

OIMMP Workshop, GTM NERR, Florida – February 23, 2017

Options for Mapping Subtidal and Intertidal Oyster Reefs

Ray Grizzle and Krystin Ward
Jackson Estuarine Laboratory
University of New Hampshire

1. Major components of ecological mapping in general
2. Options for subtidal reefs: sonars, towed video, diving
3. Options for intertidal reefs: airplane, drone, satellite
4. Case study: Mapping subtidal and intertidal oyster reefs in Apalachicola Bay, Florida

Mapping Collaborators

- Mark Provencha (NASA)
- Jamie Adams (UNH; Google)
- Jenn Greene (UNH; The Nature Conservancy)
- Linda Walters (University of Central Florida)
- Semme Dijkstra (UNH Center for Coastal and Ocean Mapping)
- Tom Waddington, Tom Reis (Substructure, Portsmouth, NH)
- Laura Geselbracht (The Nature Conservancy)
- Bill Pine (University of Florida)
- Melanie Parker, Steve Geiger (Florida FWC)

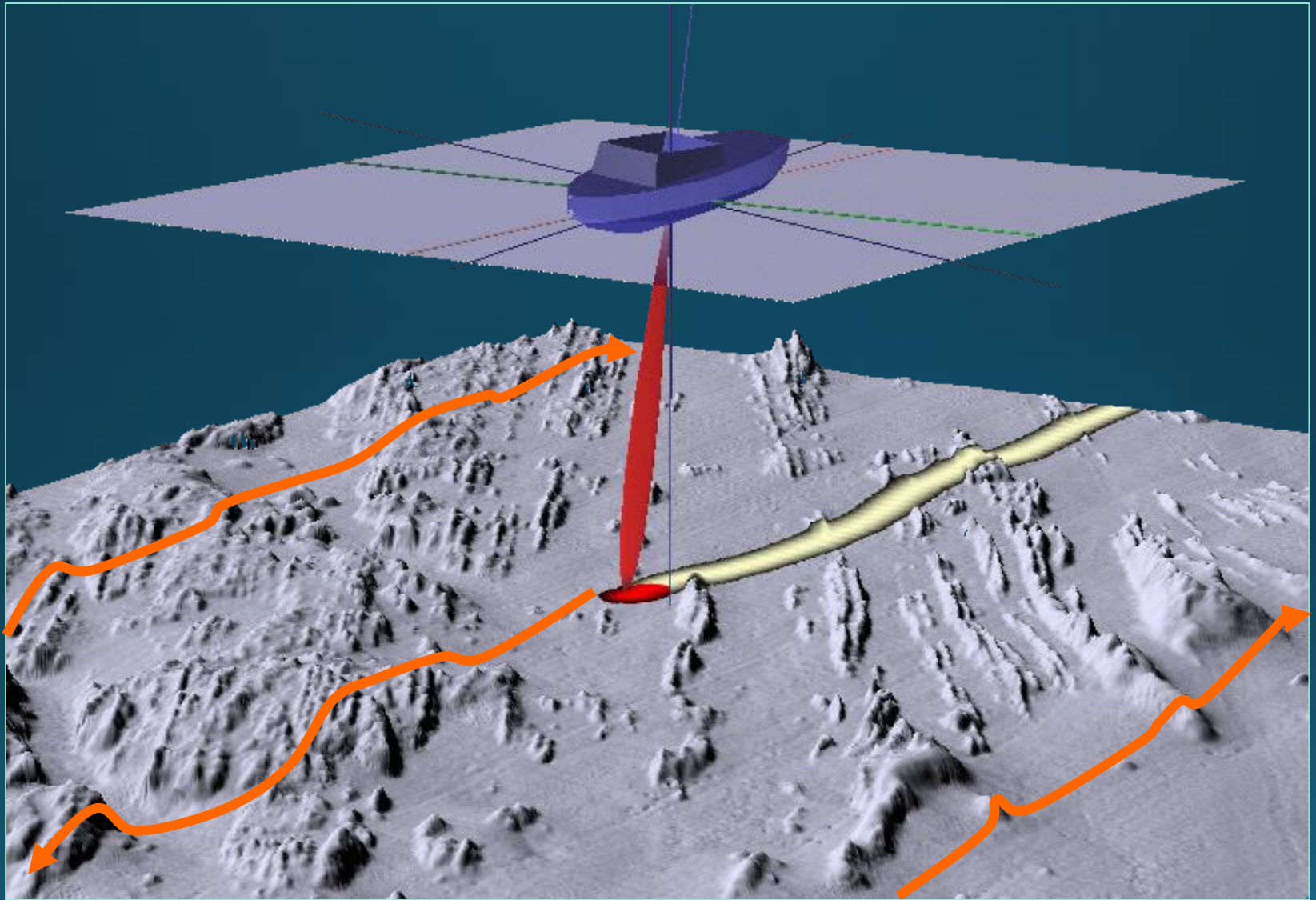
1. Major Components of Ecological Mapping

