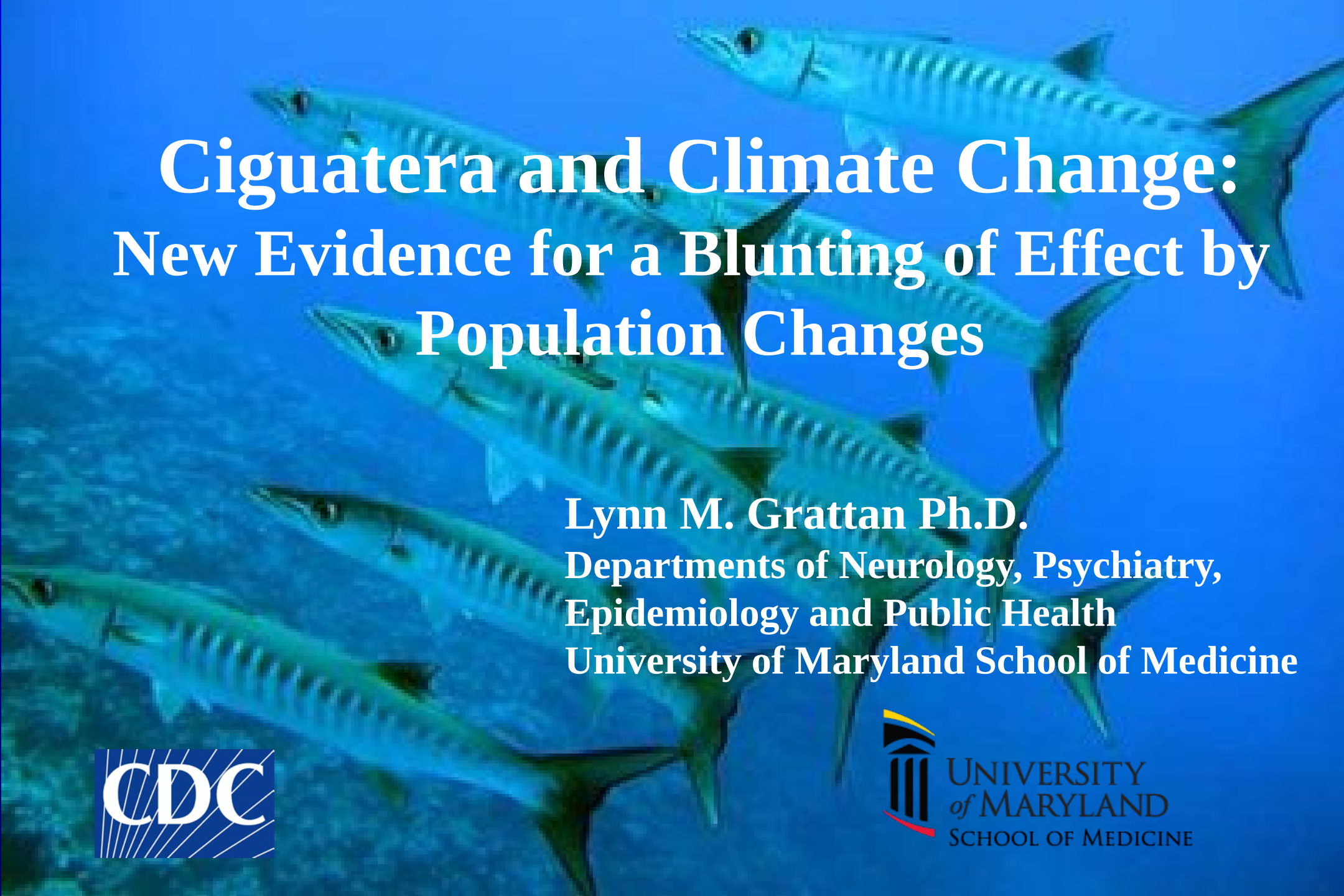


Ciguatera and Climate Change:
New Evidence for a Blunting of Effect by Population Changes

Lynn M. Grattan Ph.D.
Departments of Neurology, Psychiatry, Epidemiology and Public Health
University of Maryland School of Medicine

