Chapter 5
Tampa and Sarasota Bays

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Description of the region

Tampa Bay

Located on the central Gulf coast of Florida, Tampa Bay is Florida's largest open-water estuary with a surface area of 1,036 km^2 (400 mi^2) (Fig. 5.1; TBEP 2017). The bay receives freshwater flow from four major rivers (Hillsborough, Alafia, Manatee, and Little Manatee) and more than 100 small tributaries. Tampa Bay has a large, permanent connection to the Gulf of Mexico and has strong tidal currents at the mouth of the bay. There are five passes that connect to the Gulf of Mexico (Pass-a-Grille Channel, Bunces Pass, Egmont Channel, Southwest Channel, and Passage Key Inlet) as well as connections to Clearwater Harbor in the north through Boca Ciega Bay and the Intracoastal Waterway. Tampa Bay connects to the south to Sarasota Bay through Anna Maria Sound. The watershed area is about 5,700 km^2 (2,200 mi^2) and includes large portions of Hillsborough, Pinellas, and Manatee counties, as well as smaller portions of Pasco, Polk, and Sarasota counties (TBEP 2017). Outside of the Tampa Bay watershed, the greater region also includes Clearwater Harbor and St. Joseph Sound in northwestern Pinellas County (Fig. 5.1). The Tampa Bay area includes many city, county, and state parks and preserves, aquatic preserves, and national wildlife refuges. The entire region lies within the Southwest Florida Water Management District (SWFWMD) and the bay has one of the 28 National Estuary Programs in the United States.

The Tampa Bay area is highly urbanized with a population of over 3 million people. Local hydrology has been altered by freshwater withdrawal from tributaries and the construction of water reservoirs in order to meet urban water demands (Yates and Greening 2011). Urban construction has led to the channelization of stormwater, which increases the rate of surface water delivery and also transports nutrients and other pollutants to the bay. By the 1970s, Tampa Bay faced severe water quality problems and habitat degradation as a result of excessive nutrient input. These nutrient inputs were reduced through upgraded wastewater and stormwater treatment, lower industrial emissions, and other improvements in Tampa and St. Petersburg, reversing trends in eutrophication and improving habitat quality throughout the bay (Greening and Janicki 2006, Holland et al. 2006, Sherwood et al. 2017).

Tampa Bay has an average depth of 4 m (12 ft); this average depth has increased by more than 5% since 1900 as a result of channel dredging and rising sea level (Goodwin 1984, SWFWMD 1999). The bay has been dredged extensively for the creation of shipping channels and approximately 51% of Tampa Bay's shoreline has been altered (Coastal Environmental, Inc. 1994). In developed areas, the shoreline is generally hardened as rip-rap or a seawall; remaining natural shorelines are dominated by mangroves. The average tidal range in Tampa Bay is 0.4 m (1.2 ft) (SWFWMD 1999).

Eastern oyster (*Crassostrea virginica*) reefs are found in intertidal areas throughout Tampa Bay and are often clustered near freshwater inputs (Kaufman 2017). Mean

