Harmful Algal Blooms (HABs)

Definition:
• “Red/Brown/Yellow/etc Tides”
• Proliferation of microscopic organisms
• Marine, fresh & estuarine waters
• 🐐 Potential danger to:
  – Environment
  – Wildlife
  – Humans
Harmful Algal Bloom
Our Filthy Seas
Causes of HABs?

DEPENDS on Individual Organism!!!!

- Environmental/Biological factors
- Anthropogenic Factors
  - Human Interactions
  - Pollution & Nutrients
  - Global Change
Causes of HABs

- Microscopic organisms
- “Harm” =
  - Oxygen deprivation
  - Natural toxin-production
HAB Toxins

• Natural Toxins
  – Harmful in minute (picogram) doses

• Can **NOT** be
  – detected
    • No taste or smell
  – eliminated
    • Heat and acid stable
    • Cleaning, storage, cooking

• Work at cellular level
Marine Toxins Affecting Man

PbTx-2

PbTx-1

CFP

DA

STX

TTX

OA
Ciguatoxin Effects on the Sodium Channel in Nerve Cells
Economic Costs of HABs


- Public Health
- Commercial Fisheries
- Recreation & Tourism
- Monitoring & Management
Herbivore ingests toxic dinoflagellates

Toxin producing dinoflagellates

Toxic herbivore

Eaten by carnivore

Toxic carnivore

Eaten by man
Seafood Consumption

- Conflicting Health Advice & Data
- Bivalve Consumption (FAO 2004)
  - France & Norway: 35% consume 1-11x/yr = 4.2 “eating occasions”/yr
  - US: 8.6 “eating occasions”/yr
- Seafood Consumption (NAS 2007)
  - US: > 16 lbs/person/yr
- Subpopulation & Individual Variability
HAB Human Diseases: Air/Water Exposure

Guidelines for drinking-water quality
SECOND EDITION
Addendum to Volume 1 Recommendations
HAB Known Human Diseases
HAB Known Human Diseases

- Paralytic Shellfish Poisoning (PSP)
- Neurotoxic Shellfish Poisoning (NSP)
- Diarrheic Shellfish Poisoning (DSP)
- Amnesiac Shellfish Poisoning (ASP)
- Azaspiracid Z/Shellfish Poisoning (AZP)

- Ciguatera Fish Poisoning
- Pufferfish “Fugu” (Tetrodotoxin)/(Saxitoxin)
- ?Brevetoxin Fish Poisoning

- Aerosolized (Brevetoxin) Red Tide
- Blue Green Algae/Cyanobacterial
- ??Pfiesteria/PEAS
- ??Ovatoxin/Ostreopsis
- OTHER?
<table>
<thead>
<tr>
<th>Transvector</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shellfish</td>
<td>PSP</td>
</tr>
<tr>
<td></td>
<td>NSP</td>
</tr>
<tr>
<td></td>
<td>DSP</td>
</tr>
<tr>
<td></td>
<td>ASP</td>
</tr>
<tr>
<td></td>
<td>AZP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fish</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ciguatera</td>
</tr>
<tr>
<td></td>
<td>Fugu (Tetrodotoxin/Saxitoxin)</td>
</tr>
<tr>
<td></td>
<td>?Brevetoxin Fish Poisoning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water/Aerosol</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Brevetoxin) Red Tide</td>
</tr>
<tr>
<td></td>
<td>Blue Green Algae/Cyanobacteria</td>
</tr>
<tr>
<td></td>
<td>(?Pfiesteria/PEAS)</td>
</tr>
<tr>
<td></td>
<td>(?Ovatoxin/Ostreopsis)</td>
</tr>
</tbody>
</table>
HAB Human Diseases: Clinical Epidemiology

Known Clinical Epidemiology

- Onset
- Attack Rate = # ill/# Exposed
- Symptoms
- Fatality
- ??Chronic Disease
- Treatment
- Other
HAB Human Diseases

