Social Amplification of Risk in Coastal Tourism Destinations with Harmful Algae Blooms

Sergio Alvarez, Ph.D.

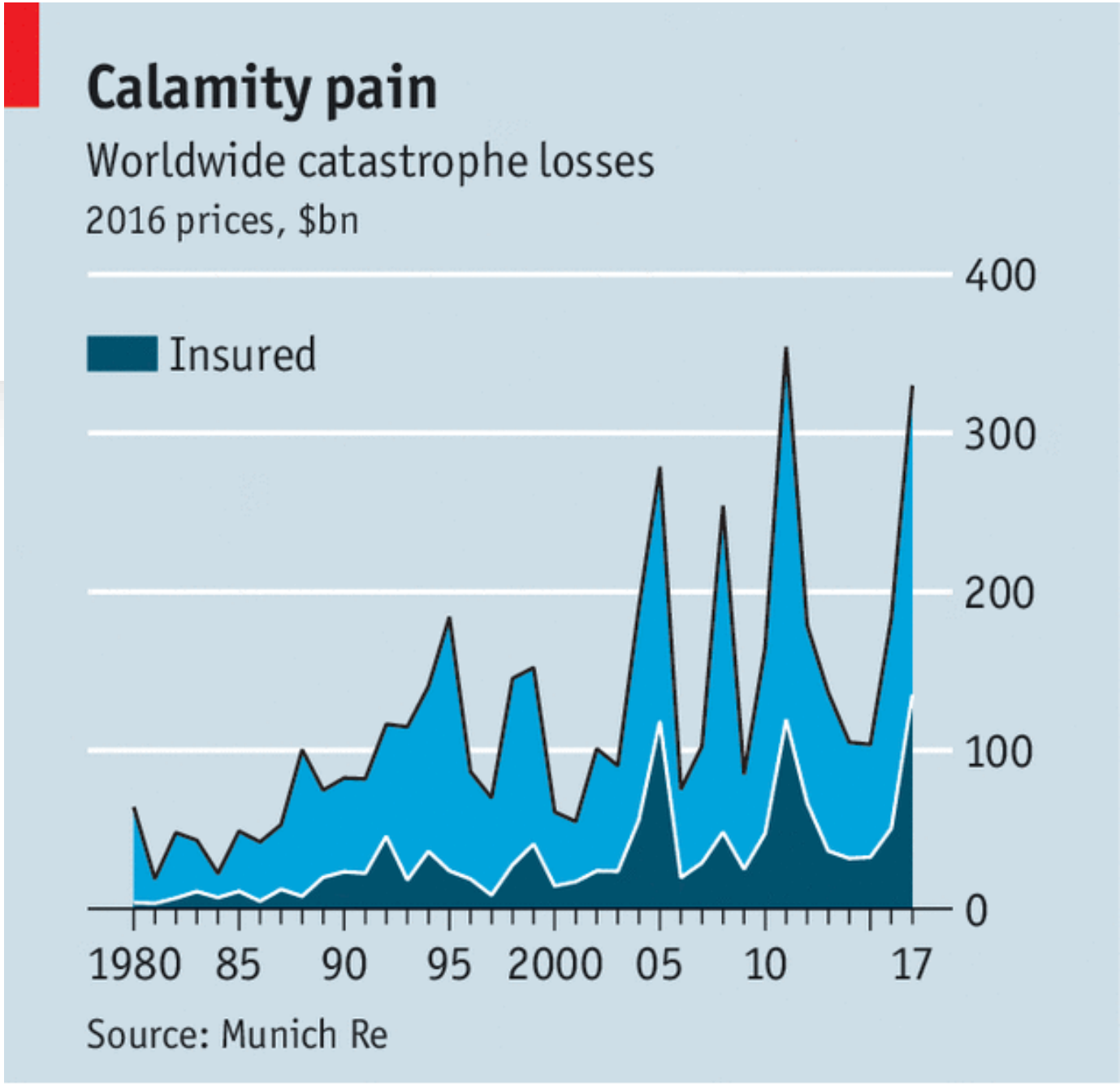
Rosen College of Hospitality Management / National Center for Integrated Coastal Research

University of Central Florida

Trends in economic losses from natural disasters

The inflation corrected economic losses of natural disasters have been increasing over the last few decades (Botzen et al., 2019).

The main contribution to the upward trend in losses comes from socio-economic and demographic factors such as population growth, ongoing urbanization, and increasing values being exposed (Hoeppe, 2016).



Types of economic losses traditionally considered

Direct losses or impacts refer to the *damage to the assets* caused *directly* by a natural disaster, with the losses occurring at the time of the disaster or shortly thereafter (e.g., destruction of residences, businesses, productive capital, infrastructure, crops, livestock, and monetized physical and mental health impacts).

Direct impacts can lead to *indirect impacts*.

Indirect losses or impacts refer to changes in economic activity that *follow* the disaster. These include interruptions of economic activities and spillover effects due to the substitution of production and the demand for reconstruction.

Source: Botzen et al., 2019

Limitations of the current conceptualization of natural disasters

A natural disaster involves destruction of physical assets.

(**Physical bias**)

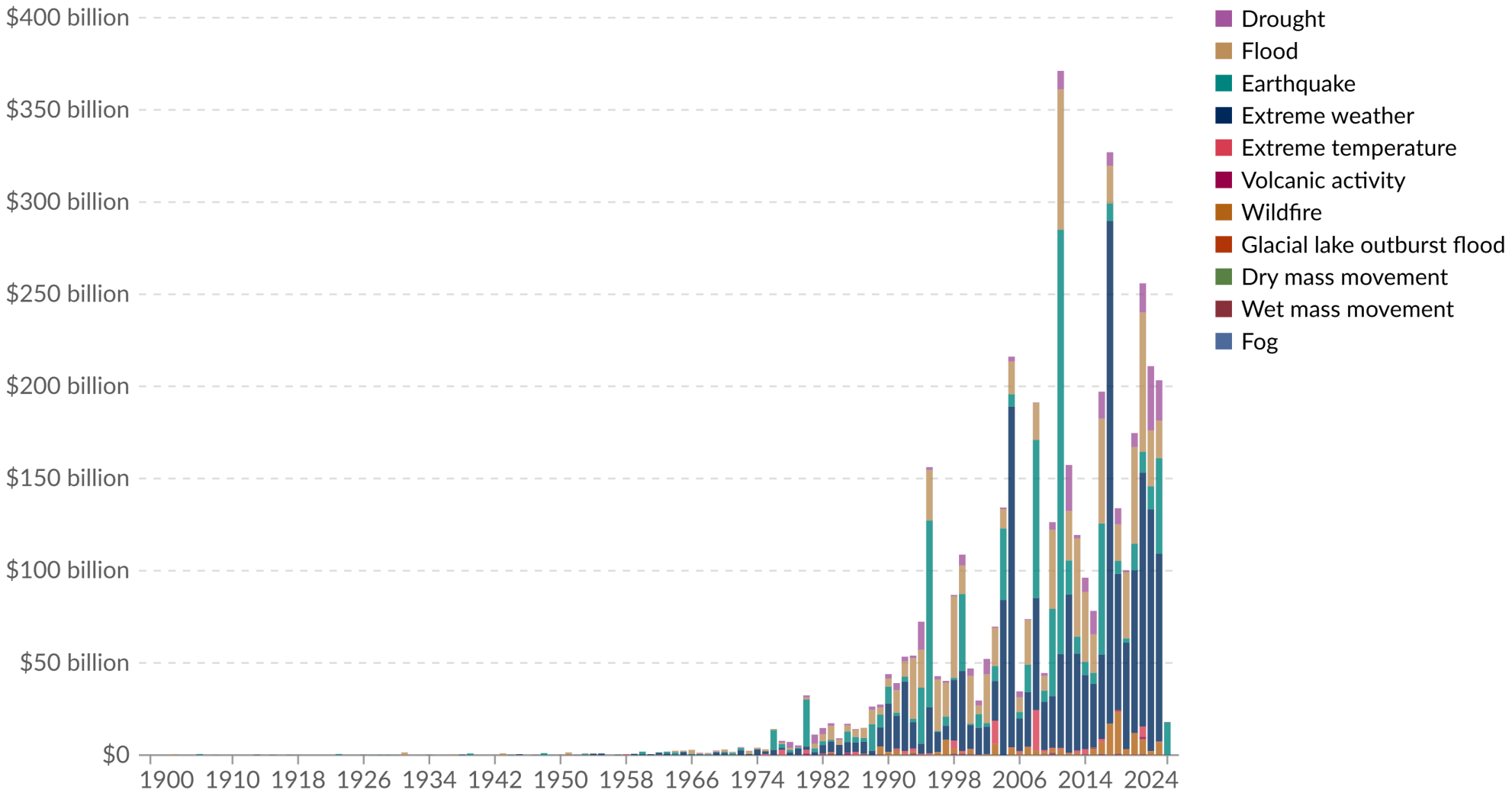
Changes in economic activity attributed to the disaster arise from the physical impacts and are driven by changes in production activities or reconstruction/rebuilding.

(**Reconstruction bias**)

Economic damage by natural disaster type, 1900 to 2024

Our World in Data

Global economic damage from natural disasters, differentiated by disaster category and measured in US$ per year.



Data source: EM-DAT, CRED / UCLouvain (2024)

OurWorldinData.org/natural-disasters | CC BY

Note: Data includes disasters recorded up to April 2024.

