Public Health & Florida Red Tides
From Remote Sensing to Poison Information

Florida Red Tide

- Routes of Exposure
- Target Populations
- Health Effects
Florida Red Tide Research

K. brevis, Charlotte Harbor, Charlotte Sun Herald, Paul Schmidt
Florida Red Tide

*Karenia brevis*

(formerly *Gymnodinium breve*, *Ptychodiscus brevis*)

- Whole (live) Cell
- Lysed (ruptured) Cell

- Intra-cellular Toxins
- Extra-cellular Toxins
Brevetoxins

PbTx Type-2

\[
\begin{align*}
PbTx-2: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{C}(=\text{CH}_2)\text{CHO} \\
PbTx-3: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{C}(=\text{CH}_2)\text{CH}_2\text{OH} \\
PbTx-5: & \quad R_1 = \text{CH}_3\text{CO}, \quad R_2 = \text{CH}_2\text{C}(=\text{CH}_2)\text{CHO} \\
PbTx-6: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{C}(=\text{CH}_2)\text{CHO} \\
& \quad \text{27,28 peroxide} \\
PbTx-8: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{C}(=\text{CH}_2)\text{COCH}_2\text{Cl} \\
PbTx-9: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{CH(}\text{CH}_3\text{)CH}_2\text{OH} \\
\end{align*}
\]

PbTx Type-1

\[
\begin{align*}
PbTx-1: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{CH(}\text{CH}=\text{CH}_2\text{)CHO} \\
PbTx-7: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{CH(}\text{CH}=\text{CH}_2\text{)CH}_2\text{OH} \\
PbTx-10: & \quad R_1 = H, \quad R_2 = \text{CH}_2\text{CH(}\text{CH}_3\text{)CH}_2\text{OH} \\
\end{align*}
\]
Brevetoxin Effects on the Sodium Channel in Nerve Cells

Nerve Cell

Cytosol

Voltage-Dependent Sodium Channel

\( \text{Na}^+ \)

Brevetoxin
Sentinel Species
Neurotoxic Shellfish Poisoning
NSP Outbreak:
Lee County, Florida
July 5 - 18, 2006

- 5 separate clusters
- 13 ill from recreationally harvested clam
- Outbreaks also in 1995, 1996, 2001, 2005
Brevetoxin Fish Poisoning

Red tides and marine mammal mortalities

Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom.

Flewelling et al. Nature 2005
Aerosolized Florida Red Tide (Brevetoxins) & Recreational Exposure
Aerosolized Florida Red Tide (Brevetoxins) & Occupational Exposure
Rat/Sheep as Model Systems
Florida Red Tide (Brevetoxins) & Baseline and Pre/Post Exposure Evaluation
Emergency Room Visit Rates (Sarasota, FL)

<table>
<thead>
<tr>
<th>Coastal &gt; Inland</th>
<th>Relative Risk</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2001 Red Tide Coastal Residents vs 2002 NO Red Tide Coastal Residents</td>
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<table>
<thead>
<tr>
<th>Respiratory Diagnoses</th>
<th>2001</th>
<th>2002</th>
<th>Change</th>
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</thead>
<tbody>
<tr>
<td>All respiratory combined</td>
<td>54%** INCREASE</td>
<td>31%</td>
<td>**Statistically Significant</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>31%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronchitis</td>
<td>56%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>44%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Airways</td>
<td>64%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other diagnosis</td>
<td>41% DECREASE</td>
<td></td>
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</tr>
</tbody>
</table>

** Statistically Significant
Florida Red Tide
Inland Exposure
Inter-disciplinary Collaboration

- CDC
- Florida Department of Health
- Florida Department of Environmental Protection
- Florida Marine Research Institute
- Harbor Branch
- Lovelace Institute
- Mote Marine Lab
- NIEHS
- S. Florida Poison Information
- Univ Miami School of Medicine/RSMAS
- Univ North Carolina (Wilmington)
Current Situation
Florida Red Tide & Remote Sensing Monitoring
Florida Red Tide (Brevetoxin) & Organism & Toxin Monitoring

