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# Integrating scientific and local knowledge to address socio-ecological impacts of red tide on Florida's west coast



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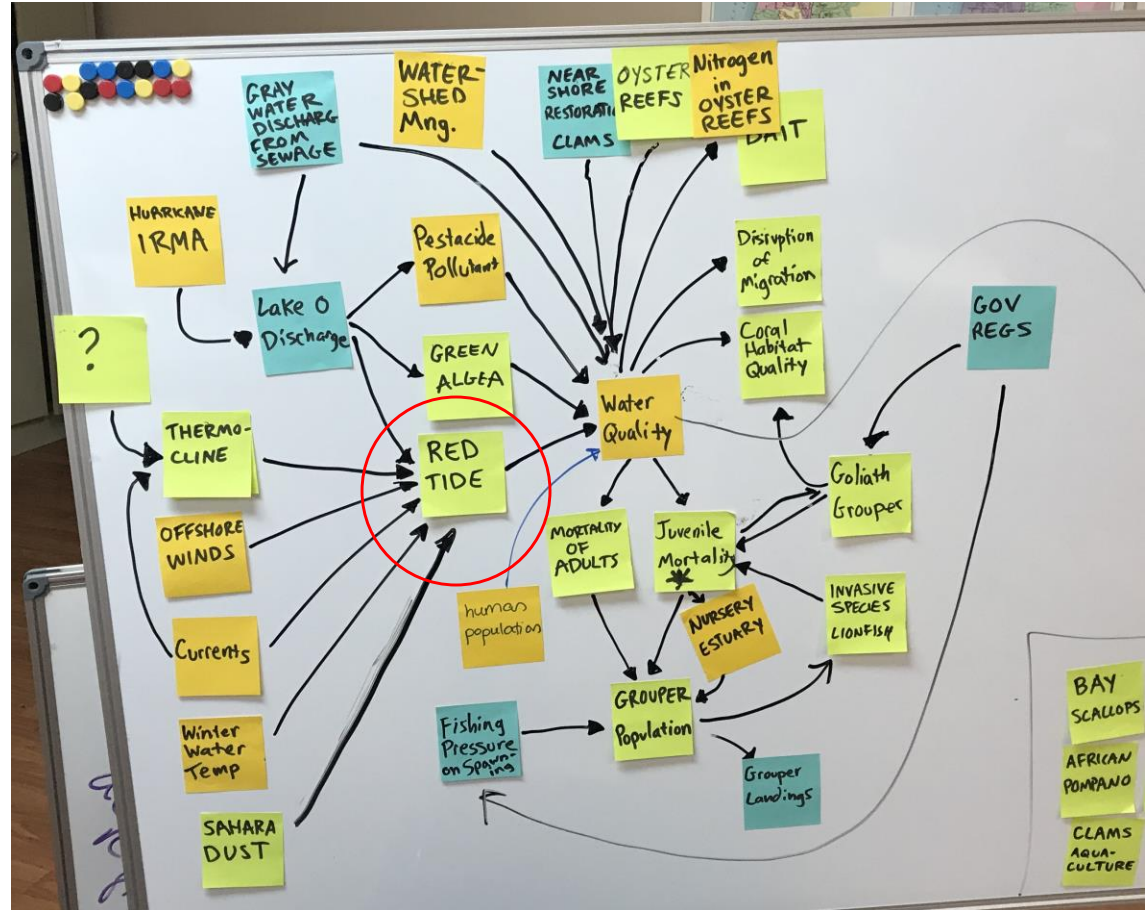
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# 2018 Workshop Highlights Negative Impacts of Red Tide



# Red Tide in West Florida

- HAB caused by brevetoxin producing dinoflagellate *Karenia brevis*
- Normal in Gulf of Mexico.
- But increasing number of long-lasting red tide events in last 20 years
- Environmental impacts increase with longer duration and extent
  - Mass mortalities/fish kills
  - Habitat loss
  - Disrupted migration patterns
  - Delayed fish population recovery.