CDC

UNIVERSITY of MARYLAND SCHOOL OF MEDICINE

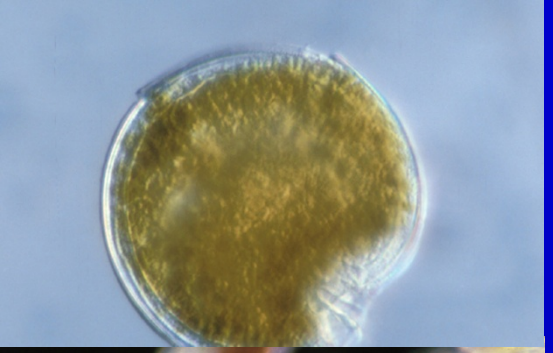
Study Partners

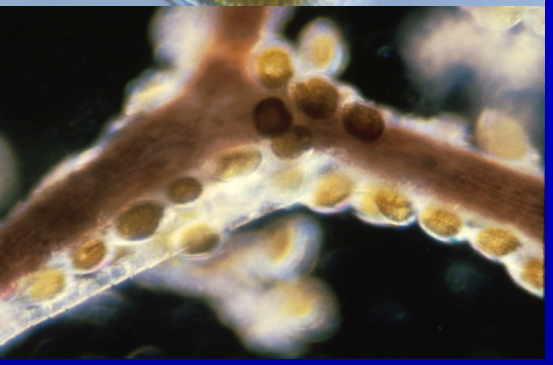
Centers for Disease Control and Prevention {U01} :
Impact of climate on dinoflagellates and ciguatera fish poisoning

- Emerging Pathogens Institute,
- J. Glenn Morris
  - Elizabeth Radke
- Woods Hole Oceanographic Institution
  - Don Anderson
  - Mindy Richlen
  - Katie Pitz
- University of the Virgin Islands
  - Tyler Smith
- University of Maryland School of Medicine
  - Lynn Grattan
  - Sparkle Roberts
- UFL Center for Ocean-Atmospheric Prediction Studies, Florida State University
  - Vasu Misra
- Gulf Coast Seafood Laboratory, Food and Drug Administration
  - Alison Robertson
  - Robert Dickey
  - Steven Plakas
- St. Thomas Fishermen's Association
  - David Olsen
- On island Study Coordinator
  - Margaret Abbott

Ciguatera

- Results from eating tropical reef fish that carry “ciguatoxin”
- Causes clinical syndrome marked initially by GI symptoms, followed by neurologic and cardiac symptoms





gambiertoxins
(precursor compounds)

herbivorous fish

carnivorous fish

Ciguatoxins, human illness

- **Most frequently reported marine toxin disease in the world, affecting > 50,000 people per year**
- **Major constraint on fisheries in many regions (tourism, recreational economies)**