K. brevis (cells/l):
- 0 to 1000
- 1000 to 5000
- 5000 to 20000

Relative Chlorophyll Fluorescence:
- 0.6 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 3.0
- 3.0 to 11.8

October 19-21, 2004
Florida Red Tide (Brevetoxin) & Organism & Toxin Monitoring
Florida Red Tide \textit{(Karenia brevis)} Positive Samples
1954 to Present
Sarasota County Beach Conditions Report

Siesta Key
Last Report: 09/26/2006 2:34pm

Dead Fish: None
Water Color: Moderate
Respiratory Irritation: Slight
Wind From: N
Surf: Calm
Beach Flag: Green

Links to Red Tide Cell Count/Bloom status reports:
www.mote.org
www.caregllnvironment.net
research.myfwc.com
coastwatch.noaa.gov
Florida Aquatic Toxins Hotline
888.232.8635

University of Miami School of Medicine
Poison Control Information Center
Florida Poison Information Center
- Toll-Free, 24 Hour Marine and Freshwater Hotline (English & Spanish)
  - Poison Information Specialist
  - Florida Red Tide
    - Current Location
    - Health Information
  - Ciguatera Fish Poisoning
  - Shellfish Poisonings
  - Saxitoxin/Pufferfish Poisoning
- Case Reporting to FL DOH/CDC
- Surveillance data
- Evaluation of Service

888-232-8635
Sneezing? Coughing? Watery Eyes?

Your symptoms may be related to Florida Red Tide. People with asthma or respiratory problems should avoid red tide areas especially when winds are blowing on shore.

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

Breathe Easy During a Red Tide

This informational material was funded by the Florida Department of Health.
Aquatic Toxins Program

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www.myfloridaEH.com
Message of the Day

New Updates to Merlin!! -------- September 19th, 2007

Version 7.1

As of 7:30am Wednesday, August 19, 2007 we have released a new version of Merlin. Some of the issues addressed with this version are:

- **Multi-county Access** – update to correct the Investigator drop-down lists available to users with 'multi-county' access
- **Basic Case** – update to allow a Lab Report Date after the Date Reported to CHD on the Basic Case page
- **Basic Case** – update to correct the Link Outbreak function on the Basic Case page
- **Basic Case** – update to remove [Set DX Status] button on the left-side of the Basic Case page when a FL Disease Code does not have a Case Definition screen
- **Patient Profile** – update to allow more than 255 characters in the Profile Notes field
- **Patient Profile** – update to correct the label for the Profile History page
- **Lab Result Entry** – update to remove the Hep B (+HBsAg In Pregnant Women) value from the FL Disease Code list when patient gender is Male
- **Unprocessed Electronic Labs** – update to remove Hep B (+HBsAg In Pregnant Women) value from the FL Disease Code list when processing results when patient gender is Male
- **Unattached Labs** – update to place notes found under the ELR Order and ELR Observation data segments in the notes fields on the Unattached Lab screen after processing lab result from Unprocessed Electronic Labs task list
- **Unattached Labs** – update to add a text box under the specimen drop down list which captures the specimen description available in
CDC HABISS

- HAB-related Illness Surveillance System
- State Health Depts & Other Partners
- Integrated Web-based & Privacy-Protected Database
  - Human
  - Animal
  - Environmental
Data Entry
View and Edit Response Data in the surveys you have been given data entry privileges to.

Survey Management
View, Edit and Manage Surveys you own or have been given design privileges to.

Data Management
Export Response Data to RDC Response, Excel or Access files for the Surveys you own or have been given data management privileges to.

Library
View, Edit and Manage survey, page and question templates for use in survey design.

Windows & Handheld
Download the RDC Windows and Handheld software for use with RDC surveys while offline or in the field.

Comments and Suggestions
Send questions, comments or suggestions to the RDC Support Team.
Marine Mammal Stranding Networks
Outreach & Education
Medical Fact Sheets

Neurotoxic Shellfish Poisoning

CAUSATIVE AGENT: Neurotoxic Shellfish Poisoning (NSP) is caused by the consumption of seafood contaminated with the neurotoxin saxitoxin. The saxitoxin is produced by dinoflagellates called Karenia brevis. K. brevis is principally distributed throughout the Gulf of Mexico, and occasionally along the mid- and south-Atlantic Coasts. Commonly referred to as “Florida red tide,” blooms of K. brevis may occur during late summer and fall, but can appear any time of the year.