Source: FWC



Source: New York Times, 8/31/18



Fish kills on Sanibel Island, Source: NPR, 8/23/2018



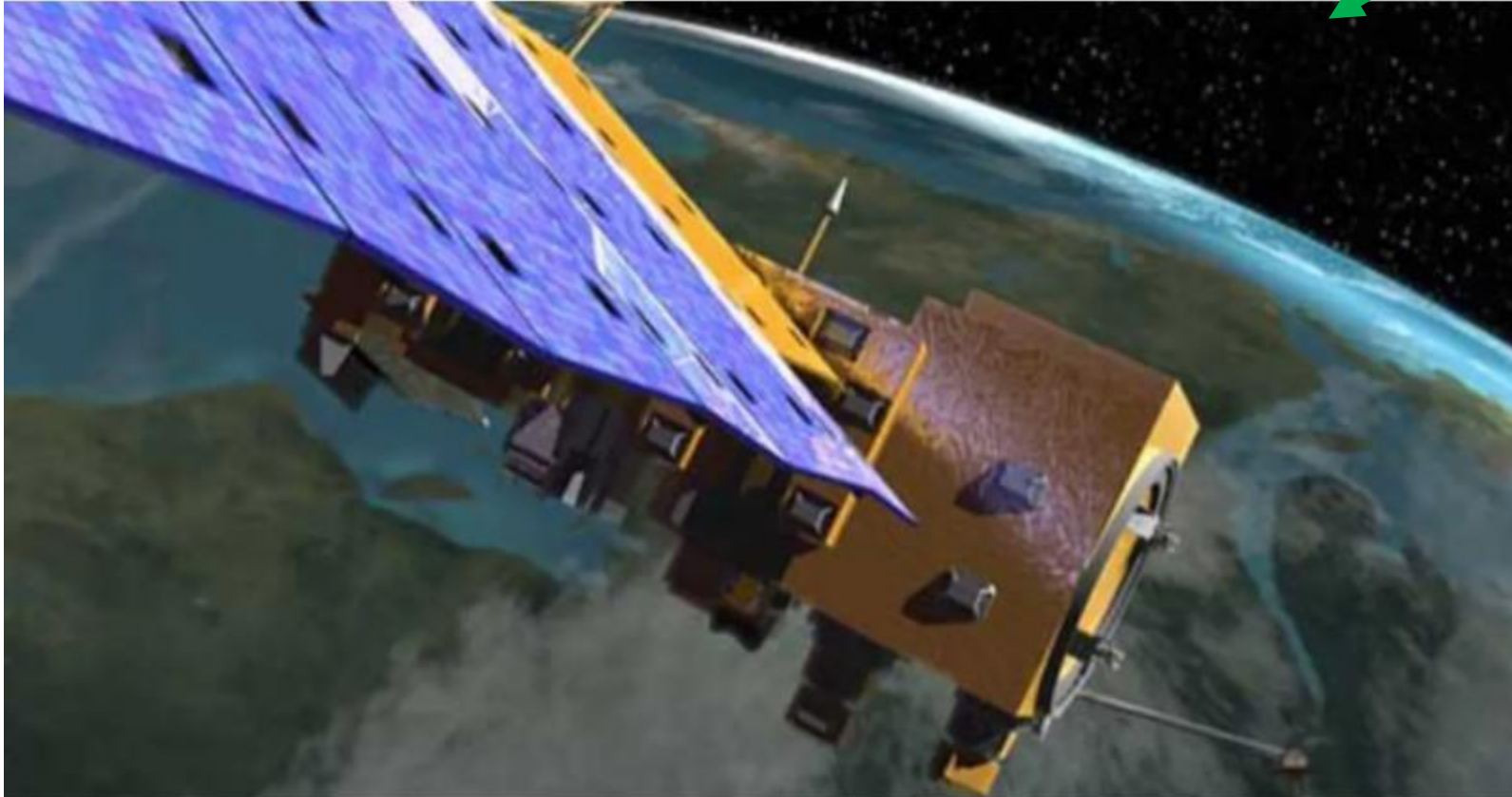
# Social and Economic Impacts

- Decrease in tourist visitation
  - Hotels and restaurants
  - Charter industry
- Commercial fisheries disrupted
- Decline in sale of local finfish and shellfish (seafood safety concerns)
- Aquaculture (clam and oyster) harvests lost
- Real estate values decrease
- Public health affected

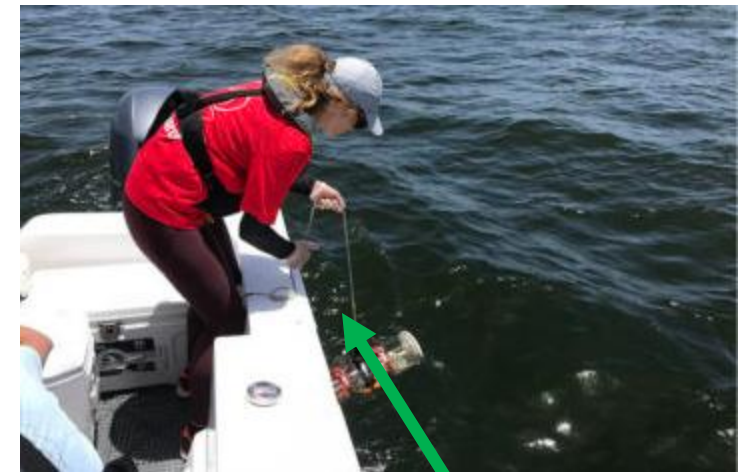


# Normal Data Sources on Red Tides

Surface blooms  
Offshore areas  
Since 1999



Water Sampling during the 2017-2019 Red Tide. Photo credit: Florida Fish and Wildlife Conservation Commission



Inshore sampling  
Since 1954

MODIS: Moderate Resolution Image Spectroradiometer Satellite





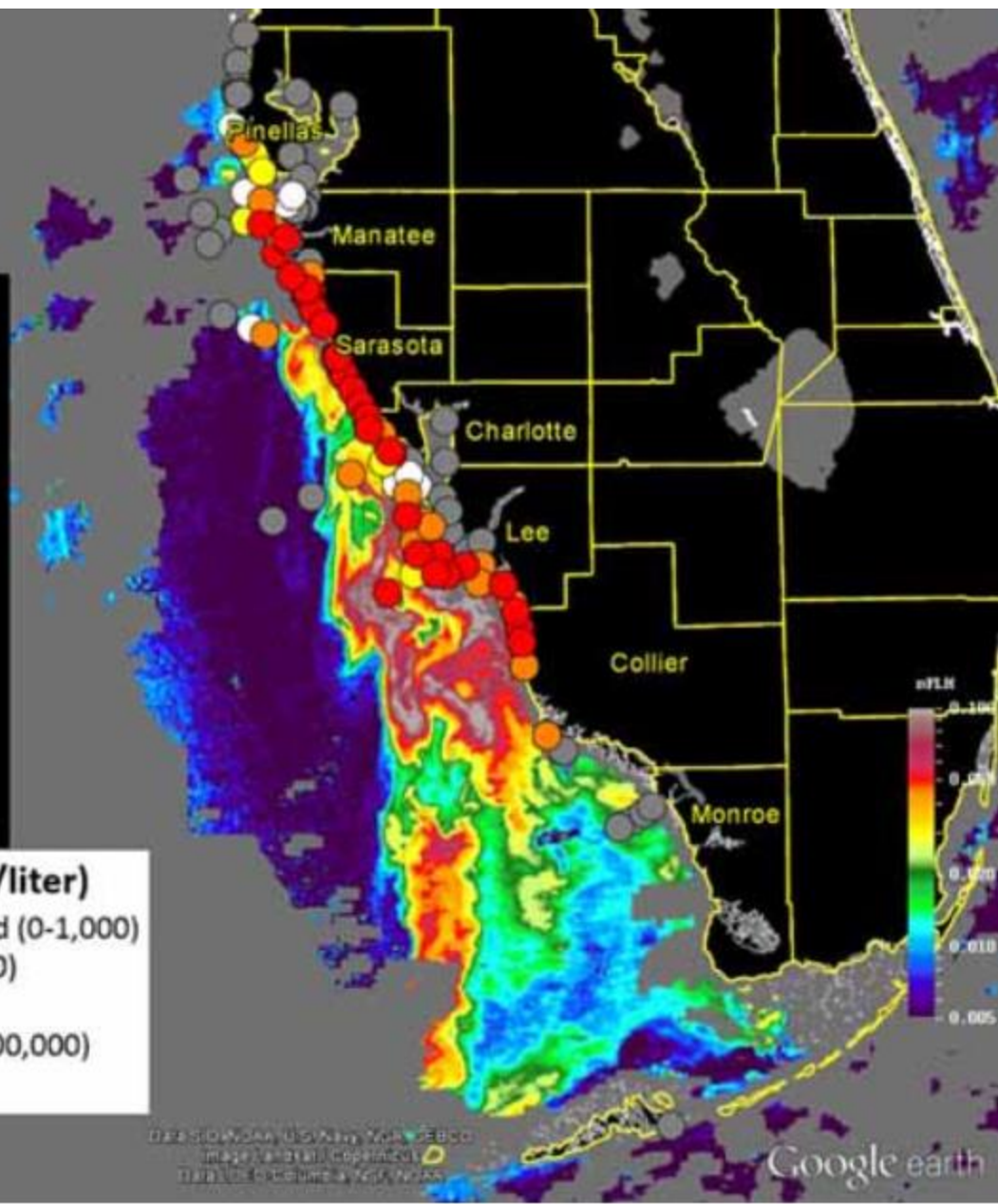
### Southwest Coast *Karenia brevis* concentrations 08/14/2018 – 08/21/2018

