

# Human Health & Water Issues

Micro & Macro: Harmful Algal Blooms,  
Climate Change & Infectious Diseases  
Disaster-Related H<sub>2</sub>O Injuries, Illnesses

## SC Water Resources Conference Charleston, SC

Wednesday, October 15, 2008

**Robert Ball, MD, MPH**  
*Infectious Disease Consultant & Epidemiologist*  
*SC Department of Health & Environmental Control*



R. Ball, MD, MPH

# Human Health Impact of...

## SHOE By Chris Cassatt & Gary Brookins



shoecomics.com



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# Human Health, Coastal Populations, & Climate Change: Micro Issues

1. Emerging Infectious Diseases
2. Mosquito/ pest-borne diseases
3. Others: ie, Harmful Algal Blooms (HABs)
4. ↓Food safety & quality (eg, flooding, droughts, environmental contamination, foodborne illnesses, infectious diseases)

# HARMFUL ALGAL BLOOMS: Some Effects on Human Health

## *so-called "FISH POISONINGS"*

- Ciguatera - ingestion: Gamber. toxicus/ neuro Sx
- Paralytic shellfish poisoning: Alex. sp/ neuro, paral.\*
- Neurotoxic shellfish poisoning: G. breve/ neuro, GI\*
- Diarrhetic s.p.: Dinophysis/ GI Sx – okadoic acid
- Amnesic s.p.: Ps. pungens/ amnesia, neuro Sx – domoic acid (found in many marine animal events)  
(Scombroid - ↑ histamine ingestion → neuro Sx)

*MOST ARE INGESTION-RELATED, from **HABs** 2<sup>o</sup> ↑ water temps & pollution.*

*\* "red tides"*





# MMWR

Morbidity and Mortality Weekly Report

September 1, 2006 / Vol. 55 / No. 34

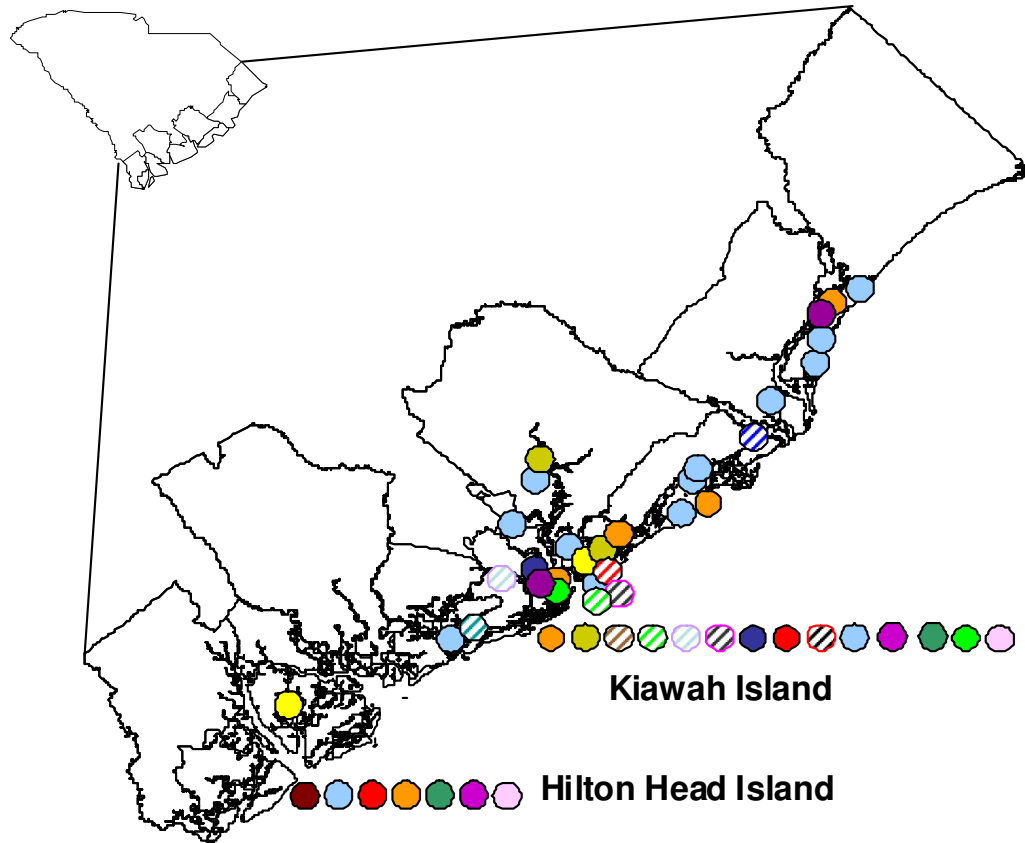
## Ciguatera Fish Poisoning — Texas, 1998, and South Carolina, 2004

2<sup>o</sup> to Global Warming

The temperatures of the northern Caribbean and extreme southeastern Gulf of Mexico have been predicted to increase 4.5°F–6.3°F (2.5°C–3.5°C) during the twenty-first century, with greater temperature increases in higher latitudes (7). Higher temperatures favor *G. toxicus* growth (8) and are likely to alter fish migration patterns. Ciguatera outbreaks previously have been correlated with sea-surface temperature increases in the south Pacific Ocean (9) and Tahiti (10). These data suggest *G. toxicus* proliferation likely will continue and perhaps increase in the Gulf of Mexico (2) and along the southern Atlantic coastline.

