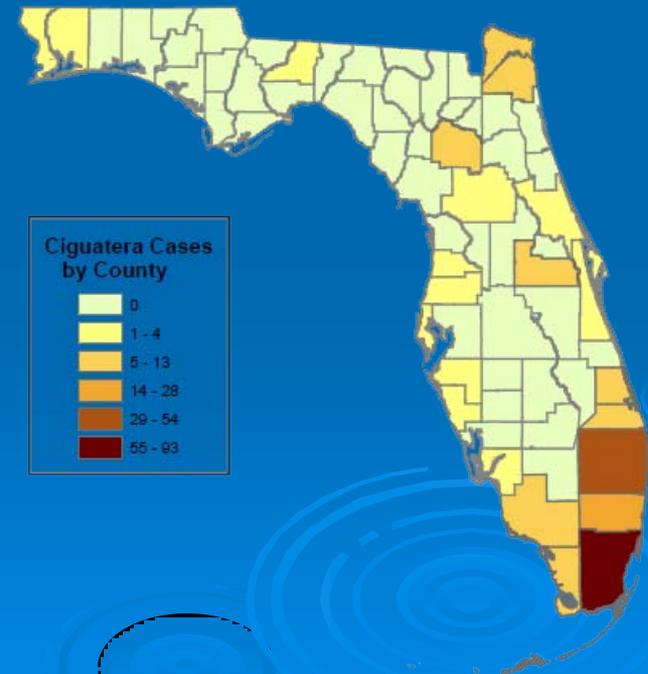
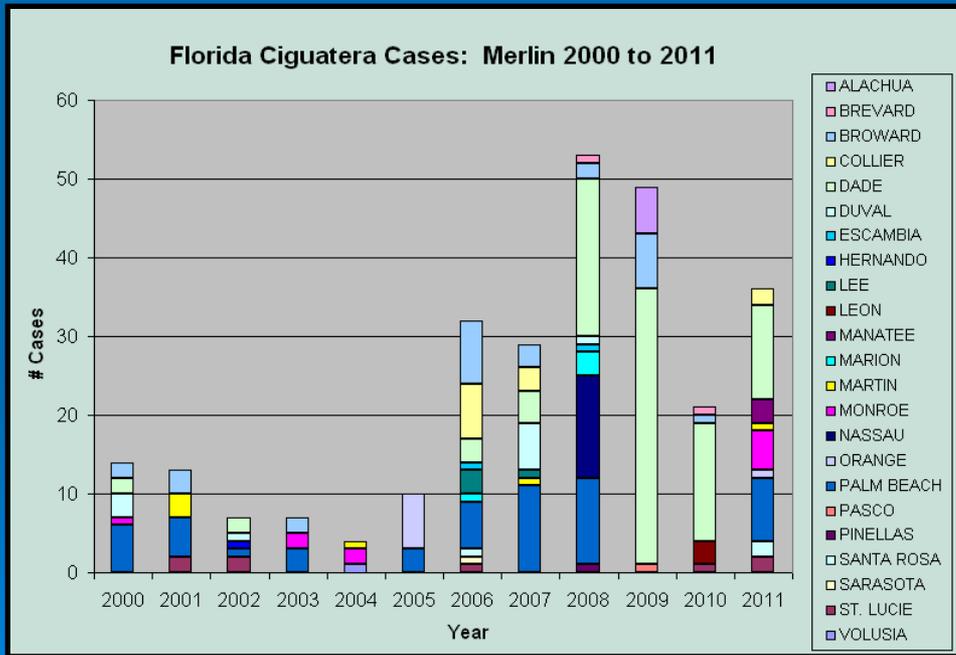
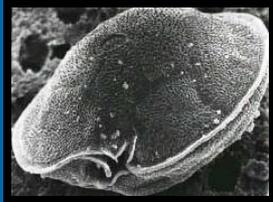
# Neurotoxic Shellfish Poisoning (NSP)

- Outbreaks in 1995, 1996, 2001, 2005, 2006
- From recreationally harvested shellfish

