Assessment of Artificial Reefs Impacted by Hurricane Michael

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Hurricane Michael

- Landfall in Mexico Beach as a major Category 4 storm in October 2018
  - Maximum sustained winds 154 mph
  - Over 10 ft storm surge
  - Hurricane force winds (>74 mph) extended 30 miles from the eyewall

- Strongest hurricane on record to make landfall in the FL panhandle

- $25.1 billion in damages
Impacted Artificial Reefs

- Artificial reefs have been displaced in the past due to storm-force winds
- 650 artificial patch reefs experienced hurricane force winds
- 1300 artificial patch reefs experienced tropical storm force winds
Assessment Sites

Bell Shoals (15-25 ft depth)

Sherman/Crooked Island Sites (60-75 ft depth)
Assessment Methods

**Side Scan Operations**
- Compare pre- and post- storm imagery
- Locate displaced reefs

**Dive Observations**
- Ground truth side scan imagery
- Assess damage to artificial reef material
Assessment Methods

- Same track pre- and post-storm
  - Pre-storm: September 2017
  - Post-storm: December 2018

- Three days to map Bell Shoals
  - 28 lines that were 4 miles long
  - Each track 290 ft apart
  - 6.25 mi² area

- Post-processing
  - Cleaning the imagery
  - Identifying materials
Assessment Methods

- Locations of individual material manually identified in pre- and post- imagery

Pre-Imagery (September 2017)

Post-Imagery (December 2018)
Assessment Methods

• Displacement of material locations assessed in ArcGIS

Pre-Imagery (September 2017)

Post-Imagery (December 2018)

MB-196

△ Pyramid Modules

● Ecosystem (Piling)
Results – Bell Shoals

- Five reef types
  - Secondary use concrete
  - Ecosystem (Piling)
  - Grouper Box w/ Ecosystem
  - Reefball
  - Pyramid

- Material deployed 1997-2018

- 61 distinct artificial patch reefs

- Pre-storm: 524 individual artificial reefs
- Post-storm: 500 individual artificial reefs
Material Assessment

**Ecosystem with Piling**

- No damage or movement

**Grouper Box with Ecosystem**

- No damage or lateral movement
- Grouper box subsided or buried

FWC January 2019
Material Assessment

Secondary Use Concrete

- No damage or movement
- Material uncovered

Gordy’s Reef

Bell Shoals Total:
- Pre-storm: 1,077.5 ft$^2$
- Post-storm: 6,205.4 ft$^2$

Photo Credit: MBARA
June 2010
Material Assessment

Reefballs

- No damage and minimal movement
- More uncovered than buried

Karl Sinclair Reef

Bell Shoals Total:
- Pre-storm: 70 Reefballs
- Post-storm: 83 Reefballs

Photo Credit: MBARA
June 2010
Material Assessment - Pyramids

- Only module type displaced
- Minimal damage observed
- Majority moved outside patch reef
- Displaced pyramids toppled
Material Assessment - Pyramids

- Most pyramids identical
- Search for memorial reefs
- Memorial reef easily identified
  - Unique plaque
  - Embedded object: Sport memorabilia
Billy Gillen Memorial Reef

- Deployed April 7, 2015
- Identified by Georgia Bulldog and plaque
- Measured displacement distance: 956 ft (North)
- Expect similar movement for other pyramids
Where did the Pyramids move?

83% oriented SE-SW
Pyramid Movement

• Not all pyramids were displaced
  • 35% remained in patch reef
  • Other material impeded movement

• Majority of the pyramids moved
  • Mean distance: 803 ft
  • Max confirmed distance: 956 ft
  • Max estimated distance: 2,887 ft
    (>0.5 miles)
Crooked Island & Sherman Sites

- Modules deployed 2016 and 2017
- Depth: 60-75 ft
- High precision deployment
  - GPS placed upon the crane boom
  - Allows for pre- and post- comparison
Crooked Island & Sherman Sites

• 5 patch reefs surveyed
  • 65 modules pre-storm
  • 65 modules post-storm

• Module Types
  • Super Reef Pyramid
  • FL Limestone Pyramid
  • Grouper Box w/ Ecosystem

• Each module type:
  • No evidence of movement
  • No apparent damage
Conclusion - Summary

• Secondary Use, Reefballs, Ecosystem on Pilings and Grouper Boxes remained in same location

• FL Limestone Pyramids (8 ft)
  • Only moved in shallow water (<25 ft)

• Has artificial reef function changed?
  • Habitat
    • Relief vs Footprint
    • Different fishing and diving experience
      • Cluster vs Spread
  • Fish assemblage structure
    • Forage Area vs Complexity
Future Monitoring

Prioritize Side Scan:

1. Mid-depth Sites (50-75 ft)
   - Car Body
   - Tower Sites

2. Deeper Sites (85-115 ft)
   - North Site
   - South Site
   - Bridge Span
   - SAARS H
   - LAARS A

• Continue dive assessments
Bell Shoals Hurricane Assessment Viewer:
http://arcg.is/11yWDT
Questions