# HABs and SC's Estuaries

## Harmful Algal Blooms in South Carolina



Thanks to Dr. Alan Lewitus  
& colleagues for these data 2005

**N = 19 genera, mostly in residential & recreational coastal ponds**

# Case report: Blue-green Algal Bloom - James Island, SC 2000

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- Blue-green algal bloom: residential pond
- June 2000: 7 yo girl waded briefly in water < 2' deep → immed. dev. severe body rash, respir. & constitutional Sx
- LMD provided emerg. care, Sx cleared
- DHEC: high # Anabaena & Microcystis algal forms (LM only) in pond water

# COMPARATIVE LETHALITY OF TOP 23 SELECTED TOXINS AND CHEMICAL AGENTS (LD<sub>50</sub> in laboratory mice) - USAMRIID, Blue Book 2001

<u>AGENTS 1-12</u>	<u>LD50 (µg/kg)</u>	<u>SOURCE</u>	
C. botulinum Toxin	0.001	Bacterium	
Shiga Toxin	0.002	Bacterium	
Tetanus Toxin	0.002	Bacterium	
Abrin	0.04	Plant (Rosay Pea)	<b>HABs</b>
Diphtheria Toxin	0.10	Bacterium	
<b>Maitotoxin</b>	<b>0.10</b>	<b>Marine Dinoflagellate</b>	
Palytoxin	0.15	Marine Soft Coral	
<b>Ciguatoxin</b>	<b>0.40</b>	<b>Fish-Marine Dinoflagellate</b>	
Textilotoxin	0.60	Elapid Snake	
C. perfringens toxins	0.1-0.5	Bacterium	
Batrachotoxin	2.0	Arrow-Poison Frog	
Ricin	3.0	Plant (Castor Bean)	



# COMPARATIVE LETHALITY OF TOP 23 SELECTED TOXINS AND CHEMICAL AGENTS (LD<sub>50</sub> in laboratory mice) - USAMRIID, Blue Book 2001

<u>AGENTS 13-23</u>	<u>LD50 (µg/kg)</u>	<u>SOURCE</u>
Conotoxin	5.0	Cone Snail
Taipoxin	5.0	Elapid Snake
Tetrodotoxin	8.0	Puffer Fish
Tityustoxin	9.0	Scorpion
<b>Saxitoxin</b>	<b>10.0(inhal,2.0)</b>	<b>Marine Dinoflagellate</b>
VX	15.0	Chemical Agent
SEB (Rhesus/aerosol)	27.0	Bacterium
<b>Anatoxin-A(s)</b>	<b>50.0</b>	<b>Blue-Green Alga (found in SC)</b>
<b>Microcystin</b>	<b>50.0</b>	<b>Blue-Green Alga (found in SC)</b>
Soman (GD)	64.0	Chemical Agent
Sarin (GB)	100	Chemical Agent