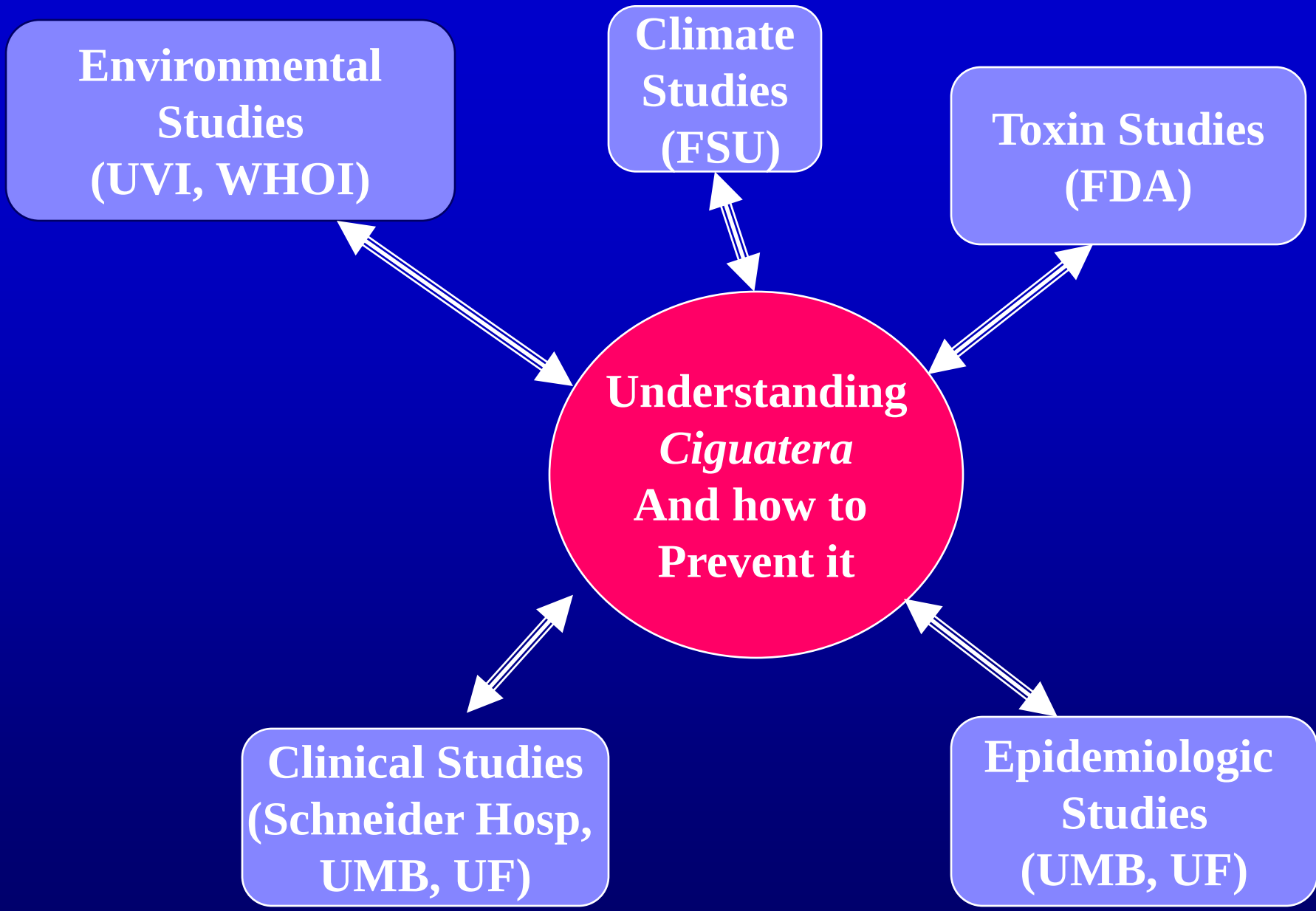
Ciguatera Fish Poisoning - Fish

- **Fish are unaffected by toxin**
- **Fish look and taste normal**
- **Toxin is not affected by cooking**
- **Internal organs more likely to be toxic**
- **Larger fish more likely to be toxic**
  - **St. Thomas study: toxicity increased for larger fish in any given species**
- **May be geographic localization of toxicity**
- ***No good method currently available for identifying toxic fish***

Ciguatera: Incidence

- **U.S. Virgin Islands:**
  7.3 cases/1,000 population/year*
- **Miami:**
  0.05 cases/1,000 population/year
- **South Pacific:**
  0.97-2.19 cases/1,000 population/year
- **Reunion Island:**
  0.08 cases/1,000 population/year

***population-based survey**


Environmental Studies (UVI, WHOI)
Climate Studies (FSU)
Toxin Studies (FDA)
Understanding *Ciguatera* And how to Prevent it
Clinical Studies (Schneider Hosp, UMB, UF)
Epidemiologic Studies (UMB, UF)

Center For Marine and Environmental Studies

Changing Caribbean Climate and Threats to Reefs

OPEN ACCESS Freely available online PLoS one

Caribbean Corals in Crisis: Record Thermal Stress, Bleaching, and Mortality in 2005

C. Mark Eakin[1*], Jessica A. Morgan[2], Scott F. Heron[3,4], Tyler B. Smith[5], Gang Liu[2], Lorenzo Alvarez-Filip[6,7], Bart Baca[8], Erich Bartels[9], Carolina Bastidas[10], Claude Bouchon[11], Marilyn Brandt[5], Andrew W. Bruckner[12], Lucy Bunkley-Williams[13], Andrew Cameron[14], Billy D. Causey[15], Mark Chiappone[16], Tyler R. L. Christensen[2], M. James C. Crabbe[17], Owen Day[18], Elena de la Guardia[19], Guillermo Díaz-Pulido[20,21], Daniel DiResta[22], Diego L. Gil-Agudelo[23], David S. Gilliam[24], Robert N. Ginsburg[25], Shannon Gore[26], Héctor M. Guzmán[27], James C. Hendee[28], Edwin A. Hernández-Delgado[29], Ellen Husain[30], Christopher F. G. Jeffrey[31], Ross J. Jones[32], Eric Jordán-Dahlgren[33], Les S. Kaufman[34], David I. Kline[35,27], Philip A. Kramer[36], Judith C. Lang[37], Diego Lirman[25], Jennie Mallela[38,39], Carrie Manfrino[40], Jean-Philippe Maréchal[41], Ken Marks[37], Jennifer Mihaly[42], W. Jeff Miller[43], Erich M. Mueller[44], Erinn M. Muller[45], Carlos A. Orozco Toro[46], Hazel A. Oxenford[47], Daniel Ponce-Taylor[14], Norman Quinn[48], Kim B. Ritchie[9], Sebastián Rodríguez[10], Alberto Rodríguez Ramírez[23], Sandra Romano[5], Jameal F. Samhouri[49], Juan A. Sánchez[50], George P. Schmahl[51], Burton V. Shank[52], William J. Skirving[3], Sascha C. C. Steiner[53], Estrella Villamizar[54], Sheila M. Walsh[55], Cory Walter[9], Ernesto Weil[13], Ernest H. Williams[13], Kimberly Woody Roberson[31], Yusri Yusuf[56]

