Medical Ecology For Physicians


Basic Science
Medical Ecology
Applied Science

Basic Sciences:

Geology

Ecology

Oceanography

Hydrology

Biochemistry and Molecular Biology

Physics

Atmospheric Sciences

Chemistry

Remote Sensing

Applied Sciences:

Biostatistics

Medical Sciences

Epidemiology

Anthropology

Agronomy

Environmental Health Sciences

Socio-Medical Sciences

Toxicology

Medical Geography

PLoS BIOLOGY

Beyond the Fire-Hazard Mentality of Medicine: The Ecology of Infectious Diseases

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http://biology.plosjournals.org/plosonline/?request=get-document&doi=10.1371/journal.pbio.0000022

Environment and Infectious Diseases

SARS

West Nile Virus

Cholera

SARS

8,500 cases in 2003

Mortality rate: 15%

Route of transmission: unknown
(possibly fecal-oral; probably not droplet)

Source of original outbreak: **unknown**

SARS in Health Care Workers

Table 1. Description of healthcare workers in whom severe acute respiratory syndrome developed

Patients	Occupation	Duration of exposure to index patient	Precautions	Special considerations
Patient 1	Registered nurse	22 h	Gown, gloves, surgical mask[b]	• Present during intubation of airway • Performed all primary nursing activities on 2 shifts
Patient 2	ICU resident	31–60 min	N-95 mask, gown, gloves	• Performed difficult intubation of airway
Patient 3	Registered nurse	None	Not applicable	• Assigned to patient 3 rooms down hall from index patient
Patient 4	Registered nurse	31–60 min	Gown, gloves, surgical mask	• Assisted primary nurse with bathing of index patient
Patient 5	Anesthetist	11–30 min	Gown, gloves, surgical mask	• Performed difficult intubation of airway
Patient 6	Respiratory therapist	4 h	None	• Instituted NPPV • Inserted arterial line
Patient 7[c]	Respiratory therapist	6 h	Gown, gloves[b]	• Instituted NPPV • Frequently manipulated oxygen mask

[a]ICU, intensive-care unit; NPPV, noninvasive positive-pressure ventilation.
[b]Denotes precautions that were taken by the healthcare worker sometimes but not always during exposure.
[c]Patient 7 has been classified as a suspected case, as she did not have radiographic lung infiltrates.

Length of Time of Exposure to Patients with SARS and Development of SARS in Healthcare workers

Table 3. Development of severe acute respiratory syndrome (SARS) in healthcare workers, depending on time spent in index patient's room (N=31)[a]

Time spent in index patient's room	No. (%) healthcare workers with specified exposure with SARS	No. (%) healthcare workers without specified exposure with SARS	Odds of developing SARS after specified exposure	95% CI for OR	p value
≤10 min	0/11	6/20 (30)	0.097[b]	(0.005 to 1.91)[b]	0.07
≥31 min	5/12 (42)	1/19 (5)	12.9	(1.27 to 131)	0.022
≥4 h	3/4 (75)	3/27 (11)	24.0	(1.85 to 311)	0.016

[a]CI, confidence interval; OR, odds ratio.
[b]These logit estimators use a correction of 0.5 in every cell of the table that contains a zero.

Why the WHO Influenza Surveillance System Missed the SARS outbreak:

Clinical Criteria

Early illness

- Presence of two or more of the following features: fever (might be subjective), chills, rigors, myalgia, headache, diarrhea, sore throat, or rhinorrhea

Mild-to-moderate respiratory illness

- Temperature of >100.4° F (>38° C)* **and**
- One or more clinical findings of lower respiratory illness (e.g., cough, shortness of breath, or difficulty breathing)

Severe respiratory illness

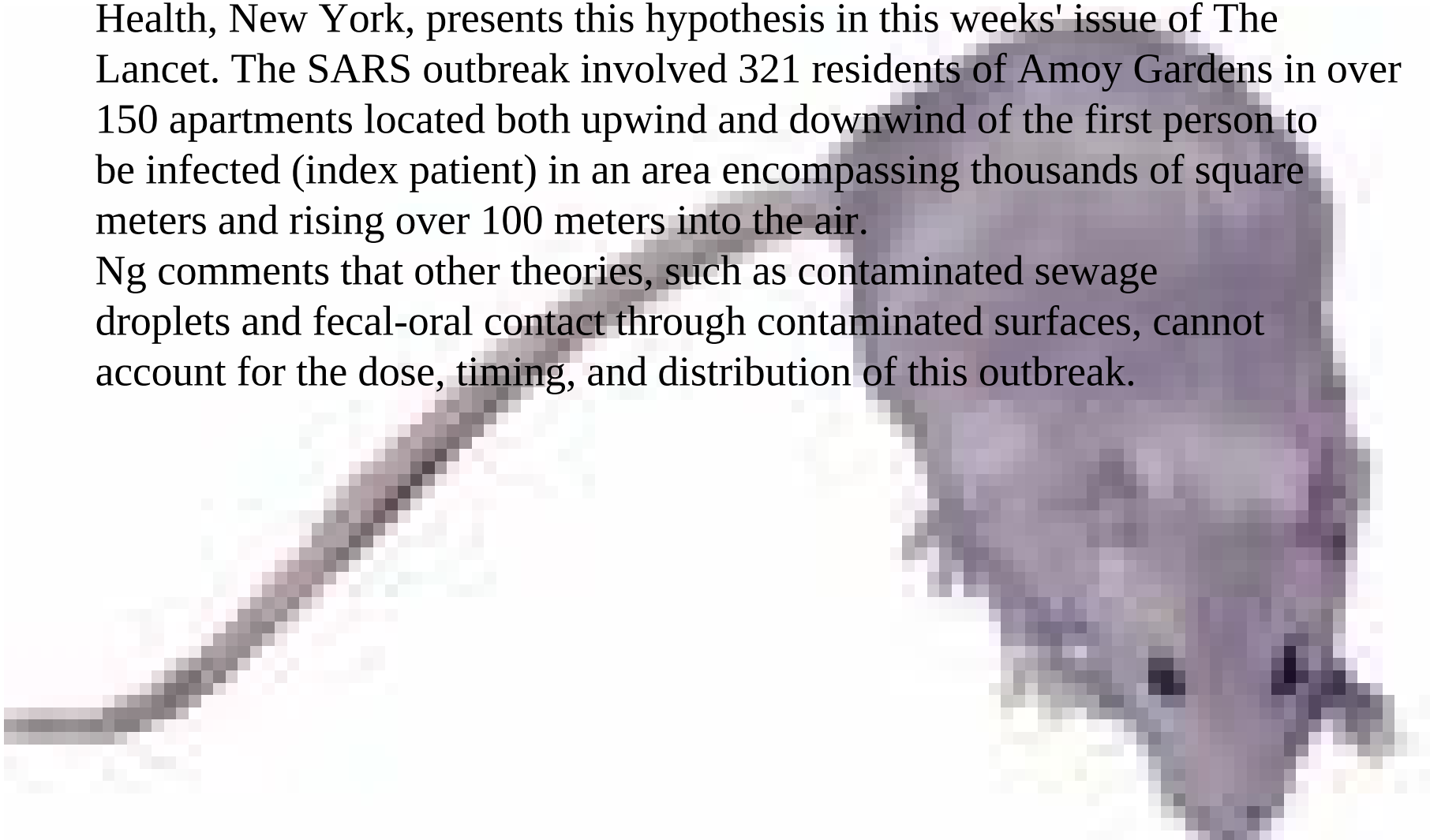
- Meets clinical criteria of mild-to-moderate respiratory illness **and**
- One or more of the following findings:
  - Radiographic evidence of pneumonia, **or**
  - Acute respiratory distress syndrome, **or**
  - Autopsy findings consistent with pneumonia or acute respiratory distress syndrome without an identifiable cause

China to Kill 10,000 Civet Cats in Effort to Eradicate SARS

Rat May Be Source of Vector in SARS Outbreak

Dr. Stephen K. C. Ng, of Columbia University School of Public Health, New York, presents this hypothesis in this weeks' issue of The Lancet. The SARS outbreak involved 321 residents of Amoy Gardens in over 150 apartments located both upwind and downwind of the first person to be infected (index patient) in an area encompassing thousands of square meters and rising over 100 meters into the air.

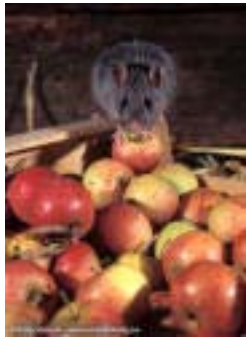
Ng comments that other theories, such as contaminated sewage droplets and fecal-oral contact through contaminated surfaces, cannot account for the dose, timing, and distribution of this outbreak.



A Change In WHO Surveillance Strategy

"We must remain vigilant," said Henk Bekedam,
the senior World Health Organization official in China.
"We cannot know for certain whether SARS will return again."

That may depend in part on the roof rats of Hong Kong.