- Remote sensing of reef: sonars, digital imagery, underwater videography
- Georeferencing of remote sensing data
- Interpretation (classification) of data
- Initial map production (GIS) = overlaying remotely sensed data on a basemap
- Map accuracy assessments: spatial and thematic
- Final map production

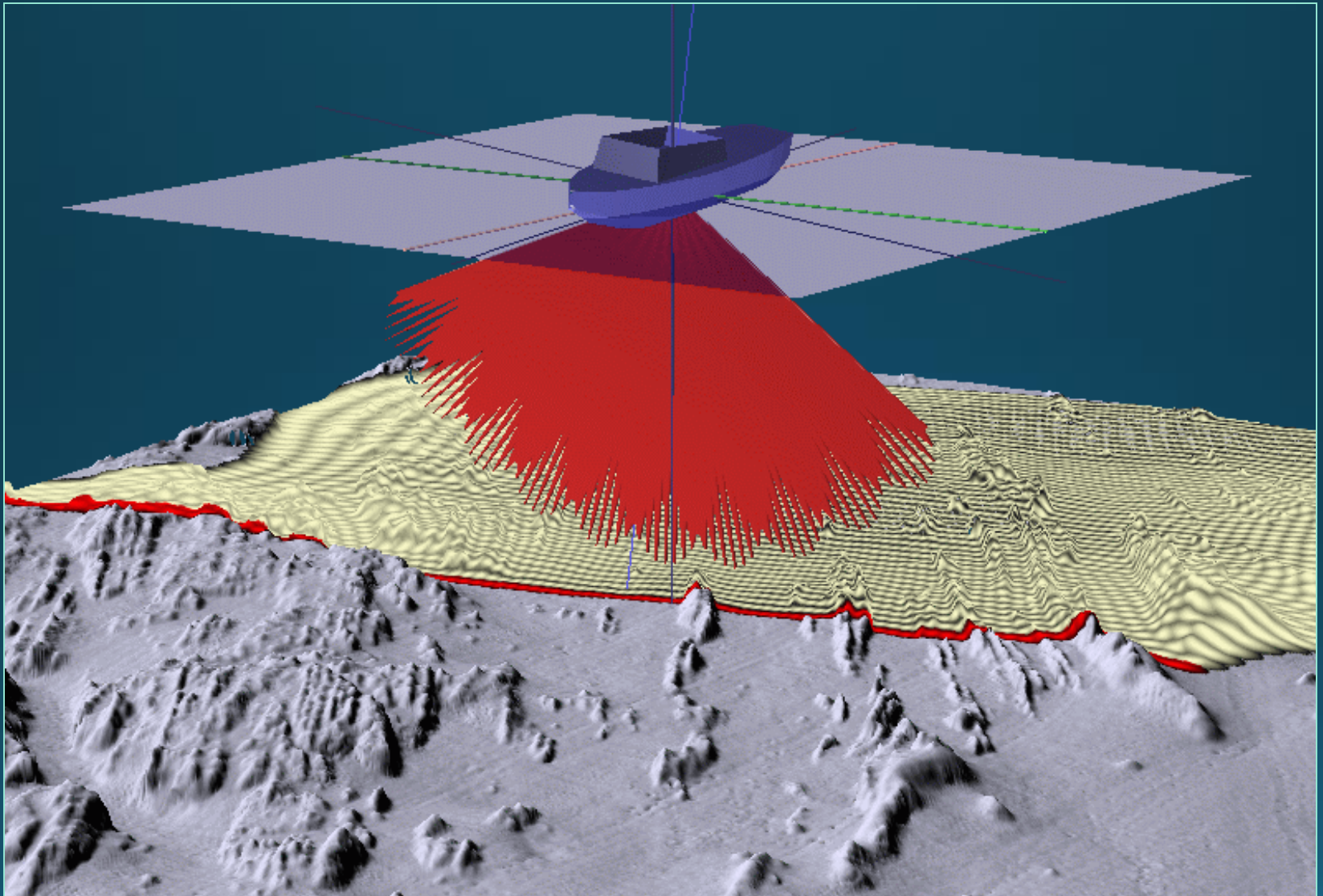
2. Options for subtidal remote sensing

- Sonars (=acoustics): single beam, multibeam, sidescan
- Towed videography
- Probes, chains, etc.
- Diving