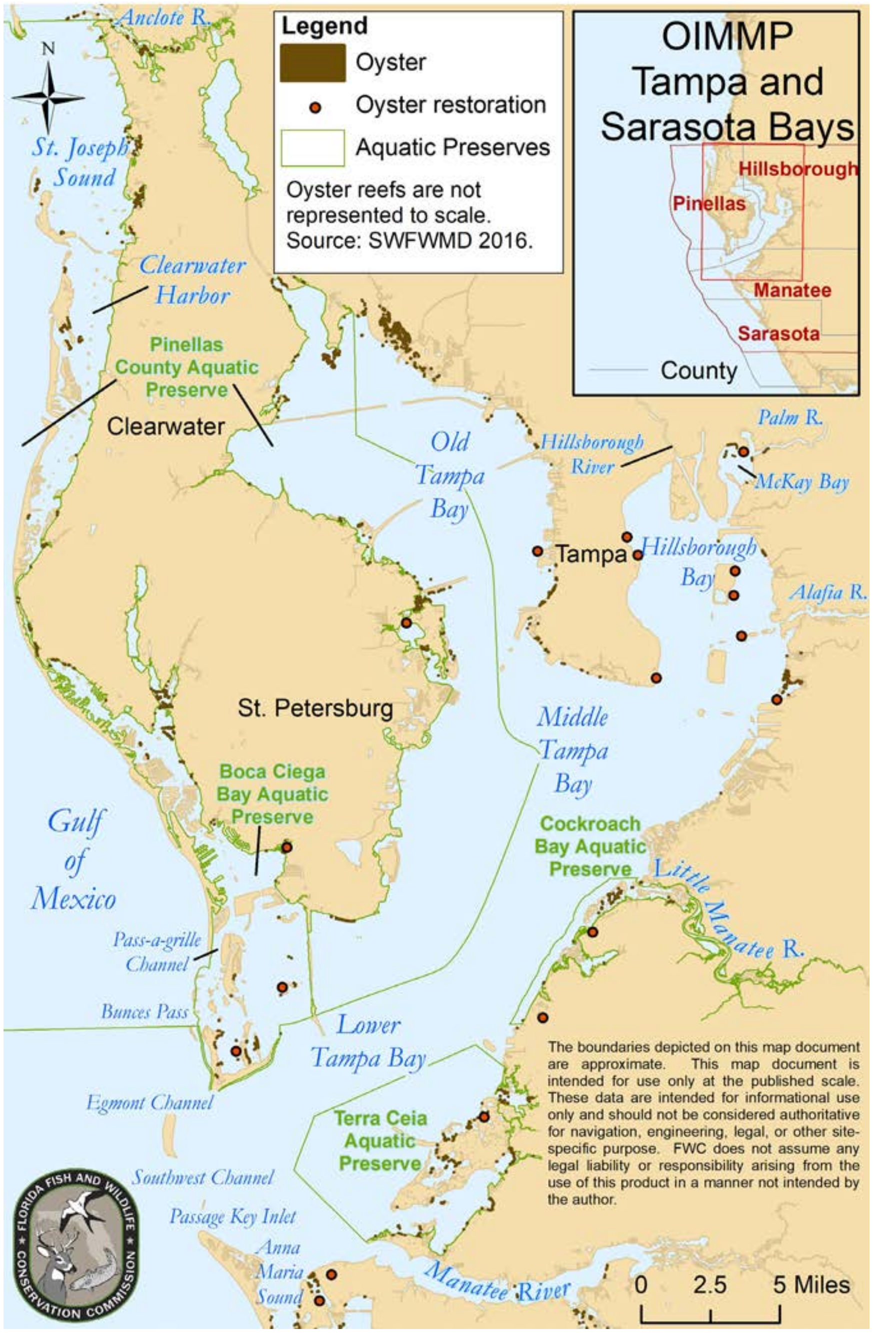

Figure 5.1. Mapped oyster extent in Tampa Bay. Oyster mapping source: SWFWMD 2016 (from 2016 aerial photographs).

monthly salinity on oyster reefs in Lower Tampa Bay ranges from 25 to 36 (Parker et al. 2013), but salinity can reach the low 20s during wet seasons (Drexler et al. 2014). Although Tampa Bay is highly urbanized, the bay does not face the extreme hydrologic impacts and salinity fluctuations seen in south Florida, making it a comparatively stable habitat for oysters (Arnold et al. 2008, Parker et al. 2013). However, tidal flow and flushing are restricted by multiple causeways in the upper reaches of Old Tampa Bay (located in northwestern Tampa Bay; Fig. 5.1). In a study of oyster density and recruitment across estuaries in central and southern Florida, Tampa Bay was found to have the most stable oyster population and a reef population density of 104–442 oysters/m^2 (10–41 oysters/ft^2) (Parker et al. 2013). As the lower bay provides relatively stable salinity, a lack of suitable hard substrate is the primary factor limiting oyster distribution (Morrison et al. 2011). The sediments of Tampa Bay are largely made up of sand and carbonate shell fragments, with clays and organic sediment becoming more prominent in the upper reaches of the bay (Brooks and Doyle 1998). Intermittent hard bottom, including subtidal oyster reefs and low-relief limestone outcroppings, are also found in the bay. Like oyster reefs, hard bottom is considered essential fish habitat and supports sponges, soft corals, algae, and live rock. Hard bottom has been mapped in selected parts of Tampa Bay (Savercool and Lewis 1994, Kaufman 2017), but the full extent of hard bottom and subtidal oyster reefs is unknown (TBEP 2017).

Oyster reefs in Tampa Bay were most recently mapped in 2016 by the SWFWMD seagrass and oyster mapping effort (Fig. 5.1; SWFWMD 2016). Oyster extent includes natural reefs and restoration sites created by multiple organizations since the early 2000s. Old Tampa Bay contained approximately 44% of Tampa Bay's oyster habitat in 2016 (Table 5.1; Kaufman 2017). Oysters that grow in close association with mangroves or seawalls are frequently not mapped or included in acreage estimates due to the difficulty of mapping these peripheral habitats using aerial imagery (O'Keife et al. 2006, Kaufman 2017). However, oyster populations on seawalls or mangrove roots often have a higher density and biomass than oysters in reefs in Tampa Bay (Drexler et al. 2014). Although oysters on mangrove

Table 5.1. 2016 mapped oyster reef extent in segments of Tampa Bay. Data source: SWFWMD, as presented in TBEP 2017.

Bay segment	Oyster reefs (ha)	Oyster reefs (ac)
Old Tampa Bay	29.8	73.6
Hillsborough Bay	5.0	12.2
Middle Tampa Bay	5.2	12.9
Lower Tampa Bay	6.3	15.6
Boca Ciega Bay	15.5	38.3
Manatee River	2.4	5.8
Terra Ceia Bay	3.2	8.0
Total	67.3	166.4

roots and seawalls are significantly smaller, they have similar condition index, fecundity, and recruitment as reef oysters and therefore are an important component of the bay-wide population (Drexler et al. 2014).

The oyster disease dermo (*Perkinsus marinus*) is relatively common year-round in Tampa Bay and has been found in 50% of oysters on natural reefs, 45% of oysters on seawalls, 42% of oysters on mangrove roots, and 38% of oysters in restoration habitats (Drexler 2011, Drexler et al. 2014). The increased prevalence of dermo on natural reefs may be linked to longer submergence times or greater age of oysters there than of oysters on seawalls or mangrove roots (Drexler et al. 2014). Although dermo infections are common, intensity is quite low and averages less than one on Mackin's (1962) scale of zero to five, where a zero indicates no infection and five is a severe infection (Arnold et al. 2008, Drexler et al. 2014). There is no evidence of MSX (*Haplosporidium nelsoni*) in Tampa Bay oysters (Arnold et al. 2008).

Several organizations including Tampa Bay Watch, Manatee County, and numerous supporting partners have conducted oyster restoration efforts since the early 2000s (TBEP 2017). In addition, intertidal restoration projects or living shorelines often directly (through use of oyster bags or reef modules) or indirectly (through oysters growing on red mangrove prop roots) result in increased oyster habitat (NOAA 2015, Brandt Henningsen pers. comm.). The Tampa Bay Estuary Program (TBEP) tracks restoration of coastal habitats, including oyster reefs, in the Tampa Bay area and provides summaries in a geo-spatial format on the Tampa Bay Water Atlas at http://www.tampabay.wateratlas.usf.edu/restoration/.

Oyster harvesting

Tampa Bay had a robust commercial fishery in the late 1800s that yielded up to 227 metric tons (500,000 pounds) annually (Finucane and Campbell 1968). Most of this harvest originated in northern parts of Old Tampa Bay. Yields dramatically decreased in the first half of the 1900s, and by the 1950s commercial oyster harvest declined to an annual yield around 2.3 metric tons (5,000 pounds) (Fig. 5.2; Finucane and Campbell 1968, Arnold and Berrigan 2002, Morrison et al. 2011). Harvest temporarily rebounded in the mid-1960s, largely as a result of cultch distribution on leased oyster grounds in Old Tampa Bay (Finucane and Campbell 1968). Cultch was also distributed in sections of Middle Tampa Bay for commercial fisheries (Whitfield 1975).