This Just In:

China: Urban Rats Test Positive for SARS in Guangzhou

Urban rats may prove to be the source of infection for the new SARS case reported in December 2003 from Guangzhou, capital of Guangdong Province. The China Daily reports that laboratory tests have determined that rats caught in the SARS victim's apartment were carrying the SARS virus. Local media in Guangzhou had reported the patient had been trapping rats that had invaded his apartment before he showed any SARS symptoms; the patient had said that he had no known contact with the civet cat species identified publicly by the Chinese government as the probable source or reservoir for the disease.

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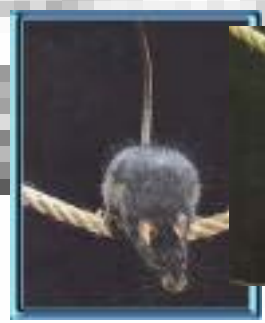
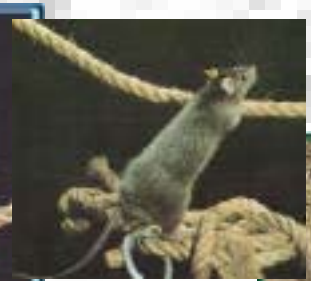
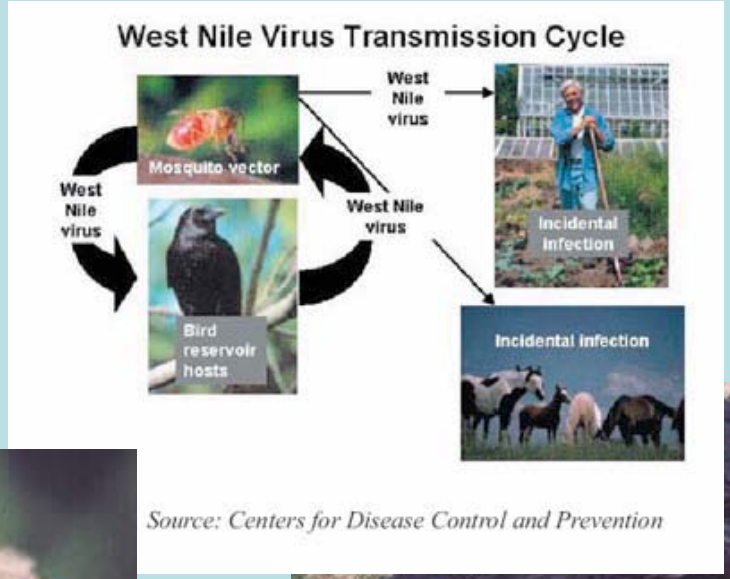
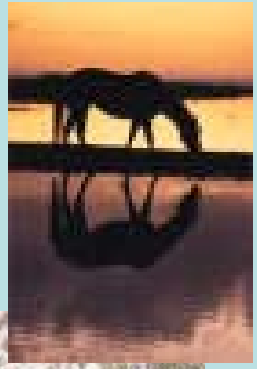




West Nile Virus



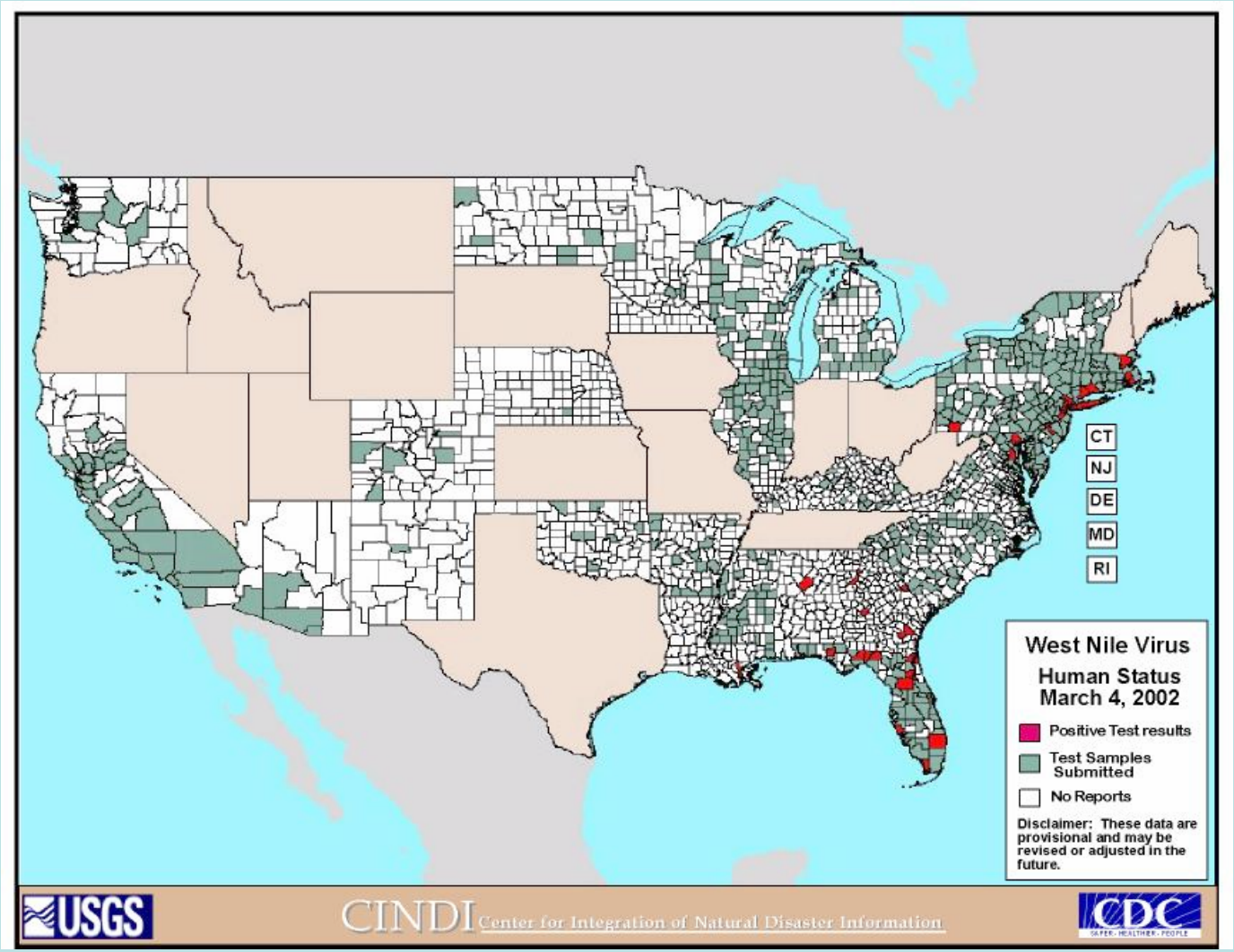


Culex pipiens

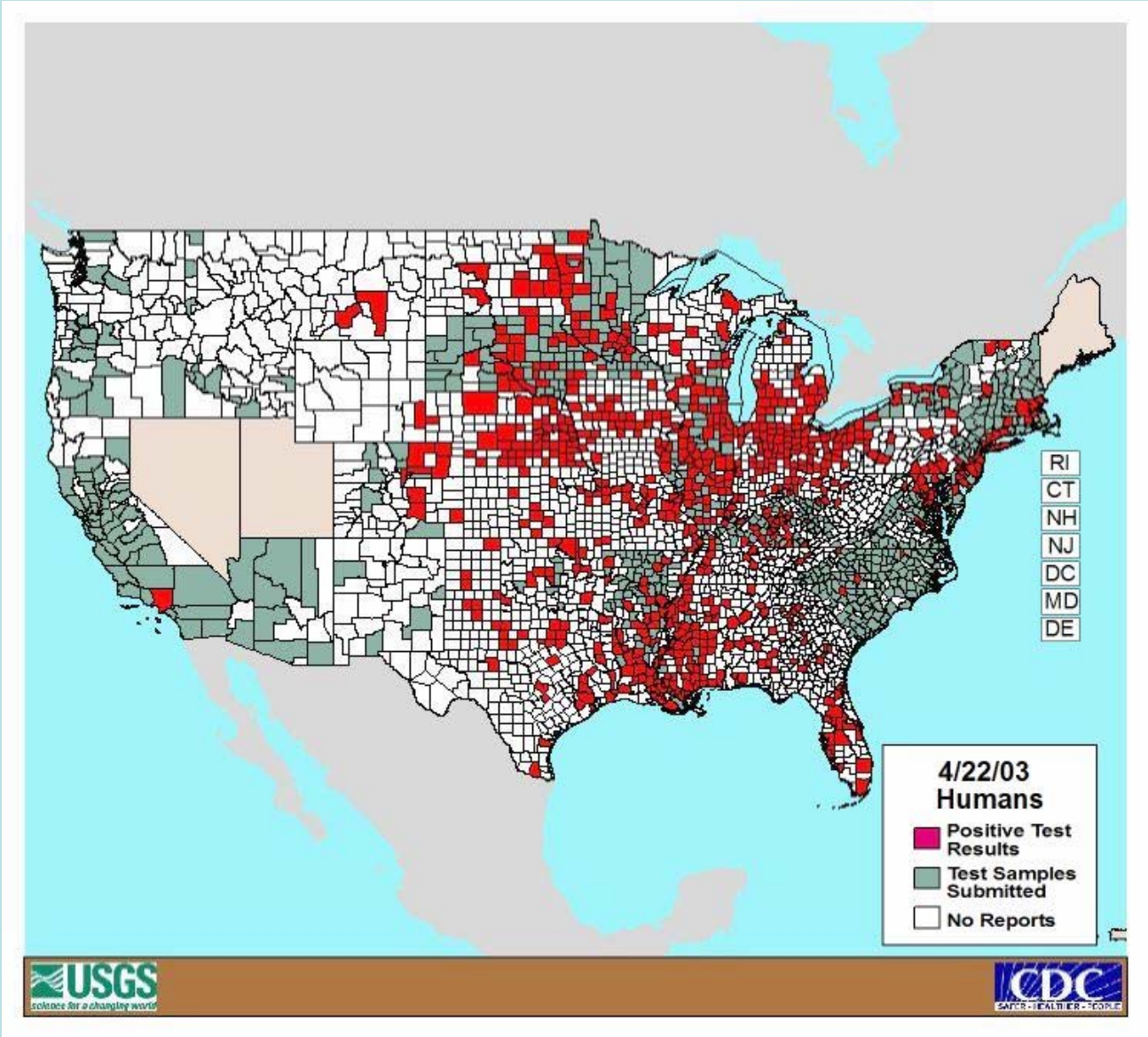
WNV

"You know, it wouldn't kill ya to go outside and get some exercise."

