Trabue Harborwalk Oyster Reef Restoration

Two Year Post Installation Results

Provided to the CHNEP TAC

Report Prepared by
Laura Geselbracht, Senior Marine Scientist, The Nature Conservancy (TNC)
Collaborators: Andrea Graves, TNC; Anne Birch, TNC
August 2018

Introduction

In 2012, The Nature Conservancy (TNC) funded and worked with the Charlotte Harbor National Estuary Program (CHNEP) and the Southwest Florida Oyster Working Group (SWFOWG) – made up of local partners with experience and knowledge in various aspects of oyster reef restoration – to develop Florida's first estuary-wide, science-based oyster habitat restoration plan. In December 2012, the CHNEP Management Conference approved the Charlotte Harbor Oyster Habitat Restoration Plan (Boswell et al. 2012). The plan contains a Restoration Suitability Model (RSM) that spatially defines potentially suitable areas in Charlotte Harbor for oyster reef restoration based on 5 criteria: bathymetry, tidal river salinity isohalines, seagrass persistence, proximity to boat channels, and presence of aquaculture lease areas. Output from the RSM indicates that there is over 40,000 acres of highly suitable area for oyster restoration within the Charlotte Harbor System. The plan's long-term project objectives include establishing vibrant and growing oyster reef habitat in the Charlotte Harbor with a restoration goal of 1,000-6,000 acres of oyster habitat.

Funding from The Mosaic Company Foundation enabled TNC to initiate implementation of a pilot oyster reef restoration project in the Charlotte Harbor System. TNC worked with the CHNEP and Florida Department of Environmental Protection - Charlotte Harbor Aquatic Preserves (FDEP-CHAP) to identify an appropriate location for the project. The project location ultimately selected was the shallow intertidal area off Trabue Harborwalk, a linear walking trail and park located in the City of Punta Gorda along tidal portions of the Peace River. Selection of the project location was based on the highly suitable areas identified in the Charlotte Harbor Oyster Habitat Restoration Plan, presence of an oyster larvae source, accessibility for volunteers and adjacency to publicly owned property.

Since no known oyster habitat restoration projects had been conducted in the northern portion of Charlotte Harbor, TNC designed a pilot project to test methods that might typically be used for larger restoration projects in the region. Three methods were selected: loose fossil shell, bags of loose fossil shell, and oyster mats using recycled shell. Fossil shell was selected as a material for the loose and bagged shell reefs due to the limited availability of recycled oyster shell. Both the bag and mat materials used in reef construction are aquaculture grade plastic that are expected to be encapsulated as the reefs grow.

The pilot project was designed to facilitate comparison of how well the three approaches perform. Three reefs of each material approximately 4 m by 9 m in size were constructed and one control site was established. A reference site could not be found near the project area as the previously observed natural reefs no longer exist. A monitoring plan based on the Oyster Habitat Restoration Monitoring and

Assessment Handbook Guidelines (Baggett et al, 2014) was developed and implemented to assess reef performance and effect on adjacent habitats and native species. Monitoring plan elements included: project footprint and reef area; reef height; live oyster density and size frequency; water temperature, salinity, dissolved oxygen and clarity/turbidity; oyster recruitment and cluster formation; macroinvertebrate use of the reef; waterbird utilization of the reefs; habitat stability (accretion/erosion between reef and mangrove shoreline) and submerged aquatic vegetation. Results of the monitoring collected during Year 2 post-installation (collected in November and December 2017) are provided below. Methods are not detailed below as they are available from the Year 1 post-installation monitoring report available at: https://tnc.box.com/s/evwkg0lvkdem7b095xfmd6cw8ge4hdsh. Some results provided below are only the highlights of results from reports provided to TNC from contractors and partners. Full reports on these resources are available upon request.

Key Results Two Years Post Reef Installation

Reef Height and Area

Reef height appears to have varied somewhat since the time of deployment (Table 1), however, there is one confounding factor. Prior to the Year 1 monitoring, the project team changed the measurement method to facilitate collection of data in typical field conditions which sometimes includes choppy waves. The Year 1 and Year 2 monitoring methods remained the same. If monitoring method did not have a substantial effect on results, the reduction in height for the mat and bagged shell reefs could be explained by initial settlement of the materials into the sandy-mud substrate. This however, doesn't explain why the loose shell reefs experienced no settling in Year 1.

Table 1. Reef Height (cm) by reef type

	mat average	bag average	loose shell average
Deployment	8.9	17.6	12.3
Year 1	4.9	12.3	14.3
Year 2	7.0	16.0	13.3

Between Years 1 and 2, The mat and bagged shell reefs increased in height and the loose shell reefs experienced a slight decrease in height (Table 1, Figure 1). This slight average decrease in height could be explained by a modest amount of shell that pushed off the reef to the immediately adjacent area following Hurricane Irma. The reduction in height is small however (1 cm) and could also be explained by sampling variability. In general, the trend in reef height is positive. Sampling in future years will further inform how the reefs are progressing. Areal extent of the reefs has not changed. This is easily determined by the position of the corner markers on the reefs.

