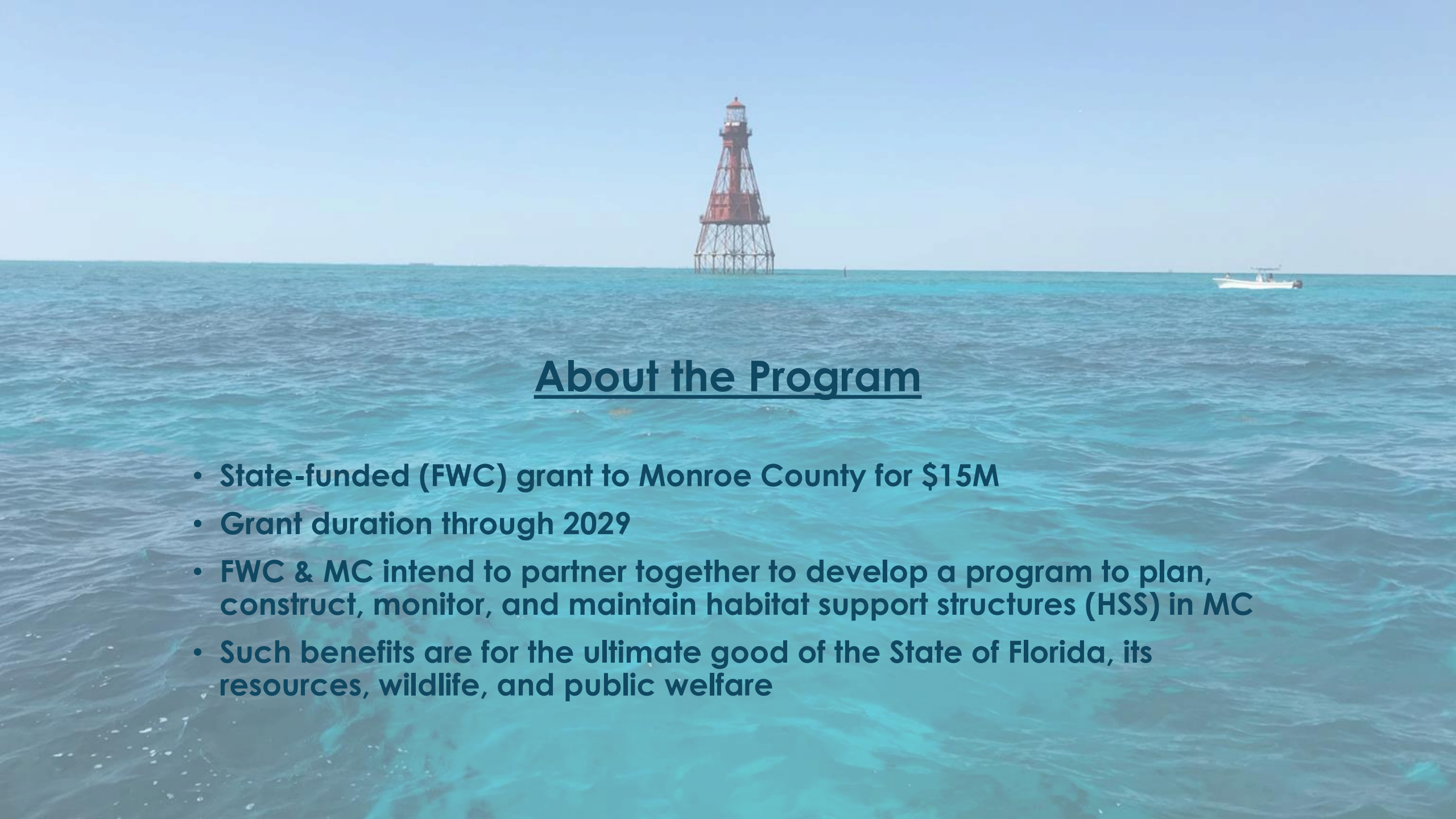
Mitigating for the Loss of Quality Habitat in the Florida Keys

# Monroe County

## Artificial Reefs

(aka Habitat Support Structures)

Dr. Hanna R. Koch, Director



# About the Program

- State-funded (FWC) grant to Monroe County for $15M
- Grant duration through 2029
- FWC & MC intend to partner together to develop a program to plan, construct, monitor, and maintain habitat support structures (HSS) in MC
- Such benefits are for the ultimate good of the State of Florida, its resources, wildlife, and public welfare






# Florida Keys Marine Ecosystem













# [Habitat]

The resources and conditions present in an area that produce occupancy, which may include survival and reproduction, by a given organism







**The maintenance of quality and diverse habitats**

**supports the maintenance of biodiversity,**

**which is the basis for healthy, productive, and resilient ecosystems**







# One key component of the habitat concept = structural complexity







**Structural complexity supports greater species richness and abundance.**

↓

**Structurally complex environments have more microhabitats and niches available.**







Consequences of habitat loss & degradation

↓

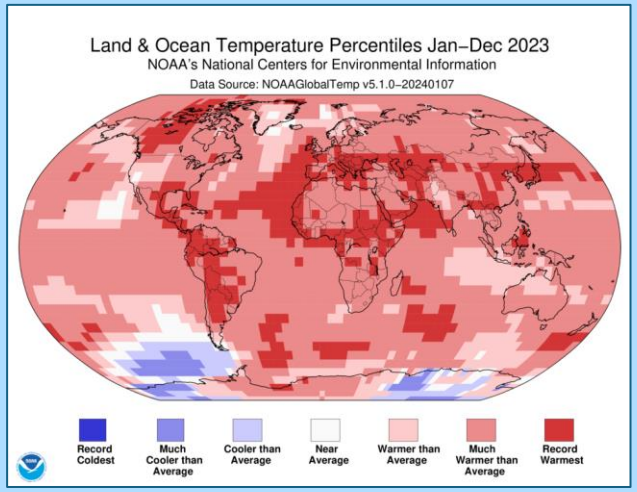
Reduction in abundance & diversity of organisms