WNV 2001


CT
NJ
DE
MD
RI
West Nile Virus
Human Status
March 4, 2002
Positive Test results
Test Samples Submitted
No Reports
Disclaimer: These data are provisional and may be revised or adjusted in the future.
USGS
CINDI Center for Integration of Natural Disaster Information
CDC

WNV 2002


RI
CT
NH
NJ
DC
MD
DE
4/22/03
Humans
Positive Test Results
Test Samples Submitted
No Reports
USGS
science for a changing world
CDC

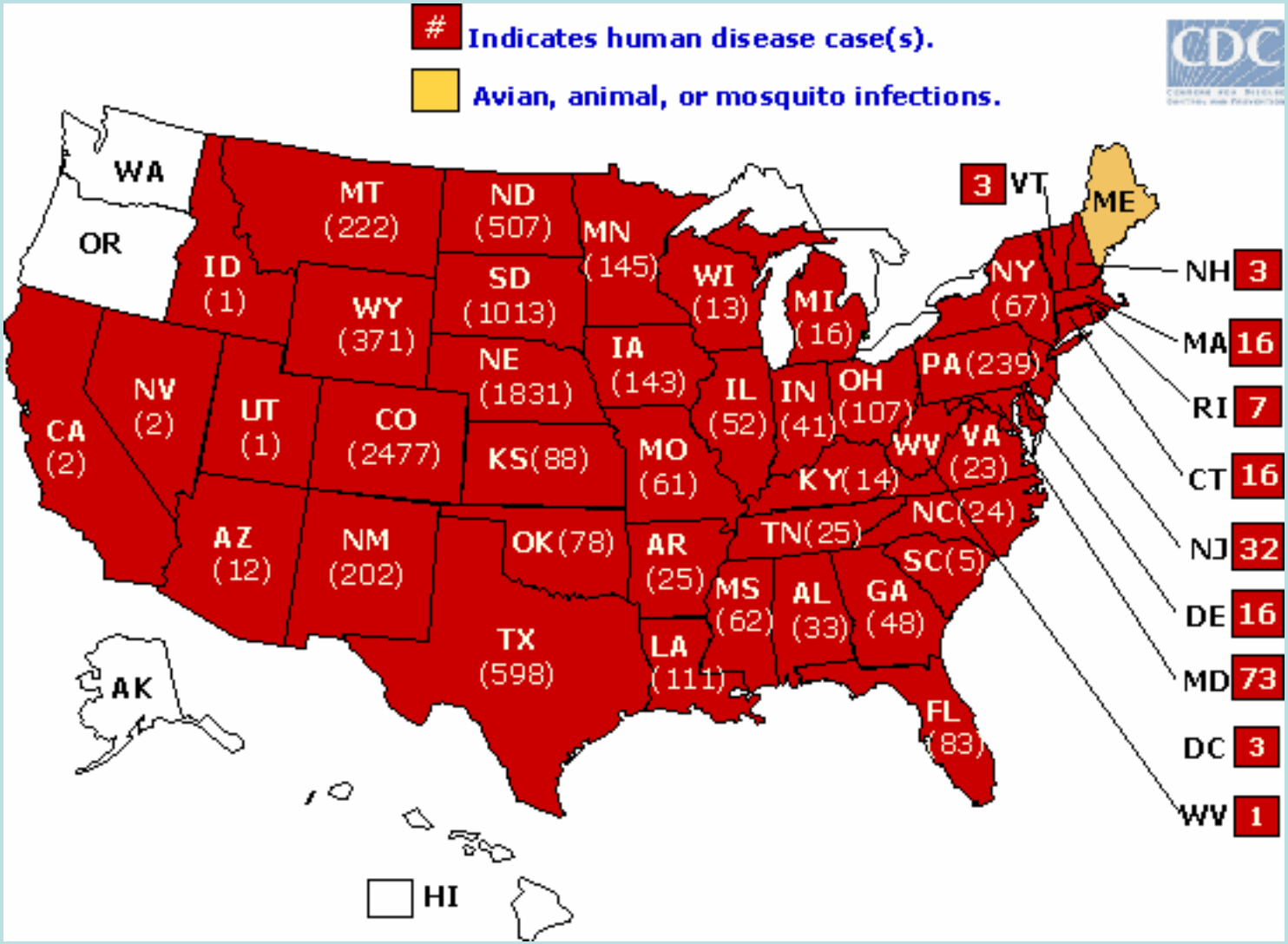
2002

Total Infections: 623,400

Total Cases: 4,156

Total Deaths: 284

WNV 2003


#
Indicates human disease case(s).
Avian, animal, or mosquito infections.
CDC
WA
OR
ID (1)
MT (222)
ND (507)
MN (145)
SD (1013)
WY (371)
NE (1831)
IA (143)
WI (13)
MI (16)
NY (67)
VT 3
ME
NH 3
MA 16
RI 7
CT 16
NJ 32
DE 16
MD 73
DC 3
WV 1
PA (239)
OH (107)
IN (41)
IL (52)
MO (61)
KS (88)
CO (2477)
UT (1)
NV (2)
CA (2)
AZ (12)
NM (202)
OK (78)
AR (25)
TX (598)
LA (111)
MS (62)
AL (33)
GA (48)
FL (83)
SC (5)
NC (24)
VA (23)
TN (25)
KY (14)
AK
HI