SIGNS/SYMPTOMS: Initial complaints typically include abdominal pain, nausea, vomiting, and diarrhea accompanied by progressive paralysis. Other effects include anorexia, headache, and vertigo. Paradoxical temperature sensation (feeling hot and cold sensations) is seen in Ciguatera Fish Poisoning, but has also been reported in NSP. In more severe cases of NSP, coma, stupor, and a depressed or labile blood pressure may also be observed.

ONSET/DURATION: Onset of symptoms occurs within minutes to hours, definitely within 24 hours, of consuming seafood contaminated with saxitoxin. Duration of the illness is generally short, lasting from a few hours to several days.

DIAGNOSIS: Diagnosis is generally based on a clinical evaluation of symptoms and recent food history. Most laboratories are testing for saxitoxin, however the use of a hemagglutination ELISA test to evaluate biological fluids such as urine is experimental at this time.

TREATMENT: No specific treatments are available at this time, but a supportive and symptomatic approach may be useful in the future. Although not well researched, the illness appears to be self-limited, and therapy is supportive and symptomatic-driven.

RISK GROUPS: All persons are susceptible to NSP. However, young children, the elderly, and those individuals with underlying neurologic disease may be at increased risk.

PREVENTATIVE MEASURES: The contaminated seafood is described as tasting delicious and the toxin cannot be removed from the shellfish by different preparation or storage methods. The Florida Department of Agriculture and Consumer Services classes shellfish harvesting areas where K. brevis cell counts exceed 5,000 cells per liter. In recent years most NSP cases have been the result of illegal harvesting of shellfish from closed areas. See www.state.fl.us/agriculture/environmental_health/ for shellfish harvesting area status.

REPORTING REQUIREMENTS: NSP cases must be immediately reported to the local county health department pursuant to Section 381.0331(1), Florida Statutes.

ADDITIONAL INFORMATION
Aquatic Toxins Hotline (Florida Poison Information Center): 1-888-221-5636
The Florida Department of Health’s Aquatic Toxins Program at www.medicinenet.com

AQUATIC TOXINS PROGRAM
Protecting Florida’s citizens and visitors from Harmful Algal blooms and related illnesses through
RESEARCH • SURVEILLANCE • EDUCATION

Neurotoxic Shellfish Poisoning

Reporting code = 98500
Case Report Form: 1. CDC 52.13 (9/89) Investigation of Foodborne illness

Clinical case definition
Onset is within a few minutes to a few hours after consumption of epidemiologically implicated seafood. Symptoms include tingling and numbness of lips, mouth, fingers, and toes; muscular aches; dizziness, reversal of hot and cold sensations; pupillary dilation; and usually accompanied by diarrhea, vomiting and ataxia. Illness is self-limited and milder than paralytic shellfish poisoning; paralysis has not been documented. Duration is from a few minutes to a few hours or a few days at most.

Laboratory criteria for diagnosis
- Detection of toxin in epidemiologically implicated shellfish

Case classification
Confirmed: Clinically compatible illness that is associated with consumption of shellfish from areas where other toxic shellfish have been found.

From:
Surveillance Case Definitions for Select Reportable Diseases in Florida
Florida Department of Health
Bureau of Epidemiology
June 2003
Red Tide Online is a service to Florida businesses provided by the Red Tide Alliance of FWC - Florida Marine Research Institute, Mote Marine Laboratory, and Solutions To Avoid Red Tide. The purpose of this website is to provide information about Red Tide facts and information pertaining to health and safety issues involved in a Red Tide event.