*Karenia brevis* cell abundance is shown here overlaid on ocean color satellite images (showing normalized fluorescence line height, or nFLH, an index of chlorophyll *a*) from 08/21/2018, provided by the Integrated Red Tide Information System (IRIS) at <http://optics.marine.usf.edu/projects/iris.html>. The hotter colors in the image show higher levels of chlorophyll *a*, and the grey represents cloud cover.

NOTE: Sampling efforts for other areas are not depicted on this map.

### *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 Gaps

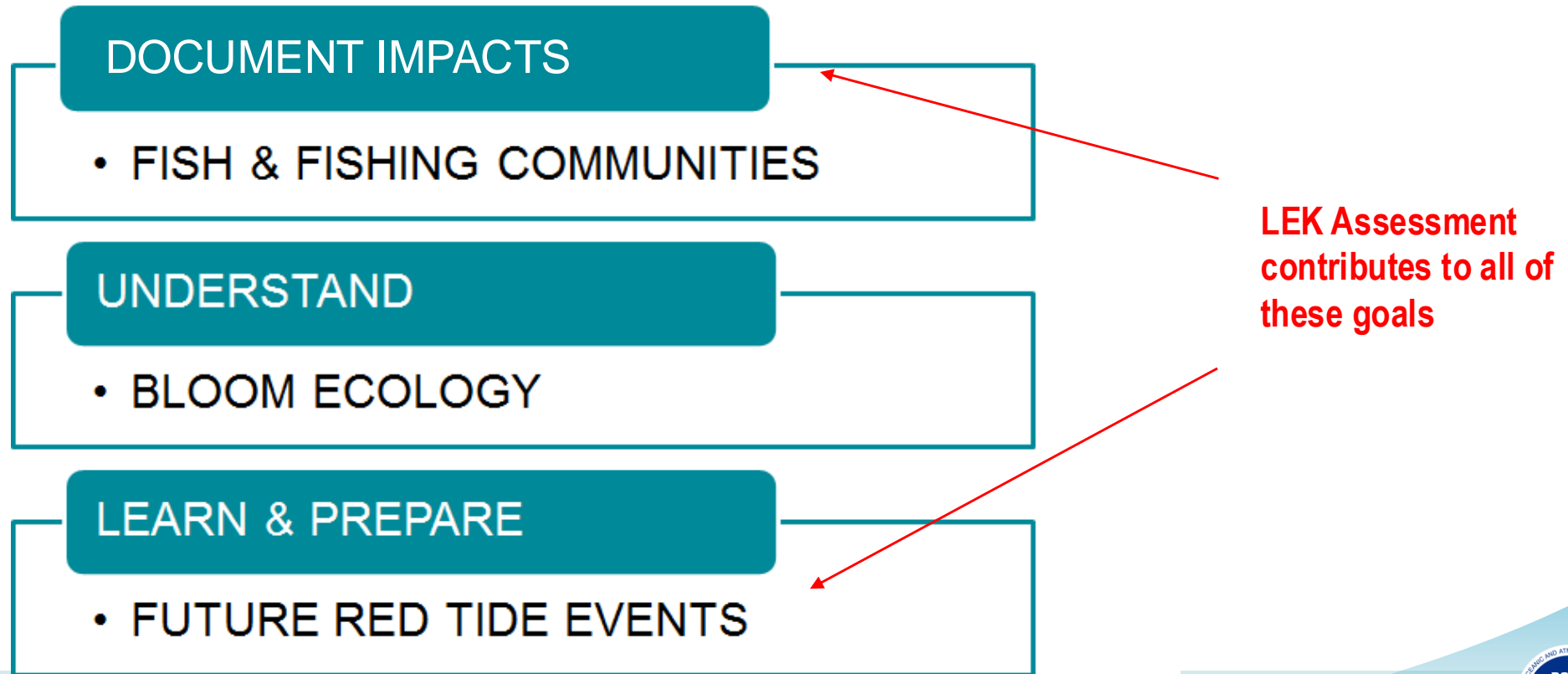
- Severity Patterns
- Ecosystem Impacts
- Resilience



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# Red tide response plan

- **Interdisciplinary and Collaborative:** Sustainable Fisheries, Social Sciences, Protected Resources, Ocean Chemistry and Ecosystems, external partners from Universities and NGOs;
- **Stakeholder engagement and LEK focus**



