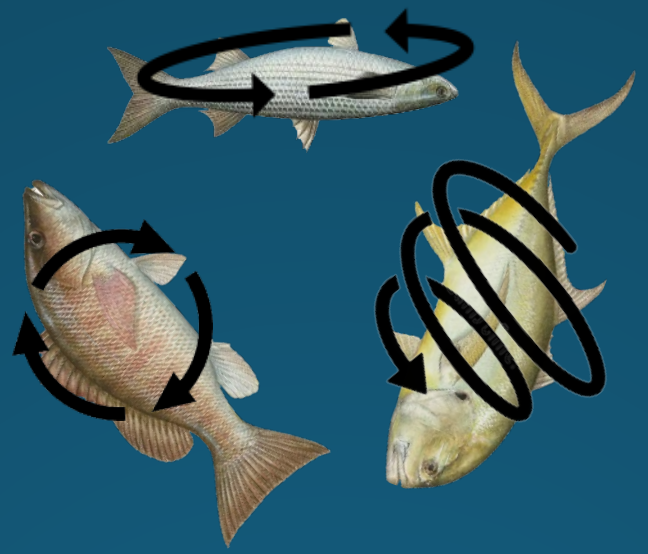
The Dance of Death Returns:

Keys Spinning Fish Event, Historical Context and Overview from FWC



Micah Bakenhaster & Theresa Cody

FWC Fish and Wildlife Research Institute, Fish and Wildlife Health Subsection

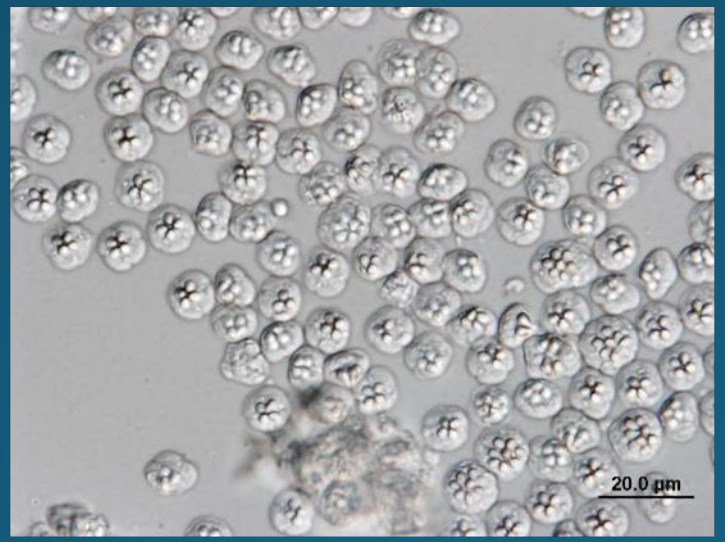
FWC Fish and Wildlife Health Subsection (aquatic animal health team)

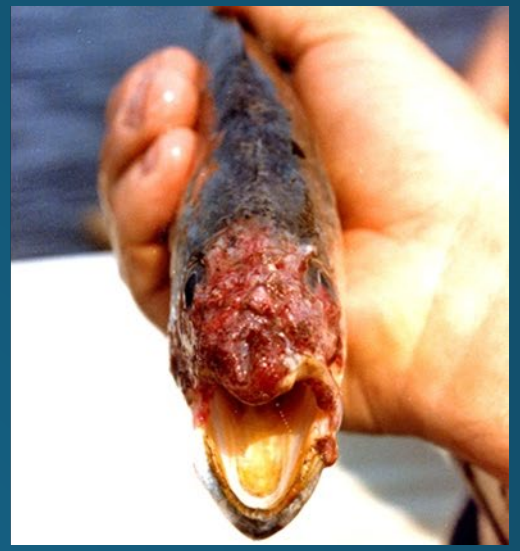
Theresa Cody, co-presenter in absentia, FWH Team Leader

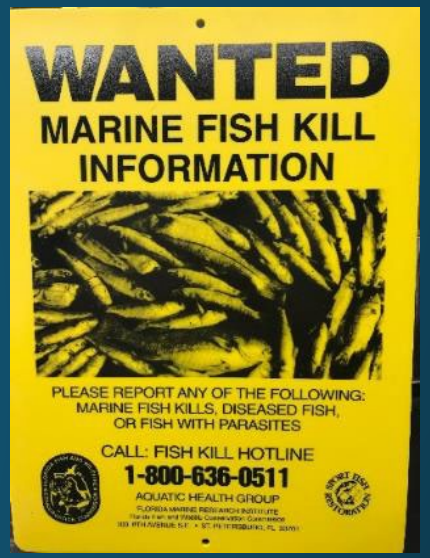
- Wild fish health monitoring

- Basic and applied research on fish pathogens and diseases

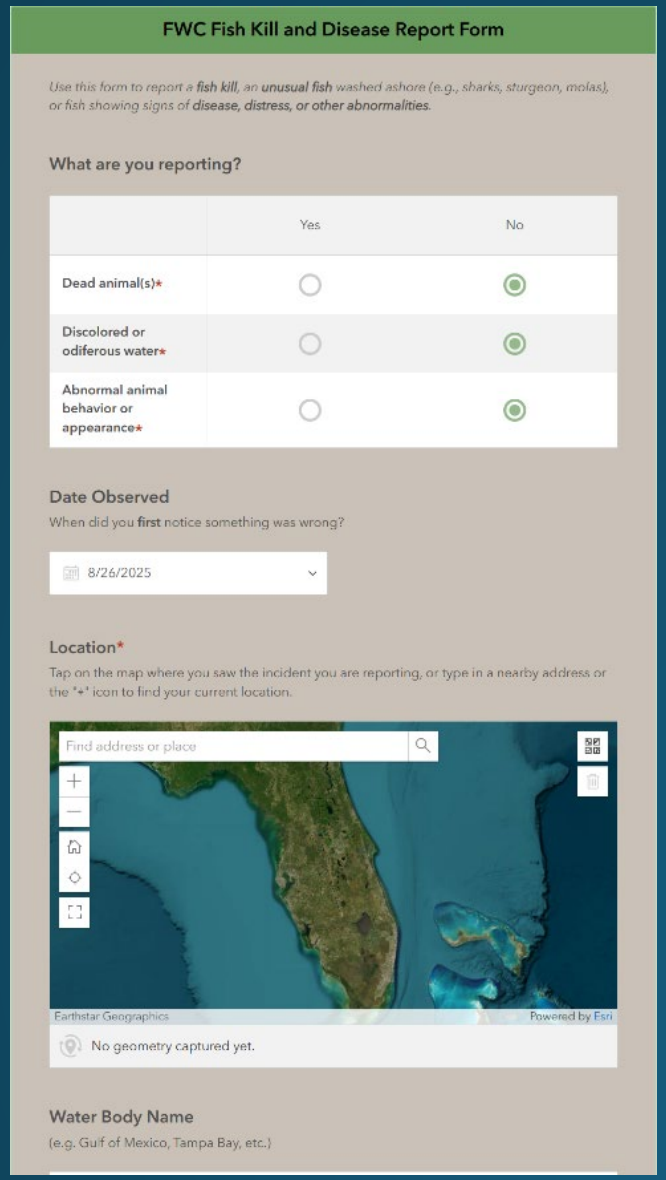
- Fish Kill Hotline, documenting and investigating aquatic animal health events







FWC Marine Fish Kill Hotline



- Operating since 1995

- Toll free number and mobile-friendly online reporting form

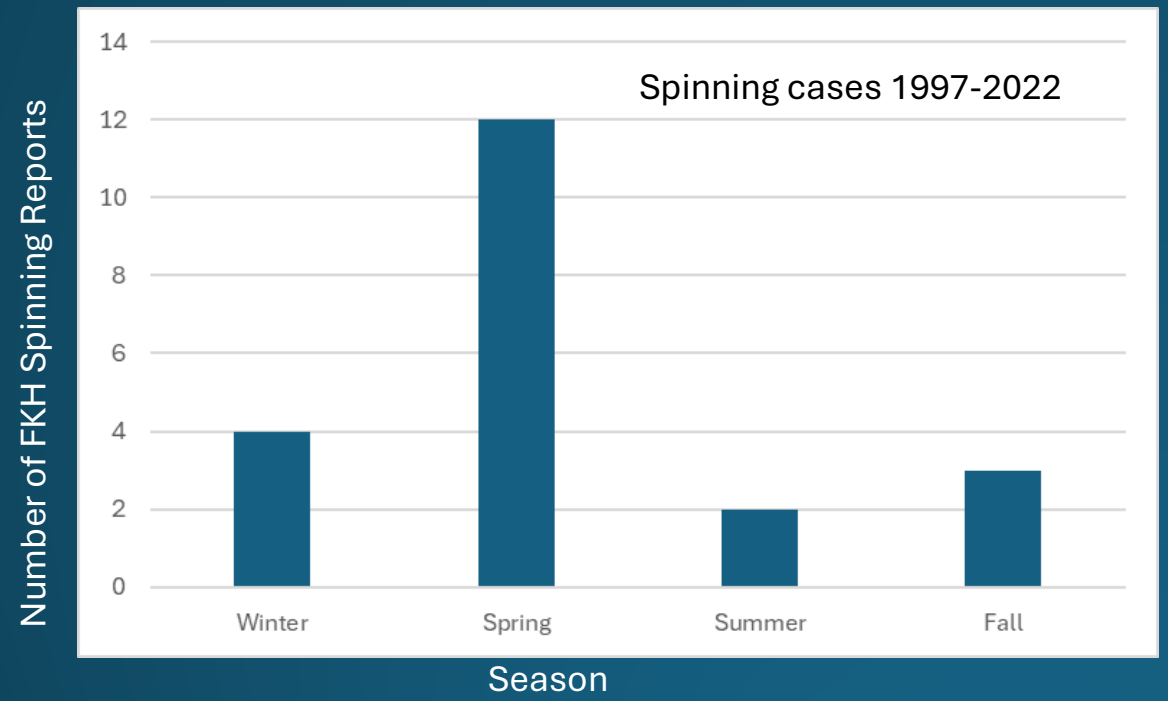
- In late 2023, began receiving persistent public reports of spinning fish in the Florida Keys