# Drivers of Marine Habitat Loss and Degradation in the FL Keys

## Ocean warming

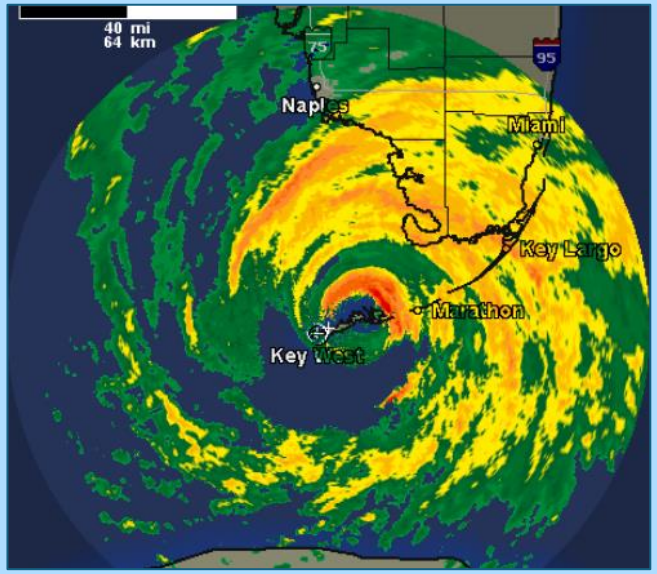



## Coastal development

## Water quality

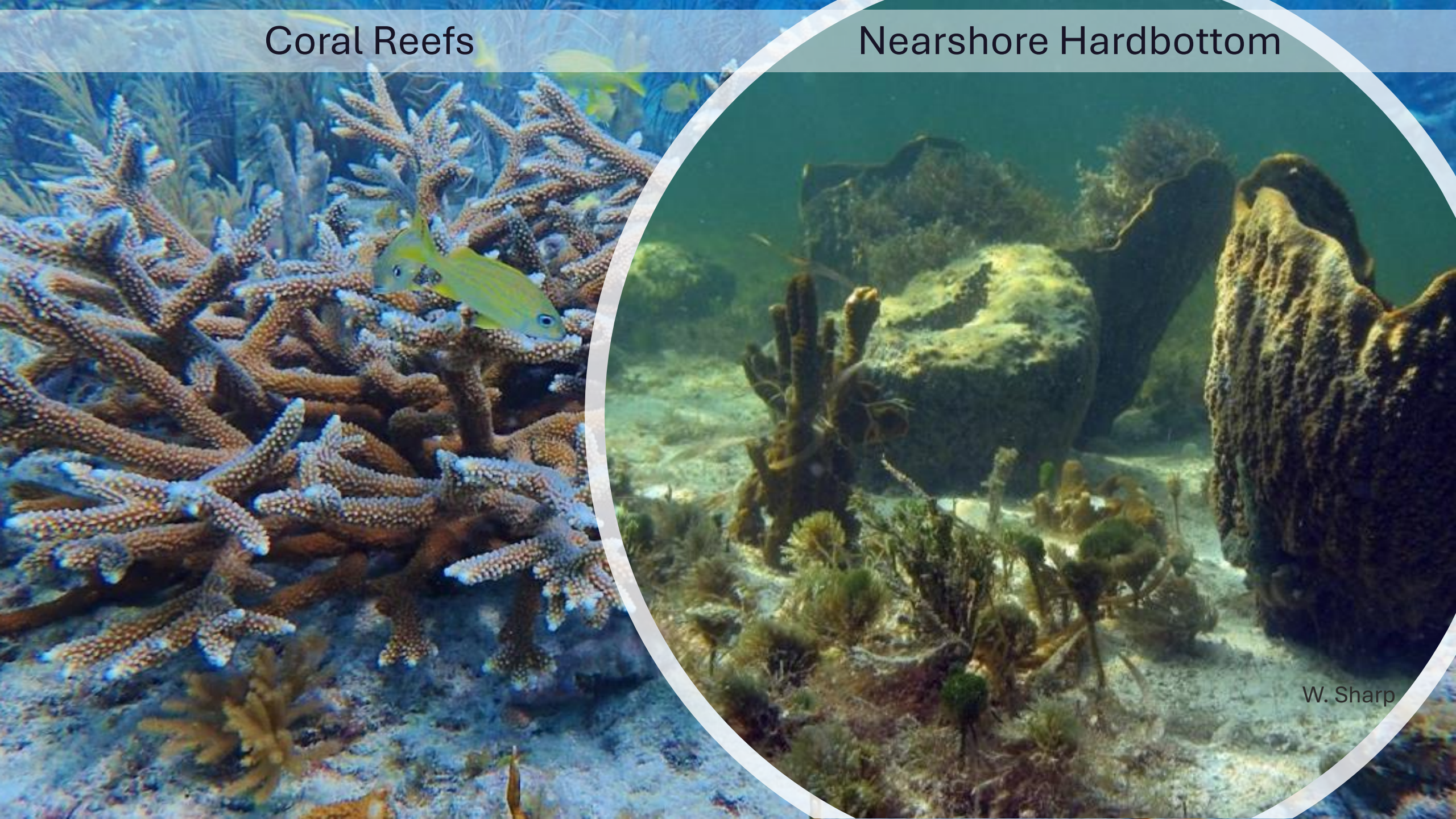

## Direct human impacts

## Storms

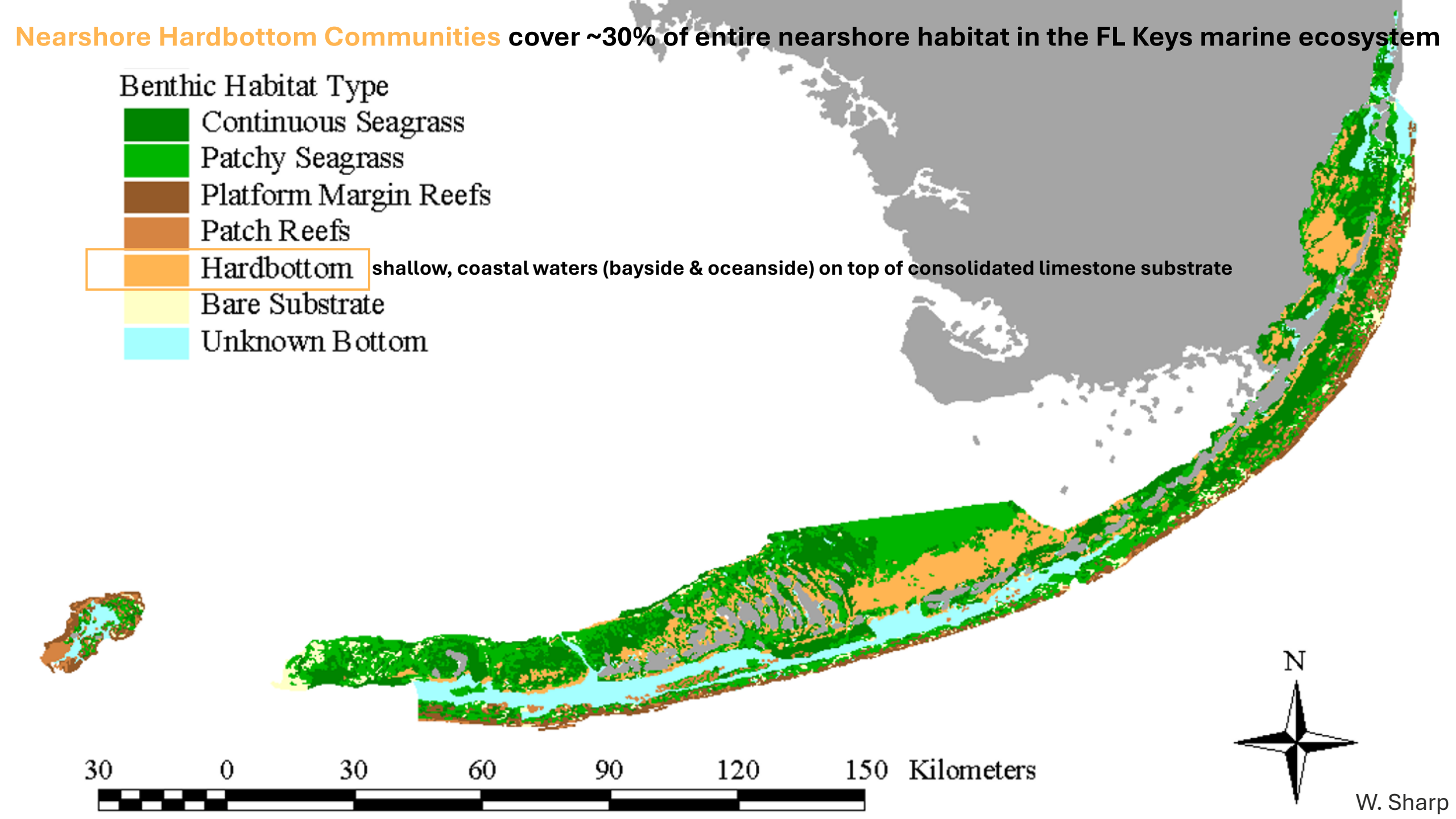


## Coral Reefs

## Nearshore Hardbottom



**Nearshore Hardbottom Communities** cover ~30% of entire nearshore habitat in the FL Keys marine ecosystem




shallow, coastal waters (bayside & oceanside) on top of consolidated limestone substrate

W. Sharp

**Structural complexity = low relief organisms**

sponges
soft corals
macroalgae
solution holes

# Shallow Nearshore Hardbottom

(Bayside)