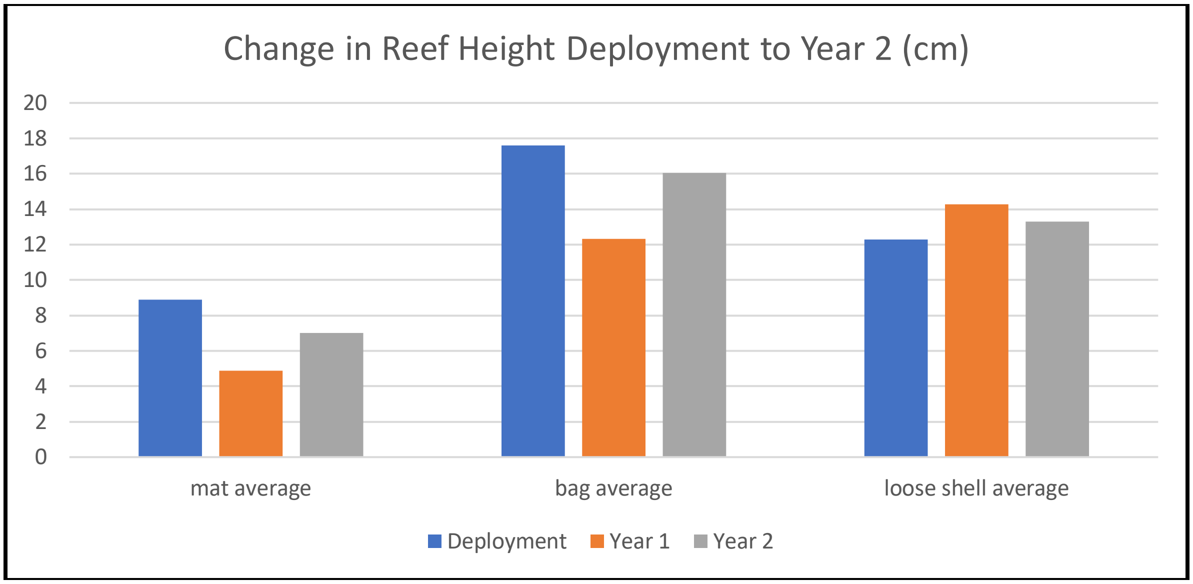

Figure 1. Change in reef height from deployment to Year 2.

Live Oyster Densities and Totals

Environmental conditions were not optimal for oysters in 2017 as reflected in the decrease in oyster counts on two of three reef types (Table 2). The densities may reflect a temporary condition caused by Hurricane Irma, however only observational information by project staff is available. As noted above, the physical structure of the reefs was minimally affected by Hurricane Irma. The primary changes in condition noted following the hurricane was the noticeable accumulation of fine sediments around the reef perimeters (approximately 1-3 cm) and approximately 50% of oysters on the reefs recently dead (box oysters).

Even with these challenging environmental conditions in 2017, reefs overall lost only 31% of live oysters compared to 2016 (Table 3) due to continued strong recruitment which made up for a significant portion of the dead oysters (Figure 2). Our measure of success for the Trabue reefs was set at 413 oyster/m^2 based on densities found at reference reefs monitored near and around Sanibel Island by the Sanibel Captiva Conservation Foundation (Mark Thompson, SCCF, pers.com). With this success criterion, only the bagged shell reefs exceeded it in 2017 (1800 oysters/m^2) and the mat reefs fell just short at 410 oysters/m^2. The loose shell reefs were below the success criterion by a comfortable margin (329 oysters/m^2).

Table 2. Density of Live Oysters on Reefs (live oysters/m^2)

Reef Type	1 year November 2016	18 months May 2017	2 years November 2017
Mat Reefs	154	206	410
Loose Shell Reefs	714	769	329
Bagged shell reefs	2,186	2,674	1,800

The bagged shell reefs continued to have the most live oysters by a wide margin, followed by the loose shell reefs and the mat reefs. All 3 reef types saw strong recruitment of oysters with bagged shell reefs having a particularly good distribution of size classes (Table 3). Mat reefs had the lowest density of live oysters, but some of the largest individual oysters.

Table 3. Live Oyster Count by Reef Type

Reef Type	1 year	18 months	2 years
Mat Reefs	17,270	23,072	45,920
Loose Shell Reefs	87,108	93,818	40,138
Bagged shell reefs	260,134	318,206	214,200
Total all reefs	364,512	435,096	300,258
Percent change from previous sampling:		19%	-31%

