2013 Volunteer Tidal Shoreline Survey

Al Yeno with the U.S. Coast Guard Auxiliary shows FDEP Florida Coastal Management Program Grant Coordinator Dornecia Allen how volunteers completed the shoreline survey.

Charlotte Harbor National Estuary Program
Technical Report 13-2
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The Charlotte Harbor National Estuary Program is a partnership of citizens, elected officials, resource managers and commercial and recreational resource users working to improve the water quality and ecological integrity of the greater Charlotte Harbor watershed. A cooperative decision-making process is used within the program to address diverse resource management concerns in the 4,700-square-mile study area. Many of these partners also financially support the Program, which, in turn, affords the Program opportunities to fund projects. The entities that have financially supported the program include the following:

U.S. Environmental Protection Agency
Southwest Florida Water Management District
South Florida Water Management District
Florida Department of Environmental Protection
Florida Coastal Zone Management Program
Peace River/Manasota Regional Water Supply Authority
Polk, Sarasota, Manatee, Lee, Charlotte, DeSoto, and Hardee Counties
Cities and Towns of Sanibel, Cape Coral, Fort Myers, Punta Gorda, North Port, Venice,
Fort Myers Beach, Winter Haven, and Bonita Springs
and the Southwest Florida Regional Planning Council.

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Executive Summary

The Charlotte Harbor National Estuary Program (CHNEP) conducted volunteer tidal shoreline surveys in 2007, 2010 and 2013, for more than 4,000 urban parcels in each survey year. The surveys augmented 2007 aerial photograph interpretation and provided condition trends information on the tidal shorelines most subject to human management. Though none of the three surveys were 100% complete, there was nearly 100% coverage between the last two surveys of 2010 and 2013.

Reviewing groups of parcels that were surveyed in both 2007 and 2013 demonstrates an increase in mangrove presence. Mangrove gains have been documented for 36 miles compared to mangrove losses for 22 miles between 2007 and 2013. A different set of parcels were surveyed in both 2010 and 2013. During this period an increase in mangrove presence was also documented. Mangrove gains have been documented for 33 miles compared to mangrove losses for 28 miles between 2000 and 2013.

The extent of invasive exotic vegetation has increased between 2010 and 2013. The increases are most notable on the shorelines of Lemon Bay and Alligator Creek, associated with the presence of Brazilian pepper.

In 2004, Hurricane Charley damaged mangrove forests and shorelines along its path. In 2007, damage associated with Hurricane Charley was evident. Approximately 4 miles (2%) of shorelines surveyed had severe damage. By 2010, severe damage was documented on 3 parcels representing less than a mile of shoreline. By 2013, no severe damage could be found. Moderate damage could still be found near Bokeelia, at the north end of Pine Island.

In 2013, oysters were surveyed along 72 miles of urban shoreline, where volunteers' vessels could approach the shoreline closely enough to conduct the survey. Half of the documented shoreline had oysters and the other half had no oysters. Oysters tended to be located on the shorelines of highest estuarine salinity and not located along the banks of the Caloosahatchee, Myakka River and Alligator Creek.

The information from the three surveys provides status and trends information and can introduce property owners to better ways to manage their shorelines. During the 2013 survey, NOAA contacted CHNEP for the data to "assist with their efforts to protect smalltooth sawfish habitat, and for getting a better idea where the primary constituent elements exist for their recovery and conservation."

Lessons have been documented for improvements to future volunteer tidal shoreline surveys. CHNEP will be seeking funding opportunities to support a 2016 volunteer tidal shoreline survey.

Purpose

In 2005, the Charlotte Harbor National Estuary Program (CHNEP) adopted a list of environmental indicators to aid in assessing the relative condition of the estuaries and associated watersheds. During 2006 and 2007, the CHNEP was updating its *Comprehensive Conservation and Management Plan* (CCMP). A gap of knowledge was identified regarding priority action 'FW-D: Enhance fish and wildlife habitat along shorelines…,' with special reference to quantifiable objective 'FW-1: … Manage natural mangrove habitats to their historic extent (1980) to enhance and improve their ecological functions and, where feasible, restore mangrove habitats in urban areas."

The associated environmental indicator was "FW-i: Condition of mangrove shoreline (i.e. percent hedged mangroves, hardened shoreline, and damaged mangroves) by basin." The information gap was stated as: "Map shoreline treatments including hedged mangrove, windowed mangrove, uplifted mangrove, vertical seawall, riprap revetment, lawn, herbaceous wetlands, etc." The type of shoreline can indicate the level of storm and pollution protection, and the amount and quality of habitat available for fish, other aquatic organisms and birds. Such information can be used in multiple capacities including; coastal planning, environmental management, and recreational interests. Involvement of the extensive local boating community in data collection was identified as an effective way to obtain detailed information that cannot be obtained using other techniques such as aerial photograph interpretation.

In 2007, CHNEP contracted with a contractor to interpret aerial photographs of tidal shoreline attributes to begin addressing the gap of knowledge. However, shoreline condition such as the mangrove height, mangrove trimming, presence of exotic vegetation and hurricane damage could not be derived from aerial photograph interpretation, particularly on urban lots. The first CHNEP volunteer tidal shoreline survey was initiated in 2007 to augment the contractors work and collect information on shoreline condition.

Three years later, in 2010, CHNEP was developing its first *Seven-County Watershed Report.* The 2010 update of the volunteer tidal shoreline survey was used to begin addressing trends in shoreline condition changes. Furthermore the volunteer time served as in-kind match for a funded grant to review permitting practices in CHNEP's coastal environment.

For 2013, CHNEP pursued a Coastal Partnership Initiative grant, offered by the Coastal Management Program of the Florida Department of Environmental Protection (FDEP) and funded by the National Oceanic and Atmospheric Administration (NOAA). The grant also allowed for a Geographic Information Systems (GIS) shape file to be developed tied to the volunteer surveys, so that data from all three triennial volunteer surveys could be viewed spatially, for the first time.

Methods

2007 Survey

In 2006, CHNEP Program Scientist Jaime Boswell designed CHNEP's first Volunteer Tidal Shoreline Survey, executed in 2007. The approach followed a similar survey conducted by Sarasota County. The 2007 survey was to expand the Sarasota approach to other tidal shorelines within the CHNEP, primarily within Charlotte County and Lee County. The survey was to also augment a project with a contractor to the CHNEP to conduct aerial photograph interpretation of the entire CHNEP tidal shoreline. Part of the contractor's project included input of the volunteer data into a database. The dual approach addressed both extent and quality of shorelines as directed in the CCMP and the adopted Environmental Indicators Report.

Several successful shoreline survey success were reviewed, many of which utilized the assistance of volunteers. Shoreline surveys are extremely time consuming and field intensive, but do not need to be technically intense. The Massachusetts Riverways program, for example, uses volunteers in an Adopt-a-Stream program. This program continues to enlist the help of volunteer stream-teams to monitor the streams throughout the entire state. Other riverwatch programs have modeled similar programs after the Riverways program. Another example was conducted by the Virginia Institute of Marine Science and resulted in Shoreline Situation Reports (SSR) for the entire state of Virginia. The development of this program is described in the 1999 report, *Development of Guidelines for Generating Shoreline Situation Reports Establishing Protocols for Data Collection and Dissemination*, by Marcia Berman and Carl Hershner.

Interested groups and individuals were invited to participate in planning the CHNEP Volunteer Tidal Shoreline Survey project and provide input into the type of data collected. The vision of the project was to have interactive maps available on the internet depicting shoreline condition and shoreline features throughout the entire Charlotte Harbor area extending from coastal Venice to Estero Bay, and including the tidal Peace, Myakka and Caloosahatchee rivers. This final vision was not implemented until the 2013 survey.

The following outline directed the development of the methodology for the 2007 survey:

1. Why?
    - Collect baseline data to promote better planning for estuary protection and restoration
    - Identify habitat
    - Identify lands suitable for protection
    - Determine the impact of new development
    - Promote understanding of watershed issues
    - Identify wetlands suitable for restoration
    - Determine the impact of point and non-point pollution

2. What do you plan to achieve?
    - Educate public officials and local residents
    - Restore the quality of the estuary for recreational and natural resource purposes

- Work with officials to ensure proper siting and buffering of new development
- Protect fish and wildlife
- Locate good fisheries habitat and stream restoration sites

3. What are you going to do with the data you collect?
    - Create a report on the state of the estuary shoreline to share with local residents, public officials, resource managers, and scientists.
    - Identify areas to protect and restore aquatic habitat
    - Share information with state and regional agencies to enhance their planning and protection strategies for the estuary.

Volunteer Structure and Duties

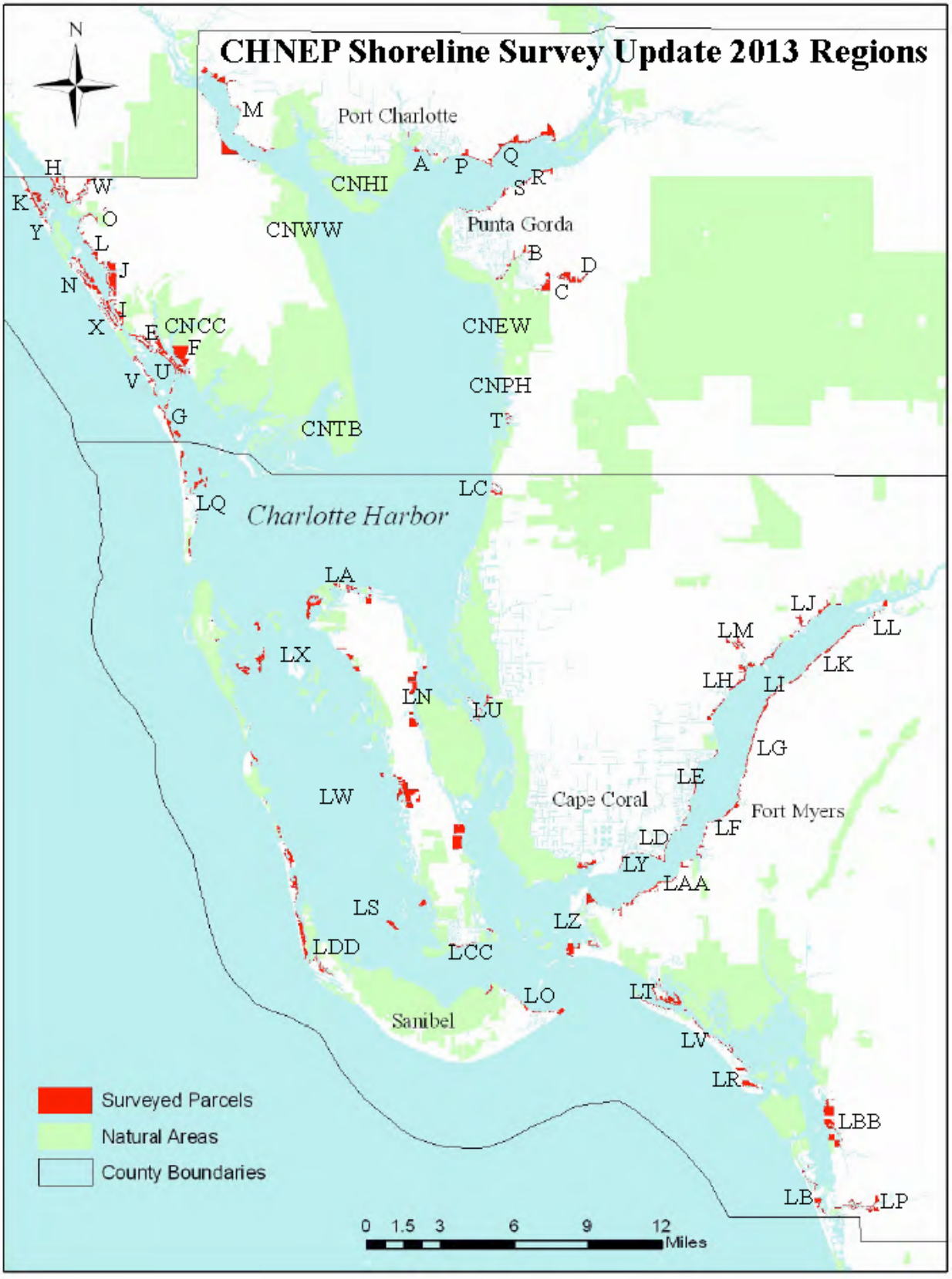
1. Steering Committee
    - Review and discuss methodology
    - Create list of organizations to help recruit volunteers
    - Assist in promoting the program
    - Create press release plan
    - Provide technical assistance
    - Review final products
2. Team Leaders (1-2 per club/organization)
    - Attend training session
    - Host training session for teams
    - Attend post survey meeting
3. Clubs/Organization members
    - Attend team training session
    - Conduct surveys
    - Deliver completed data forms

The project used the best existing data to create a base map for field verification. This base map included the 2003 FWRI shoreline condition line shapefile, the most recent available aerial photography from each county and other relevant shapefiles (e.g., marinas, boat ramps). Large areas consisting of hardened shorelines that can be verified from aerial photographs were not a high priority for groundtruthing (e.g., Port Charlotte and Cape Coral canal systems).

The CHNEP study area was broken down, using a grid system to allot portions of the study area to volunteer groups for groundtruthing. The size of each grid cell was based on an estimated time to survey a given area using either power boats or kayaks. Field testing of methodology resulted in estimates of 1 hour per mile of variable shoreline (e.g. canals/city shoreline), and 4-8 miles per hour of continuous shoreline (e.g. buffer preserve) using a power boat. Kayak times are estimated at 0.5 - 1 mile/hour.

The regions that were identified are shown on the map titled *CHNEP Shoreline Survey Update 2013 Survey Parcels*.

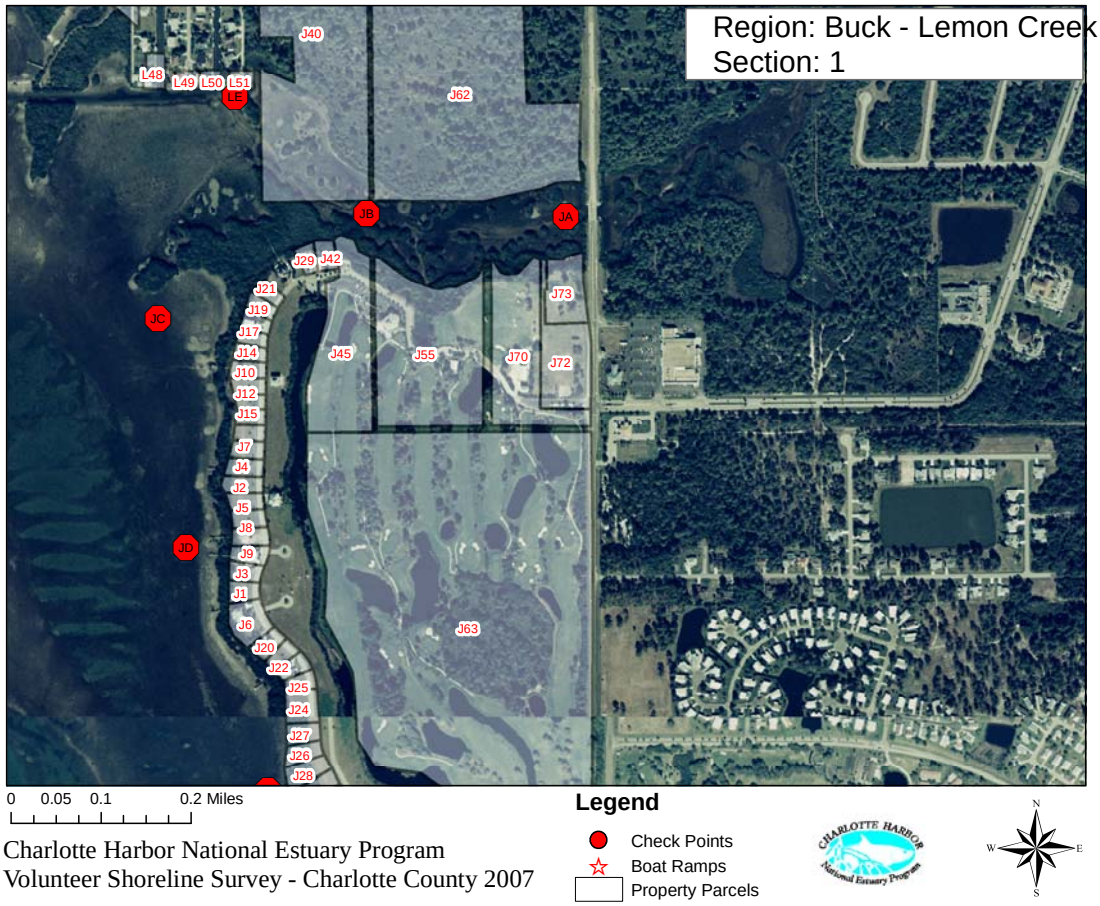
CHNEP Shoreline Survey Update 2013 Survey Parcels



Each team leader was informed of the estimated time to collect the required field data for certain segments; they then decided which area(s) their team would be responsible for. Each volunteer boat (2 or more participants) was provided survey packets to include: water proof maps and datasheets, pencils, detailed methodology (including pictures of shoreline conditions), a clipboard. Each survey boat was requested to have a GPS for collecting accurate locations of each shoreline condition start and end point, and a camera for recording photographs at locations of interest. Examples of the maps provided are shown below. The region and section are identified with parcels and associated Site ID codes.