Economic damage by natural disaster type, 1900 to 2024

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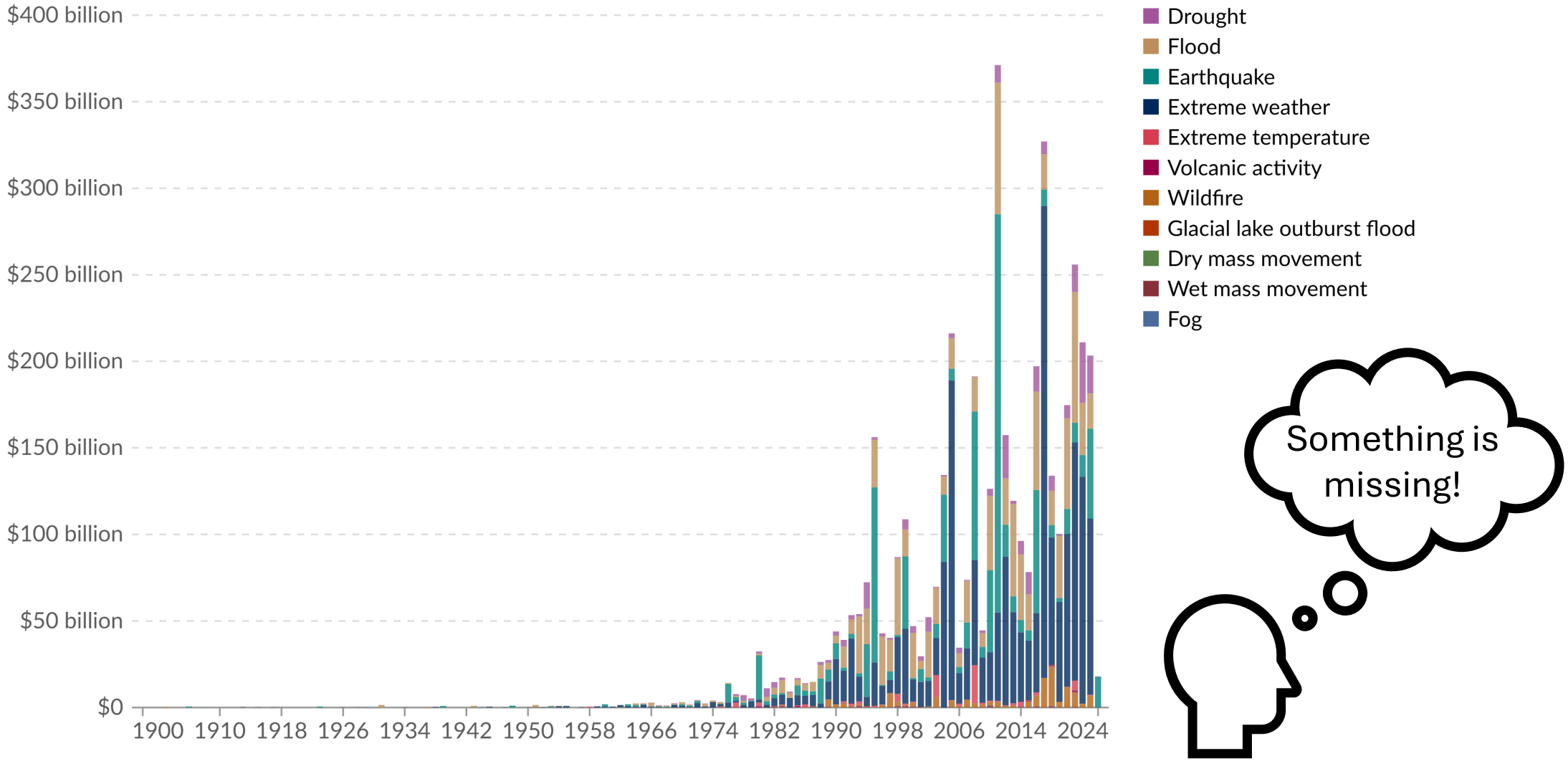


Data source: EM-DAT, CRED / UCLouvain (2024)

OurWorldinData.org/natural-disasters | CC BY

Note: Data includes disasters recorded up to April 2024.

Harmful Algae Blooms (HABs) as a natural disaster

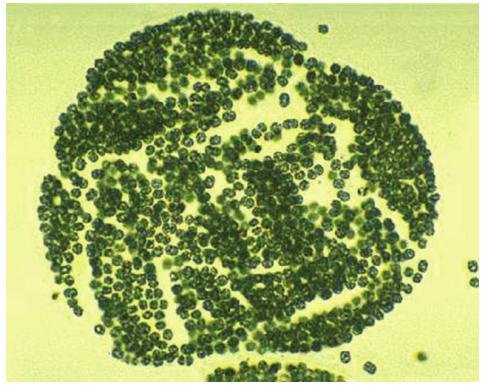
Naturally occurring microscopic organisms in water ("algae")

Become a nuisance because

- Produce **toxins**
- Unsightly or smelly
- Kill fish and other wildlife

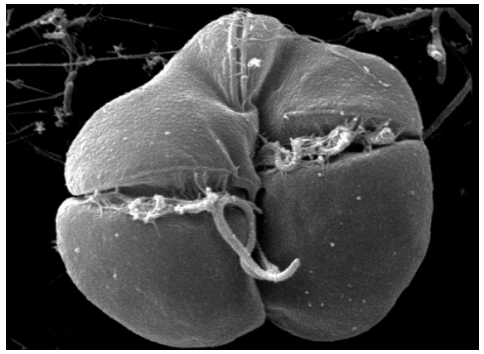
There are **several types** of organisms that can cause HABs

- Over 60 species identified worldwide

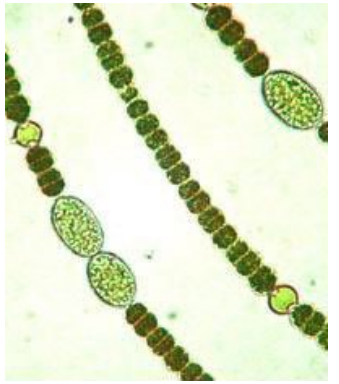


Microcystis spp.
a.k.a. Blue-green algae

Aureoumbra lagunensis
a.k.a. Brown tide

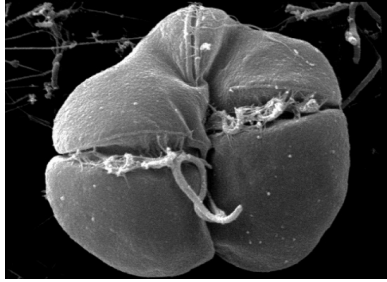


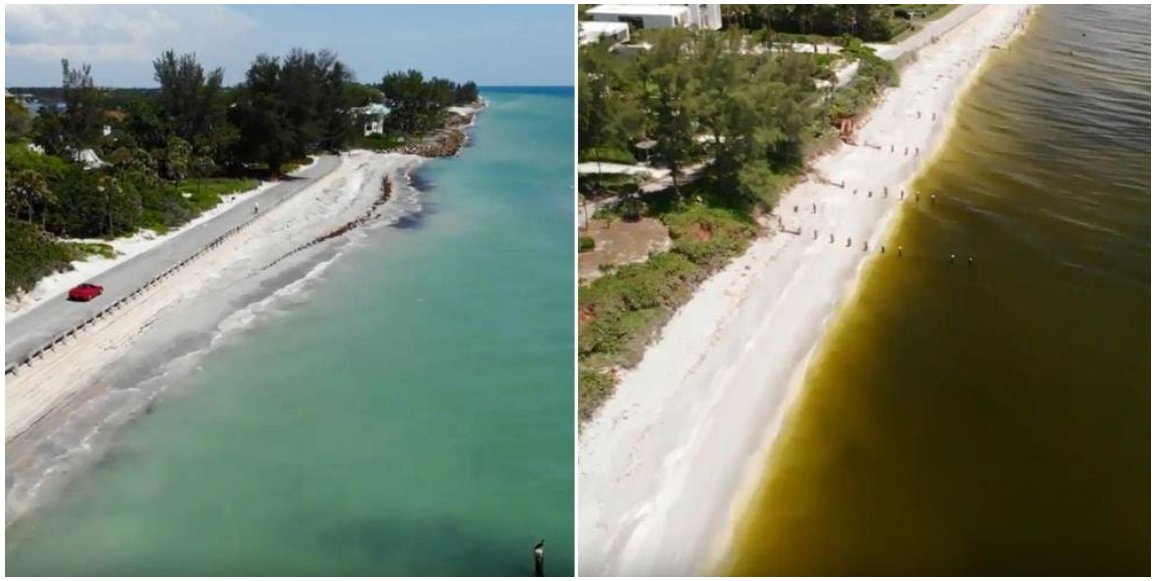
Karenia brevis
a.k.a. Red tide



Anabaena spp.
a.k.a. Blue-green algae

Florida Red Tide





Casey Key (Sarasota County) Before and During Red Tide
Photos by Cody Johnson

Dinoflagellate *Karenia brevis* produces **brevetoxins** that **kill wildlife** and cause **irritation** in humans