Based on records of shell production from leases, Estevez (2010) estimated that Tampa Bay once held 800 ha (1,980 ac) of oyster reefs and submerged shell. Oyster shell was extensively harvested for use in the construction industry and over 25.9 million metric tons (28.5 million US tons) of oyster shell were mined between 1931 and 1974 (Whitfield 1975). Kaufman (2017) estimated oyster reef extent in the 1970s was 75–140 ha (186–345 ac) while recent mapping efforts place current reef extent in Tampa Bay at 53–67 ha (131–166 ac) (SWFWMD 2016, Kaufman 2017).

Portions of Lower Tampa Bay are open to harvest (Fig. 5.3) contingent on levels of fecal coliform bacteria and other contaminants, which often correlate with intensity of rainfall events (FDACS 2017). The commercial harvest in Tampa Bay has often been closed since 1995 as a result of fecal coliform and other contaminant levels (Fig. 5.2; SWFWMD 1999).

Sarasota Bay

The Sarasota Bay region includes Sarasota Bay proper, Palma Sola Bay in Manatee County, and a series of smaller, contiguous bays to the south (Fig. 5.4). The bay connects with Tampa Bay to the north through Anna Maria Sound and to the Gulf of Mexico through four tidal inlets: Longboat, New, and Big Sarasota passes and Venice Inlet. Sarasota Bay is not an estuary under the influence of a major river, but rather a restricted coastal lagoon bounded by barrier islands. Phillippi Creek, which drains into Roberts Bay, is the largest of 16 tidal tributaries that flow into the system. Sarasota Bay has 135 km^2 (52 mi^2) of open water and a watershed comprising 390 km^2 (150 mi^2) (SBEP 2007). The region lies within the SWFWMD. The area from Palma Sola Bay south to Blackburn Bay comprises the Sarasota Bay Estuary Program (SBEP) while Dona and Roberts Bay in the extreme southern part of the system are within the boundaries of the Charlotte Harbor National Estuary Program (CHNEP).

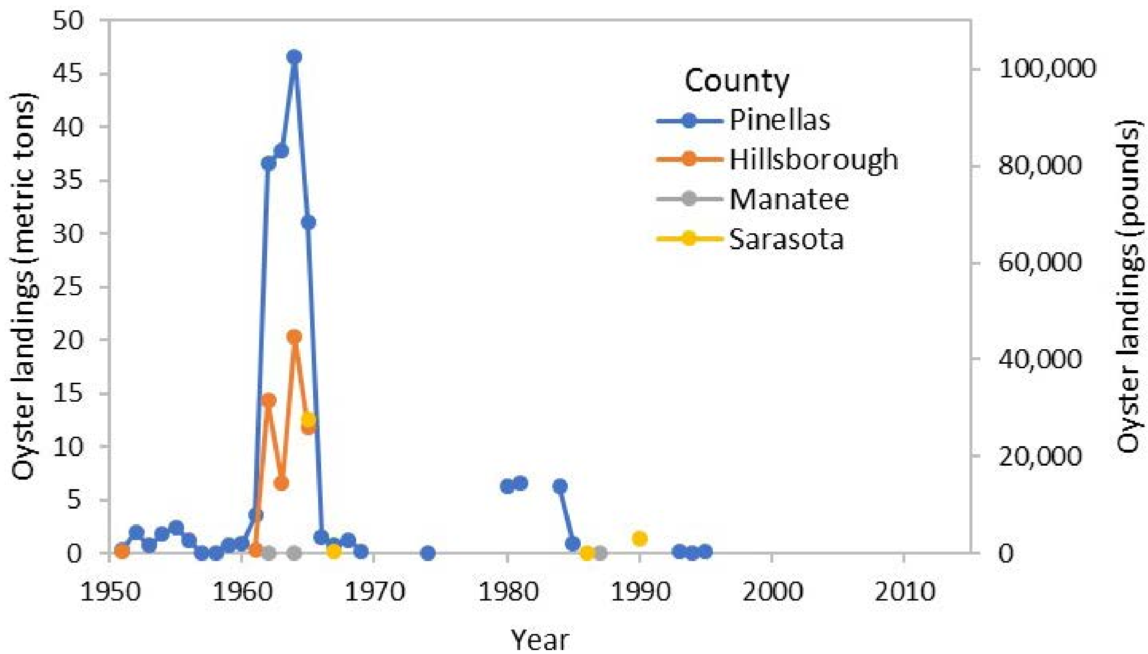

Figure 5.2. Oyster harvest in Tampa Bay (Pinellas, Hillsborough, and Manatee counties) and Sarasota Bay (Manatee and Sarasota counties). Data source: FWC 2018 and summary of Florida commercial marine fish landings (see Appendix A). Oyster landings prior to 1986 were collected under a voluntary reporting system.