Volunteers were given the following directions:

- Location data does not need to be taken at the shoreline.
- Data should be collected parallel to the shoreline, as close as logistically possible.
- Shallow waters will determine how close boats can get to the shoreline.
- It is recommended to allow for the best conditions that volunteers conduct surveys at high tide, when access to near shore areas will be easier, and there is less chance of damaging bottom habitat and/or boats.



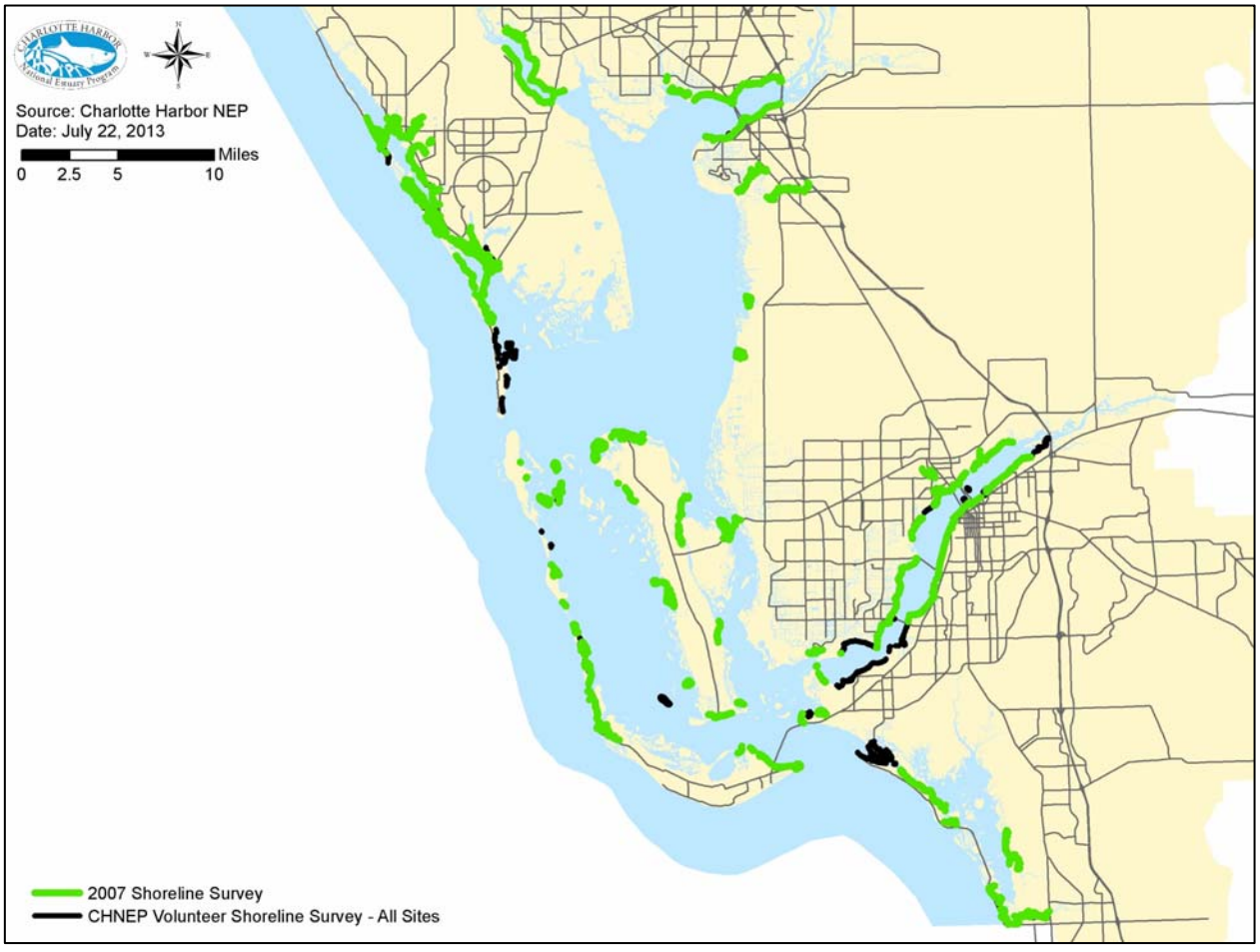
Team leaders attended a training session held in February 2007 at which teams signed-up for shoreline segments, and became familiarized with field methodology. Volunteer packets were distributed at the training session or delivered to team leaders shortly after.

Team leaders were responsible for training individual volunteers within their "teams," assigning segments and distributing packets. Technical assistance was provided by CHNEP staff and other technical steering committee members when needed.

Team leaders attended a meeting to discuss the success/challenges that their teams experienced, and to hand in their team's data sheets, photos and maps. This meeting was held in April 2007.

A total of 5,540 lots within 57 specified regions were extracted from the original Property Appraisers' files and coded with specific Site Identification (Site ID) codes.

Of the 5,540 parcels identified for the volunteer tidal shoreline survey in 2007, 4,379 parcels (79%) were surveyed in 2007. These parcels represented 201 miles or 82% of the shoreline length identified for the survey.



The resulting database for 2007 included the following fields:

2007 Field Names	Field Description
Site_Idcap	Site Identification Codes assigned as the tie between GIS and database files.
ID	Database autonumber
Boat_Name	Name given to the volunteer's vessel
Date	Date the field volunteer field investigation took place.
Region	Identification Code assign for one of 57 regions. Same letter as within SiteID.
Mangroves	Classification for Mangrove Presence (Greater than 30%, Less than 30%, None)
Site_ID	Original Site Identification Codes that included small and capitalized letters.
Hurricane Damage	Classification given for hurricane damage (Severe, Moderate, Light/None)
Mangrove_Height	Classification for Mangrove Height (>20 feet, 10-20 feet, 6-10 feet, <6 feet)
Mangrove_Trim	Classification for mangrove trimming (Yes, No)
Exotics	Classification for exotic vegetation presence (Yes, No)
Exotic Type	Some internal geodatabases use field to draw from the next three fields, unused
Exotic Type BP	Classification for Brazilian pepper presence (Yes, No)
Exotic Type AP	Classification for Australian pine presence (Yes, No)
Exotic Type SM	Classification seaside mahoe presence (Yes, No)
comment	Comment field for anything that is notable.
photo_id	Field for photo identification

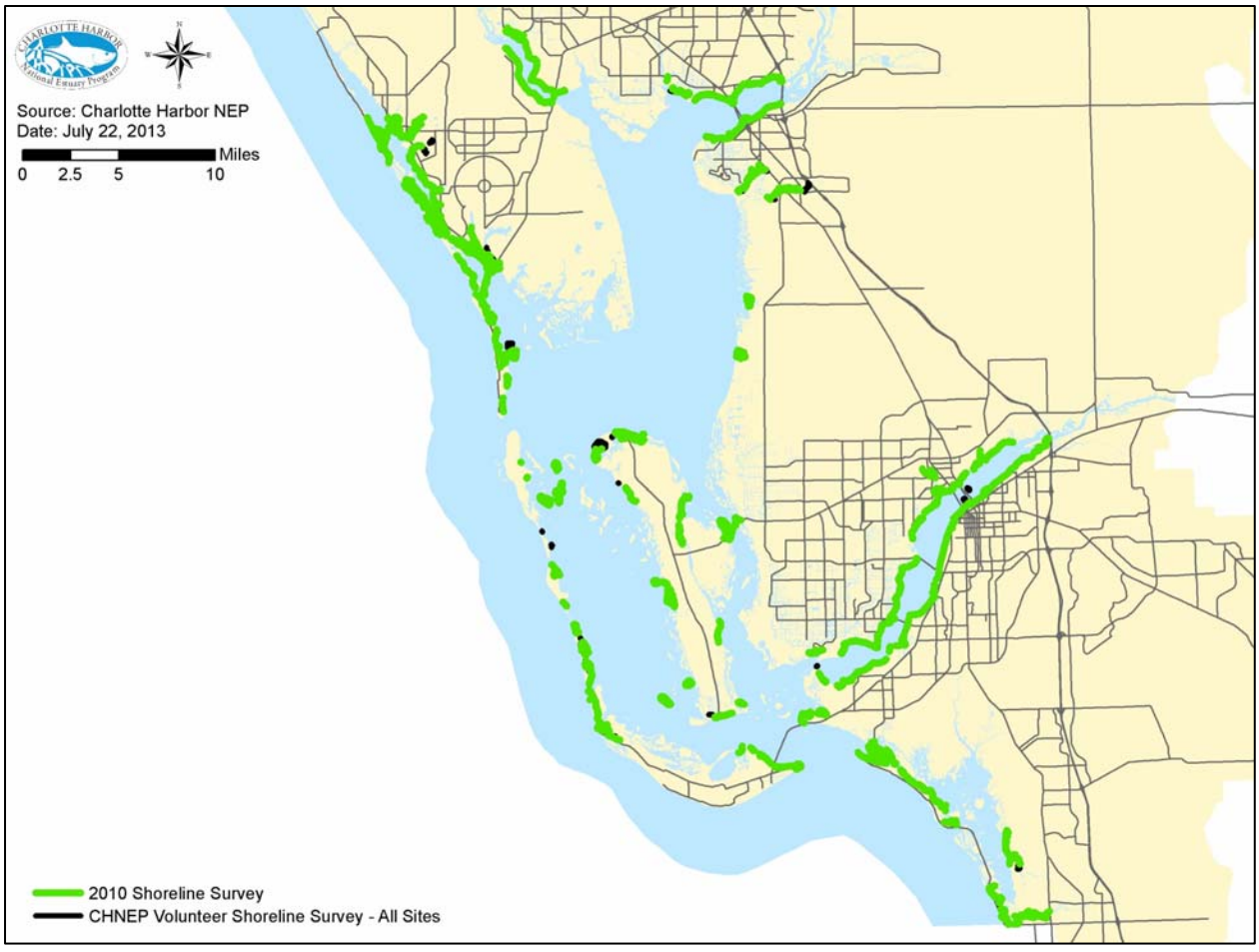
2010 Survey

In 2009, CHNEP drafted a Wetland Program Development Grant application to conduct *A Watershed Analysis of Permitted Coastal Wetland Impacts and Mitigation Methods within the Charlotte Harbor National Estuary Program Study Area.* The grant application included a replication of the 2007 Volunteer Tidal Shoreline Survey in order to help assess change on the shoreline. The grant was awarded and the survey was initiated. The information from the shoreline survey and the watershed analysis of permitted coastal wetland impacts complemented each other.

CHNEP Program Scientist Judy Ott coordinated the 2010 survey. Because the 2010 survey did not include the associated aerial photograph interpretation, Program Scientist Ott added presence and type of shoreline hardening (that was found in the aerial photograph portion of the 2007 work) and oysters (which were a new addition to the study approach).

A consultant was hired to input the volunteer data into a database.

Of the 5,540 parcels identified for the volunteer tidal shoreline survey in 2007, 4,952 parcels (89%) were surveyed in 2010. These parcels represented 221 miles or 90% of the shoreline length identified for the survey. Of the 5,540 parcels, 4,086 parcels (74%) were surveyed in both 2007 and 2013.



The resulting database for 2010 included the following fields:

2010 Field Names	Field Description
Site_ID	Site Identification Codes assigned as the tie between GIS and database files.
Boat_Name	Name given to the volunteer's vessel
ID1	Database autonumber
Date	Date the field volunteer field investigation took place.
Region	Identification Code assign for one of 57 regions. Same letter as within SiteID.
Mangroves	Classification for Mangrove Presence (Greater than 30%, Less than 30%, None)
Mangrove_Height	Classification for Mangrove Height (>20 feet, 10-20 feet, 6-10 feet, <6 feet)
Hurricane Damage	Classification given for hurricane damage (Severe, Moderate, Light/None)
Mangrove_Trim	Classification for mangrove trimming (Yes, No)
Exotic Type BP	Classification for Brazilian pepper presence (Yes, No)
Exotics	Classification for exotic vegetation presence (Greater than 30%, Less than 30%, None)
Exotic Type AP	Classification for Australian pine presence (Yes, No)
Exotic Type SM	Classification seaside mahoe presence (Yes, No)
Hardening	Classification for shoreline hardening (Greater than 30%, Less than 30%, None)
Hardening Type	Classification for shoreline hardening type (seawall, riprap, both, other)
comment	Comment field for anything that is notable.
Oysters	Classification for oyster presence (True, False)
ID	Database autonumber does not equal ID1
photo_id	Field for photo identification, unused.

2013 Survey

In 2012, the CHNEP submitted a Coastal Partnership Initiative (CPI) grant to continue the Volunteer Tidal Shoreline Survey as a triennial effort. Because the CPI grant focused on the volunteer and public outreach aspects of the survey, CHNEP Communications Manager Maran Brainard Hilgendorf coordinated the 2013 effort.

Lessons learned from the 2007 and 2010 effort were applied to the 2013 effort. A weakness of the 2007 and 2010 studies was the lack of a shoreline GIS file tied to the Site IDs. The information continued as parcel polygons, prohibiting meaningful shoreline distance analysis. Parcel-based analysis yielded useful social data but not overall shoreline condition data. Here "social data" is used in the sense of behavioral information regarding property owners. A single property owner with a very large relative shoreline has a bigger impact to total shoreline condition than a single property owner with a relatively small shoreline. Parcel-based polygons could not yield overall condition information. Therefore, development of a shoreline GIS file with the appropriate ties to Site IDs was included in the 2013 effort.

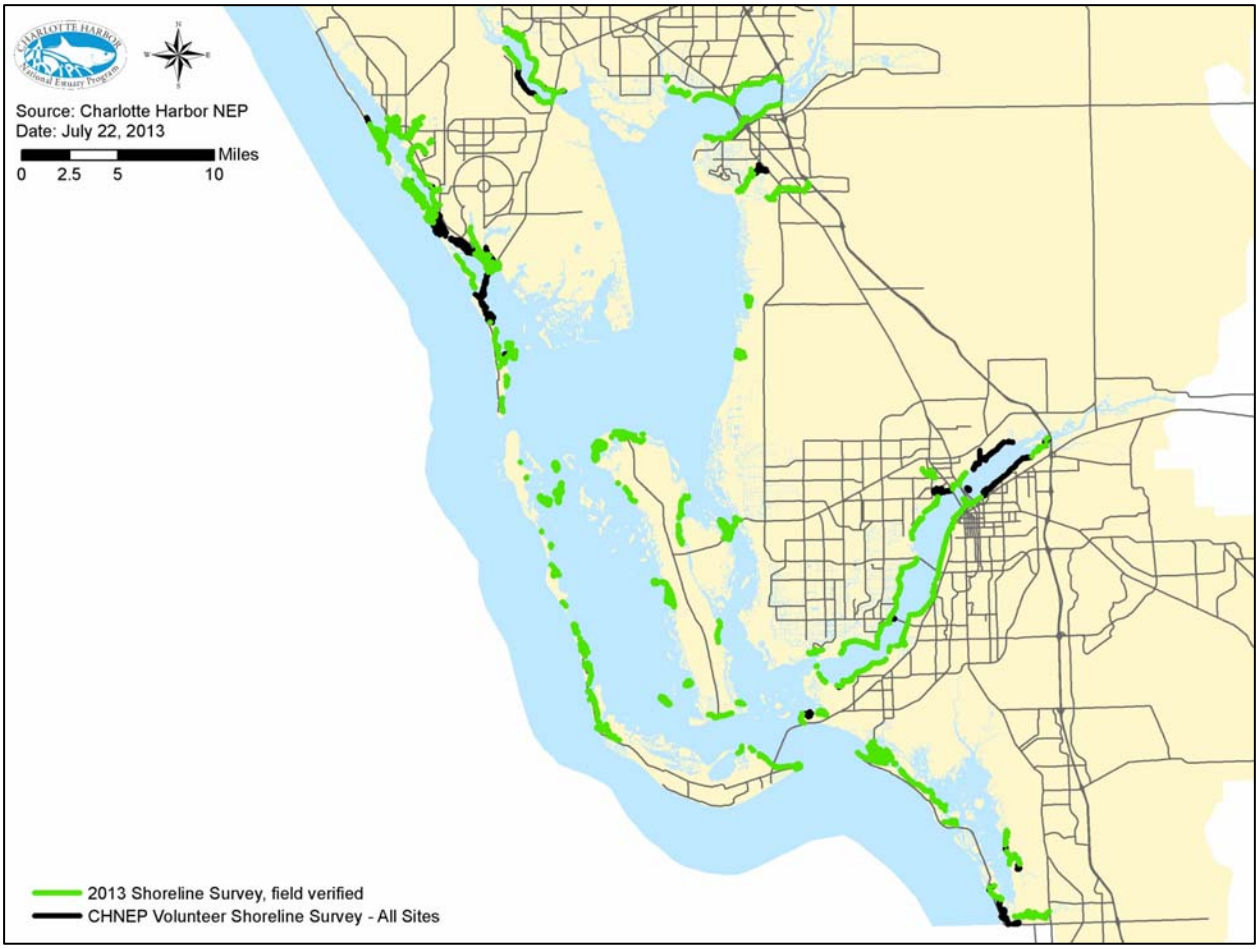
A second weakness was the inability of volunteers to enter their own data into the database. In 2011, the CHNEP launched its online Water Atlas through the University of South Florida, Florida Center for Community Design and Research. The 2013 enhancements contract with University of South Florida included the addition of a page where volunteers could input their own data. The database did not include default values and allowed for null values where no data existed. Default values proved to be a problem with the 2010 survey.

Just as new information (shoreline hardening and oysters) was added in 2010, mangrove trimming style (hedging, uplift, windows and mixed) was added in 2013.