W. Sharp





# Essential Fish & Invertebrate Habitat (Shelter, Refuge, Nursery, Foraging)



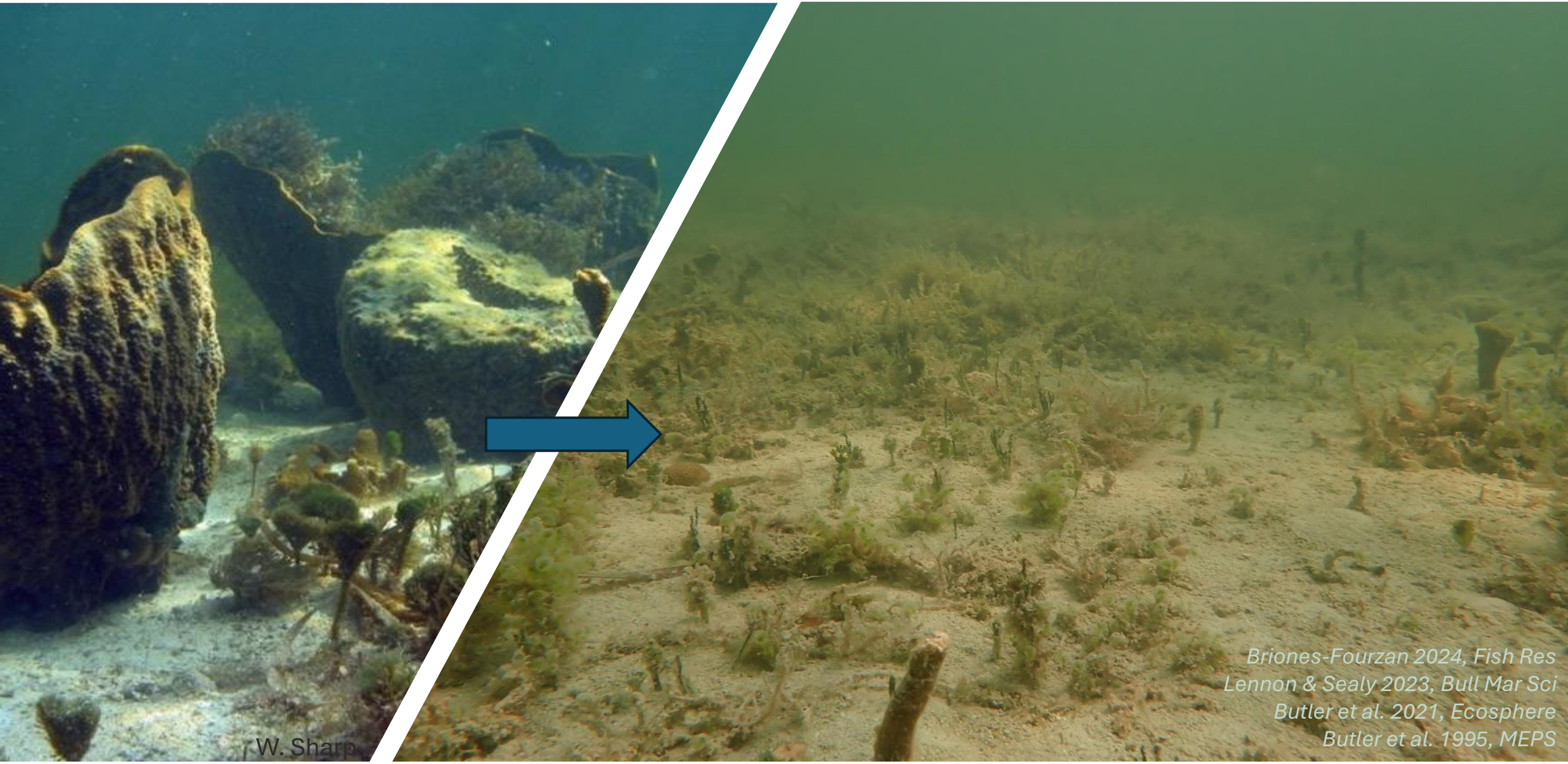


**Newly settled and juvenile fishes account for over 80% of fishes found on NHCs in SE Florida**




**Many of these species are critical for commercial and recreational fisheries**

# Substantial Changes in Habitat Landscape, Community Composition, & Ecology

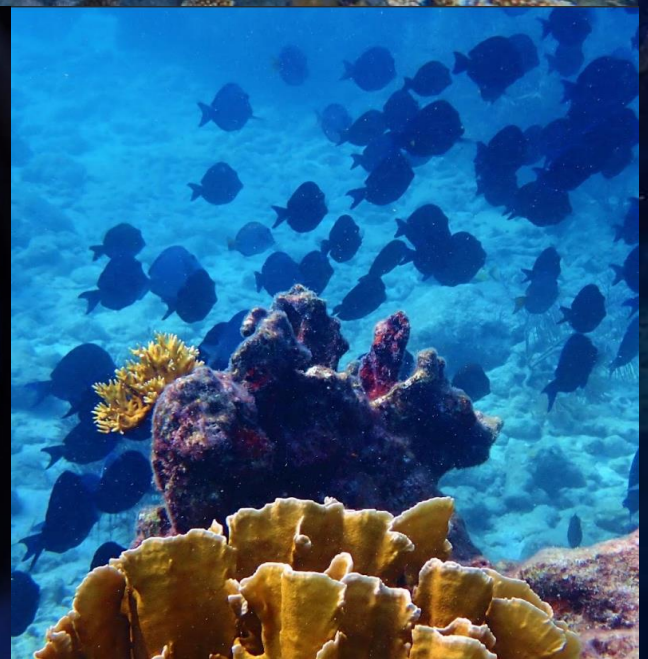



**Widespread loss of sponges and soft corals > less habitat & food resources > declines in fish diversity**

# Substantial Changes in Habitat Landscape, Community Composition, & Ecology


**Widespread loss of sponges and soft corals > less habitat & food resources > declines in fish diversity**

# Coral Reefs

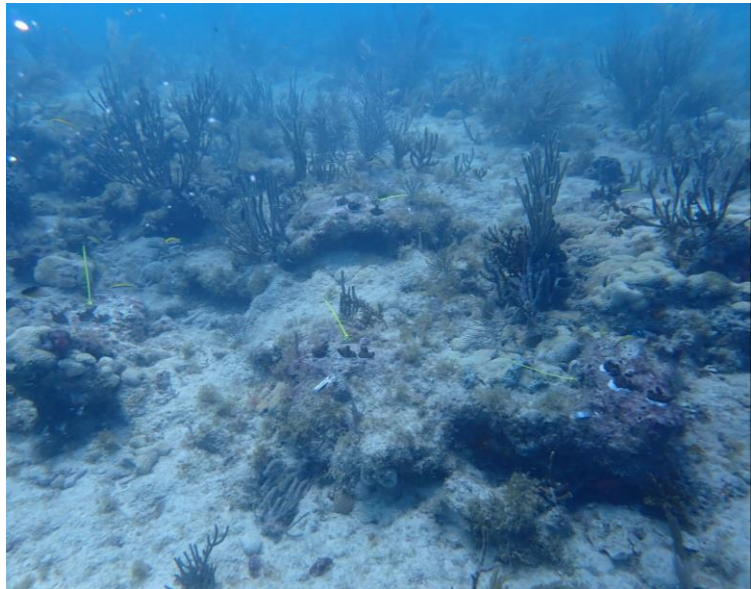


Reduced Coral Cover & Structural Complexity

Reef Flattening

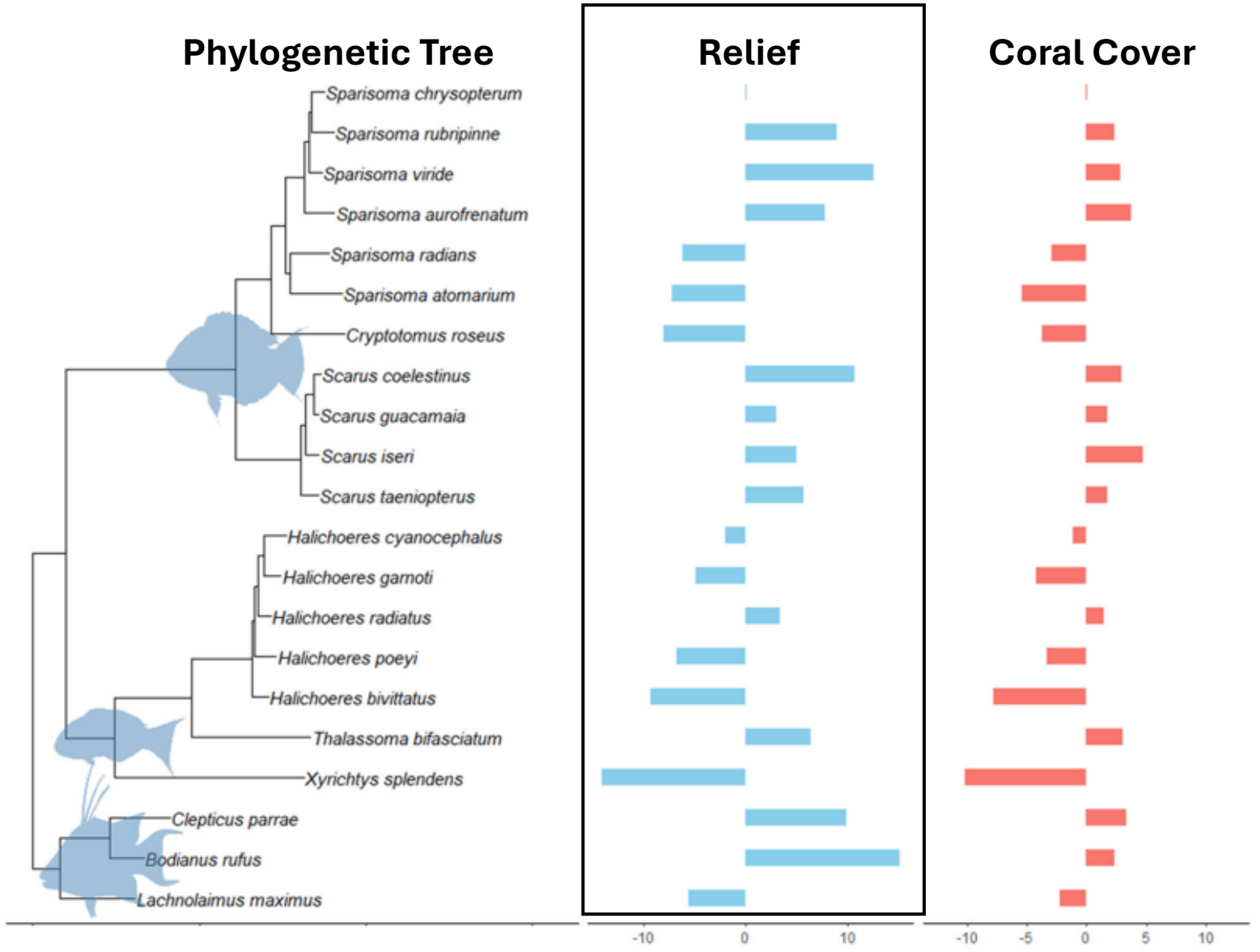
Negative Feedbacks on Fish Assemblages

*Helder, Burns & Green 2022, Ecol Indic*
*Burman et al. 2012, Mar Ecol Prog Ser*
*Alvarez-Filip et al. 2015, PLoS One*
*Rogers, Blanchard & Mumby 2014, Curr Biol*




# Need to Consider New Synergistic Management Strategies


# Coral Cover ≠ Structural Complexity on Low Coral Cover Reefs

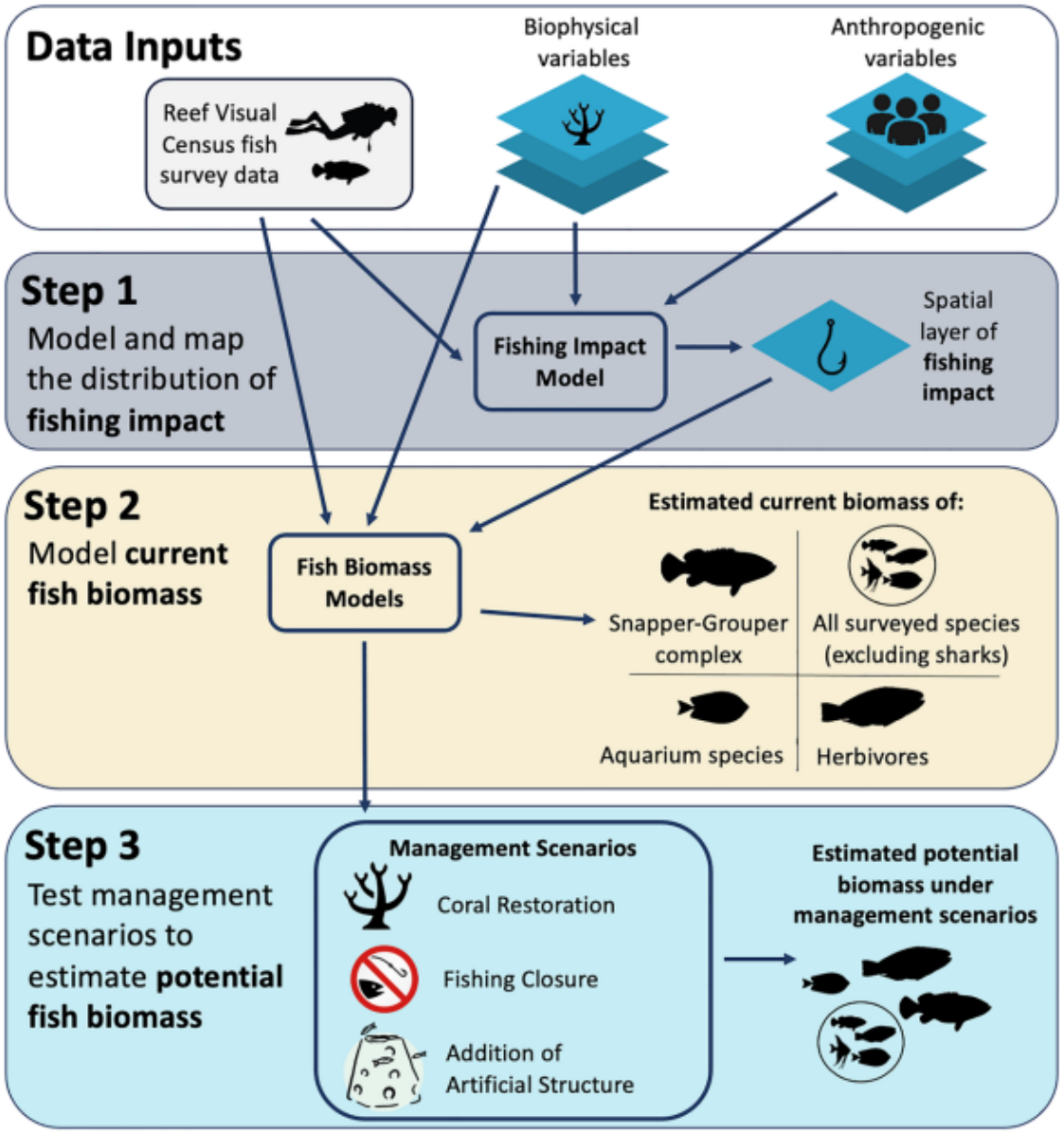



**Maximum hard relief**

Had greater impact on the density and diversity of fishes compared to coral cover