2003

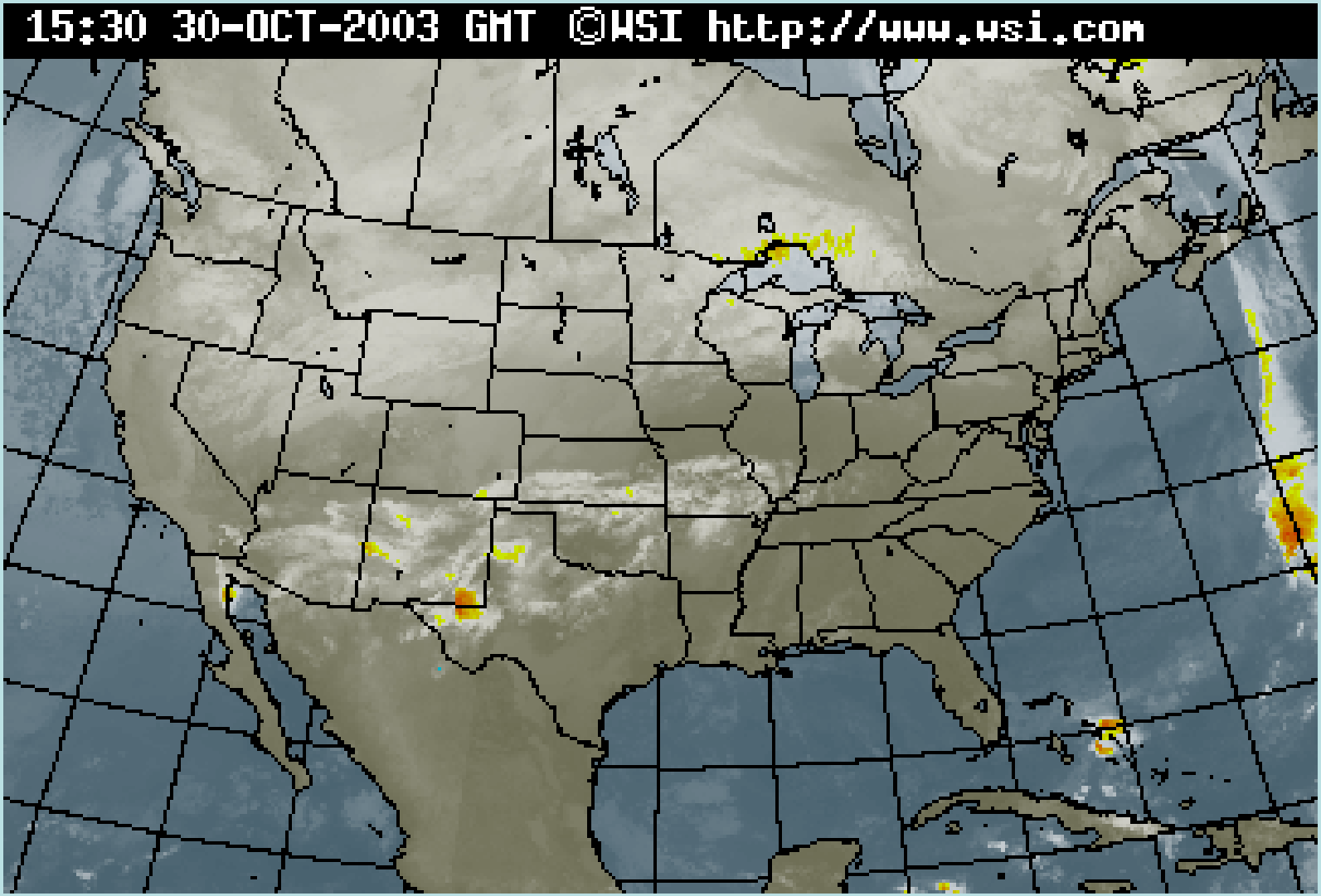
Total Infections: 1, 678,600

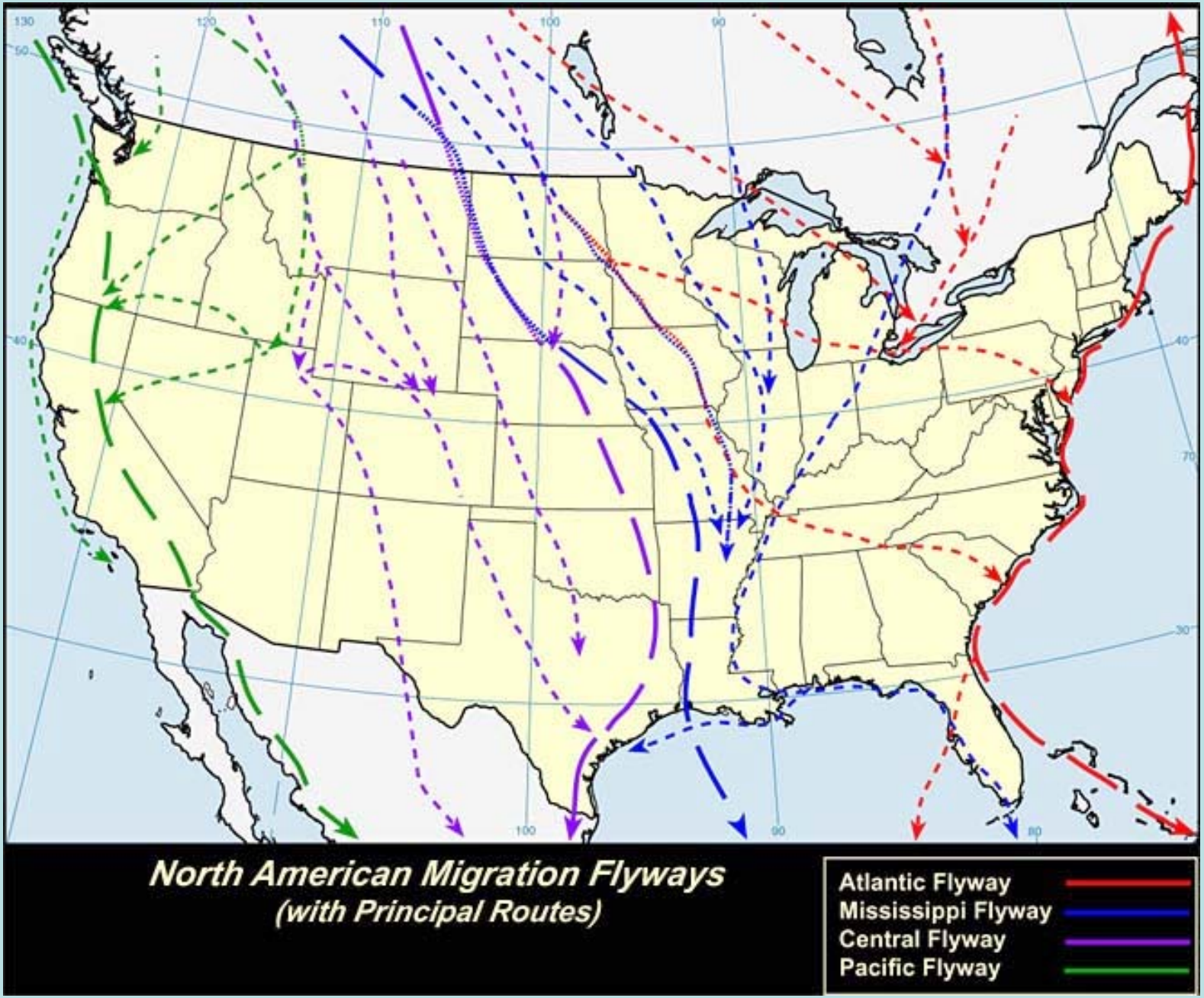
Total Cases: 8,393

Total Deaths: 184

Why The Rapid Spread West?

Prevailing Winds Are From West To East




North American Migration Flyways
(with Principal Routes)
Atlantic Flyway
Mississippi Flyway
Central Flyway
Pacific Flyway

All Major US Highways Run East-West And North South

Ecology of West Nile Virus

Epidemics Begin During:

Chronic Drought

High Summer Temperatures

Epidemics Spread 1-2 Weeks After The Drought Is Broken

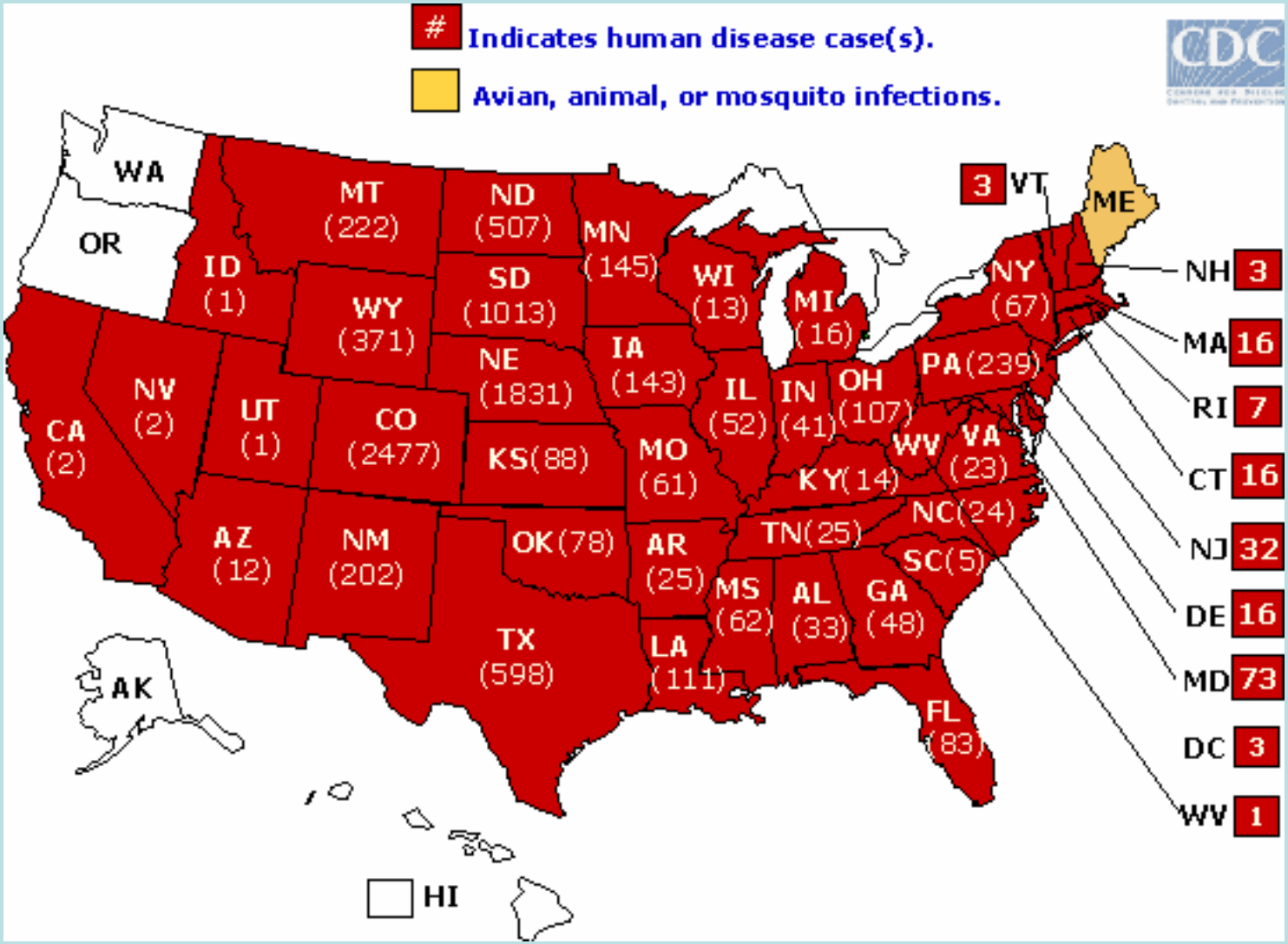
The Epidemic Is Over Within 3-5 Weeks After The Drought Is Broken

