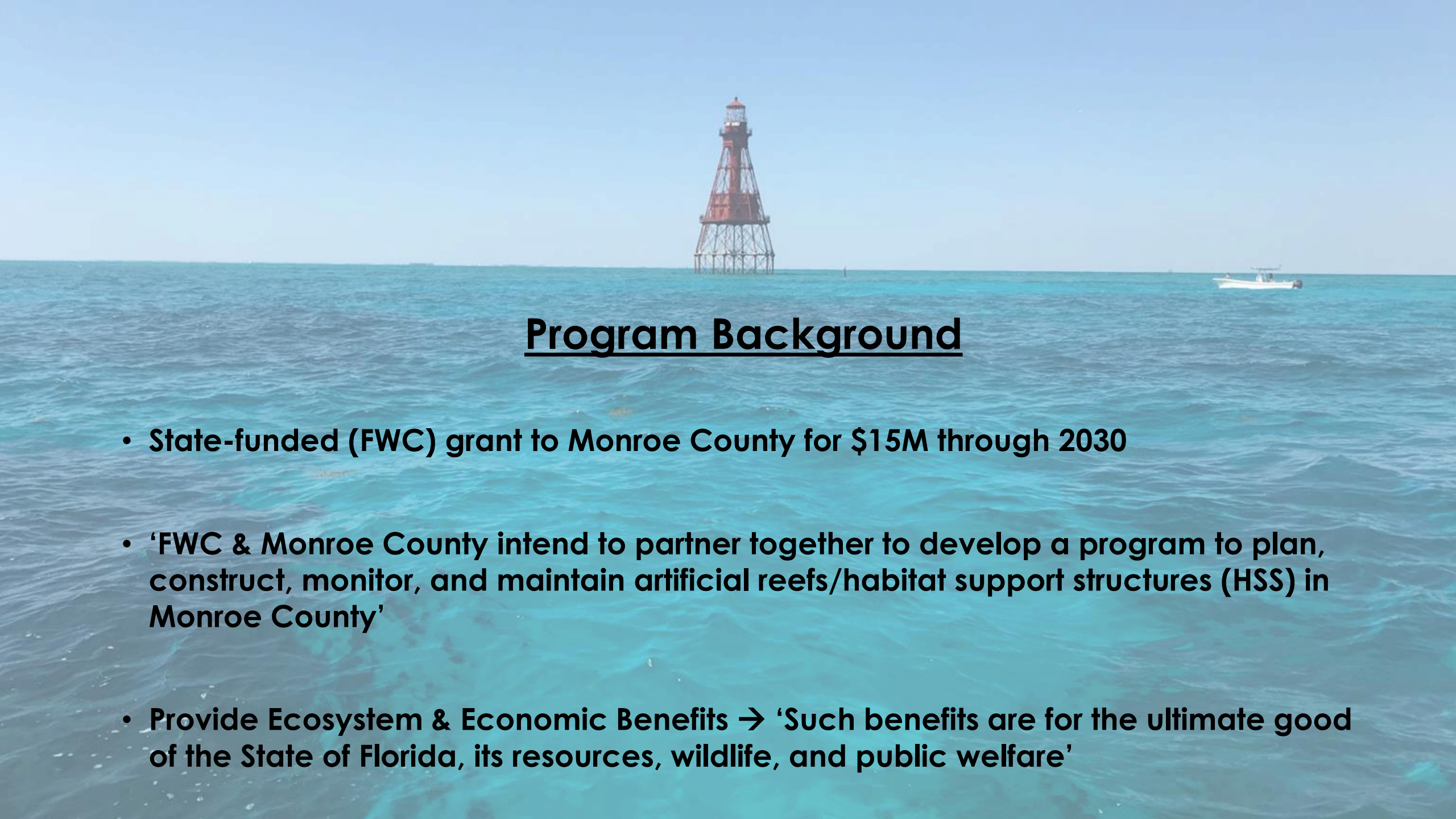
Monroe County

Artificial Reefs

Dr. Hanna R. Koch, Director



Program Background

- State-funded (FWC) grant to Monroe County for $15M through 2030
- 'FWC & Monroe County intend to partner together to develop a program to plan, construct, monitor, and maintain artificial reefs/habitat support structures (HSS) in Monroe County'
- Provide Ecosystem & Economic Benefits → 'Such benefits are for the ultimate good of the State of Florida, its resources, wildlife, and public welfare'

Program Objectives

1. ‘Provide offshore recreational fishing and diving opportunities, reduce pressure on natural reef and hard bottom sites, and reduce user conflicts by providing additional recreational fishing and diving sites in state and federal waters of the Gulf of Mexico’

2. To establish a framework for the design, placement, monitoring, and maintenance of HSS
   - Address habitat deficits as related to fish and invertebrate histories
   - Promote 3D complexity, biodiversity, diverse fish assemblages
   - Provide ecological support and improve ecosystem function

Long-term Goal: Create networks of sites from near to offshore on Gulf & Atlantic sides

Projects in Development

Outside FKNMS:

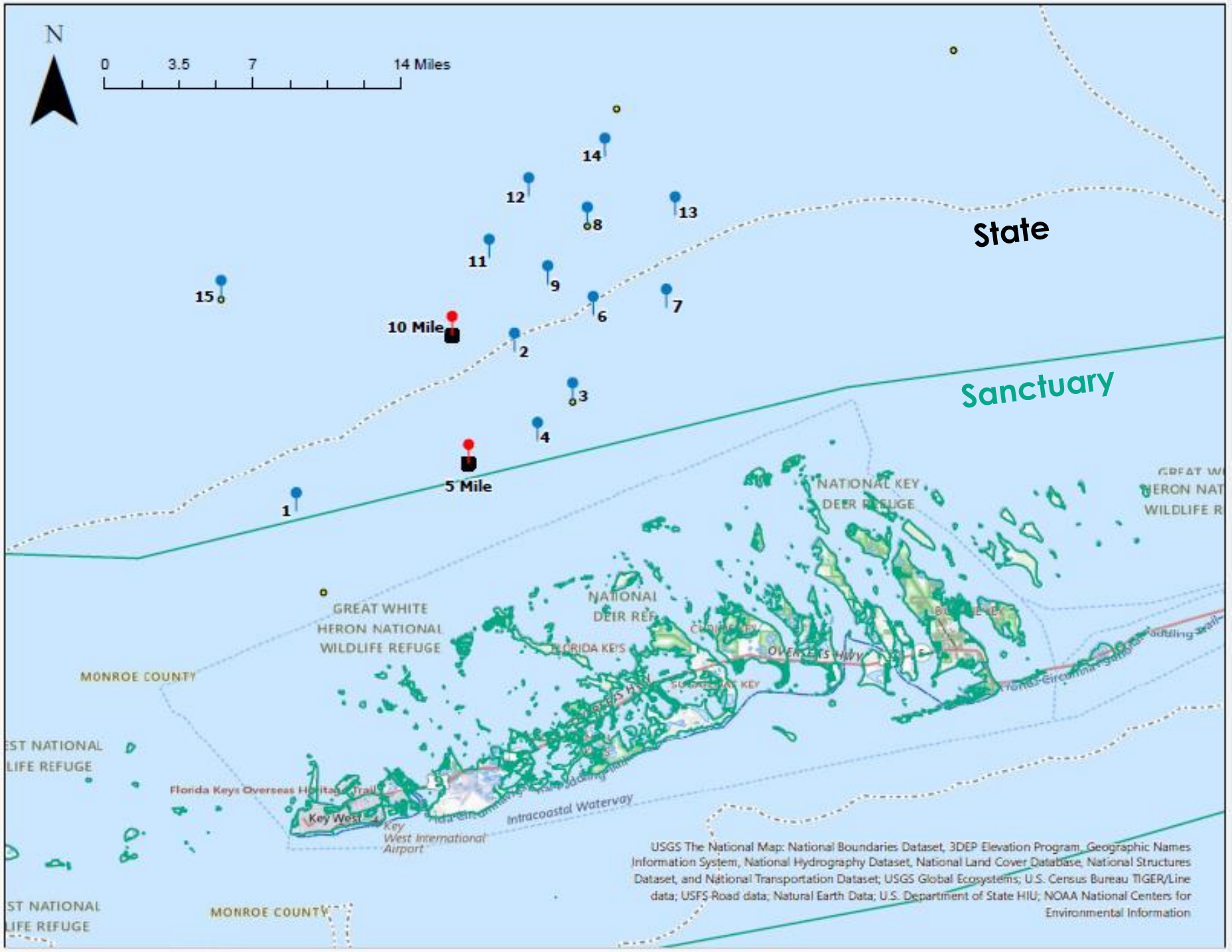
- Gulfside Network

Inside FKNMS:

- Habitat Support Structures Pilot Program

Gulfside Network

- Up to 10 sites
- 2-5 miles apart
- 5-15 miles offshore
- State & federal waters
- Multiple patch reefs/site
- 40-60’ deep
- Sand plain/ No structure
- Angler/local stakeholder input meeting in 2023



Gulfside Network Purpose:
Services to be Provided

Ecological

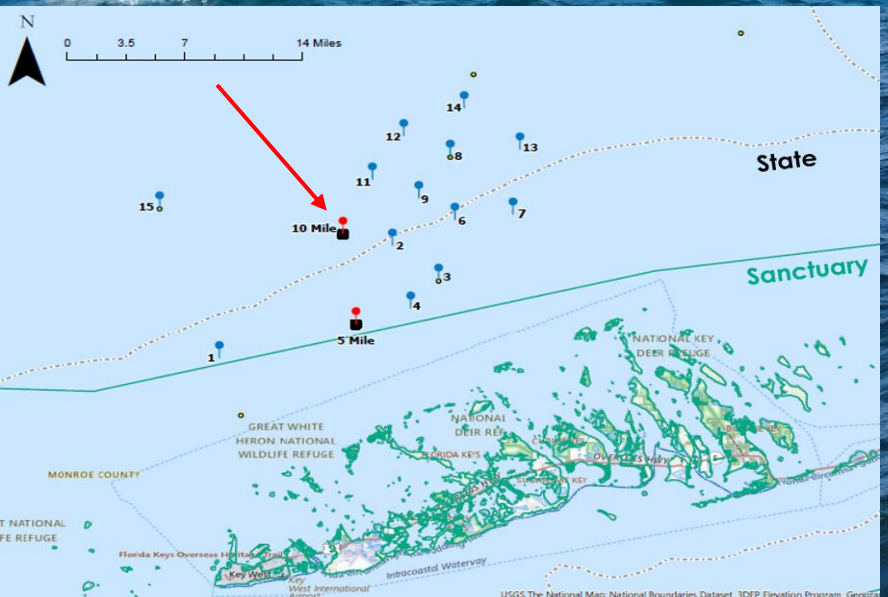
- Fish habitat: Complex, diverse, quality
  - Waypoints
  - Low relief habitat for early life stages & juveniles via unpublished nodes

Social

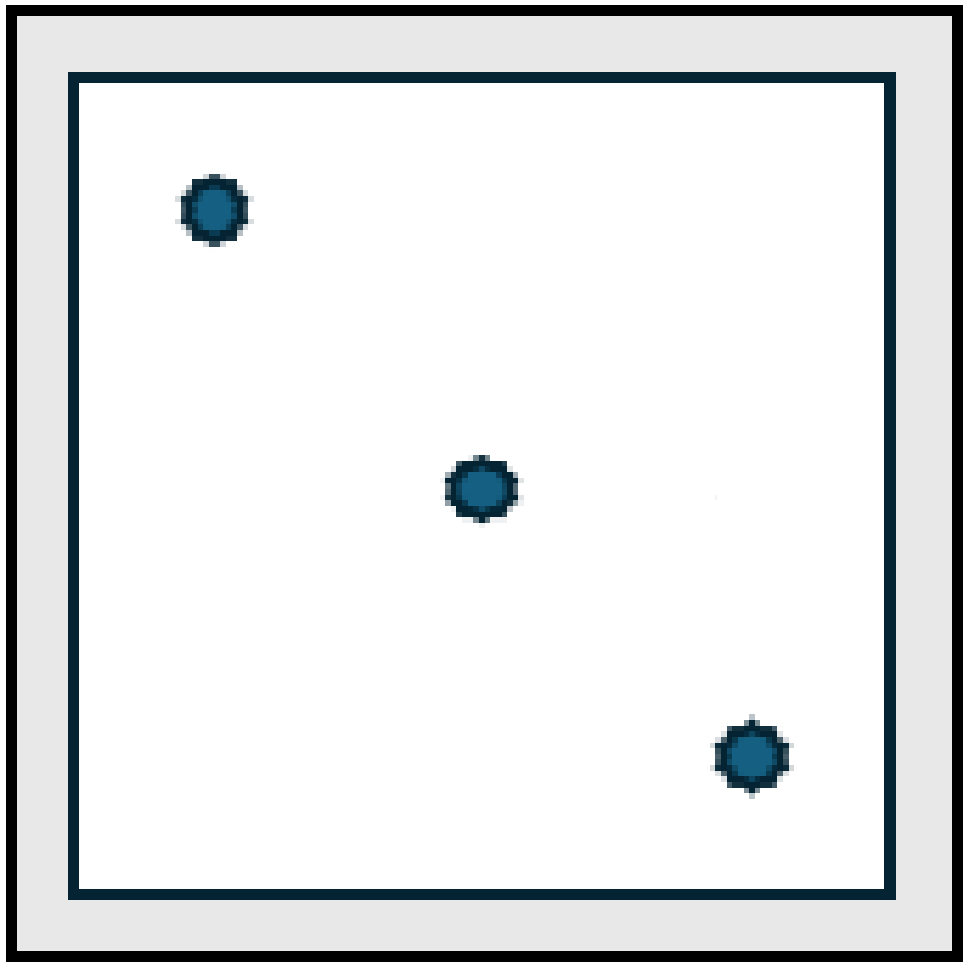
- New fishing & diving opportunities
  - Draw and disperse activity

Variety of Structure Styles & Sizes → Promote Biodiversity

Gulfside 10 Mile Reef: Power Pole Deployment



Gulfside 10 Mile Reef



→ 3 patch reefs: layered stacks, 6-12’ vertical relief, ~50-75’ diameter, variety of spaces