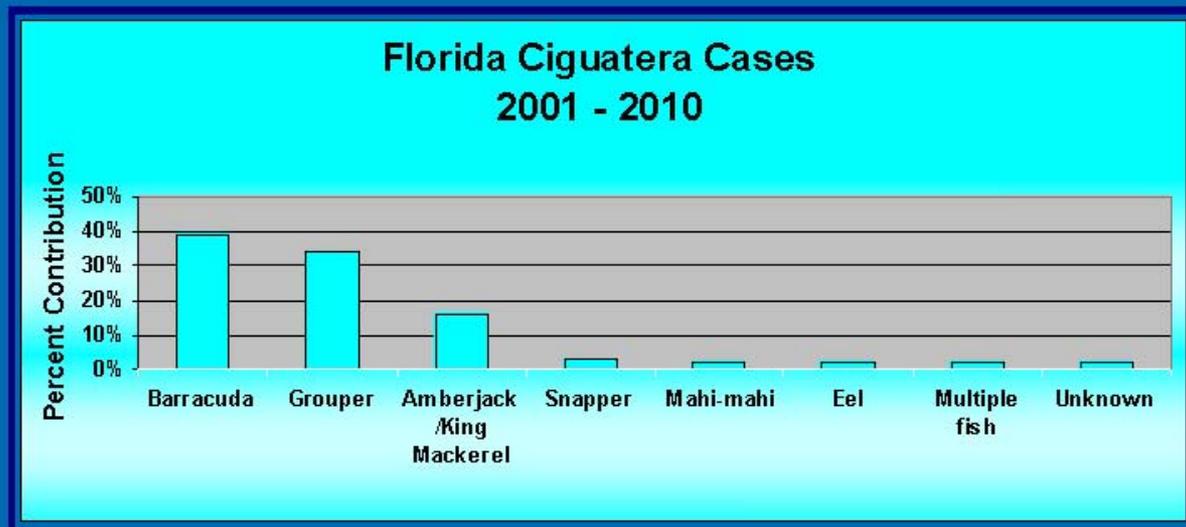


# Ciguatera Fish Poisoning

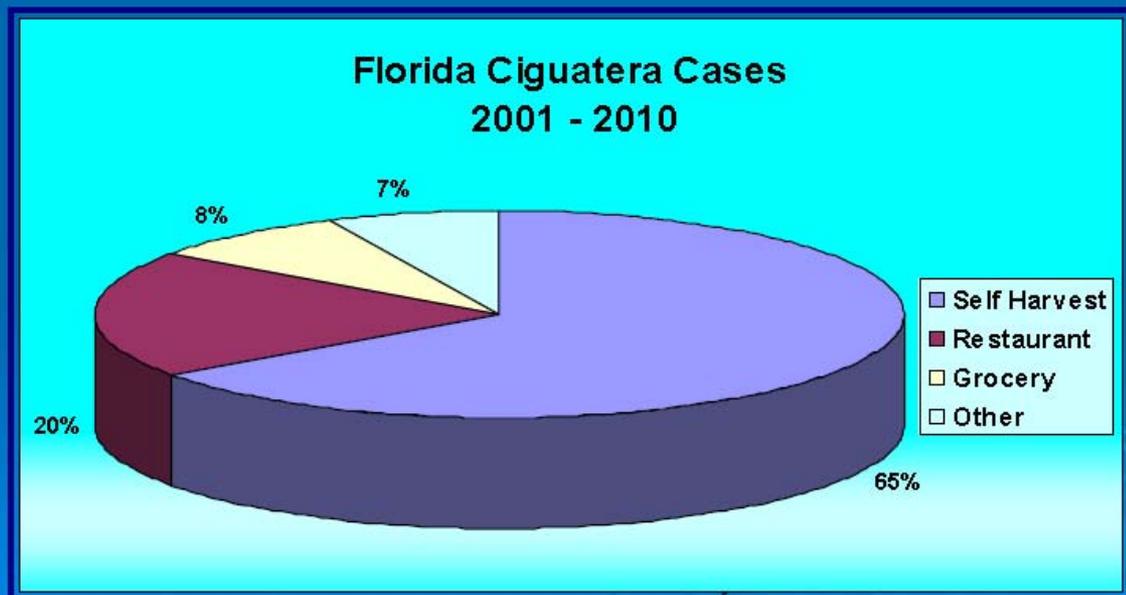
*(Gamberdiscus toxicus)*



# Fish Types Implicated in Outbreaks

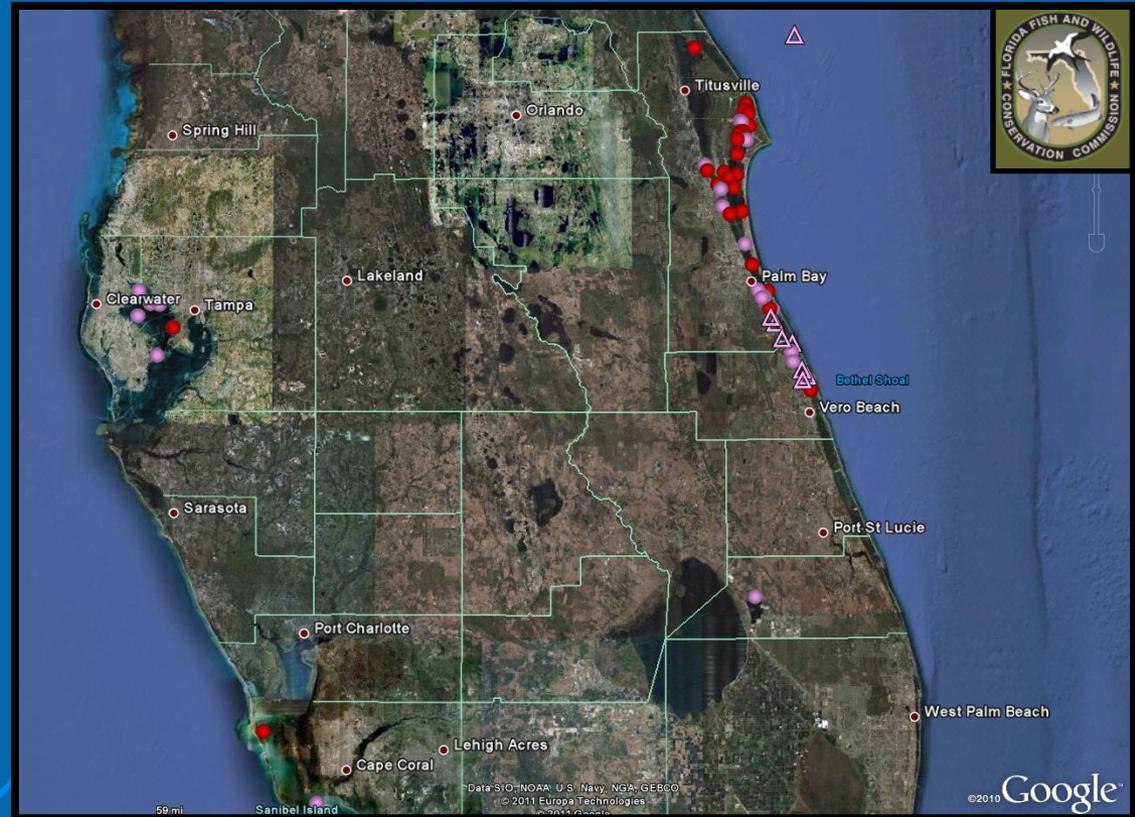
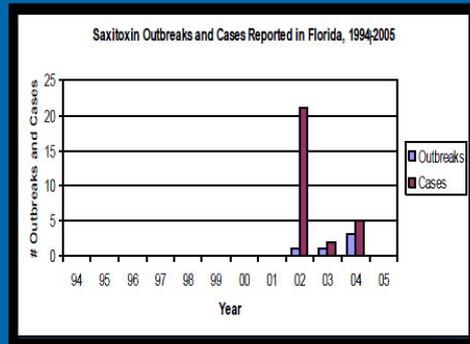
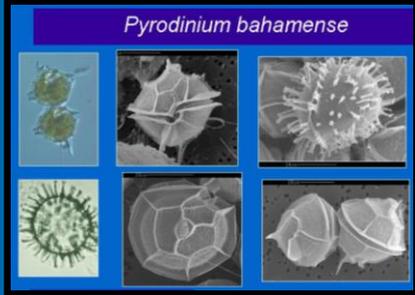


# Source of Fish



# Saxitoxin Puffer Fish Poisoning

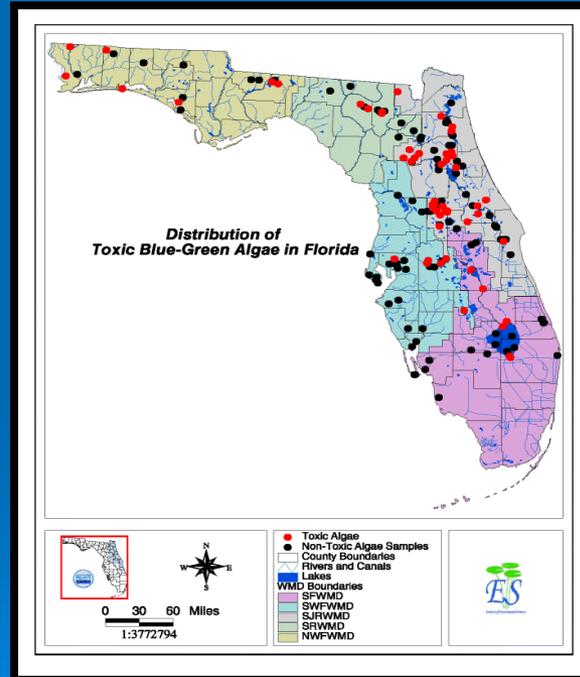
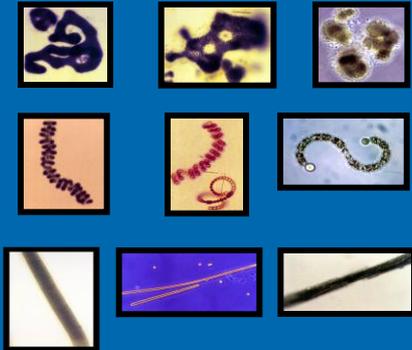
*(Pyrodinium bahamense)*



# Freshwater HABs

## Blue Green Algae (Cyanobacteria)

*Microcystis, Cyndrospermopsis, Anabaena, Planktothrix  
Aphanizomenon, Lyngbya wollei, Oscillatoria, others?*



Cypix

# Cyanobacteria Blooms in Florida



# Florida's Surface Drinking Water Resources

10-15% of Florida's population utilizes surface water supplies for drinking water