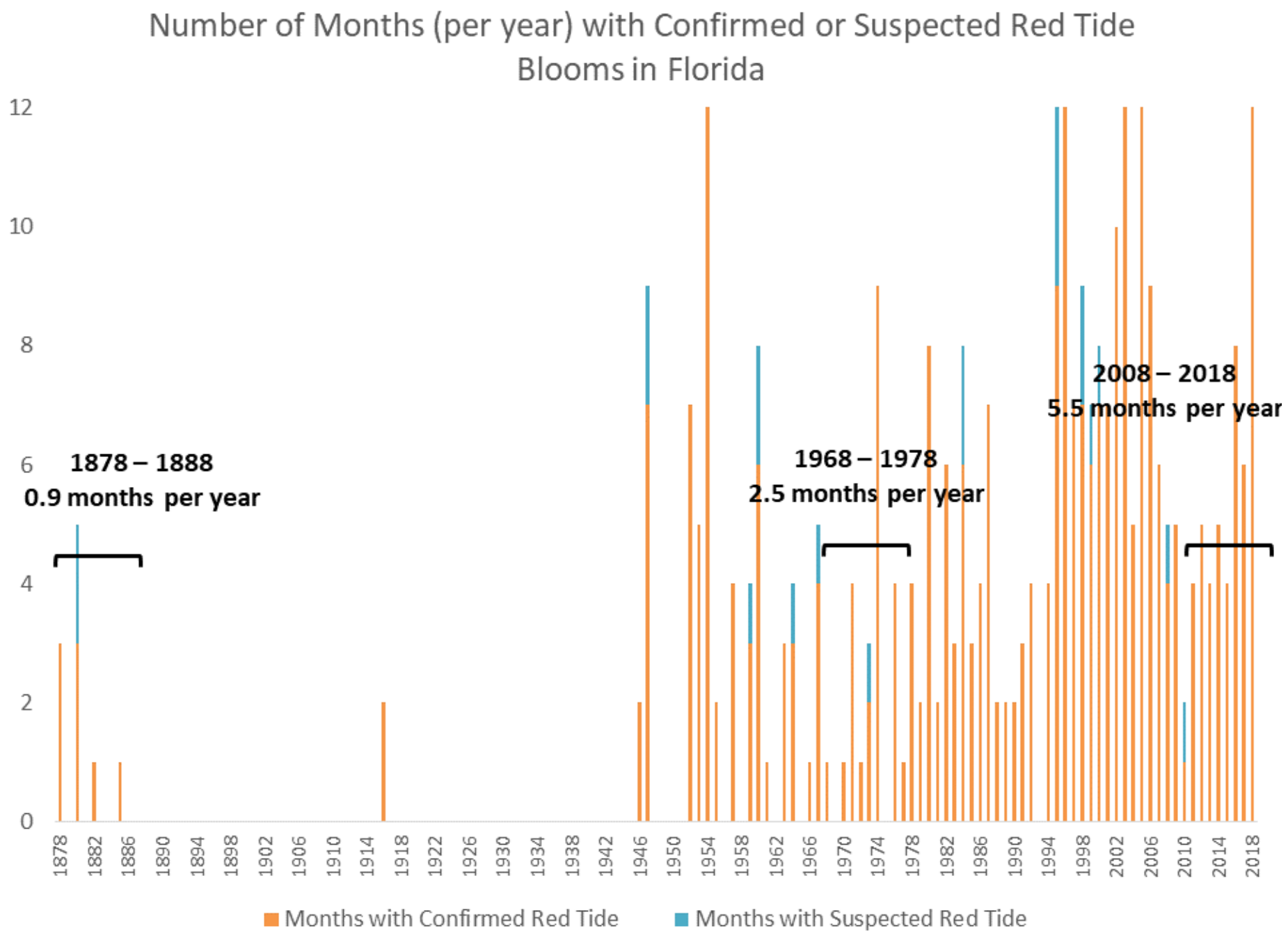
Brevetoxins can affect the **neurological**, **gastrointestinal**, **cardiovascular**, or **respiratory systems**.

Eating fish poisoned with brevetoxins can cause **neurotoxic shellfish poisoning**

Blooms **occur naturally** along the Gulf Coast

Winds and **water currents** can push the blooms toward the shoreline

Blooms near the coast may be **further fueled** by excess nutrients from rural and urban runoff



Data from the Florida Fish and Wildlife Conservation Commission

PRESS RELEASES

Buchanan, Soto Introduce Bill to Mitigate Harmful Algal Blooms

March 27, 2025

Legislation Defines Harmful Algal Blooms as "Major Disaster," Unlocks FEMA Assistance

Follows Recent Health Alerts Linked to Red Tide in Southwest Florida

WASHINGTON — Today, **Congressman Vern Buchanan, Co-Chairman of the bipartisan Florida delegation**, and **Rep. Darren Soto** (D-Fla.), introduced legislation to protect Southwest Florida's economy and environment from harmful algal blooms like red tide. The *Protecting Local Communities from Harmful Algal Blooms Act* would include algal blooms in the definition of a "major disaster," providing both technical and financial assistance from the federal government to states suffering from outbreaks of harmful algal blooms.

Related Links

Press Releases

PRESS RELEASES

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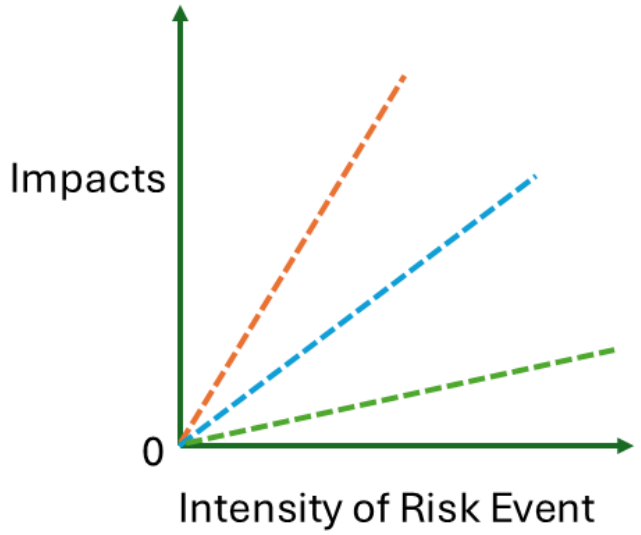
Related Links

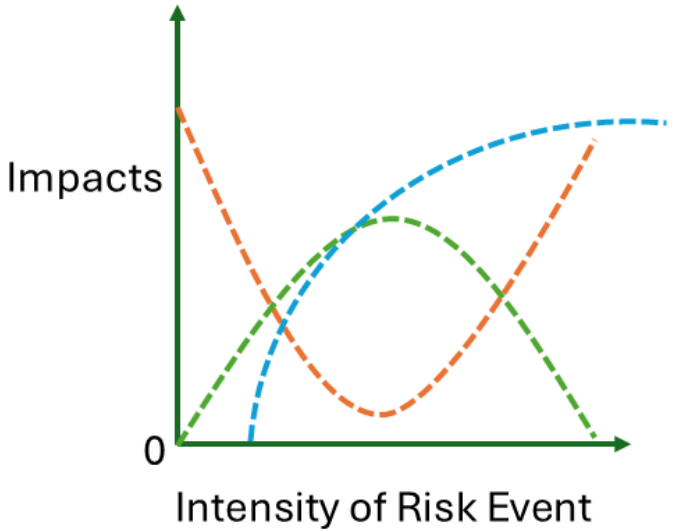
Press Releases

Challenging the physical and reconstruction bias of natural disaster conceptualization:

The case of Harmful Alage Blooms



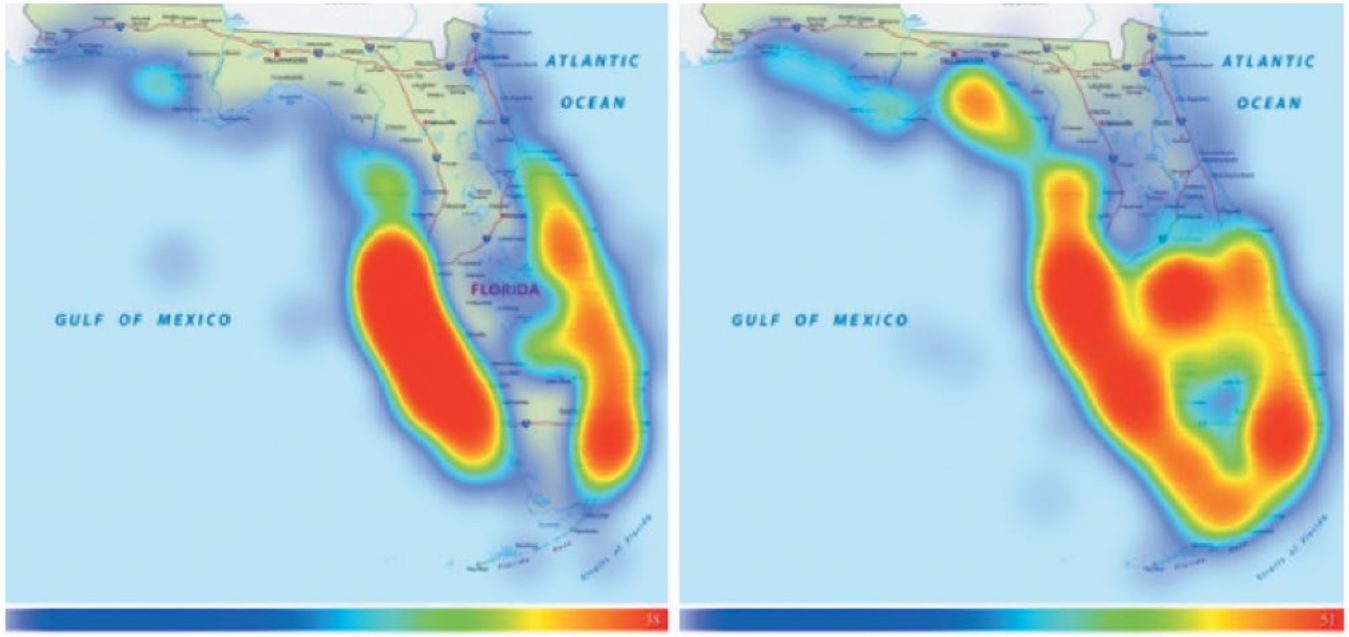
H1: Impacts increase linearly and proportionally as the intensity of the risk event increases.



H2: Impacts of risk events respond nonlinearly as the intensity of the risk event increases.

Proposition 1: HABs Affect Destination Image

Cahyanto and Liu-Lastres (2020) examined the relationships between media exposure, risk perception, and visitor's behavioral responses.



In-state visitors' perception on Red Tide

Out-of-state visitors' perception on Red Tide

JOURNAL OF TRAVEL & TOURISM MARKETING
2020, VOL. 37, NO. 4, 447–459
https://doi.org/10.1080/10548408.2020.1783426

Routledge
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ARTICLE

Check for updates

Risk perception, media exposure, and visitor's behavior responses to Florida Red Tide

Ignatius Cahyanto [a] and Bingjie Liu-Lastres [b]

[a]Department of Management, B.I. Moody III College of Business Administration, University of Louisiana at Lafayette, Lafayette, LA, USA; [b]Department of Tourism, Event, and Sport Management, School of Health and Human Science, Indiana University-Purdue University Indianapolis, Indianapolis, IN

ABSTRACT

Florida's Red Tide outbreak, a major environmental disturbance in 2018, not only garnered nation-wide attention but also affected both in-state and out-of-state visitors. Guided by the Social Amplification of Risk Framework (SARF), this study examined the relationships between media exposure, risk perception, and visitors' behavioral responses. Data were gathered from two surveys in late 2018. The findings validate the practicality of applying SARF to the current context. This study also found that both perceived consequences and access to the community are significant predictors of visitor behavior. This study further discussed how to market destinations during turbulent times.