Countries In Which West Nile Is Endemic*:

Israel
Southern Egypt
South Africa

* All have major deserts

WNV 2003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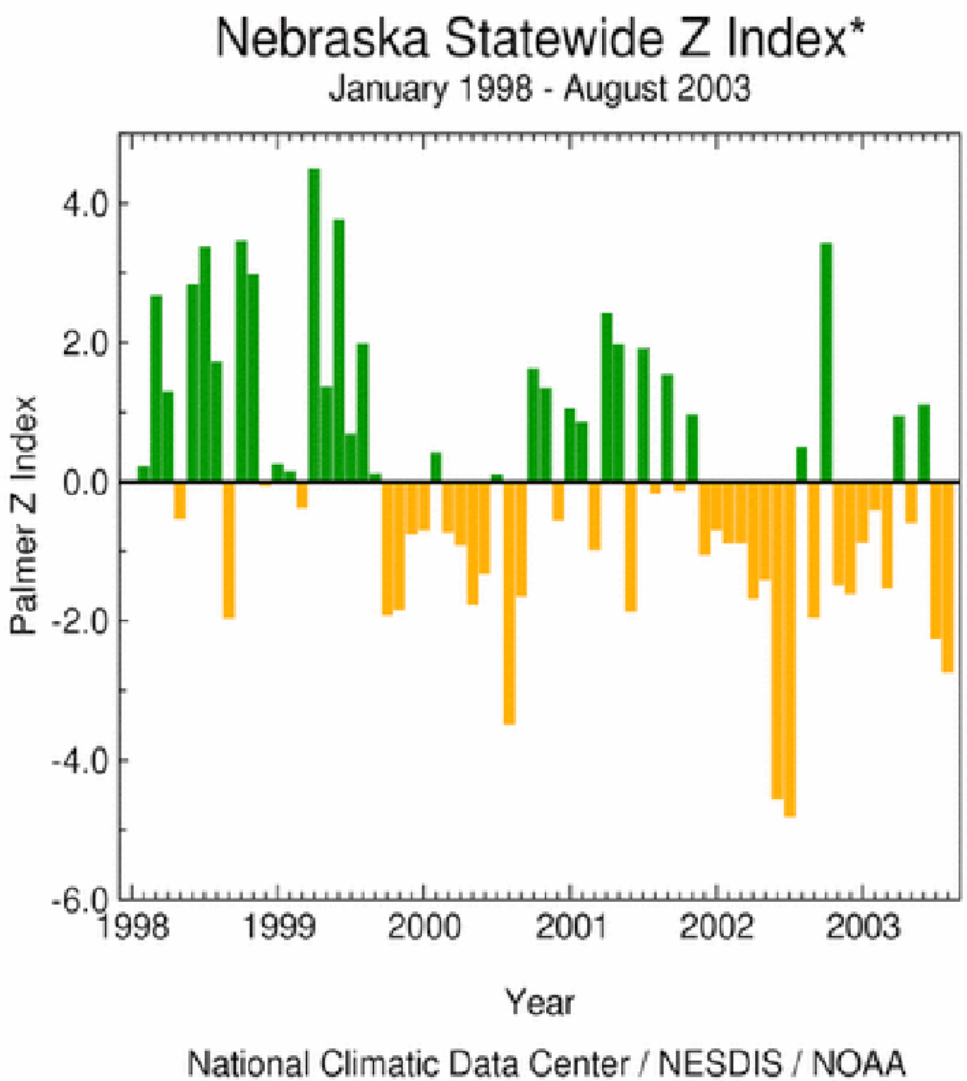
LA (111)
MS (62)
AL (33)
GA (48)
FL (83)
SC (5)
NC (24)
VA (23)
TN (25)
KY (14)
AK
HI