- Paralytic SHELLfish Poisoning (PSP) (Saxitoxin)
- PufferFISH “Fugu” (Tetrodotoxin)
- Acute Onset (5-30 min-hours; < 24 hrs)
- High Attack Rate
- Neurologic; GastroIntestinal, Respiratory
- Fatality (1-60%)
- Short Duration (days)
- Chronic Disease
- Supportive Rx; Other
Fugu=Pufferfish Poisoning
(Tetrodotoxin & Saxitoxin)
HAB Human Diseases

Diarrheic Shellfish Poisoning (DSP) (Okadaic Acid+)

- Acute Onset (30 min-3 hr; 24 hrs)
- High Attack Rate
- Gastrointestinal
- Short Duration (days)
- Chronic Disease: Cancer
- Supportive Rx
HAB Human Diseases

Neurotoxic Shellfish Poisoning (NSP) (Brevetoxin)
- Acute Onset (30 min-3 hr; < 24 hrs)
- High Attack Rate
- Neurologic; GastroIntestinal
- Short Duration (days)
- Chronic Disease: Neurologic?
- Supportive Rx
Amnesiac Shellfish Poisoning (ASP) (Domoic Acid)

- ?Onset: hours (?< 24 hrs)
- ?High Attack Rate
- Neurologic; ?Other
- ?Fatality (3%)
- ?Chronic Disease (yrs): ??Amnesia
  - Sea Lions
  - ?susceptible populations
- ?Supportive Rx
HAB Human Diseases

Azaspiracid Shellfish Poisoning (AZP) (Azaspiracid)

- Onset: hours (<24 hrs)
- High Attack Rate
- Gastointestinal (Intestine, Liver)
- Fatality
- Chronic Disease (yrs): Cancer
- Supportive Rx
HAB Human Diseases

Blue Green Algae/Cyanobacteria (Multiple Toxins)

- Onset
- Attack Rate
  - Sensitive Subpopulations
- GastroIntestinal; Dermatologic; Hepatic; Renal; Neurologic; Respiratory; Other
- Fatality (0-20%)
  - Dialysis patients
- Chronic Disease (yrs): Hepatic, Cancer
- Rx
Florida Blue Green Algae Sampling: Surface Water

Distribution of Toxic Blue-Green Algae in Florida

Toxic Algae
Non-Toxic Algae Samples
County Boundaries
Rivers and Canals
Lakes
WMD Boundaries
SWFMD
SJRWMD
SRWMD
NWFWMED
HAB Human Diseases

Ciguatera (Ciguatoxin; ?Maitotoxin, etc)

- Acute Onset (1-24 hr)
- ?High Attack Rate
- Neurologic; GastroIntestinal, Cardiovascular
- ?Fatality (0.1-12%)
- Long Duration (weeks to yrs)
- Chronic Disease: Neurologic, ?Chronic Fatigue, ?Other
- ?Rx: Supportive, Mannitol, ?TCA, ?Other
# Table 1  Reported Frequency of Clinical Symptoms of Ciguatera