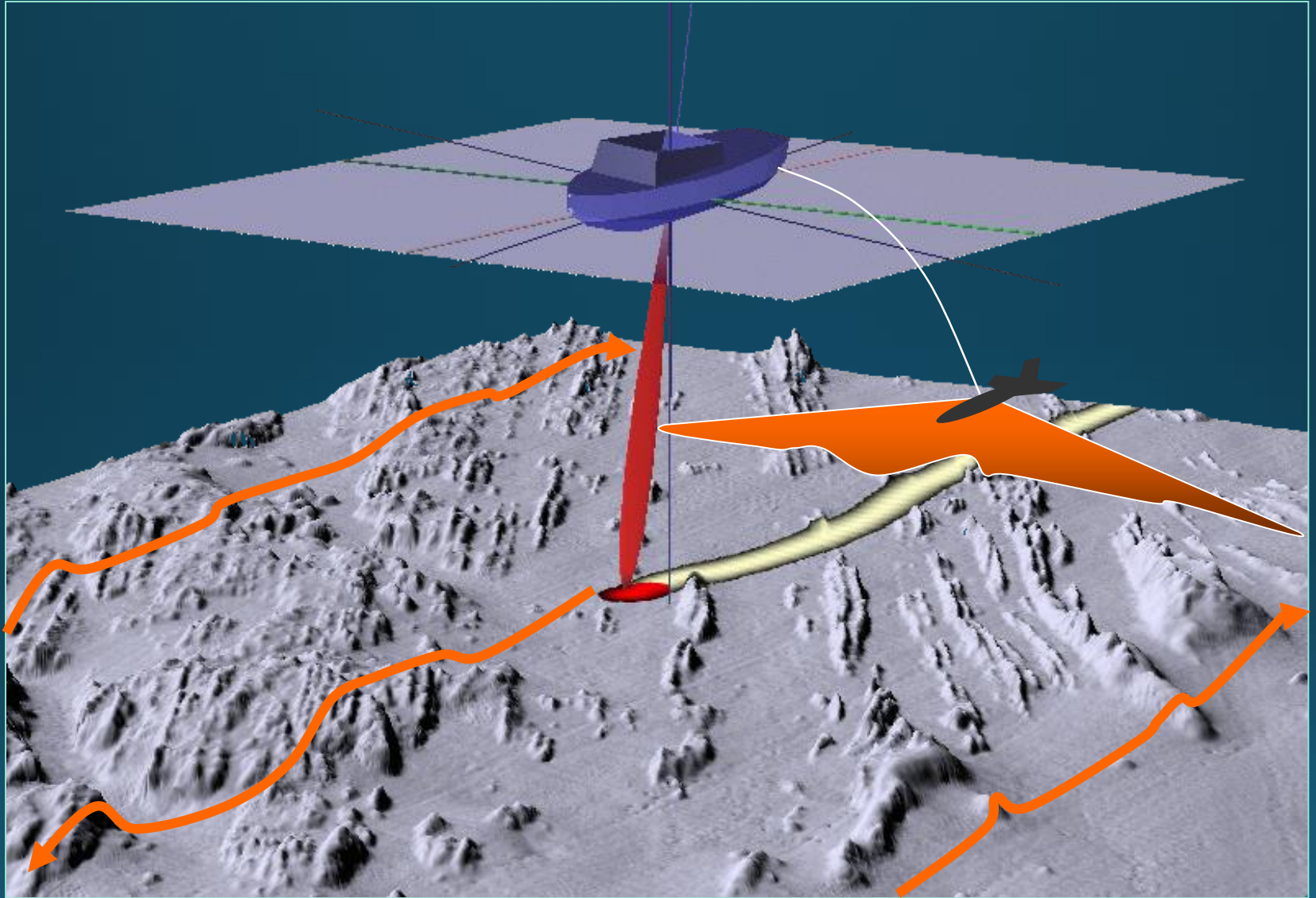
Single Beam Sounder



Multibeam Sonar



Sidescan Sonar



Towed underwater video: Remote sensing to map production

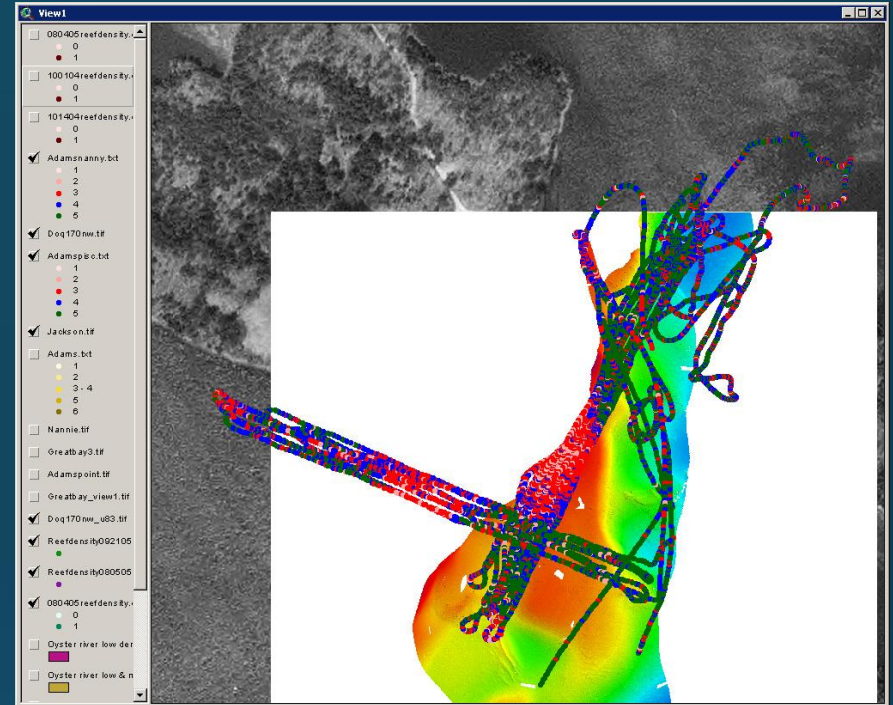


- Collect video and GPS data
- Classify imagery in lab: construct spreadsheet with imagery classes and coordinates
- Import classified data into GIS
- Overlay classified data onto basemap
- Produce final map



Single beam superimposed on multibeam bathymetry

- Single beam and multibeam sonars capable of delineating oyster reef boundaries
- Bathymetry alone potentially useful in mapping reef boundaries