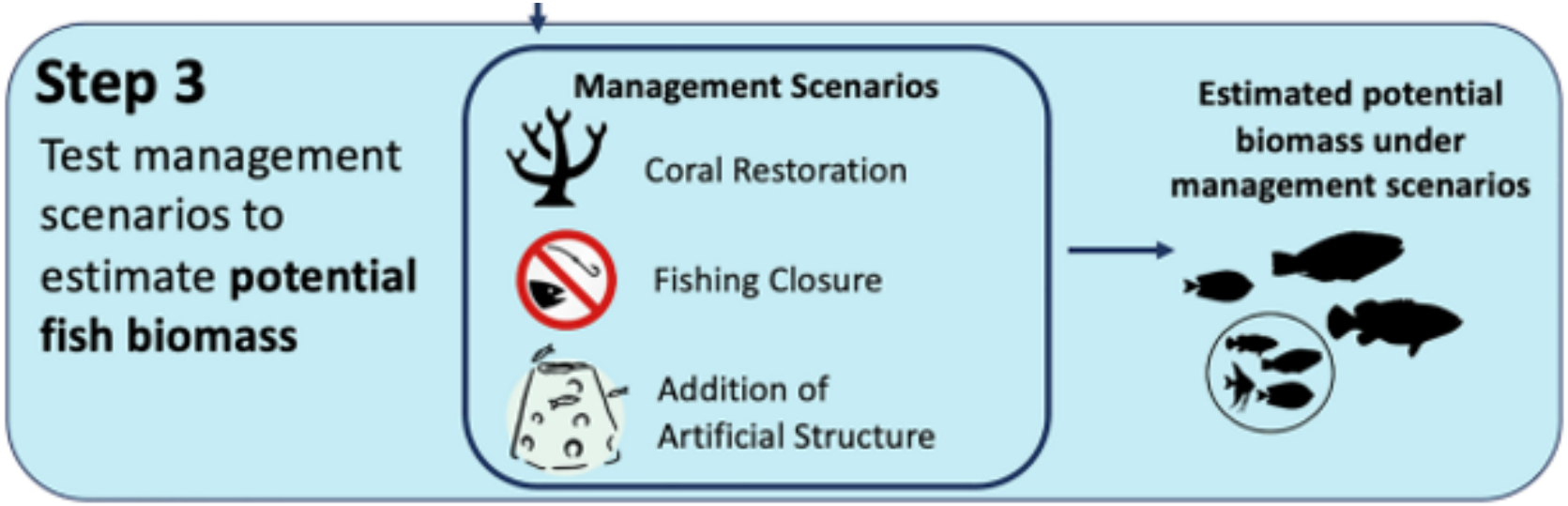
*Kochan et al. 2023, Oikos*
*Graham & Nash 2013, Coral Reefs*

# How may Different Management Scenarios Impact Fish Biomass?




*Zuercher et al. 2023, Aquatic Conserv*

# How do Different Management Scenarios Impact Fish Biomass?

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# The most effective *single* management measure for increasing predicted fish biomass → substantial increase in reef complexity

| Management scenario | All species | | Snapper–grouper | | Grazing species | | Aquarium species | |
|---|---|---|---|---|---|---|---|---|
| | kg ha$^{-1}$ (SD) | %Δ | kg ha$^{-1}$ (SD) | %Δ | kg ha$^{-1}$ (SD) | %Δ | kg ha$^{-1}$ (SD) | %Δ |
| Current | 657 (252) | – | 218 (137) | – | 98 (35) | – | 189 (52) | – |
| I: Reef restoration – phase 1a (moderate) | 689 (242) | 5% | 237 (159) | 8% | 94 (33) | -4% | 198 (52) | 5% |
| II: Reef restoration – phase 2 (extensive) | 996 (508) | 52% | 285 (191) | 31% | 103 (41) | 5% | 225 (69) | 19% |
| III: Artificial structure | 1,132 (482) | 72% | 314 (208) | 44% | 121 (42) | 23% | 258 (70) | 37% |
| IV: Fishing closure | 698 (204) | 6% | 269 (110) | 23% | 112 (42) | 14% | 201 (52) | 6% |
| V: Reef restoration + fishing closure | 1,094 (520) | 67% | 369 (150) | 69% | 117 (48) | 19% | 240 (72) | 27% |
| VI: Artificial structure + fishing closure | 1,241 (477) | 89% | 411 (160) | 89% | 136 (49) | 39% | 274 (73) | 45% |

*Zuercher et al. 2023, Aquatic Conserv*
*Rogers et al. 2015, Glob Change Biol*

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**?? Artificial structure + reef restoration (hybrid reefs)**

*Zuercher et al. 2023, Aquatic Conserv*
*Rogers et al. 2015, Glob Change Biol*

MONROE COUNTY
18 23
SOUTHERNMOST COUNTY IN THE UNITED STATES

NOAA
FLORIDA KEYS NATIONAL MARINE SANCTUARY

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

# Habitat Support Structures

## A Pilot Program

# Habitat Support Structures

A Pilot Program

## Goal:

To design, deploy, and evaluate habitat support structures for creating long-term, quality, stable habitat & improving conditions and resources within the Florida Keys marine environment

# Habitat Support Structures

A Pilot Program

## Long-term Goal:

Create networks of sites from near to offshore on Gulf and Atlantic sides to support ontogenetic movements of fish

# Habitat Support Structures

A Pilot Program

## Basis of Approach:

**Characterize** habitats and their (structural) deficits as related to fish and invertebrate life histories

*Lack of specific habitat (from loss) & quality habitat (from degradation)*

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## A Pilot Program

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**Test** HSS that functionally mimic and/or enhance the structural components that historically provided complexity

*Treatments: material type, structure style, size, scale (benthic footprint), restoration component (hybrid reefs)*

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## A Pilot Program

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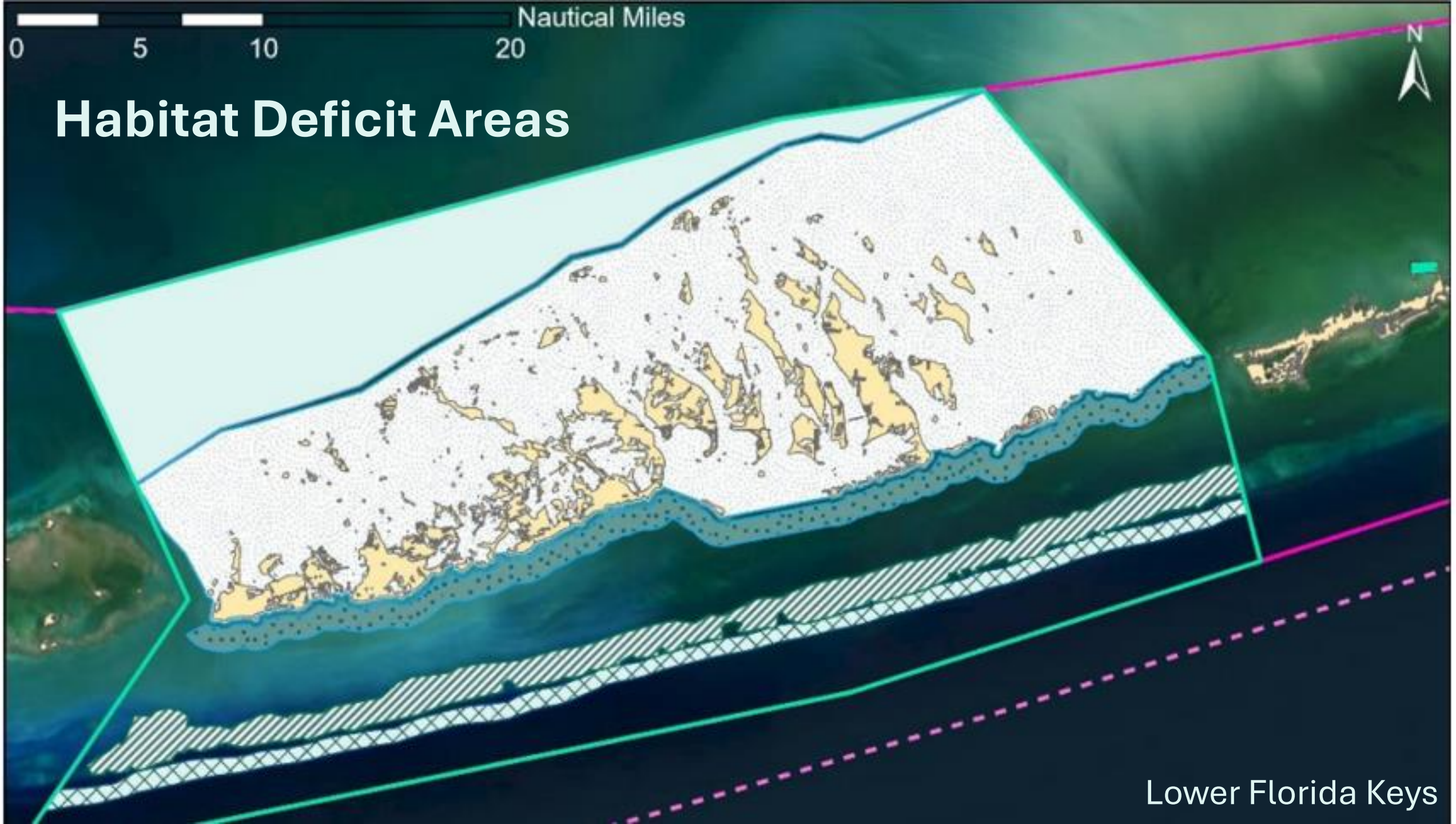
*Treatments: material type, structure style, size, scale (benthic footprint), restoration component (hybrid reefs)*