Nebraska - 1831 cases

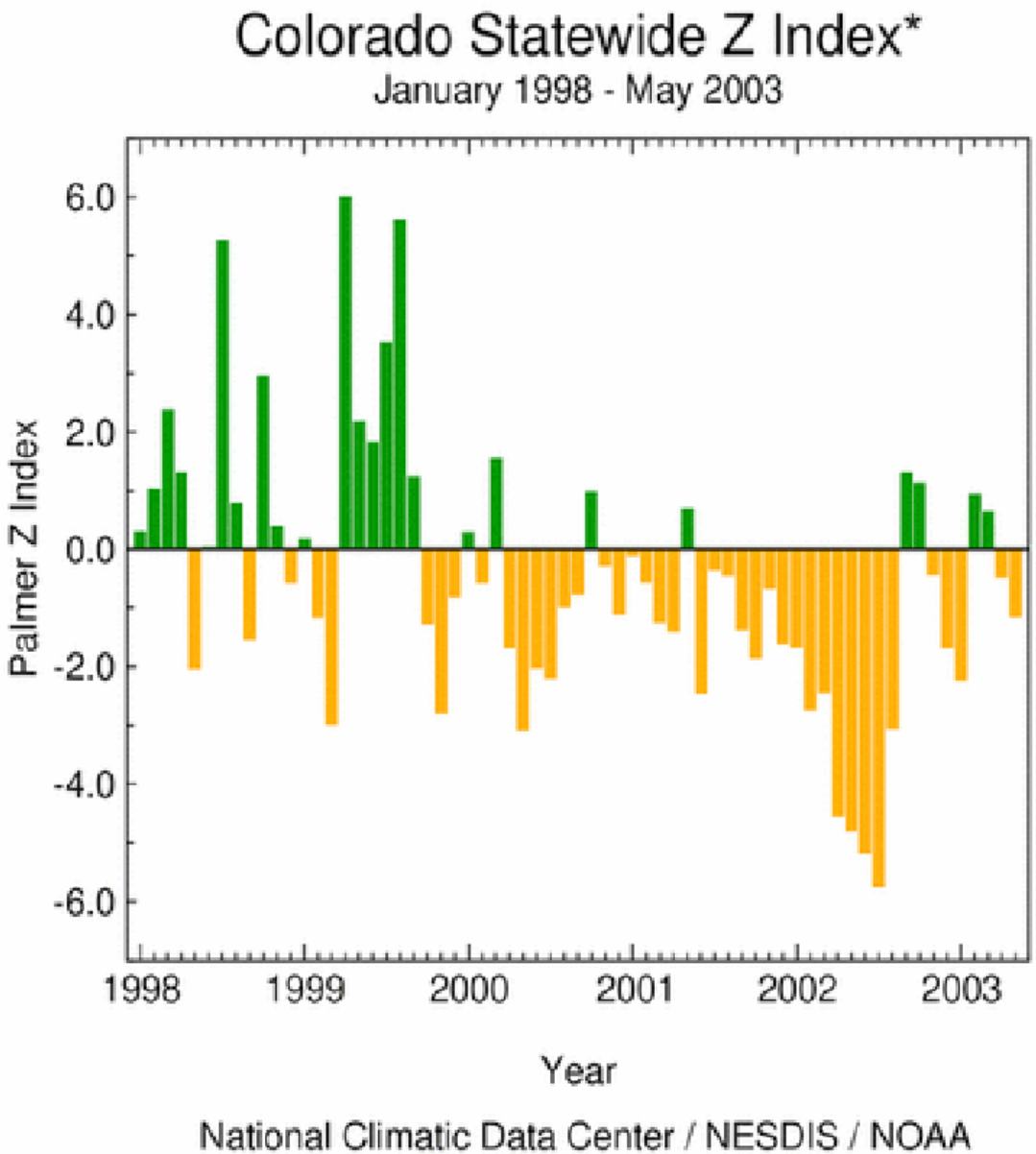
Colorado - 2477 cases

South Dakota - 1013 cases



*Palmer Z Index
Short-Term Drought

Dry Spell
Wet Spell

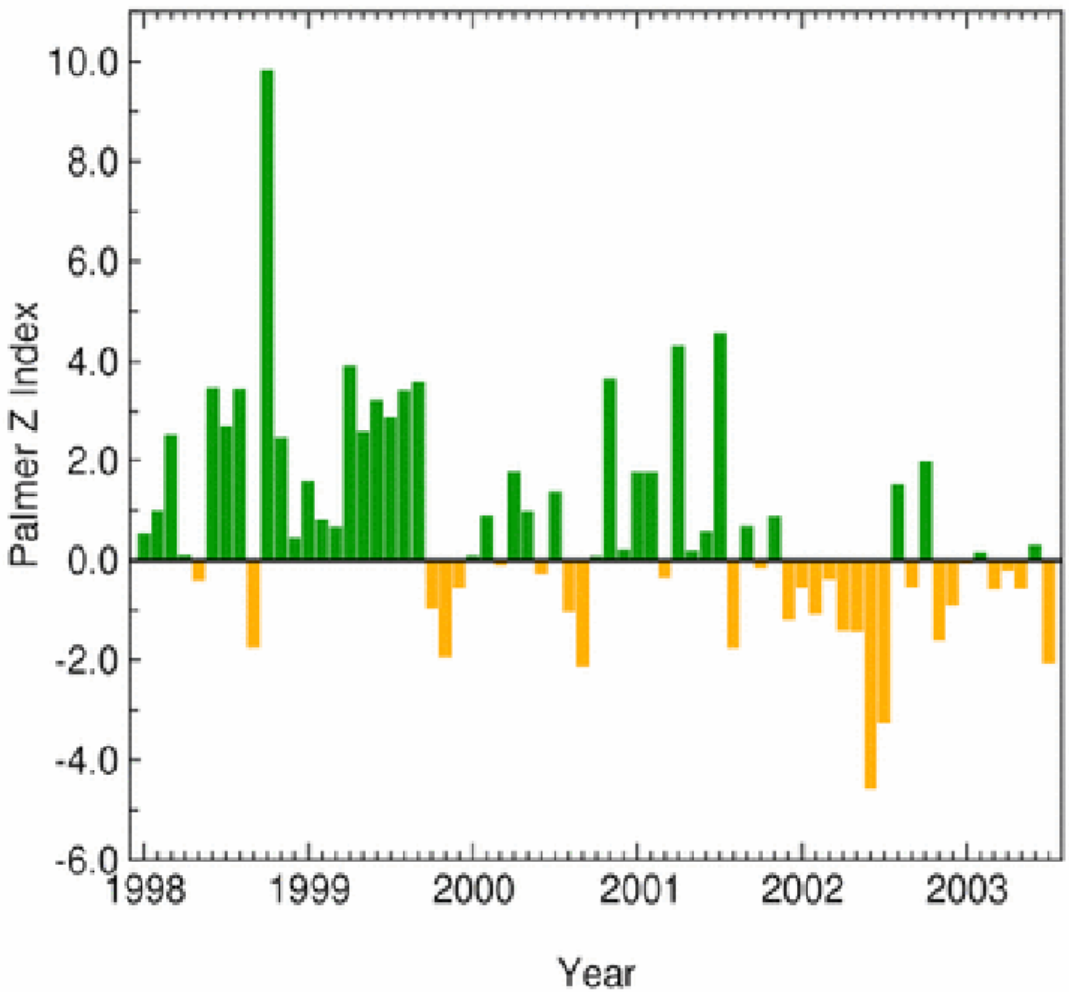


*Palmer Z Index
Short-Term Drought

Dry Spell
Wet Spell

South Dakota Statewide Z Index*

January 1998 - July 2003

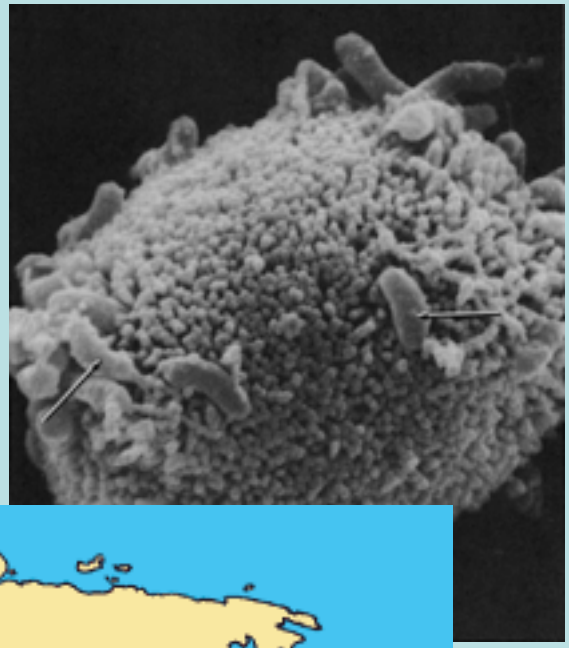


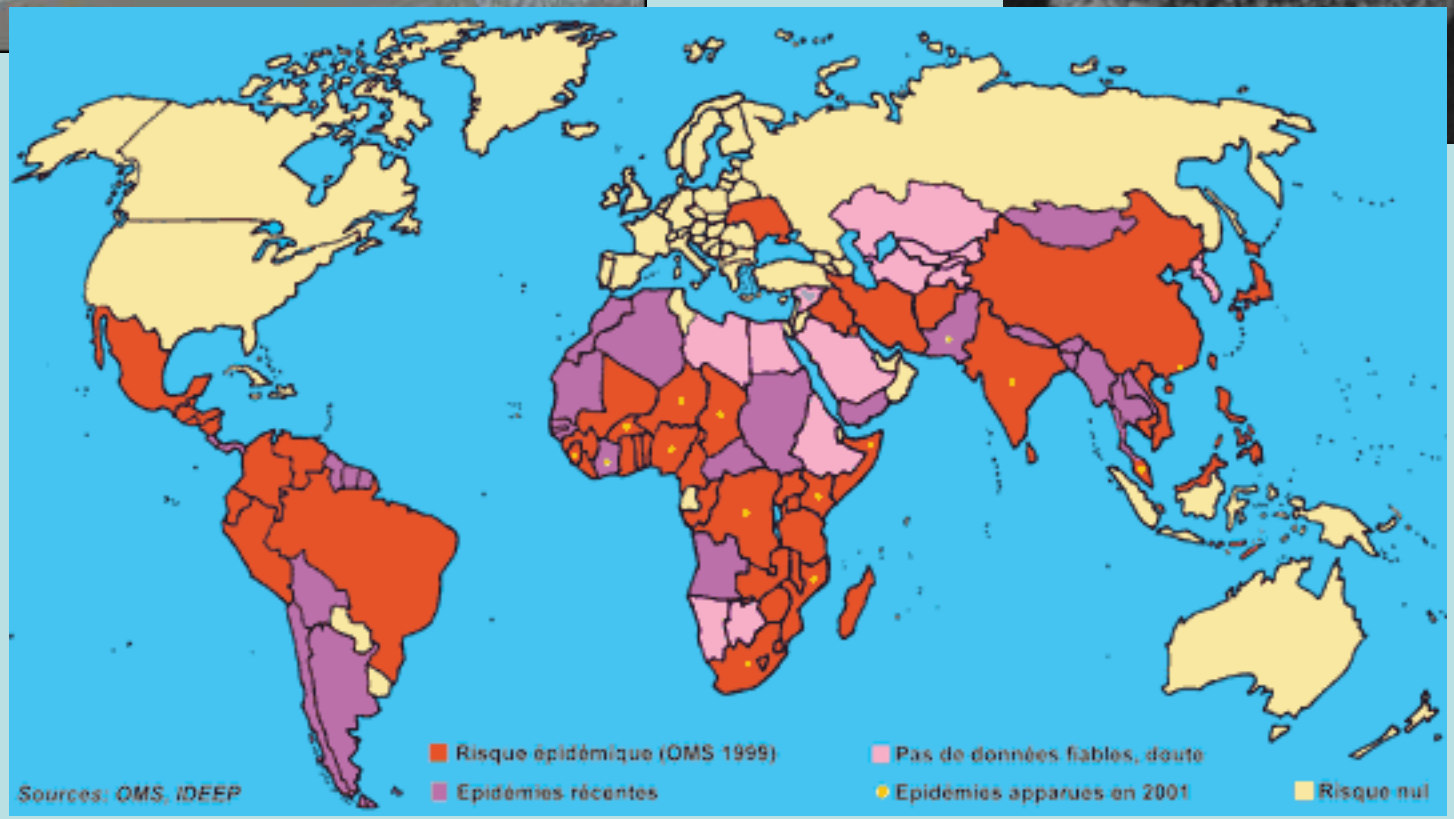
