

2020 National Conference on Beach Preservation Technology

February 5-7
Hyatt Regency Sarasota, FL



olsen
associates, inc.
Coastal Engineering



High Resolution Underwater Mapping of the Osborne Tire Reef (OTR), Fort Lauderdale, Florida

Mark Schroeder , Keith Spring, Chip Bamberger,
John Morgan, PLS , and Chris Creed, P.E .



Pensacola

Jacksonville

*Atlantic
Ocean*

FLORIDA

Tampa

Sarasota

Fort Lauderdale

Miami

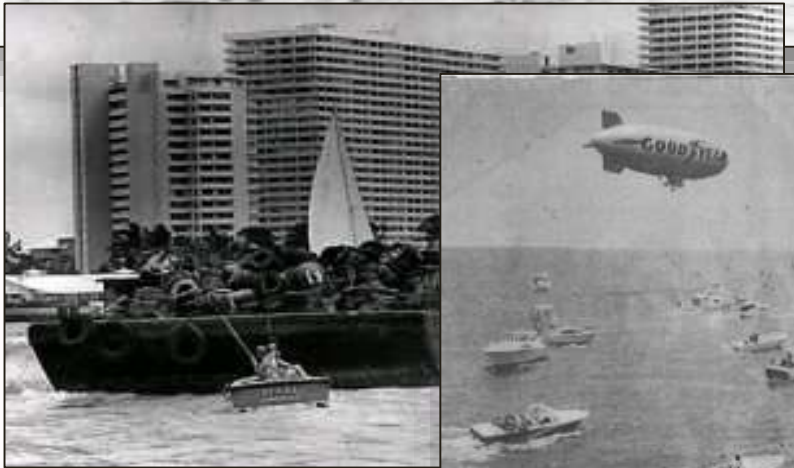
*Gulf of
Mexico*

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
© 2019 Google
US Dept of State, Geographer

Imagery Date: 12/13/2015 77°36'18.82" N 81°13'18.98" W elev 0 ft eye alt 1060.19 mi

In the 1970s and early 80s, waste tires were placed offshore Ft Lauderdale as fishing enhancement reefs....



Commencement Celebration



An underwater photograph showing a vast field of sea urchins on the ocean floor. Several divers are visible in the background, with bubbles rising from their equipment. The water is a deep blue color.

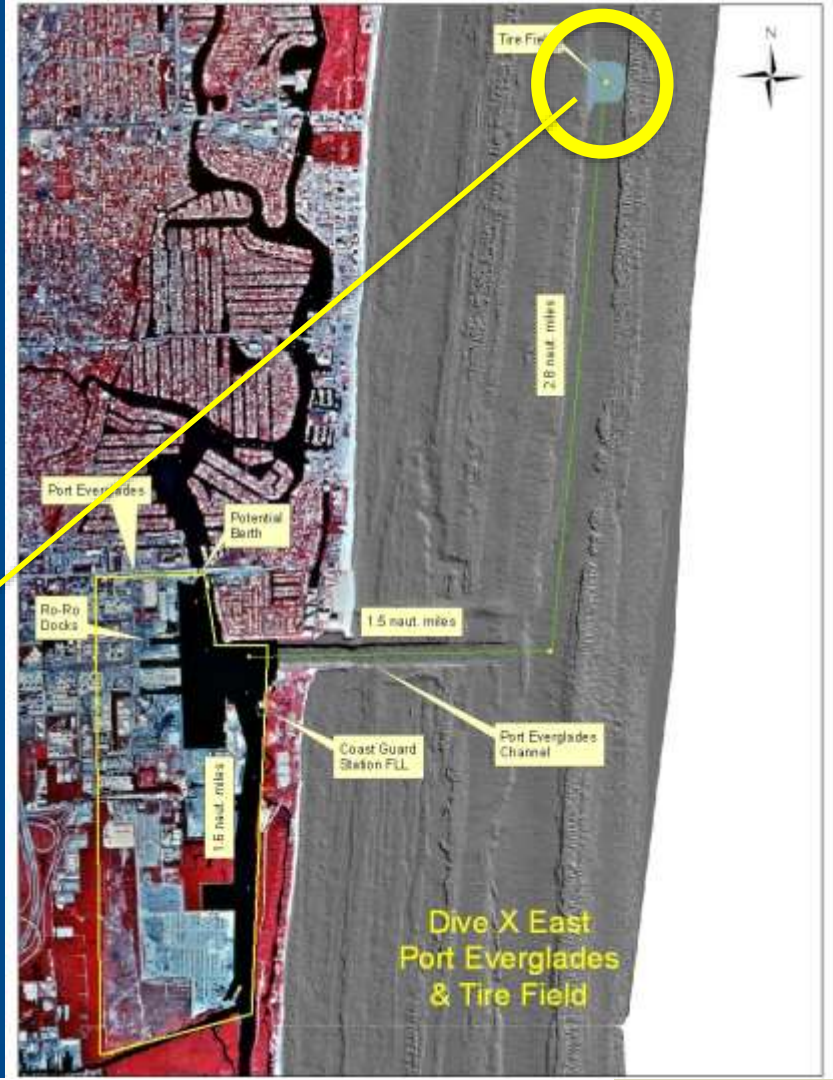
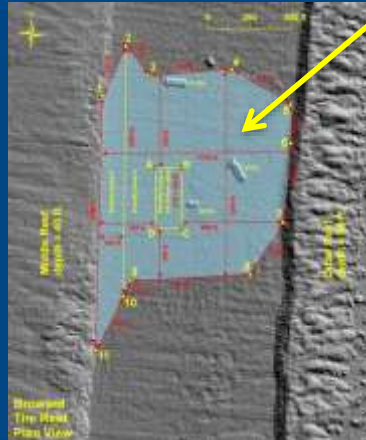
2,000,000 +