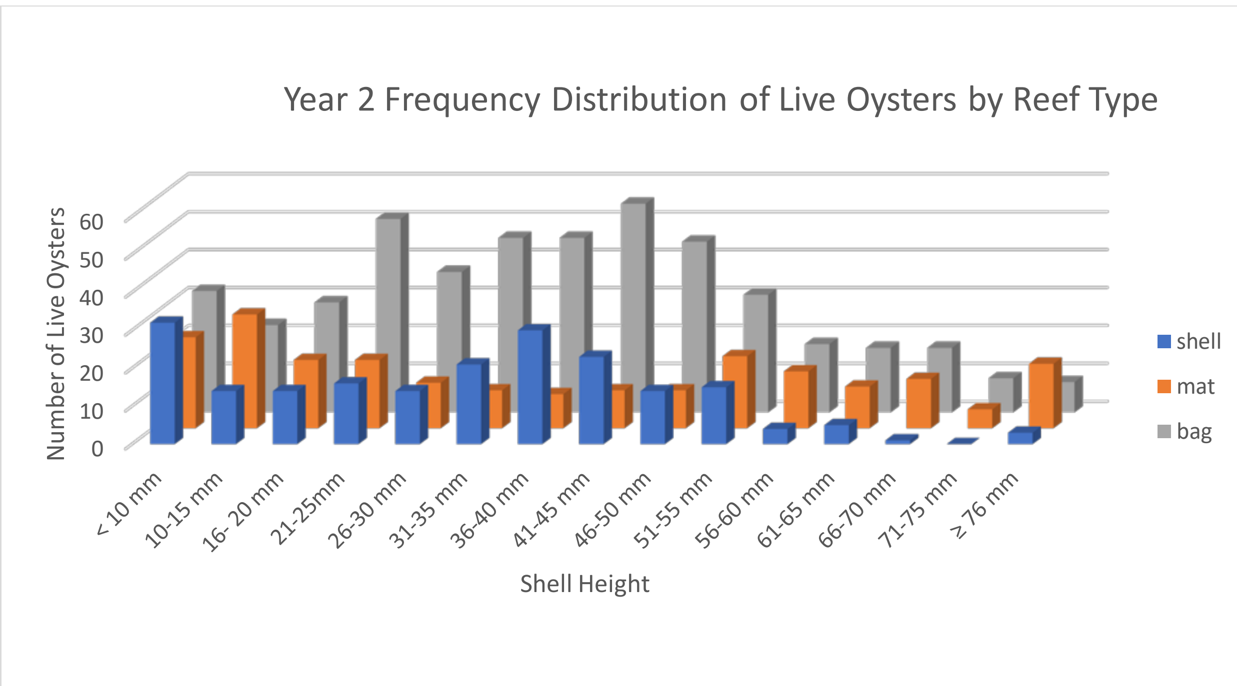

Figure 2. Size frequency of live oysters on the Trabue reefs by type.

<u>Invertebrate Epifauna on the Reefs (Summarized from report by Mr. Ford Walton submitted to TNC)</u>

Year 2 sampling found a total of 25 taxa and 525 individuals in the reef and control samples (Table 4). The bag reef samples had the largest mean number of taxa, with 10.3, and a mean of 94.7 individuals (11.9 per liter). The shell reef samples had the fewest taxa with 8.0 and the largest number of individuals with 100.7 (23.2 per liter). The mat reef samples had a mean of 8.33 taxa, and smallest mean number of individuals with 61, but the highest density of individuals at 35.3 per liter. The control samples had a mean of 7 taxa and 10.3 individuals.

Table 4. Number of Taxa and Individuals for Reef Types and Control

Reef Types/ Control	Number Taxa (Species/Species Groups)	Number Individuals
Bagged Shell	10.3	94.7
Loose Shell	8	100
Mat Reef	8.33	61
All reef types	25	525
Control	7	10

Bag samples had the highest mean biomass, at 22 grams (2.75 grams/liter reef material), next were the mat samples at 11 grams (6.2 g/l), and lowest were the shell samples at 8 grams (1.8 g/l). The measured biomasses include only the taxa removed from the reef material, so do not include the oysters themselves, or the firmly attached organisms, which would significantly increase the total biomass of the samples. *Eurypanopeus depressus* (mud crab) had the highest total biomass, at 81 grams, with *Ischadium recurvum* (hooked mussel) and *Panopeus* cf. *simpsoni* (mud crab) next at 23g and 15g respectively. These biomasses are for three samples of each reef material, rather than nine samples per material as in previous studies.

Three taxa, *Eurypanopeus depressus* (mud crab*), Neanthes succinea* (a polychaete) and *Balanus improvisus* (barnacle) were in all 9 reef samples. Three others, an unidentified nemertean, Melita sp. (amphipod), and *Ficopomatus miamiensis* (tube worm) were present in 66% or more of the reef samples. Both numbers of individuals and, to a lesser extent, biomass data are dominated by a single species, *Eurypanopeus depressus.*

Only Balanus improvisus, *Mulinia lateralis* (clam), and *Cistena gouldii* (sand-tube worm) were present in all three control samples, but small Peneus (commercial shrimp) and *Callinectes sapidus* (blue crab) were present in two samples and one sample, respectively.

The sampling procedure did not produce a complete collection of the macroinvertebrate community of the oyster reefs and the underlying substrate. The procedure underestimated attached and boring organisms, (barnacles, tube worms, mussels, some polychaetes), and organisms smaller than 3 millimeters, (most amphipods, isopods, polyclads, polychaetes, and small mollusks). The numbers of larger decapods and mollusks are representative.