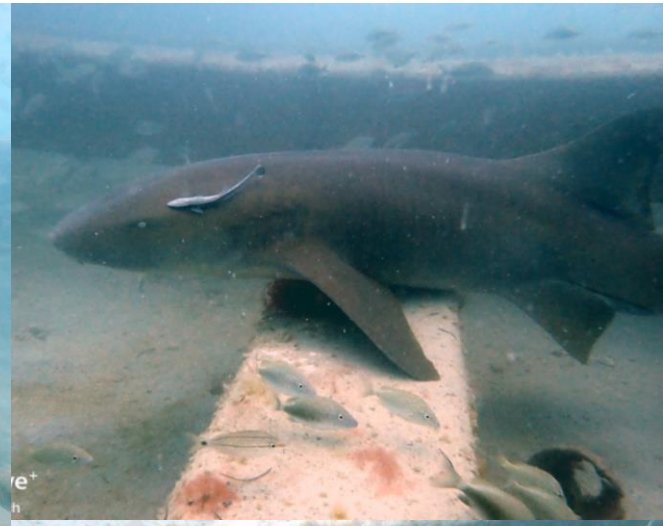
Post-Deployment Surveys

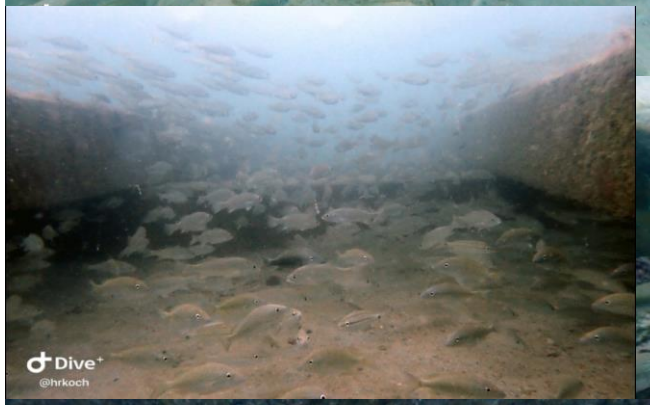
3 Days

Post-Deployment Surveys

3 Days

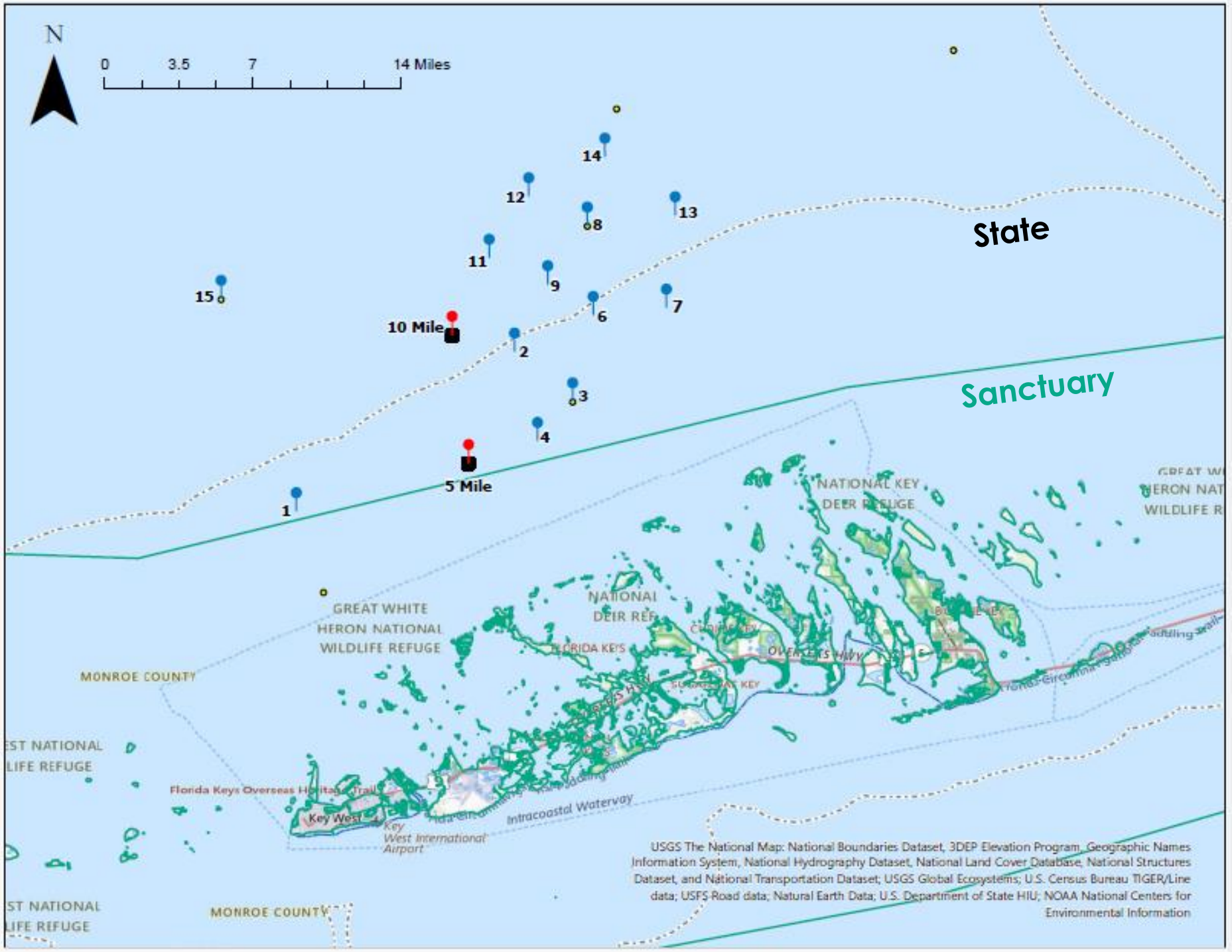
6 Months





Gulfside Network

- Add low relief structure variety to Gulfside 10 Mile
- Awaiting new permits
  - 5 federal pending
  - 5 state approved
- Monitoring Plan



Habitat Support Structures

A Pilot Program

Working Group: John Hunt (FWC), Hanna Koch (MC), Andy Bruckner (FKNMS), Carolyn Kalinowski (FWC), & Keith Mille (FWC)

Habitat Support Structures

A Pilot Program

Goal:

To design, deploy, and evaluate habitat support structures for improving conditions and resources within the Florida Keys National Marine Sanctuary



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

↓

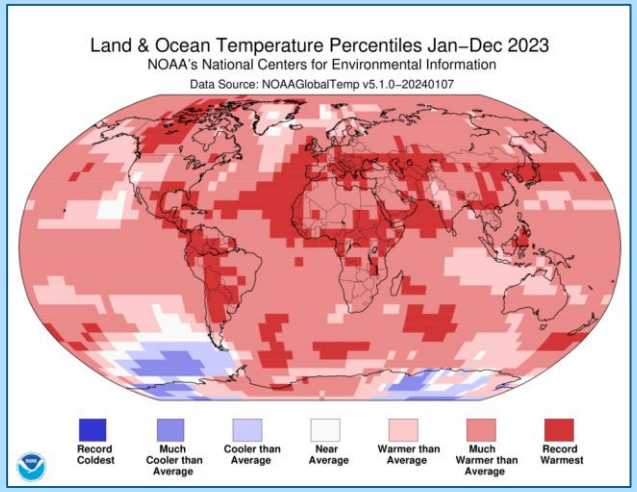
Reduction in abundance & diversity of organisms