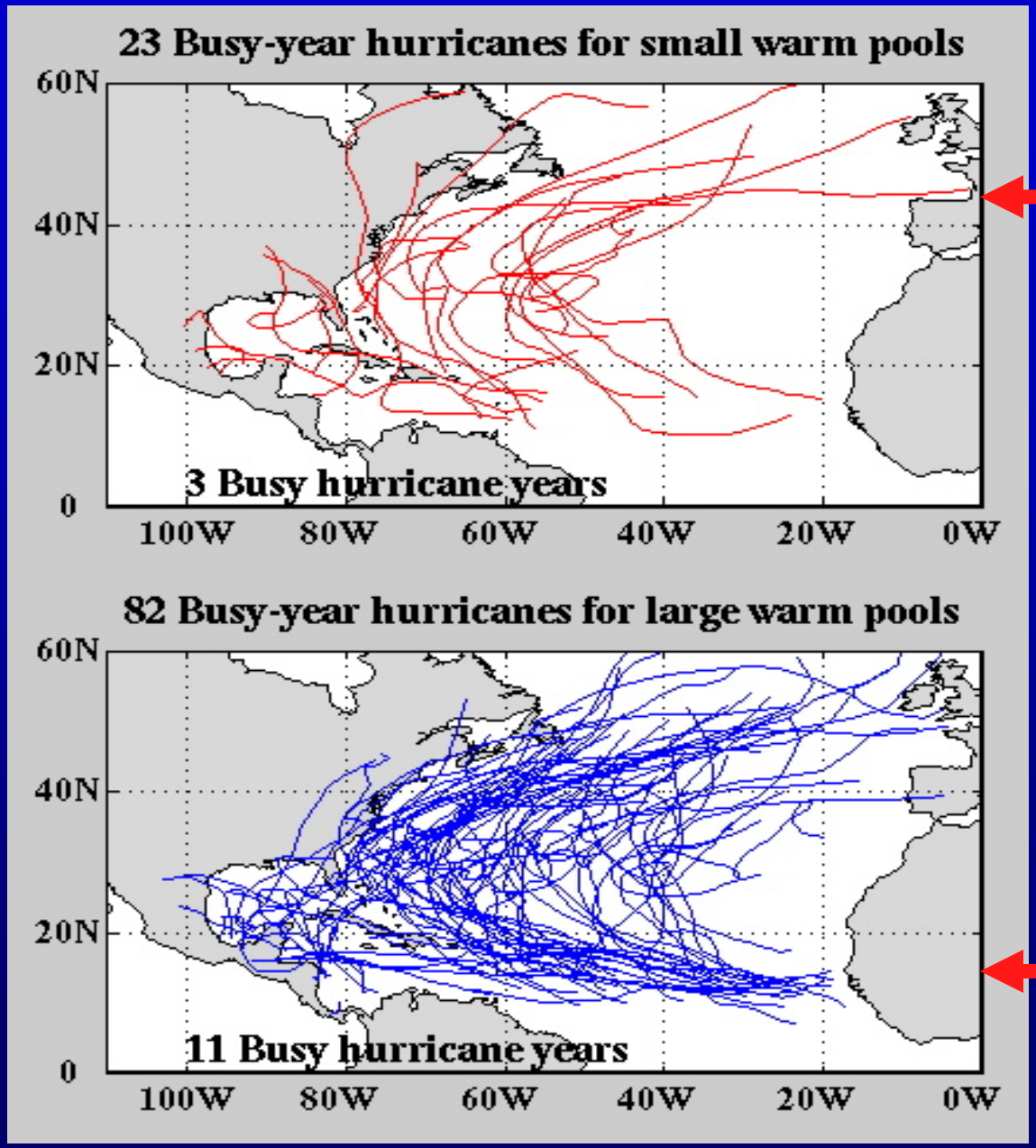
Vol 451|31 January 2008|doi:10.1038/nature06422 nature

LETTERS

Large contribution of sea surface warming to recent increase in Atlantic hurricane activity

Mark A. Saunders[1] & Adam S. Lea[1]

54 Years of Atlantic Hurricanes (1950-2003)



Of the 18 years with small warm pools

3 busy years, 23 storms

Busy hurricane years

= years for which the number of late-season hurricanes fall within the top tercile of all years