In order to provide the most complete information possible, Communications Manager Hilgendorf and Jamie Boswell (on contract) completed parcel information for those that were not surveyed in the field, using Google Earth. This approach is consistent with the aerial photograph augmented with volunteer survey approach used in 2007. Where appropriate, the augmented set was utilized. For conditions which could only be viewed in the field such as mangrove trim height, the field verified data were used.

Of the 5,540 parcels identified for the volunteer tidal shoreline survey in 2007, 4,540 parcels (100%) were surveyed in 2010. These parcels represented 246 miles or 100% of the shoreline length identified for the survey. However, this aspect to the survey was augmented with Google Earth.

For the field verified component of the survey, 4,333 parcels (78%) were surveyed in 2013. It represented 198 miles or 80% of the shoreline length identified for the survey.

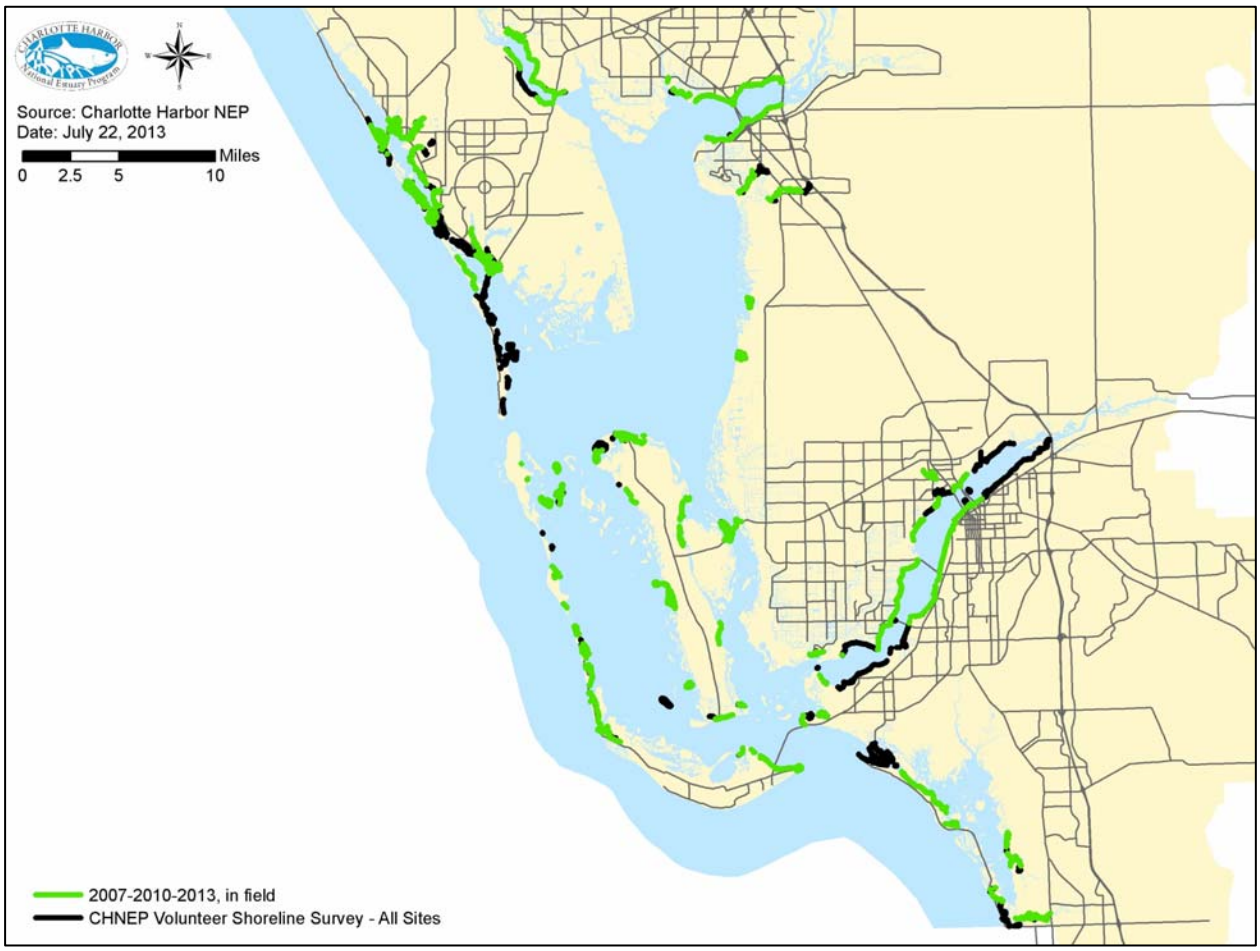


The resulting database for 2013 included the following fields:

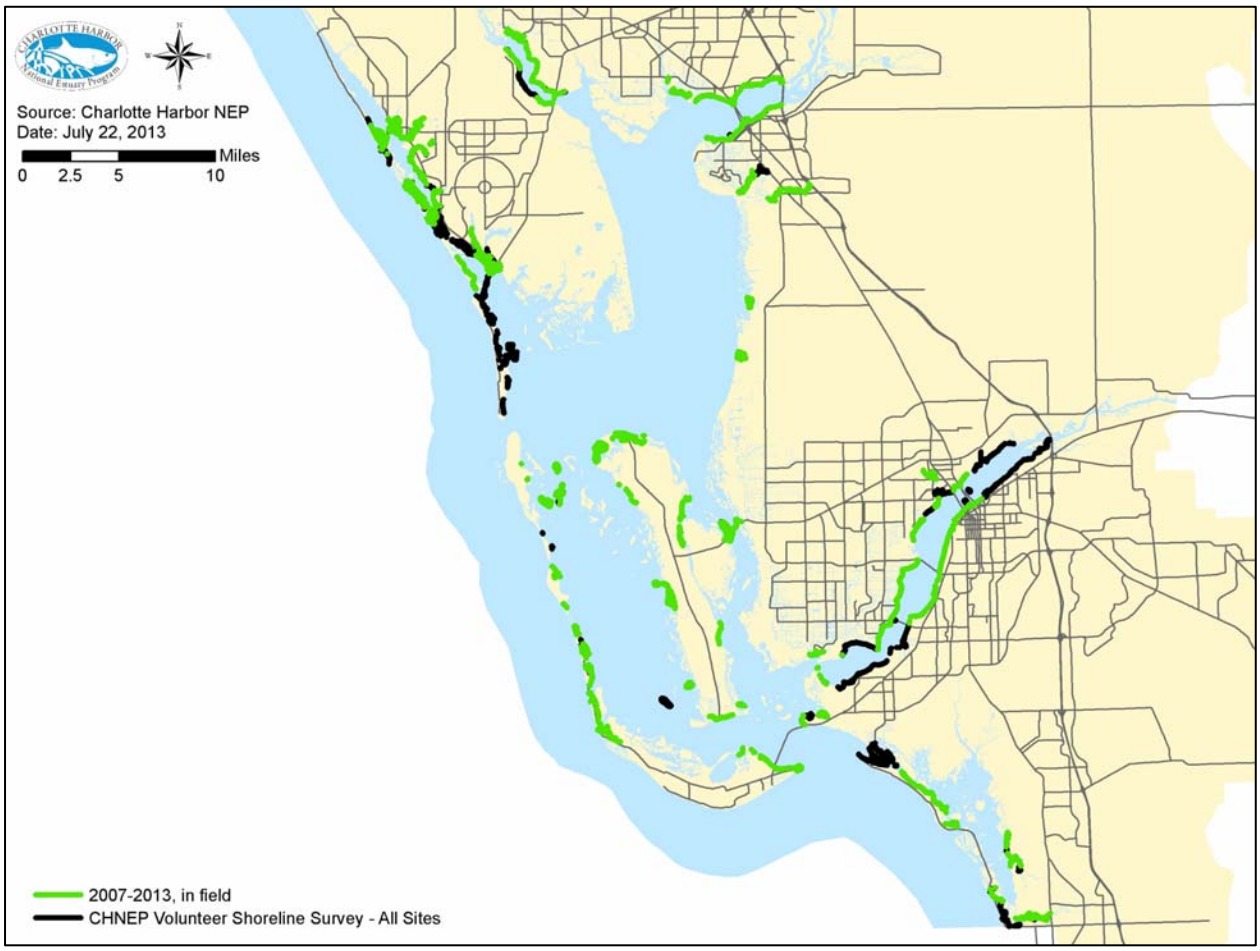
2013 Field Names	Field Description
SiteID	Site Identification Codes assigned as the tie between GIS and database files.
ParcelName	Same as SiteID
RegionCode	Identification Code assign for one of 57 regions. Same letter as within SiteID.
RegionName	Name of Region, e.g. RegionName Alligator Bay=RegionCode A.
TripDate	Date the field volunteer field investigation took place.
TripID	Trip Identification Code
BoatLength	Length of vessel.
GroupName	Name volunteer group gave to itself.
BoatDescription	Description of the vessel.
EngineType	Type of Engine on the vessel.
GPSMakeModel	Geo-positioning System make and model, e.g. Garmin GPSmap 498
MapDatum	Map Datum used on GPS. e.g. decimal degrees
PositionFormat	Position format used, e.g. DD MM SS
TideStation	Tide Station used, but null throughout database.
VolunteerHours	Volunteer Hours clocked by the volunteers, for use in in-kind match.
StartTide_ft	Tide at start of the trip.
StartTime	Time at the start of the trip.
EndTime	Time at the end of the trip.
StartTideLocation	Location at the start of the trip.
EndLocation	Location at the end of the trip.
EndTide_ft	Tide at end of the trip.
CreatedEmail	Email account of the person entering the data on the Water Atlas
CreatedName	Name of the person entering the data on the Water Atlas
ParcelID	Parcel Identification Code.
Region	Same as RegionCode
County	County, Lee or Charlotte
RegName	Same as RegionName
ResultID	Identification code given to each record entered into the database
SortOrder	Code given to return the order data to its original order.
TripID2	Same as TripID
ParcelID2	Same as ParcelID
MangrovesHeight	Classification for Mangrove Height (>20 feet, 10-20 feet, 6-10 feet, <6 feet)
MangrovesPresent	Classification for Mangrove Presence (Greater than 30%, Less than 30%, None)
HurricaneDamage	Classification given for hurricane damage (Severe, Moderate, Light, None)
MangrovesTrimmed	Classification for type of mangrove trimming (Hedged, Window, Uplift, None)
Exotics_BP	Classification for Brazilian pepper presence (Yes, No)
ExoticsPresent	Classification for exotic vegetation presence (Greater than 30%, Less than 30%, None)
Exotics_AP	Classification for Australian pine presence (Yes, No)
Exotics_EA	Classification for earleaf acacia presence (Yes, No)
Exotics_SM	Classification seaside mahoe presence (Yes, No)
ShorelineHardened	Classification for shoreline hardening (Greater than 30%, Less than 30%, None)
OystersPresent	Classification for oyster presence (Yes, No)
ShorelineHardenedType	Classification for shoreline hardening type (seawall, riprap, both, other)

Intersection of 2007, 2010 and 2013 Surveys

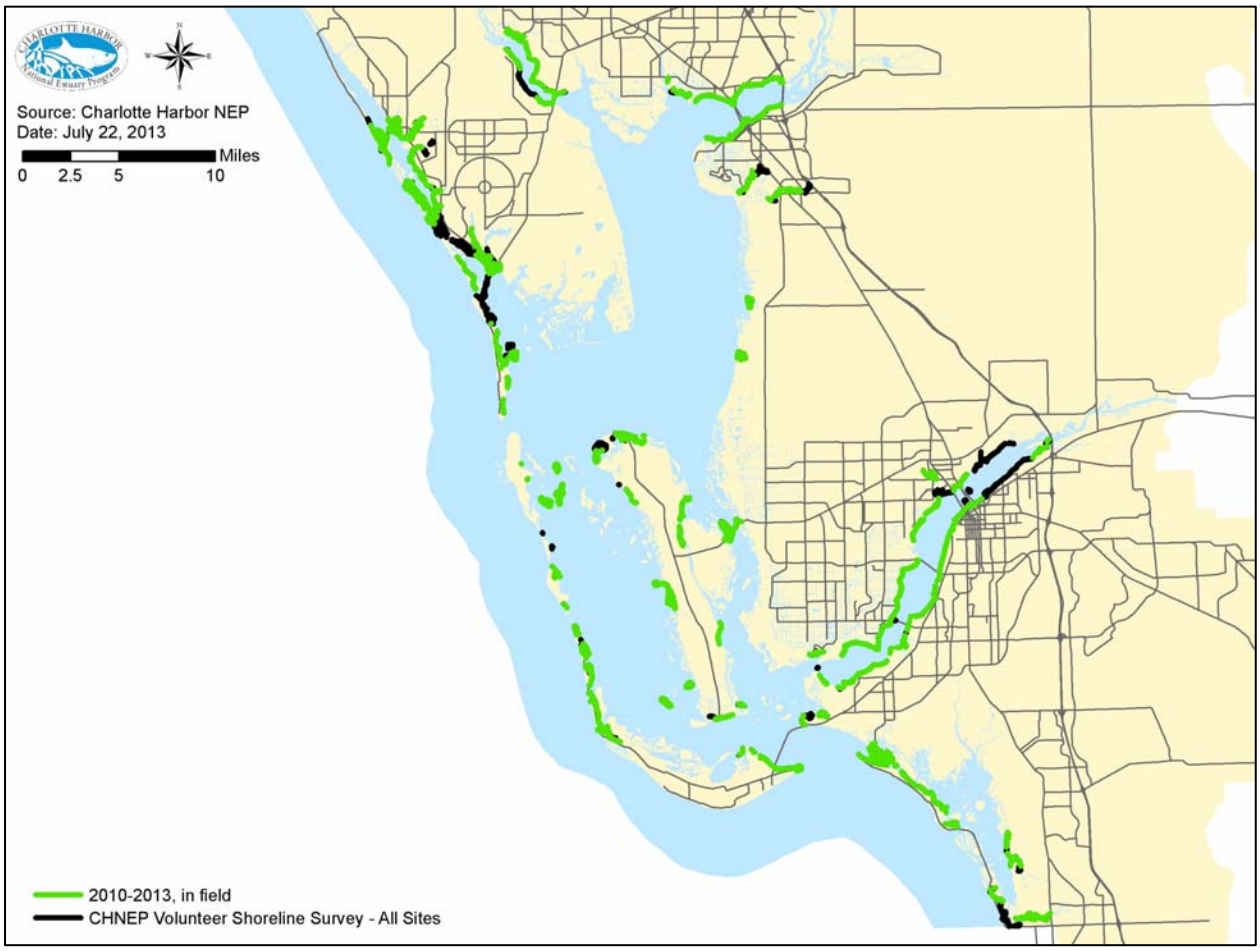
A strength of the repeated survey approach the ability to track trends through a group of common parcels. There were 3,243 parcels (59%) surveyed in the field in 2007, 2010 and 2013. This constituted 152 miles, or 62% of the urban tidal shoreline.



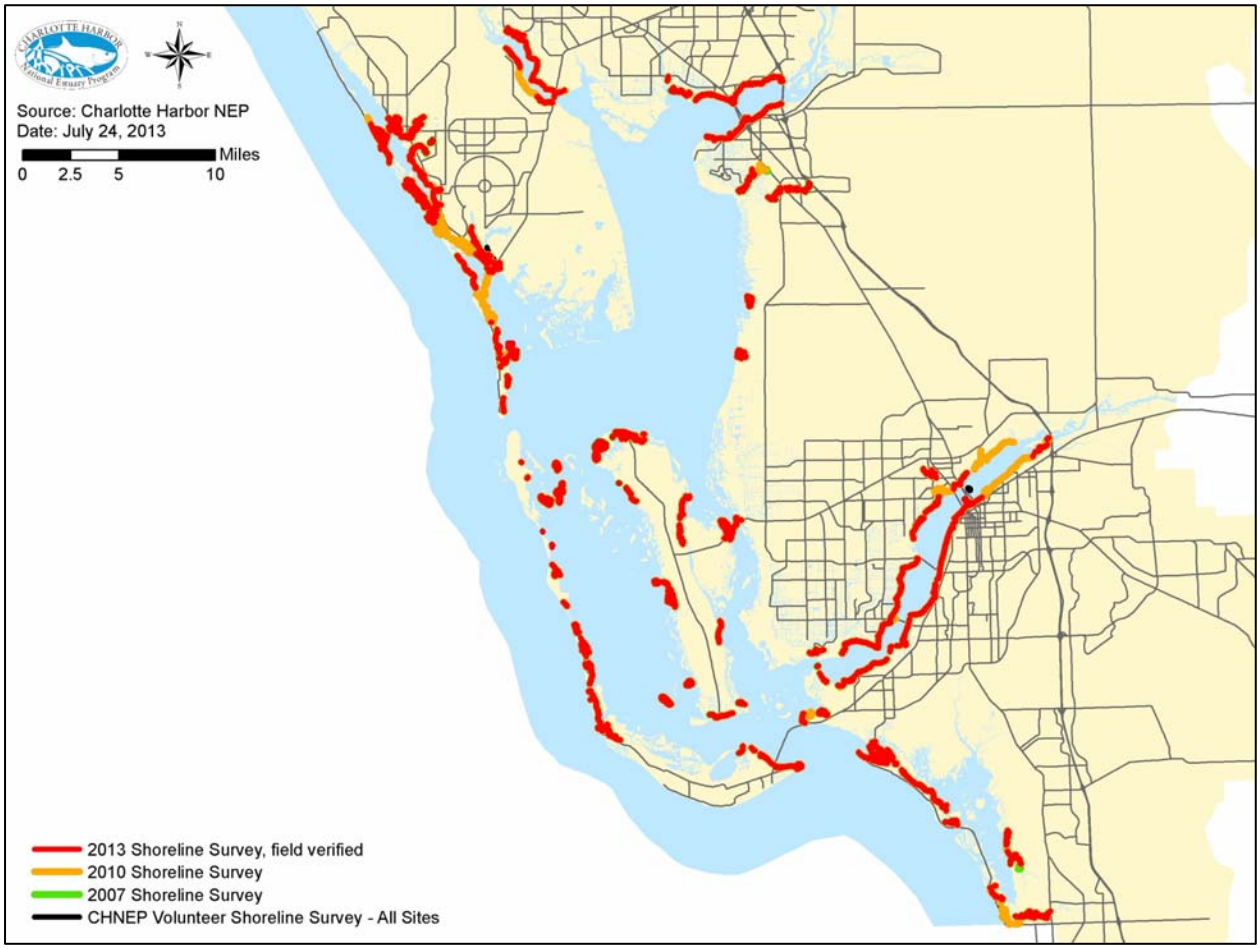
There were 3,467 parcels (63%) surveyed in the field in 2007 and 2013. This constituted 165 miles, or 67% of the urban tidal shoreline.