Drivers of Marine Habitat Loss and Degradation in the FL Keys

Ocean warming

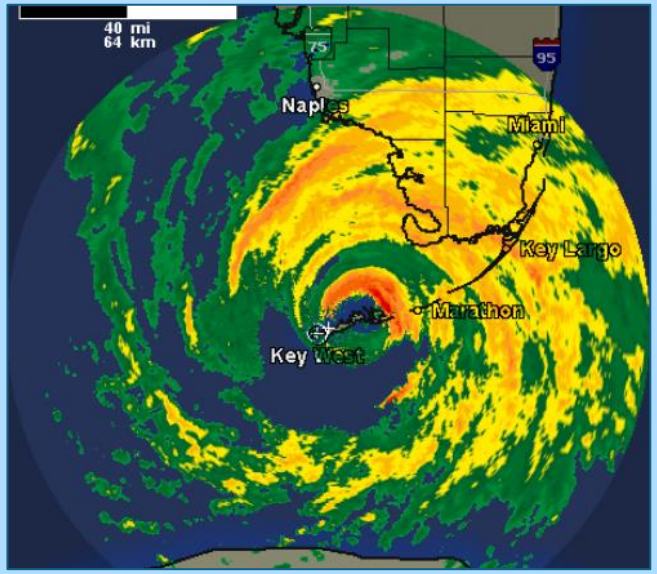


Coastal development

Water quality

Direct human impacts

Storms



Habitat Support Structures

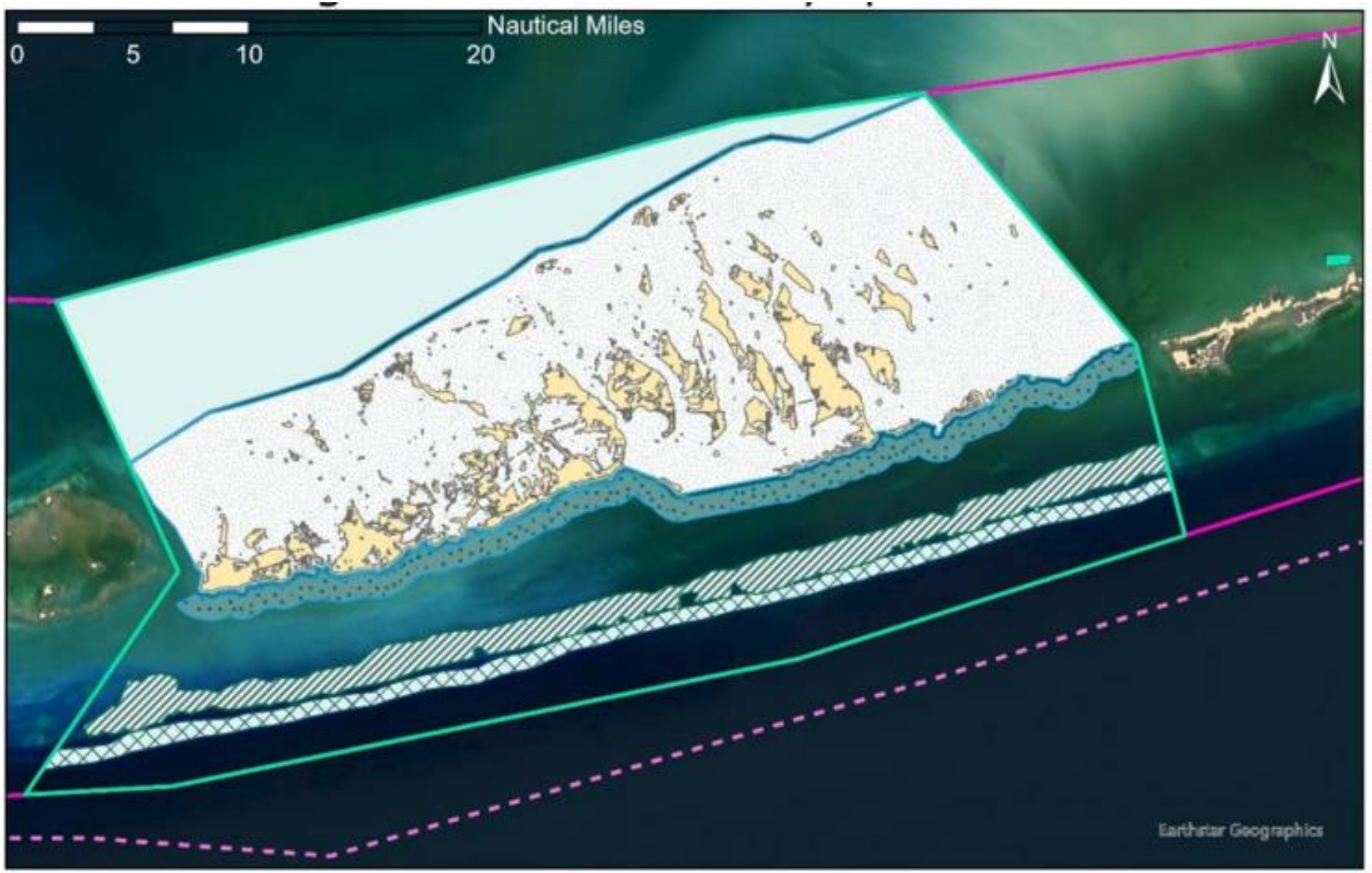
A Pilot Program

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)

5 Habitat Deficit Areas as exemplified in the Lower Florida Keys Region



Legend

- Lower Keys
- Land
- Southern Gulf of Mexico
- Nearshore hardbottom
- Solution hole survey site
- Nearshore ocean
- Offshore waters
- Deep reef
- FKNMS Boundary
- FKNMS Boundary (proposed)

Florida Fish and Wildlife Conservation Commission
Division of Marine Fisheries Management
Florida Artificial Reef Program
Prepared By: Carolyn Kalinowski
06/04/2024

Southern Gulf of Mexico | Nearshore hardbottom | Solution hole survey site | Nearshore ocean | Offshore waters | Deep reef

Habitat Support Structures

A Pilot Program

Basis of Approach:

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)

Habitat Support Structures

A Pilot Program

Basis of Approach:

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

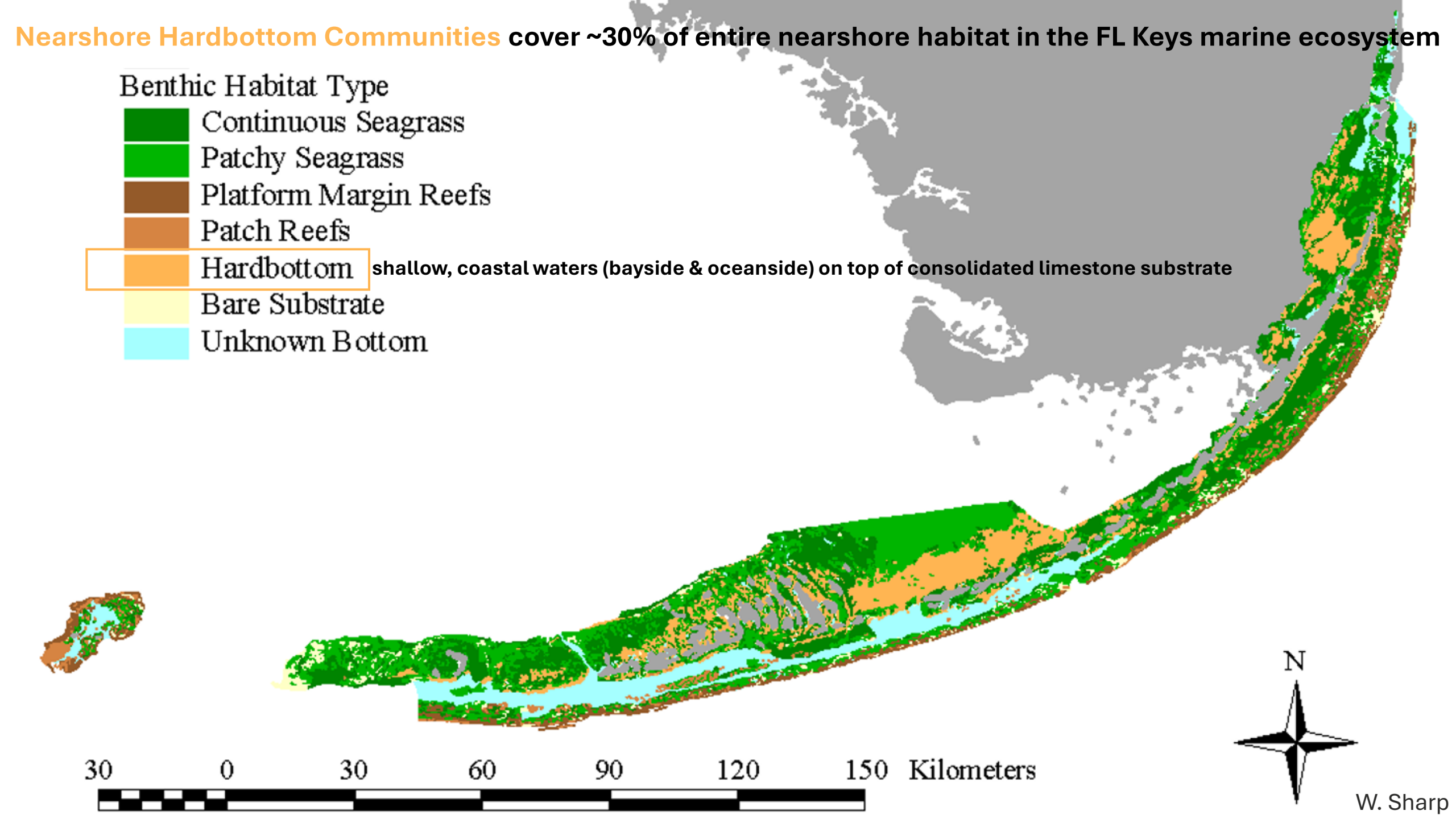
Treatments: material type, structure style, size, scale (benthic footprint), restoration component (hybrid reefs)