**Evaluate** net ecological and ecosystem outcomes (negative, neutral, positive) based on comprehensive monitoring plan

*Executed by a team of local experts & scientists*


Nautical Miles
0
5
10
20
N
Habitat Deficit Areas
Lower Florida Keys


MBARA


Danielle Morley, Dr. Grace Casselberry, Dr. Lucas Griffin, Dr. Robert Ellis, Dr. May Lehmensiek, Dr. Chelsey Crandall, Dr. Andy Danylchuk, Evan Prasky, Dr. Jacob Brownscombe, Dr. Timothy Rowell, Sarah Fangman, Dr. Hanna Koch, Dr. Christopher Sweetman, Dr. Lisa Hollensead

# Monroe County

## Artificial Reefs

## Program Principles:

Science-based
Ecosystem-focused
Social Perspectives
Sustainability
Adaptive Management
Stakeholder Input
Education & Outreach

# Monroe County

## Artificial Reefs

## Economic Analysis on the Benefit of Artificial Reefs in FL:

**Fishing and diving activity on artificial reefs annually:**

- Provides > 39,000 jobs for Floridians
- Generates > $3 billion of economic activity
- Accrues > $1 billion in income to Floridians
- Produces $250 million in state revenues

Sea Grant FLORIDA

# Monroe County

## Artificial Reefs

## No One Size Fits All

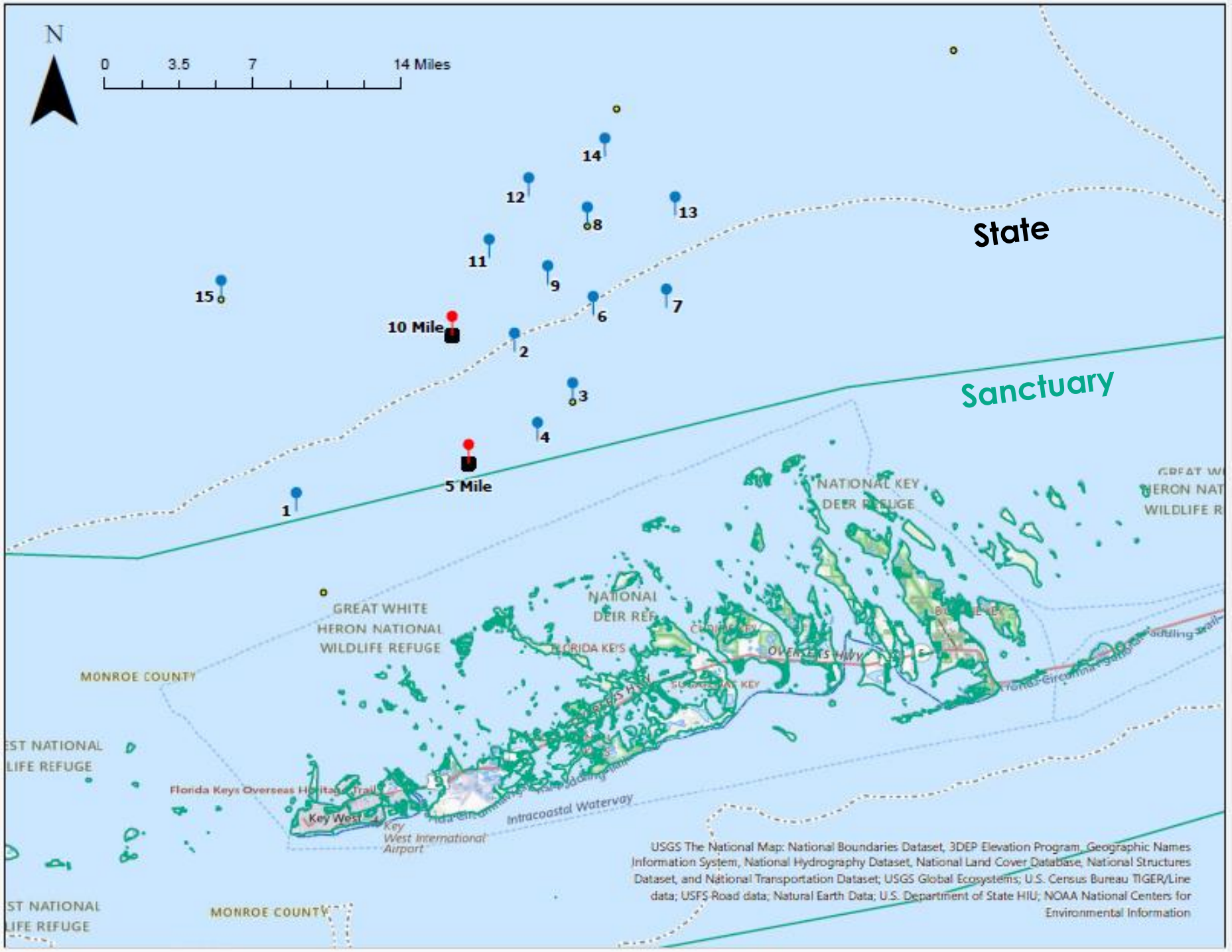
Gulfside Network
Dive Training Reefs

# Monroe County

## Artificial Reefs

# Gulfside Network

- 5-15 miles offshore
- State & federal waters
- 40-60’ deep
- Sand plain, no structure
- Identified as having a lot of potential during angler/local stakeholder meeting in 2023



# Gulfside Network Purpose:
## Services to be Provided
## Questions to be Asked

### Ecological

- Fish habitat: Complex, diverse, quality
  - Waypoints

- What species are using these structures and why?