There were 4,013 parcels (72%) surveyed in the field in 2010 and 2013. This constituted 181 miles, or 74% of the urban tidal shoreline. The pairing is not only the most recent set but has the best coverage.



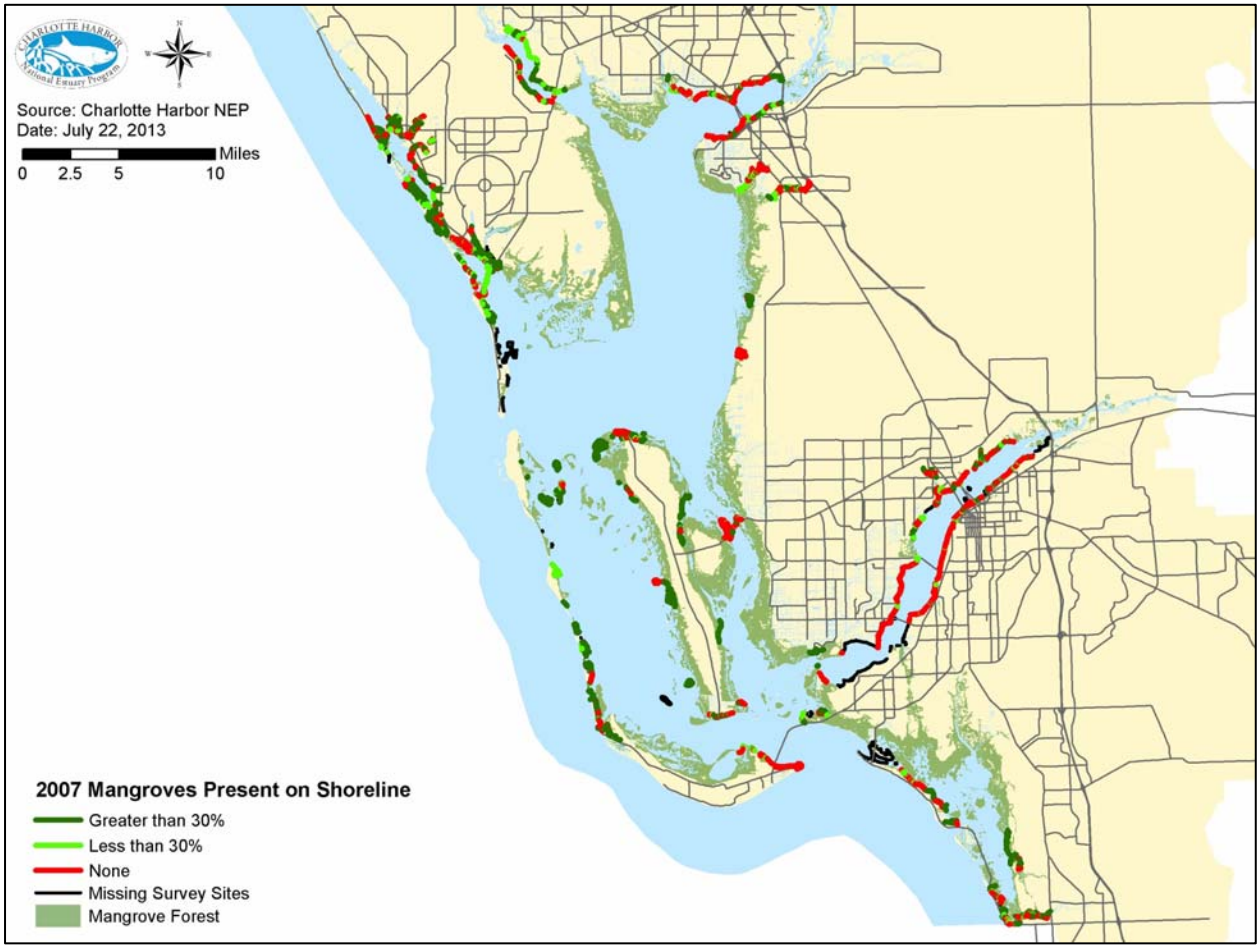
The following map demonstrates that nearly all parcels were surveyed in 2010 or 2013.



Results

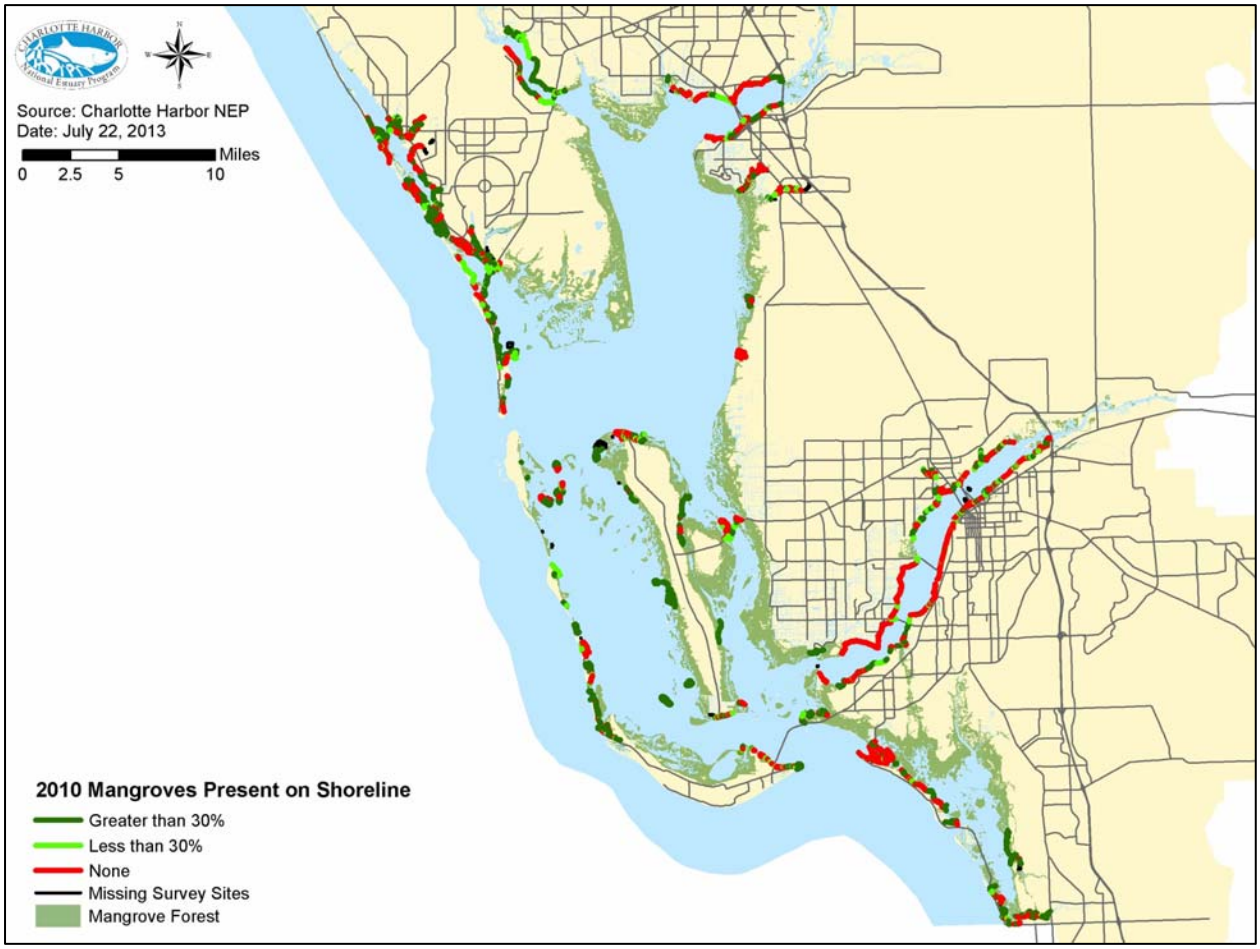
Mangrove Presence

In 2007, 201 of 246 miles of shoreline were surveyed for mangrove presence. Ninety-two miles (46%) of urban shoreline had a greater than 30% mangrove extent. Since only 33% of parcels had greater than 30% mangrove, larger parcels were more likely to have greater than 30% mangrove extent. Conversely, 78 miles of urban shoreline (39%) had no mangroves present while 54% of parcels had no mangrove present.



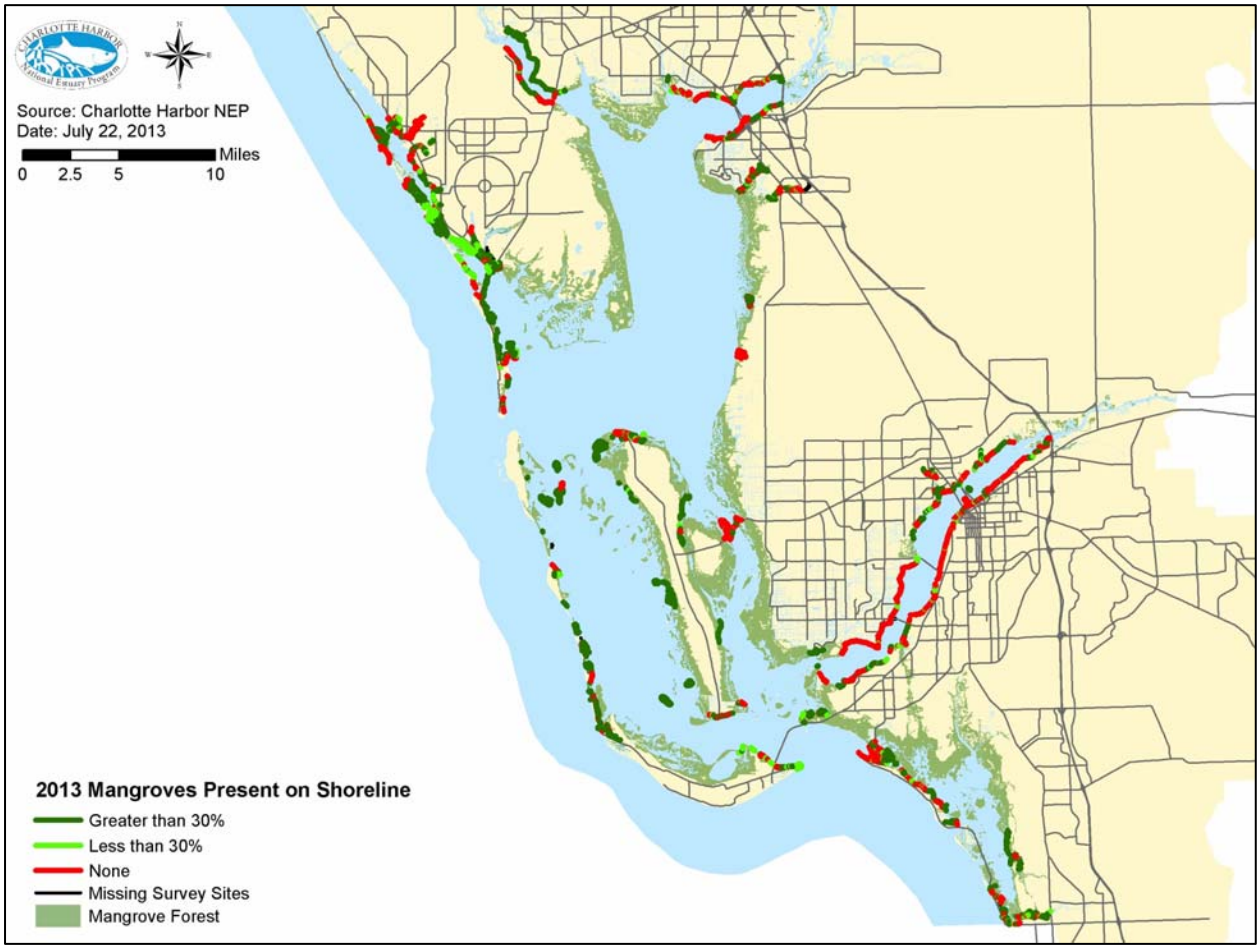
2007 Mangroves	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Greater than 30%	92	45.9%	1,428	32.6%
Less than 30%	31	15.3%	609	13.9%
None	78	38.7%	2,342	53.5%
Total	**201**		**4,379**	

In 2010, 221 of 246 miles of shoreline were surveyed for mangrove presence. One-hundred six miles (48%) of urban shoreline had a greater than 30% mangrove extent. Since only 34% of parcels had greater than 30% mangrove, larger parcels continued to be more likely to have greater than 30% mangrove extent than smaller parcels. Conversely, 85 miles of urban shoreline (39%) had no mangroves present while 52% of parcels had no mangrove present.



2010 Mangroves	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Greater than 30%	106	48.1%	1,674	33.8%
Less than 30%	29	13.2%	717	14.5%
None	85	38.7%	2,561	51.7%
Total	**221**		**4,952**	

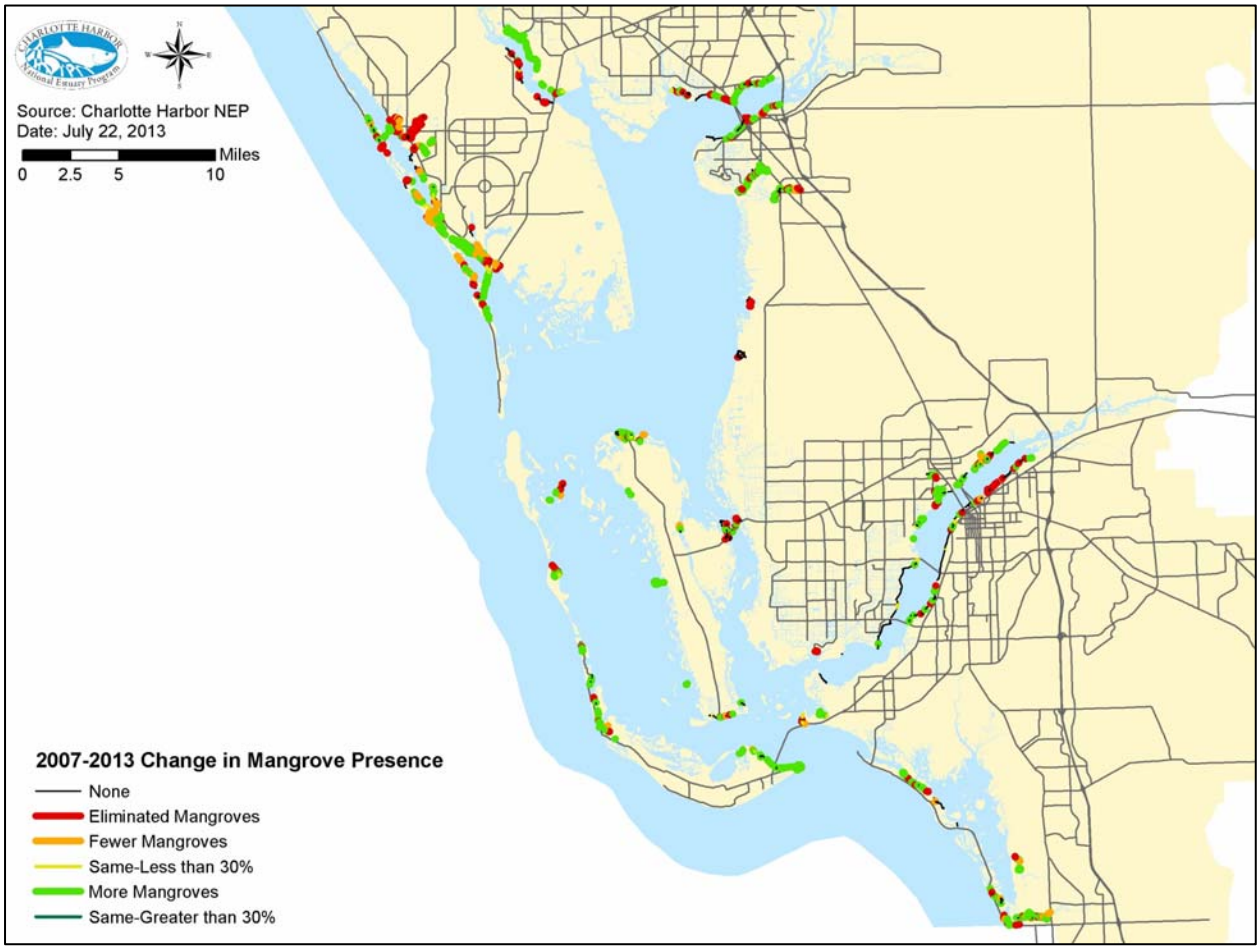
In 2013, 238 of 246 miles of shoreline were surveyed for mangrove presence. One-hundred twenty-four miles (52%) of urban shoreline had a greater than 30% mangrove extent. Since only 34% of parcels had greater than 30% mangrove, larger parcels continued to be more likely to have greater than 30% mangrove extent than smaller parcels. Conversely, 85 miles of urban shoreline (36%) had no mangroves present while 52% of parcels had no mangrove present.