<table>
<thead>
<tr>
<th>Symptoms (reported by % frequency)</th>
<th>Caribbean (n=442)</th>
<th>Caribbean (n=57)</th>
<th>Caribbean (n=129)</th>
<th>Caribbean (n=16)</th>
<th>Caribbean (n=80)</th>
<th>Caribbean (n=6)</th>
<th>South Pacific Islands (n=12,890)</th>
<th>Western Pacific (Australia) (n=167)</th>
<th>South Pacific Islands (n=3,009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td>78.7</td>
<td>77</td>
<td>81</td>
<td>76</td>
<td>56</td>
<td>83</td>
<td>66</td>
<td>72.6</td>
<td>49</td>
</tr>
<tr>
<td>Vomiting</td>
<td>42.5</td>
<td>37</td>
<td>40</td>
<td>68</td>
<td>69</td>
<td>69</td>
<td>66</td>
<td>38.8</td>
<td>50</td>
</tr>
<tr>
<td>Nausea</td>
<td></td>
<td>82</td>
<td></td>
<td>69</td>
<td>100</td>
<td></td>
<td></td>
<td>43.5</td>
<td>50</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>64.5</td>
<td>58</td>
<td>30</td>
<td>75</td>
<td>74</td>
<td>66</td>
<td>42.5</td>
<td>29</td>
<td>46.3</td>
</tr>
<tr>
<td>Neurological</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthralgia</td>
<td>78.7</td>
<td>75</td>
<td>34</td>
<td>31</td>
<td>60</td>
<td></td>
<td>85.9</td>
<td>29</td>
<td>85.7</td>
</tr>
<tr>
<td>Myalgia</td>
<td>79.0</td>
<td>75</td>
<td>34</td>
<td>86</td>
<td>94</td>
<td>56</td>
<td>85.3</td>
<td>38</td>
<td>81.5</td>
</tr>
<tr>
<td>Extremity paresthesia</td>
<td>81.0</td>
<td>79</td>
<td>71</td>
<td>38</td>
<td>36</td>
<td>50</td>
<td>89.0</td>
<td>82</td>
<td>89.2</td>
</tr>
<tr>
<td>Circumoral paresthesia</td>
<td>69.5</td>
<td>79</td>
<td>38</td>
<td>54</td>
<td>38</td>
<td>38</td>
<td>88.1</td>
<td>82</td>
<td>89.1</td>
</tr>
<tr>
<td>Temperature reversal</td>
<td>64.3</td>
<td>77</td>
<td>23</td>
<td>50</td>
<td>48</td>
<td>16</td>
<td>87.2</td>
<td>65</td>
<td>87.6</td>
</tr>
<tr>
<td>Headache</td>
<td>56</td>
<td>45</td>
<td>47</td>
<td>50</td>
<td>39</td>
<td></td>
<td>59.6</td>
<td>25</td>
<td>59.2</td>
</tr>
<tr>
<td>Dizziness/vertigo</td>
<td>50.0</td>
<td></td>
<td>47</td>
<td>56</td>
<td>33</td>
<td>16</td>
<td>42.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weakness</td>
<td>84</td>
<td></td>
<td>30</td>
<td>94</td>
<td>65.4</td>
<td></td>
<td>60.0</td>
<td>70</td>
<td>60.0</td>
</tr>
<tr>
<td>Chills/sweating</td>
<td>36</td>
<td></td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td>59.6</td>
<td></td>
<td>59.0</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dysuria</td>
<td>25.0</td>
<td></td>
<td></td>
<td>31</td>
<td></td>
<td></td>
<td>12.6</td>
<td>18.7</td>
<td></td>
</tr>
<tr>
<td>Pruritus</td>
<td>77.0</td>
<td>66</td>
<td>48</td>
<td>100</td>
<td>45</td>
<td>66</td>
<td>44.0</td>
<td>5</td>
<td>44.9</td>
</tr>
<tr>
<td>Dental pain or “looseness”</td>
<td>32.1</td>
<td>23</td>
<td>13</td>
<td>19</td>
<td>11</td>
<td></td>
<td>20.7</td>
<td>24.8</td>
<td></td>
</tr>
<tr>
<td>Dyspnea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.1</td>
<td></td>
<td>16.1</td>
</tr>
<tr>
<td>Skin rash</td>
<td>32.1</td>
<td></td>
<td></td>
<td>31</td>
<td></td>
<td></td>
<td>20.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stinn et al 2001
Symptom Course of Sub/Chronic Ciguatera

Lawrence et al 1980
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
Brevetoxin Fish Poisoning: New Pathway!

Naar, Flewelling, et al

Chronic Low Dose Exposures??
Aerosolized (Brevetoxin) Florida Red Tide
Conclusions: Humans

- Emergency room visits GI & Respiratory
- Acute Respiratory Effects
  - Symptoms in Asthmatics & Occupational
  - PFTs in Asthmatics
- Sub Acute Respiratory Effects
  - Symptoms & PFTs Asthmatics
  - Increased ER Respiratory Admissions
- Chronic Respiratory Effects
  - ?None in stable asthmatics; ?Unstable
  - ?Pneumonia, Bronchitis increased risk
Pfiesteria piscicida / PLOs???