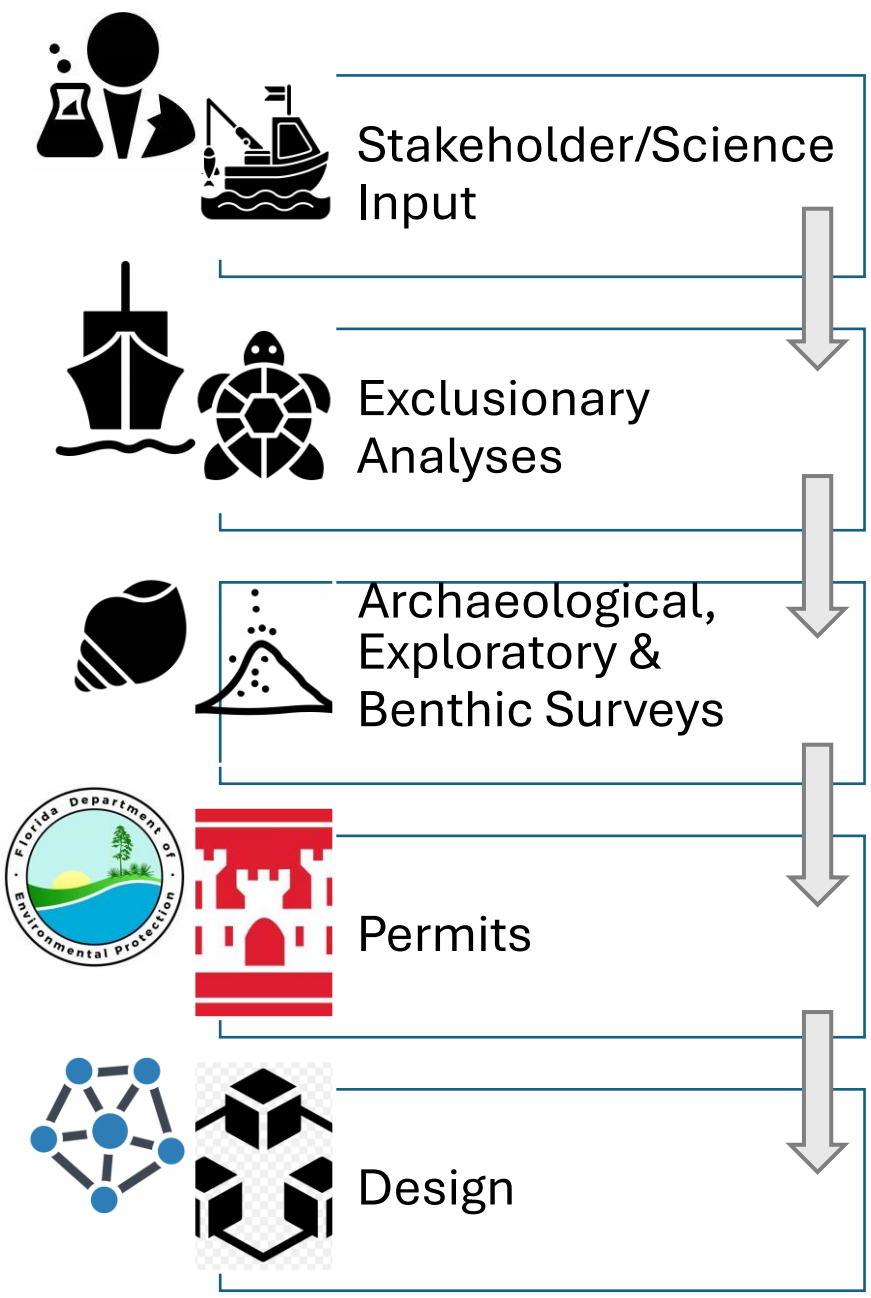
### Social

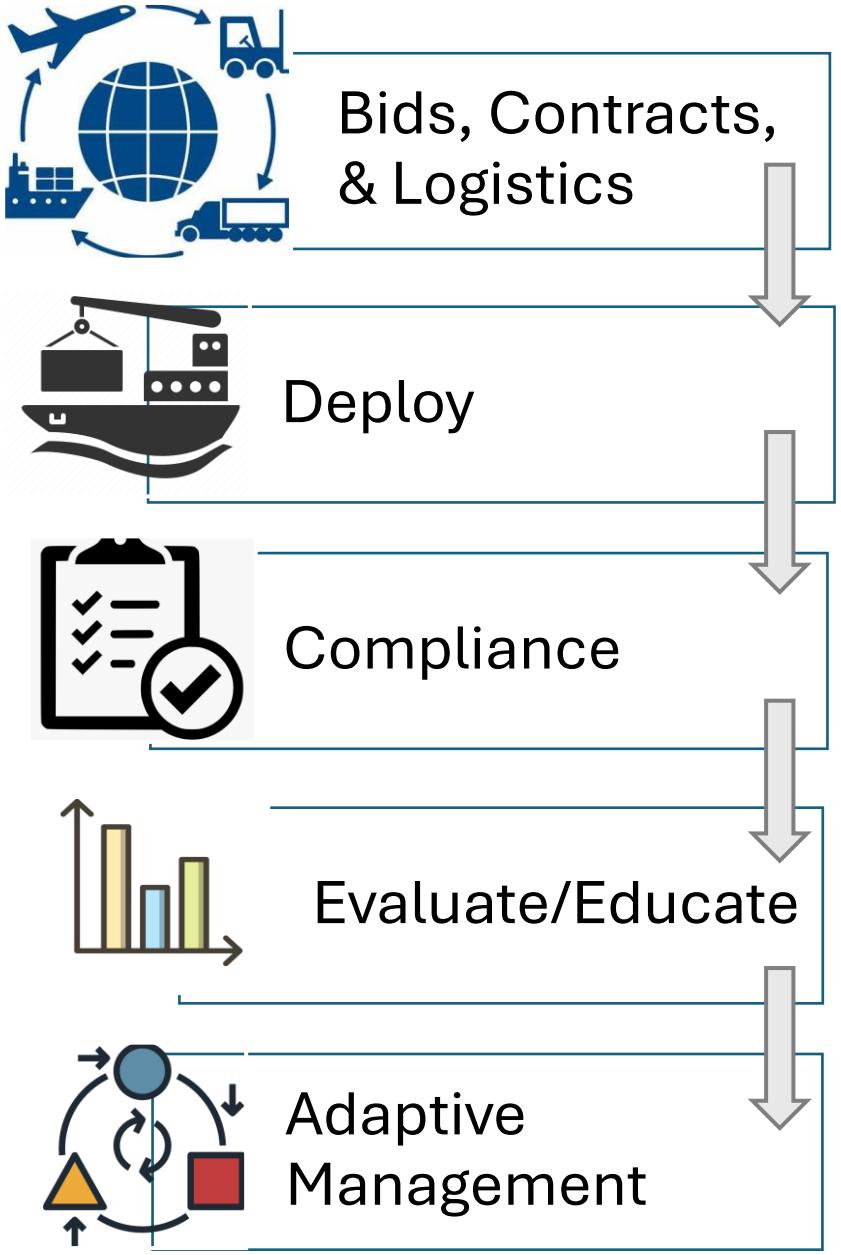
- New fishing & diving opportunities
  - Draw and disperse activity

- Do social perspectives change over time?