*Palmer Z Index
Short-Term Drought

Dry Spell
Wet Spell

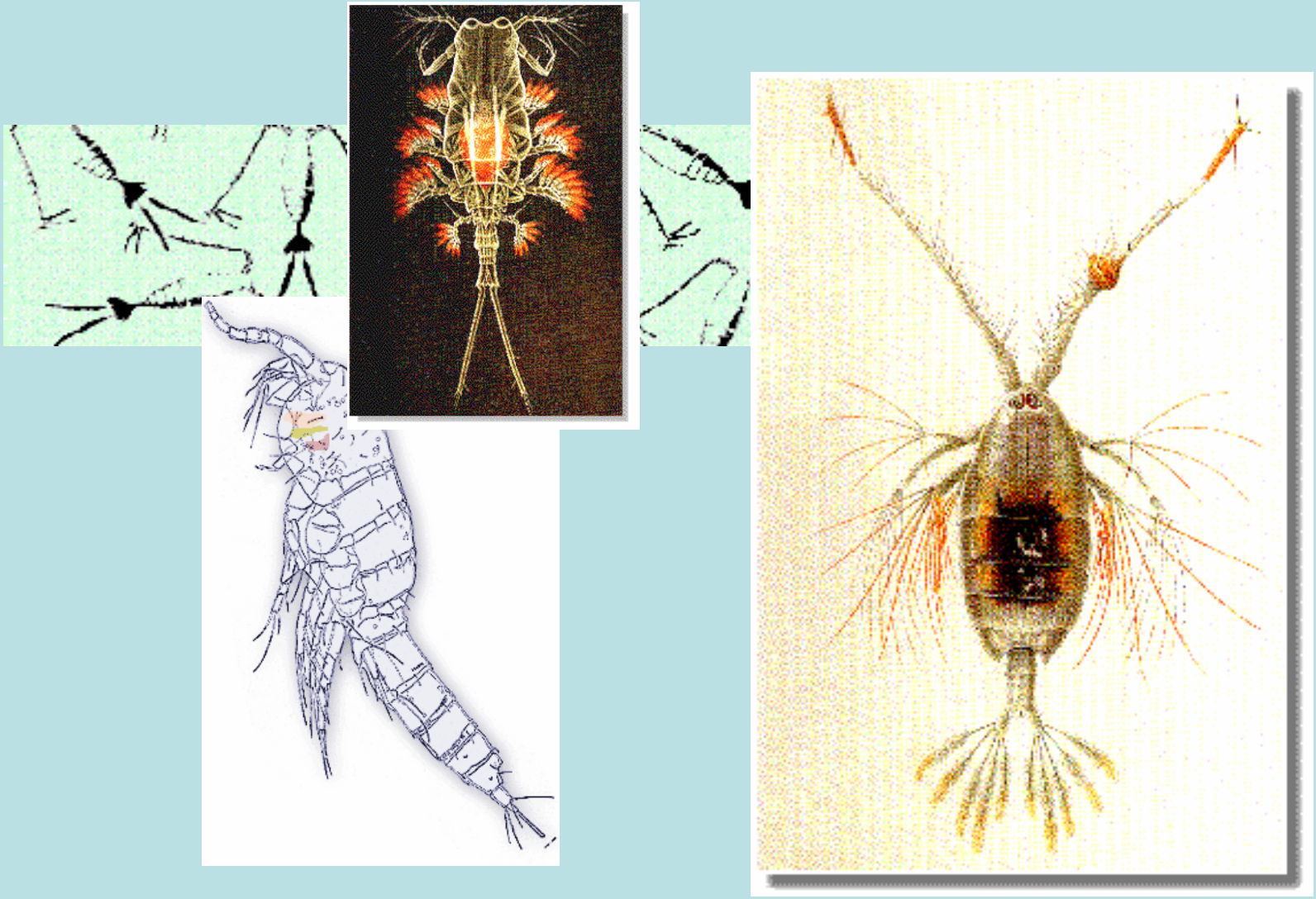
National Climatic Data Center / NESDIS / NOAA

Cholera




Risque épidémique (OMS 1999)
Epidémies récentes
Pas de données fiables, doute
Epidémies apparues en 2001
Risque nul
Sources: OMS, IDEEP

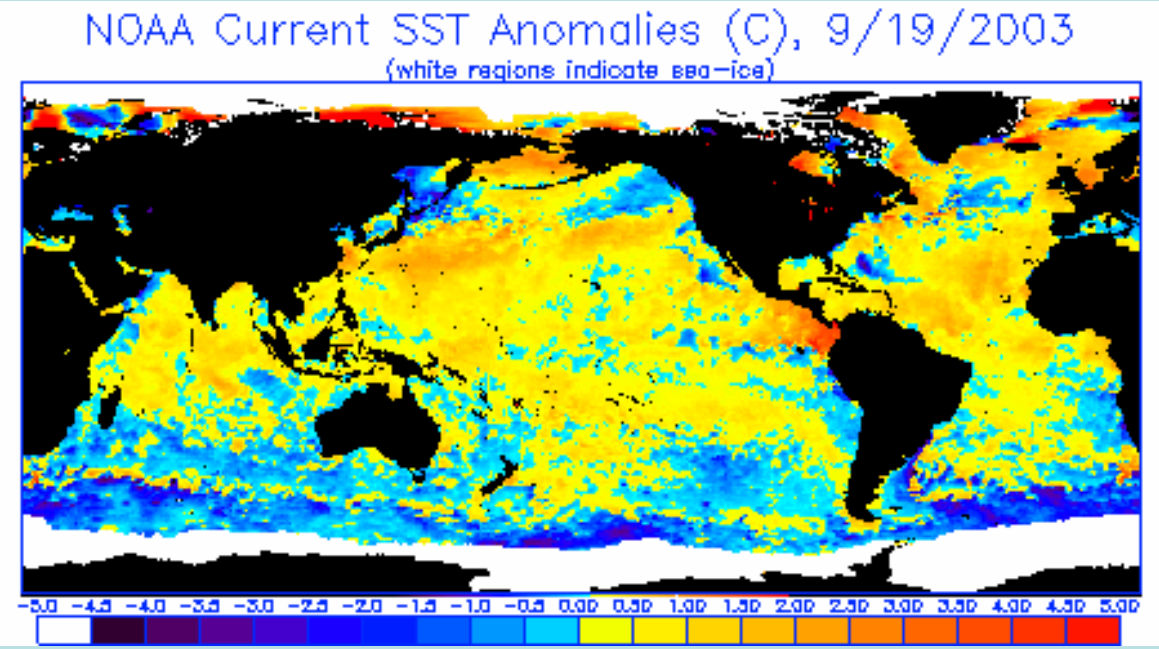
V. cholerae is often found attached to the planktonic organisms