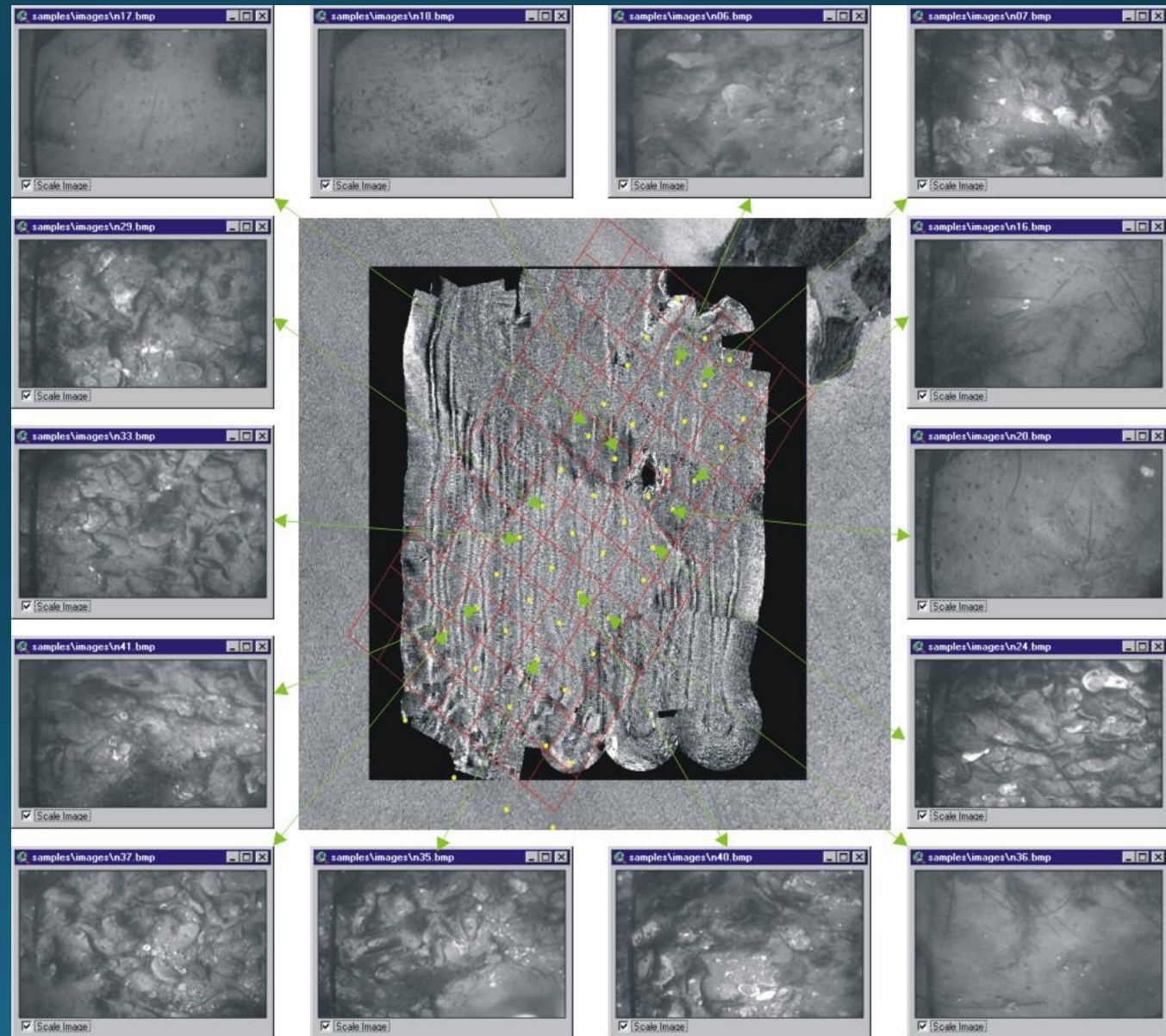
Towed video classified data

- Red dots denote high density shell
- Towed video confirms reef boundaries delimited by multibeam
- Additional reef information obtained by video



Using video drop camera to ground-truth sidescan sonar

- Sidescan yielded map of reef shape and size
- Video confirmed presence and relative densities of live oysters



Summary of Subtidal Methods (sonars and towed video)

- Multibeam and sidescan potentially provide large scale coverage AND high resolution
- Single beam sounders comparable in spatial scales to towed video, but much faster tow speeds
- Video used to ground-truth all types of remote sensing methods; i.e., video is easy to interpret...
- Video can potentially be used instead of single beam, but limited by water clarity