Floridan Aquifer unable to meet projected demands for 2020



# Olga Water Treatment Plant, Caloosahatchee River, Lee County



# NOAA HAB [Red Tide] Bulletin



## Gulf of Mexico Harmful Algal Bloom Bulletin

Region: Southwest Florida

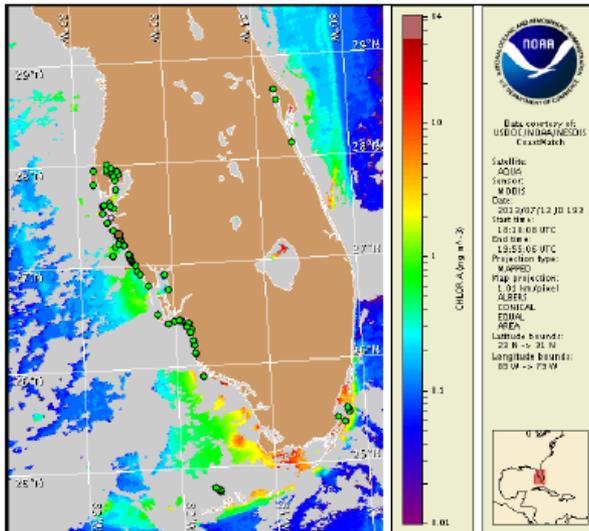
Monday, 15 July 2013

NOAA National Ocean Service

NOAA Satellite and Information Service

NOAA National Weather Service

Last bulletin: Monday, July 8, 2013



Satellite chlorophyll image with possible *K. brevis* HAB areas shown by red polygon(s), when applicable. Points represent cell concentration sampling data from July 7 to 11: red (high), orange (medium), yellow (low b), brown (low a), blue (very low b), purple (very low a), pink (present), and green (not present). Cell count data are provided by Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute. For a list of sample providers and a key to the cell concentration categories, please see the HAB-OFS bulletin guide:

[http://tidesandcurrents.noaa.gov/hab/habfs\\_bulletin\\_guide.pdf](http://tidesandcurrents.noaa.gov/hab/habfs_bulletin_guide.pdf)

Detailed sample information can be obtained through FWC Fish and Wildlife Research Institute at:

<http://myfwc.com/redtidestatus>

To see previous bulletins and forecasts for other Harmful Algal Bloom Bulletin regions, visit at: <http://tidesandcurrents.noaa.gov/hab/bulletins.html>

## Conditions Report

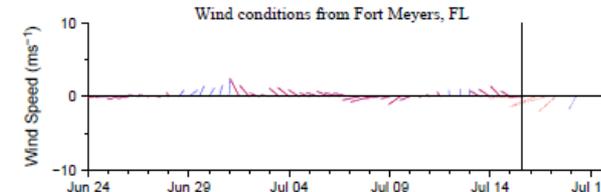
*Karenia brevis* (commonly known as Florida red tide) ranges from not present to background concentrations along the coast of southwest Florida, including the Florida Keys. No respiratory irritation is expected Monday, July 15 through Monday, July 22. Check [http://tidesandcurrents.noaa.gov/hab/beach\\_conditions.html](http://tidesandcurrents.noaa.gov/hab/beach_conditions.html) for recent, local observations.

## Analysis

Two recent samples, one collected at Mullet Key in Pinellas County and the other at Palma Sola Bay bridge in Manatee County, contained background concentrations of *Karenia brevis* (FWRI; 7/8-9). All other samples collected alongshore and offshore southwest Florida, from Pinellas to Monroe County, including the Florida Keys, did not indicate the presence of *K. brevis* (FWRI, MML; 7/8-7/10).

MODIS Aqua imagery has been obscured by clouds alongshore southwest Florida over the last several days limiting analysis. MODIS Aqua imagery from July 12 (shown left), does not indicate elevated levels of chlorophyll alongshore the visible portions of Sarasota County. Harmful algal bloom formation alongshore southwest Florida is not expected today through Monday, July 22.

## Urizar, Fenstermacher



Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts. Wind observation and forecast data provided by NOAA's National Weather Service (NWS).

## Wind Analysis

**Southwest Florida:** Easterly winds (5-15 kn, 3-8 m/s) today through Wednesday. North-easterly winds (10 kn, 5 m/s) Thursday and easterly winds (5 kn) Thursday night. South-easterly winds (5 kn) Friday becoming southwesterly in the afternoon.