ARTICLE HISTORY
Received 23 July 2019
Revised 8 May 2020
Accepted 11 June 2020

KEYWORDS
Red Tide; Florida; tourism; risk; media; SARF; Harmful Algal Blooms; destination marketing; tourism crisis; social amplification of risk

CURRENT ISSUES IN TOURISM
https://doi.org/10.1080/13683500.2020.1817876

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Check for updates

Exploring the host-Guest interaction in tourism crisis communication

Biingjie Liu-Lastres [a] and Ignatius P. Cahyanto [b]

[a]Department of Tourism, Event and Sport Management, Indiana University-Purdue University Indianapolis, Indianapolis, IN, USA; [b]Department of Marketing and Hospitality, University of Louisiana at Lafayette, Lafayette, LA, USA

ABSTRACT

The purpose of this study was to explore the host–guest interaction in tourism crisis communication. Guided by a practice-based approach, our study used the recent event of the 2018 Florida Red Tide as the context. It explored both visitors' and residents' information-acquiring and sharing practices in crisis communication. A total of 969 potential visitors and 460 Florida residents were surveyed, respectively. The findings of our study show that visitors preferred residents as their primary information sources in the crisis communication process. Repeat visitors who have no children and are the primary decision-maker are more likely to rely on residents for risk information than first-time visitors. The results further indicate that most respondents in the resident sample have shared Red Tide information with visitors through various channels. Knowledge and social identity influenced their information-sharing behaviour. The findings suggest that residents can act as risk insiders in tourism crisis communication. A new research direction involving the guest–host interaction in tourism crisis management is proposed. This study offers practical implications for promoting effective risk and crisis communication in destinations and incorporating residents in tourism crisis communication and management.

ARTICLE HISTORY
Received 9 September 2019
Accepted 26 August 2020

KEYWORDS
Guest-host interaction; tourism crisis communication; risk insiders; Florida; Red Tide

Proposition 2: HABs Impact the Housing Market

Florida's housing market is in part driven by long and short term out-of-state visitors in search of mild winter weather.

If economic losses are driven by damage to physical assets or reconstruction, there should be no losses in the housing market from HABs.

Bechard (2020, 2021) used Zillow data analyzed with hedonic valuation methods to examine changes in housing prices resulting from HABs.

Findings indicate that **housing sale prices decrease** in areas impacted by blooms.

- 10% - 30% impact in sale price for properties located 1 – 5 miles from the shore.

Longer blooms result in larger reductions in sale prices, but the relationship between bloom duration and reduction in sale prices is **non-linear**.

Environmental and Sustainability Indicators 5 (2020) 100019

Contents lists available at ScienceDirect

Environmental and Sustainability Indicators

journal homepage: www.journals.elsevier.com/environmental-and-sustainability-indicators/

External costs of harmful algal blooms using hedonic valuation: The impact of karenia brevis on Southwest Florida

Andrew Bechard [1]

University of Rhode Island, USA

ARTICLE INFO

Keywords:
Harmful algal blooms
Karenia brevis
Red tide
Florida gulf coast
Econometrics
Hedonic valuation

ABSTRACT

We use a hedonic valuation method to measure the costs of harmful algal blooms to properties in Southwest Florida. Persistent blooms of "red tide" have lasted for over months at a time and can render the appeal of the Gulf Coast useless, usually a valuable amenity to property prices in the area. We study property prices over a sixteen-year period during which, four major blooms plagued the coast. We find property prices within five miles of the coast decline about 10% during a persistent bloom. Property prices also decrease more, in a non-linear fashion as blooms persist for additional months. Our estimate of local costs, although the first of its kind for this region and this type of algae, is similar to those found elsewhere in the literature for different algae across the country. Our results show the importance of mitigation, as counties face tight budgets and must realize the full external costs of these blooms.

J Real Estate Finan Econ (2021) 62:242–257
https://doi.org/10.1007/s11146-020-09749-6

Gone with the Wind: Declines in Property Values as Harmful Algal Blooms Are Blown Towards the Shore

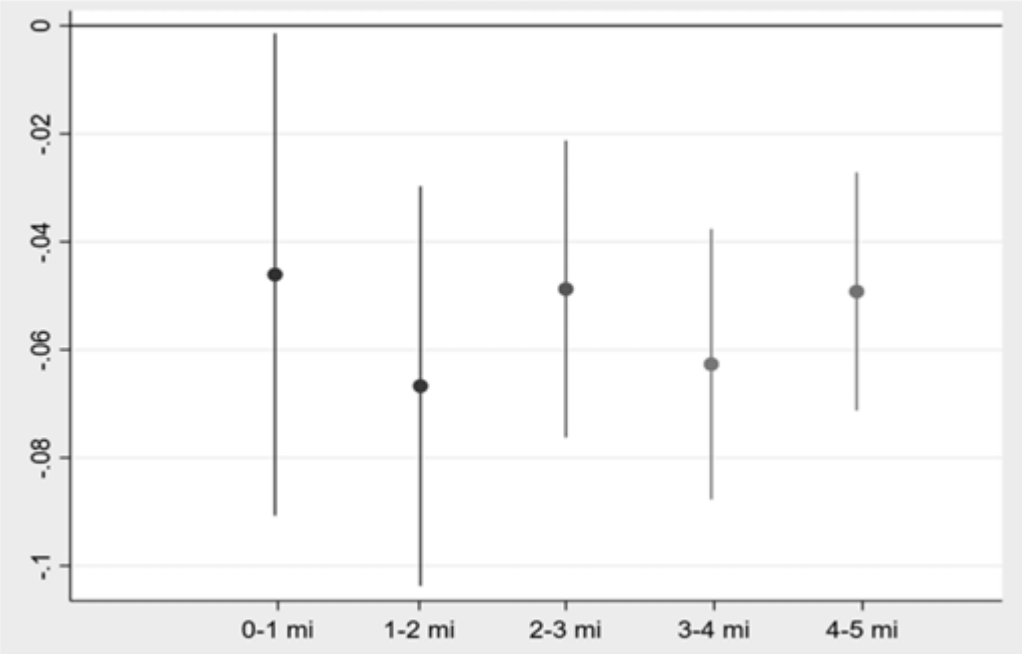
Andrew Bechard [1]

Published online: 14 February 2020

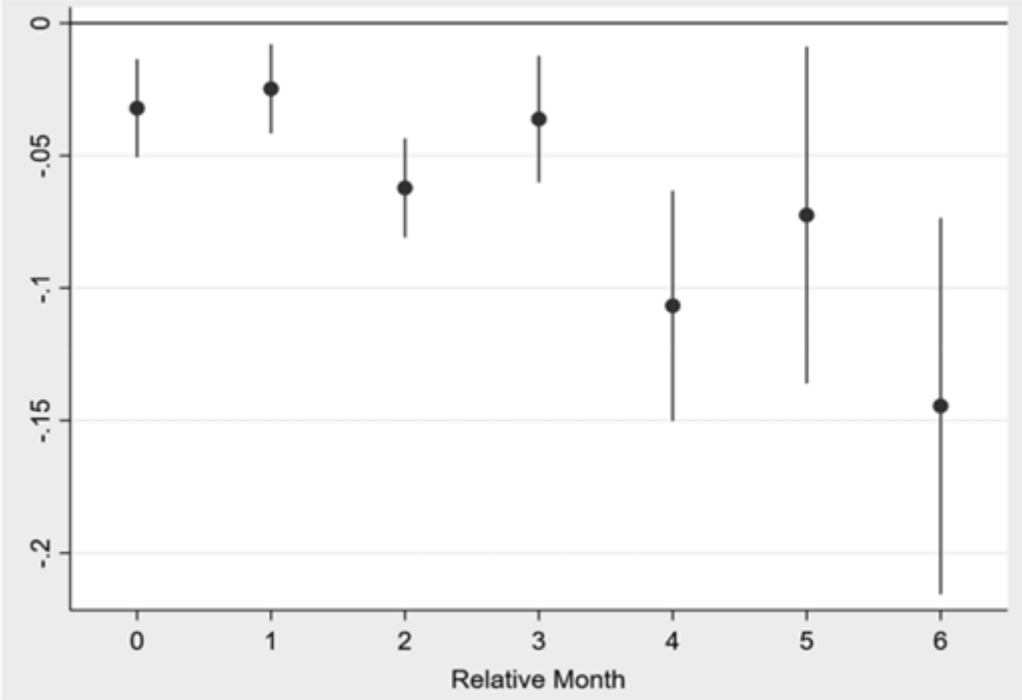
Abstract
Florida's Gulf Coast is known as a retirement hotspot, with property values along the coast rising faster than almost anywhere else in the country. However, the coastal amenities that help boost prices, quickly turn to dis-amenities when there is a prolonged red tide bloom in the Gulf. Using a difference in differences hedonic valuation model, we examine six Southwestern Florida counties heavily impacted by four major algal bloom in the past 20 years. We find that affected properties within 1 mile of the coast sell for up to 30% less compared to similar homes sold during the same month in an unaffected county. With red tide predicted to increase in frequency and severity, mitigation of the effects must be paramount for these counties. Losses occur in almost all sectors of the economy, and for a state that relies so much on the health of the environment, declines in property values are a sign that action must be taken against these blooms.

Keywords Harmful algal blooms · Karenia brevis · Red tide · Florida Gulf Coast · Difference-in-differences · Econometrics · Hedonic valuation

Bechard, A. (2020). External costs of harmful algal blooms using hedonic valuation: The impact of Karenia brevis on Southwest Florida. Environmental and Sustainability Indicators, 5, 100019.



Estimates of the effect of red tide on housing prices **by mile range**, along with 95% Confidence Intervals for all property types.



Estimates and 95% Confidence Intervals **for each month duration** of a bloom on housing prices compared to unaffected months for all property types.