3. Remote Sensing of Intertidal Reefs

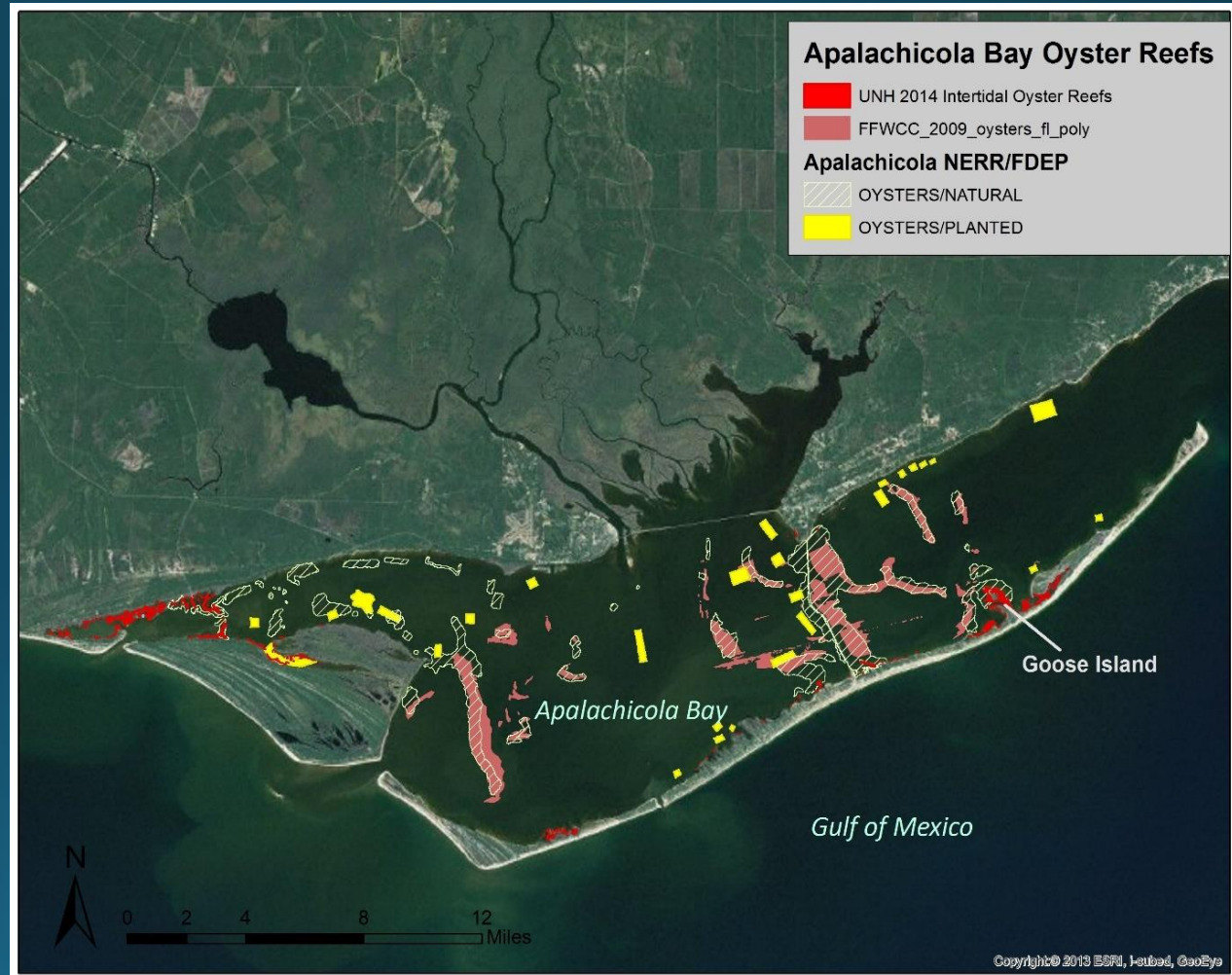
- Low-altitude aerial (airplane) imaging: photography (visible and hyperspectral), lidar
- Balloon-deployed photography
- Kite-deployed photography
- Drone-deployed photography
- Satellite high-resolution photography