2013 Mangroves	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Greater than 30%	124	52.0%	1,812	33.5%
Less than 30%	29	12.1%	786	14.5%
None	85	35.8%	2,817	52.0%
Total	**238**		**5,415**	

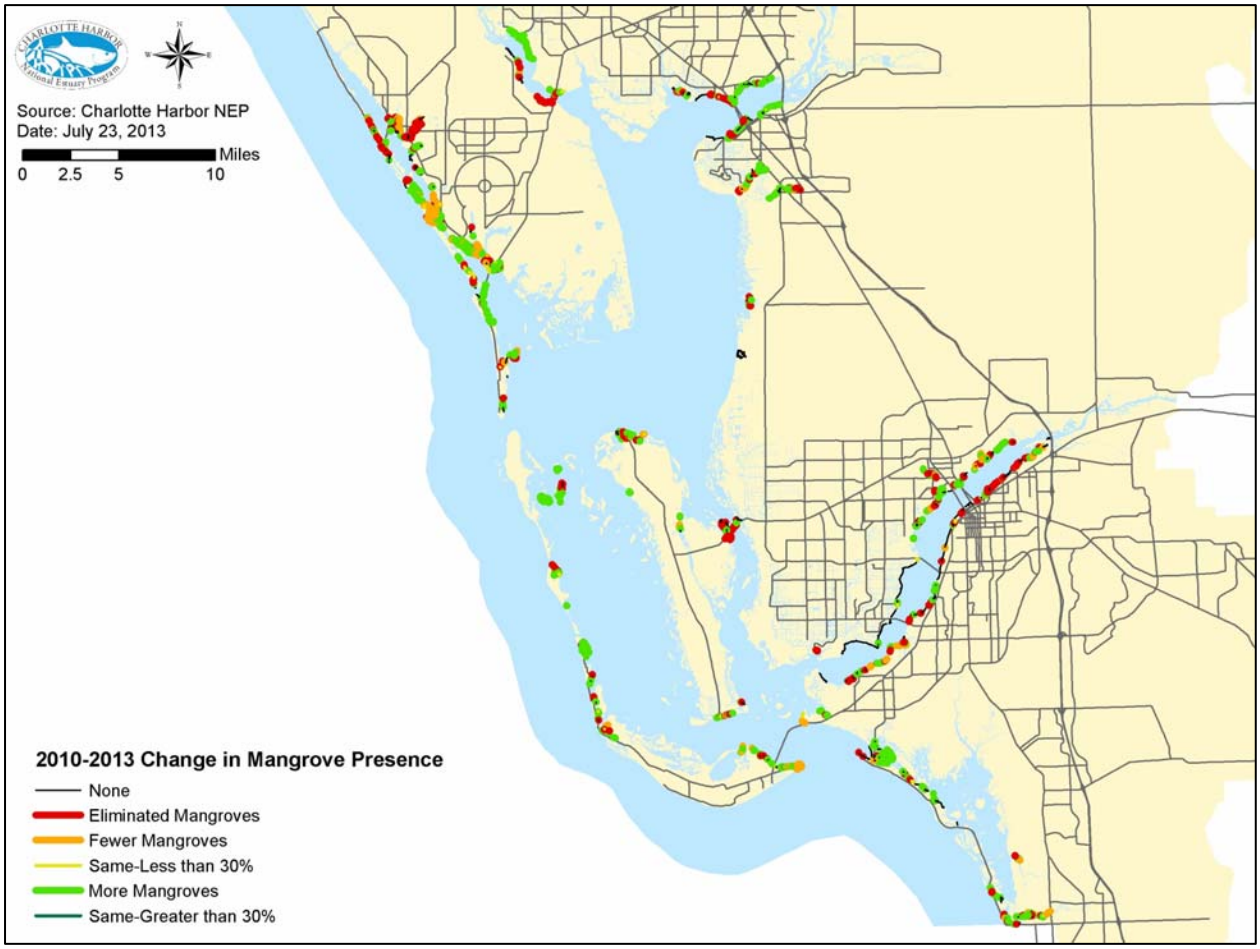
From survey to survey, percentages of miles and parcels that had greater than 30% mangroves, less than 30% and no mangroves did not vary significantly.

However, reviewing groups of parcels that were surveyed in both 2007 and 2013 demonstrates an increase in mangrove presence. Mangrove gains have been documented for 36 miles compared to mangrove losses for 22 miles between 2007 and 2013.



Mangrove Presence	2007 Greater than 30%	2007 Less than 30%	2007 None	Total Of Miles
2013 Greater than 30%	77	16	11	104
2013 Less than 30%	8	8	9	26
2013 None	7	7	55	68
Total of Miles	92	31	76	198

A different set of parcels were surveyed in both 2010 and 2013. During this period an increase in mangrove presence was also documented. Mangrove gains have been documented for 33 miles compared to mangrove losses for 28 miles between 2010 and 2013.

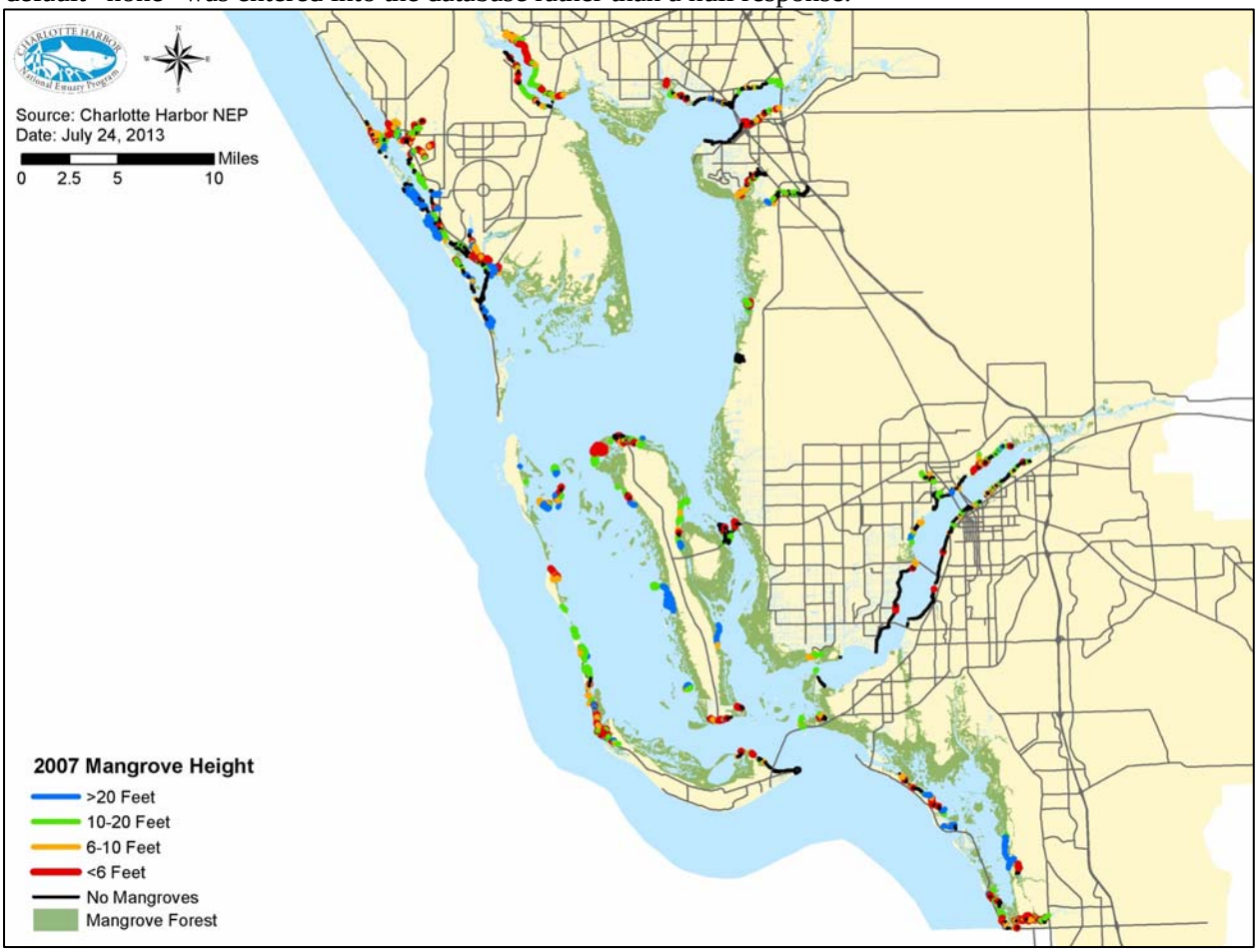


Mangrove Presence	2010 Greater than 30%	2010 Less than 30%	2010 None	Total Of Miles
2013 Greater than 30%	88	10	15	113
2013 Less than 30%	10	8	8	26
2013 None	7	11	62	80
Total of Miles	105	28	85	219

In both periods 2007-2013 and 2010-2013, mangrove losses were most prominent in Lemon Bay (near the Tom Adams Bridge), west shore of tidal Myakka River, the community of Charlotte Harbor and the south shore of the tidal Caloosahatchee River.

Mangrove Height

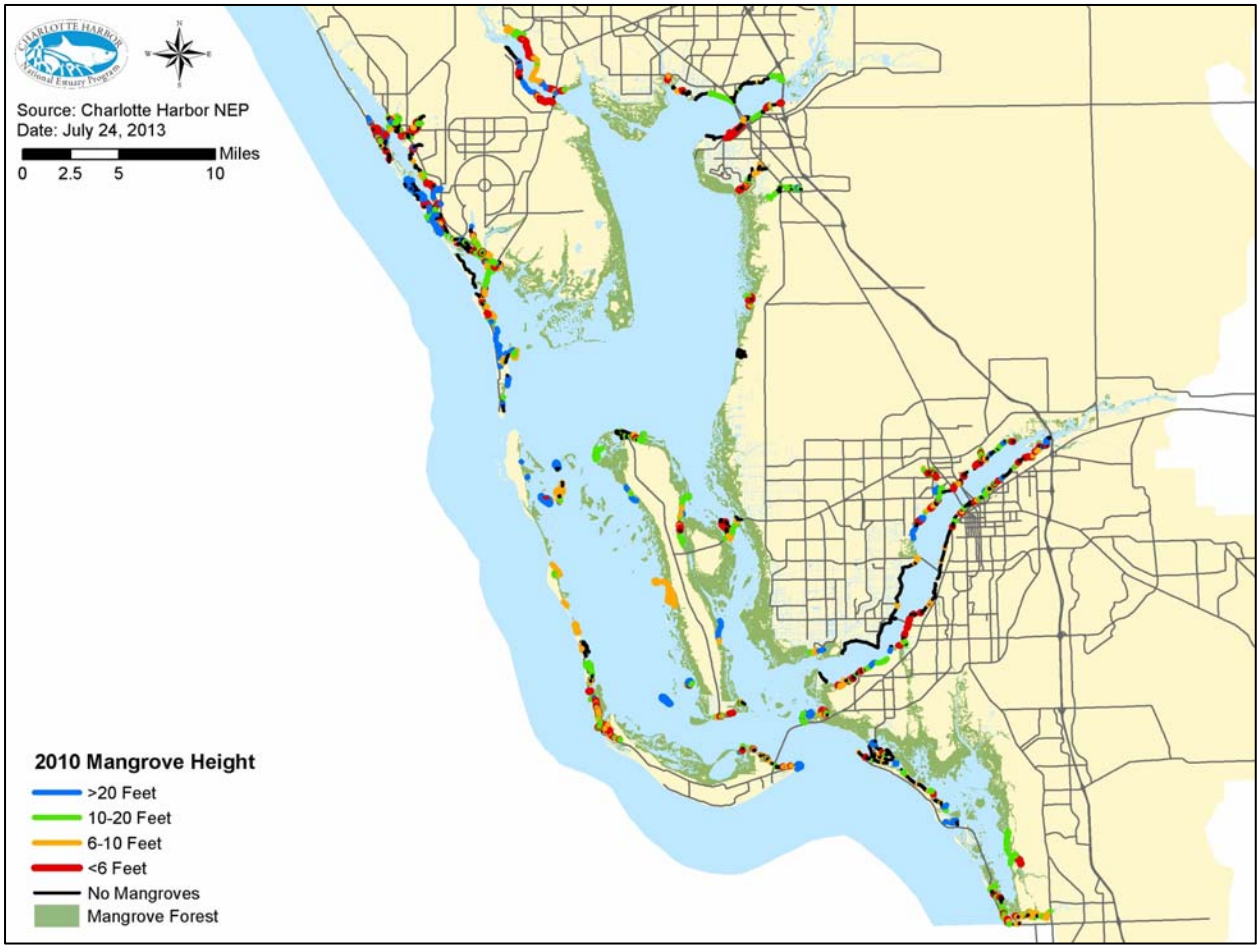
In 2007, 201 miles were assessed for mangrove height of the 201 miles surveyed for mangrove presence. However, 78 miles were identified as having no mangroves present, compared to 91 miles for no mangroves under the height determinations. Conceivably, 13 miles had no height determination and a default “none” was entered into the database rather than a null response.



Seventy miles (35%) of urban shoreline had mangroves of 10 feet or greater in height. Since only 21% of parcels had mangroves of 10 feet or greater in height, larger parcels were more likely to have taller mangrove than smaller parcels. A similar percentage between miles (20%) and parcels (19%) had mangroves of 10 feet or less in height.

2007 Mangrove Height	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
>20 Feet	28	14.1%	439	10.0%
10-20 Feet	42	20.8%	464	10.6%
6-10 Feet	22	11.1%	466	10.6%
<6 Feet	17	8.6%	361	8.2%
No Mangroves	91	45.4%	2,649	60.5%
Total	**201**		**4,379**	

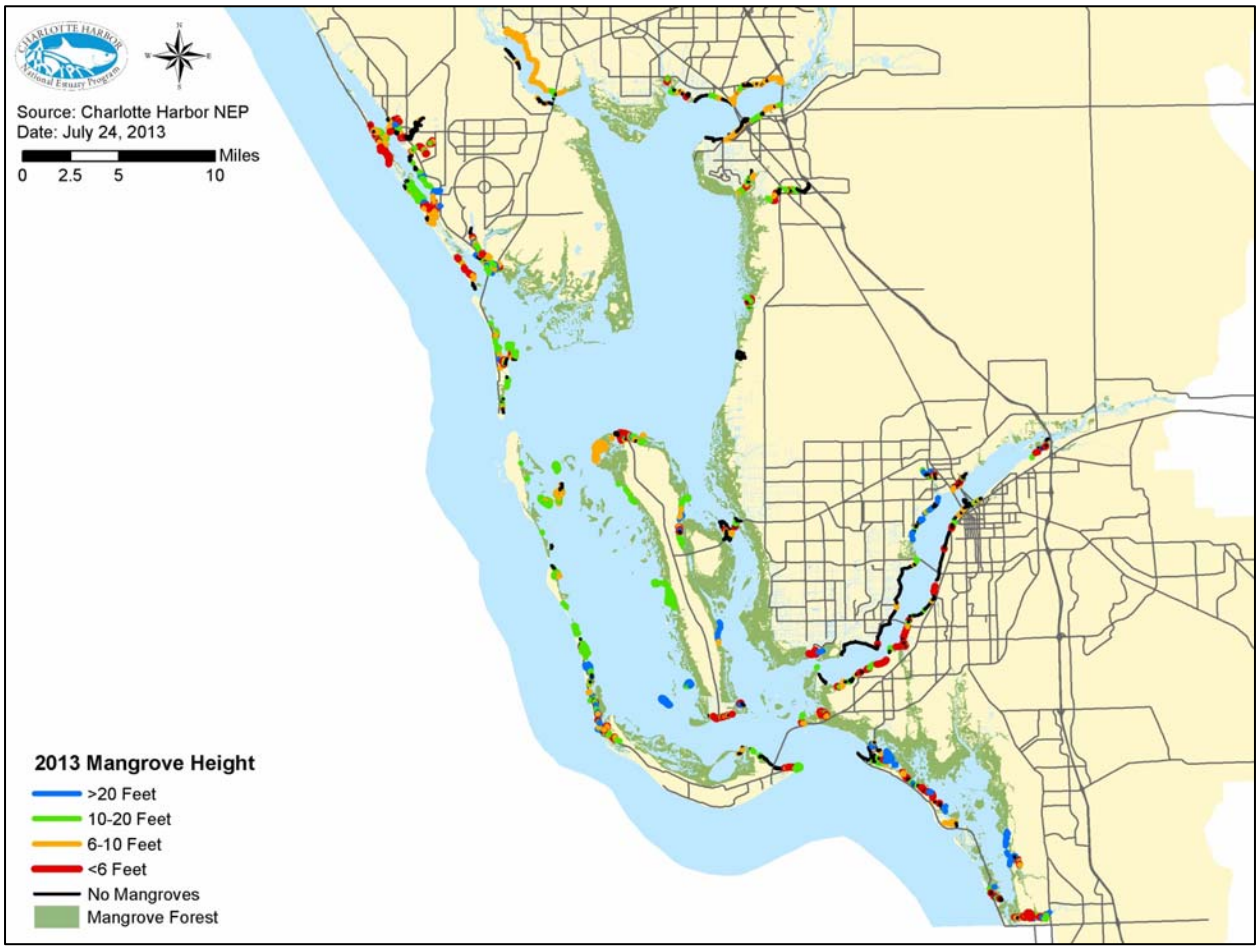
In 2010, 221 miles were assessed for mangrove height of the 211 miles surveyed for mangrove presence. However, 78 miles were identified as having no mangroves present, compared to 85 miles for height determinations. Conceivably, 7 miles had no height determination and a default “none” was entered into the database rather than a null response.