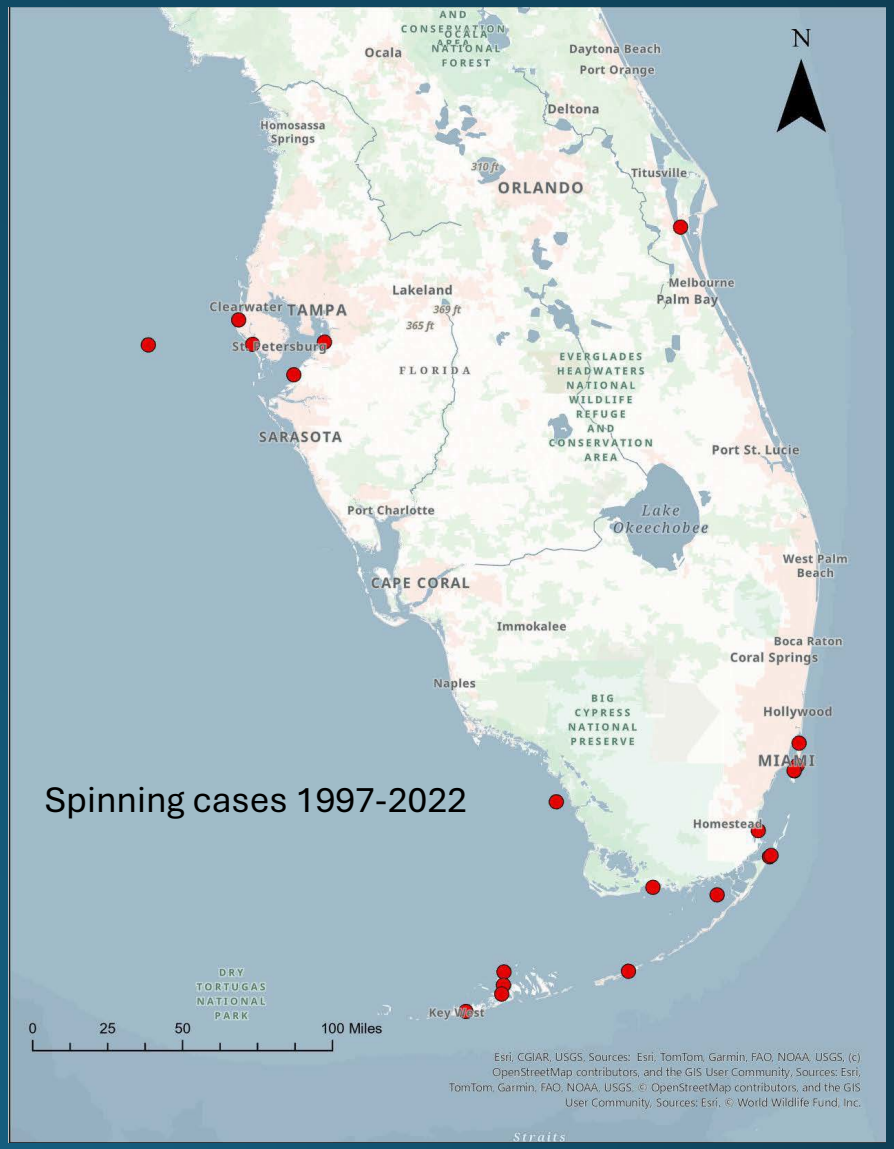
- The initially suspected cause, red tide, could not be corroborated with satellite imagery, or water and tissue samples

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

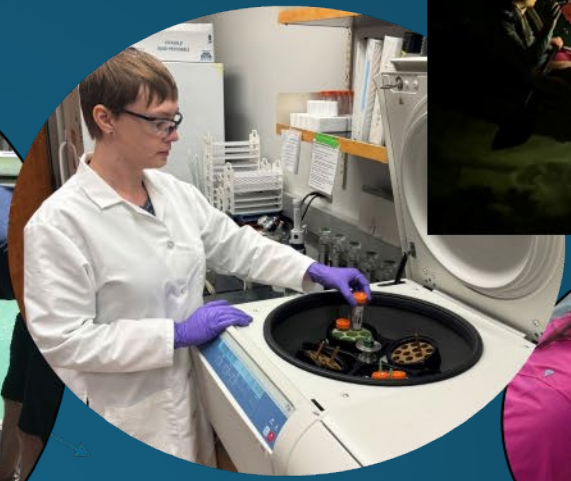
Fish Kill Hotline Reports of Spinning Fish Before the Keys Event

- 22 similar case reports (not reliably attributable to red tide) documented from 1997-2022
- Most common from Miami through the Keys and Florida Bay
- Occurred sporadically and generally in isolation or limited clusters
- Most common in spring, least common in summer months





Public servants were mobilized to conduct field and laboratory investigations



Spinning Fish Event, Florida Keys 2023-present

Spinning mullet in residential canal, Big Coppitt Key 4/10/2024

Spinning Fish Working Group

- In January of 2024, an informal working group was formed

- Participants included various state, federal, academic, and private laboratories, and Lower Keys Guides Association provided critical field observations and support

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

Potential Causes Investigated in 2025

X Unsupported hypotheses

- Water quality problems
- Contaminants
- Pesticides
- Communicable diseases

Hypothesis with support →

- Algal toxins

What we know

- There were major anomalies in the phytobenthos involving species capable of producing neurotoxins (FGCU)

- Numerous algal neurotoxins were present in environmental and tissue samples (USA-DISL)

- Some mixture of those toxins, in some concentrations, caused abnormal swimming behavior when laboratory fish were directly exposed to them (USA-DISL)

- Clinical signs, epidemiological trends, and pathology suggest acute or chronic neurotoxin exposure

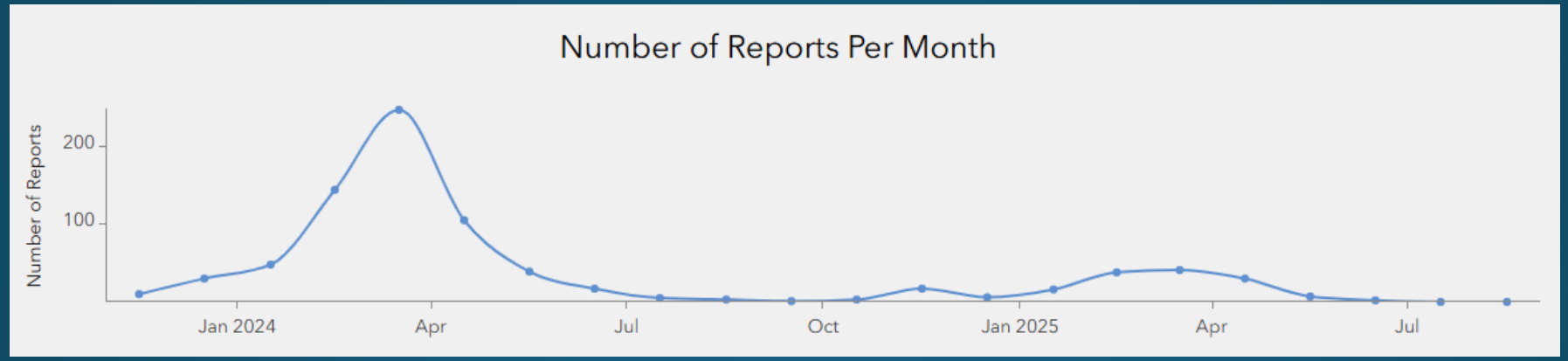
- No strong, consistent evidence to support other hypotheses (including red tide, pathogens, & contaminants)