# Incorporating LEK: Objectives and Methods

## Methods

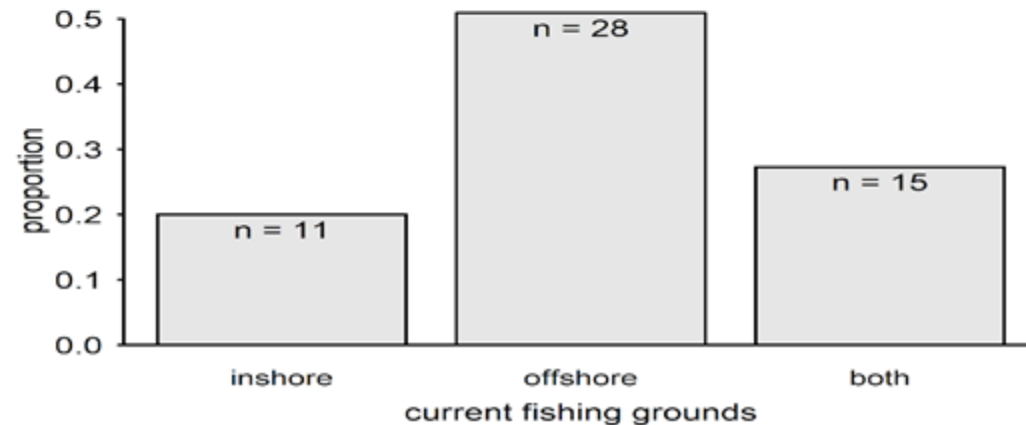
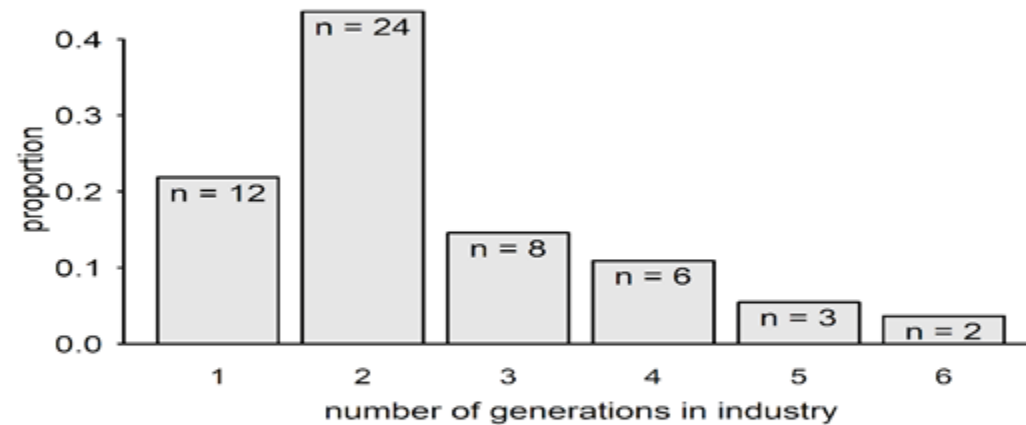
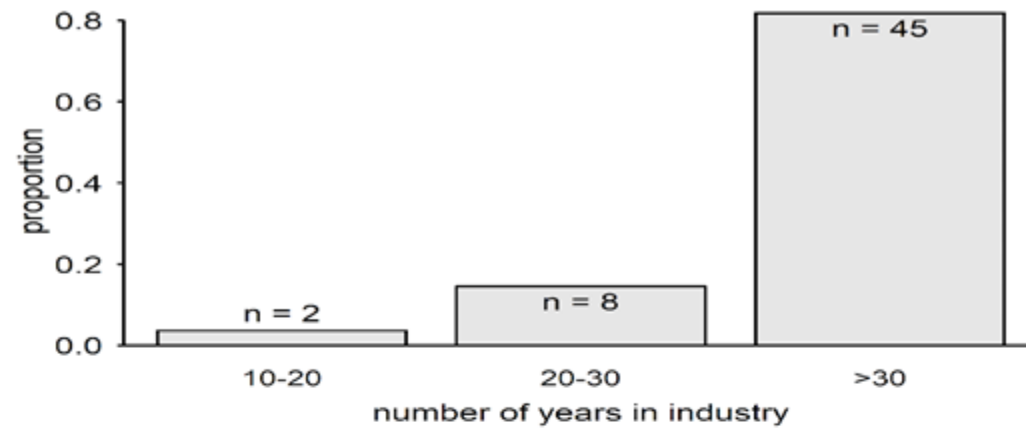
- 54 oral histories & participatory mapping
- Interdisciplinary teams
- Snowball sampling
- Commercial and for-hire fishermen

## Objectives

- How have red tides varied in time, space and severity?
- What are the impacts of red tides on fish populations, habitats, fishing businesses and communities?
- What are ecological signals and hypotheses of red tide event occurrence and intensity?
- How have fishermen and fishing businesses adapted to red tide?



