

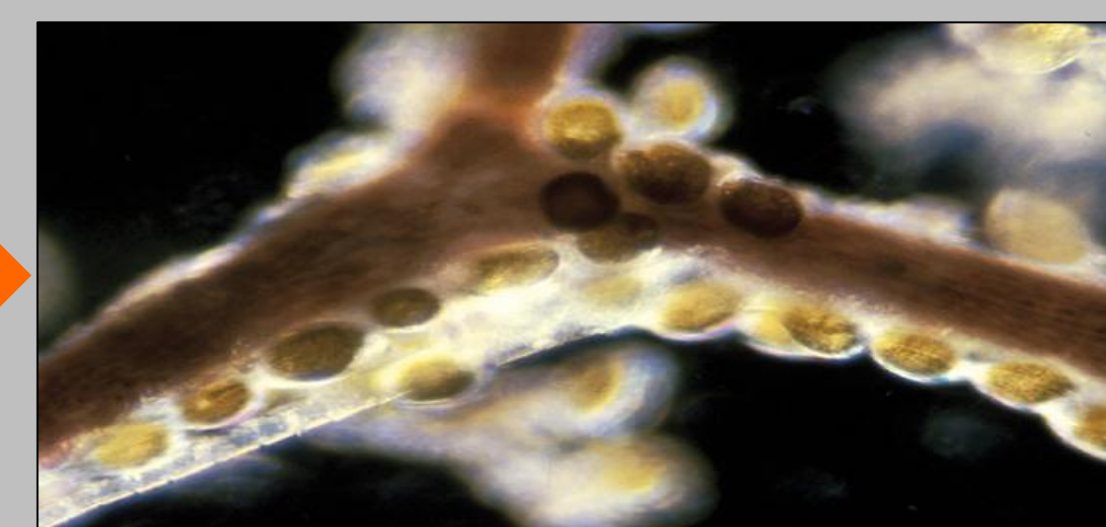
Ciguatera fish poisoning in St. Thomas, USVI: trends over 30 years

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Environmental factors
(temperature, coral reef health)



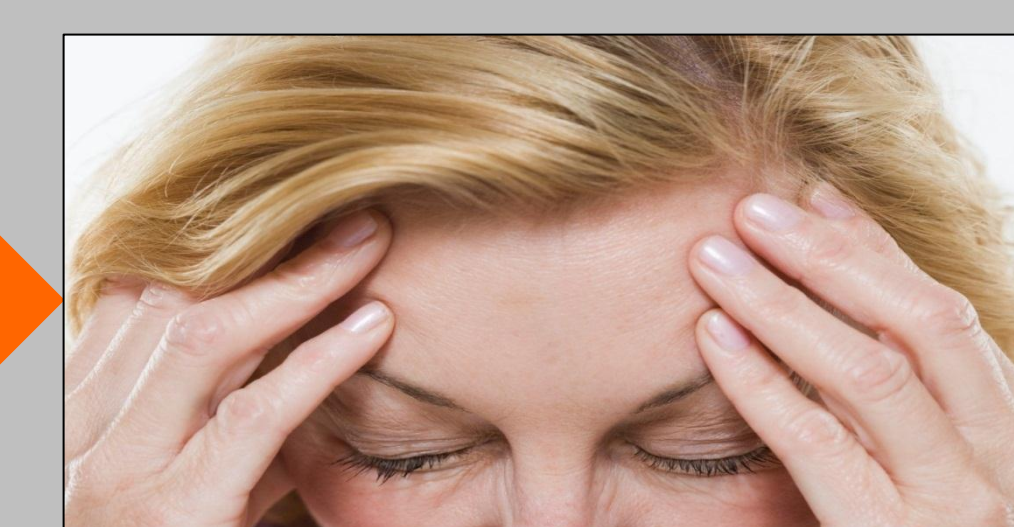
Toxin producing microalgae,
Gambierdiscus dinoflagellates



Herbivorous fish



Carnivorous fish



Human illness (gastrointestinal
and neurologic symptoms)

INTRODUCTION

Ciguatera fish poisoning is caused by the consumption of reef fish containing toxins produced by *Gambierdiscus* dinoflagellates. There are an estimated 50-500 thousand cases per year worldwide, primarily in tropical and subtropical areas¹. A few studies have suggested that there may be an increase in ciguatera incidence associated with increasing seawater temperature², which would be concerning because of the potential higher disease risk that could occur with climate change.