Florida Keys Spinning Fish Event Public Reporting Trends

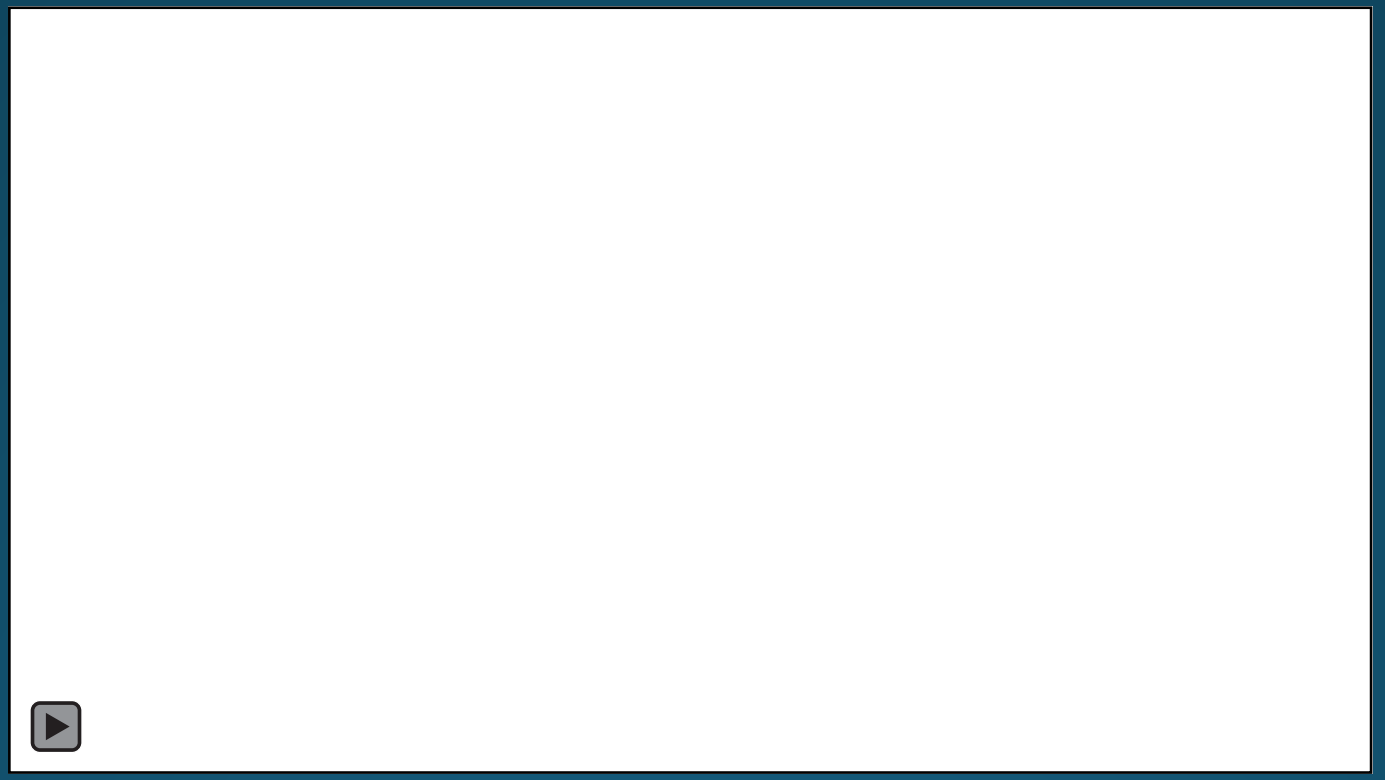
- First Reports of spinning fish (to Bonefish Tarpon Trust) in November 2023, from Middle Keys

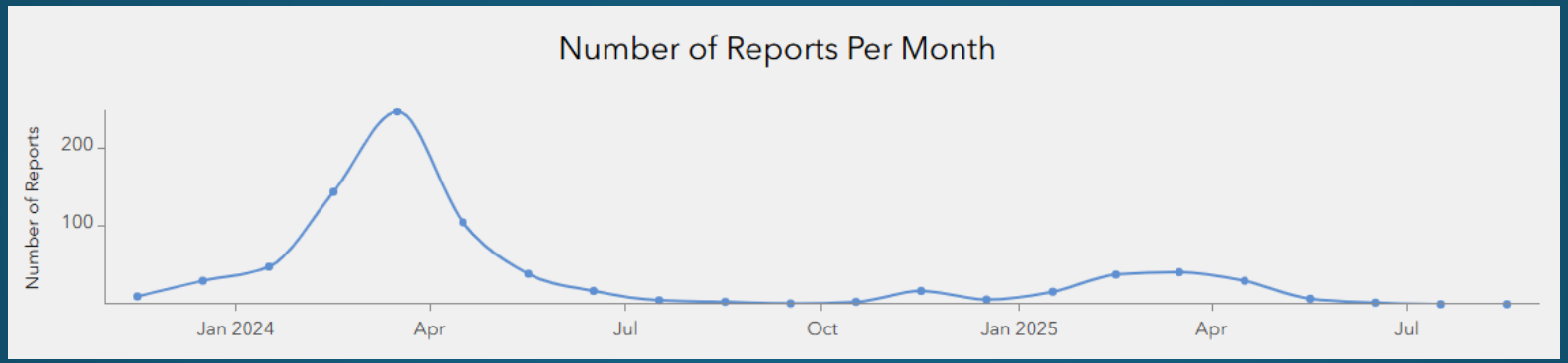
- To date, >800 associated public reports

- Reporting rates peaked in March 2024, declined precipitously by summer, and have remained low with a slight bump in spring 2025



Florida Keys Spinning Fish Event Public Reporting Trends



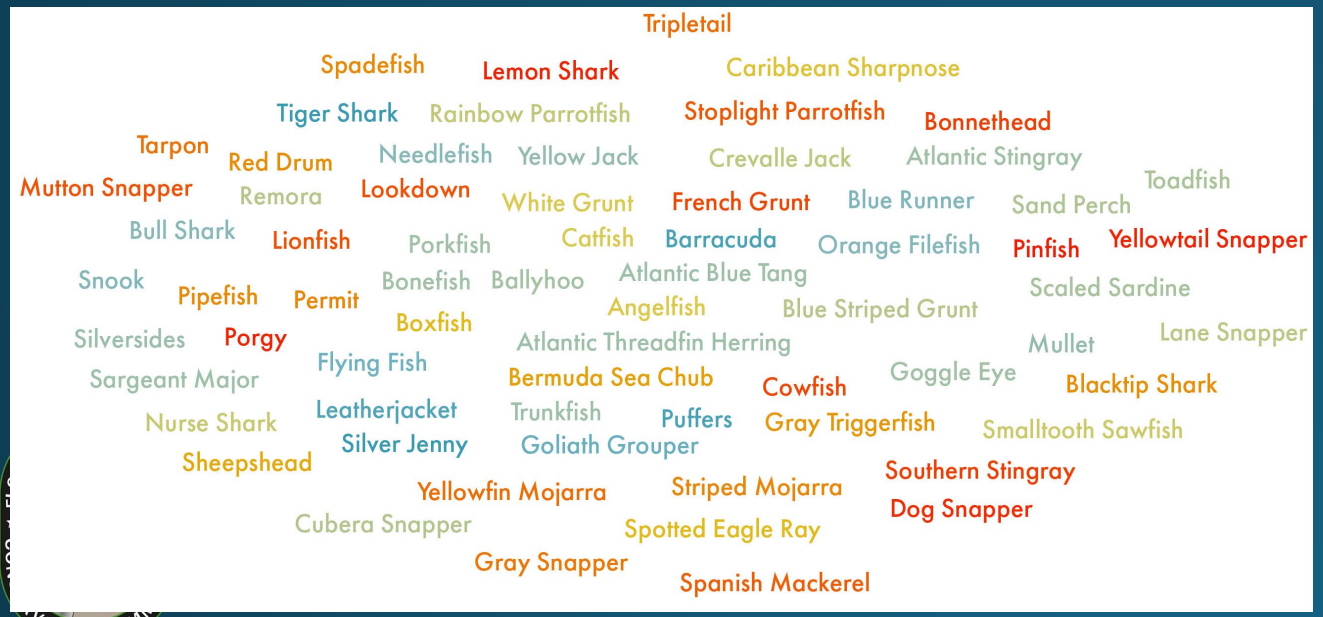


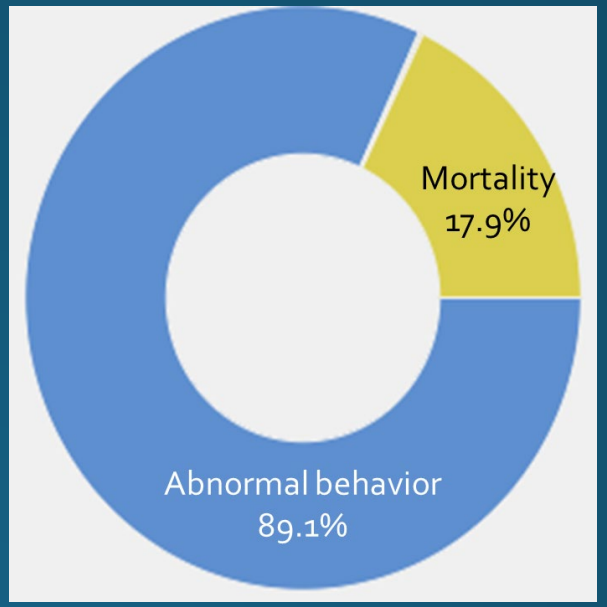
Florida Keys Spinning Fish Event Public Reporting Trends