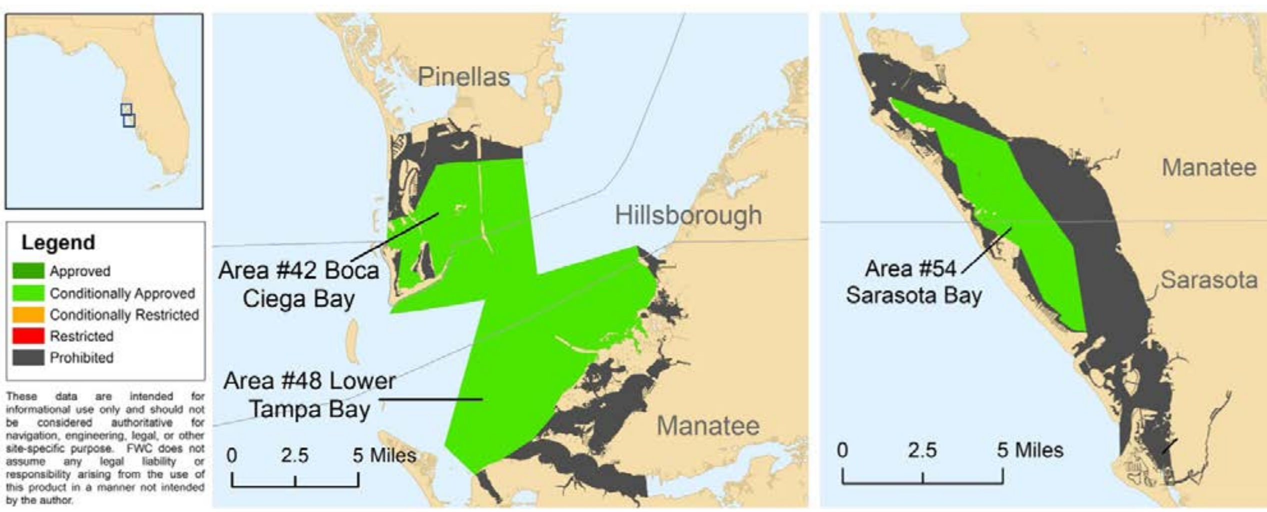

Figure 5.3. Current shellfish harvest areas in Tampa Bay and Sarasota Bay (FDACS 2017).

The cities of Sarasota and Bradenton are located along Sarasota Bay and the barrier islands are also highly developed. Many of the area's coastal wetlands have been lost to urban development and more than 160 km (100 mi) of seawalls are present today around Sarasota Bay, making up more than 80% of the bay's shoreline (SBEP 2010). As development expanded in the 1950s and 1960s, increased coastal runoff and poor wastewater management resulted in poor water quality due to excess sediments, nutrients, and other pollutants. Similarly, hydrologic alteration and canal systems around Dona and Roberts bays have tripled the historical freshwater flow into the small bays, reducing salinity and increasing nutrient load (CHNEP 2013). By the late 1980s, Sarasota Bay had reduced bivalve and fish harvests and diminished extent of seagrass beds (SBEP 2010). Nearly 1,820 ha (4,500 ac) of benthic habitat in Sarasota Bay, including oyster reefs and seagrass beds, were covered by dredge-and-fill operations (SBEP 2006). The SBEP was formed in 1989, and the community began to improve water quality and stormwater management in order to aid shoreline habitats, local fisheries, and seagrass extent (SBEP 1992). As a result of these efforts,

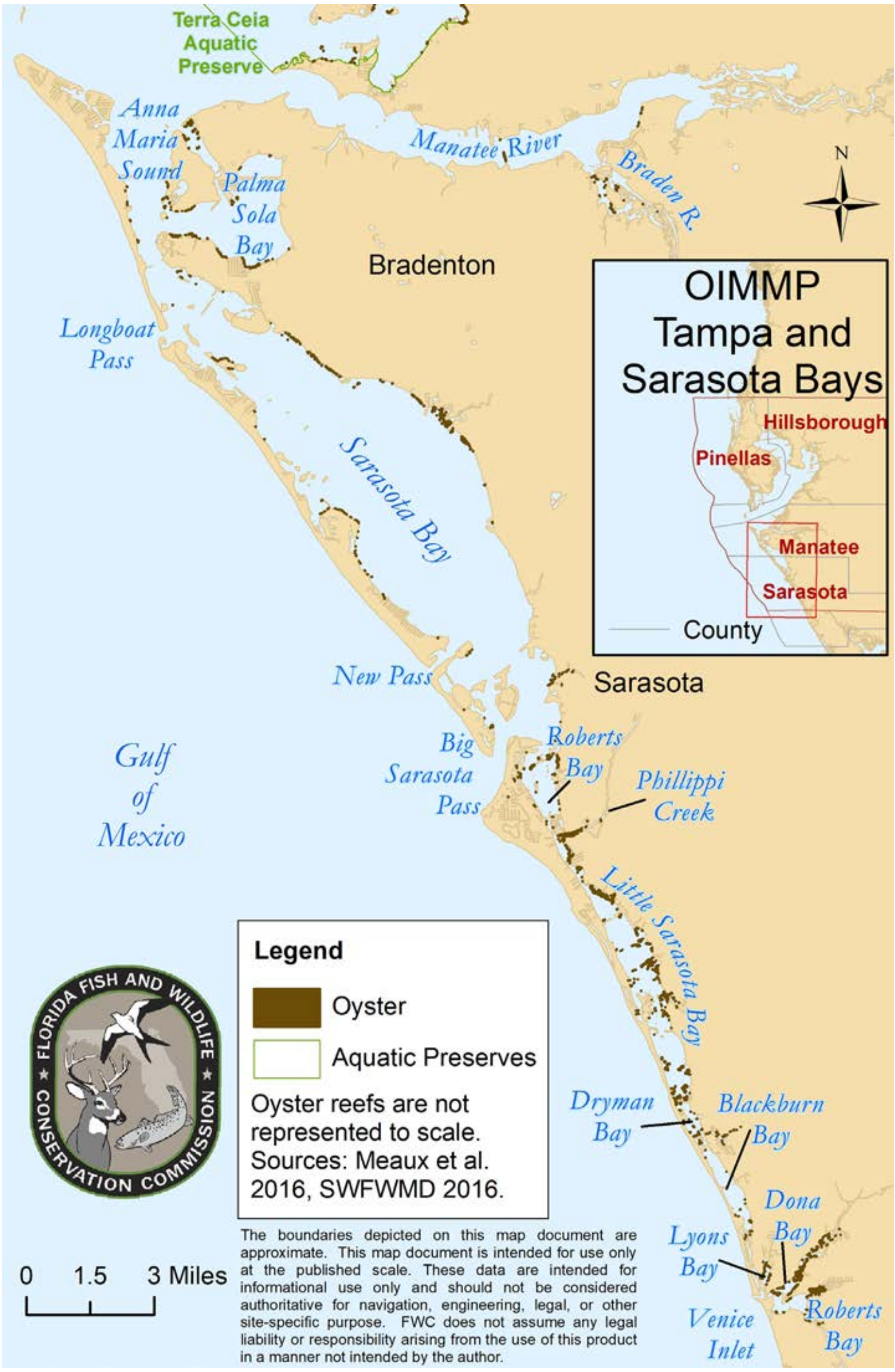

Figure 5.4. Mapped oyster extent in Sarasota Bay. Oyster mapping sources: Meaux et al. 2016 (from 2008–2012 field surveys) and SWFWMD 2016 (from 2016 aerial photographs).

nitrogen pollution decreased 64% from 1988 to 2010 and nitrogen loading from wastewater decreased 95% (SBEP 2010).