{note: Brevetoxin & Domoic acid LD<sub>50</sub> average ~ 200-300 µg/kg}

# **Blue-green Algae: Anabaena & Microcystis**



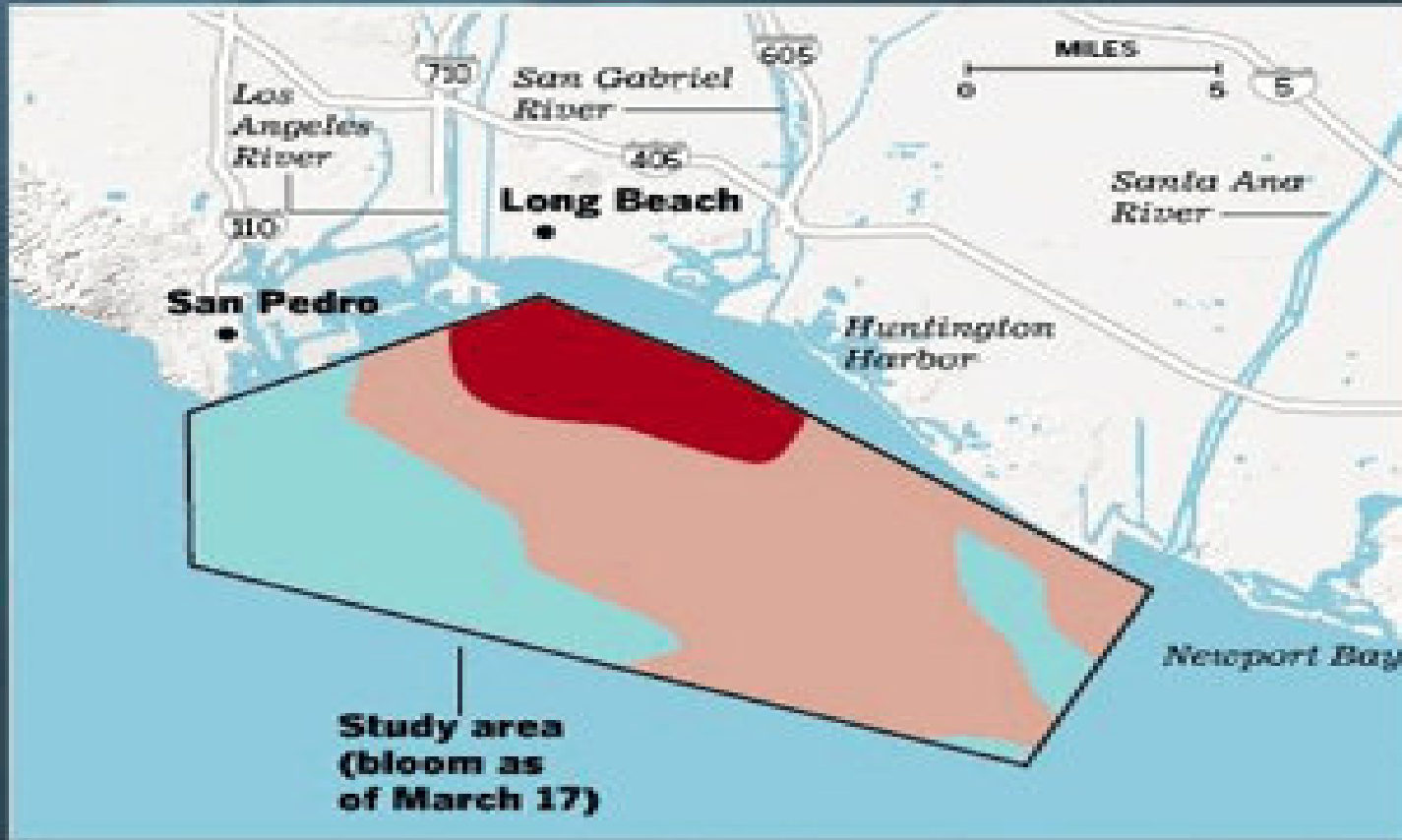
# Toxic bloom

High levels of the algae-produced toxin domoic acid have been found off the mouths of the Los Angeles and San Gabriel rivers. USC researchers are trying to determine whether the river discharges cause the toxic bloom that poisons sea life.



Higher levels

Lower levels



pseudo-nitzschia)  
etc. →  
domoic acid  
a potent  
neurotoxin



Source: USC department of biological sciences. Graphic by Leslie Carlson  
Los Angeles Times

R. Ball, MD, MPH

# HABs & Health Impacts: Marine Life as "Ocean Canaries" espec. re: Domoic Acid Outbreaks

- California: ↑ in 2006, ↑↑ April 2007
- Birds ("seizing pelicans") & mammals
- Hundreds sickened and dead
- Domoic acid found in many marine animals (incl. sea lions & whales)
- 2<sup>0</sup> to ↑ Harmful Algal Blooms (pseudonitzschia) 2<sup>0</sup> to warmer water temps, ↑ pollution, runoff, etc
- Citizens warned against eating finfish or shellfish from affected areas



**IBRRC**  
International Bird Rescue Research Center

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San Pedro, CA

## Crisis off our coast

Deadly domoic acid killing record numl

It's happened with predictable regularity. International Bird Rescue Research Center in San Pedro in 2001. The staff at the center specializes in seabirds, and especially California calls it DA; short for Domoic Acid. The staff and dying birds they know will come, even [domoic acid outbreak](#)

# How to Document Health Impact? We need Novel Surveillance Systems

## HABISS

### Harmful Algal Bloom-related Illness Surveillance System

August 28, 2007



SAFER • HEALTHIER • PEOPLE™



Robert Bell, MD MPH

InfectiousDiseaseNews.com

Volume 20 • Number 8  
AUGUST 2007

# INFECTIOUS DISEASE NEWS<sup>®</sup>

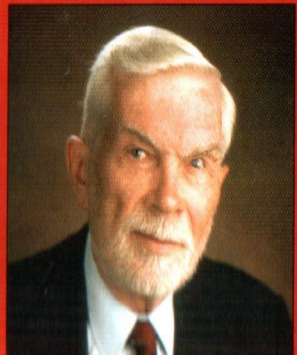
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Theodore C. Eickhoff, MD, Chief Medical Editor

20<sup>th</sup>  
Anniversary

INSIDE

THIMEROSAL, MMR  
VACCINE AND AUTISM



## World population growth may escalate rates of infectious diseases

BETHESDA, Md. – By 2015, more than 90% of the world's population growth is estimated to occur in developing nations. But many of these nations may lack the public health infrastructure to thwart zoonotic and foodborne diseases.