# FDOH Inland HAB Health Bulletin

Partners

MODIS Satellite Image

Political Boundaries

Affected Water-bodies

Partners

Affected Water-bodies

Featured Article

Other HABs



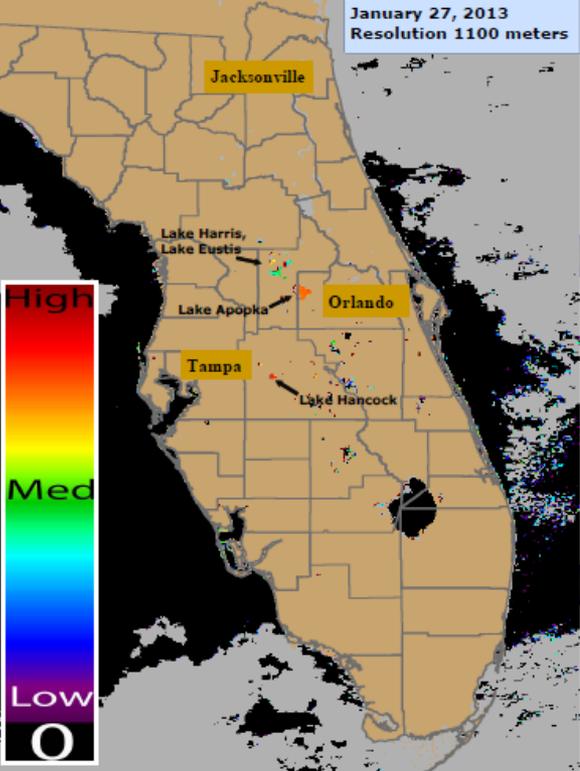
**HEALTH**

## Inland Harmful Algal Blooms Health Bulletin: Jan. 31, 2013



To report an illness related to a marine toxin or algal bloom please contact the Florida Poison Information Center-Miami Aquatic Toxins Hotline at 1-800-222-1222. For questions about the report: contact Andrew Reich, FL-DOH, at 850.245.4187. Images/data were obtained from Florida Water Management Districts, The National Oceanic and Atmospheric Administration (NOAA), NOAA National Climatic Data Centers and National Weather Centers. Support to produce this report was received through a NOAA/NASA Agreement (Number: NNH08ZDA001N)

January 27, 2013  
Resolution 1100 meters



MODIS Images display a chlorophyll-a index generated with a Moderate Resolution Imaging Spectroradiometer provided by the National Aeronautics and Space Administration (NASA)

Very low likelihood of a bloom

May indicate clouds or missing data

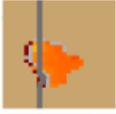
Low estimated chlorophyll-a concentrations

Medium estimated chlorophyll-a concentrations

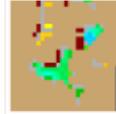
Higher estimated chlorophyll-a concentrations

### Inland HABs Conditions Report: Jan. 27, 2013

- Lake Apopka (Orange and Lake Counties) and Lake Hancock (Polk County) displayed high estimated elevated chlorophyll-a concentrations.
- Lake Harris and Lake Eustis (Lake County) displayed medium estimated elevated chlorophyll-a concentrations.

  
Lake Apopka

  
Lake Hancock

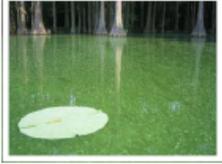
  
Lake Harris,  
Lake Eustis

### Microcystins Round Robin Study Available at FDEP

The Florida Department of Environmental Protection (FDEP) released a report on the second microcystin round robin conducted by the Bureau of Laboratories in 2009. It is posted on their website (link below) along with the report for the first 2007 round robin.

<http://www.dep.state.fl.us/labs/bioloqv/hab/index.htm>

On the right side of the webpage, see "Highlights". The report is the second from the bottom on that list, "Microcystin Round Robin Study #2". The laboratories that participated in this round robin did so at their own expense and so please thank them for their contribution to this effort. Please contact Lori Wolfe, Environmental Manager, at [loretta.wolfe@dep.state.fl.us](mailto:loretta.wolfe@dep.state.fl.us) if you have any questions or comments related to these studies.



### Marine Update: *K. brevis* bloom off SW FL and the FL Keys

**Red Tide Update - FWRI/FWC (Jan. 30):** A bloom of *Karenia brevis* persists alongshore of SW Florida, with the highest concentrations detected alongshore and offshore of Charlotte County. Very low to medium concentrations were also detected alongshore of Sarasota and Collier counties and background to very low concentrations were detected in Tampa Bay (Pinellas and Manatee counties). Fish kills and respiratory irritation continue to be reported from Sarasota County south through Lee County. See <http://myfwc.com/media/2482760/midweek0130.pdf>

**NOAA Conditions Report - (Jan. 31):** Very low to high concentrations of *Karenia brevis* (commonly known as Florida Red Tide) are present along- and offshore southwest Florida from southern Pinellas to Collier County, as well as offshore the gulfside of the lower Florida Keys ... Over the past few days, reports of respiratory irritation were received from Sarasota and Charlotte counties. Reports of dead fish were received from Charlotte and Lee counties. To read the full NOAA conditions report, visit: <http://tidesandcurrents.noaa.gov/hab/bulletins.html>.