Satellite imagery and ecological mapping

- 1972: Landsat 30 m resolution
- 1999: Aster 15 m resolution
- 2001: Quickbird 0.6 m resolution
- 2007: Worldview 1 0.5 m resolution
- 2008: GeoEye 1 0.4 m resolution
- 2016: Worldview 4 0.3 m resolution

4. Mapping Oyster Reefs in Apalachicola Bay

- Oysters occur in subtidal and intertidal zones
- Sonars used (by USGS in 2006) to map subtidal reefs
- Online satellite imagery used to produce new map of intertidal reefs



Mapping Intertidal Reefs in Apalachicola Bay



- 1,017 reefs mapped ranging from 9 m² (=MMU) to 7.3 ha
- >100 reefs ground-truthed (>90% thematic accuracy)
- 90 reefs quantitatively sampled (quadrat counts, etc.)
- Shell “rakes” or “dead margins” mapped in several areas
- Major shell density classes (low, medium, high) easily discernable in satellite imagery

Comparison of Intertidal Methods

- Low-altitude aerial imagery: the 'gold standard' for mapping because of resolution, types of imagery, historical imagery, etc. → major drawback is cost for acquiring new imagery
- Drones, balloons, etc: same advantages as low-altitude aerial → major drawback is speed of image acquisition, and thus cost per unit area mapped
- Satellite imagery: fast-approaching other imagery in most respects, and it's free!

Publications on mapping subtidal eastern oysters

- Allen, Y.C., C.A. Wilson, H.H. Roberts, and J. Supan. 2005. High resolution mapping and classification of oyster habitats in nearshore Louisiana using sidescan sonar. *Estuaries* 28:435-446.
- DeAlteris, J. T. 1988. The application of hydroacoustics to the mapping of subtidal oyster reefs. *Journal of Shellfish Research* 7:41-45.
- Dial Cordy Associates. 2011. Benthic Habitat Mapping and Substrate Characterization in the Northern Estuaries, Florida. Final Report. USCOE, Jacksonville District. Dial Cordy and Associates Inc. 490 Osceola Avenue Jacksonville Beach, FL 32250.
- Grizzle, R., S. Dijkstra, B. Smith. 2008. Development of a General Protocol for Characterizing Subtidal Oyster Reefs Using Remote Sensing Techniques (Project Number R/MED-2). Final Report to NH Sea Grant.
- Grizzle, R.E., M. Brodeur, H. Abeels, and J.K. Greene. 2008. Bottom habitat mapping using towed underwater videography: subtidal oyster reefs as an example application. *Journal of Coastal Research* 24:103-109.
- Smith, G.F., D.G. Bruce, and E.B. Roach. 2001. Remote acoustic habitat assessment techniques used to characterize the quality and extent of oyster bottom in the Chesapeake Bay. *Marine Geodesy* 24:171-189.
- Smith, G.F., E.B. Roach, and D.G. Bruce. 2003. The location, composition, and origin of oyster bars in mesohaline Chesapeake Bay. *Estuarine Coastal and Shelf Science* 56:391-409.
- Smith, G.F., D.G. Bruce, E.B. Roach, A. Hansen, R.I.E. Newell, and A.M. McManus. 2005. Assessment of recent habitat conditions of eastern oyster *Crassostrea virginica* bars in mesohaline Chesapeake Bay. *North American Journal of Fisheries Management*. 25:1569-1590.
- Twichell, D.C., B.D. Andrews, H.L. Edmiston, W.R. Stevenson. 2007. Geophysical mapping of oyster habitats in a shallow estuary; Apalachicola Bay, Florida. U.S. Geological Survey Open-File Report 2006-1381. 34 pp.
<http://woodshole.er.usgs.gov/pubs/of2009/1031>.
- Twichell, D., L. Edmiston, B. Andrews, W. Stevenson, J. Donoghue, R. Poore, and L. Osterman. 2010. Geologic controls on the recent evolution of oyster reefs in Apalachicola Bay and St. George Sound, Florida. *Estuarine, Coastal and Shelf Science* 88:385-394.