Seventy-nine miles (36%) of urban shoreline had mangroves of 10 feet or greater in height. Since only 22% of parcels had mangroves of 10 feet or greater in height, larger parcels were more likely to have taller mangrove than smaller parcels. A similar percentage between miles (24%) and parcels (23%) had mangroves of 10 feet or less in height.

2010 Mangrove Height	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
>20 Feet	33	14.8%	398	8.0%
10-20 Feet	46	20.7%	678	13.7%
6-10 Feet	37	16.6%	707	14.3%
<6 Feet	17	7.5%	446	9.0%
No Mangroves	89	40.4%	2723	55.0%
Total	**221**		**4,952**	

In 2013, 198 miles were assessed for mangrove height of the 238 miles surveyed for mangrove presence. Lack of mangrove presence was identified for 85 miles of shoreline compacted to no mangroves for 77 miles for trimming assessments. Differences are consistent between mangrove presence which gained for the Google Earth augmentation and the field verified height information.

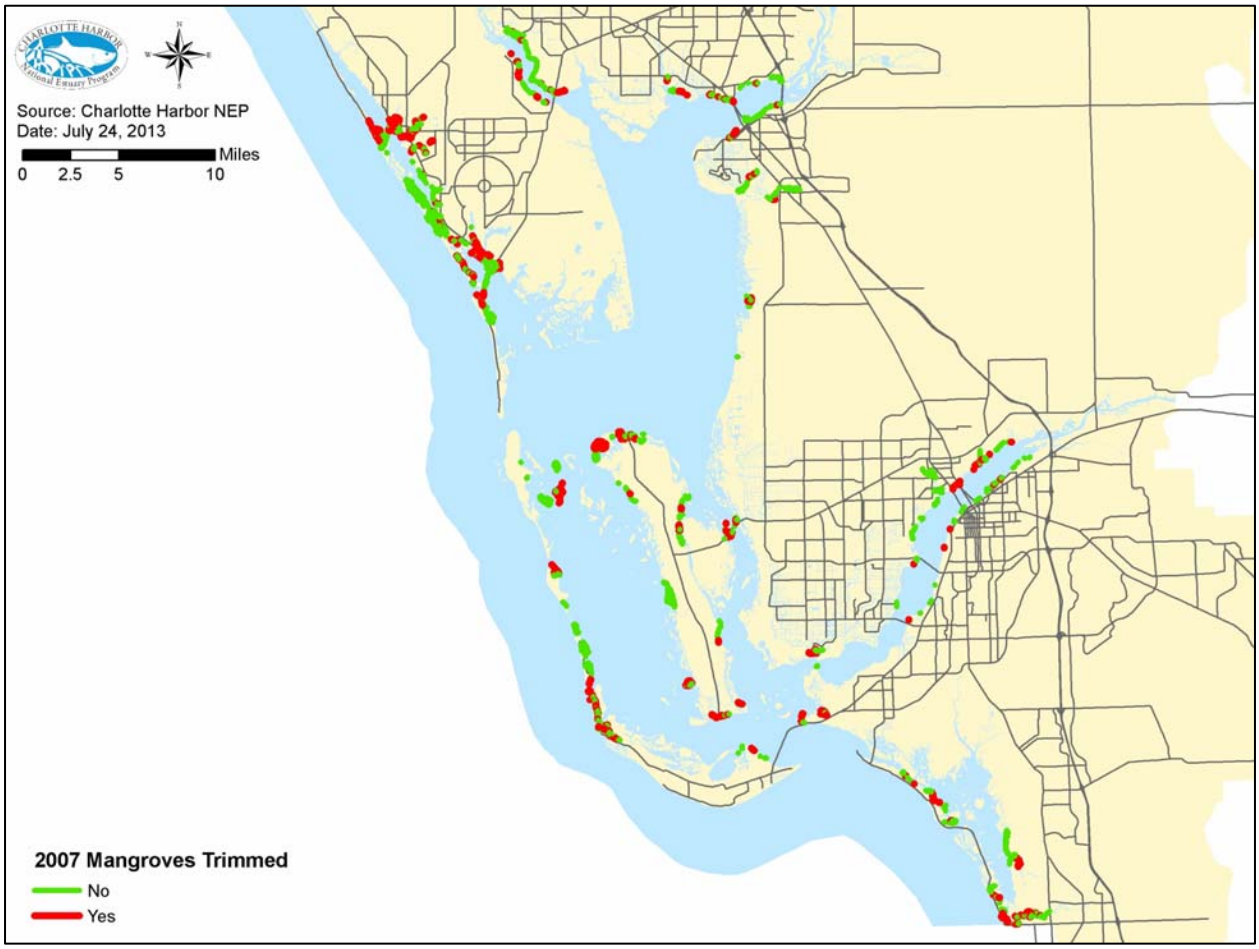


Seventy miles (35%) of urban shoreline had mangroves of 10 feet or greater in height. Since only 17% of parcels had mangroves of 10 feet or greater in height, larger parcels were more likely to have taller mangrove than smaller parcels. A similar percentage between miles (26%) and parcels (28%) had mangroves of 10 feet or less in height.

2013 Mangrove Height	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
>20 Feet	21	10.4%	194	4.5%
10-20 Feet	49	24.8%	546	12.6%
6-10 Feet	38	19.0%	752	17.4%
<6 Feet	14	7.0%	440	10.2%
No Mangroves	77	38.8%	2401	55.4%
Total	**198**		**4,333**	

Mangrove Trimming

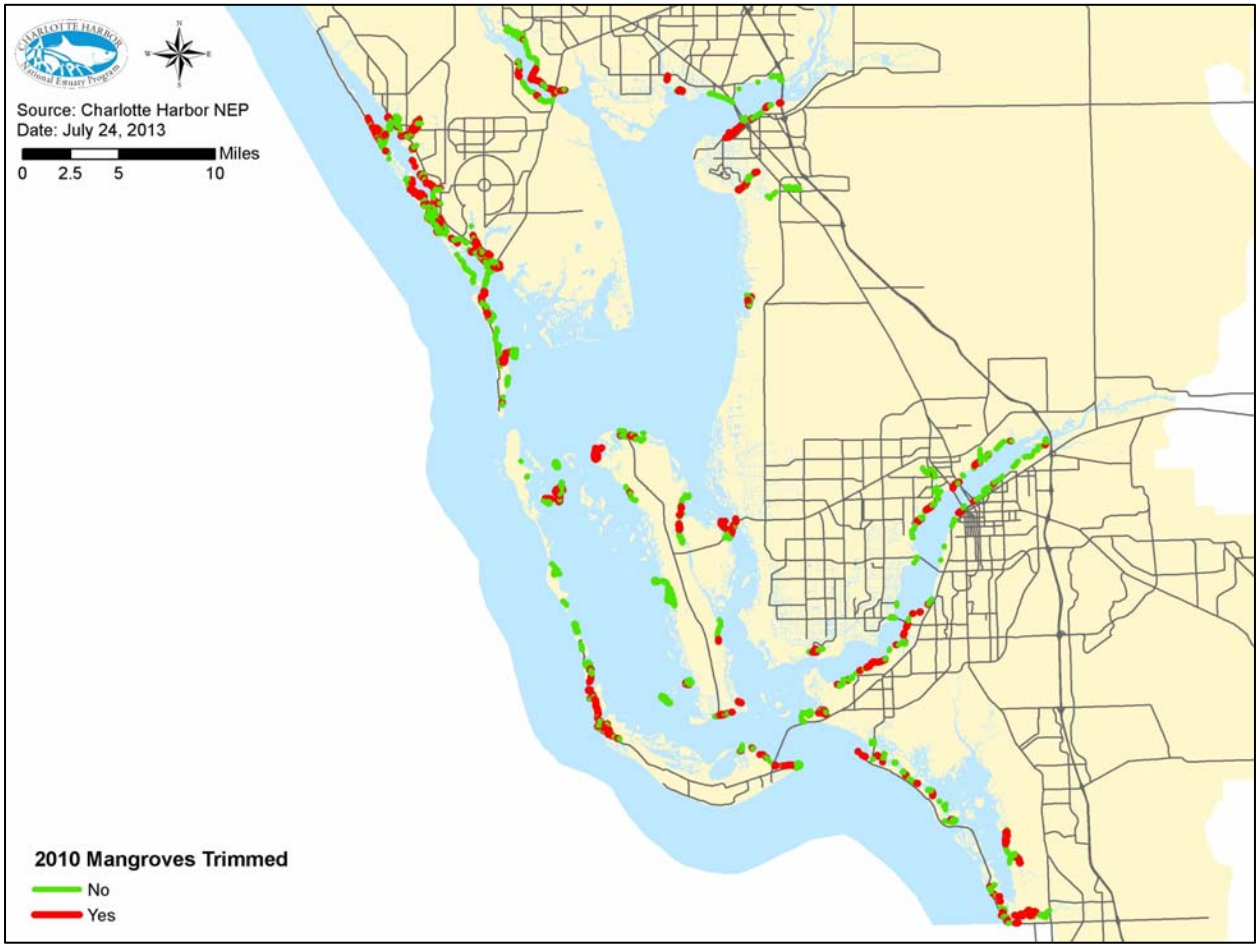
In 2007, 123 miles were assessed for mangrove trimming of the 123 miles identified for mangrove presence.



Twenty-nine miles (23%) of urban mangroves were trimmed. Since 33% of parcels had trimmed mangroves, smaller parcels were more likely to have trimmed mangrove than larger parcels.

2007 Mangroves Trimmed	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
No	94	76.6%	1,366	67.1%
Yes	29	23.4%	671	32.9%
Total	**123**		**2,037**	

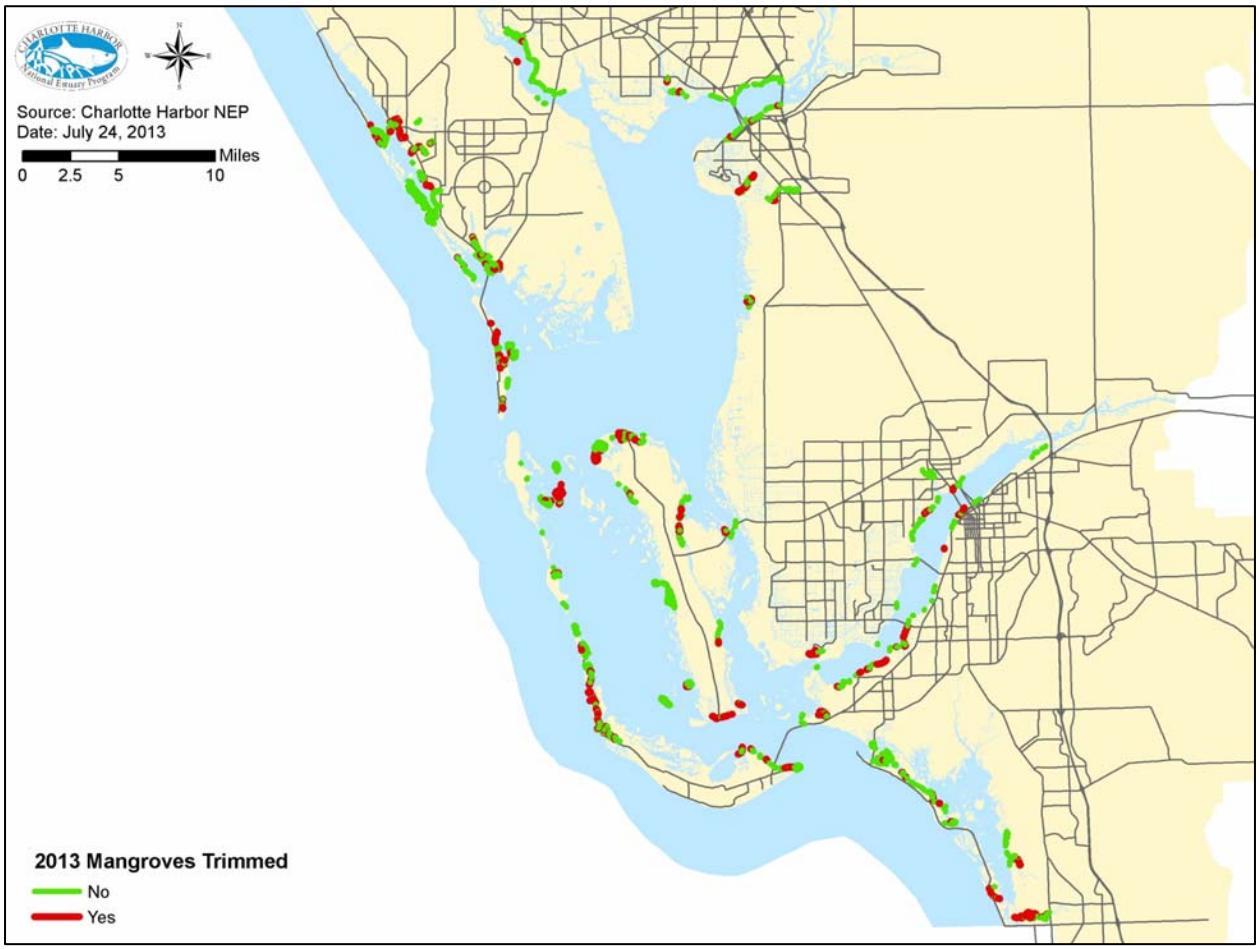
In 2010, 135 miles were assessed for mangrove trimming of the 135 miles identified for mangrove presence.



Twenty-nine miles (29%) of urban mangroves were trimmed. Since 40% of parcels had trimmed mangroves, smaller parcels were more likely to have trimmed mangrove than larger parcels.

2010 Mangroves Trimmed	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
No	96	70.8%	1,437	60.1%
Yes	39	29.2%	954	39.9%
Total	**135**		**2,391**	

In 2013, 121 miles were assessed for mangrove trimming of the 153 miles identified for mangrove presence. Within the mangrove height data, however, 121 miles were field verified for mangrove presence.



Twenty-two miles (18%) of urban mangroves were trimmed. Since 30% of parcels had trimmed mangroves, smaller parcels were more likely to have trimmed mangrove than larger parcels.

2013 Mangroves Trimmed	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
No	99	82.0%	1,352	70.4%
Yes	22	18.0%	568	29.6%
Total	**121**		**1,920**	

In 2013, trimming style was assessed for the first time. References from *Mangrove Trimming Guidelines for Homeowners* issued by the Florida Department of Environmental Protection were given to volunteers. Trimming styles include hedging, windows and uplifting (shown as undercutting below.) Uplifting allows sun-tolerant leaves to continue to protect the shade leaves and is healthier for the tree than hedging. For that reason, the more positive term "uplifting" was used with the volunteers than the more negative term "undercutting."

Trimming Styles

There are several styles of trimming that can provide a pleasing view of the water. While hedging is the form most commonly used, it often is the most environmentally damaging. Other alternate styles can provide a view in a manner that is less stressful to the mangroves and may require less maintenance.

Windows: A view through large trees can be obtained by selective limb removal within the lower or central area of the tree. Windowing allows for a view while maintaining shade, privacy, a windbreak and additional habitat for wildlife.