* Two property types considered: Single family and multi-family

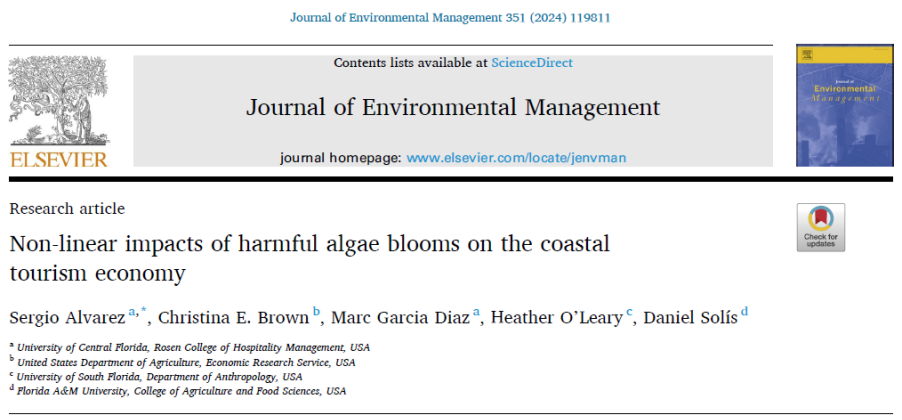
Proposition 3: HABs Reduce Visitation and Spending in Coastal Destinations

Studies by Bechard (2019, 2020) and Alvarez et al. (2024) that use panel data methods rely on data from the Florida Department of Revenue and the Florida Fish and Wildlife Conservation Commission.

Different econometric approaches have consistently shown that even though HABs do not destroy physical assets or drive reconstruction efforts, they do result in billion-dollar losses to the service industry.

Alvarez et al. (2024) estimated statewide losses from red tide in 2018 at **$2.7 billion**.

Higher concentrations of the red tide organism do not necessarily result in higher economic losses.



Journal of Environmental Management 351 (2024) 119811

Contents lists available at ScienceDirect

Journal of Environmental Management

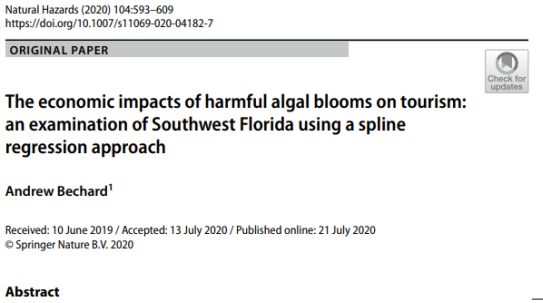
journal homepage: www.elsevier.com/locate/jenvman

Research article

Non-linear impacts of harmful algae blooms on the coastal tourism economy

Sergio Alvarez [a,*], Christina E. Brown [b], Marc Garcia Diaz [a], Heather O'Leary [c], Daniel Solís [d]

[a] University of Central Florida, Rosen College of Hospitality Management, USA
[b] United States Department of Agriculture, Economic Research Service, USA
[c] University of South Florida, Department of Anthropology, USA
[d] Florida A&M University, College of Agriculture and Food Sciences, USA



Natural Hazards (2020) 104:593–609
https://doi.org/10.1007/s11069-020-04182-7

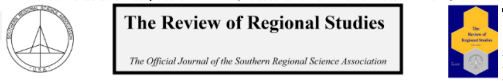
ORIGINAL PAPER

The economic impacts of harmful algal blooms on tourism: an examination of Southwest Florida using a spline regression approach

Andrew Bechard[1]

Received: 10 June 2019 / Accepted: 13 July 2020 / Published online: 21 July 2020

Abstract
Harmful algal blooms (HABs) can be a natural hazard unlike anything else. Whereas a hurricane or tornado has a sudden and devastating impact to an area, an HAB can slowly impact people and the environment over the course of weeks, even months. Karenia brevis, more commonly known as red tide, can have this effect along the Gulf Coast of Florida, lasting for many weeks in a row, causing large-scale deaths in fish and other marine life, and respiratory issues in humans. These harmful effects can effect tourism, as visitors are not able to enjoy the coastlines Florida is famous for. We test a 6 county re Pinellas County, FL down to Collier County, FL, to determine the magnitude v an additional day of red tide affects tourism-related revenues. Using a spline approach, we find that an additional day of red tide in a month with 17 days red tide drives monthly lodging sector sales down by 1–2%, and restaurant s down by 0.5–1%. As these blooms are increasing in frequency and persistency, of great importance to counties and effected businesses to control and mitiga blooms as soon as possible. If not, losses and harmful effects will only contin



The Review of Regional Studies
The Official Journal of the Southern Regional Science Association

Harmful Algal Blooms and Tourism: The Economic Impact to Counties in Southwest Florida*

Andrew Bechard

Department of Economics, University of Rhode Island, USA

Abstract: The most recent red tide bloom in the summer of 2018 served as a wake up call to ma in the Gulf region of Florida. The algal bloom decimated the coast, killing off scores of fish and mari life. As beaches were forced to close, tourists and residents alike were no longer producing usual econom activity on the shorelines. This, however, has happened before. We consider four major blooms from t past twenty years, two in 2005, one in 2006, and the aforementioned bloom in 2018. All lasted for over thr months and had significant impacts on the economy. We examine the effects of two industries, the lodgi and restaurant sectors, to determine the magnitude of losses in taxable sales caused by red tide. Using difference-in-differences model, we compare taxable sales in counties affected by red tide to those that were unaffected. We find that affected counties produce 5-7 percent and 1.5-2.5 percent less in the lodging and restaurant sectors, respectively. If red tide blooms become more frequent and persistent, losses for coastal businesses could also continue to grow. Policy and strategy to mitigate economics losses must take into consideration the harmful effects of these algal blooms.
Keywords: difference-in-differences, economics, harmful algal blooms (HABs), Karenia Brevis, red tide
JEL Codes: L83, M38, Q51

ABSTRACT

Harmful algae blooms (HABs) occur in water bodies throughout the globe and can have multi-faceted impacts on tourism. However, little is known of the magnitude of economic losses to the tourism sector as a result of HABs. There is limited understanding of the empirical relationships between HAB intensity and duration, and the effects of this phenomenon on the tourism sector. This study is based in the state of Florida, USA, a notable sun, sand, and sea destination in the western hemisphere, where blooms of a marine harmful algae are a recurrent threat to coastal tourism. The empirical framework is based on a month and county-level panel database that combines sales by tourism-related businesses with observations from the official HAB surveillance system of the state of Florida. We use time and space fixed-effects regressions to estimate the loss in tourism revenue associated with one additional day of red tide. Results indicate that impacts of HABs on tourism do not follow a linear pattern with increasing HAB concentrations, but rather appear to follow an inverted-U pattern. In other words, higher concentrations of the HAB organism do not necessarily imply higher economic losses, suggesting that the impacts of HABs on tourism are not driven solely by the biophysical element of cell density. Rather, these impacts appear to be mediated and amplified by human dimensions. The loss to tourism-related businesses due to the 2018 Florida red tide bloom was estimated to be $2.7 billion USD, which implies that HABs and their impact on tourism can be considered as a potential 'billion-dollar' disaster.

Harmful Algae 85 (2019) 101689

Contents lists available at ScienceDirect

Harmful Algae

journal homepage: www.elsevier.com/locate/hal

Red tide at morning, tourists take warning? County-level economic effects of HABS on tourism dependent sectors

Andrew Bechard

Department of Environmental and Natural Resource Economics, University of Rhode Island, 45 Upper College Rd, Kingston, RI 02881, United States

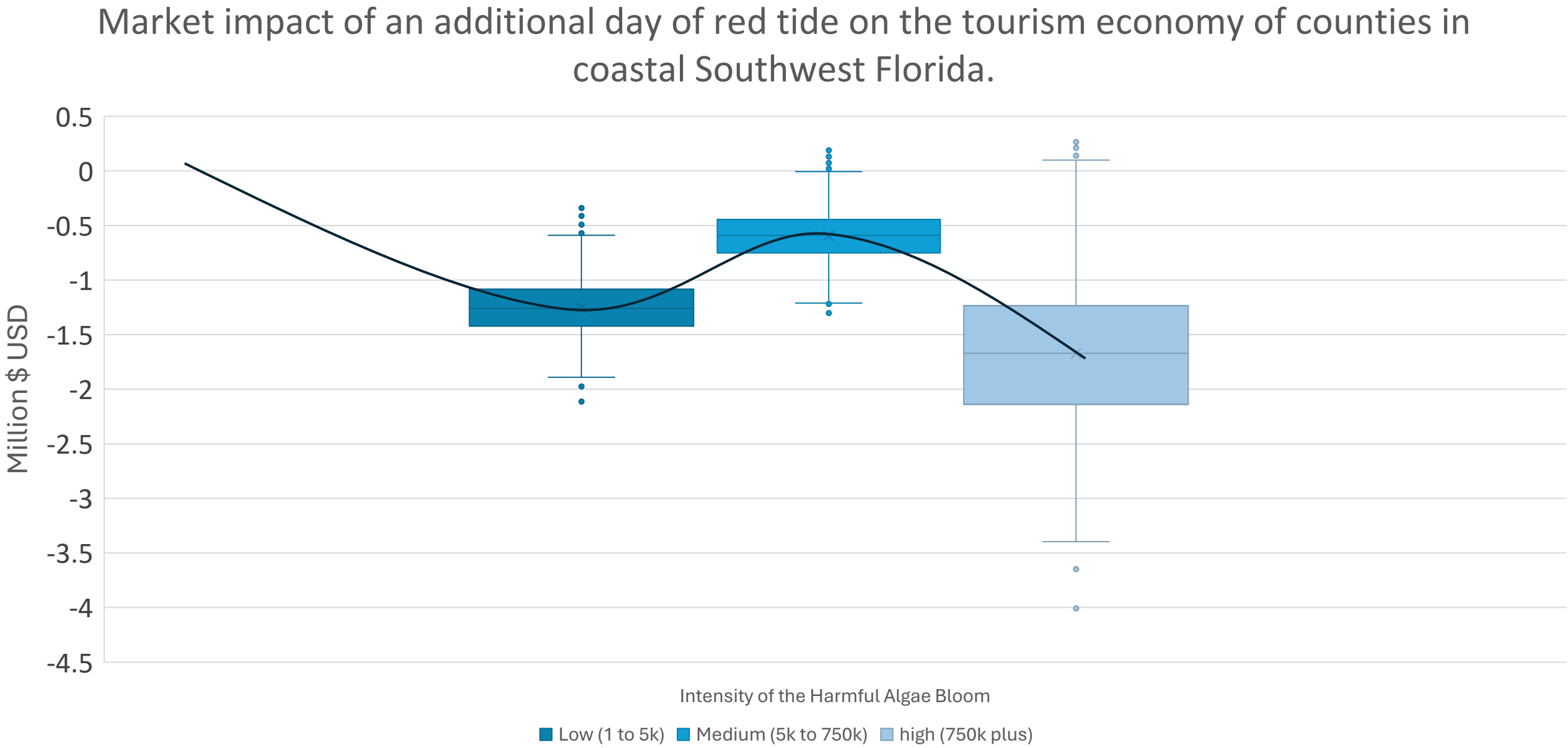
ARTICLE INFO

Keywords:
Economics
Harmful Algal Blooms (HABs)
Karenia Brevis
Red tide
Time series
ARIMA modeling

ABSTRACT

A tourism dependent state such as Florida relies on its environment and climate to attract visitors and generate revenue. HABs can certainly have an impact on the coastal waters of the Gulf, but does this necessarily drive away tourist related activity? To determine not only if the impact of HABs is significant, but also at what magnitude, a time series econometric model was used to study effects of persistent and severe blooms on counties in Southwestern Florida, particularly Sarasota County, hit hardest by blooms in 2006 and 2018 that lasted multiple months. Lodging and restaurant sectors of the economy were found to have monthly losses of 15% and 1.75% respectively, during months when red tide was present. Neighboring counties unaffected by severe blooms did not experience significant losses to these sectors. These results support the intuition that effects of HABs reach far beyond the waters of the Gulf, and as red tide grows in frequency and severity, more economic loss could lie ahead.