Pfiesteria piscicida

Cryptoperidiniopsoid

Dinoflagellate
New HAB Human Diseases?

- Geographic spread & new Locations
  - Ballast water, spat

- New transvectors
  - e.g. Brevetoxin FISH disease

- Known “Orphan” toxins
  - Cyclic imines
  - Pectenotoxins
  - Yessotoxins
  - Cyanotoxins

- New/Unknown toxins
  - ?Ovatoxin

- Mixtures????????
Shellfish Safety – Algal toxins

EU working group on emerging toxins (May 2012)

1. Ciguatoxins
   Emerging in southern European waters

2. Ovatoxins
   Emerging in Mediterranean

3. Cyclic Imines
   Spirolides everywhere, others sporadic

4. TTX
   Gasteropod (PT) & fish in Mediterranean
<table>
<thead>
<tr>
<th>Prevalence</th>
<th>Location</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4%</td>
<td>St Thomas</td>
<td>McMillan 1980</td>
</tr>
<tr>
<td>7.0%</td>
<td>Puerto Rico</td>
<td>Holt 1984</td>
</tr>
<tr>
<td>8.5%</td>
<td>Tahiti</td>
<td>Bagnis 1979</td>
</tr>
<tr>
<td>43.0%</td>
<td>South Pacific</td>
<td>Rogers 1986</td>
</tr>
<tr>
<td>70.0%</td>
<td>Polynesian Isles</td>
<td>Lewis 1986</td>
</tr>
<tr>
<td>Incidence/10,000 py</td>
<td>Location</td>
<td>Reference</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>0.3</td>
<td>Hawaii</td>
<td>Anderson 1983</td>
</tr>
<tr>
<td>0.8</td>
<td>Reunion Isles</td>
<td>Quod 1996</td>
</tr>
<tr>
<td>3.0</td>
<td>Queensland</td>
<td>Gillespie 1986</td>
</tr>
<tr>
<td>5.0</td>
<td>Dade Ct, FL</td>
<td>Lawrence 1980</td>
</tr>
<tr>
<td>30.0</td>
<td>Guadeloupe</td>
<td>Czernichov 1984</td>
</tr>
<tr>
<td>40-75</td>
<td>Culebra (PR)</td>
<td>Azziz 2012</td>
</tr>
<tr>
<td>75.0</td>
<td>US Virgin Isles</td>
<td>Morris 1982</td>
</tr>
<tr>
<td>2820.0</td>
<td>Marshall Isles</td>
<td>Lewis 1986</td>
</tr>
<tr>
<td>5850.0</td>
<td>French Polynesia</td>
<td>Lewis 1986</td>
</tr>
</tbody>
</table>
Ciguatera Reporting

- Under-Diagnosis
- Under-Reporting
- Inadequate Cluster Follow-Up

- 90-98% Ciguatera NOT Reported in US
Ciguatera Fish Poisoning Reporting by physicians in an endemic area

- 1st Care Physicians in Miami-Dade County
  - Endemic Ciguatera

- Majority of Physicians NOT aware:
  - Diagnosis
  - Treatment
  - Reporting

(McKee et al 2001)
Harmful Algal Blooms Cause Human Illness
1544
## HAB Human Diseases: Current “Prevention” = Monitoring

<table>
<thead>
<tr>
<th>Disease</th>
<th>Transvector</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSP</td>
<td>Organism/Toxin</td>
</tr>
<tr>
<td>NSP</td>
<td>Shellfish Bed Monitoring</td>
</tr>
<tr>
<td>DSP</td>
<td></td>
</tr>
<tr>
<td>ASP</td>
<td></td>
</tr>
<tr>
<td>AZP</td>
<td></td>
</tr>
<tr>
<td>Ciguatera</td>
<td></td>
</tr>
<tr>
<td>Fugu</td>
<td></td>
</tr>
<tr>
<td>(Tetrodotoxin/Saxitoxin)</td>
<td></td>
</tr>
<tr>
<td>?Brevetoxin Fish</td>
<td>?Fish Monitoring</td>
</tr>
<tr>
<td>(Brevetoxin) Red Tide</td>
<td>?Water/Air Monitoring</td>
</tr>
<tr>
<td>Blue Green Algae</td>
<td></td>
</tr>
<tr>
<td>?Ovatoxin/Ostreopsis</td>
<td></td>
</tr>
</tbody>
</table>
Regular monitoring
1991 - 2000