<u>Waterbird utilization of the restored reefs and surrounding area</u>

Bird observations on and around the reefs increased during the Year 2 post-installation of the reefs. In Year 1, a total of 21 wading and other birds were observed. This number increased to 86 in Year 2. The number of species observed also increased during the second year of observations from 8 to 15 (Table 5, Figures 3 & 4).

Table 5. Bird counts on and around reefs, Year 1 and Year 2 compared

Species	Nov 2015 - Oct 2016	Nov 2016 - Oct 2017
Little Blue Heron	7	13
Belted Kingfisher	2	
Little Green Heron		2
White Ibis	3	20
Double-crested Cormorant	2	13
Snowy Egret		3
Grackle	2	2
Mottled Duck	2	3
Laughing Gull		1
Great Egret	1	2
Brown Pelican	2	10
American Oystercatcher		3
Osprey		3
Killdeer		7
Great Blue Heron		1
Mourning Dove		3
TOTAL Individuals	21	86
TOTAL Species	8	15

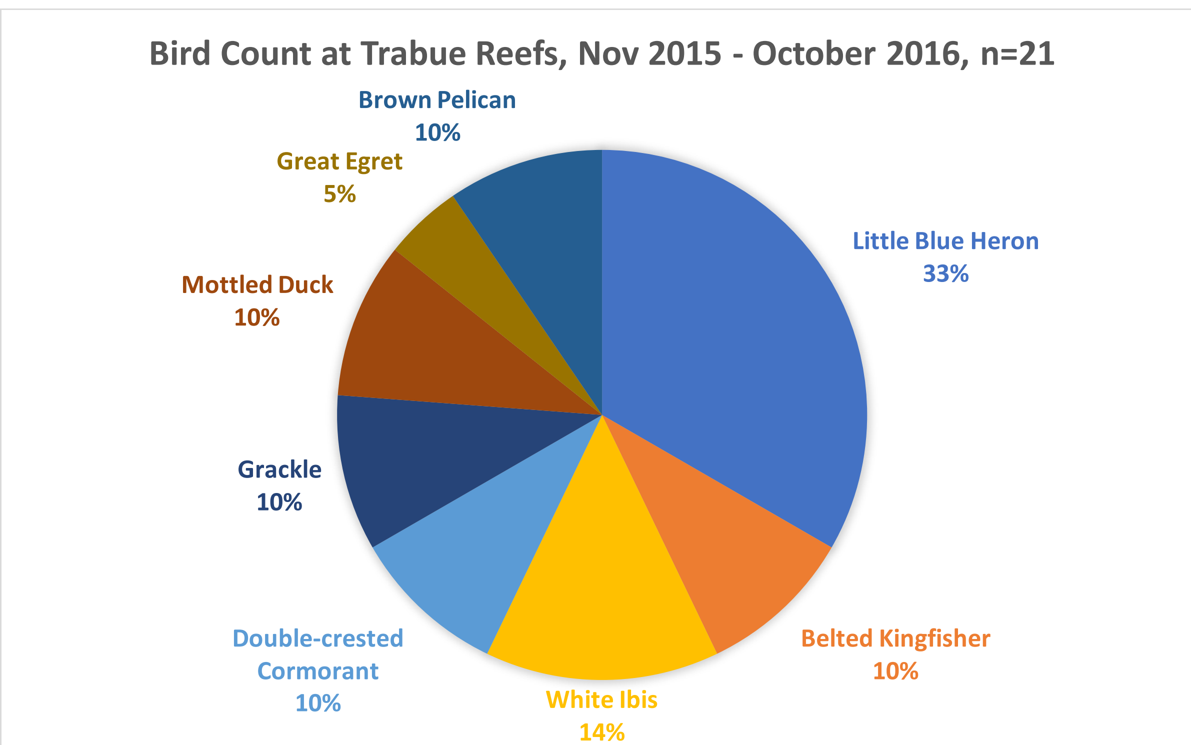

Figure 3. Wading and other bird observation around the restored oyster reefs, Year 1

