Florida Trustee Implementation Group

Charlotte Harbor Intertidal Oyster Mapping 2024

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Overview

The Deepwater Horizon Natural Resource Damage Assessment Florida Trustee Implementation Group awarded the Florida Fish & Wildlife Conservation Commission (FWC) funds to conduct habitat suitability analyses to identify optimal locations for oyster restoration along the Gulf coast of Florida. Six estuaries of interest were selected for habitat analyses: Pensacola Bay, St. Andrew Bay, Suwannee Sound, Withlacoochee River, Crystal River, Tampa Bay, and Charlotte Harbor. This mapping effort was to designed to replace older mapping layers and identify any previously unmapped oyster extent for inclusion in the statewide compilation of live oyster habitat, Oyster Beds in Florida (OBIF). Maps will also be used to help create regional oyster habitat suitability analyses. Mapping was divided into subtidal or intertidal efforts due to differing methodologies. This report encompasses intertidal oyster habitat mapping of Charlotte Harbor.

Methods and Results

Potential oyster reefs were digitized in ArcMap 10.8.1 (ESRI; Redlands, CA) with no minimum mapping unit. Imagery basemaps in ArcMap (Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community) and Google Earth Pro 7.3.6 (Google LLC; Mountain View, CA) were used to identify potential oyster habitat and determine delineation boundaries (2022 – 2023 imagery for Lee County). Once digitized, potential oyster reefs were visually analyzed with consideration of color, shape, texture, and location and classified as 'moderate-' or 'low-confidence', based on the cartographer's interpretation of the imagery.

A number of oyster mapping efforts have previously been completed in Charlotte Harbor. Historical maps are available from the 1950s (Photo Science 2007) and the 1980s (Harris et al. 1983). More recent oyster maps include those based on 1999 imagery (FWC and SFWMD 1999), and 2004 imagery (Avineon 2004, Volety and Savarese 2004). The Southwest Florida Water Management District regularly maps seagrass from aerial imagery (SWFWMD 2016, 2018, 2020, 2022). These seagrass maps also outline oyster reef (mapped polygons include an assortment of live oyster reefs, loose shell, and rubble). Finally, subtidal oyster maps are available from side-scan sonar mapping efforts (Dial Cordy and Associates Inc. 2011, 2019). This mapping effort focused on updating intertidal oyster reefs in Lee County, in the area previously mapped by FWC and SFWMD (1999).

A random subset (~25%) of moderate-confidence reefs and all low-confidence reefs were targeted for ground-truthing. Ground-truthing efforts were conducted by FWC personnel in December 2022 and March, August, and November 2023. Not all sites selected for ground-truthing could be evaluated due to site access, tides, or time constraints. The substrate of each ground-truthed reef was visually inspected or probed with a pole and classified as oyster reef, sand/mud, oyster shell/shell hash, scattered live oyster, or rip rap. Oyster reefs were classified as areas with a minimum of 30% live oyster coverage (estimated visually); sites with less than 30% cover were classified as scattered live oyster (Baggett et al. 2014). Only live reefs were included in the final map. Results from ground-truthing were then used to reclassify confidence accuracy of all remaining reefs that were digitized but not visited. Only polygons that were confirmed reef or had a high confidence in accuracy after reclassification were included in maps.

Between the northern Lee County border and the Caloosahatchee River, 291 potential reefs were digitized and 124 were targeted for ground-truthing. Of these, 74 were visited. Following reclassification based upon information gathered during ground-truthing, the final map consisted of 126 oyster reefs for the region (Figs. 1 and 2, Table 1). Ground-truthing data determined that 90% of moderate-confidence reefs and 14% of low-confidence reefs were classified correctly Fig. 2, Table 1).

Conclusion

In total, 126 intertidal oyster reefs were identified through this mapping effort (Fig. 1). This map was added to OBIF as a replacement layer for FWC and SFWMD (1999) and Volety and Savarese (2004).