- **Little to no benthic recruitment**
- **Dispersal of tires over adjacent seafloor and reef and beyond...**
- **Physical damage to shoreward reef tract**

Credit: Pat Quinn, Ph.D., Broward County

- ~ 1 mile offshore of Fort Lauderdale Beach
- Between 2nd and 3rd reef tracts
- ~ 70 feet of water



Past Removal Efforts

- 2001 - Small project
(NSUOC – NOAA grant)
- 2005 - First mapping effort
(Broward County)
- 2007,08,09 - Three large missions.
Broward, NOAA, DoD Innovative
Readiness Training Program.
72,000 tires removed
- 2015 - Commercial Contract



- 341,000 tires removed (est.)
- \$17 / tire (current estimate)
 - does not include disposal fee and Port fees
- Past estimates have put the cost as high as \$70 per tire. (\$49M total project cost...)

FDEP and other agencies are evaluating more cost effective removal programs

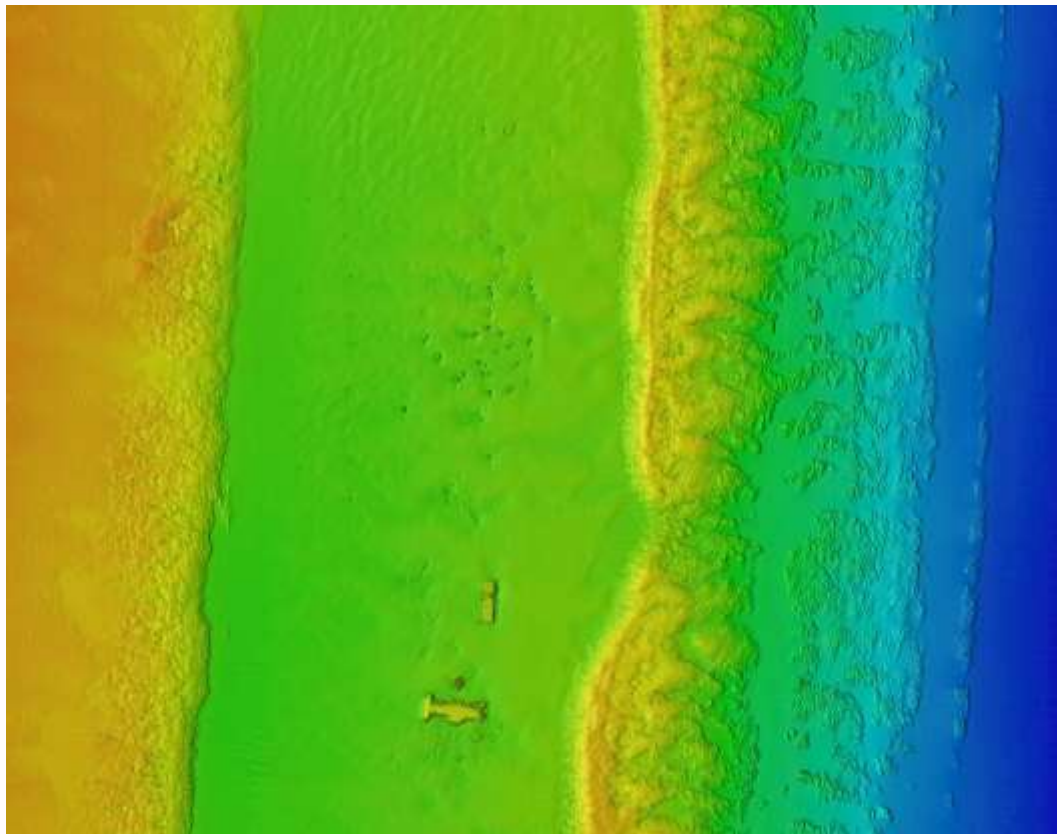




CSA assessed the current condition of the **Osborne Tire Reef (OTR)** using multibeam, side-scan, towed video, and diver surveys to create high resolution underwater maps

Approach:

- Remotely sense entire area
- Visualize with towed video
- Conduct diver mapping to provide ground-truthing
- Record *in-situ* measurements of density and abundance



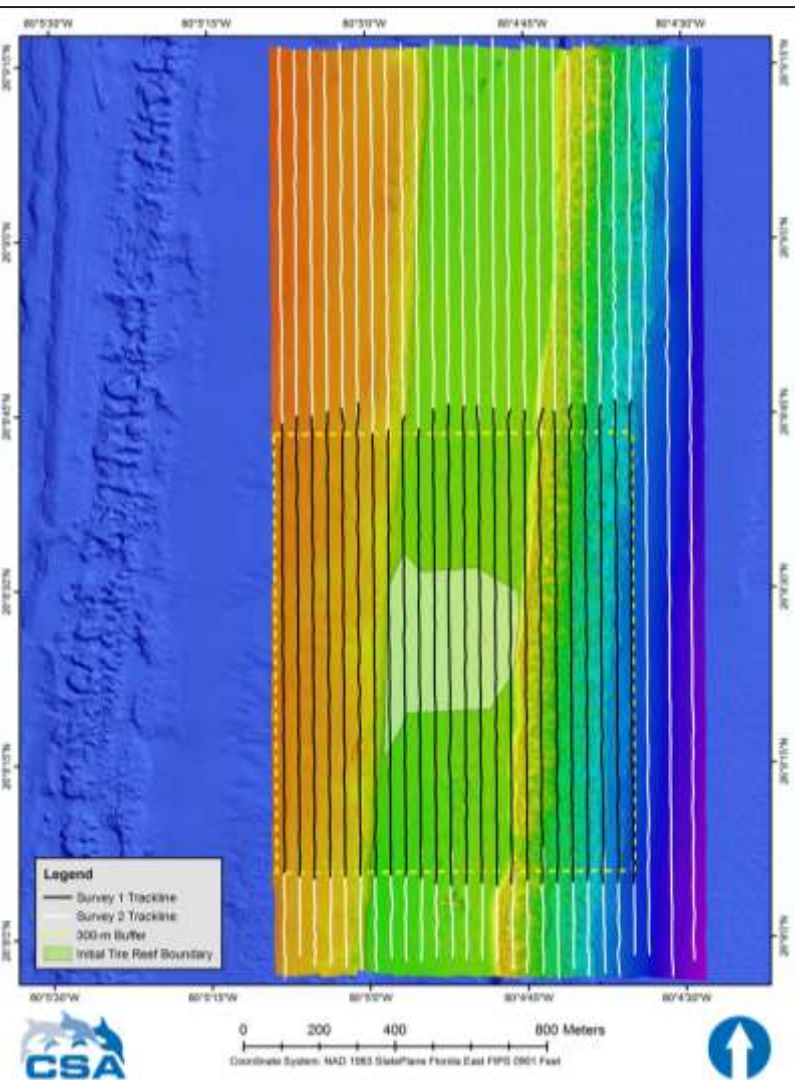
- Multibeam original OTR extent
- Expanded area - tires outside OTR
- R2 Sonic 2024 Multibeam echo sounder
 - 450 kHz
 - Applanix POS MV Wavemaster: real time motion-corrected location data
 - Micro X SV Base X2 sound velocity profiler used to refine soundings in post-processing