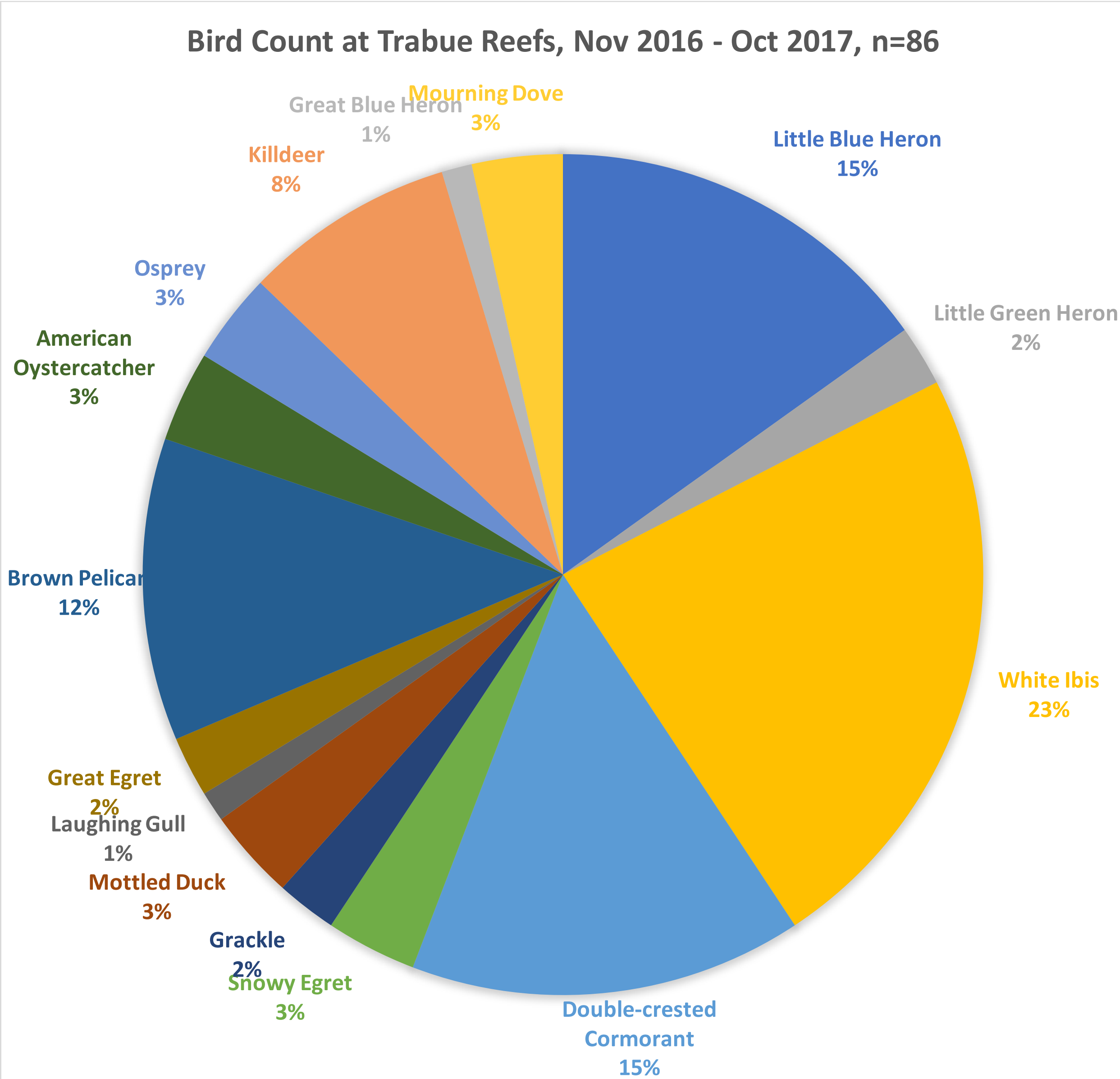

Figure 4. Wading and other bird observation around the restored oyster reefs, Year 2

<u>Smalltooth sawfish utilization of area around the restored reefs</u>

During the second year of post reef installation sampling, Florida Fish and Wildlife Conservation Commission (FWC) researchers found that juvenile smalltooth sawfish continued to use the southern shoreline of the Lower Peace River at night and interacted with the oyster restoration reefs on short temporal scales. They also discovered, for the first time, that some of the tagged sawfish used the southern shoreline and the area around the oyster reefs extensively during day and night hours (Figure 5).