Potential reefs that were determined during ground-truthing to be misclassified were most commonly composed of sand/mud (17.6%), followed by oyster shell/shell hash (13.5%), scattered, live oyster (9.5%), and rip rap (4.1%; Figs. 2 and 3, Table 1). Separating potential reefs into moderate-confidence and low-confidence strata for ground-truthing can focus efforts on areas that have the potential to be reefs, but lack the distinctive visual cues of oyster reefs, enhancing ground-truthing efficiency and improving overall accuracy of oyster maps. Because ground-truthing focused on including many low-confidence reefs, overall ground-truthing accuracy was 55% (Table 1).

It is worth noting that Hurricane Ian made landfall in Charlotte Harbor as a high-end category 4 storm on September 28, 2022, after potential new reefs were digitized but before ground-truthing began. Imagery from the NOAA/NGS (National Oceanic and Atmospheric Administration/National Geodetic Survey) Emergency Response for Hurricane Ian (NGS 2024) was reviewed and compared to pre-hurricane imagery prior to ground truthing. It was determined that Hurricane Ian had low immediate impact on the shape or extent of potential reefs in the mapping area. This study did not attempt to quantify the impact of Hurricane Ian on oyster reef populations.

The following characteristics were notable for Charlotte Harbor:

- 67% of oyster reefs identified were located in Pine Island Sound, between Cayo Costa and the northern half of Pine Island (Figs. 4 and 5), compared to 31% of oyster reefs mapped in the same region by FWC and SFWMD (2001).
- Oyster reef loss was most apparent between Matlacha Pass and San Carlos Bay as 48% of reefs were found in this area in 2001; however, only 18% of reefs were located in the same area in this mapping effort (Fig. 4). Polygons classified as reef by FWC and SWFWMD (2001) were found to be sand/mud or shell/shell hash substrates in this mapping assessment. Although these sites are no longer live reef, they could be suitable substrate for oyster restoration (Fig. 3).
- Color and texture are the primary distinguishing features of an oyster reef, though scattered oysters, sand, mud, shell hash, and rip rap, can closely resemble a reef signature depending on imagery resolution and contrast (Figs. 3 and 6). This emphasizes the need for ground-truthing when mapping with remote sensing products.

- Oyster mapping in the Caloosahatchee River was limited as reefs are predominantly subtidal (Boswell et al. 2012, Dial Cordy and Associates Inc. 2019) and this effort focused on intertidal reefs visible in aerial imagery. The only newly identified reef in upper Caloosahatchee was fringing a mangrove island (Fig. 6).

Figure 1. Oyster reefs of the Charlotte Harbor region of Florida identified through this mapping effort. Oyster reefs are not represented to scale.