- More than 80 fish species reportedly affected (teleosts and elasmobranchs)

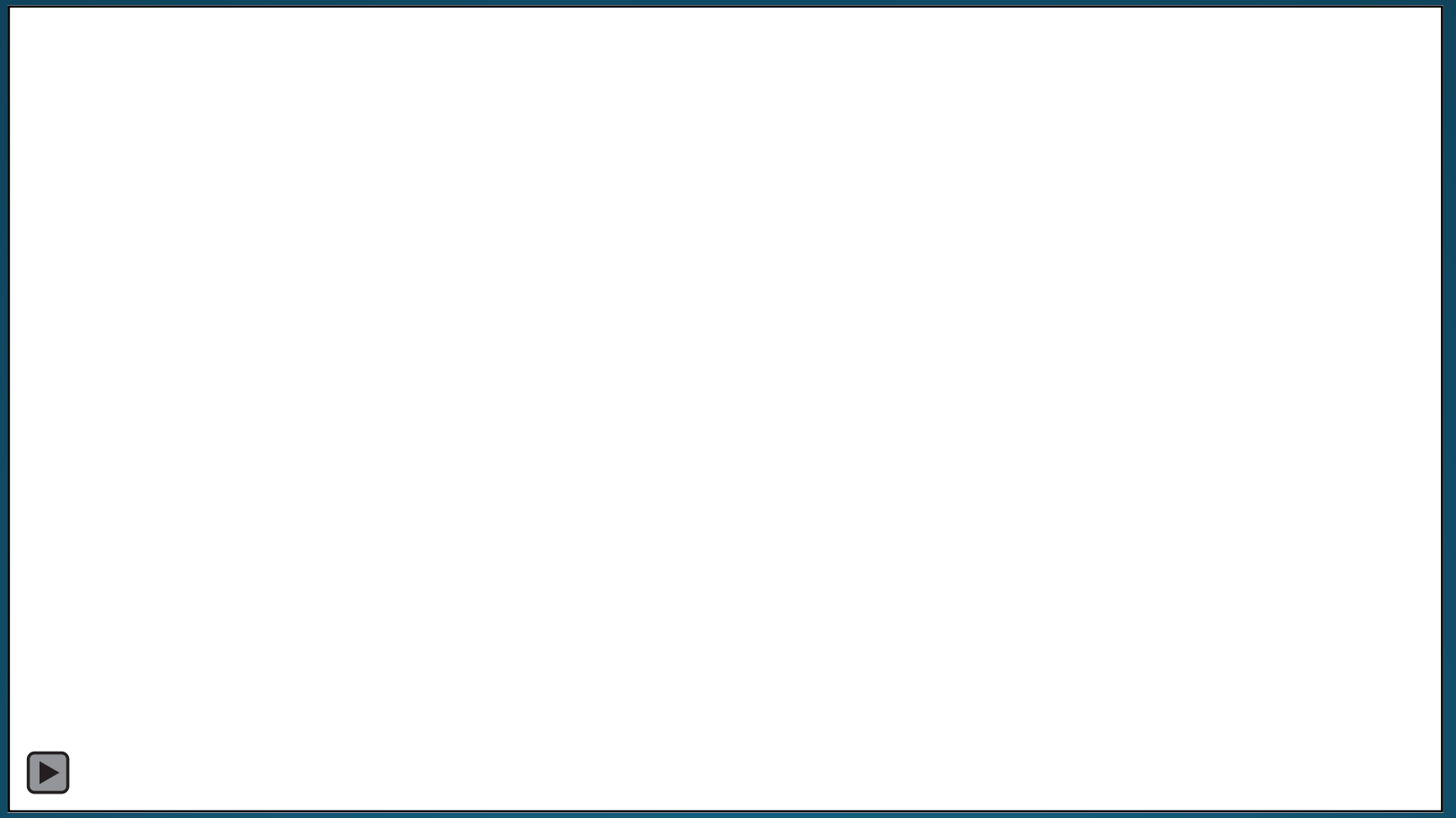
- Reports of dead fish were relatively uncommon and no reports described massive kills

- Critically endangered smalltooth sawfish were unusual; when they were reported they were frequently dead





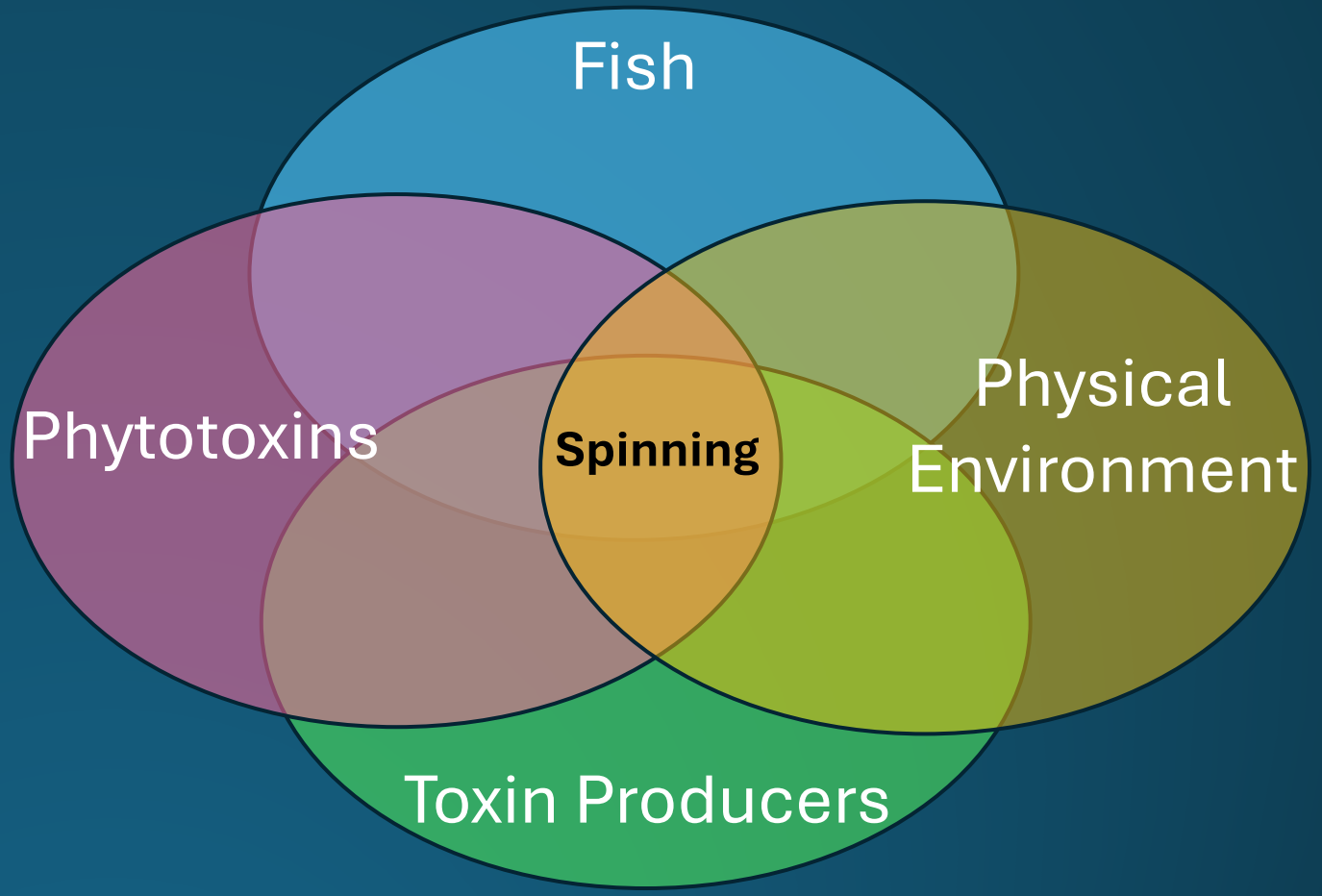
Spinning and clinically normal fish were present at the same times and places



Video capture from Coral Morphologic presents Coral City Camera
https://www.coralcitycamera.com/

Models for Understanding Spinning Phenomenon

Fish +Toxin X = Spinning

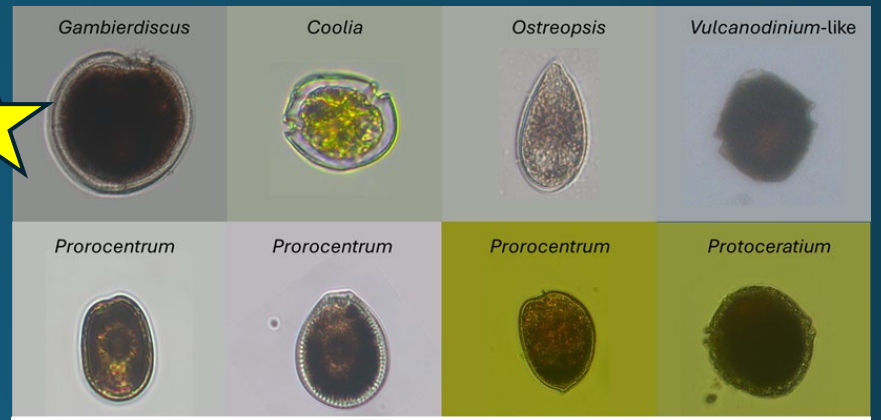


The Floridian Phytobenthos Produces Toxins Naturally

- Numerous toxins are produced by numerous species in warm marine waters globally at some baseline levels