Oysters are found along the fringes of greater Sarasota Bay, particularly near areas of freshwater input where salinity is more suitable for oyster survival. Salinity within greater Sarasota Bay is generally 30–35, although in the rainy season salinity in Little Sarasota Bay varies between 15 and 30 (Sarasota County 2017). As a result of its more favorable salinity, Little Sarasota Bay contains the largest portion of the area's oysters (Table 5.2). The majority of oyster extent in the greater Sarasota Bay area is primarily made up of natural reefs, with smaller contributions from oysters growing on seawalls, rip rap, mangrove roots, and pilings (Meaux et al. 2016). Sarasota Bay has lost much of its fringing mangroves to hardened shorelines through ongoing urban development, resulting in a loss of mangrove root habitat (SBEP 2006). Like Tampa Bay, oysters in Sarasota are also substrate-limited (SBEP 2006, SBEP 2010, SBEP 2014). To provide additional substrate, restoration efforts include the addition of fossilized shells in mesh bags and prefabricated reef ball modules (SBEP 2006).

Mounds of oyster shells at Historic Spanish Point and elsewhere provide evidence that Sarasota Bay once hosted an active oyster fishery for Native Americans (SBEP 2006). While Sarasota Bay does include a conditionally approved shellfish harvesting area (Fig. 5.3), it is opened infrequently, and commercial oyster harvest was only recorded four times between 1951 and 2017 (Fig. 5.2).

Threats to oysters in Tampa and Sarasota bays

- **Habitat loss:** Large areas of oyster habitat in Tampa and Sarasota bays have been lost to dredge and fill construction, shell mining, and poorly-regulated commercial harvesting prior to the 1970s. Dredging efforts

Table 5.2. Oyster extent in regions of the greater Sarasota Bay area, as gauged by two different mapping efforts. Differences in area are due to different mapping methods and target areas (see mapping section below for details). Data sources: Meaux et al. 2016 and SWFWMD 2016.

Bay segment	Meaux et al. (2016)		SWFWMD (2016)	
	Oyster reef (ha)	Oyster reef (ac)	Oyster reef (ha)	Oyster reef (ac)
Palma Sola Bay			2.80	6.91
Sarasota Bay	2.95	7.29	9.64	23.83
Roberts Bay, Sarasota	3.74	9.23	8.63	21.33
Little Sarasota Bay	7.03	17.38	9.41	23.26
Dryman Bay	1.03	2.55		
Blackburn Bay	0.85	2.11	0.57	1.41
Lyons Bay	1.15	2.85		
Dona Bay	0.55	1.35		
Roberts Bay, Venice	0.60	1.49		
Lemon Bay	3.22	7.95		
Total	21.13	52.21	31.05	76.74

to maintain shipping channels move and suspend sediment, which can smother neighboring reefs. Hard bottom habitats and subtidal oyster reefs have also been removed for the construction of underwater pipelines and communications cables. Although mitigation regulations require the creation of new habitats, the resulting communities on the mitigated surfaces may be different than the natural habitats (TBEP 2017).

- **Altered hydrology:** Both natural and restored oyster reefs are indirectly impacted by proximity to urban development through nutrient and pollutant runoff, but water quality has improved substantially since the 1970s–1980s (Greening and Janicki 2006, SBEP 2010). In addition to water quality, changes to natural hydrology and salinity regimes by water control structures and consumptive use have also caused adverse impacts to oyster populations (Boswell 2012, CHNEP 2013). The construction of several causeways (Sunshine Skyway, Howard Franklin, Courtney Campbell, and McKay Bay) has certainly reduced tidal flushing within Tampa Bay but the net result for oysters is poorly understood.
- **Boating impacts:** Recreational boaters harm oyster reefs through erosion from boat wakes, boat groundings, collective damage from anchors (TBEP 2017).
- **Invasive species:** The Asian green mussel (*Perna viridis*) was first documented in Tampa Bay in 1999 and is presumed to have arrived as larvae in ballast water (Baker et al. 2007, Spinuzzi et al. 2013). The mussel does not have native predators and can outcompete native bivalves for space and food (Yuan et al. 2016). Asian green mussels have been observed outcompeting eastern oysters for space in at least one location in the intertidal zone in Tampa Bay (Baker et al. 2007).
- **Climate change and sea-level rise:** Changes in hydrology from sea-level rise or climate change may impact suitable areas for oyster reefs by altering the salinity regime. Additionally, most oyster reefs in Tampa Bay are intertidal. Sea-level rise may force vertical accretion on these existing reefs, result in the loss of this habitat type, or cause upslope migration of oyster reefs in areas where their movement is not inhibited by steep slopes, seawalls, or other factors. Changes in the frequency and severity of storms (both tropical and frontal systems) and weather patterns (El Niño Southern Oscillation) affect rainfall and subsequently the location and size of optimal oyster habitat. Decreases in pH levels worldwide (ocean acidification) can be detrimental to oysters and other calcifying marine and estuarine species (Hofmann et al. 2010). However, there are some indications that increased seagrass extent (as seen in Tampa Bay over the past three decades) in areas with carbonate sediment can locally combat pH trends toward acidification (Yates et al. 2016).

Oyster reef mapping and monitoring efforts

The compilation of oyster maps used in figures in this report are available for download at http://geodata.myfwc.com/datasets/oyster-beds-in-florida.