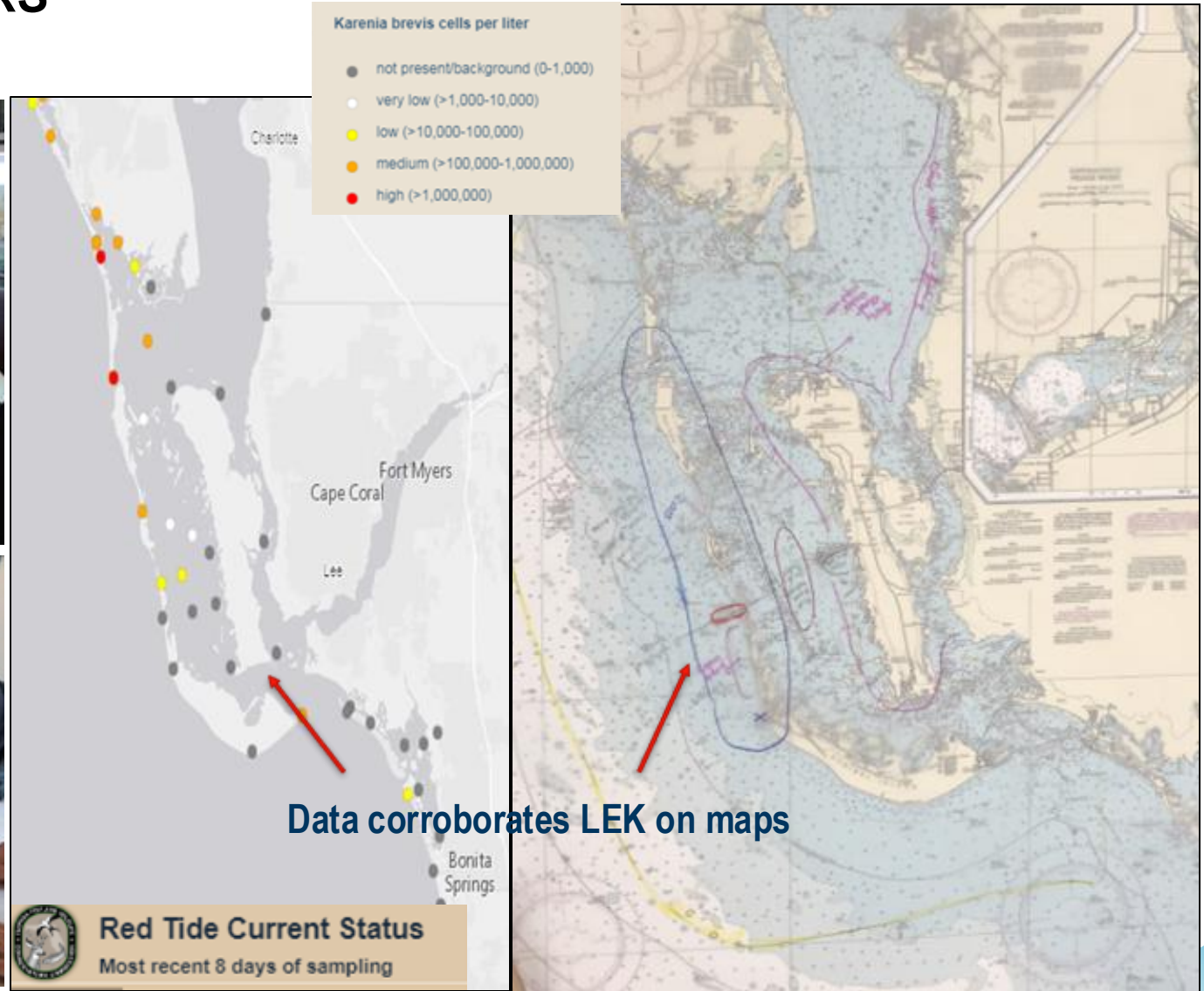




**SOCIAL  
SCIENTIST**

**FISHERY  
BIOLOGIST**

**FISHERS**







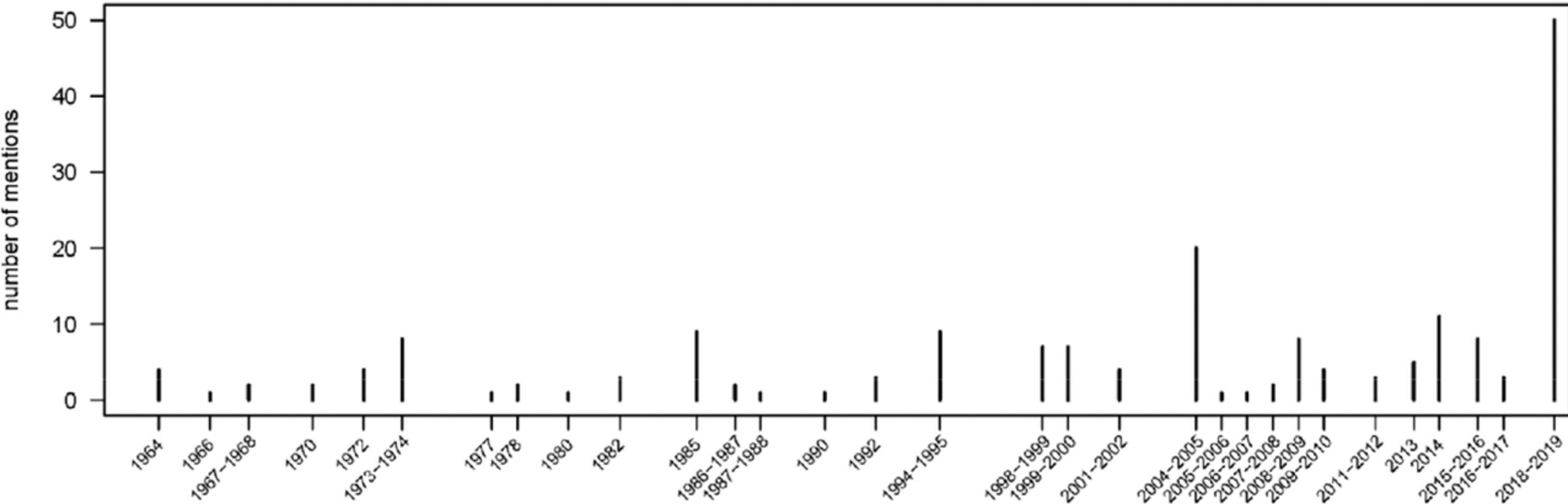


# Findings and Outcomes