- We hypothesize that deviations from the baseline “toxiscape” can manifest in fish spinning

- Hypothetical perturbations could alter community structure, upregulate toxin production, or increase bioavailability



(images not to scale, species vary within 30-100µm)

- Exposure could be through toxins in water, direct contact between toxic cells and gills, food chain, or likely a combination of these routes

External Stimuli Influenced Spinning Behavior

- Affected fish healthy enough to strike bait began spinning in live wells

- Some fish observed spinning when collected appeared to “recover” in the laboratory but began spinning again >24 h later if stressed by handling

- At night, exposure to bright light could cause spinning to intensify or cause ostensibly “recovered” fish to begin spinning again in the laboratory

Transactions of the American Fisheries Society 115:908–912, 1986

Effects of Ciguatera Toxins on the Bluehead

WILLIAM T. DAVIN, JR. AND CHRISTOPHER C. KOHLER
Fisheries Research Laboratory and Department of Zoology
Southern Illinois University
Carbondale, Illinois 62901, USA

DONALD R. TINDALL
Department of Botany, Southern Illinois University

- Fed *Gambierdiscus toxicus* cells to bluehead wrasse

- One clinical sign was periodic hyperactivity (erratic swimming, corkscrewing, hitting sides of tank, & leaping from water)

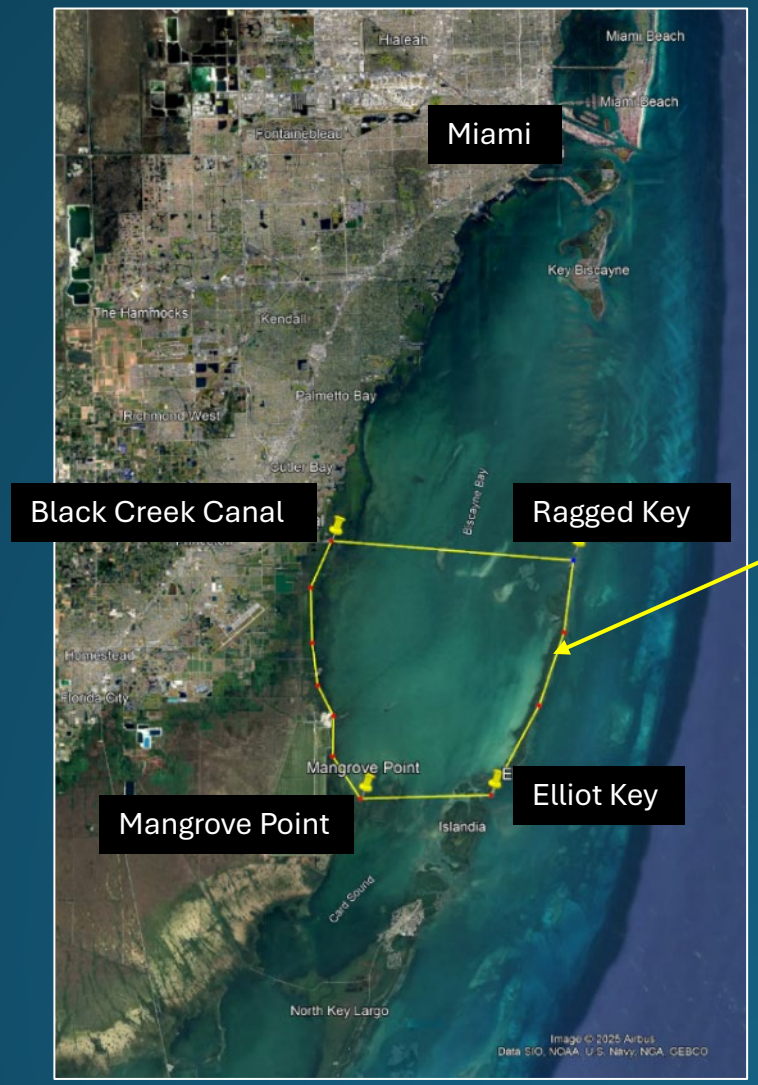
- Hyperactivity commonly triggered by external stimuli (movement around the tanks, **light intensity changes**, and introduction of food)

"The Dance of Death"

Forgotten 1973 Biscayne Bay event with many parallels to Keys Spinning Fish event

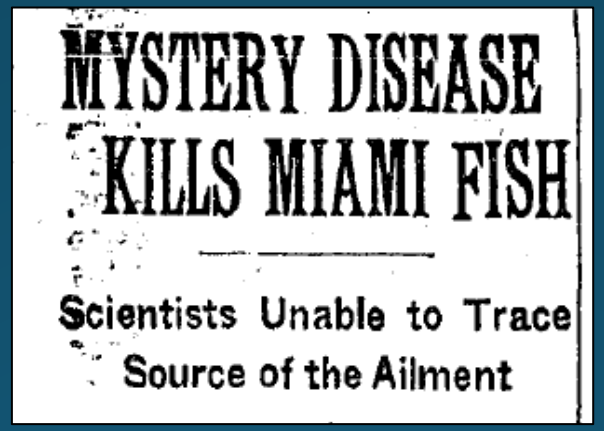
The Dance of Death 1973

March 14, 1973, southern Biscayne Bay is closed by DOH



"The…area is 'off limits' for fishing, swimming, water sports of all sorts, and boating"

The Dance of Death 1973



MYSTERY DISEASE KILLS MIAMI FISH

Scientists Unable to Trace Source of the Ailment

The New York Times 3/18/1973

Special to The New York Times

MIAMI, March 17—Thousands of fish have been killed by a mysterious disease slowly spreading from a point in Biscayne Bay, about 20 miles south of downtown Miami.

Microbiologists have not been able to identify the cause of what fisherman call the "twirling disease." They have reportedly ruled out pesticides, as well as industrial and private waste and sewage.

The affected fish swims on the surface in circles and acts as if it is gasping for air. After a period of erratic twirling, it turns lethargic and dies.

Event occurred 26 years before FWC founding

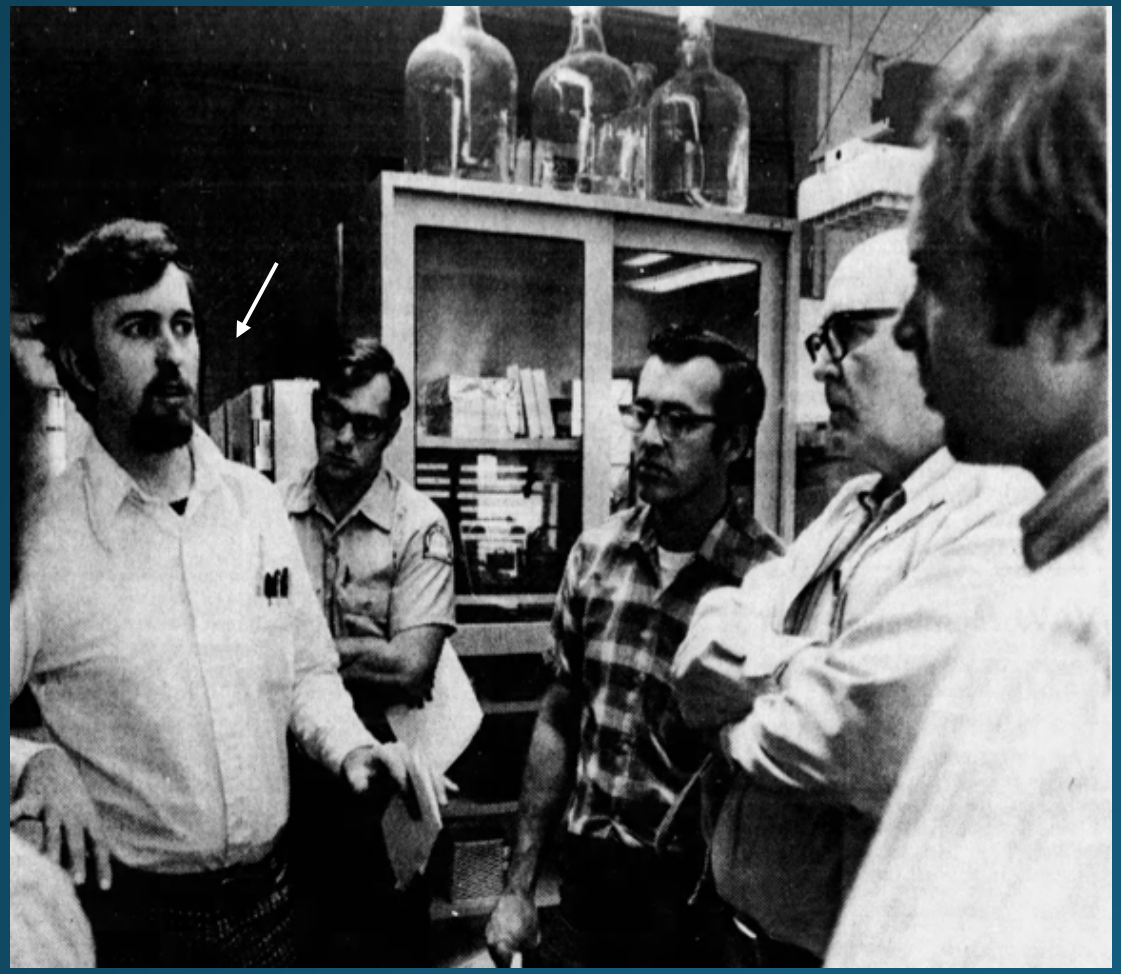
FWC Fish and Wildlife Research Institute
2025