“These nations are potential hot-spots for new emerging diseases,” said **Lonnie J. King, DVM, MS, MPA**, director of the CDC's National Cen-

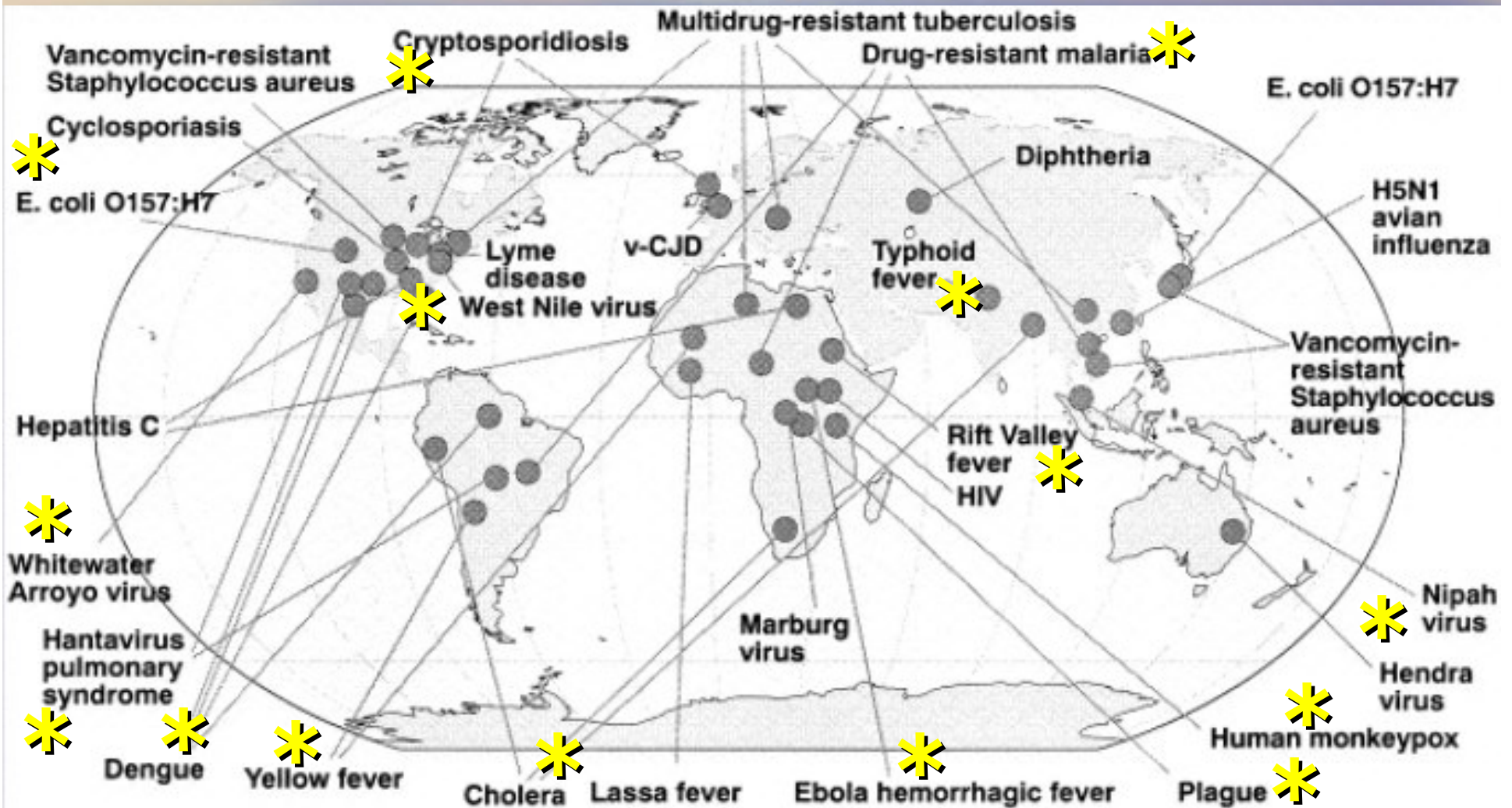
ter for Zoonotic, Vector-Borne and Enteric Diseases. King presented an outline about the concerns rising from the convergence of animal and human health from 10,000 years ago to more than 20 years in the future at the 2007 Annual Conference on Antimicrobial Resistance, held here recently.