A second hypothesis is that there is an upper temperature threshold above which the number of cases would drop. In the south Pacific the highest incidence occurred from 28-30°C³. Less research has been done in the Caribbean and the relationship between seawater temperature and ciguatera incidence in this region is still unclear.

Study Objectives

- Calculate the incidence of ciguatera fish poisoning in St. Thomas and compare it to estimates from 1980
- Assess the relationship between ciguatera incidence and sea surface temperature (SST) over the same time period
- Explore demographic and behavioral explanations for change in incidence

METHODS

Data Collection

We performed two island wide random digit dial telephone surveys of adults in St. Thomas in 2010 and 2011. We also performed a medical record review at the emergency room (ER) of the sole hospital on the island. Data for pre-1980 were obtained from past research on the island^{4,5}. We were able to obtain counts for 1971-79 and 1995-2011, with gaps from 2000-01 and 2006. SST data was obtained from National Oceanic and Atmospheric Administration's Extended Reconstruction SST dataset.

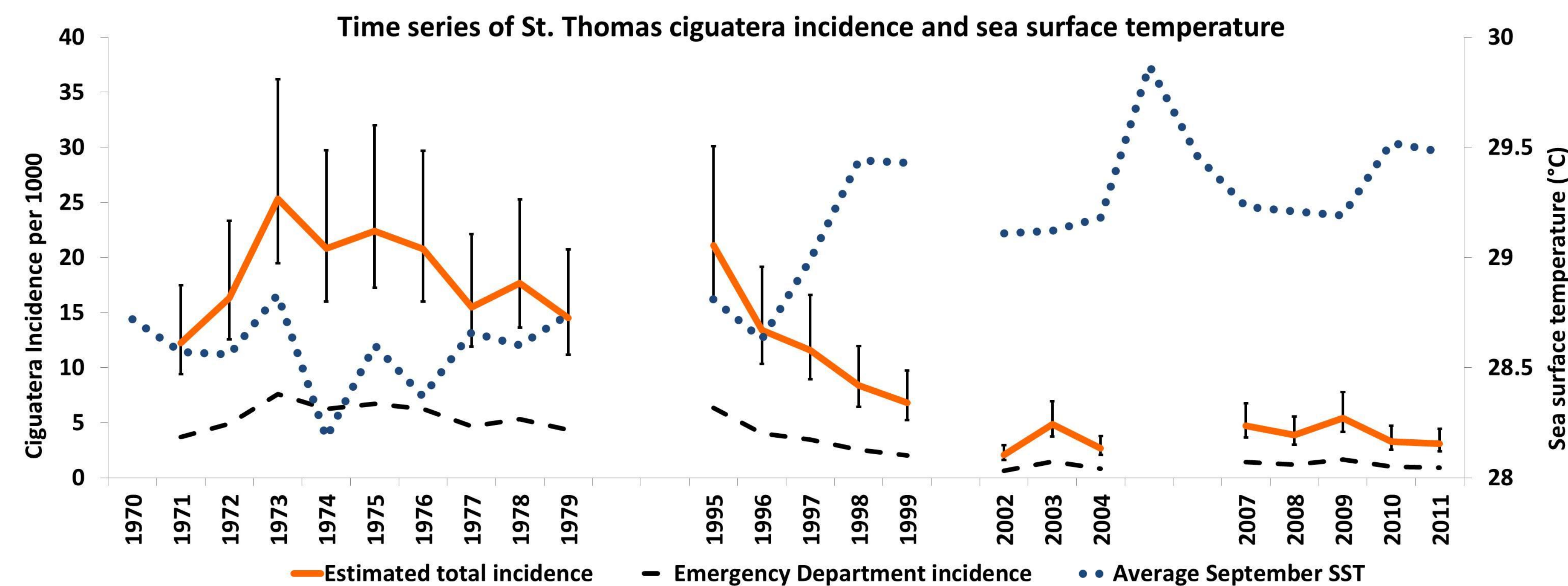
Analysis

Average annual incidence among adults over the previous five years was calculated, weighting for age, education, and sex in 2000 Census. A second estimate used incidence of ER visits divided by the proportion who visited the ER for their most recent episode. We performed correlations between average SST and incidence of ciguatera ER visits with no lag and with a lag of one year, for 1971-11 and 2002-11. Finally, the effects of population changes in risk factors were assessed by applying strata specific incidence rates from the current survey for age, education, and fish consumption to the populations in 1980 and present day (2010/11 for fish consumption, 2000 for age and education). Estimated total incidences were calculated for each variable for both time periods, and the risk difference was obtained.