DISCLAIMER - WARNING
HAEDA maps should be interpreted with caution
regarding risk of intoxication by seafood products
from the respective areas/regions/countries.
The IOC and ICES are not liable for possible misuse
of this information.

ICES countries

Results provided
No results provided

Regular monitoring
Regular monitoring
1991 - 2000

ICES countries

DISCLAIMER - WARNING
HAEDAT maps should be interpreted with caution regarding risk of intoxication by seafood products from the respective areas/regions/countries. The IOC and ICES are not liable for possible misuse of this information.
Outreach & Education

- Target Audiences
  - Seafood, Tourism, Water Industries
  - Public Health & Food Safety
  - Healthcare Providers & Patients
  - Consumers, General Public & Media

- Comprehensive & Usable

- Dissemination & Evaluation
  - Keeping Current

- Surveillance
Florida Red Tide (Brevetoxins) & Epidemiologic Study Recruitment Outreach/Education
Visit our website at:
www.mote.org/niehsredtidestudy
Become part of the Solution...

Join

S.T.A.R.T
Solutions To Avoid Red Tide, Inc.

MONITOR • CONTROL • MITIGATE
RED TIDE

Key Red Tide Facts:
• Red Tide is a microscopic alga (pan-like organism) in Florida called *Karenia brevis* or *K. brevis*.
• *K. brevis* produces a toxin that can kill fish and can cause respiratory problems in humans. People with severe respiratory problems should avoid red tide areas.
• Red Tide is a type of Harmful Algal bloom that is a world-wide problem.
• Red Tide can last days, weeks or months but can change daily.
• All seafood from restaurants and hotels is monitored and is safe to eat. Avoid eating clams and oysters taken from red tide waters.
• Red tide symptoms are coughing, sneezing, and watery eyes.

Kirkpatrick, Reich, et al

Hotels, Restaurants, Tourist Venues
Neurotoxic Shellfish Poisoning

CAUSATIVE AGENT: Neurotoxic Shellfish Poisoning (NSP) is caused by the consumption of molluscan shellfish (e.g., clams, oysters, mussels, and other filter feeders) contaminated with natural toxins known as neurotoxins, which are produced by a marine dinoflagellate called K. brevis. K. brevis is principally distributed throughout the Gulf of Mexico, and occasionally along the mid and north Atlantic Coast. Commonly referred to as “Florida red tide,” blooms of K. brevis most often occur during late summer and fall, but can be present any time of the year.

SIGNS/SYMPTOMS: Initial complaints typically include abdominal pain, nausea, vomiting, and diarrhea accompanied by progressive neurotoxic symptoms that can affect areas of the mouth and extremities. Other common symptoms include ataxia, myalgia, headache, and vertigo. Flaccid rectal temperature sensation (several of hot and cold sensations), as seen in ciguatera fish poisoning, has also been reported in NSP. In more severe cases of NSP, coma, respiratory depression, and mild to moderate respiratory may also be observed.

ONSET/DURATION: Onset of symptoms occurs within minutes to hours, generally within 24 hours of consuming neurotoxin-contaminated shellfish. 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 seafood history. Molecular testing is the only technique accepted by the FDA for testing samples for neurotoxin shellfish; however, the use of a commercial ELISA test (to screen for neurotoxic shellfish) is experimental at this time.

TREATMENT: No specific treatment is available although a non-narcotic anticholinergic may be helpful in the future. Although not well documented, 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 other individuals with underlying neurologic disease may be at increased risk.