FWC Aquatic Animal Health research group

FL DNR Marine Research Laboratory
1969

DNR Mariculture and Pathology Section

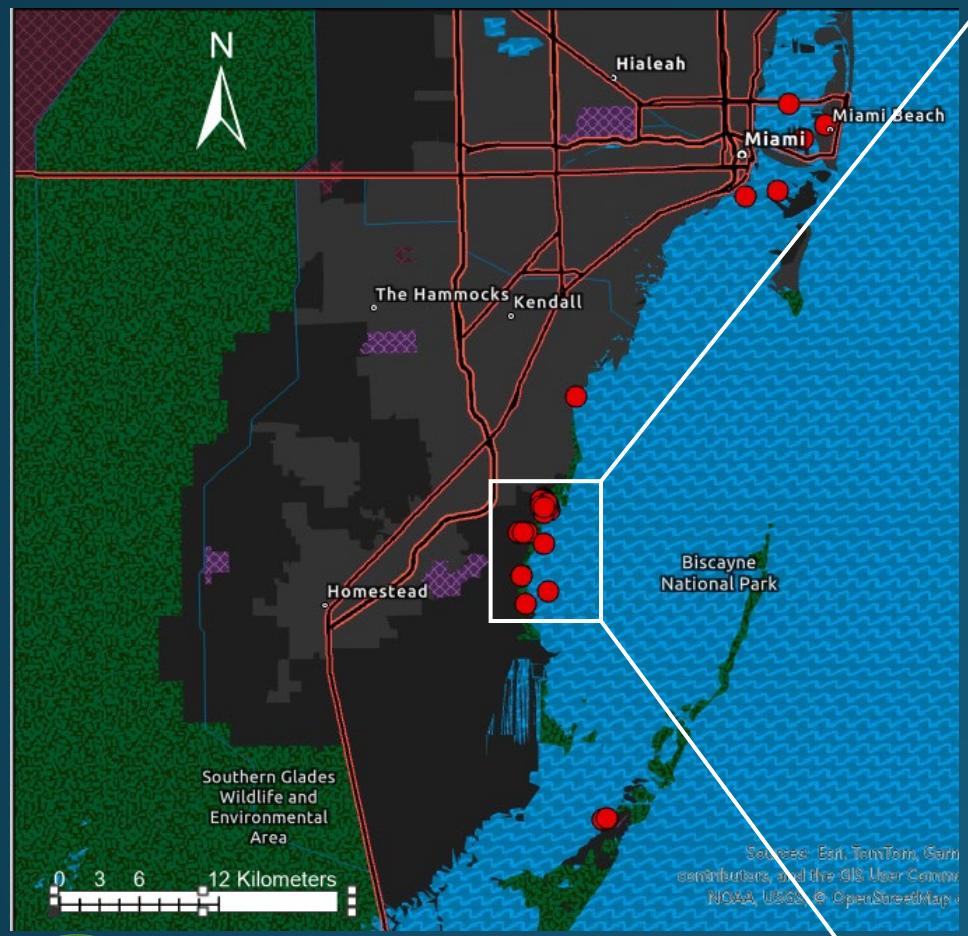
Joe Quick (1945 – 2022), FL DNR

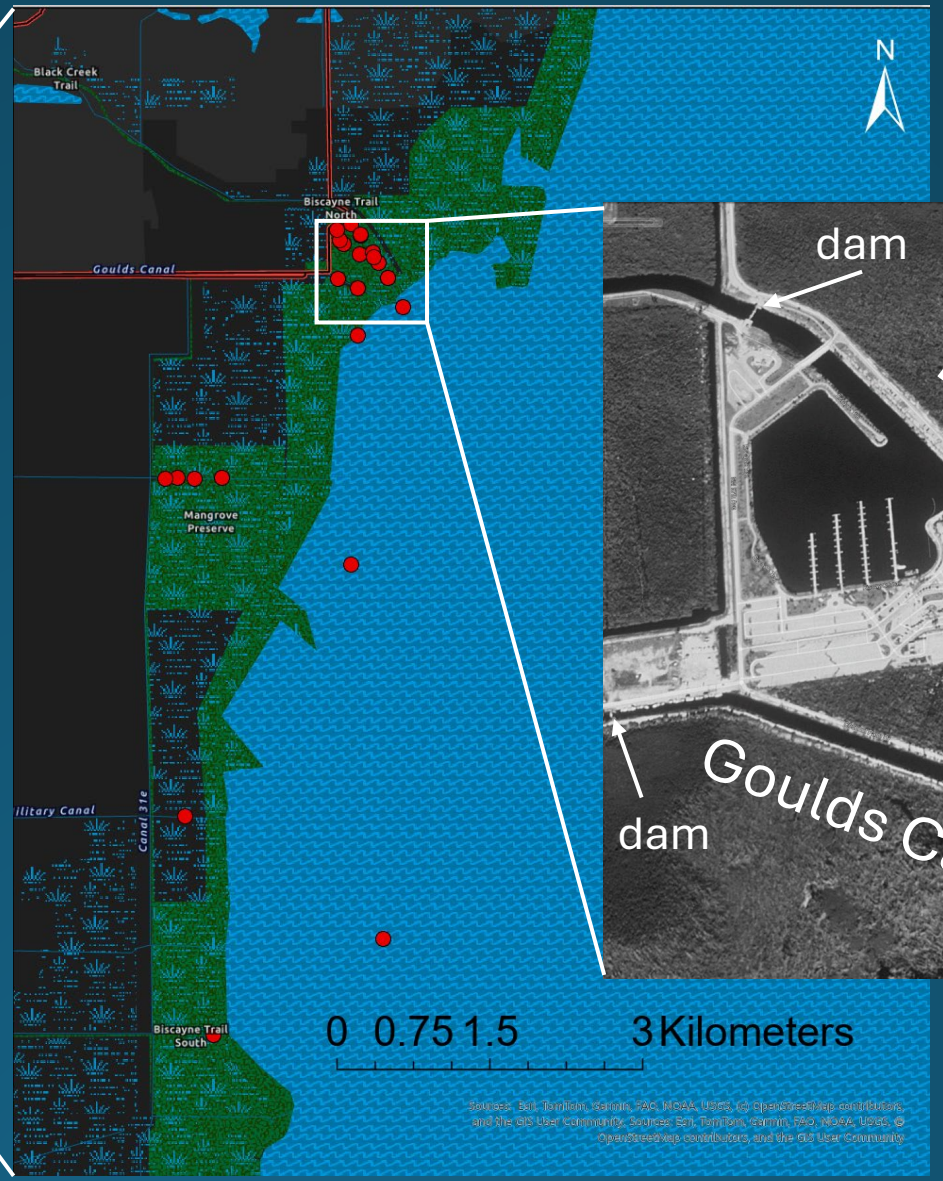


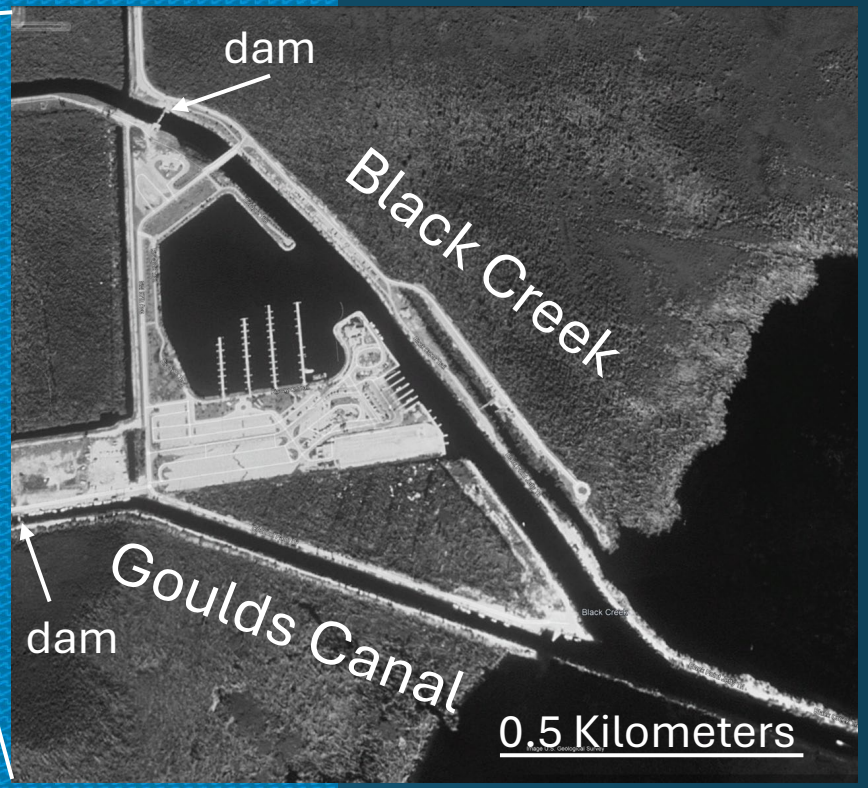
Joe Quick, DNR Mariculture and Pathology Section Leader