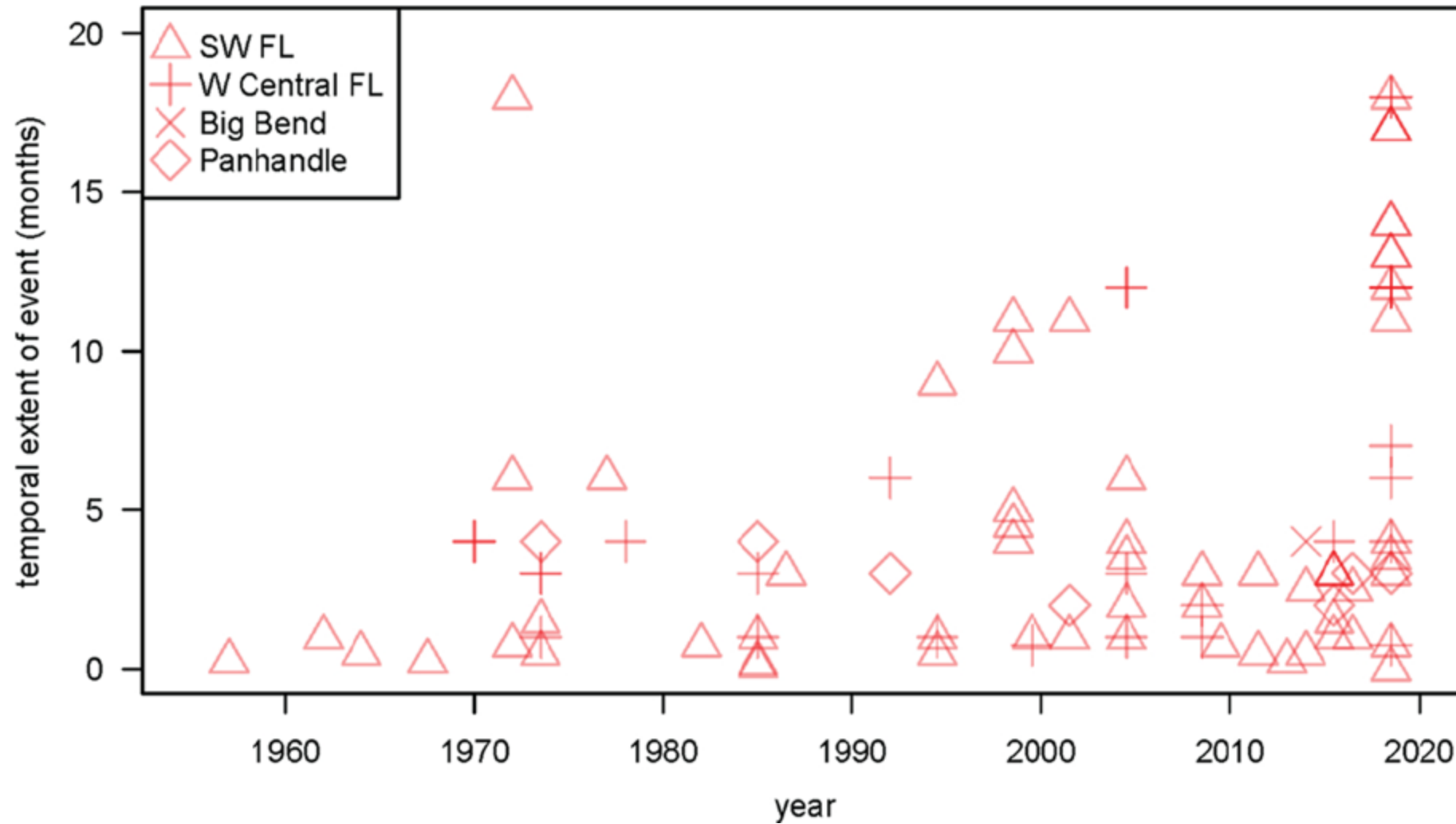
1. Red Tide Occurrences
2. Red Tide Severity by Location
3. Fishermen Resilience Factors
4. Fishermen Causes and Solutions
5. Management Outcomes