King noted that one factor that may further facilitate the spread of zoonotic diseases is the shift from rural farming

to urban farming. By 2030, an estimated 60% of people are expected to live in urban areas. King said that infectious and zoonotic diseases may be more difficult to control because livestock farming is predicted to move to the edge of these urban areas and closer to large population centers. Many of these areas may lack sufficient public health services.

*For more, see page 44.*

# Emerging Infectious Diseases: \*related to climate, water changes



# Emerging Arboviral Diseases

## ie, Dengue Fever, Malaria, West Nile Virus

### Dengue fever surging in Puerto Rico

Mosquito-borne disease reaches worst levels since 1994 epidemic

Telemundo and MSNBC.com

Updated: 8:11 p.m. ET Aug 8, 2007

SAN JUAN, Puerto Rico - Puerto Rican health authorities warned Wednesday that the potentially deadly disease dengue fever was reaching epidemic proportions and called for a territory-wide campaign to eliminate breeding grounds of disease-carrying mosquitoes.

Enid Garcia-Rivera, the U.S. territory's secretary of health and epidemiology, said 2,343 confirmed cases of dengue had been reported since the beginning of the year, more than double the number of cases reported in the same period last year and the most since the dengue epidemic of 1994.

While no deaths have yet been confirmed, the disease is spreading rapidly, with more than 300 cases reported last week alone. Because milder forms can be mistaken for common illnesses like influenza, many victims may not seek medical attention, and the true number of infections could be five to 10 times greater, the U.S. Centers for Disease Control and Prevention said.



[CDC](#) Outbreak Notice

Aug.22, 2007

### Malaria in the Bahamas: Recommendations for Travelers

The Centers for Disease Control and Prevention (CDC) has received official reports of two confirmed malaria cases in Great Exuma, Bahamas. Malaria transmission had not previously been reported from this area, until an outbreak was reported in late spring and summer 2006. One of the confirmed cases occurred in a U.S. citizen who traveled to Great Exuma in late July 2007. This patient's illness has been confirmed as malaria caused by *Plasmodium falciparum*. Malaria is not considered endemic on the islands of the Bahamas.