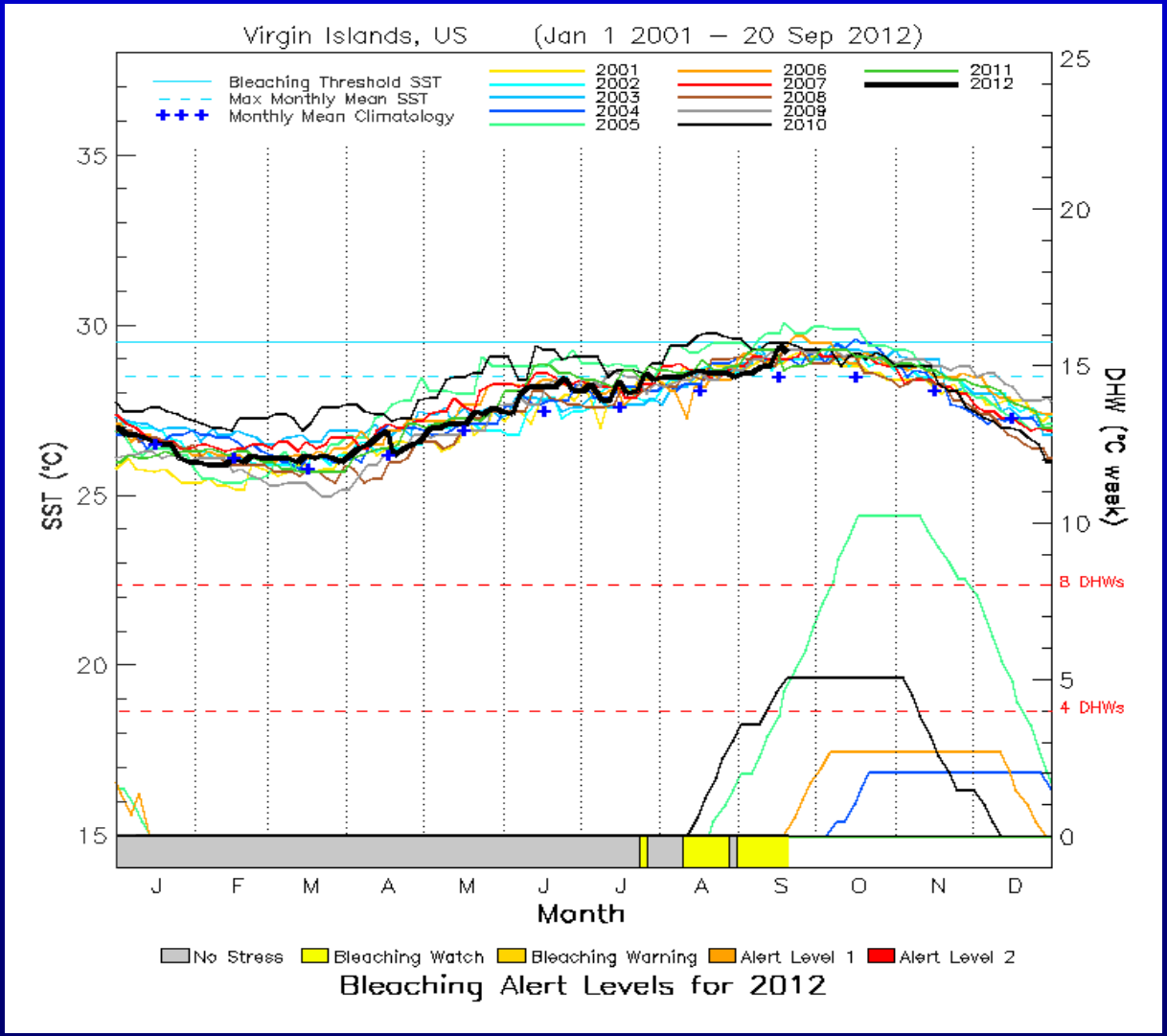
Of the 18 years with large warm pools

11 busy years, 82 storms

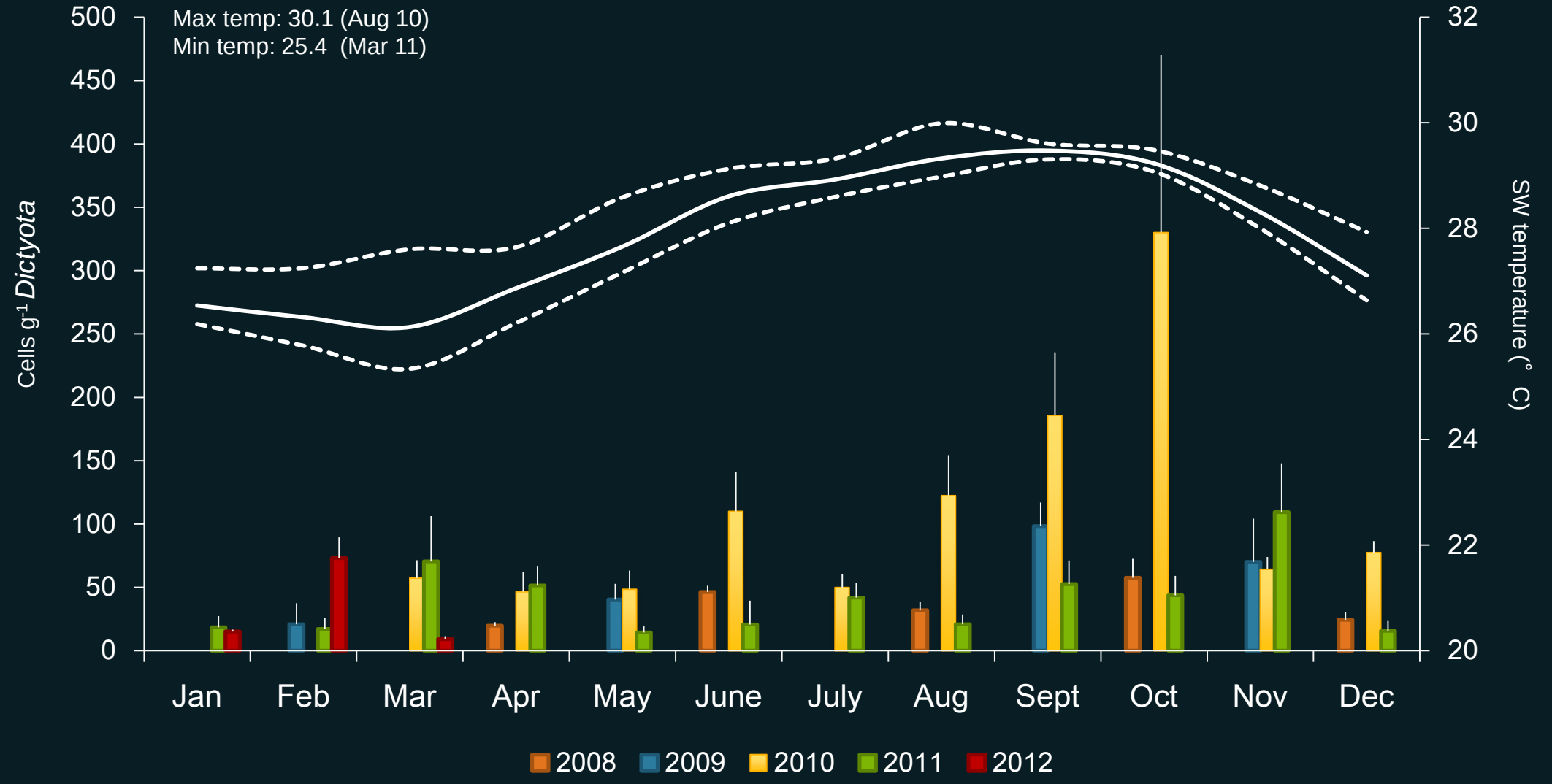
Center For Marine and Environmental Studies

Increasing Sea Surface Temperatures

- Sea surfaces temperature 1°C above the maximum monthly mean can cause mass coral bleaching
- In USVI, every year of the last decade has seen warmer summers than our climate mean