Multibeam Survey

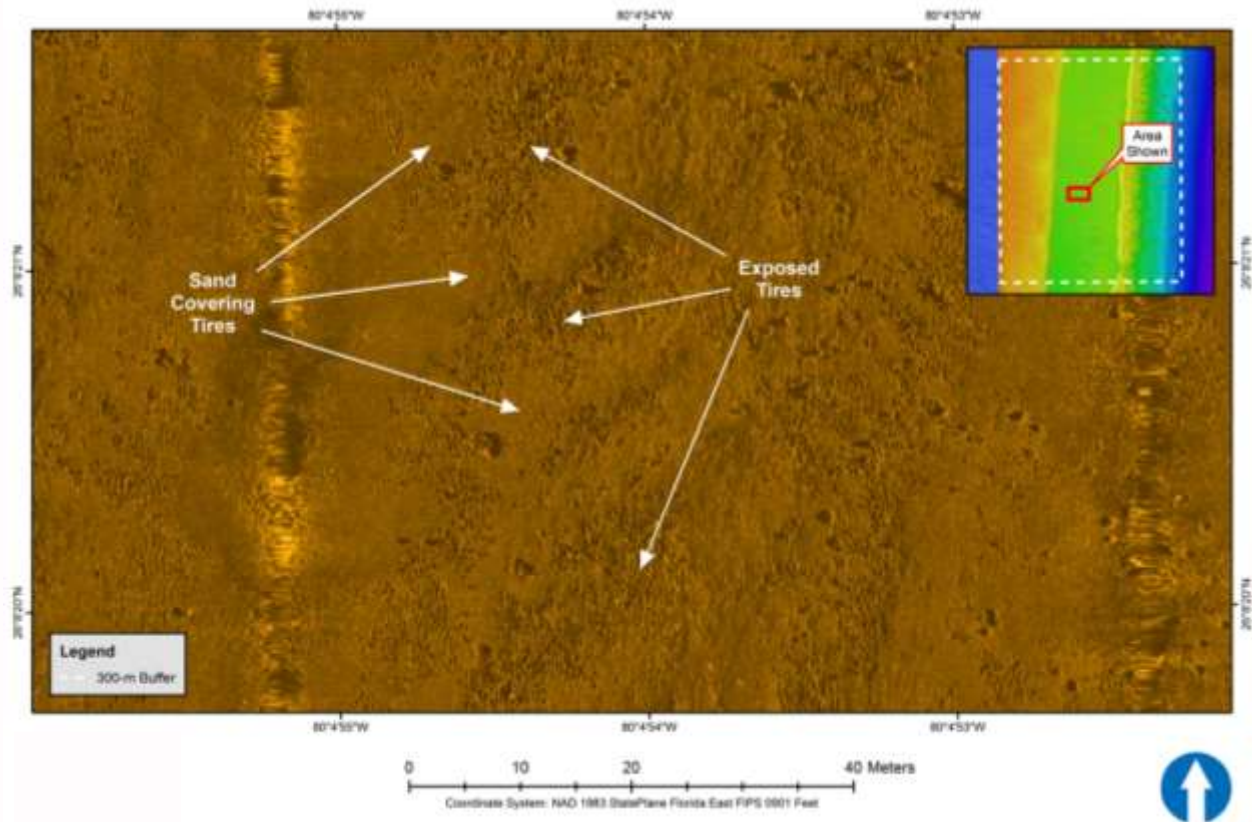
24 Parallel transects

- Oriented North-South
- Spaced at 40 m
- 300 m buffer area around OTR
- Extended buffer: 1000 m N, 500 m E & S
- Multibeam critical first step:
 - Instrumental in determining depth and location of hardbottom features
 - Easily located larger shipwrecks, manmade structures
 - Provided framework of survey area to build on with finer-scale sampling
 - Lower resolution not diagnostic for tires