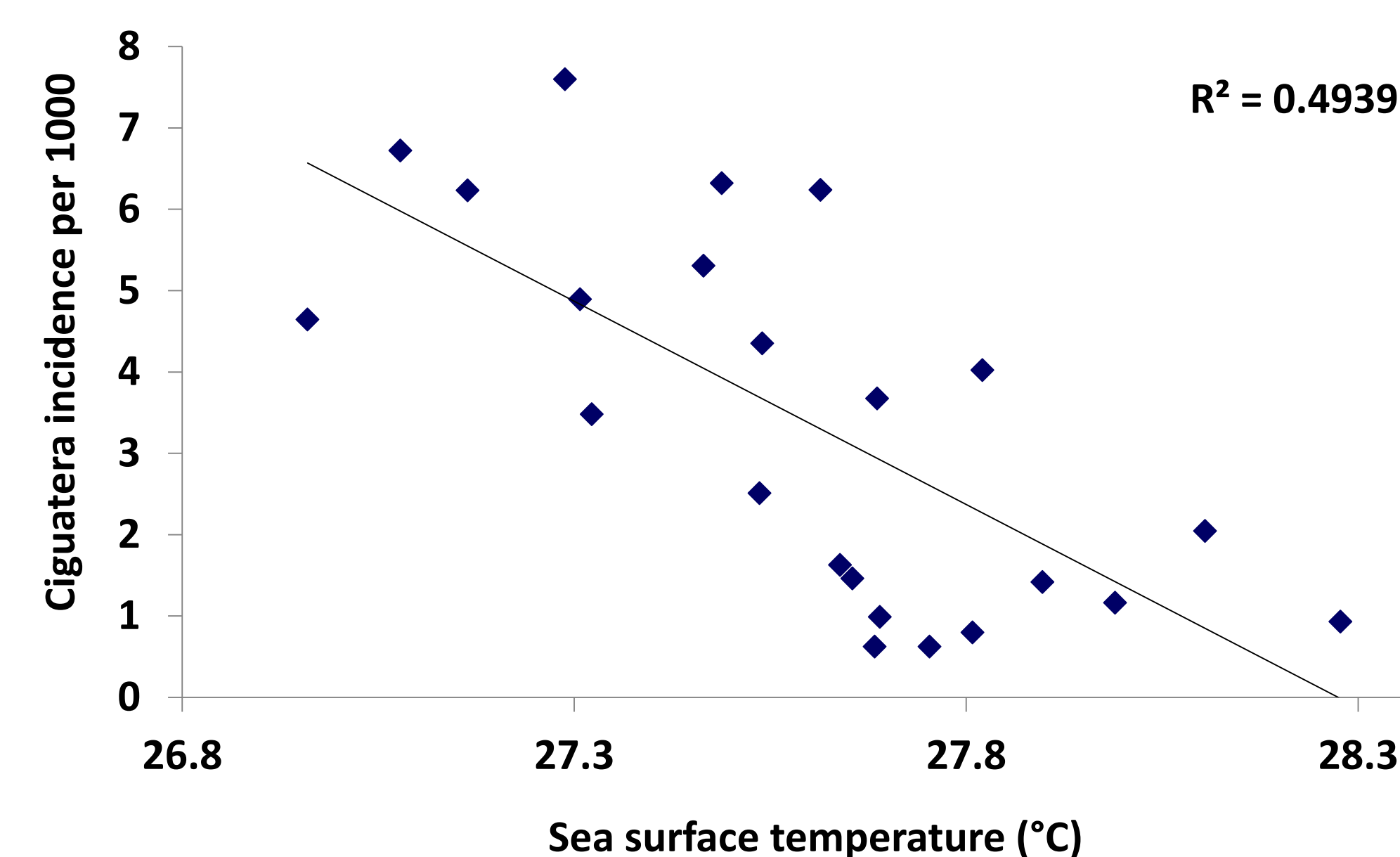
RESULTS

807 individuals participated in the telephone surveys. Of the participants, 186 (23%) had ever had ciguatera. When asked about their most recent illness, 30% (95% CI=21-39%) reported visiting the emergency room.