Alvarez, S., Brown, C. E., Diaz, M. G., O'Leary, H., & Solís, D. (2024). Non-linear impacts of harmful algae blooms on the coastal tourism economy. Journal of Environmental Management, 351, 119811.



Proposition 4: HABs Foster Social and Political Division and Polarization

Policies and management decisions in the marine environment are driven in part by public sentiment, which can grow more intense during hazard events like HABs.

Oleary et al. (2024) used machine learning to mine and analyze Twitter posts surrounding the 2017-2019 Florida red tide bloom.

The public conversations on social media sites reveal the polarized nature of HABs through nuanced language and sentiment.

Results show that there are topical differences in keywords related to place (e.g. beach, Florida, coast), agent (individual or organization), and epistemic values (reliance on scientific and/or media reports). These topical differences demonstrate different levels of politicization and partisanship.

Journal of Environmental Management 357 (2024) 120799

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

What's in a name? Political and economic concepts differ in social media references to harmful algae blooms

Heather O'Leary [a,*], Sergio Alvarez [b], Frida Bahja [c]

[a] Department of Anthropology, University of South Florida, USA
[b] Rosen College of Hospitality Management, University of Central Florida, USA
[c] Tourism Researcher, Visit Savannah, Georgia

ARTICLE INFO

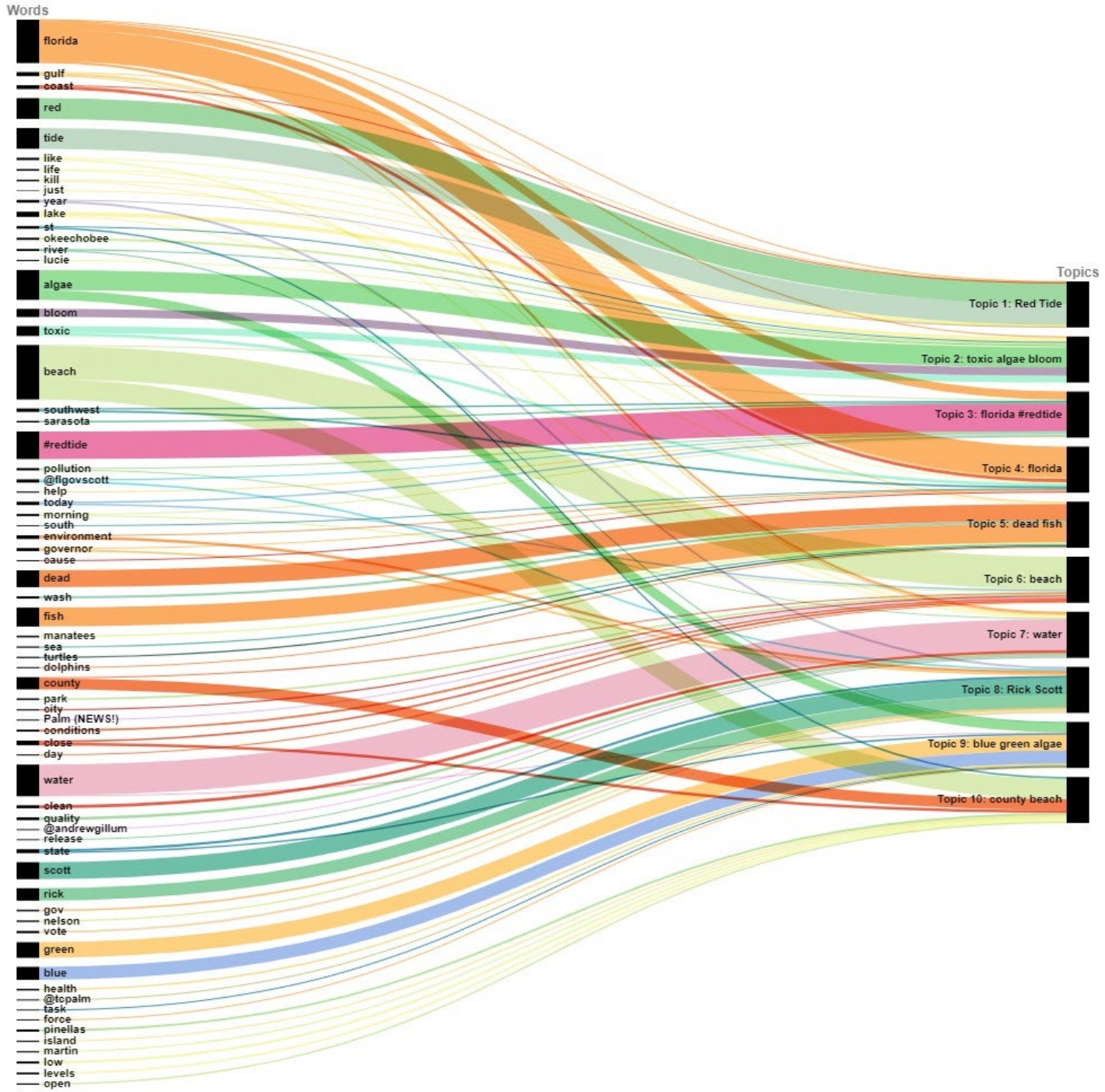
Handling editor: Lixiao Zhang

Keywords:
Discourse
Social media
Politics
Qualitative
Human dimensions
Harmful algae bloom
Red tide

ABSTRACT

Policies and management decisions in the marine environment are driven in part by public sentiment which can grow more intense during hazard events like Harmful Algae Blooms (HABs). The public conversations on social media sites like Twitter (before X) reveal the polarized nature of HABs through nuanced language and sentiment. This article uses mixed methods of machine learned topic modeling and inductive qualitative coding to describe the ways the long-term 2017–2019 *Karenia brevis* "red tide" bloom were politicized across Florida's South West coast. It finds that there are topical differences in keywords related to place (e.g. beach, Florida, coast), agent (individual or organization), and epistemic values (reliance on scientific and/or media reports). These topical differences demonstrate different levels of politicization and partisanship in qualitative analysis. Conceptually, this research demonstrates the ways different dimensions of a long-duration marine hazard can be polarized. Regarding management, this research provides insights to political and organizational stakeholders and the gaps in the discourse shaping marine hazards which can be used to strategically guide future social media engagement to manage politicization.

What if all the careful work that resource and environmental managers do can be undone by simple, seemingly uncontroversial words? In an era of increased environmental and marine distress—coupled with short format communication—the ways environmental managers choose their words is crucial, even between ostensibly inconsequential nouns like "red tide" or "algae bloom." Policies and management decisions in the marine environment are driven in part by public sentiment which can grow more intense during hazard events like Harmful Algae Blooms (HABs). The public conversations on social media sites like Twitter (before X) reveal the polarized nature of HABs through nuanced language and sentiment. This article relies on mining social media posts, and uses mixed methods of machine-learned topic modeling and human-driven inductive qualitative coding to describe the ways the long-term 2017–2019 *Karenia brevis* "red tide" blooms were politicized across Florida's South West coast. It finds that there are topical differences in keywords related to place (e.g. beach, Florida, coast), agent (individual or organization), and epistemic values (reliance on scientific and/or media reports). These topical differences demonstrate different levels of politicization and partisanship in qualitative analysis. Conceptually, this research demonstrates the ways different dimensions of a long-duration marine hazard can be polarized. Regarding management, this research provides insights to political and organizational stakeholders and the gaps in the discourse shaping marine hazards which can be used to strategically guide future social media engagement to manage politicization.