Southwest Florida Water Management District mapping

The SWFWMD has conducted seagrass mapping every two years since 1988 using a modified version of the Florida Land Use and Cover Classification System (FLUCCS; FDOT 1999) for coastal areas in the district. Subtidal habitats are mapped using natural-color 0.3-m (1-ft) resolution aerial imagery that is collected in winter. Mapped habitats include tidal flats, beaches, patchy seagrass, and continuous seagrass. The identification of monospecific oyster reefs was added in 2014 to form the oyster bar (FLUCCS 6540) classification. The most recent mapping effort was completed in 2016 (SWFWMD 2016), when SWFWMD mapped 57 ha (166 ac) of oysters in Tampa Bay (TBEP 2017) and 31.05 ha (76.74 ac) of oysters in Sarasota Bay (Table 5.2). While maps do not provide information on oyster condition (e.g., shell size, density, disease prevalence), the mapping data are important baseline information for habitat extent in the region. Oyster mapping is expected to continue at biennial intervals as a component of seagrass mapping surveys (TBEP 2017).

Tampa Bay oyster monitoring

Oysters are monitored biannually in south Florida for the Comprehensive Everglades Restoration Plan (CERP) by the Florida Fish and Wildlife Conservation Commission (FWC). Tampa Bay, Mosquito Lagoon, Sebastian River and Biscayne Bay were monitored from 2005–2007 to provide a comparison to oyster populations outside of CERP efforts (Arnold et al. 2008, Parker et al. 2013). Monitoring parameters include spatial and size distribution of adult oysters, recruitment, and growth and survival of juvenile oysters. Monitoring data also includes water quality parameters and identification of distribution and frequency of the diseases dermo and MSX (Arnold et al. 2008, Parker et al. 2013).

Tampa Bay Watch recently initiated a pilot project to monitor the outcomes of oyster restoration projects it has created over the past 20 years. Building on this work and that of other occasional projects (e.g., Drexler et al. 2014 and others), Tampa Bay Watch, in collaboration with FWC and TBEP, will create a consistent monitoring plan for natural and restored oyster reefs throughout Tampa Bay.

Investigation of automated oyster mapping

In 2004, FWC completed a TBEP-contracted effort to map oysters across Tampa Bay and develop and assess the utility of automated classification techniques for interpreting remote imagery (O'Keife et al. 2006). Hyperspectral imagery from Galileo Group flights and 2004 digital orthophoto quadrangles were used and interpreted using two automated approaches as well as traditional human interpretation. The accuracy of these three mapping efforts was assessed with ground truthing. Traditional photointerpretation was the most accurate, with 85% accuracy on free-standing reefs and 78% accuracy overall. Automated interpretation of hyperspectral imagery was not a useful tool at the time of the study but may prove more suitable with future advances in technology. Historical data from USGS 1927 topographic maps (T-sheets) and nautical charts from 1928–1988 were also geo-referenced and merged to create mosaics to facilitate tracking habitat changes over time (O'Keife et al. 2006).

Hard-bottom mapping in Tampa Bay

Kaufman (2017) created a comprehensive benthic map and report that characterized hard bottom, oyster, and tidal flat habitats for a portion of Tampa Bay. The primary objectives of the project were: 1) to create a benthic habitat map of hard and live bottom for portions of the Middle and Lower Tampa Bay and, 2) to provide data support for habitat restoration target setting of these three submerged habitat types. Approximately 105.6 ha (261.0 ac) of the assessed 8,950 ha (22,100 ac) in Lower Tampa Bay were determined to contain natural hard bottom habitat, with another 10.0 ha (24.8 ac) of artificial reef habitat (Kaufman 2017). The TBEP has an ongoing project to map hard bottom in portions of Pinellas County waters (project completion anticipated late 2019). It is recommended that this type of mapping be replicated for the entire bay.

Oyster mapping for SWFWMD minimum flows and levels

SWFWMD contracted Mote Marine Lab in 2001 to conduct field and aerial surveys of McKay Bay and the Tampa Bypass Canal to determine abundance of oysters (SWFWMD 2005). Oysters were present along the entire length of the canal and in northern McKay Bay. SWFWMD also contracted Florida Gulf Coast University in 2004 to evaluate flow levels needed to maintain appropriate salinity for oyster survival in the area. It was determined that the Tampa Bypass Canal does not need to sustain a minimum flow in order to maintain a salinity range appropriate for oysters within McKay Bay or the canal itself; however, there were times of high freshwater flow that decreased salinity beyond optimal levels for oysters within the canal (SWFWMD 2005).

NOAA Mussel Watch

The National Oceanic and Atmospheric Administration (NOAA) National Status and Trends Program has monitored pollutants in bivalves through the Mussel Watch program across the coastal United States from 1986 to present. Monitoring locations in Tampa Bay include Cockroach Bay, Hillsborough Bay, the Peter O. Knight airport, Old Tampa Bay, Papys Bayou, Mullet Key Bayou, and Navarez Park (Kimbrough et al. 2008). There are no Mussel Watch monitoring locations in Sarasota

Bay. Oysters were monitored for concentrations of heavy metals and organics in each location. Oysters contained high levels of mercury and lead as well as moderate to high levels of arsenic, copper, tin, and zinc (Kimbrough et al. 2008).

Oyster mapping in Sarasota County

Sarasota County developed methods for mapping oyster habitats with a significant focus on mapping oysters along seawalls and mangrove roots. The county used a rapid assessment technique which enabled rapid classification and large spatial coverage. The methods were published as an instructional manual (Meaux 2011) and include photographs demonstrating how to categorize types of oyster aggregations on seawalls and mangrove roots. Seventeen coastal creeks along Sarasota Bay, Venice Inlet, and Lemon Bay were mapped (example in Fig. 5.5). Results are summarized in Meaux et al. (2016) and mapping data are available at http://maps.wateratlas.usf.edu/oysters/.

Oyster monitoring in Sarasota County

The Sarasota County Oyster Monitoring Program monitors eastern oysters in greater Sarasota Bay to gauge the effect of freshwater flow on oyster condition. Monitoring locations and methods can be found in Jones (2006). Metrics include density of live and dead oysters as well as environmental parameters including rainfall, salinity, and discharge. A summary of monitoring results from 2003 to present is available at http://www.sarasota.wateratlas.usf.edu/oysters/?section=Oyster%20Monitoring%20Program.