# Red Tide Occurrences

Red tide occurrences by number of mentions



# Red Tide Severity by Location and Spatial Extent



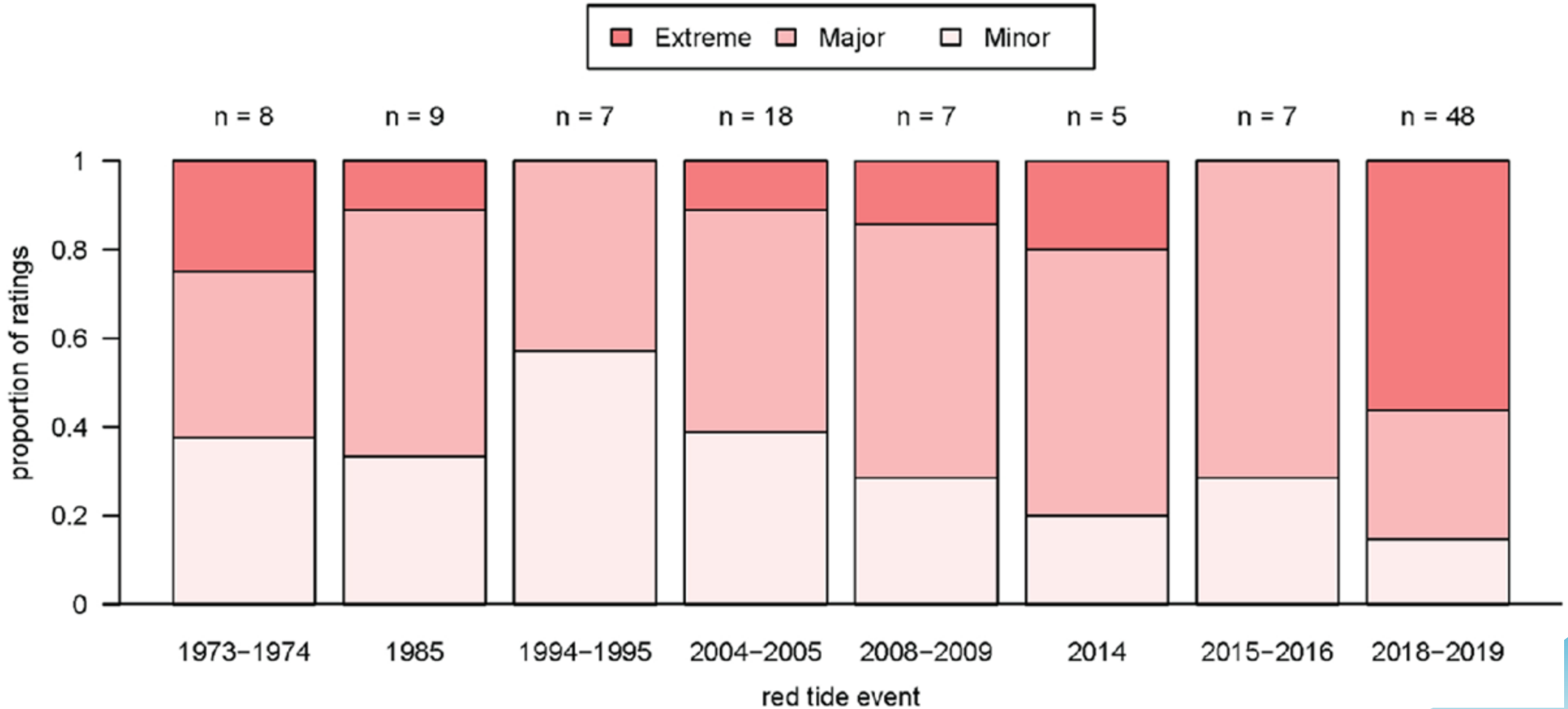


# Severity of Major Red Tide Events (Coding)

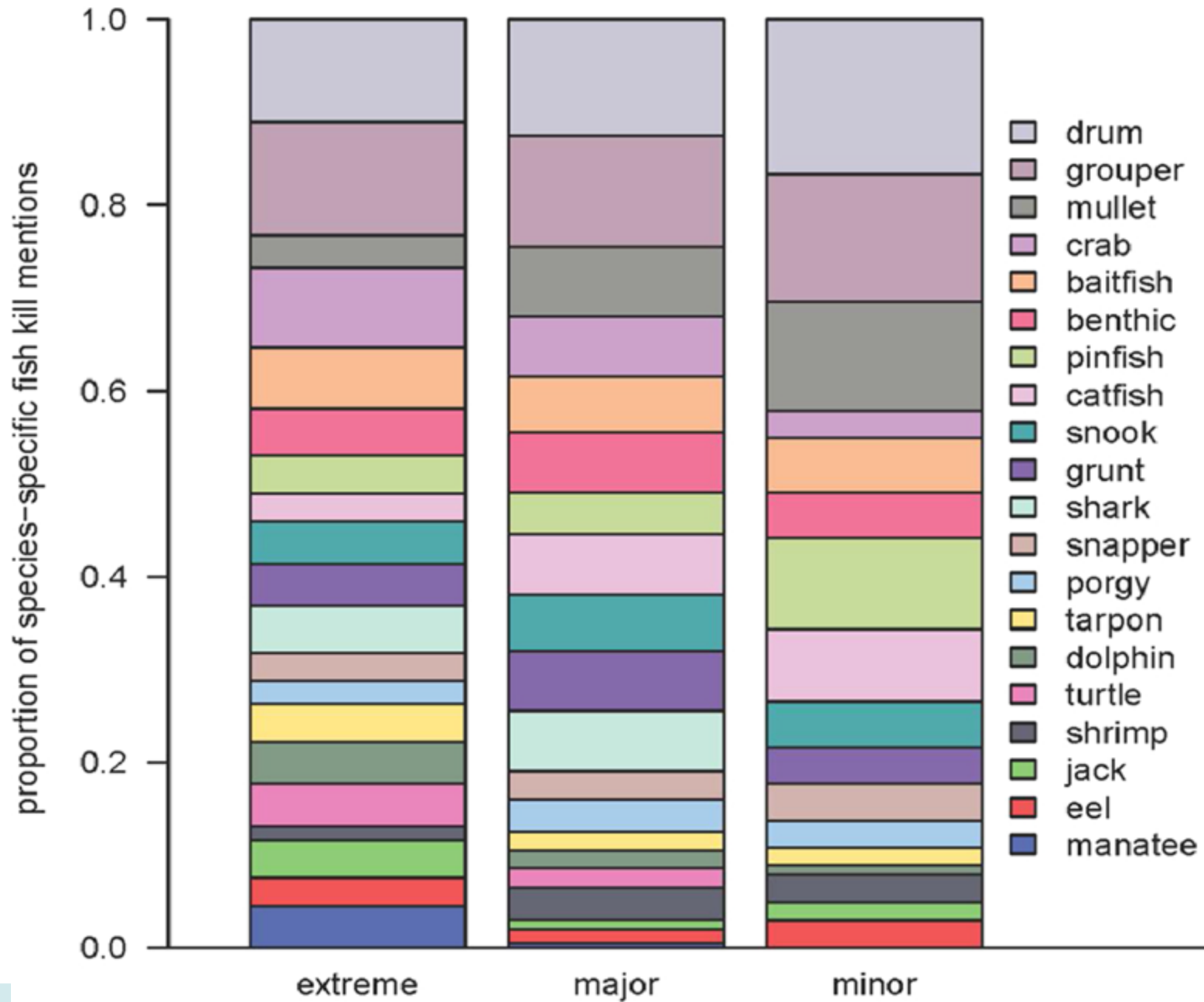
Category	Minor	Major	Extreme
Descriptors	<p> <b>Medium/minor</b>  <b>Minor</b>  <b>Normal</b>  <b>Not bad</b>  <b>Patchy</b>  <b>Small</b>  <b>Didn't have a big effect</b>  <b>Spotty</b>  <b>Three out of a ten</b> </p>	<p> <b>Bad</b>  <b>Extensive</b>  <b>Intense</b>  <b>Major</b>  <b>Miserable</b>  <b>Pretty bad</b>  <b>Really bad</b>  <b>Severe</b>  <b>Terrible</b>  <b>Very bad</b>  <b>Significant</b>  <b>Strong</b>  <b>Pretty bad</b>  <b>Big/long one</b>  <b>So bad</b>  <b>Fairly significant</b>  <b>Seven out of a ten</b> </p>	<p> <b>Nine point five out of a ten</b>  <b>Ten out of a ten</b>  <b>Devastating</b>  <b>The worst I've ever seen</b>  <b>Extreme</b>  <b>Biggest I remember</b>  <b>Worst</b>  <b>Sticking in my mind</b>  <b>Terrifying</b>  <b>Awful</b>  <b>Catastrophic</b>  <b>Insane</b>  <b>Unbelievable</b>  <b>Far above anything that happened before</b>  <b>Never seen that before</b> </p>



# Severity Level of Major Red Tide Events



# Severity of Major Red Tide Events: Impact on Fish Species



- Grouper -- similar number of mentions across severities.
- Minor events more associated with small bait fish, mullet (inshore)
- Only major and extreme events associated with shark kills
- Only extreme events associated with marine mammal mortality (dolphins/manatees)



# Fishermen perspectives – socioeconomic concerns

## Broad concern about health affects and impacts

*“During the season I was constantly coughing and phlegmy just a lot more than normal. It was not good and I’m pretty sure most of us were affected.”* (fisherman from Naples, 2018 event)