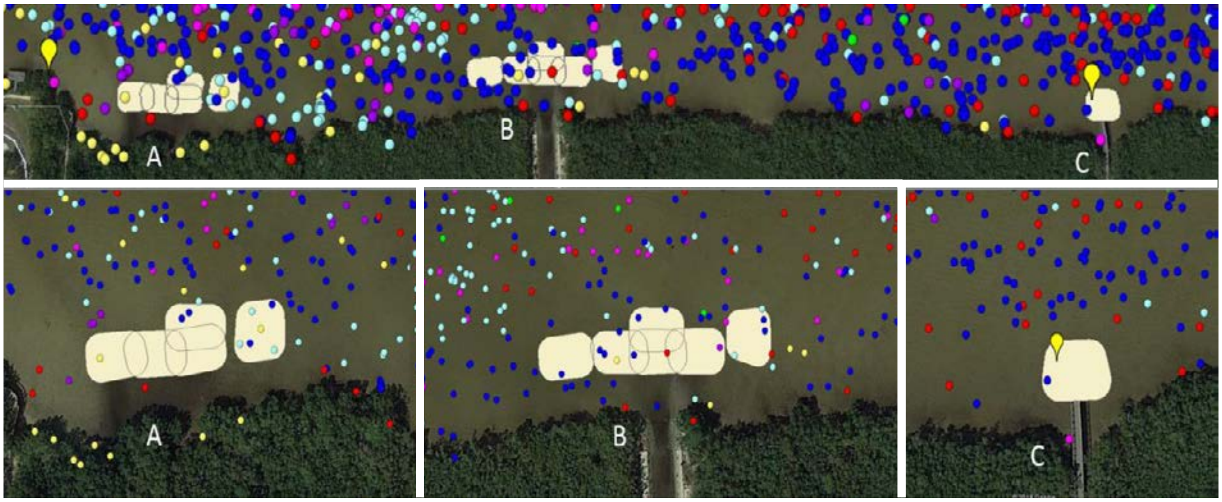

Figure 5. (from report to TNC from FWC) Sawfish interactions with the oyster reefs over the entire study (April–Nov 2017). Each color represents a different tagged sawfish (n = 7). Six out of 7 sawfish had positions that appeared to interact with the oyster reefs. The top panel shows all 7 sawfish and the oyster restoration sites; the 3 bottom panels are close-ups of the oyster restoration sites. Note that all points are plotted regardless of Horizontal Positioning Error (HPE) *(in other words, some points may look like they are in the mangroves but are actually in shallow water near the mangroves, likely at high tide).* Note: At Sites A and B, the polygons (yellow boxes) at the far right are seagrass receiving areas, not reef habitat.

Seagrass

The Florida Department of Environmental Protection, Charlotte Harbor Aquatic Preserve staff conducted pre- and post-installation seagrass surveys at the Trabue Harborwalk restoration area as part of their ongoing seagrass surveys in Charlotte Harbor. Surveys were conducted within a control site and the two areas that were established to receive seagrass plugs removed from the area where the reefs would be deployed. Seagrass transects were also established around each of the three reef sites (A, B and C).

Seagrass abundance in the control and receiving areas is low (<3%) at the project area and has declined slightly since the reefs were installed in November 2015. Although, there has been some variability over the 2-year post-installation period, especially at Site C (Figure 6). Average total shoot count has also declined to some extent in the control and transplant sites over the 2-year period (Figure 7). At Site B receiving and control areas, the decline in abundance was negligible from pre-installation of the reefs through Year 2. At the Site C receiving area, however, shoot abundance has declined from 93 to 18 shoots/m^2 from prior to receiving transplants to the Year 2 survey. Shoot count at this site peaked however 6 months following reef installation to 247 shoots/m^2. The declines at the control site over the 2-year post-installation period indicate that the declines at the reefs sites were not the result of reef placement, but rather due to ambient environmental conditions. Seagrass abundance and shoot count can vary substantially from year to year.

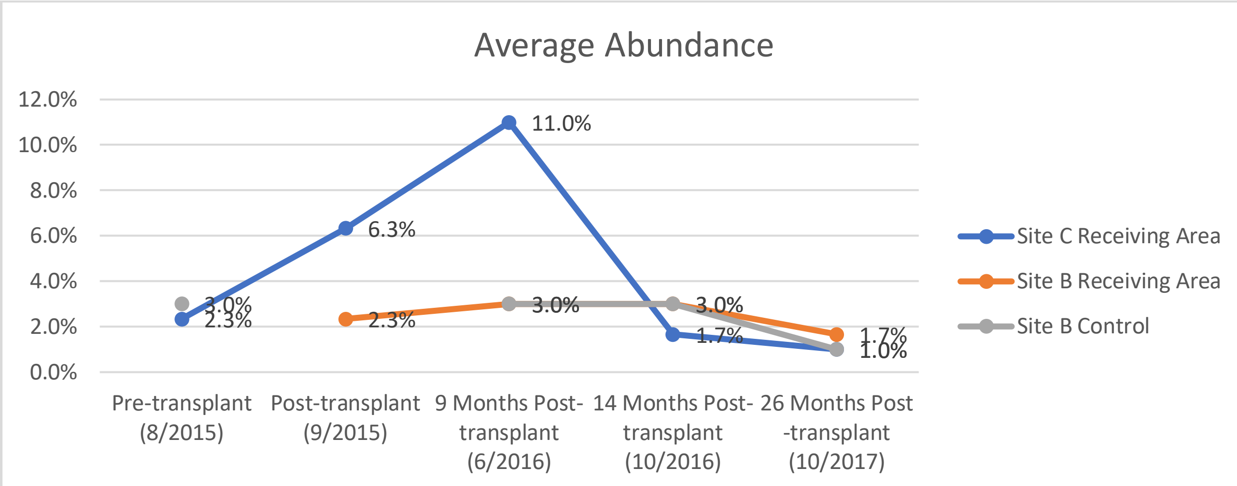

Figure 6. Average abundance of seagrass in control and transplant receiving areas from pre-transplant through the Year 2 survey.