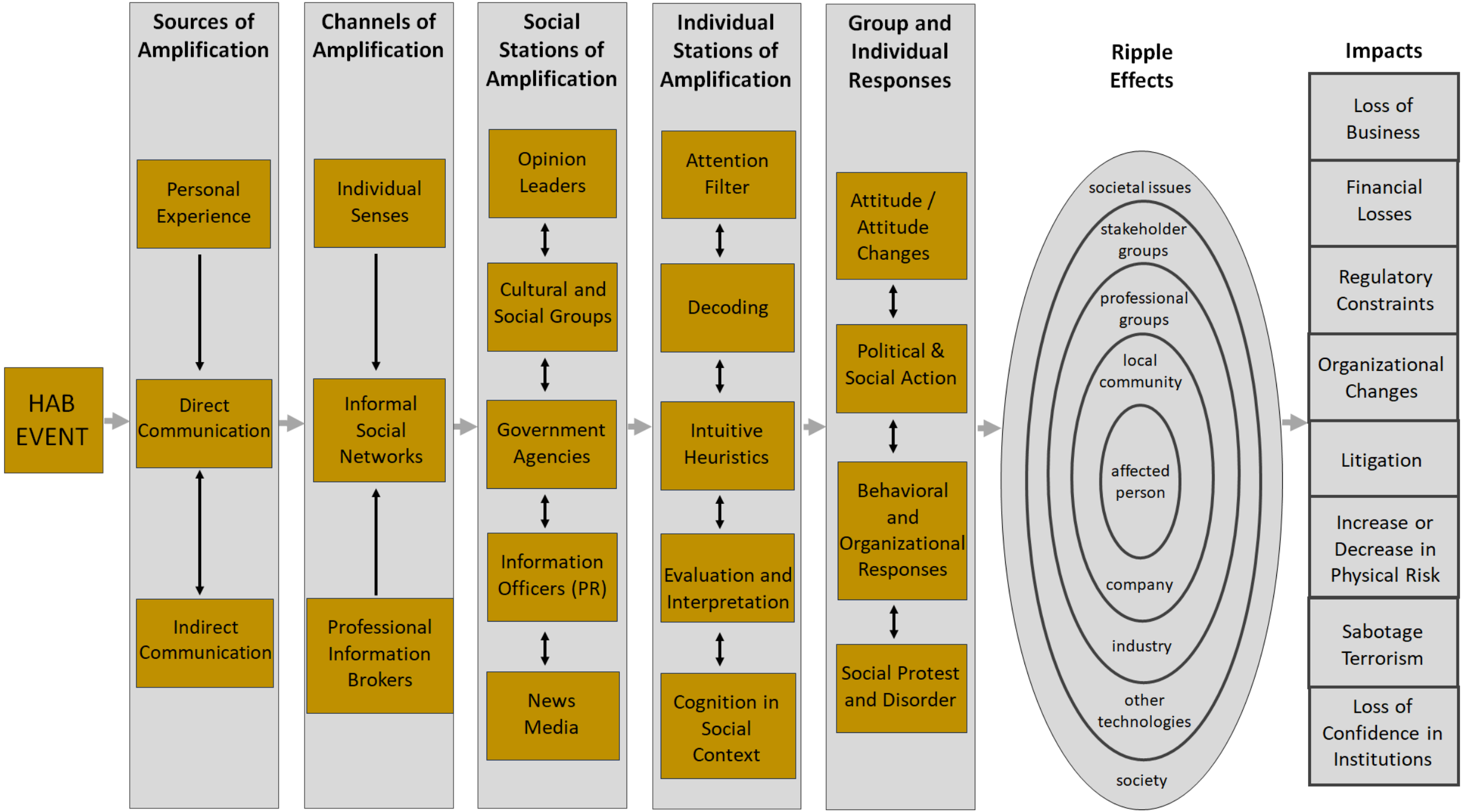
O'Leary, H., Alvarez, S., & Bahja, F. (2024). What's in a name? Political and economic concepts differ in social media references to harmful algae blooms. Journal of Environmental Management, 357, 120799.

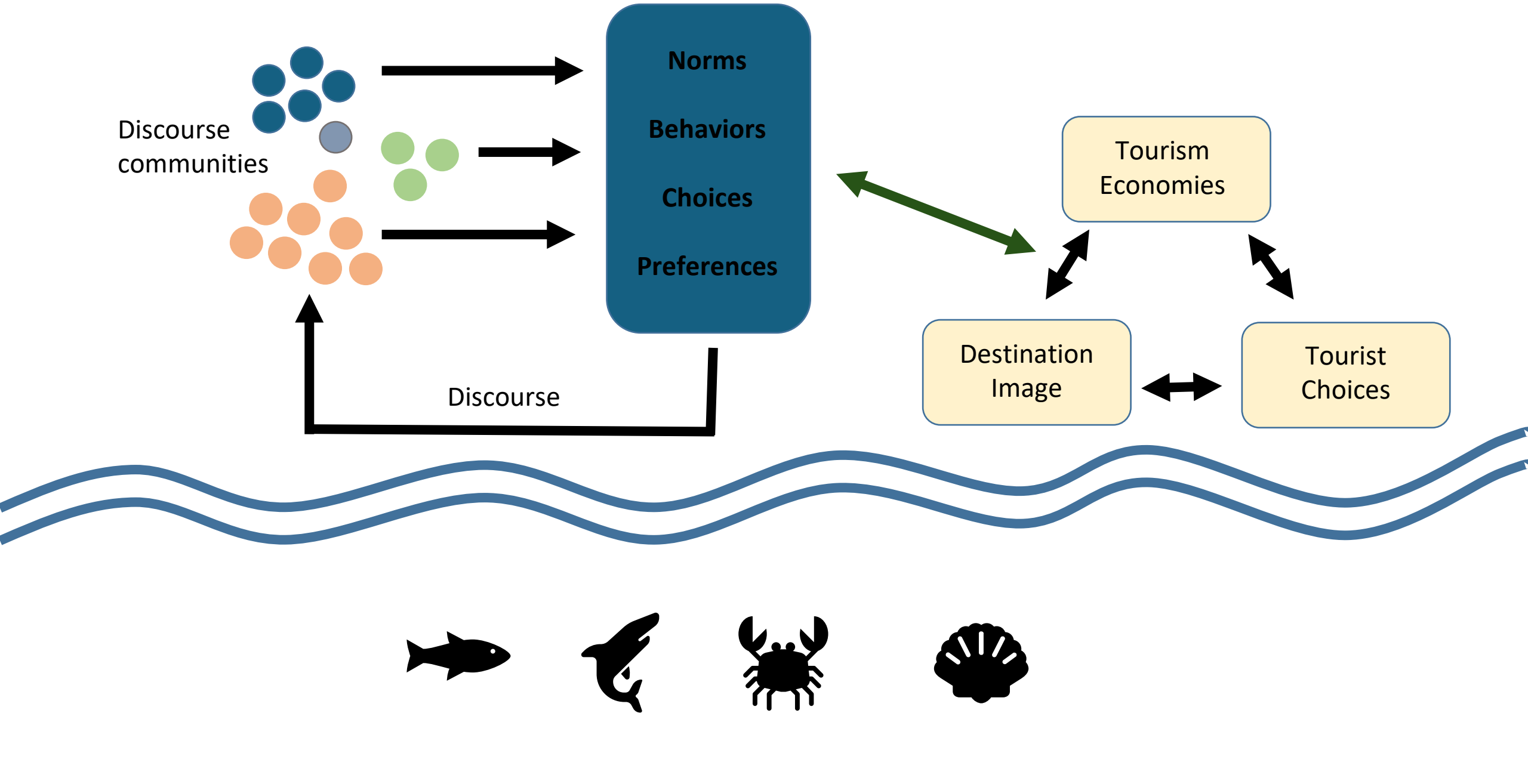
Are HABs unique, or is conventional wisdom missing something?

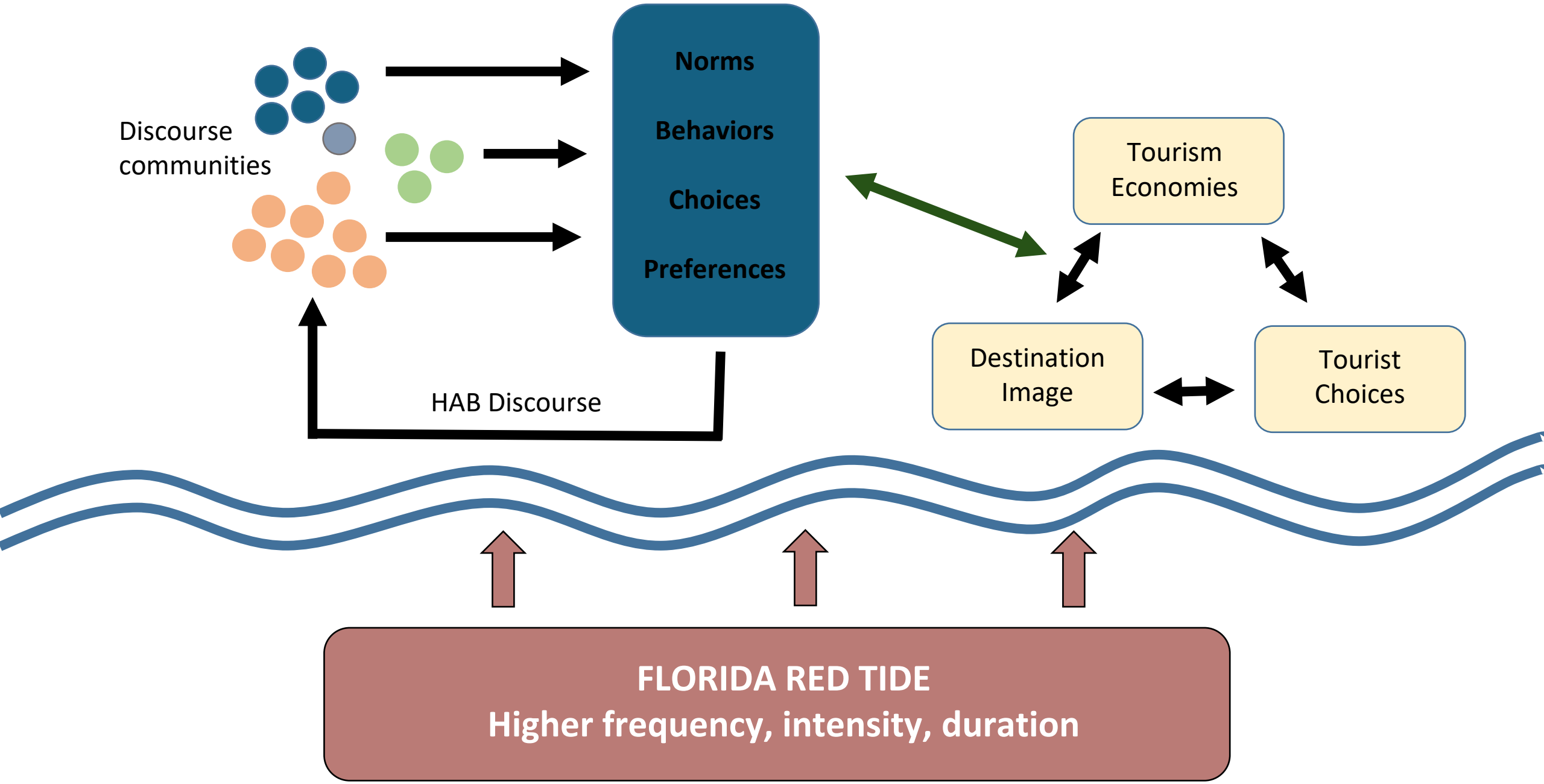
The theory of **social amplification of risk** (Kasperson et al. 1988) posits that social aspects could be responsible for the amplification or attenuation of risk.