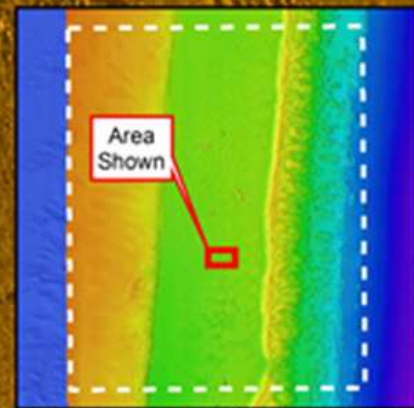
Multibeam Survey



- Side-scan sonar data recorded simultaneously with multibeam
- Dual-frequency Klein 3900 side-scan sonar
 - 445 kHz
 - Slant range 150 m
 - Imaged at 100% overlap
- High resolution

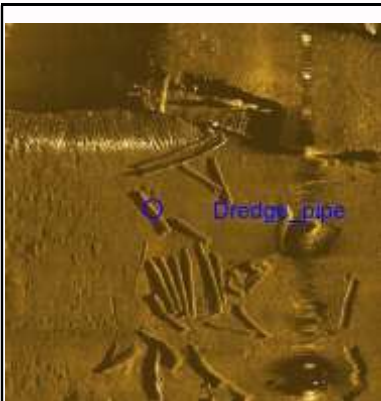


Side-scan Sonar Survey



Hexapod
Concrete Jacks

Side-scan Sonar Survey



Dredge pipe

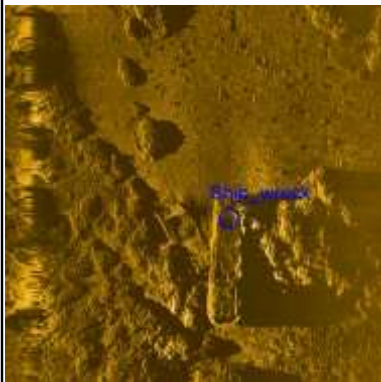
- Sonar Time at Target: 5/7/2019 12:54:35 PM
- Click Position
26.1339953987 -80.0813501407 (WGS84)
(X) 957562.24 (Y) 655456.70 (Projected)

Coordinates

- Map Projection: FL83-EF
- Acoustic Source File:
I:\¥3425_Olsen_Tire_Reef_SSDData_Survey2¥Olsen190507125300.txtf
- Ping Number: 341596
- Range to target: 48.16 US ft
- Fish Height: 19.81 US ft
- Heading: 355.380 Degrees
- Event Number: (-1)
- Line Name: Olsen190507125300
- Water Depth: 0.00 US ft

Dimensions and attributes

- Target Width: 2.65 US ft
- Target Height: 1.63 US ft
- Target Length: 19.23 US ft
- Target Shadow: 4.68 US ft



Ship wreck

- Sonar Time at Target: 4/27/2019 9:40:08 AM
- Click Position
26.1425059972 -80.0774117080 (WGS84)
(X) 958832.51 (Y) 658559.38 (Projected)

Coordinates

- Map Projection: FL83-EF
- Acoustic Source File:
I:\¥3425_Olsen_Tire_Reef_SS_Data¥Olsen190427093400.txtf
- Ping Number: 159886
- Range to target: 70.73 US ft
- Fish Height: 17.74 US ft
- Heading: 0.510 Degrees
- Event Number: (-1)
- Line Name: Olsen190427093400
- Water Depth: 0.00 US ft

Dimensions and attributes

- Target Width: 13.19 US ft
- Target Height: 7.02 US ft
- Target Length: 55.31 US ft
- Target Shadow: 47.74 US ft