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# FDOH Inland HAB Health Bulletin

## Interpreting Moderate Resolution Imaging Spectroradiometer Data

- The Moderate Resolution Imaging Spectroradiometer (MODIS) is deployed by NASA onboard the Terra (EOS AM) and Aqua (EOS PM) satellite. It passes over the earth, collecting new imagery every 1-2 days.
- This imagery is used as a surveillance tool. Data collected by the MODIS sensor are used to generate a chlorophyll-a index which is used to forecast harmful algal blooms. The results are not specific to any one HABs species and should be followed-up with onsite field observations. Data is only suggestive of a potential HAB event.
- MODIS uses a spectral band which is much coarser than MERIS, therefore only select larger water bodies in FL are visible using this technology.
- MODIS is better at depicting low to medium chlorophyll-a concentrations so once a potential bloom is depicted, a switch in algorithms may be used to improve the visibility. MODIS has a few spectral bands which have higher resolution are more comparable to MERIS although these bands do not cover all of FL.
- Several environmental factors may affect how results can be interpreted. For example, areas with abundant aquatic vegetation may present with a high Chl-a index resulting in a false positive bloom reading.
- The sensor identifies biomass near the surface (in the upper few feet of water). As a result, it may underestimate the total biomass for blooms that are mixed or dispersed through the water column.
- While patches of red or warm colors may indicate higher chlorophyll-a concentrations, these data have not been verified in most cases using ground-truth methods.

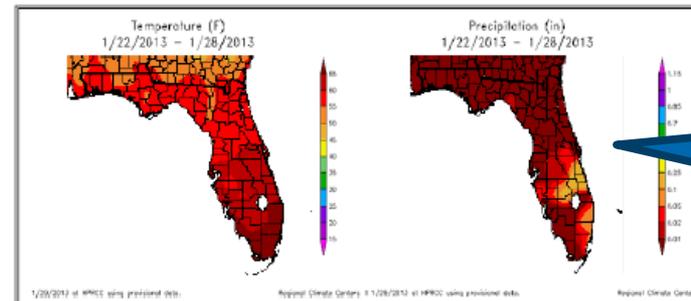
## Weather Conditions: 1/22/13 to 1/28/13 Temperature and Precipitation

- Weather conditions can impact the duration and location of blooms and the satellite imagery shown in this report may no longer be relevant.
- Images represent the last image taken with a realization that blooms may have moved, dissipated or intensified.
- Cloud coverage can obscure imagery and create patches or gray areas on map and obscure bloom detection.

January 27, 2013  
MODIS True Color Image



True  
Color  
Satellite  
Image



Climate  
Maps  
for  
Temp  
and  
Precip

To review HABs satellite reports in the Gulf of Mexico and marine waters visit the NOAA Harmful Algal Bloom Operational Forecast System bulletin archive at: <http://tidesandcurrents.noaa.gov/hab/>

**For Individual Weather Station Data-**  
Visit: <http://www.sercc.com/perspectives>

**Questions about the bulletin or suggestions- Contact**  
Andrew Reich, MS, MSPH  
850.245.4187  
andy\_reich@doh.state.fl.us

# Surveillance Tools



- Florida Poison Information Centers  
Tampa, Jacksonville, Miami



- Florida Reportable Disease System  
(Merlin)



- EpiCom



- Essence  
Syndromic Surveillance  
Includes Emerg. Dept, Urgent Care Centers  
Searchable via Chief Complaint Data

# Florida Poison Information Centers

**1-800-222-1222**



- Staffed by doctors, nurses and pharmacists
- Speak with a poison specialist
- Free, confidential service: 24/7, 365
- 3 Centers receive 550-600 total calls/ day
- > 25,000 calls since 1998 on Aquatic Toxins





# FDOH EpiCom System

Welcome Andrew Reich  
The time now is 4:35 PM  
You last visited on Friday, March 17, 2006 at 4:07:00 PM

**Alerts Activated in the Last 72 Hours**  
There have no been alerts activated during the last 72 hours.

**Latest Forum Posts**

- Food and Waterborne Disease - [Outbreaks](#) - Friday, March 17, 2006 at 12:08:30 PM
- Aquatic Toxins - [Blue Green Algae](#) - Thursday, March 16, 2006 at 4:36:25 PM
- Influenza - [Influenza Surveillance](#) - Thursday, March 16, 2006 at 2:53:51 PM
- Unclassified - [Unclassified](#) - Wednesday, March 15, 2006 at 4:18:55 PM
- Food and Waterborne Disease - [Food Recalls](#) - Wednesday, March 15, 2006 at 2:41:07 PM
- Unclassified - [Unclassified](#) - Wednesday, March 15, 2006 at 1:58:17 PM

**Forum Statistics**

There are 1521 Posts in 133 Topics in 38 Forums  
Last Post on Friday, March 17, 2006 at 12:08:30 PM  
Last Post by [roberta](#)  
There are 1225 Forum Members  
The Newest Forum Member is [miarrell](#)