The Dance of Death 1973

Geocoded locations of reported spinning/dead fish in 1973







The Dance of Death 1973

- Began in January 1973, peaked around March, and dissipated before 1974

- Public reports of spinning and dying fish mobilized government workers (analogs of contemporary DEP, FWC, DOH) to investigate and document the incident with critical support of local fishing professionals

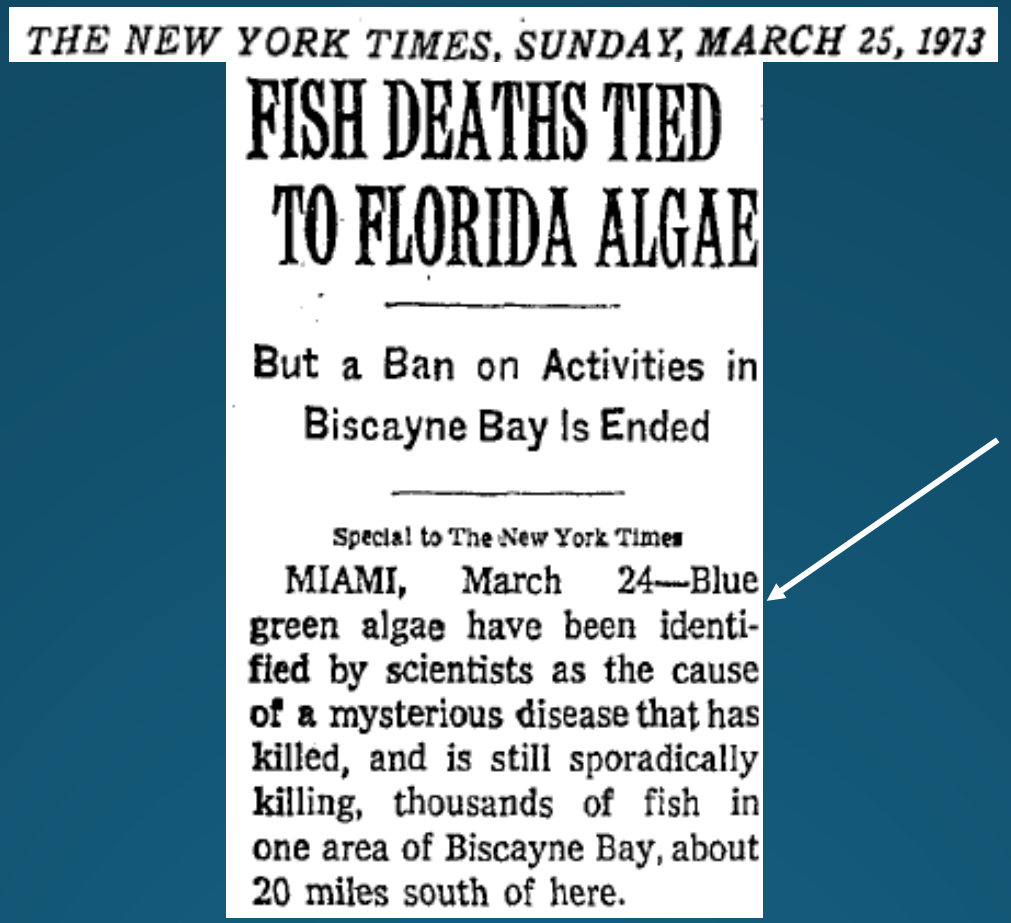
- 10's of thousands of fish were affected, and included large scale mortalities of mullet, marine catfish, and snook (mojarra, stingrays, snapper, and jacks also affected)

- In some cases, mullet behaving normally would start spinning if startled

- Investigations were collaborative and multidisciplinary involving multiple academic, state, and federal laboratories

- Prompted closure of southern Biscayne Bay for two weeks until DNR assays determined benthic algae were the likely source of neurotoxins causing the behavior and mortalities

The Dance of Death 1973



THE NEW YORK TIMES, SUNDAY, MARCH 25, 1973

FISH DEATHS TIED TO FLORIDA ALGAE

But a Ban on Activities in Biscayne Bay Is Ended

Special to The New York Times

MIAMI, March 24—Blue green algae have been identified by scientists as the cause of a mysterious disease that has killed, and is still sporadically killing, thousands of fish in one area of Biscayne Bay, about 20 miles south of here.

(Refers to research findings of Joe Quick)

"Let me first emphasize that...we did not prove blue green algae to be the cause."

- Joe Quick in a letter to William Deichmann, 5 days after NYT article

Dance of Death Investigations

X Unsupported hypotheses

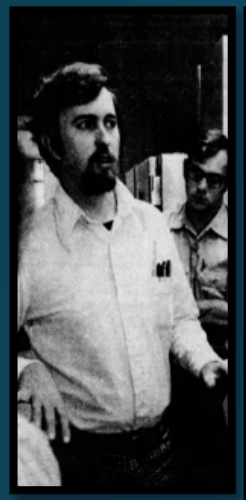
- Water quality problems
- Contaminants
- Pesticides

★ Hypotheses with support

- Communicable diseases
- Algal toxins

Dance of Death Investigations

Team Toxin



J. Quick

Dr. William Deichmann, UM
Director Center of Toxicology
(Source: University of Miami Libraries)

Team Pathogen

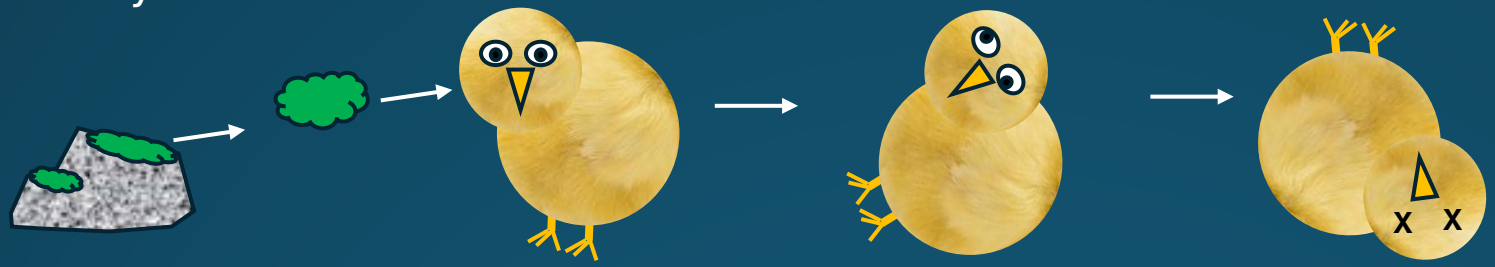
Drs. Bennett Salmann and Lanny Udey*,
UM Department of Microbiology

(*As they *might* have appeared *if* portrayed on screen by actors Eugene Levy and Al Pacino as seen in 1973's films Cannibal Girls and Serpico, respectively [Source: IMDB])

Dance of Death Investigations

Team Toxin

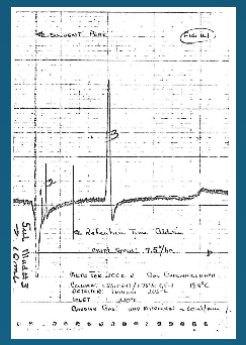
- Chick bioassays



- Cat bioassays

- Chemical analyses

Sediment
Goulds
Canal



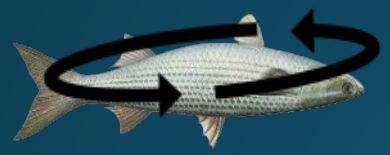
"Sediment samples contained one or more highly volatile compounds…The compound(s) were not identified"