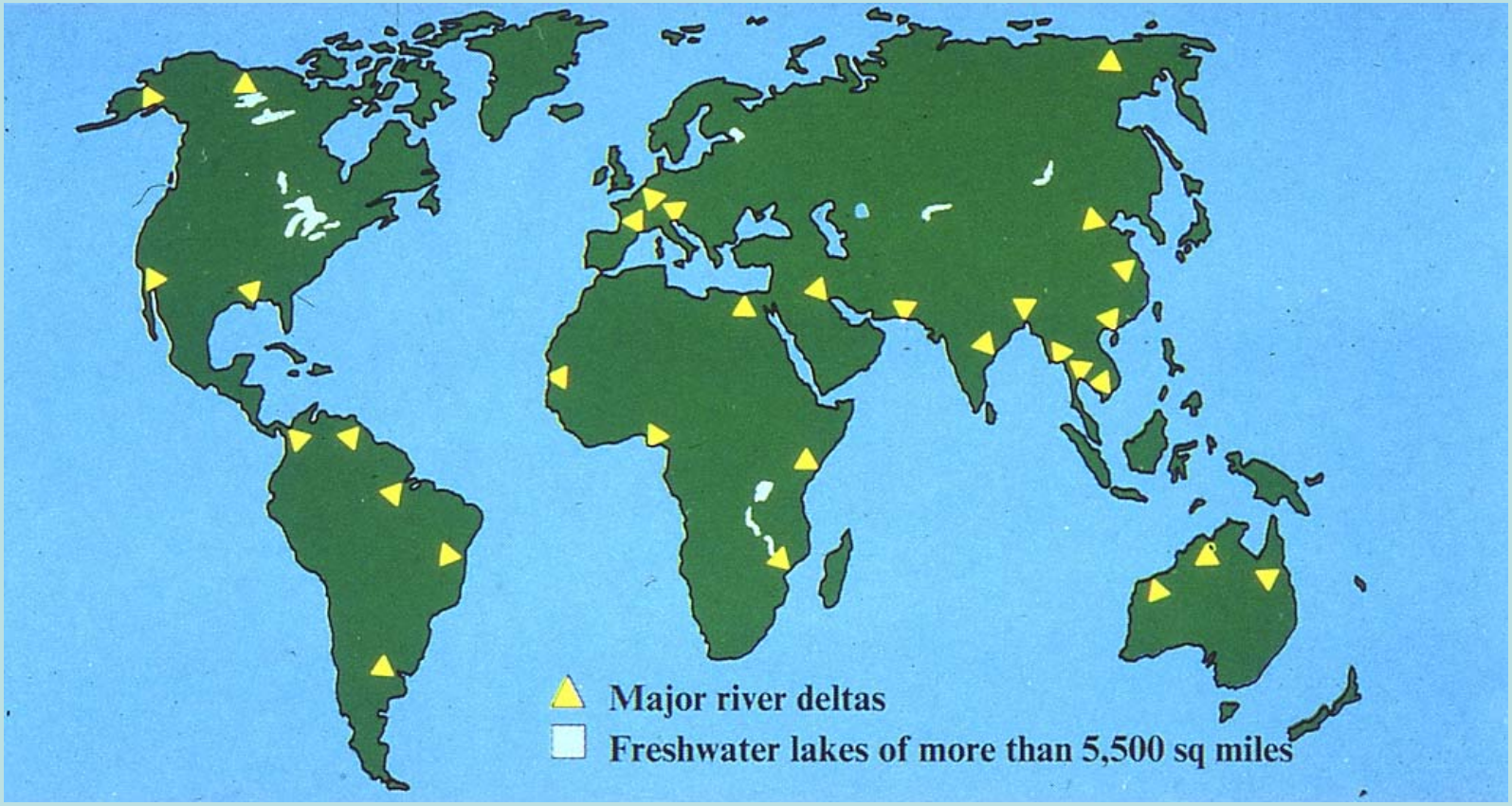
February 3, 2000

El Niño Increases Diarrheal Disease Incidence by 200 Percent

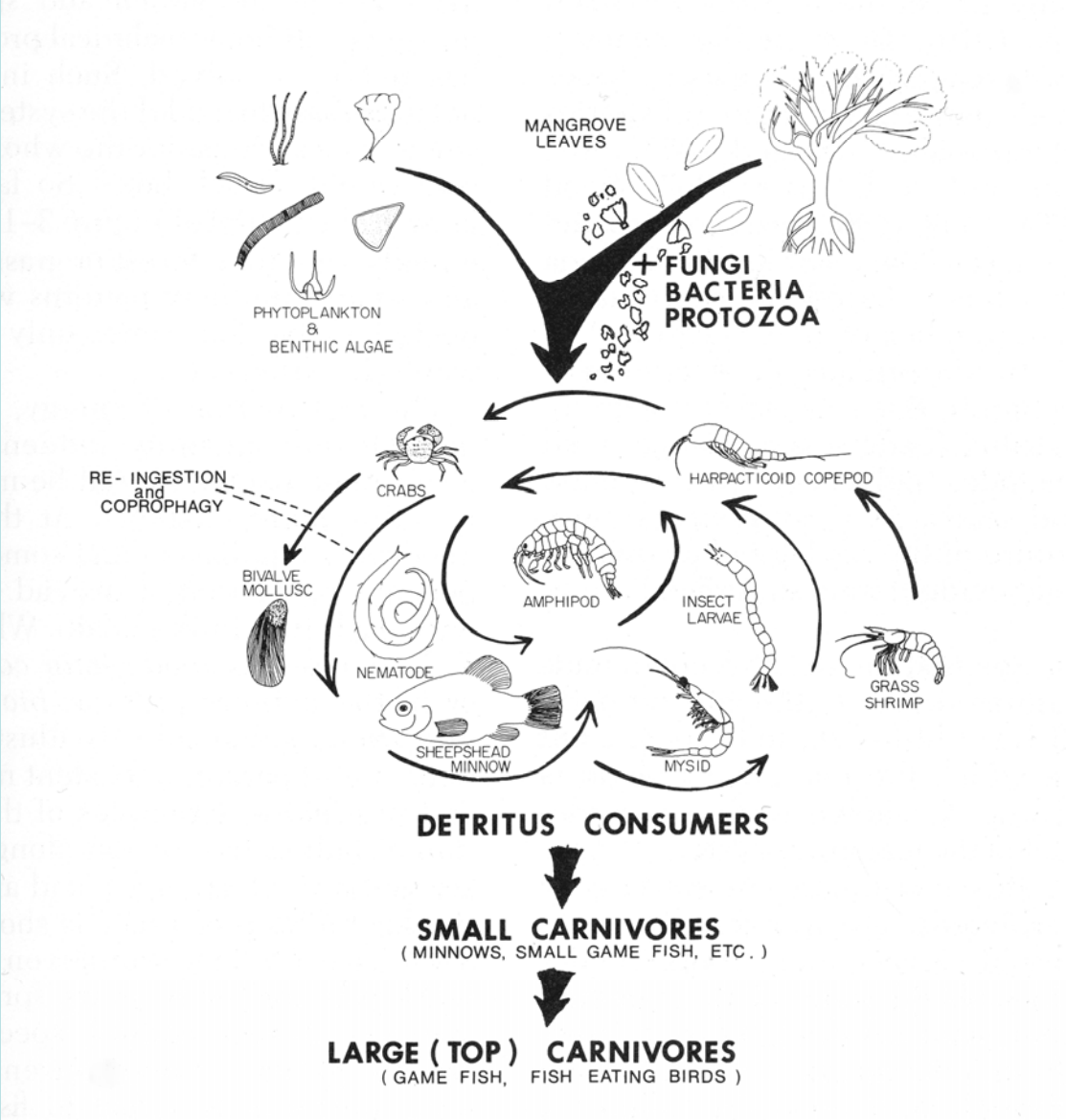
The El Niño phenomenon--the warming of the equatorial Pacific ocean that occurs every two to seven years--has been linked to outbreaks of dengue, malaria, and cholera. Now, researchers from the Johns Hopkins School of Public Health, A.B. Prisma, and the Instituto Nacional de Salud in Lima, Peru, have found that the 1997-1998 El Niño season increased hospitalizations for diarrheal disease by 200 percent, according to a study published in the February 5th issue of *The Lancet*. The results are cause for concern, said the researchers, since diarrhea already causes one billion episodes and three million deaths annually in children under five worldwide.



Distribution Of Estuaries



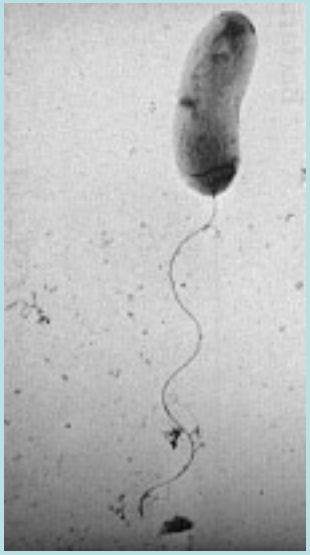
Trophic Relationships Of The Mangrove Estuary



From: E. Odum *Fundamentals Of Ecology*

New Cholera Outbreaks Frequently Occur In Communities Adjacent To Estuaries.

WHY?



*Because **Vibrio cholerae** and its relatives are marine microbes, fully integrated into their respective food webs.*

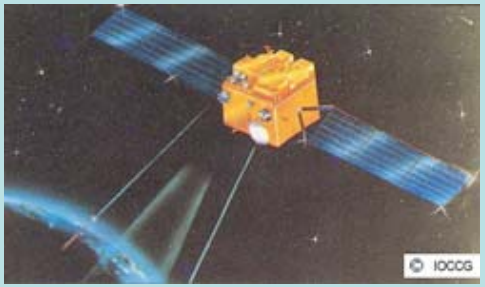
Environmental Conditions Favoring Growth Of Vibrio:

1. *Low salt*
2. *High Nutrient Load*
3. *20°C*
4. *Triggers phytoplankton bloom*
5. *Followed by zooplankton bloom*
6. *Followed by a cholera outbreak*

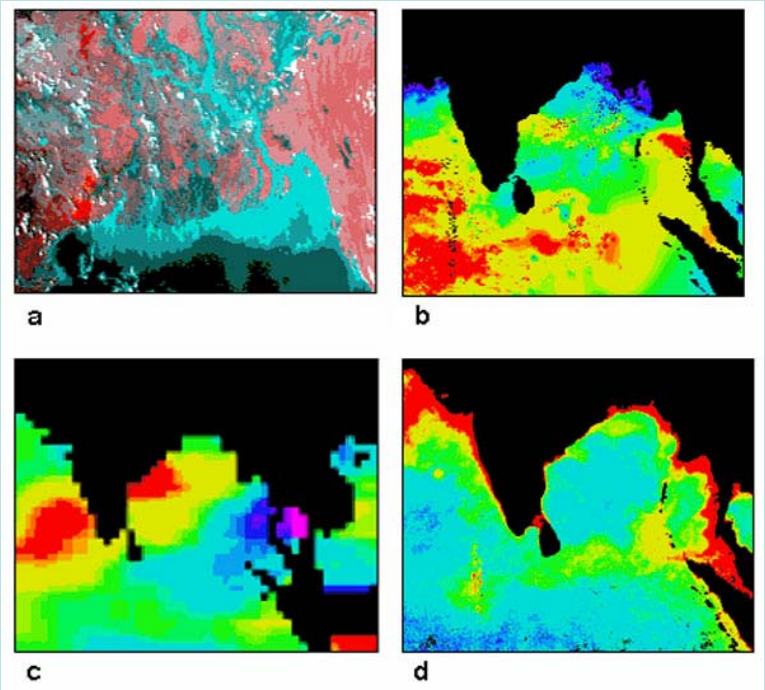
Marine copepod with *Vibrio cholerae attached to egg cases.*

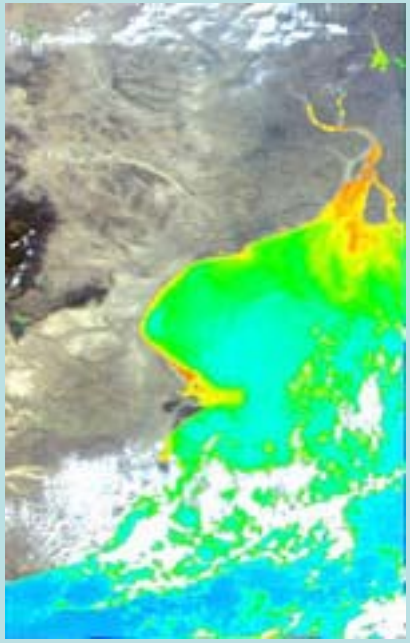
Phytoplankton Bloom

Monsoons



1. lower the salinity of the estuary
2. bring nutrients to the estuary
3. raise the ambient water temperature of the estuary





In the end, understanding the ecology of infectious diseases will allow for the application of long-term control measures.


The End