Forum <a href="#">View All</a>	Posts	Last Post
<b>Food and Waterborne Disease</b>		
<a href="#">E-coli</a>	11	Friday, August 05, 2005 at 2:16:50 PM By <a href="#">smarta</a>
<a href="#">Food Recalls</a>	107	Wednesday, March 15, 2006 at 2:41:07 PM By <a href="#">lowerm</a>
<a href="#">Outbreak Prevention</a>	31	Wednesday, March 01, 2006 at 9:57:37 AM By <a href="#">roberta</a>
<a href="#">Outbreaks</a>	213	Friday, March 17, 2006 at 12:08:30 PM By <a href="#">roberta</a>
<a href="#">Shigella</a>	2	Tuesday, August 10, 2004 at 4:41:39 PM By <a href="#">MTBonafonte</a>
<b>Aquatic Toxins</b>		
<a href="#">Blue Green Algae</a>	7	Thursday, March 16, 2006 at 4:36:25 PM By <a href="#">andy reich</a>
<a href="#">Red Tide</a>	35	Friday, January 27, 2006 at 1:59:25 PM By <a href="#">andy reich</a>
<b>Influenza</b>		
<a href="#">Deaths and Encephalopathy in Children Under 18</a>	5	Friday, March 03, 2006 at 2:03:09 PM By <a href="#">hamiltoniz</a>
<a href="#">H2N2 Laboratory Testing</a>	3	Thursday, April 14, 2005 at 7:35:24 PM By <a href="#">JZS1</a>
<a href="#">Influenza Like Illnesses</a>	5	Thursday, February 23, 2006 at 6:39:28 PM By <a href="#">vossera</a>

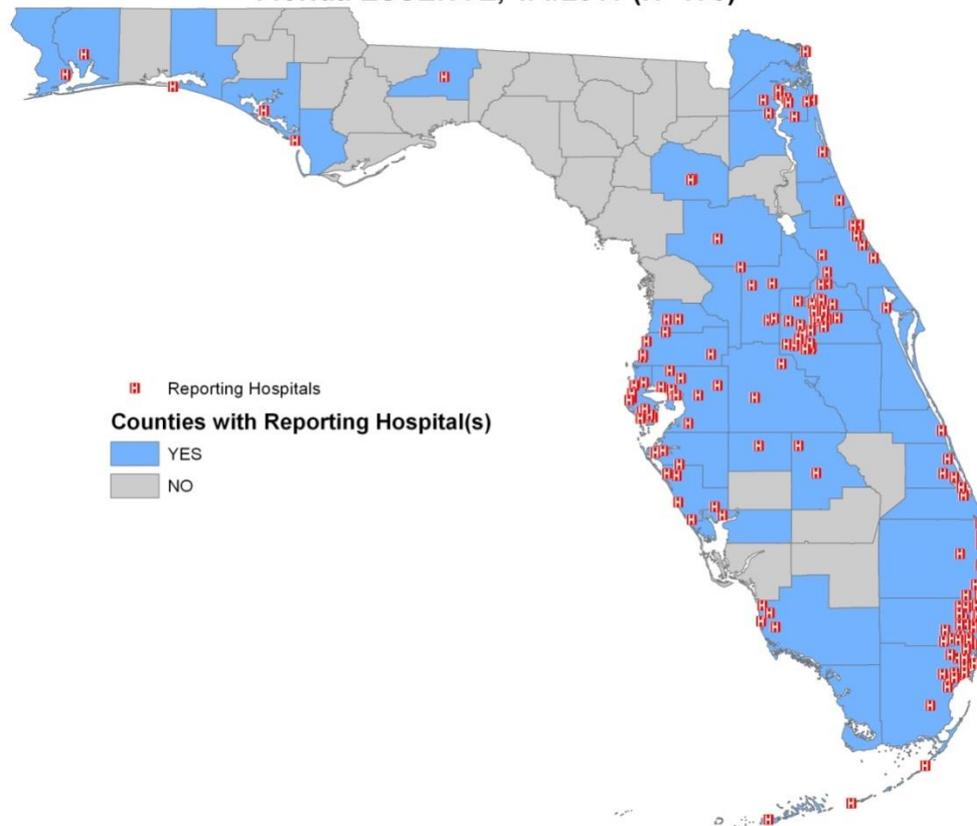
Aquatic  
Toxins  
"Forum"