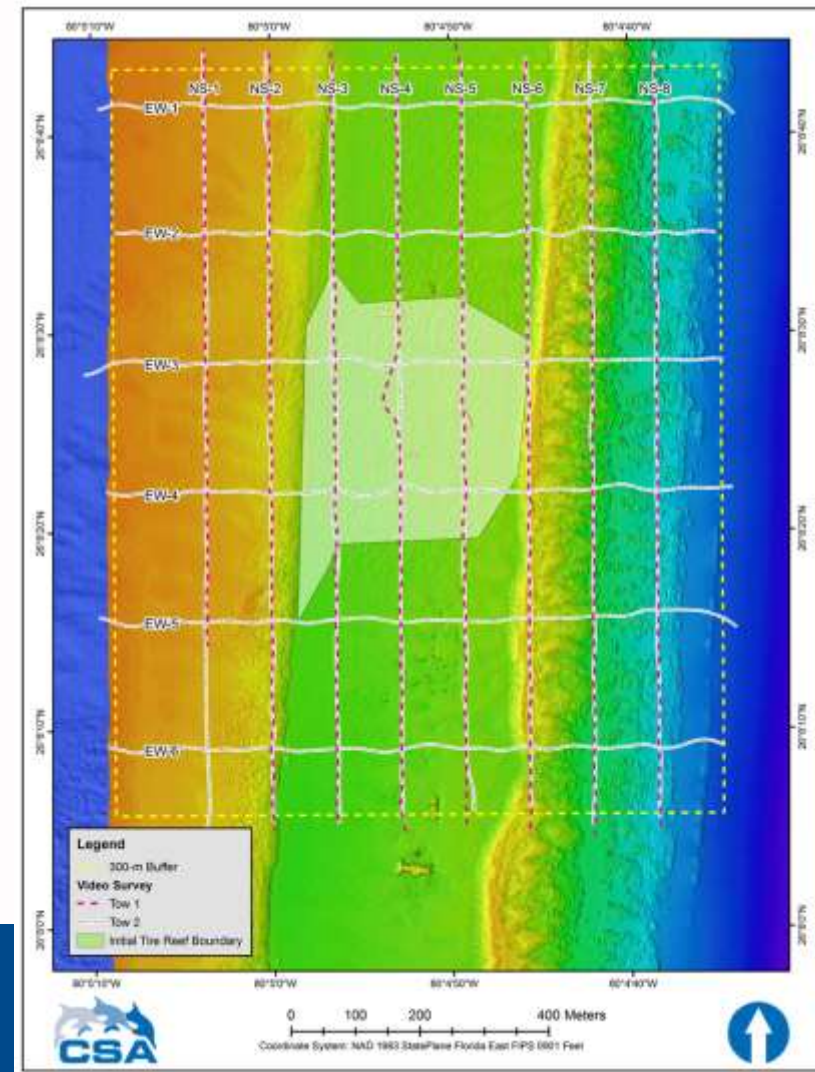
Side-scan data = most valuable due to high resolution (~8 cm), necessary to effectively image tires

Quality of side-scan imagery combined with surveying during calm seas were critical factors in the success of the project

Side-scan Sonar Survey

Towed Video Survey Rationale:

- Transect lines: N-S & E-W
- Visual overview of survey area
- Determination of key features
 - **Identified tires outside OTR boundaries**
- Guidance for diver survey effort
 - Ensured best use of in-water time
 - Noted targets for diver verification of multibeam and side-scan data