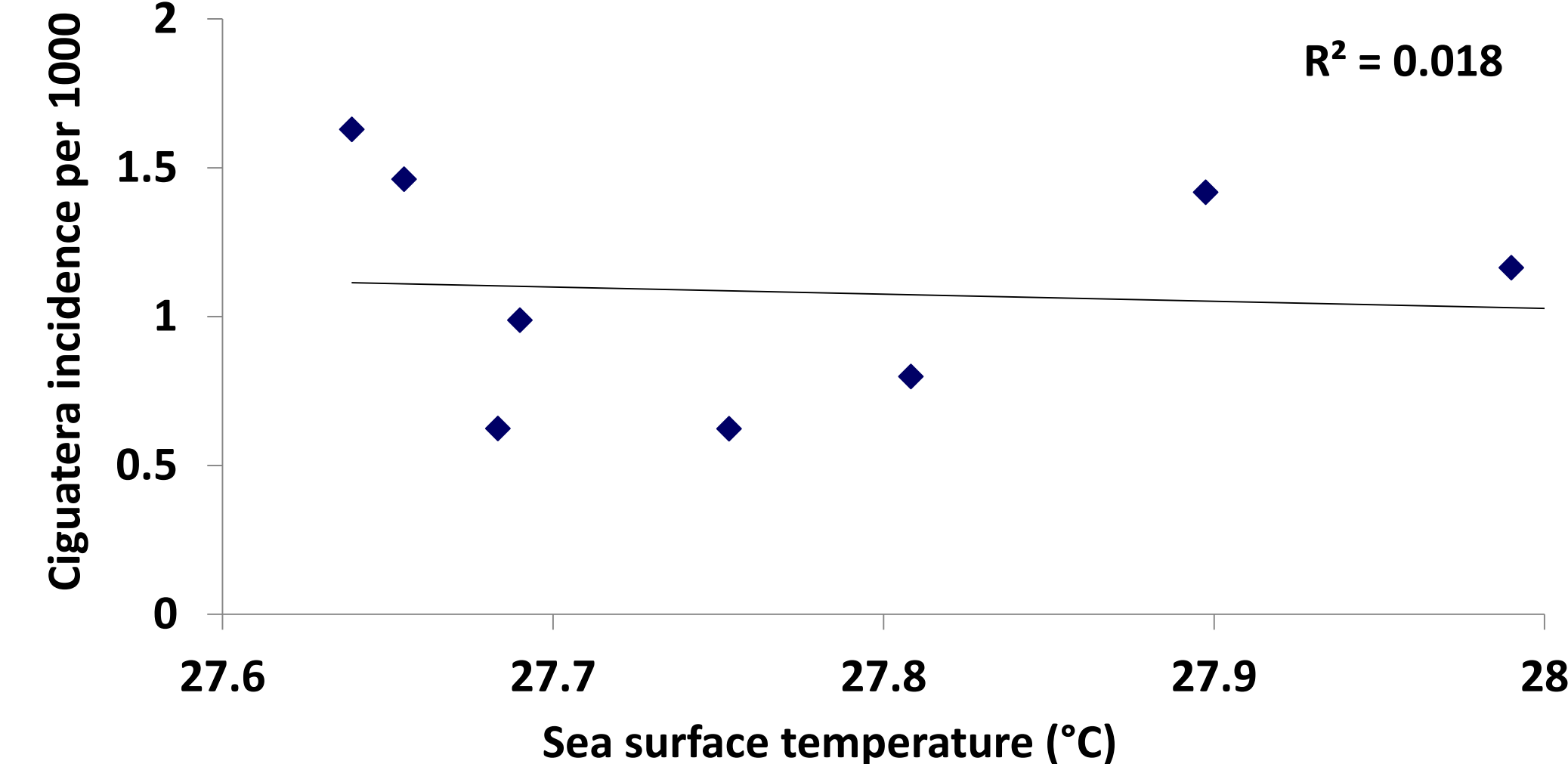
RESULTS



Correlation between SST and ciguatera ER visits with one year lag, 1971-79 and 2002-11



Correlation between SST and ciguatera ER visits with one year lag, 2002-2011



Incidence estimates of ciguatera in adults per 1000

Data source	1980	2010/11 (95% CI)
Emergency room visits (adjusted for proportion of survey participants who visited the ER for their most recent ciguatera illness)	18	6 (5-8)
Current survey vs. Morris et al. 1982 ⁴ (age adjusted to nearest Census)	14	12 (10-21)
Current survey vs. McMillan et al. 1980 ⁵ (% of households)	22%	11% (8-14%)

Risk differences of ciguatera from 1980 to 2010/11 based on population changes in risk factors

Variable	1980	2010/11	Risk difference per 1000*
Fish consumption 3 or more times a week	12%	~33%	-3.1
Education – Less than HS	50%	39%	-1.3
HS graduate	26%	26%	
Some college or more	24%	35%	
Age – Under 18	42%	32%	
18-44	39%	35%	+1.7
45 to 64	14%	25%	
65 and above	5%	8%	
Total			-2.7

*Strata specific incidence not shown; risk difference calculations assume strata specific risk remained constant from 1980 to 2010/11.

CONCLUSIONS

Key Findings

- Incidence of ciguatera fish poisoning in St. Thomas has not increased since 1980, based on multiple data sources.
- Sea surface temperature has risen over the same period, which would be hypothesized to increase incidence.
- It is unclear whether St. Thomas has reached an upper temperature threshold that is limiting ciguatera production or whether other factors, such as population changes in education and fish consumption, are obscuring the effect of temperature.

Our results demonstrate the importance of ciguatera for residents of St. Thomas. Over twenty percent of survey participants reported at least one episode in their lifetime, and 1% per year are affected. However, based on survey data and emergency room visits, it appears that ciguatera incidence has declined or at least remained stable since similar studies were performed in 1980^{4,5}.

We found an unexpected significant negative correlation between average SST and the ciguatera incidence from 1971-2011. This may indicate that with SST trending upward, St. Thomas has reached an upper temperature threshold that limits the amount of ciguatera. However, St. Thomas does not generally reach temperatures above 30°C, the threshold suggested by Llewellyn in the South Pacific³.

It is also possible that other factors caused a drop in ciguatera that coincidentally correlates with the upward trend in SST. This is supported by looking at 2002-11, a more stable period of ciguatera incidence, as the negative trend does not exist. Our other findings also provide a preliminary indication that population changes in education and fish consumption are associated with changes in ciguatera incidence over time. Future research is needed to better characterize the factors associated with ciguatera in this region to improve our understanding of how the human effects of harmful algal blooms such as ciguatera can be prevented.

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ADDITIONAL INFORMATION

Please contact Elizabeth Radke at bethradke@epi.ufl.edu or visit the study's website at www.caribcatch.org
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