PREVENTATIVE MEASURES: The contaminated shellfish are described as tasting delicious and the toxins can be removed from the shellfish by different preparation or storage methods. The Florida Department of Agriculture and Consumer Services chose shellfish harvesting areas within K. brevis cell counts of 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.Florida.gov/health/publichealth/shellfish.htm for shellfish harvesting area status.

REPORTING REQUIREMENTS: NSP cases must be immediately reported to the local county health department pursuant to Section 381.0011 (2), Florida Statutes.

ADDITIONAL INFORMATION
Aquatic Toxicosis Program (Florida Poison Information Center): 1-888-232-8855
The Florida Department of Health’s Aquatic Toxoses Program: www.floridahealth.com/aquatic

AQUATIC TOXINS PROGRAM
Protecting Florida’s citizens and visitors from Harmful Algal Blooms and related illnesses through Research • Surveillance • Education

Backer, Reich, Fleming, et al

Neurotoxic Shellfish Poisoning

Reporting code = 96800
Case Report Form:
  1. CDC 52.13 (9/69) Investigation of Foodborne illness

Clinical case definition

Onset is within a few minutes to a few hours after consumption of epidemiologically implicated shellfish. 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
Florida Aquatic Toxins Hotline

University of Miami School of Medicine
Poison Control Information Center
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.

Stephan, Reich, Kirkpatrick,, et al
Mote Marine 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.osgulfenvironment.net
research.mote.org
coastwatch.noaa.gov
Kirkpatrick, Nierenberg, et al
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 currently elevated north and south of the Lower Keys, with levels highest north and southeast of Big Mullet Key (24°35'N, 81°54'W) and 24°34'N, 81°53'W), inside the Marquessa Keys, and northeast of the Horseshoe Keys (24°48'N, 81°16'W). Elevated chlorophyll exists 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 _K. brevis_ through the Lower Keys’ larger passages on Friday and Saturday with the appearance of strong northerly 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°30'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.

Forecast

Detailed Analysis

Stump, Kirkpatrick, et al

Infrared Satellite Imagery (Chlorophyll a)

Wind Speed Graph
HAB Human Disease Issues

• Lack of Epidemiology
  – Clinical diagnosis
    • Biomarkers
    • More widely available transvector testing
  – Surveillance Lack
    • What is baseline? Is there an increase?
    • CDC HABISS (Dr Lorrie Backer NCEH)
  – Beyond Acute ??Sub/Chronic disease
    • Susceptible subpopulations
      – Chronic disease, Children, Pregnant/Lactating
HAB Human Disease Issues

• Appropriate Specific Treatments?
• Sub/chronic low dose exposure?
• Mixtures
  – Toxins
  – Microbes & Toxins
• Prevention
  – New Transvector, HAB Organism, Geography, Global Trade
• Outreach & Education
Grant Support

European Regional Development Fund (ERDF), European Social Fund (ESF), National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health (NIH), National Science Foundation (NSF), Centers for Disease Control and Prevention (CDC), Florida Dept of Health, Florida Harmful Algal Bloom Taskforce
• University of Miami Oceans & Human Health Center
  www.rsmas.miami.edu/groups/ohh/
• Florida Dept of Health Aquatic Toxins
  (http://www.myfloridaeh.com/medicine/aquatic/index.html)
• Aquatic Toxins Hotline (1 888 232 8635) (www.miamipoison.org under
  the “Plants and Animals”)
• National HAB Website  http://www.whoi.edu/redtide/
• Beach Conditions Reporting System
  (http://coolgate.mote.org/beachconditions/) and tel: 941 BEACHES
  (941 232-2437)
• Solutions to Avoid Red Tide (START) (www.start1.com)
• Florida Fish and Wildlife Conservation Commission
  (www.floridamarine.org)
• NOAA HAB Bulletins
  (http://coastwatch.noaa.gov/hab/bulletins_ns.htm)
• Florida Dept. of Agriculture Shellfish Harvesting beds around the state
  (http://www.floridaaquaculture.com/SEAS/SEAS_intro.htm)
• Healthy Beaches Program
  (http://esetappsdoh.doh.state.fl.us/irm00beachwater/default.aspx)