Molluscan bioindicators of the tidal Myakka River and inshore waters of Venice

Mote Marine Laboratory conducted a survey of major mollusk species in the lower Myakka River and Dona and Roberts bays and their tributaries (Estevez 2005). Data were collected on density, shell size, and weather index values for live and dead eastern oysters. Oysters were noted

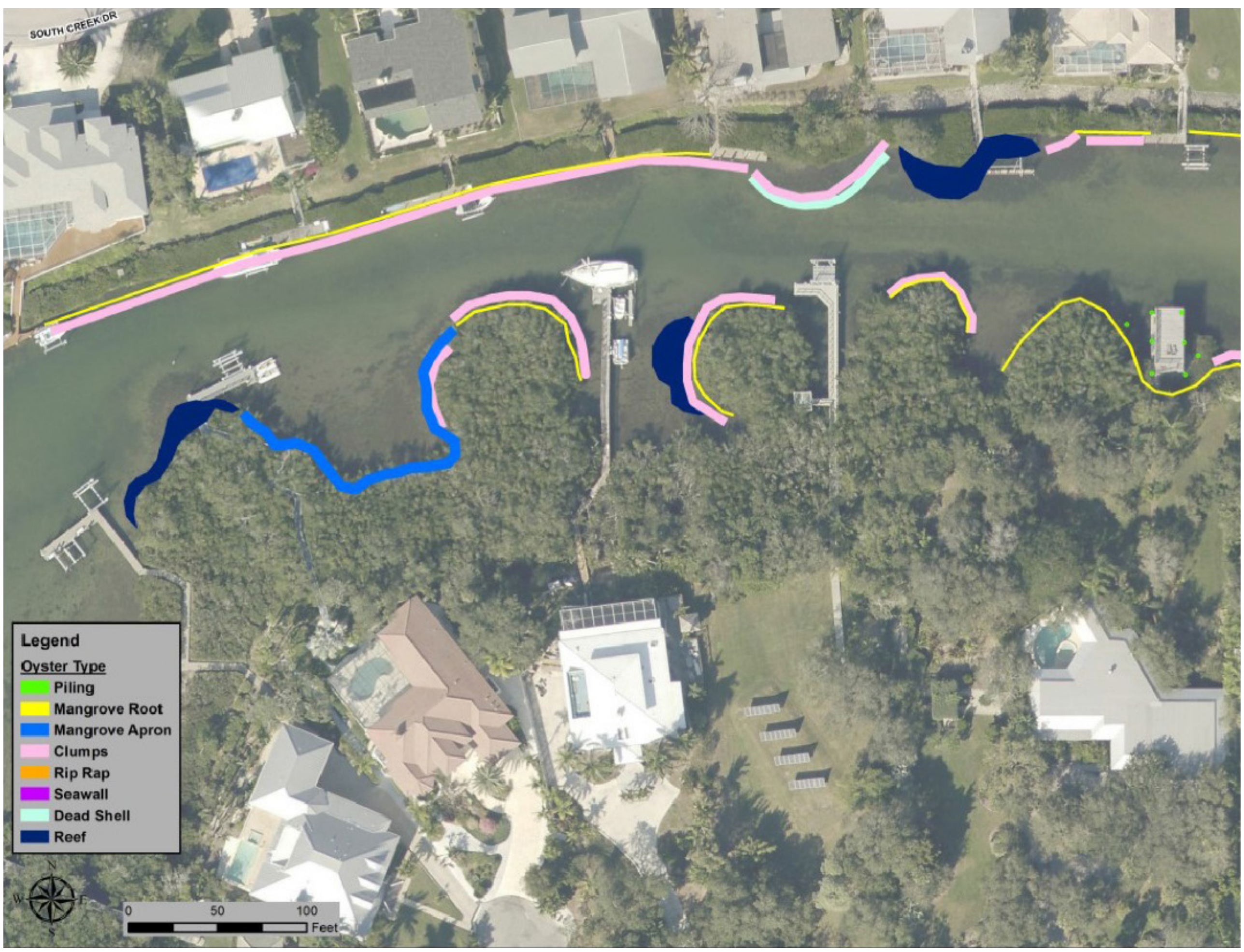

Figure 5.5. Example of the detail of oyster mapping completed in Sarasota Bay. Image credit: Meaux et al. 2016.

to be in much greater abundance in Dona and Roberts bays compared to the Myakka River (Estevez 2005).

Identification of suitable oyster habitat in Dona and Roberts bays

The CHNEP oyster habitat restoration plan was produced in 2012 in partnership with The Nature Conservancy (TNC). This plan provides an outline for identifying oyster habitat restoration goals, methods, and partnerships for the estuaries within the CHNEP study area. As part of this plan, a Restoration Suitability Model (RSM) was developed to guide future restoration decisions. The RSM uses GIS data to map the locations of suitable restoration areas on a scale of 0–100% suitability. The data layers include seagrass persistence, aquaculture lease areas, boat channels, bathymetry, and tidal river isohalines. The output for the RSM indicates that there are over 16,200 ha (40,000 ac) of highly suitable areas for oyster restoration within the CHNEP study area, including 60 ha (148 ac) within Dona and Roberts Bays (Fig. 5.6). Due to the limits of the locally-explicit data used to create the RSM model, the oyster habitat restoration plan recommends that prior to any oyster restoration, site-specific field evaluations should be conducted to further evaluate if a site is suitable for oyster restoration, and what type of methods are the most promising (Boswell 2012).