# Florida Keys Dive Training Reefs

# Timeline of Operations



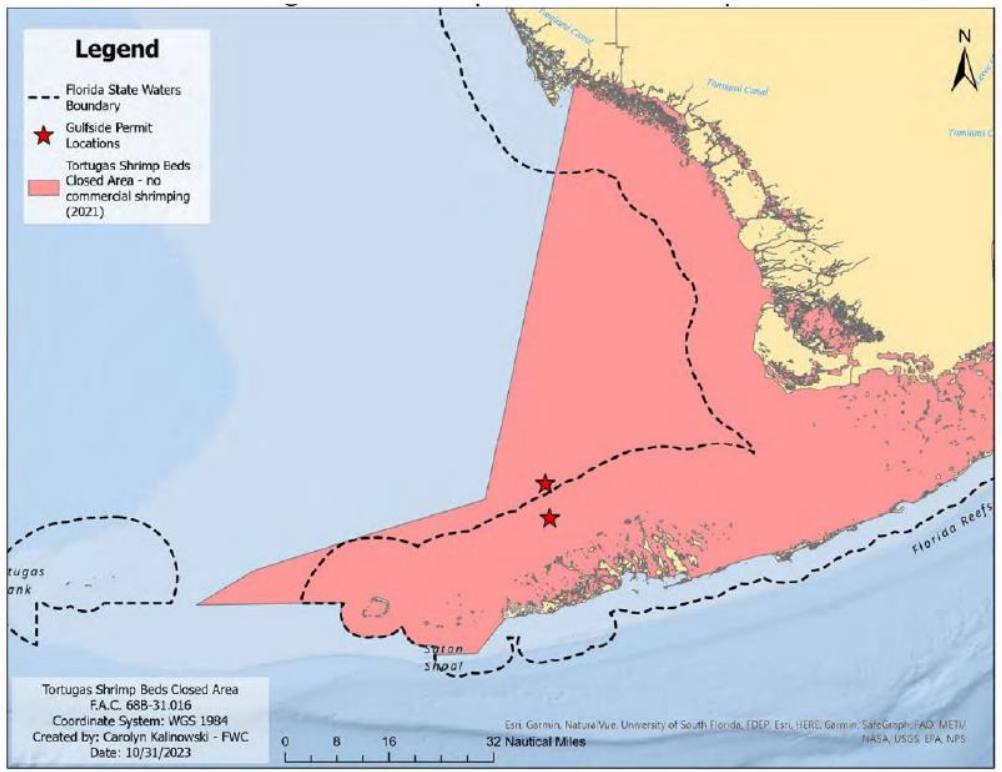



# Exclusionary Analysis

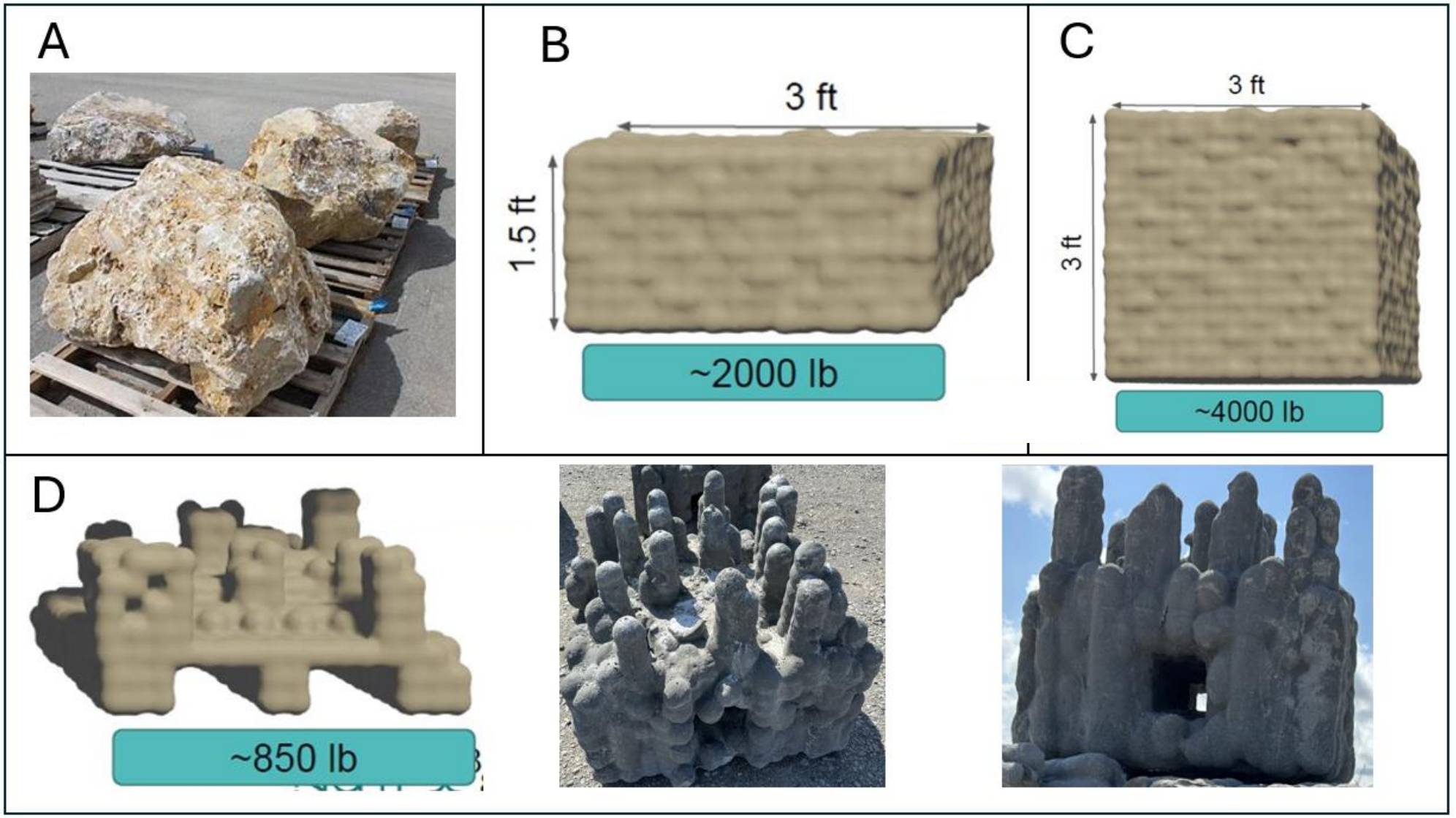
## Areas to be Avoided

- Critical habitat of ESA sp.
- Active shrimping grounds
- Telecommunication corridors
- Navigational fairways
- Heavy traffic areas
- Naval testing
- Historic sites

Figure 5: Shrimp Trawl Closure Map



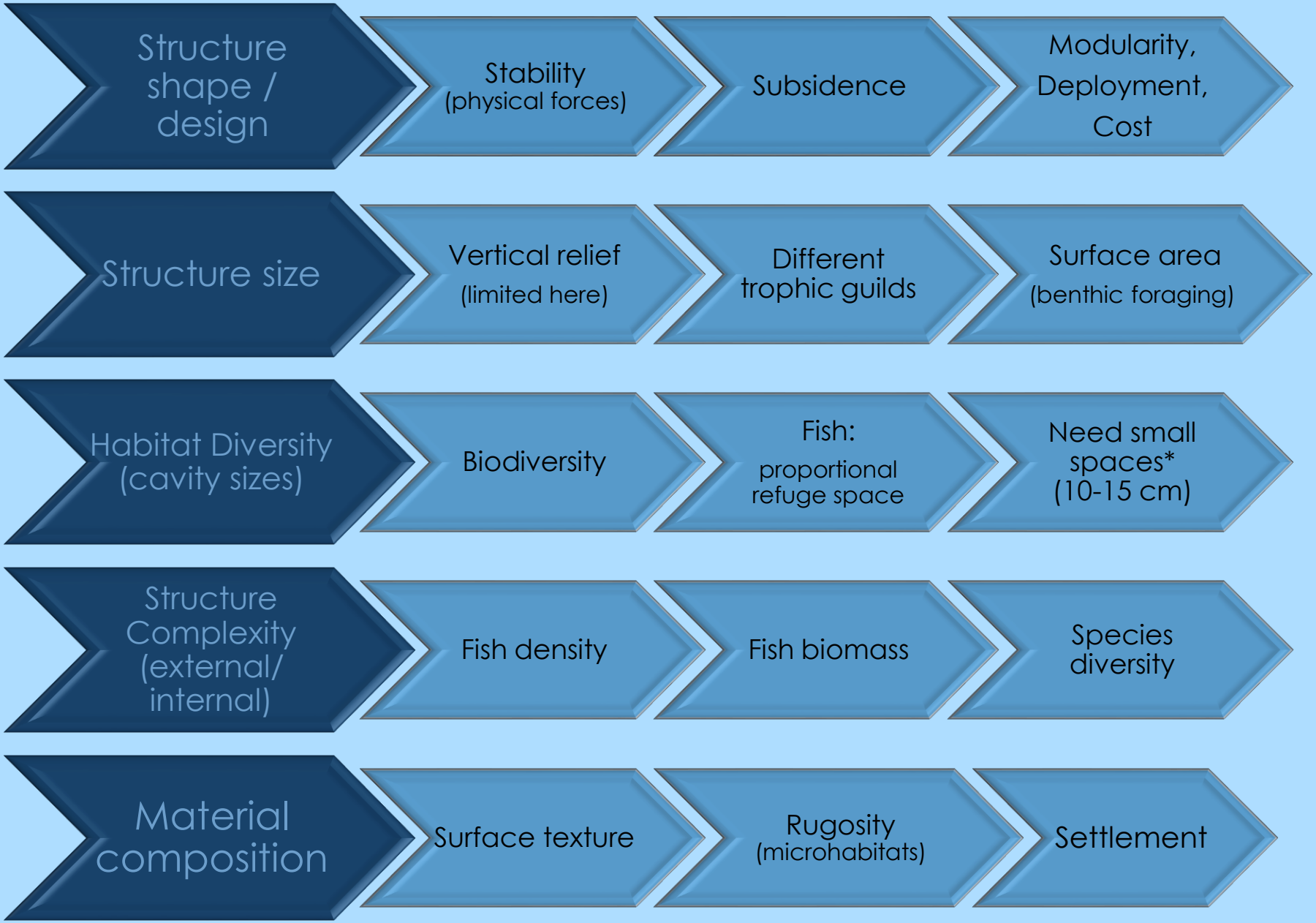
# Deficit 1: Nearshore Hardbottom - Recommendations




**Treatments:**

- Material
- Size
- Style
- Sponges
- Scale

# Patch Reef Design Considerations



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