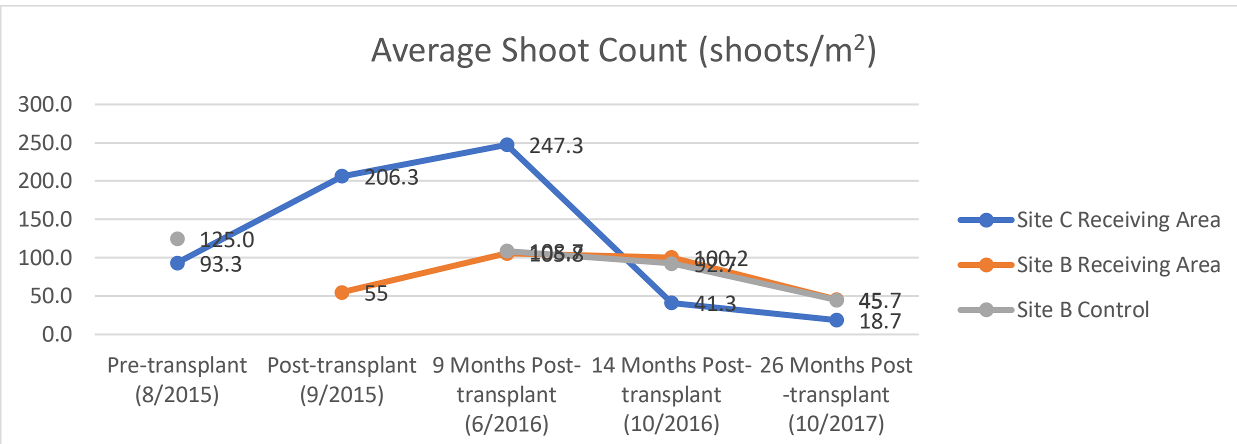

Figure 7. Average shoot count of seagrass in control and transplant receiving areas from pre-transplant through the Year 2 survey.

Seagrass abundance along the transects at the control and reef sites has been remained low from pre-installation of the reefs through the Year 2 survey, ranging from 1% to 3% (Figure 8). Control site abundance peaked to 8% 7-9 months post-installation of the reefs but declined after that. Total shoot count along the transects at the reef and control sites were moderate prior to reef installation ranging from 47 to 66 shoots/m^2 for the reef sites and 104 shoots/m^2 for the control site (Figure 9). After an increase in shoot count for all but Site D at the 7-9 months post-installation survey, shoot counts declined for these sites to 13 to 42 shoots/m^2 at the Year 2 monitoring. Site D shoot counts have been stable throughout the monitoring period, hovering between 39 to 47 shoots/m^2. The declines at the control site transects over the 2-year post-installation period indicate that the declines at the reefs site transects were not the result of reef placement, but rather due to ambient environmental conditions. Seagrass abundance and shoot count can vary substantially from year to year.

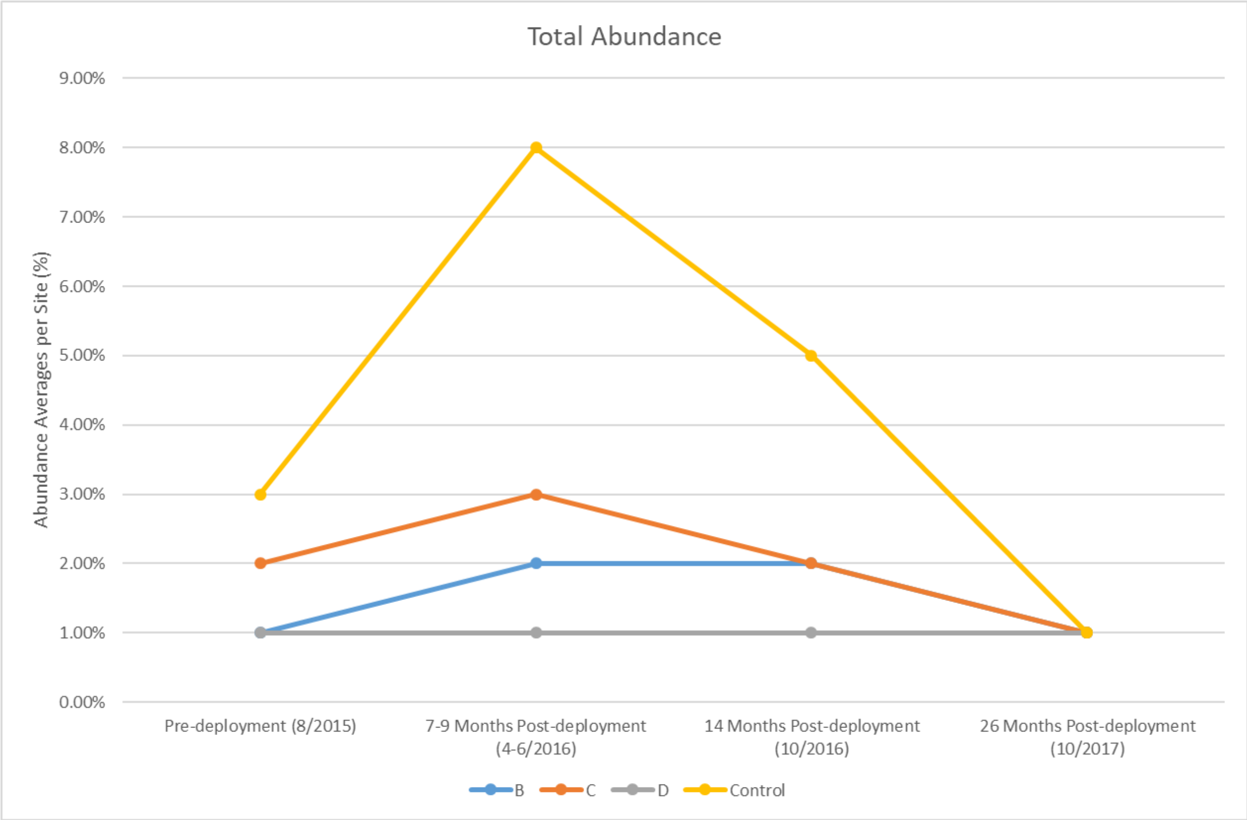

Figure 8. Average abundance of seagrass at control and reef transects from pre-transplant through the Year 2 survey.