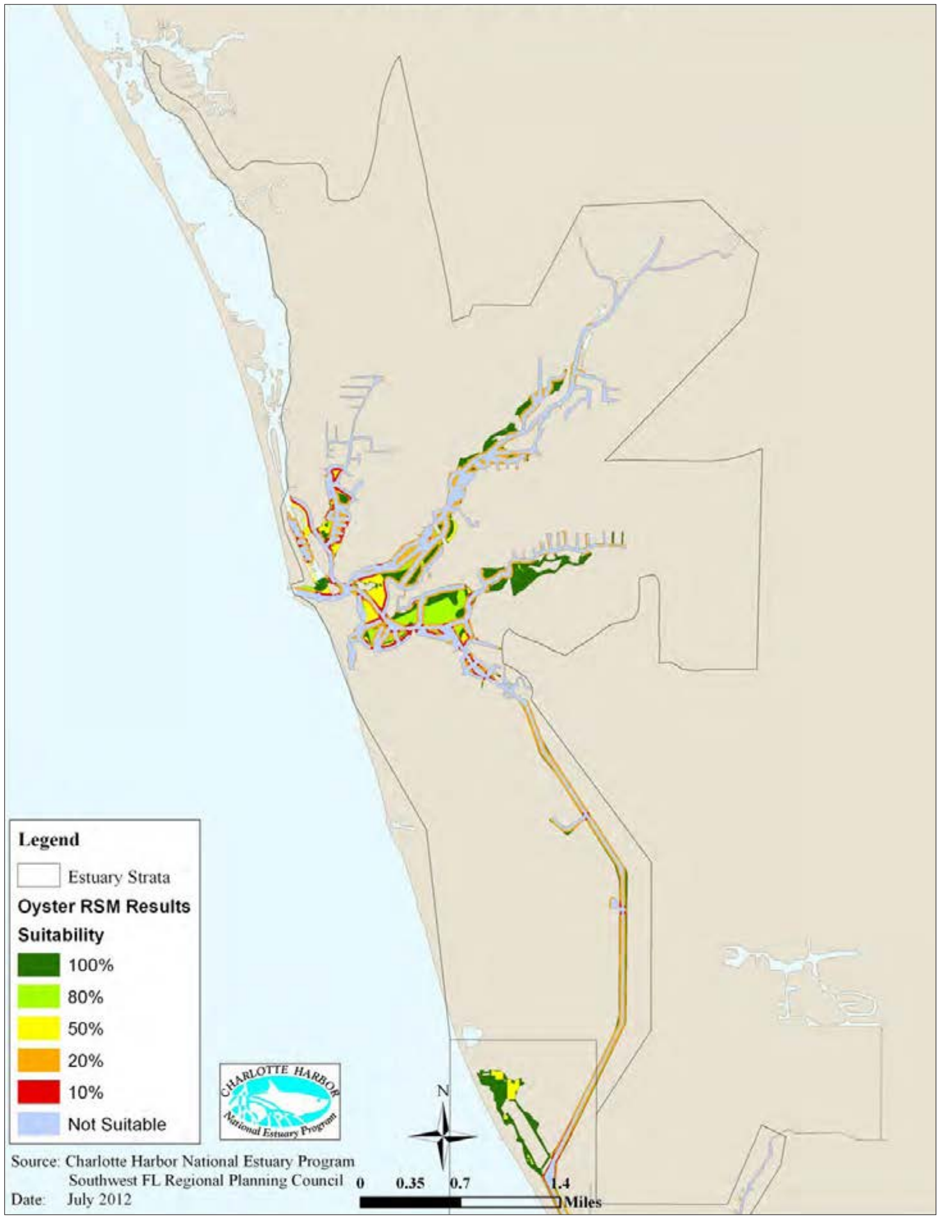

Figure 5.6. CHNEP oyster restoration suitability model results for Dona and Roberts bays. Image credit: Boswell 2012.

Recommendations for management, mapping, and monitoring

The 2017 revision of the Tampa Bay Comprehensive Conservation and Management Plan ("Management Plan"; TBEP 2017) includes 39 Actions within several different goals, such as improving water and sediment quality and improving bay habitats. Several Bay Habitat actions (BH-1, BH-2, BH-4, BH-6, and BH-8) directly address oyster and hard bottom habitat management, restoration, and monitoring. The SBEP Management Plan similarly has several actions specifically targeted at improving oyster resources (SBEP 2014). Additionally, the CHNEP Management Plan (CHNEP 2013) has been revised to include a Habitat Restoration Action Plan to address oyster habitat restoration, mapping, and monitoring in Dona and Roberts Bays Basin (CHNEP 2019). Relevant recommendations within the TBEP and SBEP

Management Plans and CHNEP oyster habitat restoration plan (Boswell 2012) include:

- Restore, mitigate, and protect priority habitats including oysters and hard bottom. Maintain proper freshwater inflow to maintain healthy oyster populations within the mouths of tidal tributaries (SBEP 2014, TBEP 2017). Continue to build partnerships to restore local oyster populations, including commercial and recreational fishing communities, with consideration for aquaculture needs (Boswell 2012).
- Continue to create oyster restoration projects in areas of the bays with suitable water quality that are substrate-limited (SBEP 2006, SBEP 2010). Increase the amount of living shorelines instead of seawalls along waterfront property (SBEP 2014, TBEP 2017).
- Create a complete rapid-assessment evaluation of the Tampa Bay shoreline for the presence of oysters on mangrove roots and hardened shorelines.
- Create and maintain a database of mitigation projects and monitoring reports of critical coastal habitats, including oyster reefs (TBEP 2017). Complete long-term monitoring on created oyster reefs to determine success of restoration efforts (Boswell 2012).
- Quantify the abundance of non-reef oysters (e.g., those growing on mangroves and seawalls). Quantify ecosystem services provided by oyster habitat in southwest Florida (Boswell 2012).
- Identify methods to improve contour plots of water quality parameters in local estuaries (Boswell 2012).
- Monitor distribution and abundance of oyster larvae in southwest Florida. Monitor biodiversity of resident and transient species associated with oyster reef communities (Boswell 2012).
- Increase targeted outreach to raise awareness regarding the ecosystem and economic value of oyster reefs in southwest Florida (e.g., press releases highlighting the benefits of oyster populations in relation to large-scale issues such as water quality, habitat conservation, water quality and water management) (Boswell 2012).

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