In other words, the **magnitude of impacts** from risk events—relative to the event's biophysical characteristics—could be increased or decreased by social factors.

The theory highlighted the **role of information** and **communication** as an **amplifier of risk**, but other social aspects of risk have been identified (e.g., Kasperson, 2014).


HAB EVENT
Sources of Amplification
Personal Experience
Direct Communication
Indirect Communication
Channels of Amplification
Individual Senses
Informal Social Networks
Professional Information Brokers
Social Stations of Amplification
Opinion Leaders
Cultural and Social Groups
Government Agencies
Information Officers (PR)
News Media
Individual Stations of Amplification
Attention Filter
Decoding
Intuitive Heuristics
Evaluation and Interpretation
Cognition in Social Context
Group and Individual Responses
Attitude / Attitude Changes
Political & Social Action
Behavioral and Organizational Responses
Social Protest and Disorder
Ripple Effects
societal issues
stakeholder groups
professional groups
local community
affected person
company
industry
other technologies
society
Impacts
Loss of Business
Financial Losses
Regulatory Constraints
Organizational Changes
Litigation
Increase or Decrease in Physical Risk
Sabotage Terrorism
Loss of Confidence in Institutions


Discourse communities
Norms
Behaviors
Choices
Preferences
Discourse
Tourism Economies
Destination Image
Tourist Choices


Discourse communities
Norms
Behaviors
Choices
Preferences
HAB Discourse
Tourism Economies
Destination Image
Tourist Choices
FLORIDA RED TIDE
Higher frequency, intensity, duration

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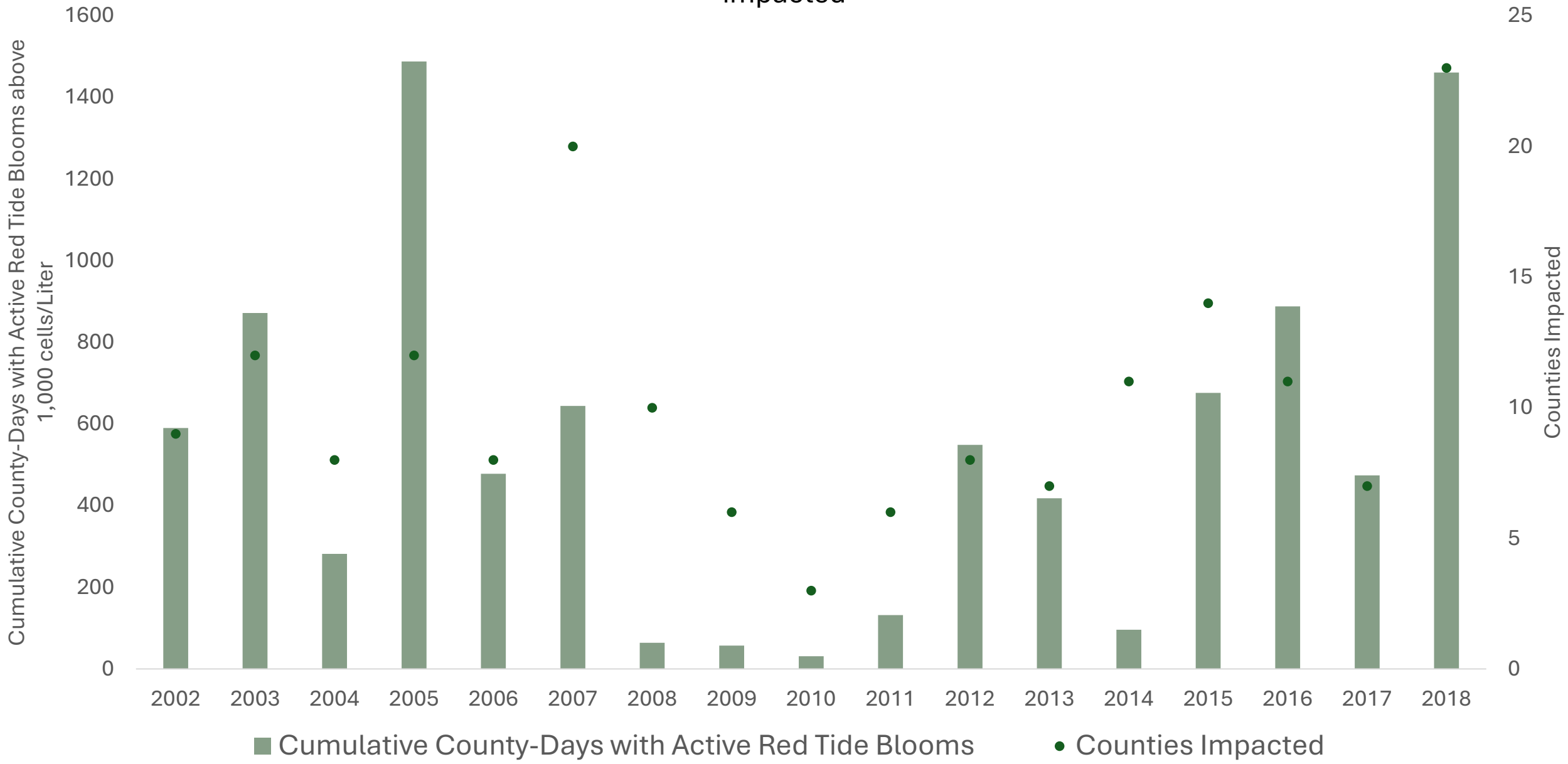
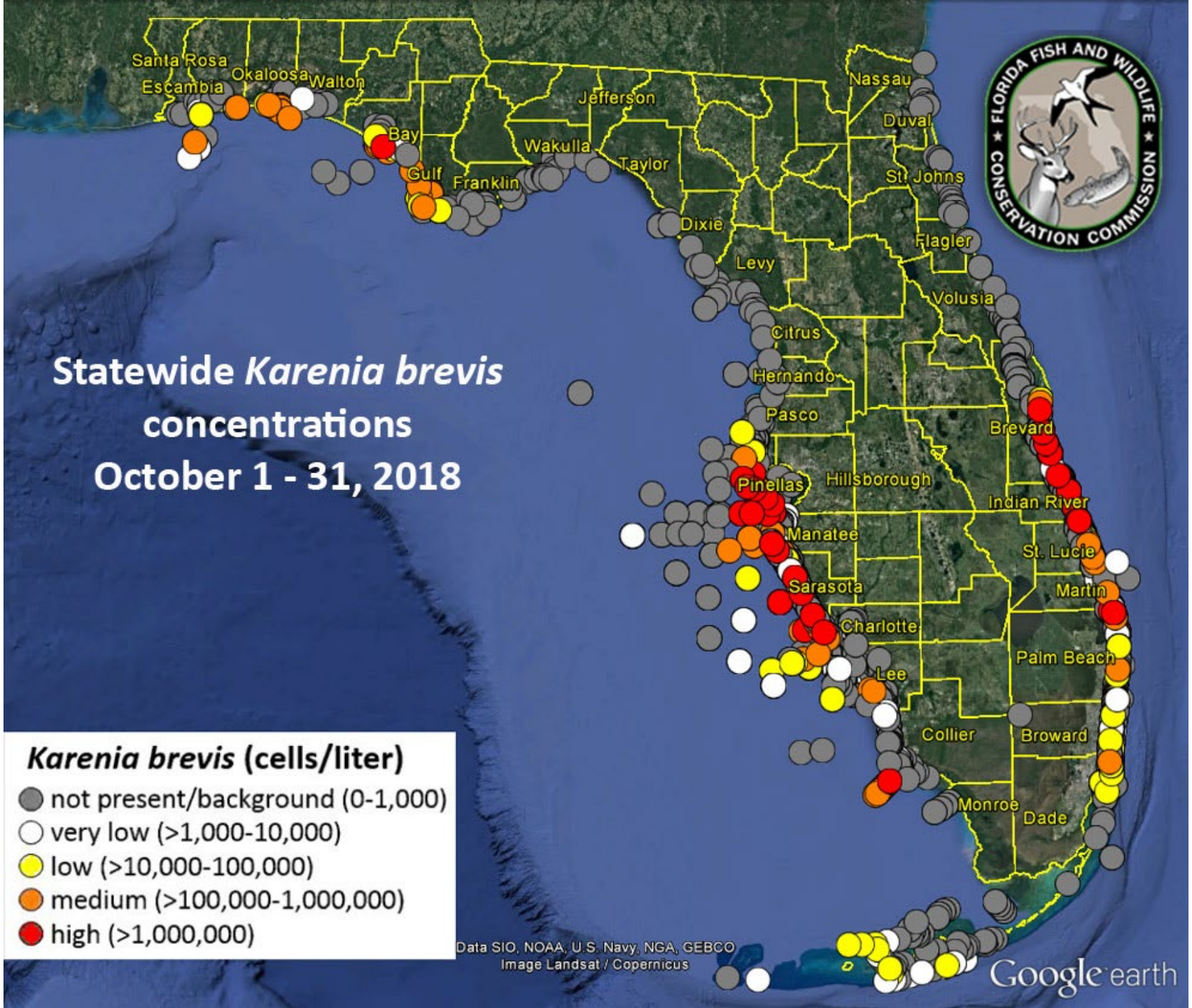


Data from the Florida Fish and Wildlife Conservation Commission


Statewide *Karenia brevis* concentrations
October 1 - 31, 2018
Santa Rosa
Escambia
Okaloosa
Walton
Bay
Jefferson
Wakulla
Taylor
Gulf
Franklin
Dixie
Levy
Nassau
Duval
St. Johns
Flagler
Volusia
Citrus
Hernando
Pasco
Pinellas
Hillsborough
Manatee
Sarasota
Charlotte
Lee
Collier
Brevard
Indian River
St. Lucie
Martin
Palm Beach
Broward
Monroe
Dade
Karenia brevis (cells/liter)
not present/background (0-1,000)
very low (>1,000-10,000)
low (>10,000-100,000)
medium (>100,000-1,000,000)
high (>1,000,000)
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google earth