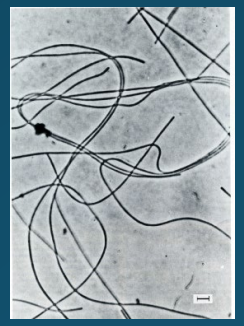
Results Not Published

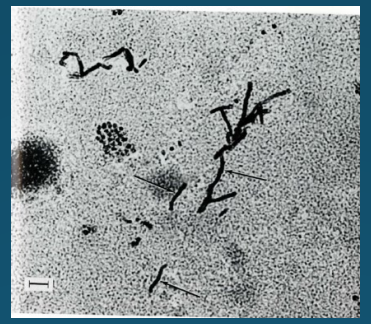
Dance of Death Investigations

Team Pathogen

- Attempt to isolate bacteria from brain



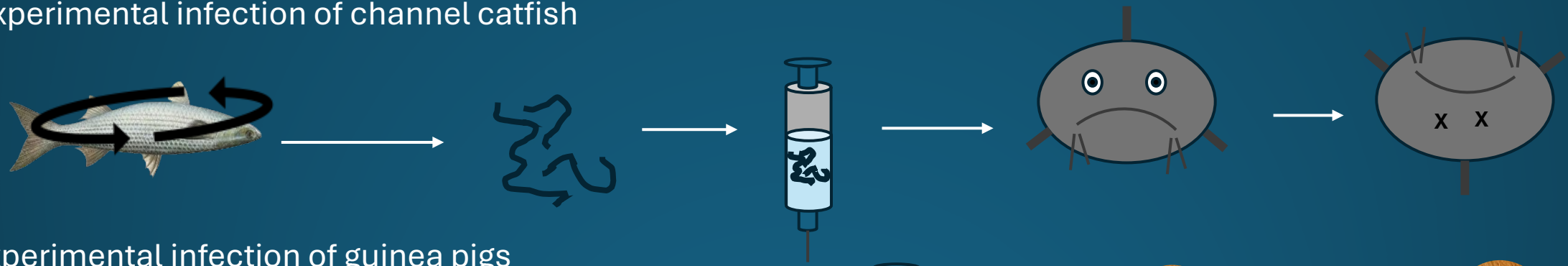




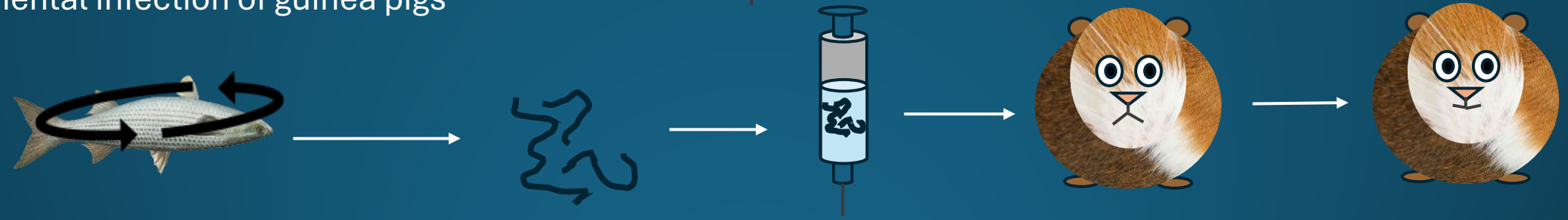
Undescribed species of anaerobic bacteria isolated from affected mullet brain tissue

(Udey et al. 1977. Journal of the Fisheries Research Board of Canada)

- Experimental infection of channel catfish



- Experimental infection of guinea pigs



Results Published

Dance of Death Investigations

Team Pathogen

Isolation and Characterization of an Anaerobic Bacterium, *Eubacterium tarantellus* sp.nov., Associated with Striped Mullet (*Mugil cephalus*) Mortality in Biscayne Bay, Florida

LANNY R. UDEY, ELAINE YOUNG, AND BENNETT SALLMAN

Department of Microbiology, University of Miami School of Medicine, Miami, Fla. 33152, USA

1977. Journal of the Fisheries Research Board of Canada

- *Eubacterium tarantellus* (= *Clostridium tarantellae*) named after the whirling Italian folk dance tarantella because of the spinning fish disease symptoms

Photo credit: Bay Area Italian Community Services; accessed 10/21/2025 (www.italianics.org)

Art credit: Sartle, Rogue Art History; accessed 09/09/2025 (www.sartle.com)

- Naming the species after the Dance of Death implied causality, but this was not convincingly demonstrated

Fish +Pathogen X = Spinning

"The Dance of Death Strikes Back"

Lesser reoccurrence in Black Creek in 1979, and officials still cited toxic algae as the most likely cause

Dance of death

Officials don't know why the fish keep dying

By ELIZABETH MORGAN
Herald Writer

Mullet twist their silver bodies in a dance of death at the center of the lake off Black Creek in South Dade.

No one knows why.

During the past two months, several hundred fish — mostly mullet, but also snook, shad and jack — have died in the salt waters of the lake near the Black Creek boat ramp at SW 248th Street, officials say.

disease, said Frank Ansley, a pollution control inspector.

This fall, the fish have been showing the same symptoms as in 1974, although the death toll hasn't been as great. Officials call this a minor fish kill. In a major kill, thousands, not hundreds, of fish die.

Pollution control officials are still trying to find out why the fish are dying.

An elaborate water test checking for runoff from

Miami Herald – 11/25/**1979**

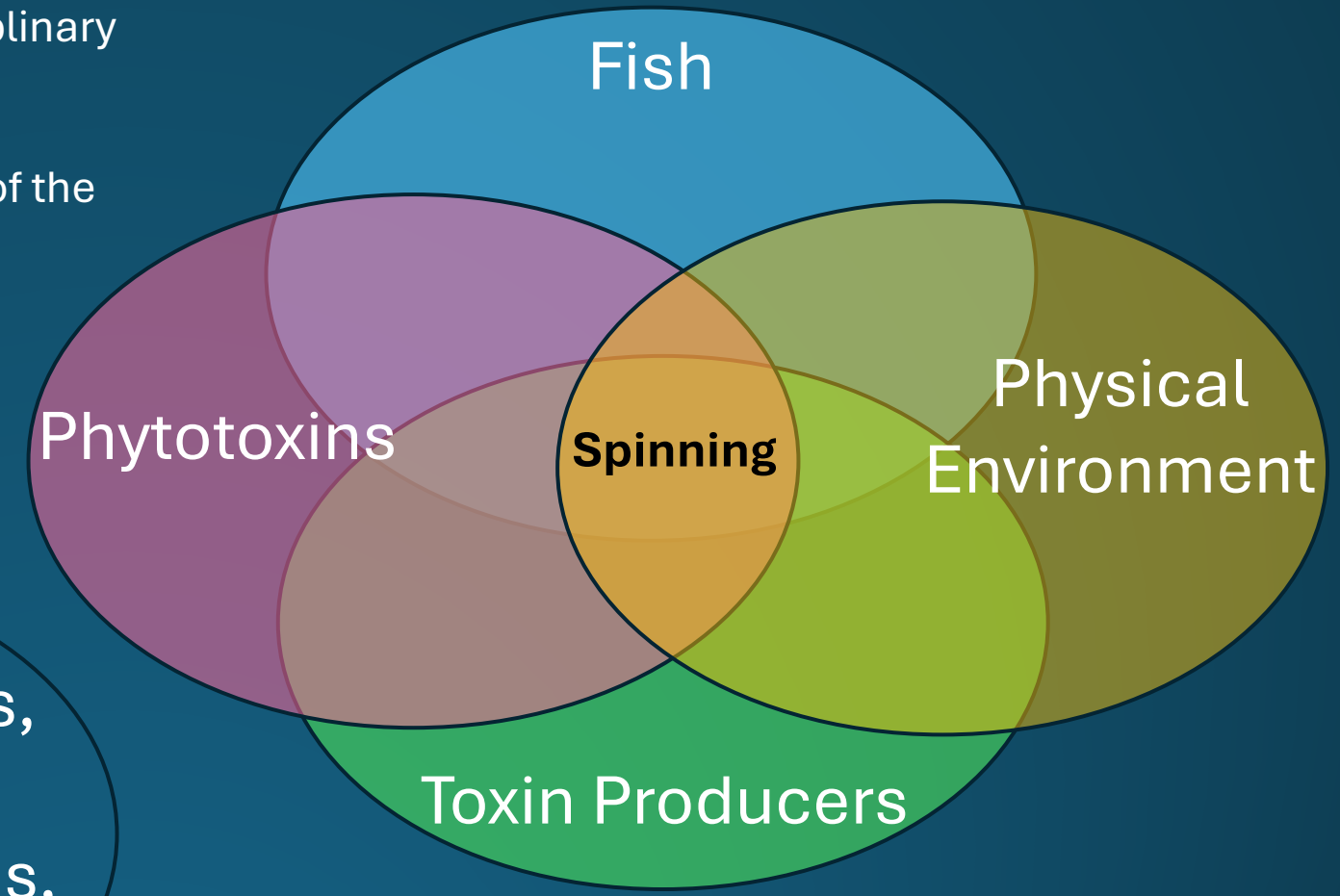
Lesson of the Dance of Death

1. Recognize that we are dealing with a cross-disciplinary research problem

2. Continue working toward a fuller understanding of the phenomenon and its impacts

3. Identify publishable units with an eye towards collaborative scientific achievement

4. Avoid siloing



Grazers, predators, symbionts, pathogens, humans, etc.