#### Recommendations for Travelers

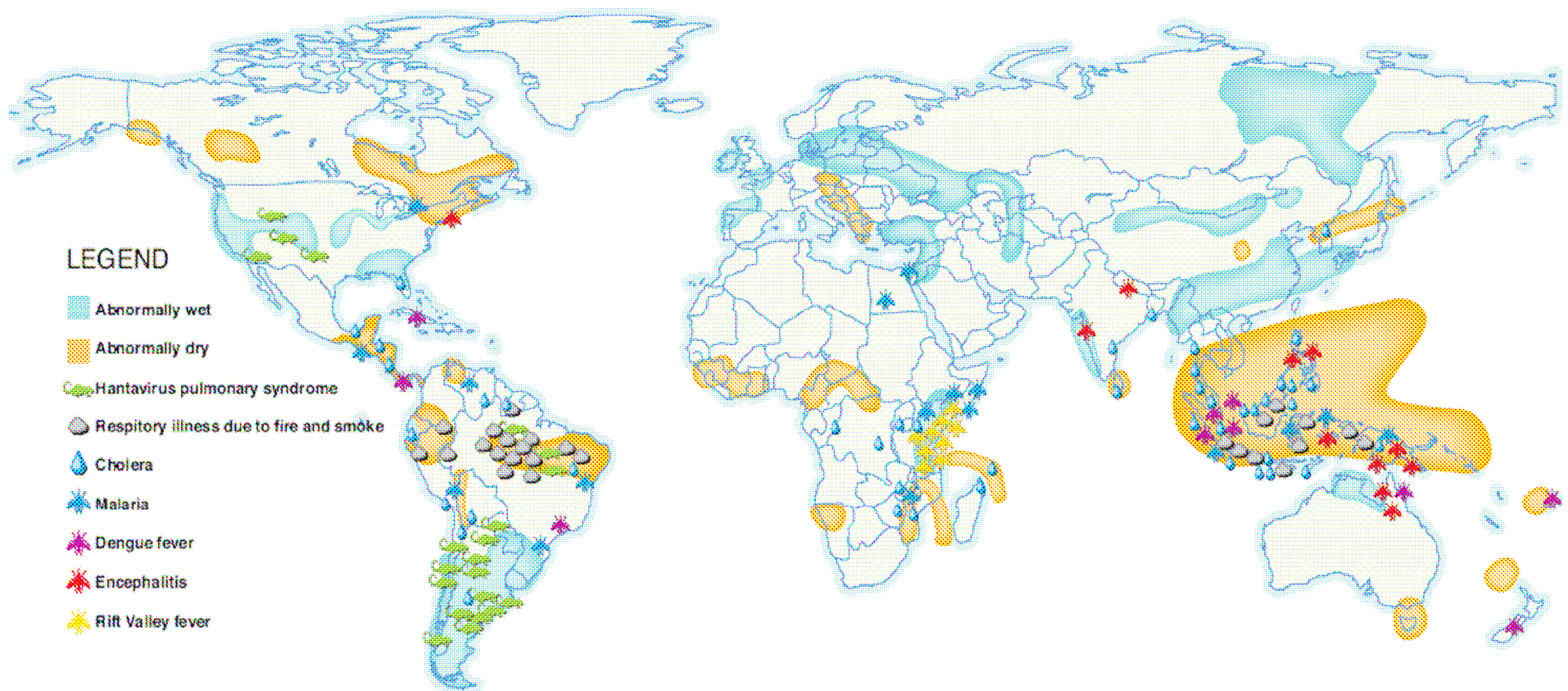
##### Antimalarial Medication

At this time, CDC is recommending chloroquine as an antimalarial medication for travelers to Great Exuma. This recommendation is expected to be temporary and does not



# Emerging Infectious Diseases

Figure 2.2 Extreme Weather Events and Disease Outbreaks: 1997-1998



*Outbreaks of infectious diseases carried by mosquitoes, rodents and water often "cluster" following storms and floods. Droughts also lead to water-borne diseases and disease from fires. The events above occurred in 1997-1998, during the century's largest El Niño.*

*Image: Bryan Christie/Scientific American August 2000*

# Human Health, Coastal Populations, & Climate Change: Macro Issues

5. Coastal overpopulation, overdevelopment in face of slowly rising sea levels
6. Beach/ocean water quality ↓ (adversely impacts both recreational & commercial)
7. ↑ Hurricane impacts (costs > lifestyles > human health toll, ↓ quality of life)
8. ↑ Air pollution (particulates & subpartic's)

# Human Health Impact: ↑ Floods

Millions face flood disease threat

**CNN 8.7.07**

**>30 million persons  
"this year- particularly intense"**

## STORY HIGHLIGHTS

- United Nations warns of major health crisis in wake of monsoon floods
- 30 million affected by rising waters in India, Bangladesh, Pakistan and Nepal
- Stagnant flood waters are lethal breeding grounds for disease and infection

**Dartmouth Flood Observatory**

**[www.dartmouth.edu/~floods](http://www.dartmouth.edu/~floods)**

(CNN) -- The United Nations is warning of a massive "health crisis" as people have been overwhelmed by the monsoonal rains in India and Bangladesh.



AP PHOTO

Villages shelter from flood waters on high ground in the Begusarai District of India's Bihar state.