Businesses can also access a free Red Tide Information Kit for use in a Red Tide Event, along with contact numbers for further information or assistance.
Hotels, Restaurants, Tourist Venues
Outreach Activities: Information, Education and Communication

- Brochures
- Trinkets
- Web Site Development
- PSAs for Hotels, Public Access Channels
- Exhibits
- Professional Enrichment Presentations
- Lay Audience Presentations
The Future?
Beyond NOAA HAB Bulletins

Gulf of Mexico Harmful Algal Bloom Bulletin 5 January 2006
NOAA Ocean Service
NOAA Satellites and Information Service
Last Bulletin: January 3, 2006

Conditions Report
A harmful algal bloom has been identified in Monroe County. Patchy low impacts are possible for the gulfside Lower Keys today and Sunday, with low to moderate impacts possible Friday and Saturday. No impacts are expected elsewhere in SW Florida through Sunday. Dead fish have been reported between Key West and Marathon in the past few days. Dead fish smell, while unpleasant, does not produce the same respiratory irritation as red tide.

Analysis
The bloom near the Lower Keys remains present. Chlorophyll levels are continually elevated north and south of the Lower Keys, with levels highest north and southeast of Big Mutil Key (24°35′N, 81°54′W) and 24°34′N, 81°53′W), inside the Monroe Keys, and northeast of the Horseshoe Keys (24°44′N, 81°16′W). Elevated chlorophyll extends along the ocean side of the Lower Keys, out to approximately 7 miles from shore. No recent samples are available for this area. A fish kill was reported on 1/3 at Egret Lane west of Marathon. Sampling is highly recommended throughout this area. Continued transport around the Lower Keys is possible throughout the weekend. Also, a slight possibility exists for the transport of additional HAB blooms through the Lower Keys’ larger passages on Friday and Saturday with the appearance of strong north to northwesterly winds.

Sampling results indicate the bloom is no longer present at the SW Florida coast, although background levels remain patchy in bay and sound areas of Sarasota and Pinellas County (FWRI 1/3). Elevated chlorophyll features remain offshore Collier and Monroe Counties near 25°36′N, 82°13′W, and offshore Lee and Collier Counties at 26°16′N, 82°27′W. Sampling, if possible, is recommended. Overall movement has been minimal, the features will likely remain offshore and continue southward migration. 

Fisher, Brandon

Forecast

Detailed Analysis

Infrared Satellite Imagery
(Chlorophyll a)

Wind Speed Graph

Satellite chlorophyll image with possible HAB area shown by red polygon(s).

Wind conditions from Vaca Key, FL

Wind speed and direction are based on 3-hourly buoy measurements. Length of line indicates speed angle indicates direction. Be aware that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are easterly; values to the right are westerly.

SW Florida: Westerly winds (5-10kt) today will shift northwesterly, strengthening to 20kts (10m/s) after midnight through Friday. Continued northwesterlies on Saturday will weaken to 15kts (8m/s) and turn northwesterly, Saturday night at 10kts (5m/s). Mild easterlies expected Sunday and Monday.

FL Keys: Northwest to north winds (10kts, 5m/s) today. Continued northwest winds (15kts, 8m/s) and gusty) will shift northerly Friday night into Saturday, increasing to 20kts (10m/s) and gusty. North to northeast winds near 15kts (8m/s) on Sunday and Monday.
Incorporation of NEW Data

- Beyond physical/oceanographic!
- CDC HABISS
- State Health Departments
- Regional Poison Information Center
- Emergency Room & Hospital Discharge
- Marine Mammal Morbidity & Mortality
- Economic data
- Volunteer networks
New Integrated Models

- Remote sensing
- Environmental Conditions
- Organism & Toxin Levels
- Human & Animal Outcomes
- Socio-economic Factors
- Confounding variables
- Ultimately PREDICTIVE
Outcomes

• KEEPING PEOPLE HEALTHY!
• Prevention & Mitigation
• Early warning for Multiple users
  – Coastal Managers
  – Public Health & Healthcare
  – Targeted Sensitive Populations
• Education & Outreach
  – Targeted
  – Solution driven
  – Continuous evaluation & improvement
• state-of-coast.noaa.gov/bulletins/
• www.doh.state.fl.us/environment/community/aquatic/
• www.Floridamarine.org/
  • www.mote.org/
  • www.start1.com/
• www.rsmas.miami.edu/groups/niehs/