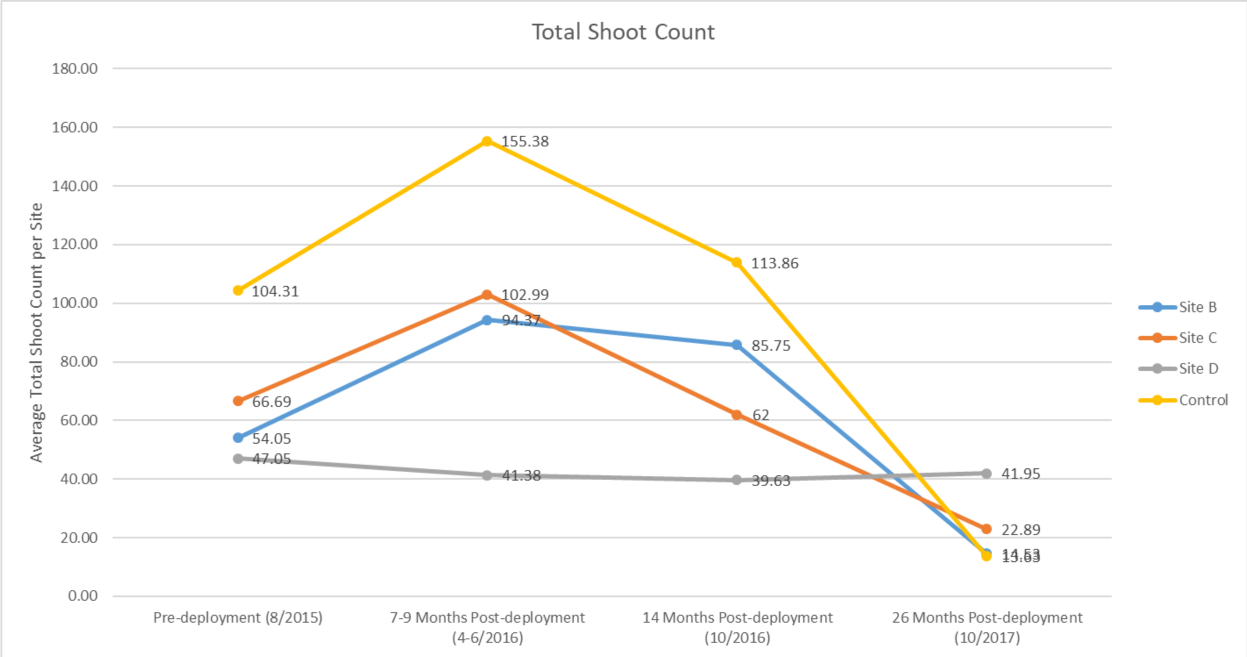

Figure 9. Average shoot count of seagrass at control and transplant transects from pre-transplant through the Year 2 survey.

Summary and Conclusions

The Trabue Harborwalk Project has demonstrated how to successfully pilot a small-scale project to test different restoration methods and involve the community in all aspects of the project. Oyster recruitment and growth on the reefs has been impressive, especially in the face of substantial perturbations such as a hurricane. The population of invertebrates now living on the reefs provides food for sport and commercially important fisheries species as well as other wildlife including birds and small mammals (raccoons for example). Wading and other birds continue to be attracted to the site and each year volunteers from the Peace River Audubon Society record bird species in the area that they have not seen in many years at that location if ever (e.g., spoonbill and American oystercatcher). Observations made following Hurricane Irma indicate that the reefs may be reducing some of the wind-generated wave energy headed towards the shore as fine sediments are accumulating on the shoreward side of the reefs. Through project funded research, FWC scientists are continuing to discover more about the daily habits of juvenile smalltooth sawfish in the Lower Peace River. Sawfish are using the area around the reefs and crossing over the reefs at times. More research is needed to determine if the reefs are providing documentable benefits to the sawfish.

Construction of reef materials, preparation of the reefs sites, deployment of the reefs and monitoring of the restored reefs has all been made possible with numerous project partners and volunteers including the City of Punta Gorda, Charlotte Harbor National Estuary Program (CHNEP), FDEP-Charlotte Harbor Aquatic Preserves, CHNEP Citizen Scientists and numerous other individuals and companies that have donated their funds, time, oyster shell and storage space to this project. Year 3 monitoring of the restored reefs and surrounding area will take place in the fall/early winter of 2018.