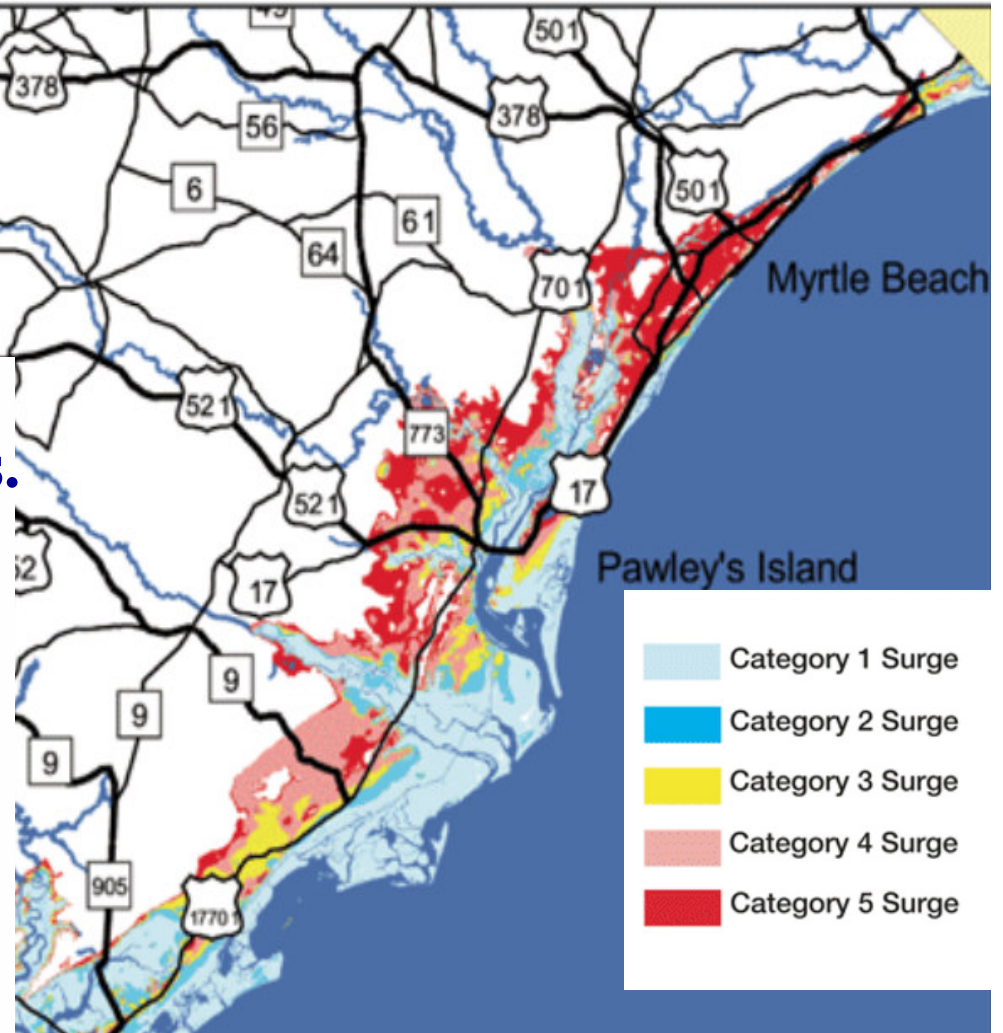
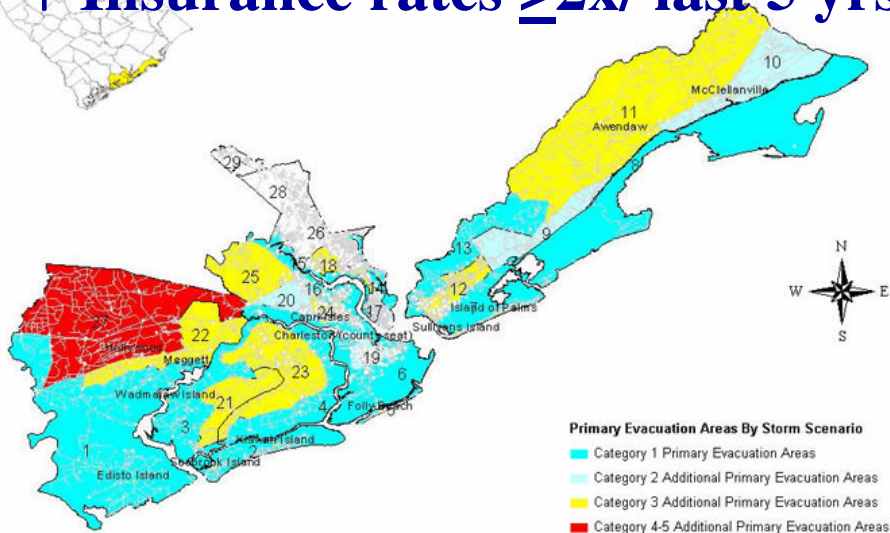


# Potential Storm Surges: SC coastal areas: now ~25 mi.inland



Charleston County Evacuation Zones

↑↑ Insurance rates  $\geq 2x$ / last 5 yrs.





## Emergency Preparedness & Response

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# Hurricanes

Plus Cyclones, Typhoons, & Other Tropical Storms

## Hurricanes 2008: Update

September 26, 2008

CDC is working with state and local governments and other federal agencies to help communities recover from Ike.

[Learn more](#)

**Now Available!**  
CDC Mobile Website With Hurricane Recovery Information

[Learn More](#)

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### Languages

- [American Sign Language \(ASL\)](#)
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### Contact CDC

800-CDC-INFO  
(800-232-4636)  
888-232-6348 (TTY)  
[cdcinfo@cdc.gov](mailto:cdcinfo@cdc.gov)

[Report an Emergency](#)

The National Suicide Prevention Lifeline  
1-800-273-TALK(8255)

## Protect Yourself and Others



### Prevent Illness & Injuries

Food, water, carbon monoxide, & other hazards.



### Clean Up

Learn how fluids, activities, & clothing affect your safety.



### Generator Safety

Prevent carbon monoxide poisoning.



### Stay Safe in the Heat

Changes in your fluid intake, activities, and clothing can help you remain safe.



### Return Home Safely

Stay safe from hazards a storm may leave in your home.



### Learn About Hurricane Preparedness

Prepare yourself for future storms.

### Information for You

[Evacuation Centers](#)

### Audio, Video, Etc.

[Podcasts, public service](#)

### Federal Hurricane Response

- [How to Get Help](#)
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# Local Problems & Solutions

Charleston South Carolina Hotels | Wild Dunes Resort ...



COASTAL  
CONSERVATION  
LEAGUE



TOM BLAGDEN

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### Sign Up!

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Stay informed about  
important issues and  
be the first to know  
about upcoming  
events.

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### Become a Member

[Click here to join.](#)

### Take Action

Find out what you can

## SPECIAL REPORT: The Environmental Connection to Public Health Protection

In this special report, The Environmental Connection to Public Health Protection, we examine such topics as the rising rates of asthma, lung cancer, obesity and other chronic diseases in South Carolina, the issue of uncontrolled port pollution, the dangers of coal fired power plants, the links between urban sprawl and obesity, and most importantly, what we can do to ensure a healthy South Carolina now and in the future. [Click here to read the report.](#)

### HOT TOPICS

The Charleston Post & Courier is doing a special series on mercury pollution in South Carolina.