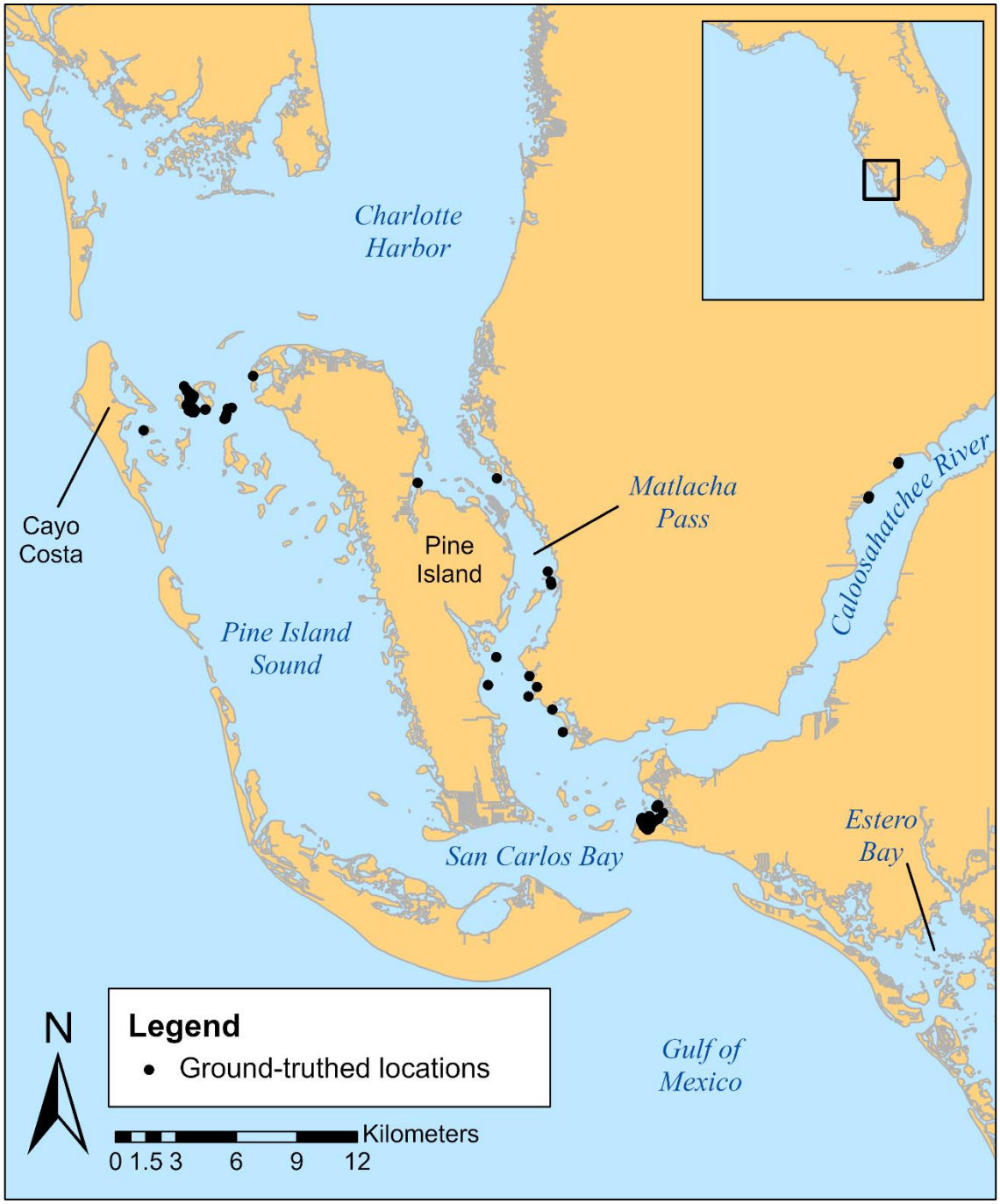

Figure 2. Map of ground-truthed locations in the Charlotte Harbor region of Florida.

Figure 3. Ground-truthing revealed two potential oyster reefs were rip rap (left) and shell/shell hash (right).

Table 1. Error matrix of ground-truthing results from field assessments in Charlotte Harbor.

Ground-truthed substrate	Moderate-confidence potential reefs	Low-confidence potential reefs	All potential reefs
Oyster reef	36	5	41
Sand/mud	1	12	13
Oyster shell/shell hash	2	8	10
Scattered live oyster, non-reef	0	7	7
Rip rap	0	3	3
Total classified correctly	36	5	41
Total sites	39	35	74
Accuracy	90%	14%	55%

Figure 4. Oyster reefs of the Charlotte Harbor region of Florida identified through this mapping effort (red) compared to 1999 effort (blue; FWC and SFWMD 1999). Oyster reefs are not represented to scale. Estero Bay was mapped in FWC and SFWMD 1999, but not in the present effort.

Figure 5. An expansive intertidal oyster reef in northern Pine Island Sound, between Cayo Costa and Pine Island.