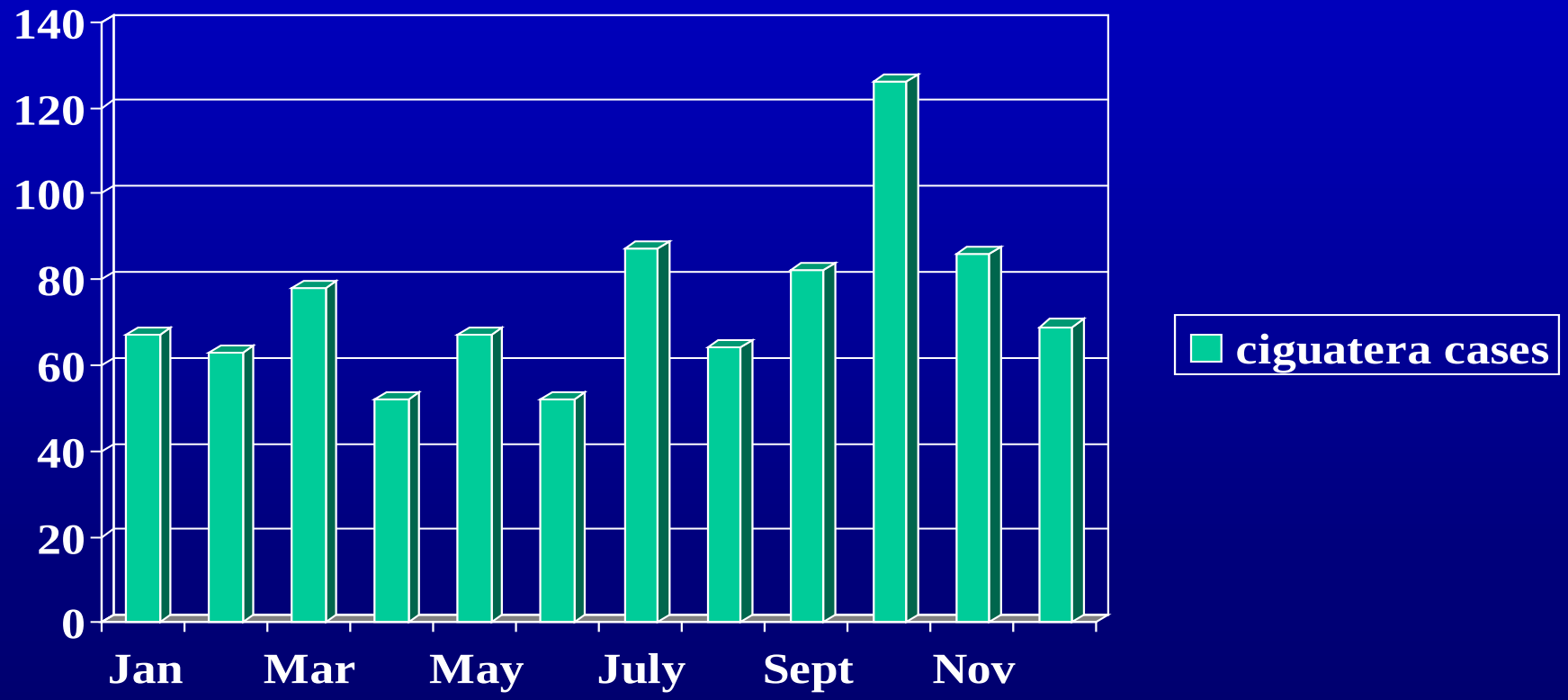


Gambierdiscus spp. abundance, Benner Bay



Gambierdiscus spp. abundance **positively correlated with SW temperature, precipitation**; negatively correlated with wind velocity (Spearman's rank correlation, $p<0.05$)

Ciguatera Cases, Emergency Department, Schneider Hospital, St. Thomas, by Month, 1995-1999



Background

- Incidence surveys performed in St. Thomas in 1980
  - 7 per 1000 (approximately 14 per 1000 among adults)
    - In person survey, Morris, et al.
  - 22% of households affected in a five year period
    - Telephone survey, McMillan, et al.
- Since this time, seawater temperatures have risen.
  - Has been suggested that increasing seawater temperature, in the context of global warming, will lead to an increase in ciguatera incidence

Research Questions

- **Has ciguatera incidence in St. Thomas changed from 1980 to 2010/2011?**
  - **We hypothesized that incidence would have increased due to the rise in seawater temperatures**
- **What demographic and behavioral factors are associated with ciguatera illness in St. Thomas?**

Telephone Survey

Two island-wide random digit dial telephone surveys in St. Thomas (November 2010 and October 2011) - Landline and cellular telephones

Eligibility criteria: adult residents of St. Thomas

Telephone Survey Questionnaire

1. **Demographics**
2. **Recent fish consumption (frequency, type of fish, how obtained)**
3. **History of ciguatera episodes in the participant and their household members**
4. **Ciguatera awareness**

Survey population

- 807 individuals participated in the telephone surveys
  - 400 in 2011 provided information about ciguatera in the past five years
- 186 (23%) had ever had ciguatera
  - 339 total episodes
- 43 households (11%, 95% CI=8-14%) had a ciguatera episode in the previous five years
- 56 (30%, 95% CI=21-39%) visited the emergency department for their most recent ciguatera illness

Emergency Department Visits

- Medical record review of emergency department at Roy Schneider Hospital
- All available records with discharge diagnosis of ciguatera were identified and reviewed
- Data from pre 1980 were obtained from past research
- Collected annual counts for 1971-79 and 1995-2011, with gaps from 2000-01 and 2006.

Incidence estimates

- **Telephone survey:**
  - **12 per 1000 (95% CI=10-21) 2010/2011**
  - **14 per 1000 in 1970's survey**
- **Emergency department visits:**
  - **18 per 1000 in 1970s**
  - **6 per 1000 (95% CI=5-8) in 2007-11**

Survey Results

- **22% of households were affected in in 1970's over 5 years**

- **11% of households were affected in 2010/2011 over the same time period.**

Population Differences

- Between 1980 and 2010/2011, we found significant differences in education (higher), age (older), and fish consumption (lower).