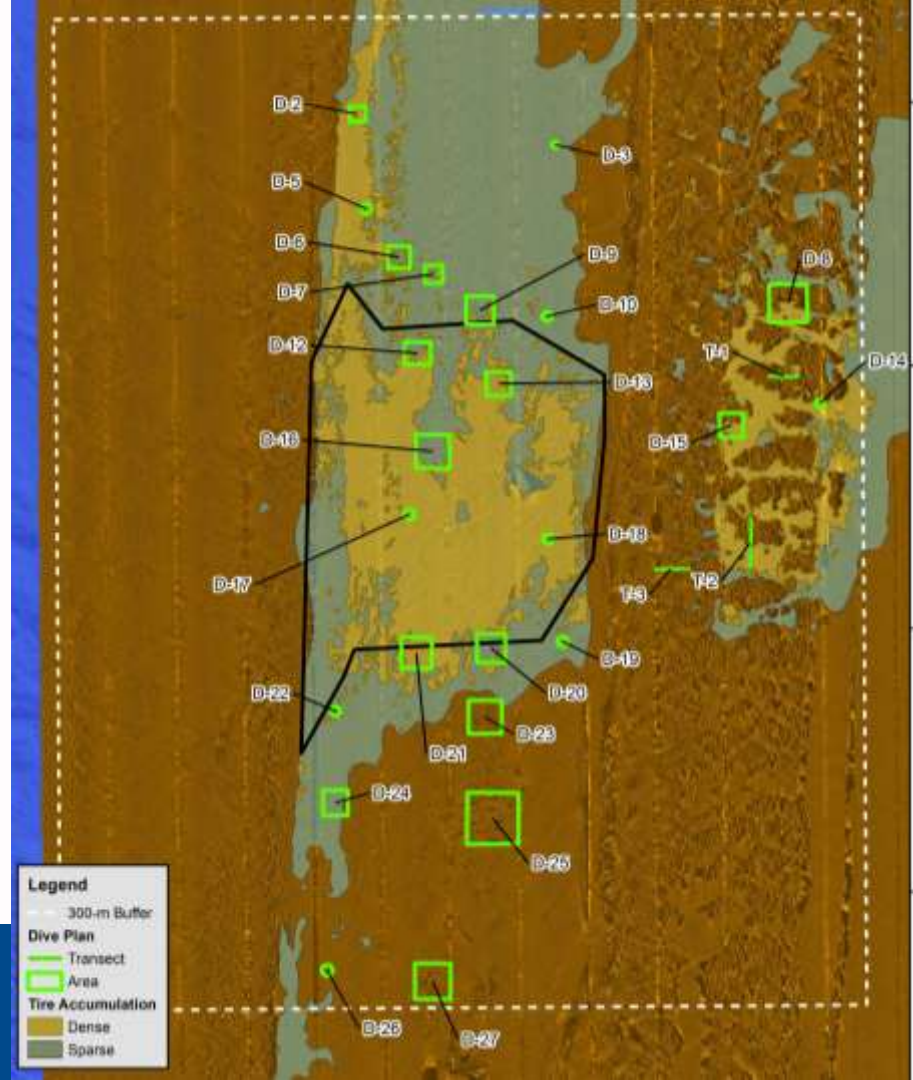


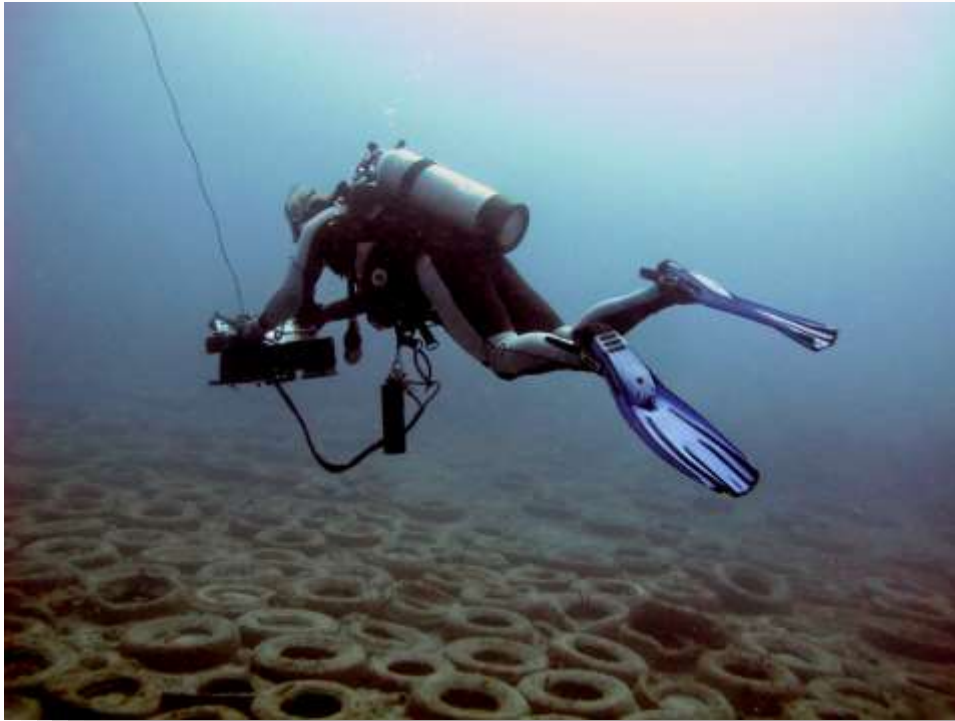
Towed Video Survey

Divers were deployed to:

- Groundtruth side-scan target areas
 - Underwater GPS
- Map extent of tires among the reef features
 - Transect surveys
- Determine tire density in accumulations
 - Quadrat-based abundance

Diver Mapping and Characterization





Shark Navigator on OTR

The Shark Navigator: submersible display, continuous GPS location and interface for diver data entry

- Geographic data from side scan preprogrammed
- Pre-plotted targets of interest and transects assessed by divers
- Annotated map *in-situ* to refine ground truth results
- Collected geographic locations of additional objects of interest

Diver Mapping – Underwater GPS



Shark Navigator Display

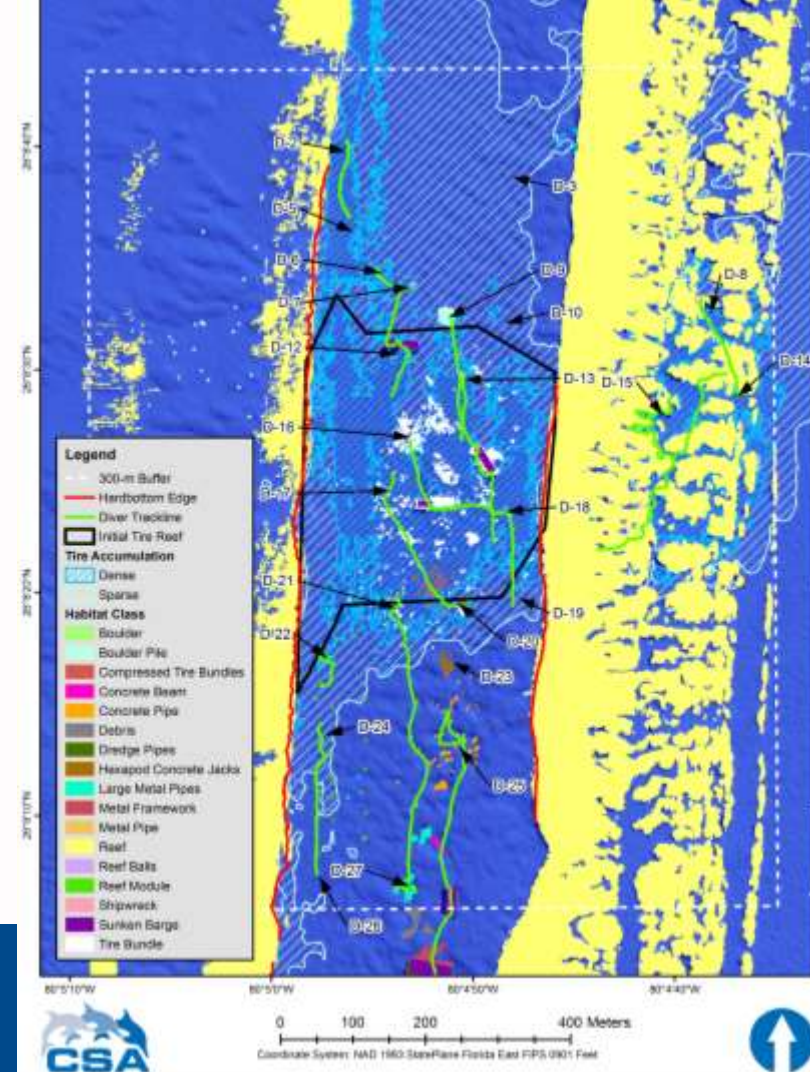
The Shark Navigator: submersible display, continuous GPS location and interface for diver data entry

- Geographic data from side scan preprogrammed
- Pre-plotted targets of interest and transects assessed by divers
- Annotated map *in-situ* to refine ground truth results
- Collected geographic locations of additional objects of interest

Diver Mapping – Underwater GPS

Final GIS mapping products:

- Large number of habitat classes encompassing important data points
- Geographic extent of tires
- Diver-verified tire densities
- Large geographic dataset of man-made debris, artificial reefs, and shipwrecks





The geophysical survey found tire accumulations much further from the original tire reef than expected.

Survey team mapped tires, artificial reefs and quantified tire density within the extensive area.

Large GIS dataset = guidance for future removal efforts.

Multiple technologies + diver verification = thorough & precise dataset

Questions?



olsen
associates, inc.
Coastal Engineering