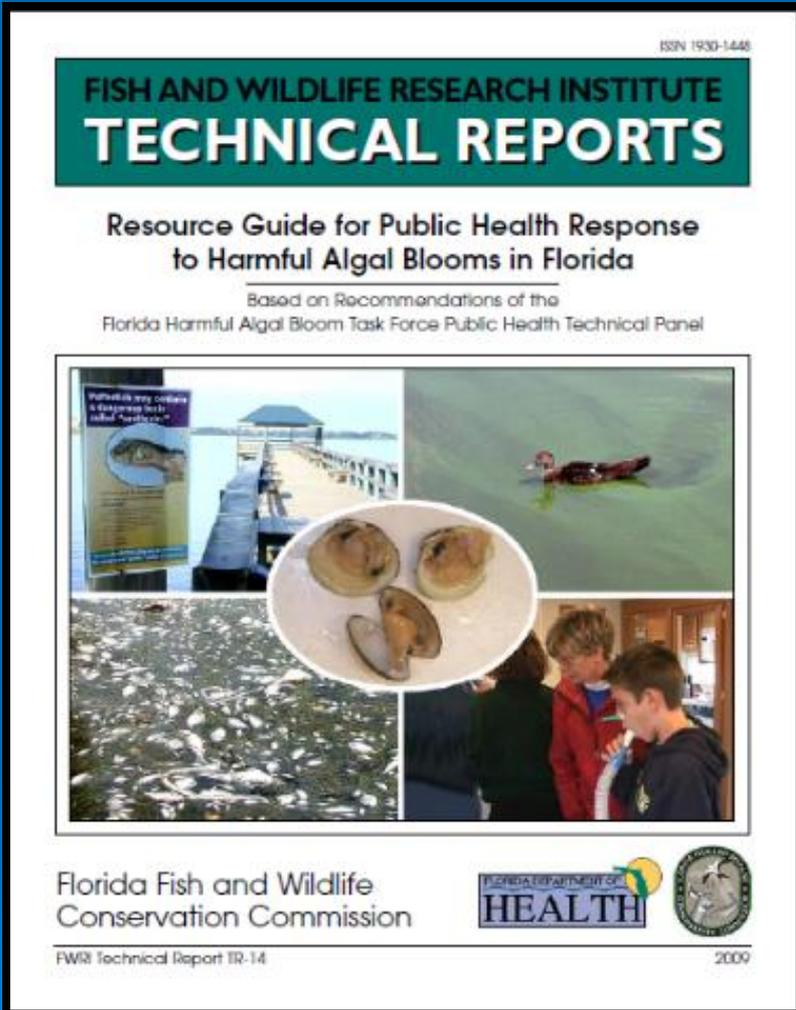
# ESSENCE Participating Hospitals

Hospital Emergency Departments and Urgent Care Centers Reporting Data to Florida ESSENCE, 1/4/2011 (N=170)





# Resource Guide for Public Health Response to HABs in Florida



Background

Responsibility

Databases

Surveillance

Regulations

Outreach

Management

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# County Specific Information

County Corner

## Tackle Box for CHD HAB Response Development

CHD - Palm Beach

New Document | Upload Document | Up | New Folder | Filter | Edit in Datasheet

Type	Name	Modified
	FWVSS Palm Beach	1/14/2011 3:14 PM
	HAB Risk Assesement - Palm Beach County 2010 v2	11/17/2010 10:27 AM
	Merlin HAB Illness Palm Beach	7/23/2010 1:27 PM
	Palm Beach County Water Atlas Chl a Report gtet 40	3/8/2011 2:37 PM
	Palm Beach County Waterways <b>NEW</b>	6/1/2011 12:31 PM
	Palm Beach Google Earth Red Tide Sampling FWC	11/17/2010 10:28 AM
	Palm Beach HAB Data FWC	5/17/2010 11:25 AM
	Palm Beach PCC ESSENCE	11/17/2010 10:30 AM

EPH Home Documents and Lists Create Site Settings Help Contact Us

County Corner Bureaus & Programs Finance & Procurement Informatics Leadership Marketing Preparedness Staff Development

Division of  
Environmental Public Health



<http://def.sharepoint.doh.ad.state.fl.us/DEH/default.aspx>

# Current Funding Acknowledgements:



- **CDC Cooperative Agreement to Enhance Surveillance of Risk Factors and Health Effects Related to Harmful Algal Blooms, #1 U38 EH000334-01**



- **National Science Foundation: Modeling the Dynamics of Harmful Algal Blooms, Human Communities, and the Social Choice of Behavioral and Policy Responses along the FI Gulf Coast, Award # 1009244**



- **NOAA/NASA: Monitoring and Forecasting Cyanobacterial Blooms for Public Health Protection and Response**



# Questions?



# Contact Information

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Centers for Disease Control and Prevention  
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Email: [lbacker@cdc.gov](mailto:lbacker@cdc.gov)

NCEH: <http://www.cdc.gov/nceh/hsb/hab/default.htm>

## Andy Reich, MS, MSPH

Aquatic Toxins Disease Prevention Program  
Florida Department of Health  
Phone: 850-245-4187  
Email: [Andy\\_Reich@doh.state.fl.us](mailto:Andy_Reich@doh.state.fl.us)

Aquatic Toxins Program:

<http://doh.state.fl.us/environment/medicine/aquatic/index.html>

# Watershed Academy Certificate

- If you would like to obtain a participation certificate, type the link below into your web browser:

<http://water.epa.gov/learn/training/wacademy/upload/2013-07-25-certificate.pdf>

- You can type each of the attendee's names into the PDF and print the certificates.

# Additional Resources

EPA HABs website:

<http://www2.epa.gov/nutrientpollution/harmful-algal-blooms>

Facebook: <https://www.facebook.com/EPAWaterIsWorthIt>

Twitter: @EPAWater

Flickr: <http://www.flickr.com/photos/usepagov/sets/72157634706332559/>

*State of the Environment* blog: <http://blog.epa.gov/epplocations/>