[Click here to read the articles](#)

CCL Director Dana



D, MPH

# Contaminated Flood Waters: Human Health Impact

- Surface waters, wells, other drinking water supplies
- Injuries (electrical, mechanical, other)
- Illnesses (infectious diseases)
  - Diarrheal Illnesses (eg, viral, bacterial, parasitic)
  - Other (eg, hepatitis A, injury-related wound inf's.)
- Chemical contamination, exposures



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[Natural Disasters](#) > [Hurricanes](#) > [Recovery](#) >

## Prevent Illness and Injuries After a Hurricane or Flood



### Prevent Illness From Food and Water

Special precautions for food and water are important after a storm.



### Prevent Other Illnesses and Injuries

Carbon monoxide poisoning, mold, and other hazards can be avoided by taking the proper steps.



### Stay Safe in the Heat

Changes in your fluid intake, activities, and clothing can help you remain safe.

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Content Source: [National Center for Environmental Health \(NCEH\)](#)





# Useful Links for Flood Preparedness and Response¶ (Floods, Potable Water, and Preventing Waterborne Disease)¶

¶  
¶  
¶

[www.bt.cdc.gov/disasters/floods](http://www.bt.cdc.gov/disasters/floods)

## Topics:¶

- I. → General Flood Preparedness and Response¶
- II. → Preparation Before the Flooding Occurs¶
- III. → Water Storage- Bottled Water and Home Containers¶
- IV. → Drinking Water after a Disaster / Emergency Disinfection of Drinking Water¶
- V. → Drinking Water Advisories¶
- VI. → Inspecting and Disinfecting Wells¶
- VII. → Sewage and Septic Tanks¶
- VIII. → After the Flood - Cleanup after the Flood¶
- IX. → Hand-washing, Sanitation, and Hygiene¶
- X. → Hauled Water or Bulk Water Delivery¶
- XI. → Water-related Diseases and Illnesses¶
- XII. → Education Materials: Posters and Flyers¶
- XIII. → Additional Resources¶

¶  
¶

## I. General Flood Preparedness and Response¶

- → CDC - [Floods](#)¶  
Guidance for protecting personal health and safety during and in the aftermath of a flood.¶  
→ (<http://www.bt.cdc.gov/disasters/floods/>)¶
- ¶
- → CDC - [Key Facts about Hurricane and Flood Recovery](#)¶  
→ Information about preventing illness from food and water, and preventing other types of illnesses and injuries during a flood¶  
→ (<http://emergency.cdc.gov/disasters/hurricanes/recovery.asp>)¶
- ¶
- → FoodSafety.gov - [Consumer Advice: Disaster Assistance](#)¶  
A gateway to federal, state, and local government websites that address food and water safety during disasters.



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### DISASTER RECOVERY FACT SHEET

## *Vibrio vulnificus* After a Disaster

### What is *Vibrio vulnificus*?

*Vibrio vulnificus* is a bacterium that is a rare cause of illness in the United States. The illness is very different from cholera, which is caused by different bacteria, called *Vibrio cholerae*. *V. vulnificus* infections do not spread directly from one person to another and are a serious health threat predominantly to persons with underlying illness, such as liver disease, or a compromised immune system. The organism is a natural inhabitant of warm coastal waters. Infection can occur after a wound is exposed to warm coastal waters where the *V. vulnificus* organism is growing. Infection may also be acquired by eating raw or undercooked seafood from those waters.

CDC receives reports of over 400 *Vibrio* illnesses each year. Of those, about 90 per year are due to *V. vulnificus*. Most *V. vulnificus* illness occurs during warm-weather months.

### Symptoms of infection with *V. vulnificus*

- Acute illness, with a rapid decline in health following exposure
- If exposed by contamination of an open wound, increasing swelling, redness, and pain at the site of the wound
- Illness typically begins within 1-3 days of exposure, but begins as late as 7 days after exposure for a small percentage of cases

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(165 Kb/3 pages)

## Human Health Impact:

↑ Drought: 2007-08 Ongoing in US West & SE, spreads to Mid-Atlantic



As Lake Lanier dried up, ~4 million persons in Georgia alone struggling with severe water shortage in 2008

SE States' AGs, Governors seeking remedies, federal court relief

# Action Steps: mobilize public

“The voting public will do little until their financial or personal health is adversely impacted.”

**The mind can absorb only  
as much as the fanny can endure.  
Thank you for your interest. Questions?**

*“Those who carry on great public schemes  
must be proof against the most fatiguing  
delays,  
the most mortifying disappointments,  
the most shocking insults,  
and what is worst of all,  
the presumptuous judgments  
of the ignorant.”*

**- Edmund Burke (1729 - 1797)**