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

Executed by a team of local experts & scientists


Shallow
Nearshore
Hardbottom
(Bayside)
W. Sharp

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)

Many of these species are critical for commercial and recreational fisheries

Substantial Changes in Habitat Landscape, Community Composition, & Ecology

W. Sharp

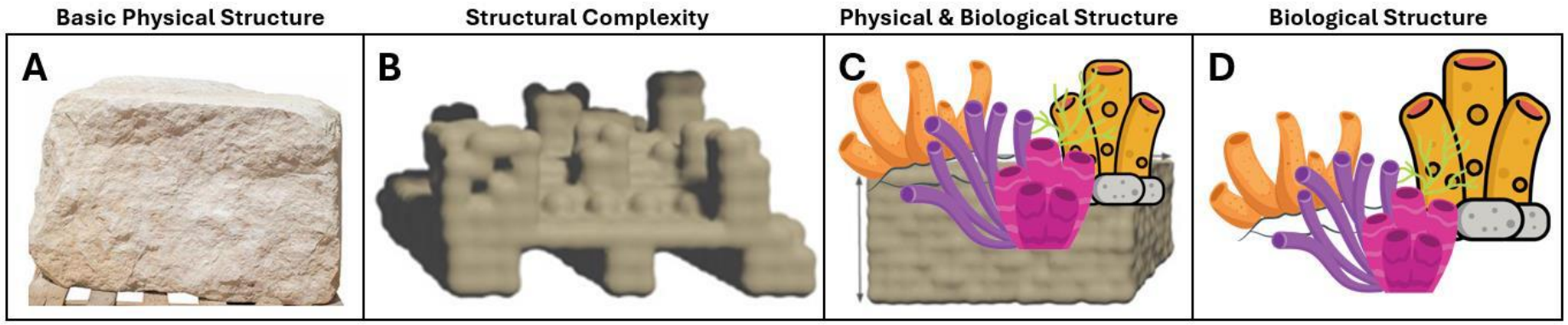
Present-day fish species richness is ~30%–40% of what it was when surveying began in the 90's

Briones-Fourzan 2024, Fish Res
Lennon & Sealy 2023, Bull Mar Sci
Butler et al. 2021, Ecosphere
Butler et al. 1995, MEPS

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


Islamorada
Layton
Duck Key
Marathon
Big Pine Key
10 mi
N


Long Key (J01)
Burnt Point (P01)
Burnt Point (E01)
N
0
2.5
5 Kilometers


Basic Physical Structure
Structural Complexity
Physical & Biological Structure
Biological Structure
A
B
C
D

Monitoring & Evaluation Plan

- Begin on annual basis
- Pre-deployment surveys to collect baseline data
- Post-deployment surveys:
  - Structure physical persistence & stability, material performance
  - Fish community metrics (species diversity, abundance, size class, behavior)
  - Benthic invert metrics for individuals settled on (e.g., corals, sponges, anemones) or living under (e.g., crabs, lobsters, mollusks) the structures
  - Fouling and algal communities (including CCA)
  - Restoration (e.g., sponges): attachment success, survival, growth
  - Where applicable, solution hole and sedimentation data
  - Basic water quality

Habitat Support Structures

A Pilot Program

Other Ideas:

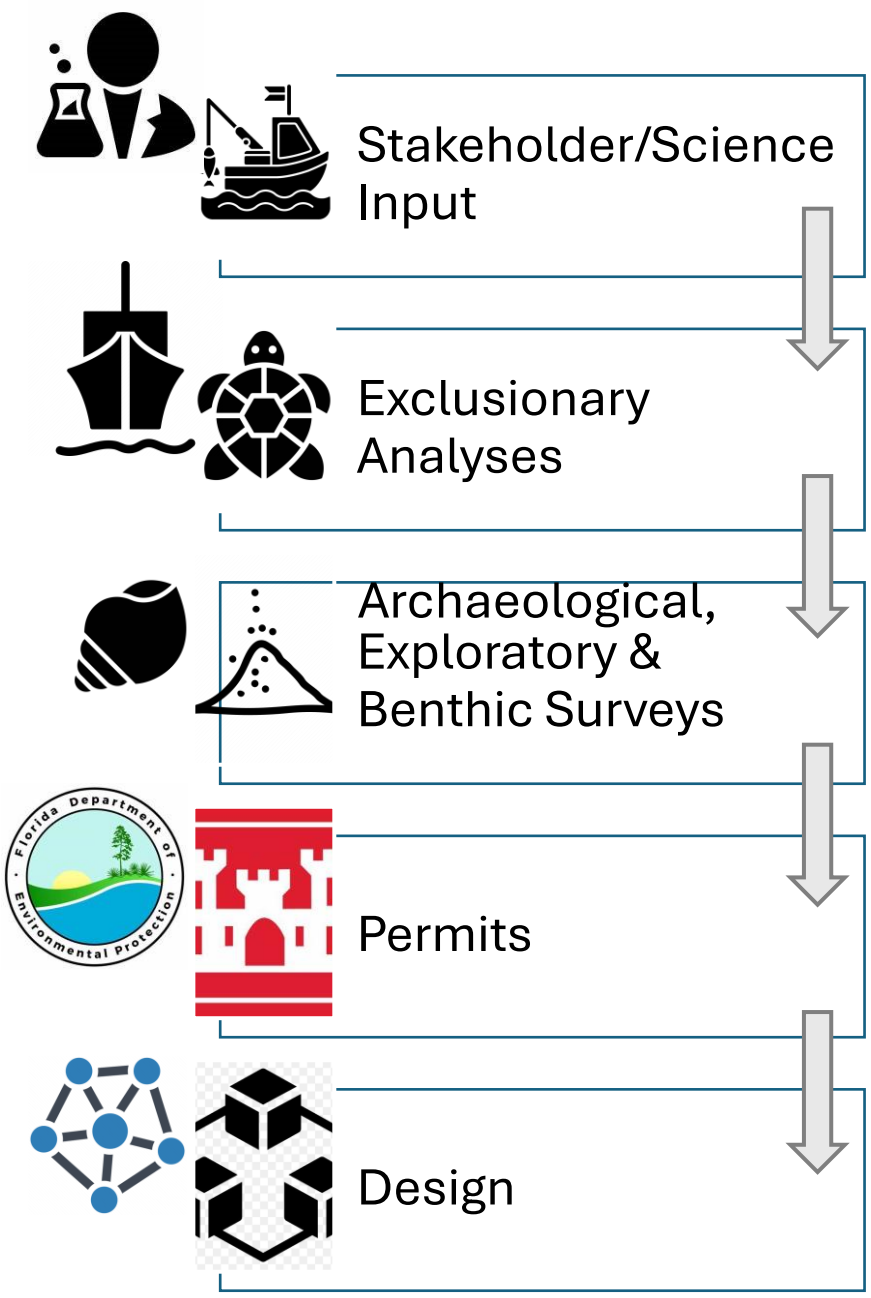
- Dive Training Reefs
- Coastal Resilience/NBs
- Hybrid Reefs
- Memorial Reefs