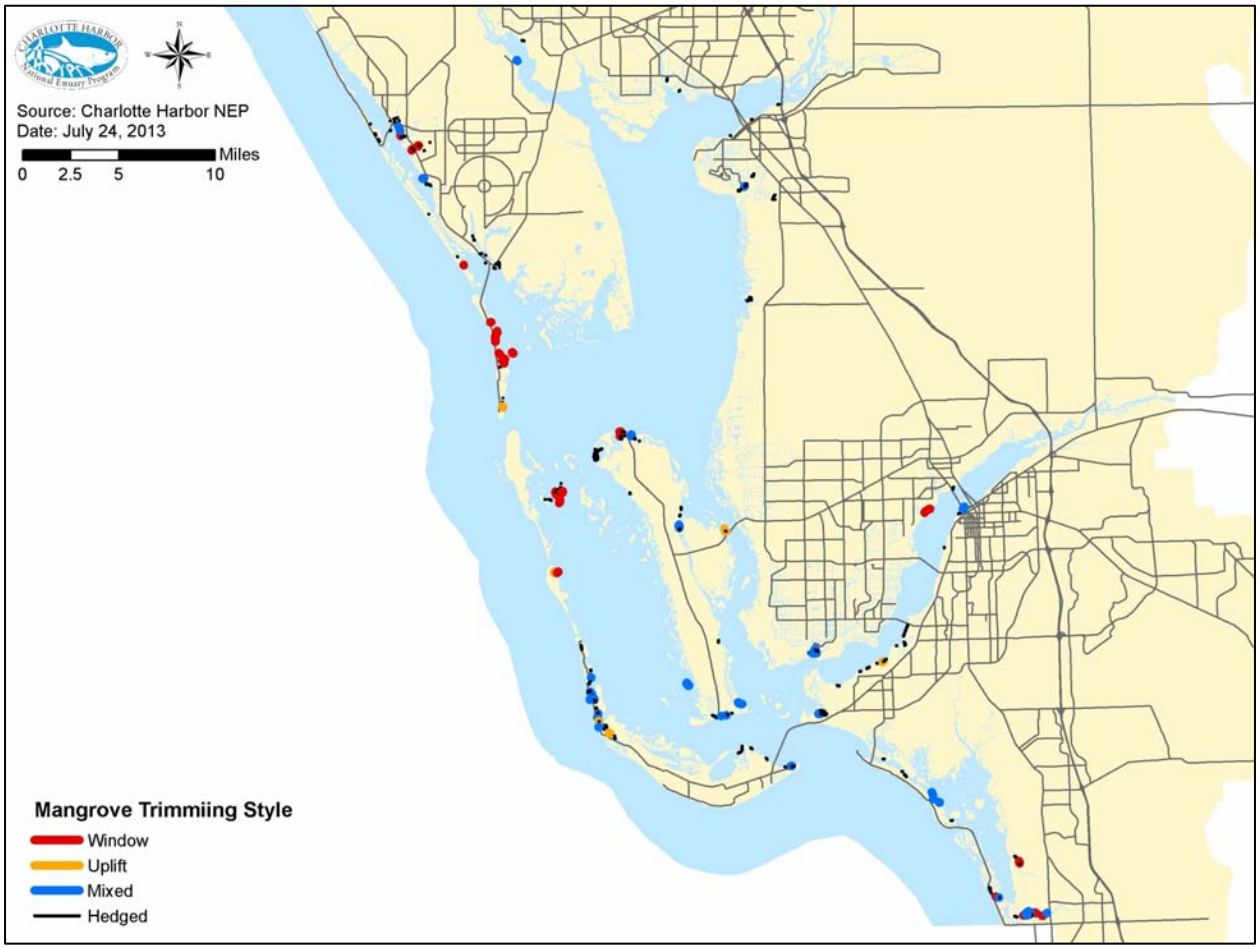
Hedging: Trimming mangroves into the hedged shape provides a view across the top of the mangroves. If all of the leaves of a tree are in the upper canopy and trimming the canopy will remove all of the leaves, then the top trimming activity of hedging may not be performed or only performed to the height that does not defoliate or otherwise damage the tree. Hedging is not recommended for red mangroves or for mature black mangroves. Trimming to form a hedge generally cannot be performed to heights of less than 6 ft. unless the property has a previously, legally established trimming configuration to a lower height and the agency has reviewed and approved documentation of the historic configuration. (see Page 14 *Reestablishment of Previous Configurations).*

Undercutting: This is the trimming of the lower portion of a tree. Undercutting as it is sometimes called, may provide a view lower than 6 feet through a taller tree but *young plants that grow up through that viewing area can not be trimmed until they exceed 6 feet.* The results will be similar to window trims with a lower view at 6 feet. Recruiting young plants (those colonizing under established trees) also should *not* be pulled out of the ground. This activity technically is a form of alteration and requires a permit.

Whatever style of trimming you choose, consider a style that can be maintained with the least loss of leaves resulting from the trimming activity. Mangrove leaves are an important source of nutrients for the smaller animals of the marine food chain, including sea grass and coral reef communities. Leaves that die naturally on the tree and then fall into the water are much more quickly biodegraded and available as a food source than healthy leaves cut from the tree. Fresh cut green leaves will stay mostly intact lying on the substrate for months before total leaf breakdown.

MANGROVE TRIMMING GUIDELINES FOR HOMEOWNERS 5

In 2013, 22 miles were identified as trimmed mangroves. Of the 22 miles of trimmed mangroves, 16 miles (71%) were hedged. The more beneficial trimming styles of windowing (11%) and uplifting (2%) are found most predominately on Boca Grande, Useppa Island and at Bonita Bay.



2013 Mangrove Trim Style	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Window	2	11.0%	74	13.0%
Uplift	0	2.0%	12	2.1%
Mixed	3	15.7%	60	10.6%
Hedged	16	71.3%	422	74.3%
Total	**22**		**568**	

For each survey, mangrove height was compared to mangrove trimming. Not surprisingly, trimmed mangroves are shorter than untrimmed mangroves.

2007 Mangrove Height	Not Trimmed	Trimmed	Total
>20 Feet	27	1	28
10-20 Feet	40	2	42
6-10 Feet	11	11	22
<6 Feet	5	13	17
Total Miles	**83**	**27**	**110**

2007 Mangrove Height	Not Trimmed	Trimmed	Total
>20 Feet	32.9%	3.9%	18.4%
10-20 Feet	47.8%	8.4%	28.1%
6-10 Feet	13.8%	40.5%	27.2%
<6 Feet	5.5%	47.1%	26.3%
Total Percentage	**75.7%**	**24.3%**	

2010 Mangrove Height	Not Trimmed	Trimmed	Total
>20 Feet	29	3	33
10-20 Feet	38	8	46
6-10 Feet	21	16	37
<6 Feet	4	12	17
Total Miles	**92**	**39**	**132**

2010 Mangrove Height	Not Trimmed	Trimmed	Total
>20 Feet	31.7%	8.6%	20.2%
10-20 Feet	41.0%	20.2%	30.6%
6-10 Feet	22.6%	40.3%	31.4%
<6 Feet	4.7%	30.9%	17.8%
Total Percentage	**70.0%**	**30.0%**	

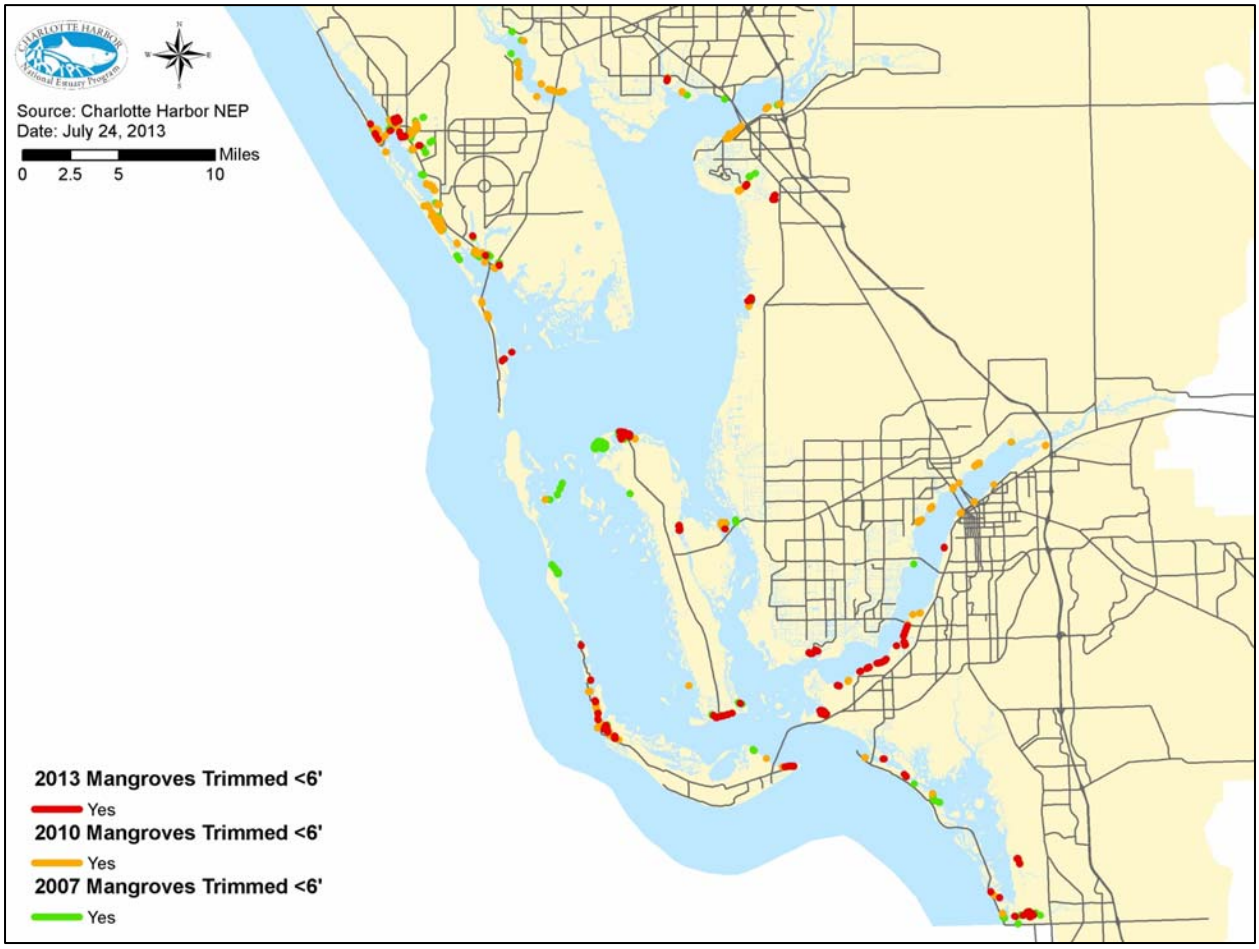
2013 Mangrove Height	Not Trimmed	Trimmed	Total
>20 Feet	18	1	18
10-20 Feet	37	3	40
6-10 Feet	17	9	27
<6 Feet	17	9	27
Total Miles	**89**	**22**	**112**

2013 Mangrove Height	Not Trimmed	Trimmed	Total
>20 Feet	19.6%	3.2%	11.4%
10-20 Feet	41.6%	14.0%	27.8%
6-10 Feet	19.4%	41.4%	30.4%
<6 Feet	19.4%	41.3%	30.4%
Total Percentage	**79.9%**	**20.1%**	

It is worthwhile to review trimmed mangroves less than 6 feet in height. Young untrimmed mangroves may be less than 6 feet in height. However, trimming mangroves to less than 6 feet in height is a violation of state law. Volunteer measurements may be in error. However, a compliance check for the areas where mangroves were found to be trimmed to less than 6 feet in height may be warranted.

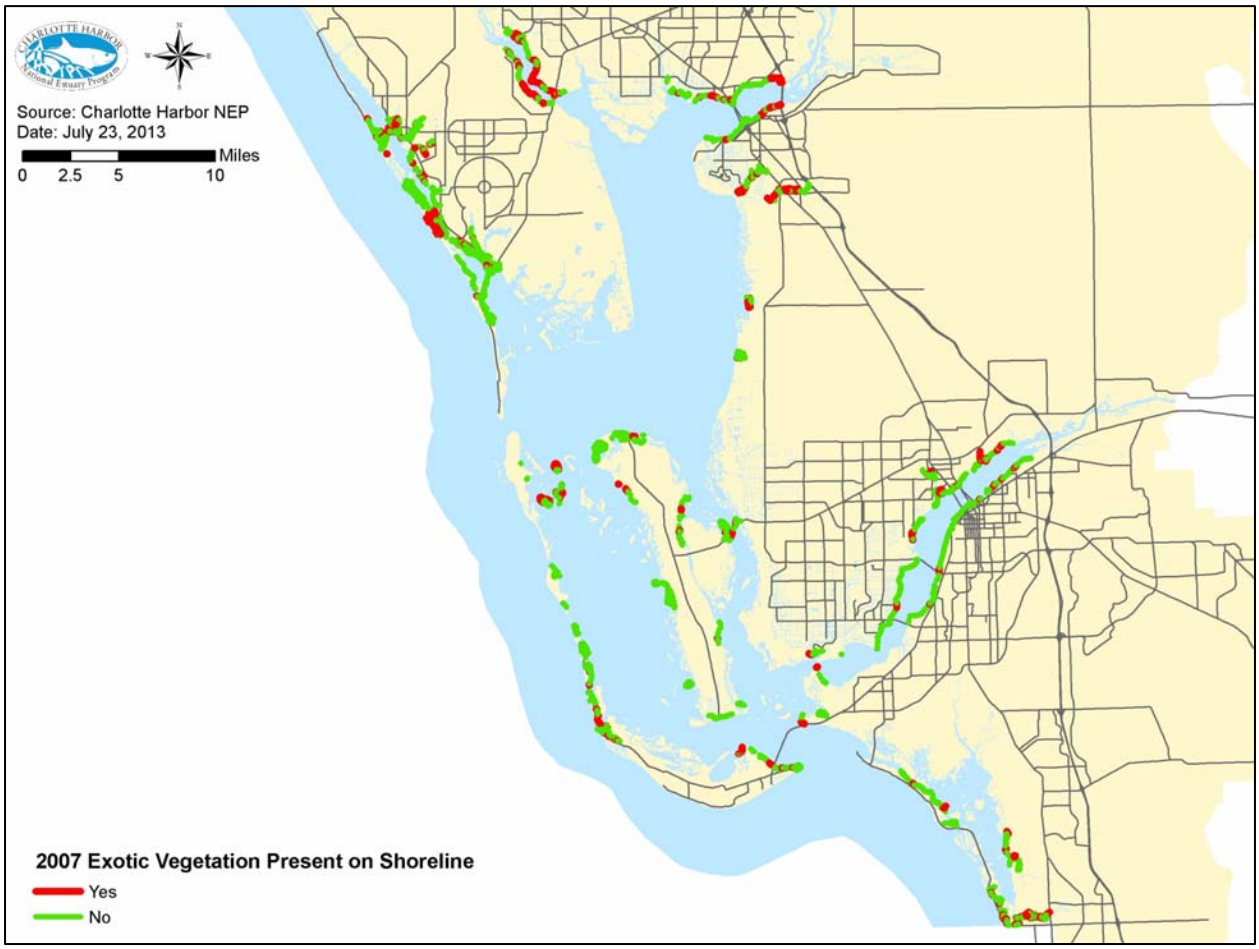
Mangroves Trimmed to under Six Feet in Height

The following map shows mangroves trimmed to less than six feet in height by survey year. The year 2013 is in red, 2010 in orange and 2007 in green. Most recent areas include Iona Cove, Captiva Island and Lemon Bay near the Tom Adams Bridge.



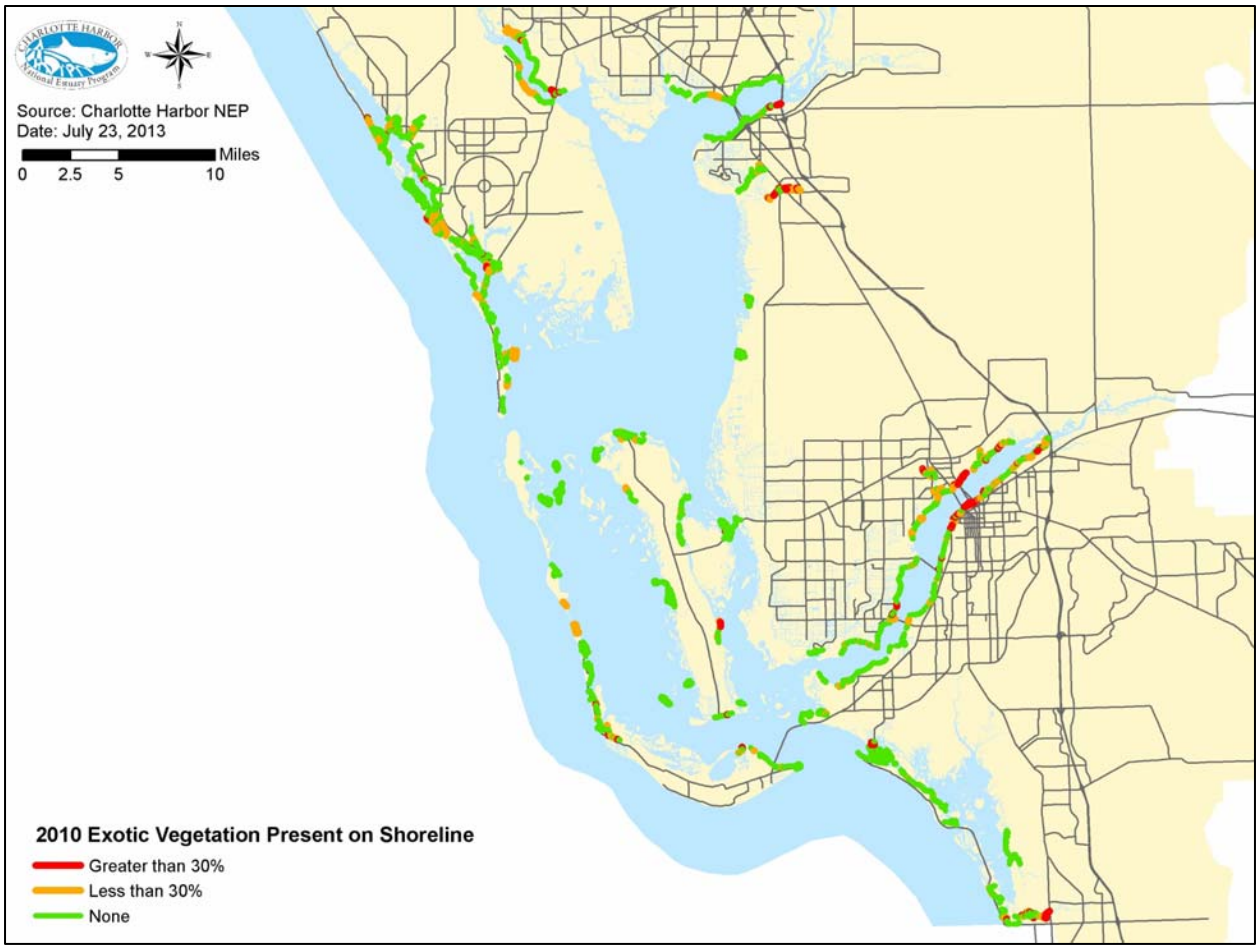
Exotic Vegetation Presence

A measure of poor shoreline condition is the presence of invasive exotic vegetation. In the CHNEP study area, common invasive exotic species include Brazilian pepper (*Schinus terebinthifolius*) Australian pepper (*Casurina* spp.) seaside mahoe (*Thespesia populnea*) and earleaf acacia (*Acacia auriculiformis*).