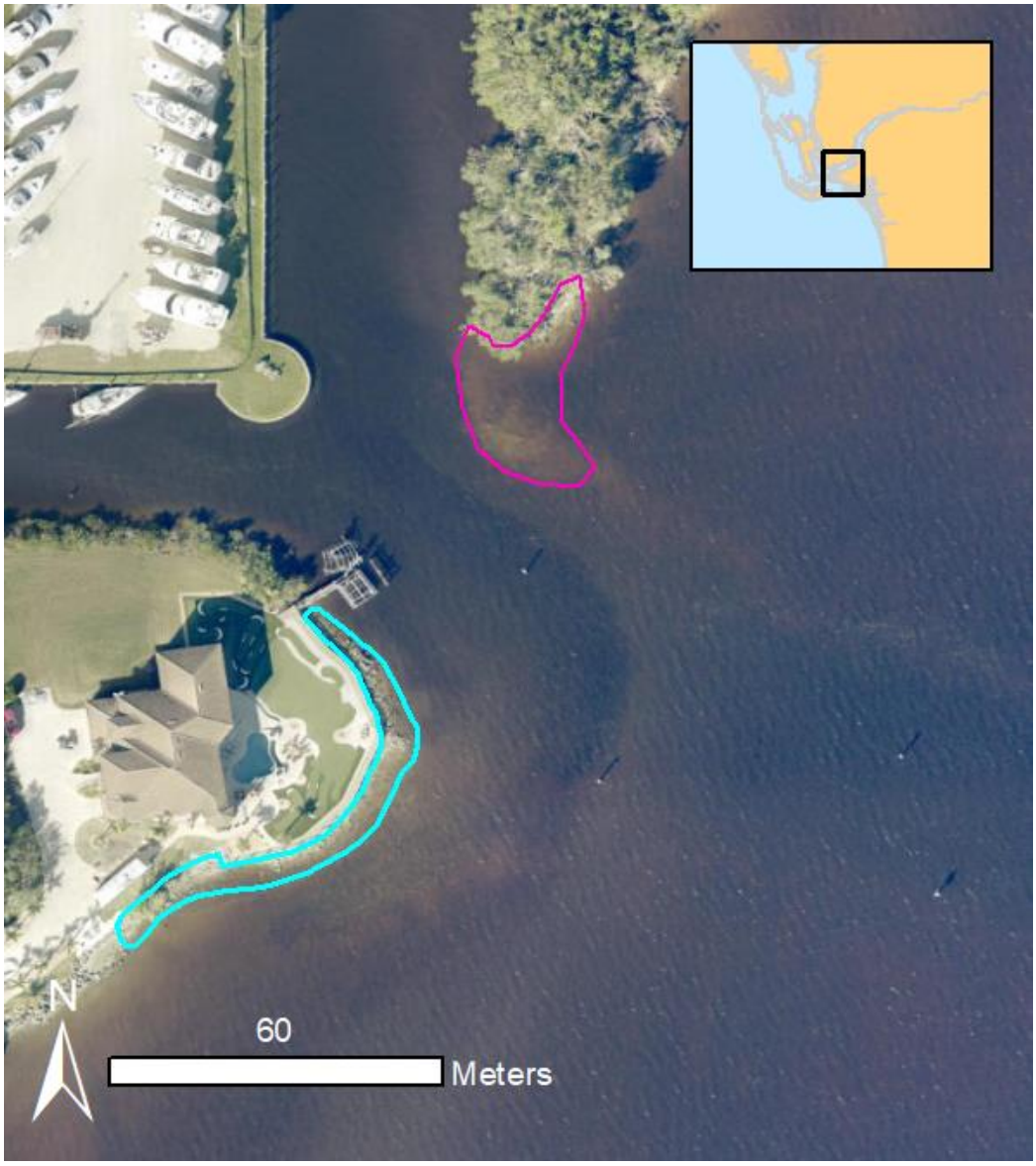

Figure 6. Outline of two potential oyster reefs (both low confidence) mapped along the Caloosahatchee River. One was confirmed as an oyster reef during ground-truthing (pink outline), while the other (blue outline) was rip rap with some scattered, live oysters.

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