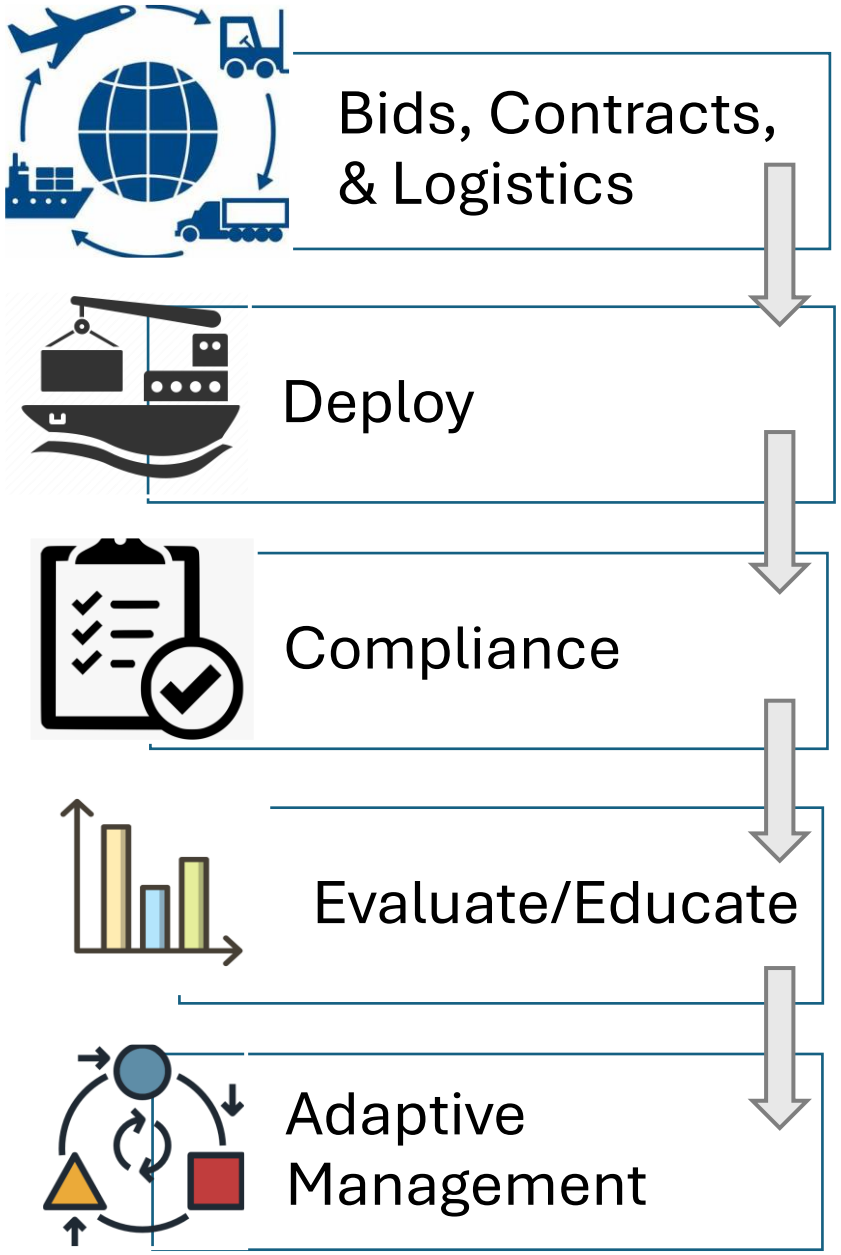
Habitat Support Structures

A Pilot Program

Thank you!