- Combined risk difference of -2.7 per 1000

Conclusion

- **We observed a *decline* in ciguatera incidence in St. Thomas from 1980 to 2010/2011**

- **This may be due to a population shift: Higher socioeconomic status, aging and lower fish consumption**

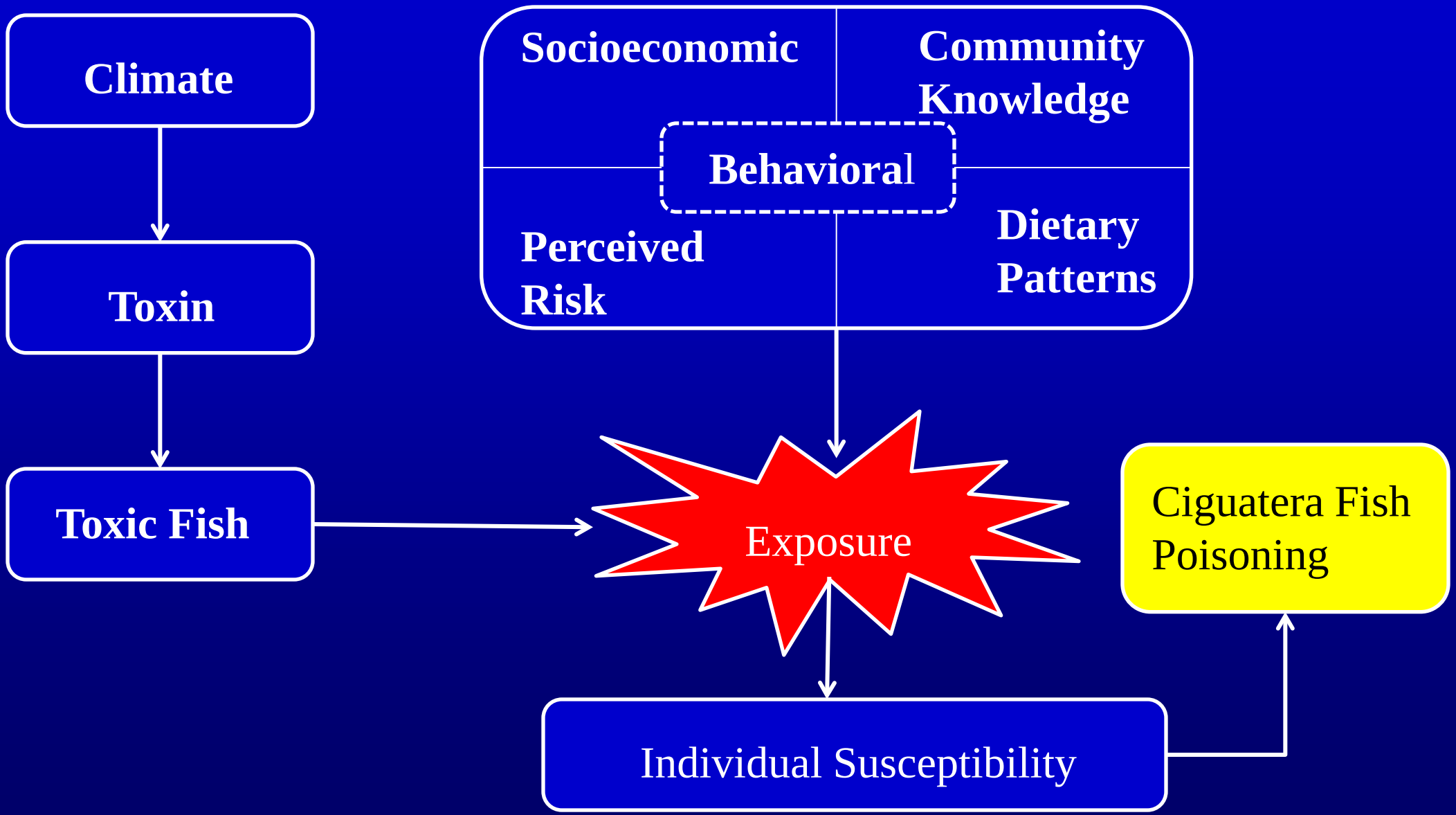
Radke et al. (2013) *American Journal of Tropical Medicine and Hygiene*, In Press

Alternatively

- St. Thomas may have reached an upper temperature threshold that is limiting *Gambierdiscus* growth

- A positive association with seawater temperature may exist but the effect of temperature is obscured by other factors (change in toxin profiles, primary dinoflagellate, or fish populations).

- Despite the decline in incidence in STX over the past 30 years, Ciguatera remains a major public health problem, affecting about 1% of the US population each year.


Climate
Toxin
Toxic Fish
Socioeconomic
Community Knowledge
Behavioral
Perceived Risk
Dietary Patterns
Exposure
Ciguatera Fish Poisoning
Individual Susceptibility