## Broad concerns about lingering impact of negative publicity on local tourism

*“The media blew it so far out, it about wiped out the charter boat fishermen last year.”* (fisherman from Ft. Myers Beach, 2018 event)

*“The news did a good job of telling the red tide was here, but didn’t say much when it was gone.”* (fisherman from Sarasota, 2018 event)

## Uncertainty about how quickly the habitat and fisheries will recover is a major decision factor for fishermen



# Fishermen perspectives – ability to adapt

## Adaptation to Typical Events

- Fish around patchy blooms
- Extended gear deployment, trial and error
- Move to fish offshore or inshore, north or south; temporarily change target species
- Temporarily delay harvesting clams and shellfish

## Adaptation to Major and Extreme Events

- Move fishing location (often very far from home port)
- Fish in deeper areas; redirect effort to other species
- run charters to fish in the “backcountry”

### **resilience begins to break down... resilience gone**

- Stop fishing and get temporary job (construction, Uber, Home Depot)
- Get job as captain/crew in a different area of the country
- switch from commercial to charter fishing, ecotourism, photo tourism
- Sell gear and equipment and leave the industry
- Retire
- Clam and shellfish harvests completely lost, aquaculture businesses shut down



# Fishermen perspectives – adaptation factors

Ability to adapt and keep fishing or drop out depends on range of factors:

## Access to financial capital

*“Permits is number one, and just like anything else, and the economy has really gone up, permits are pretty expensive more fuel, more overhead, more maintenance or tracking devices.”* (regarding costs of having to go fish offshore, fisherman from Sarasota)

## Social capital, partner and family support

*“We're seasoned fishermen. We have a lot of contacts. People that didn't know, there are a lot of them went out of business. They couldn't survive, and they went out. But we had the contacts, and we had a boat that we could move and do the job. But the people without those contacts, they just –“* (Steinhatchee fisherman)

## “Fall backs” (another job or skill)

*“I have fall backs because of my history of going back and forth to Maine. I was able to go up to Maine for a month and fish and run fairy boats and sail and stuff like that. And that made just enough money to basically make me keep my boat. Other guys weren't as lucky other guys didn't have that fall back.”* (commercial fisherman from Sarasota)





# Fishermen perspectives – adaptation factors

Ability to adapt and keep fishing or drop out depends on range of factors:

## **Persistence and “grit” (also includes age and health)**

*This red tide, a lot of guys quit because it got hard. What'd we do? Shook our head and looked around and went somewhere else. We made it work.” (Steinhatchee fishermen)*

*“I’ve been chasing my tail making a living all my life and figuring out when – when I have a disaster, I figure a way to work around it and survive it.” (fisherman from Cape Haze)*

## **Creativity and energy**

*“If you’ve got good rivers and creeks coming into it and that’s what helped Tampa Bay which was so much. You’ve got the Hillsborough River, you got the Manatee River really helped, because the guides – most of the guides that are doing in-shore fishing are running all the way up to the Manatee River to fish now...” (for-hire fisherman from Sarasota)*



# Fishermen perspectives – causes

## Much concern about general impacts of human population growth

*“Bottom line, too many people per ecosystem -- that’s the bottom line -- and they’re still coming.”*

### Factors commonly perceived to exacerbate blooms:

- Coastal development (e.g., boat traffic, canal construction, hardened shorelines)
- Wastewater from sewage leaks and septic tanks
- High precipitation events and runoff; watershed influences (e.g., agriculture, sewage, pesticides)
- Wind and current patterns
- Increasing temperatures, particularly lack of cold winters
- Caloosahatchee discharges
  - Some discharges lead to small blooms 5-7 days following -- “like clockwork”
  - Summer discharges + warm ocean temperatures problematic during existing blooms

Less common: Beach renourishment / dredging, submarine springs (small blooms)

# Fishermen perspectives – solutions

## Factors thought to reduce severity of red tide:

- **Improve overall water quality**
- Fertilizer bans during rainy season
- Improvements in sewage systems
- Clam and oyster restoration
- Natural / living shorelines

*“You’ve got to do something with that [river discharge] water, just do something with it, you’ve got to try. And then, after that you’ve got to start chipping away at golf courses, my yard. Everybody has to try, and that’s what it’s going to take. There’s not one thing that we can vote on that’s going to fix it.” (Naples fisherman)*





# Fishermen perspectives – solutions

## Strengthen communication and collaboration with fishermen

*“I think that would be nice if you could just call someone and tell them what you saw and somebody would actually come and investigate it and check it out. I’ve tried to do this a lot of times because we’re the ones that see this.”* (fisherman from Naples, FL)

*“My suggestion is if you’re wanting to focus on the red tide, poor water quality, that kind of thing, there’s almost every vessel that’s federally registered, that’s fishing in this area possibly would participate to some degree, okay?”* (fisherman from Ft. Myers Beach, FL)

## Provide better information to fishermen so they can minimize impacts

*“Now, as far as helping us, the quicker we can react to circumstances, the better. And yes, more data needs to be collected... What can you do? Turn and put a shade over it to cool the water off? [Red tide] can’t be controlled. The only thing that you could do to help a fisherman is tell these fishermen in the area that’s impacted that they’re catching fish north of the area, they’re catching fish south of the area – it’s the only thing you can do, other than give them some type of income assistance...”* (Steinhatchee, FL fisherman who had moved to Cortez, FL)

# Example of Fisheries Management Outcomes

- Gulf of Mexico red grouper stock assessment
  - LEK contributed to the development of potential red tide scenarios for 2018 (**Sagarese et. al. 2001**)
- Citizen Science Initiative (<https://floridawatermen.org/>)
  - Fishermen collect water quality data, facilitates rapid response
- Factors being identified that can enhance resilience
  - Examples: less restrictive regulations, facilitating access to quota, improved disaster assistance process.
- Red tide included as a Fisheries Ecosystem Issue within the Gulf of Mexico Fisheries Ecosystem Plan

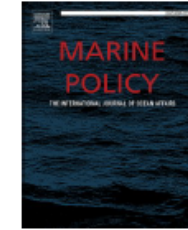




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### Use of fishermen's local ecological knowledge to understand historic red tide severity patterns

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# THANK YOU!!!!