Timeline of Operations



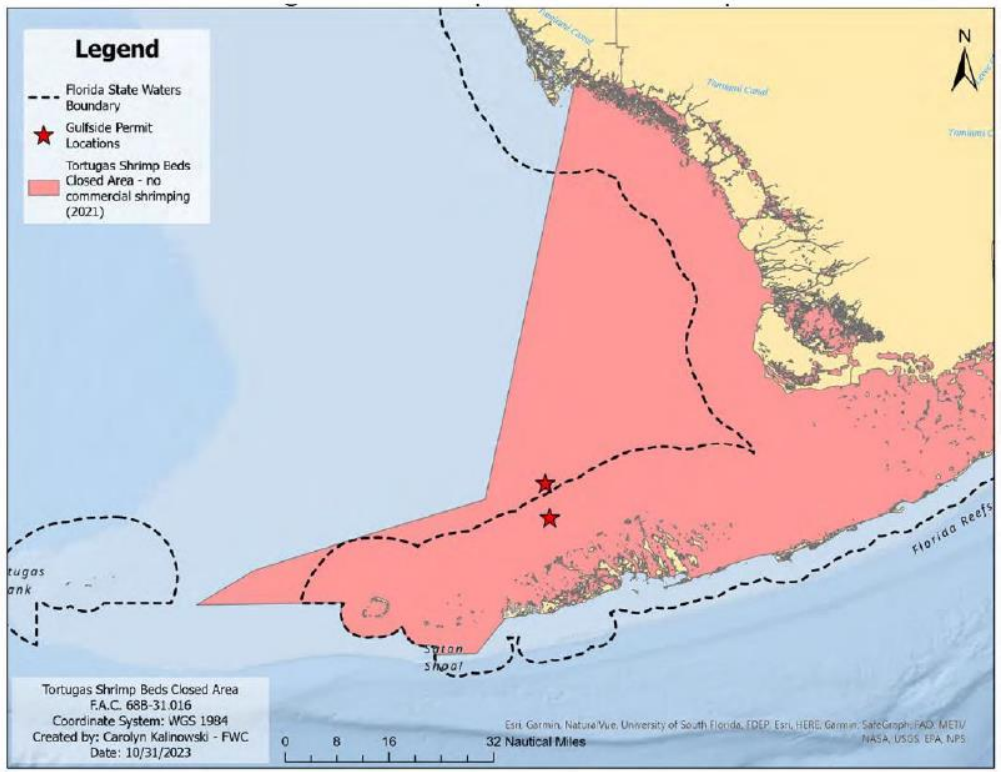


Exclusionary Analysis

Areas to be Avoided

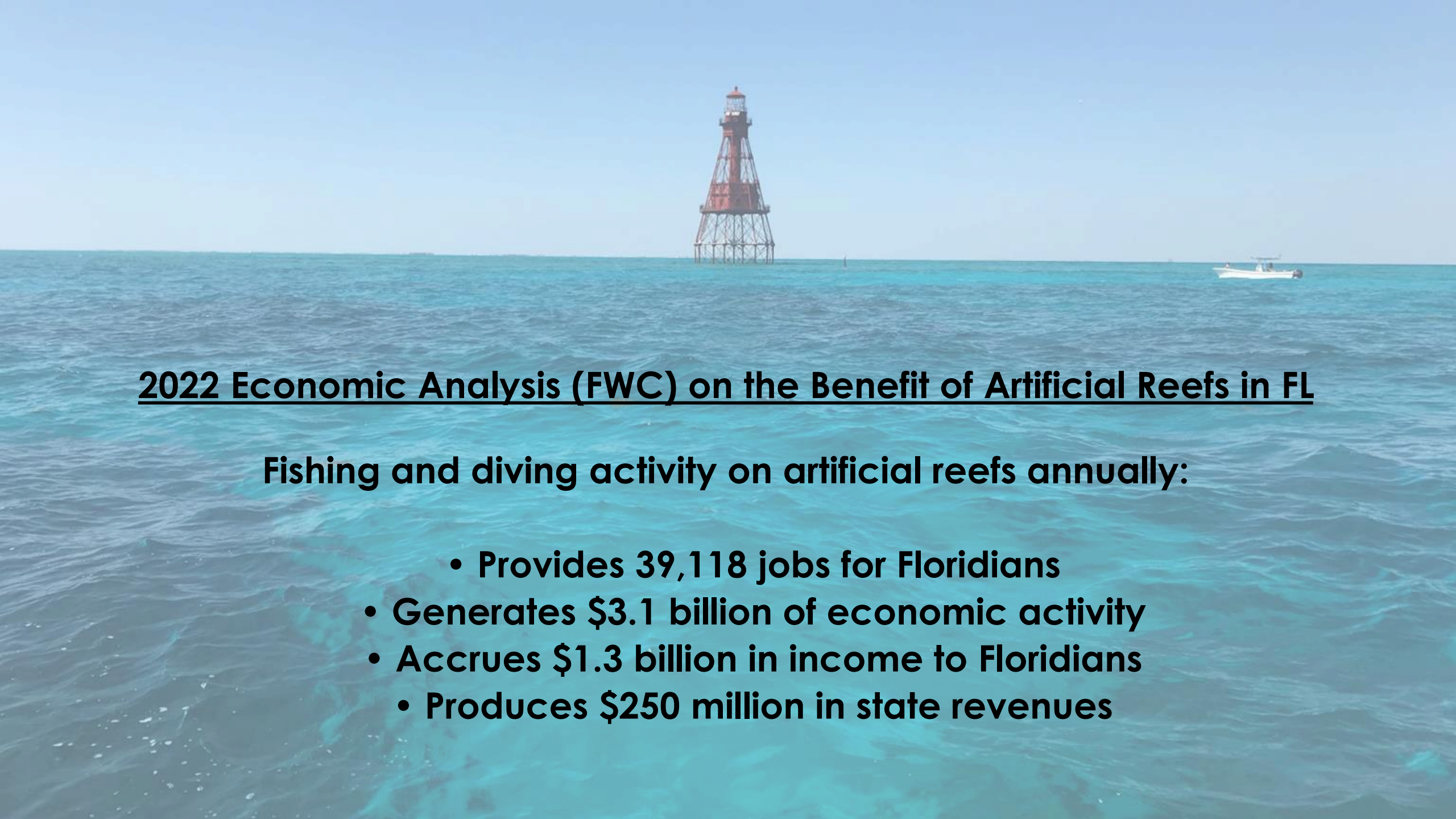
- Critical habitat of ESA sp.
- Active shrimping grounds
- Telecommunication corridors
- Navigational fairways
- Heavy traffic areas
- Naval testing
- Historic/cultural sites

Figure 5: Shrimp Trawl Closure Map



References

- **Beese et al. 2022**, Small-scale habitat complexity preserves ecosystem services on reefs
- **Pondella et al. 2022**, Theory, practice, and design criteria for utilizing artificial reefs to increase production of marine fishes
- **Paxton et al. 2020**, Meta-Analysis Reveals Artificial Reefs Can Be Effective Tools for Fish Community Enhancement but Are Not One-Size-Fits-All
- **Vivier et al. 2021**, Marine artificial reefs, a meta-analysis of their design, objectives and effectiveness
- **Paxton et al. 2024**, Evidence on the ecological and physical effects of built structures in shallow, tropical coral reefs: a systematic map
- **Birt et al. 2024**, Contribution of offshore platforms and surrounding habitats to fish production in the Bass Strait, south-east Australia
- **Paxton et al. 2022**, Fitting ecological principles of artificial reefs into the ocean planning puzzle
- **Smith et al. 2016**, A designed artificial reef is among the most productive marine fish habitats: new metrics to address 'production versus attraction'
- **Paxton et al. 2020**, Artificial habitats host elevated densities of large reef-associated predators
- **Brochier et al. 2021**, Successful artificial reefs depend on getting the context right due to complex socio-bio-economic interactions

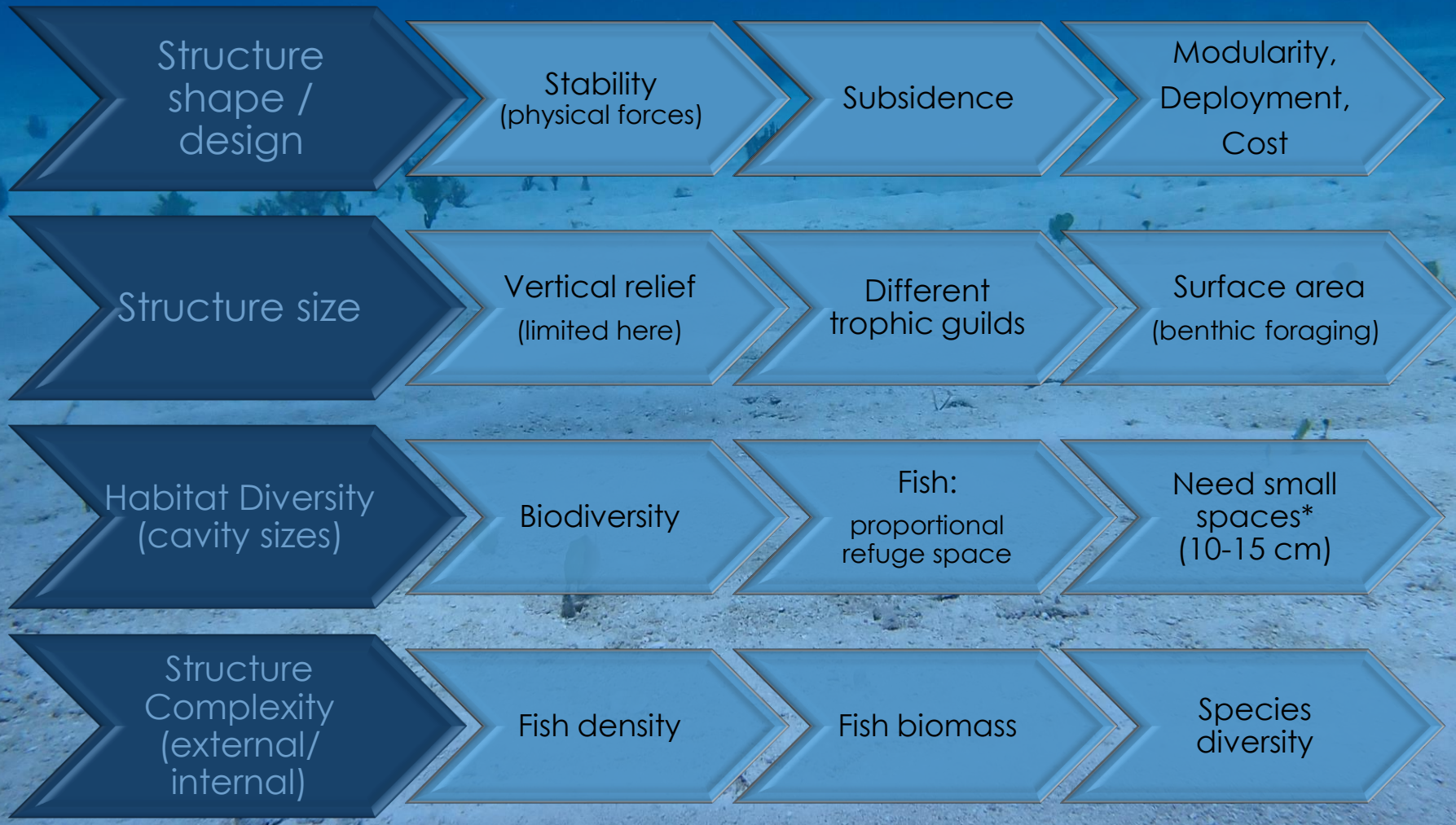


2022 Economic Analysis (FWC) on the Benefit of Artificial Reefs in FL

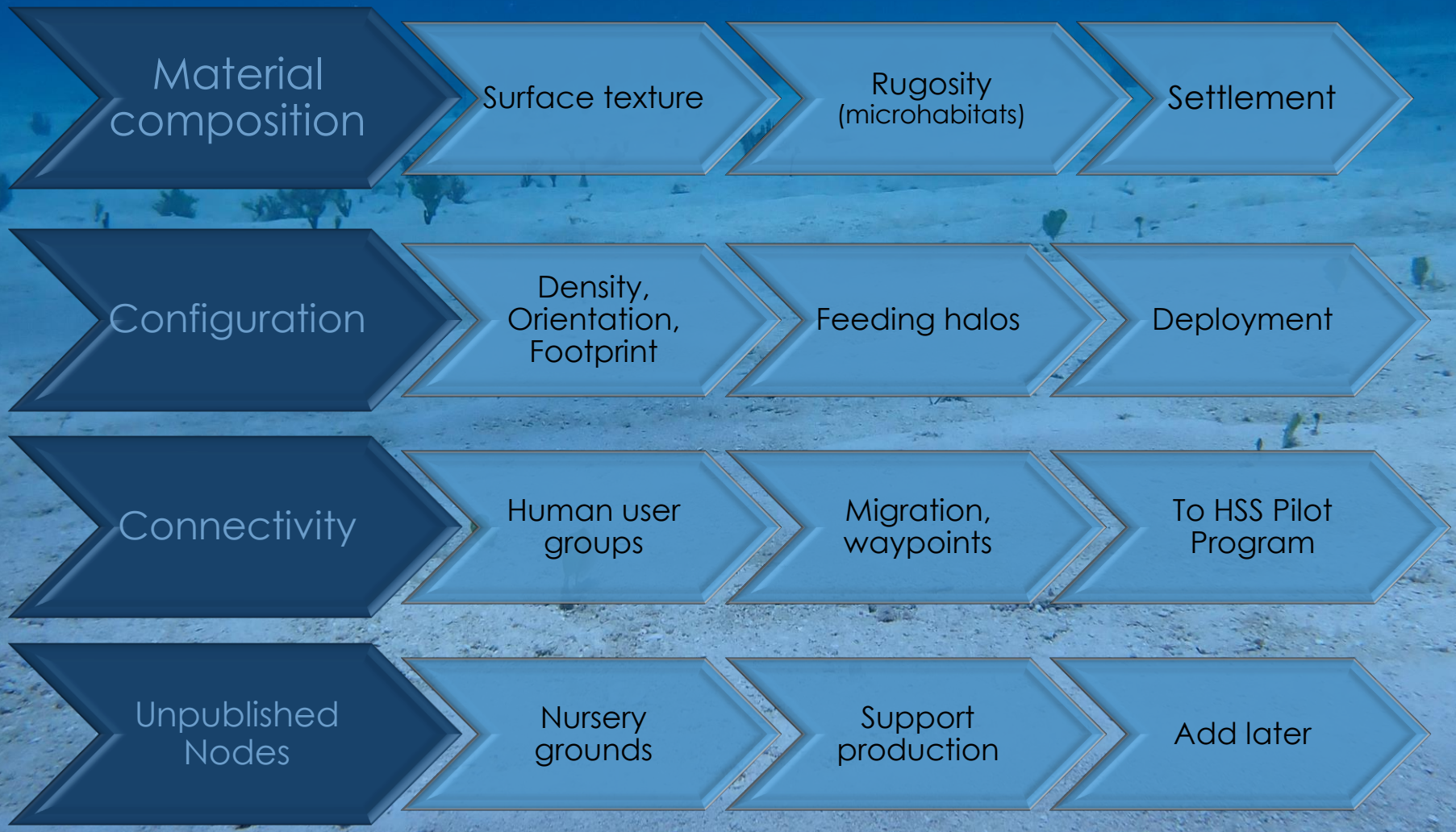
Fishing and diving activity on artificial reefs annually:

- **Provides 39,118 jobs for Floridians**
- **Generates $3.1 billion of economic activity**
- **Accrues $1.3 billion in income to Floridians**
- **Produces $250 million in state revenues**

Patch Reef Design Considerations



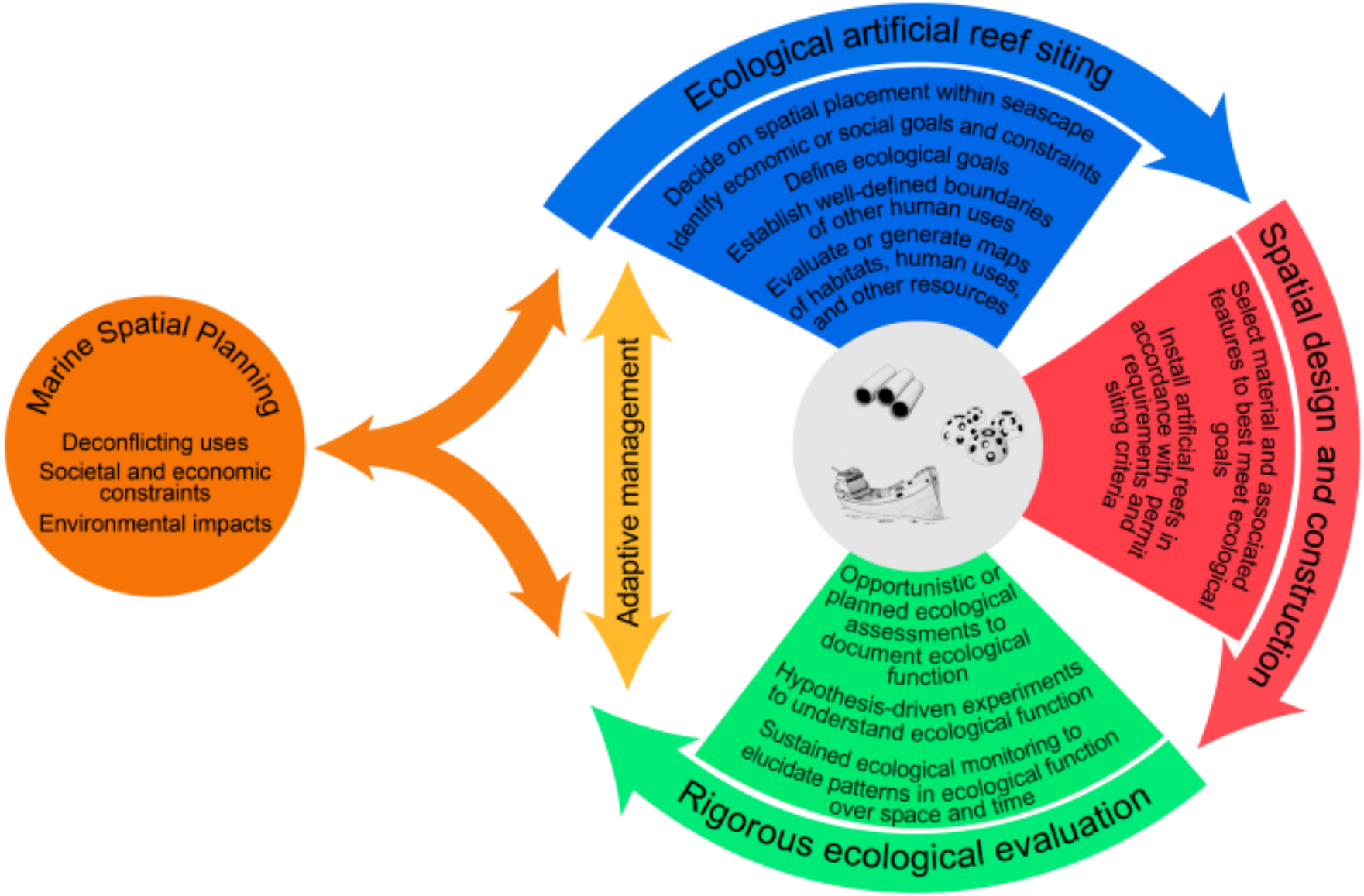
Patch Reef Design Considerations



Program Principles

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

Paxton et al 2022 Ecosphere | Fitting ecological principles of artificial reefs into the ocean planning puzzle



Deep Beyond Reefs

- Oceanside, beyond sanctuary, ~300’ (boundary extended)
- Key West, Marathon, Islamorada
- Fish habitat & spawning aggregation sites, fishing
- High vertical relief to promote fish abundance & diversity