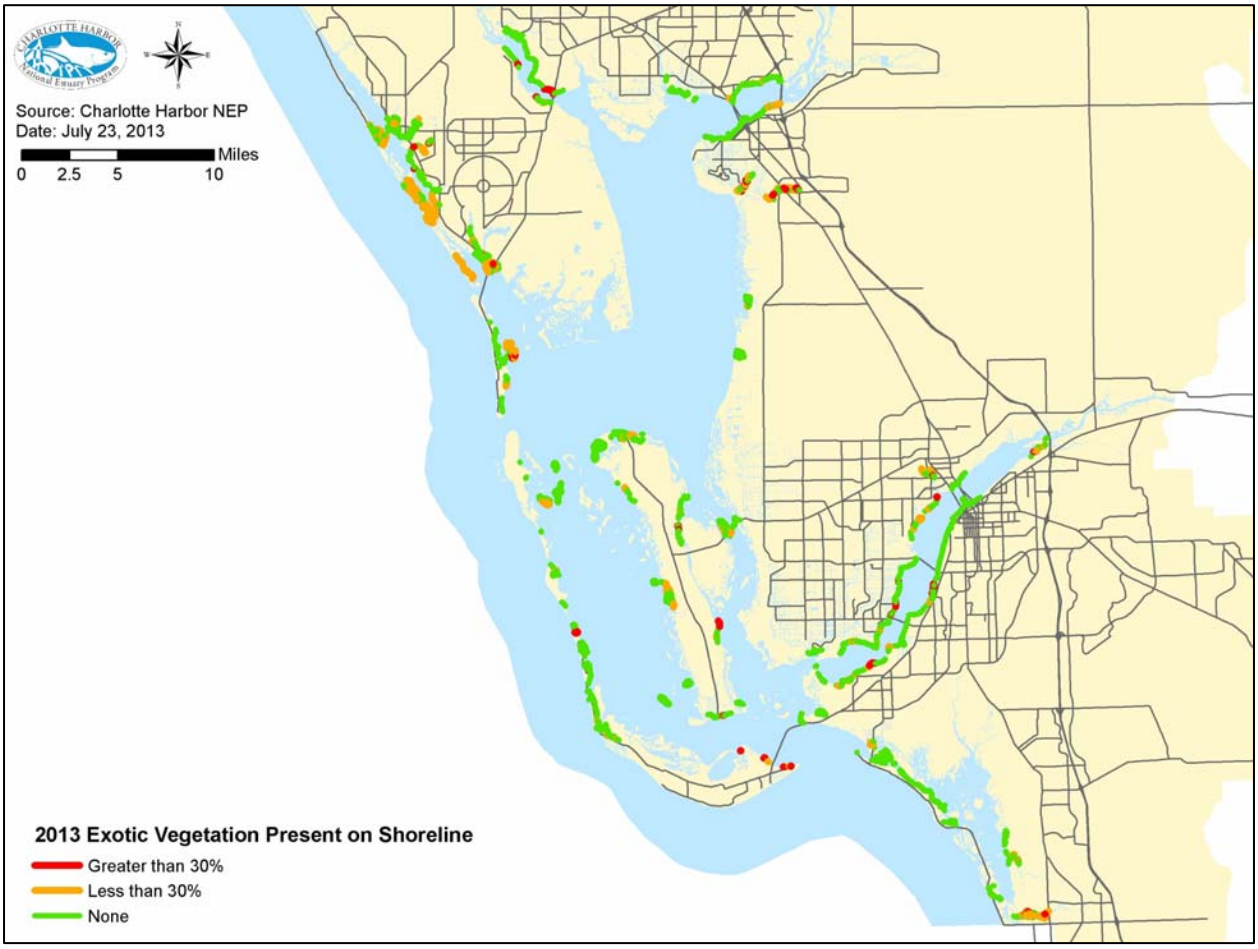
In 2007, invasive exotic vegetation was present on 34 (17%) miles of urban shoreline and on 13% of urban parcels.

2007 Exotics	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Yes	34	16.8%	578	13.2%
No	167	83.2%	3,801	86.8%
Total	**201**		**4,379**	



In 2010, invasive exotic vegetation was present on 36 (16%) miles of urban shoreline and on 13% of urban parcels.

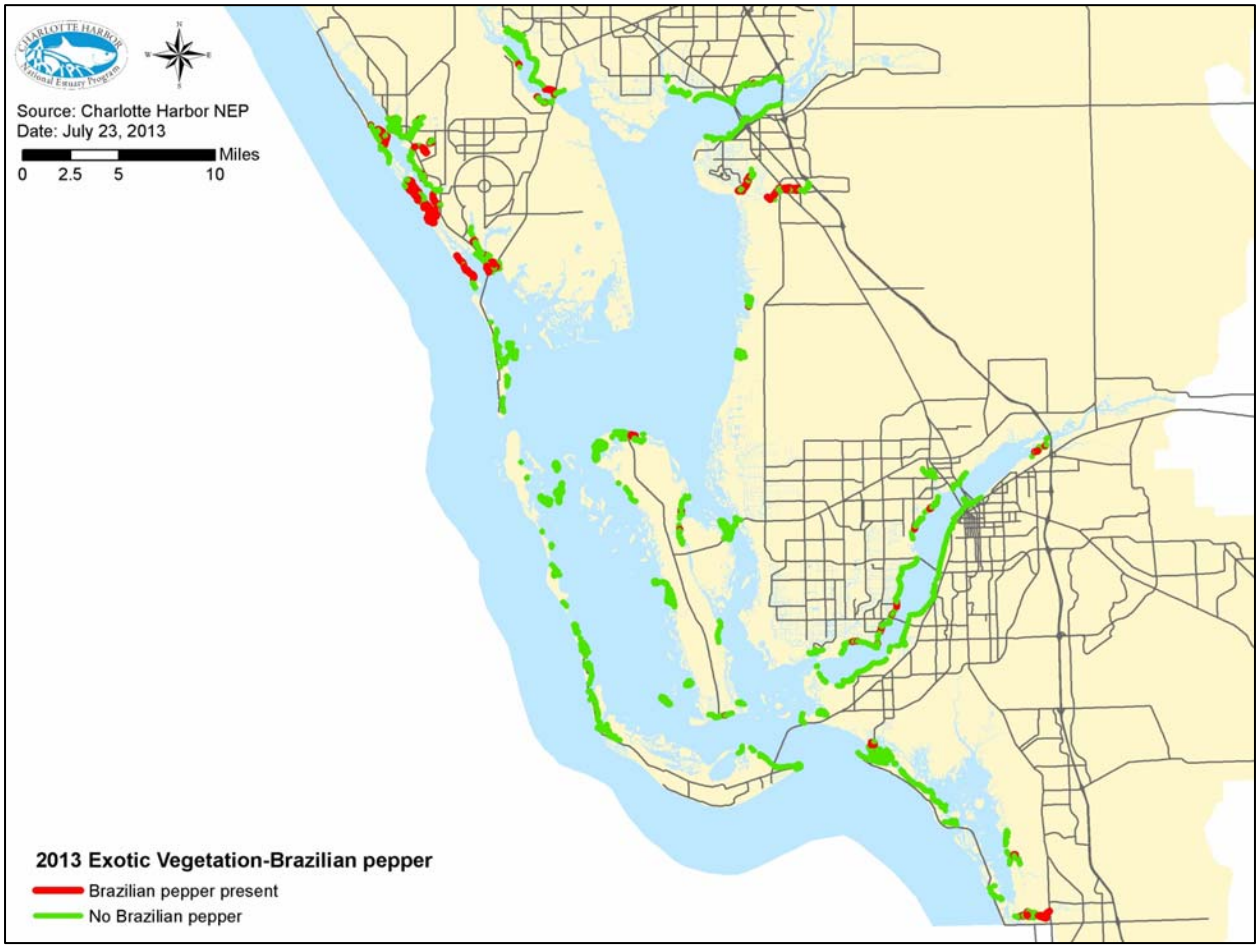
2010 Exotics	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Greater than 30%	10	4.3%	180	3.6%
Less than 30%	26	11.9%	469	9.5%
None	185	83.8%	4,303	86.9%
Total	**221**		**4,952**	



In 2013, invasive exotic vegetation was present on 36 (20%) miles of urban shoreline and on 17% of urban parcels. This was an overall increase from the 2010 survey.

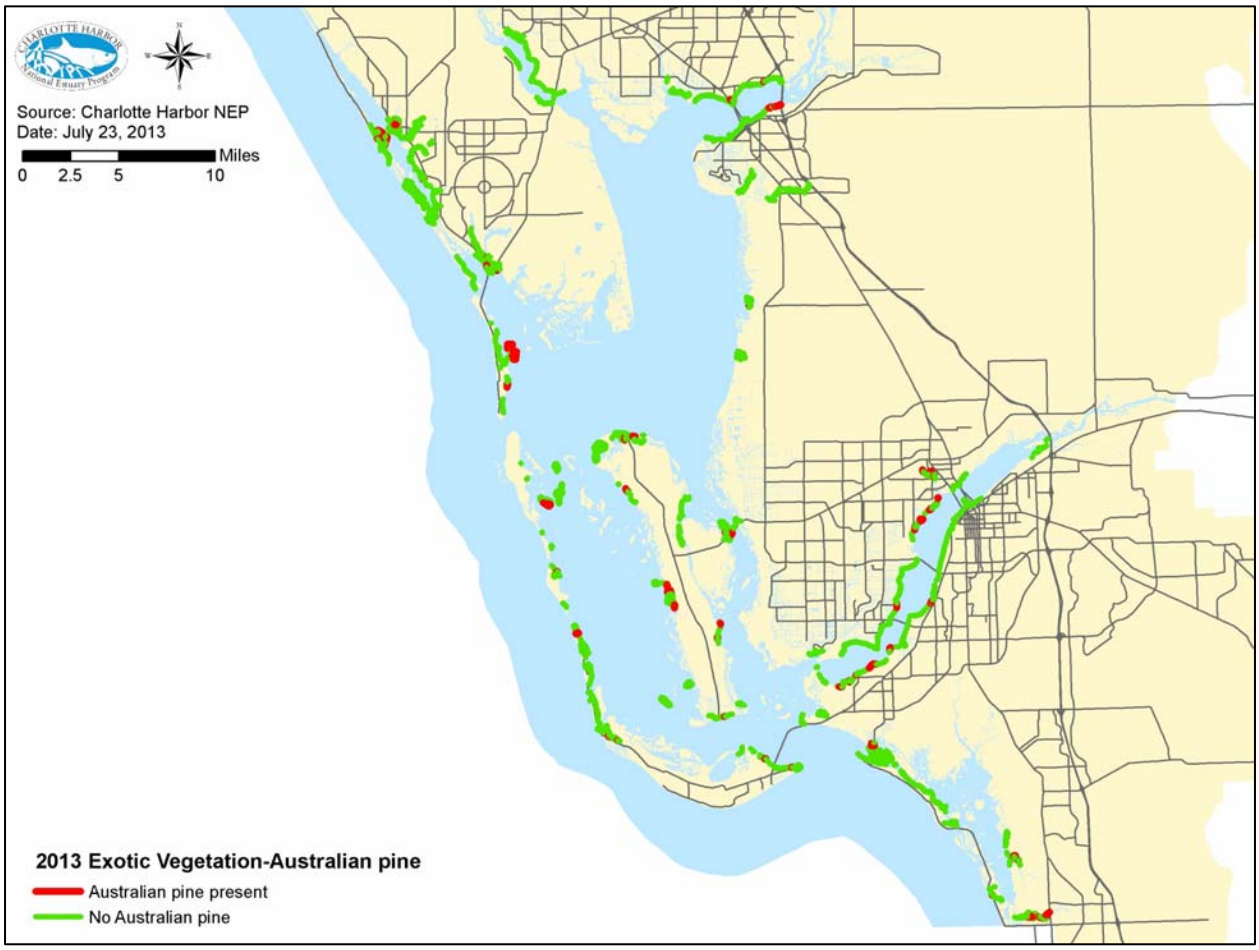
2013 Exotics	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Greater than 30%	5	2.7%	94	2.5%
Less than 30%	31	17.5%	527	14.0%
None	142	79.8%	3,132	83.5%
Total	**178**		**3,753**	

Maps of exotic vegetation presence were prepared for 2013 only. Brazilian pepper has the greatest extent of all species of invasive exotic vegetation on urban shorelines. It is particularly problematic on Lemon Bay, Alligator Creek and Imperial River.



2013 Brazilian Pepper	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Yes	24	12.4%	479	11.1%
No	173	87.6%	3,854	88.9%
Total	**198**		**4,333**	

Australian pine has the second greatest extent on urban shorelines throughout the estuarine areas of the CHNEP study area.



2013 Australian Pine	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Yes	15	7.7%	125	2.9%
No	183	92.3%	4,208	97.1%
Total	**198**		**4,333**	

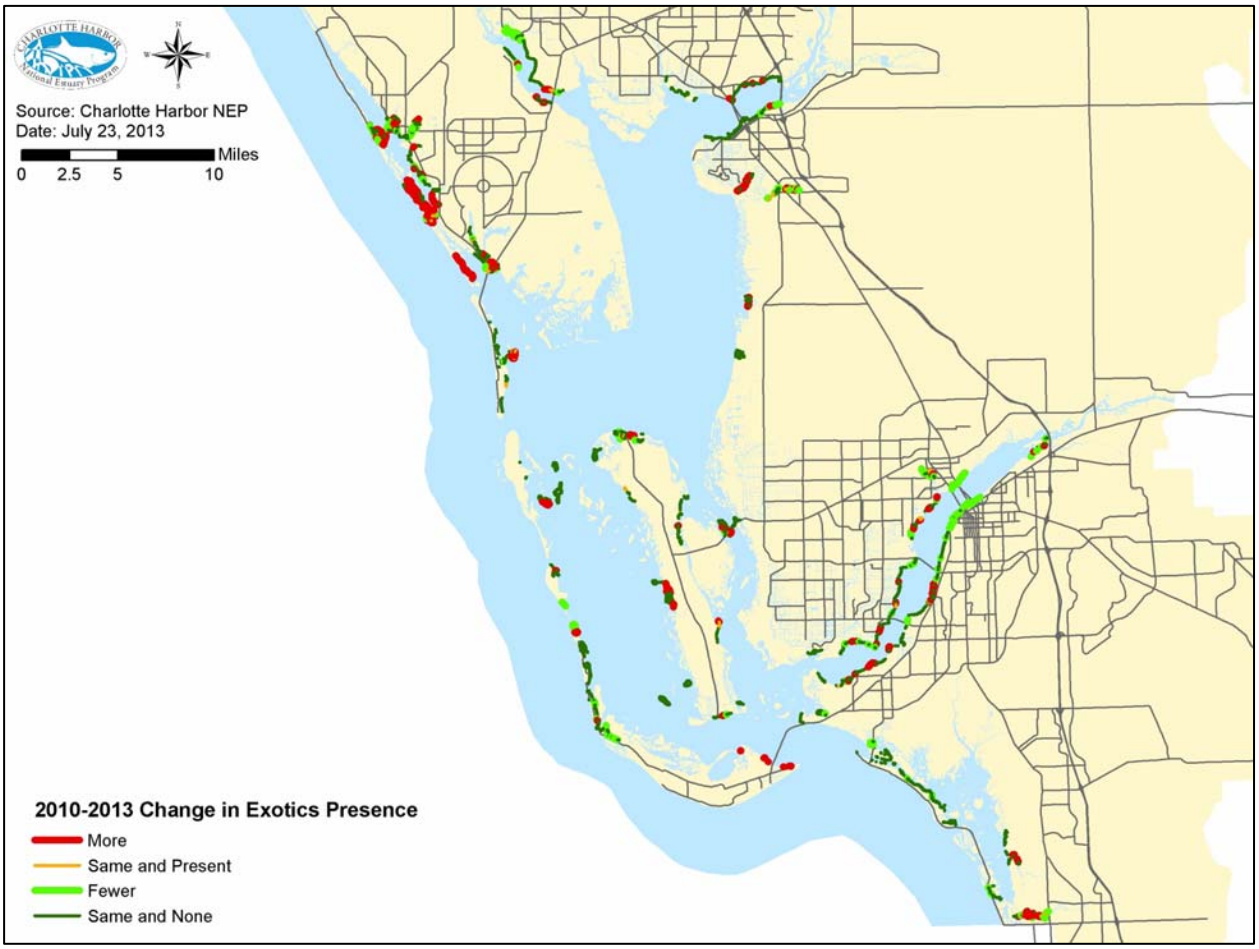
Seaside mahoe is present within the southern portion of the CHNEP study area.

2013 Seaside Mahoe	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Yes	2	1.2%	29	0.7%
No	196	98.8%	4,304	99.3%
Total	**198**		**4,333**	

Earleaf acacia was found on only one parcel and does not appear problematic on tidal shorelines in the CHNEP study area.

2013 Earleaf Acacia	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Yes	0	0.0%	1	0.0%
No	198	100.0%	4,332	100.0%
Total	**198**		**4,333**	

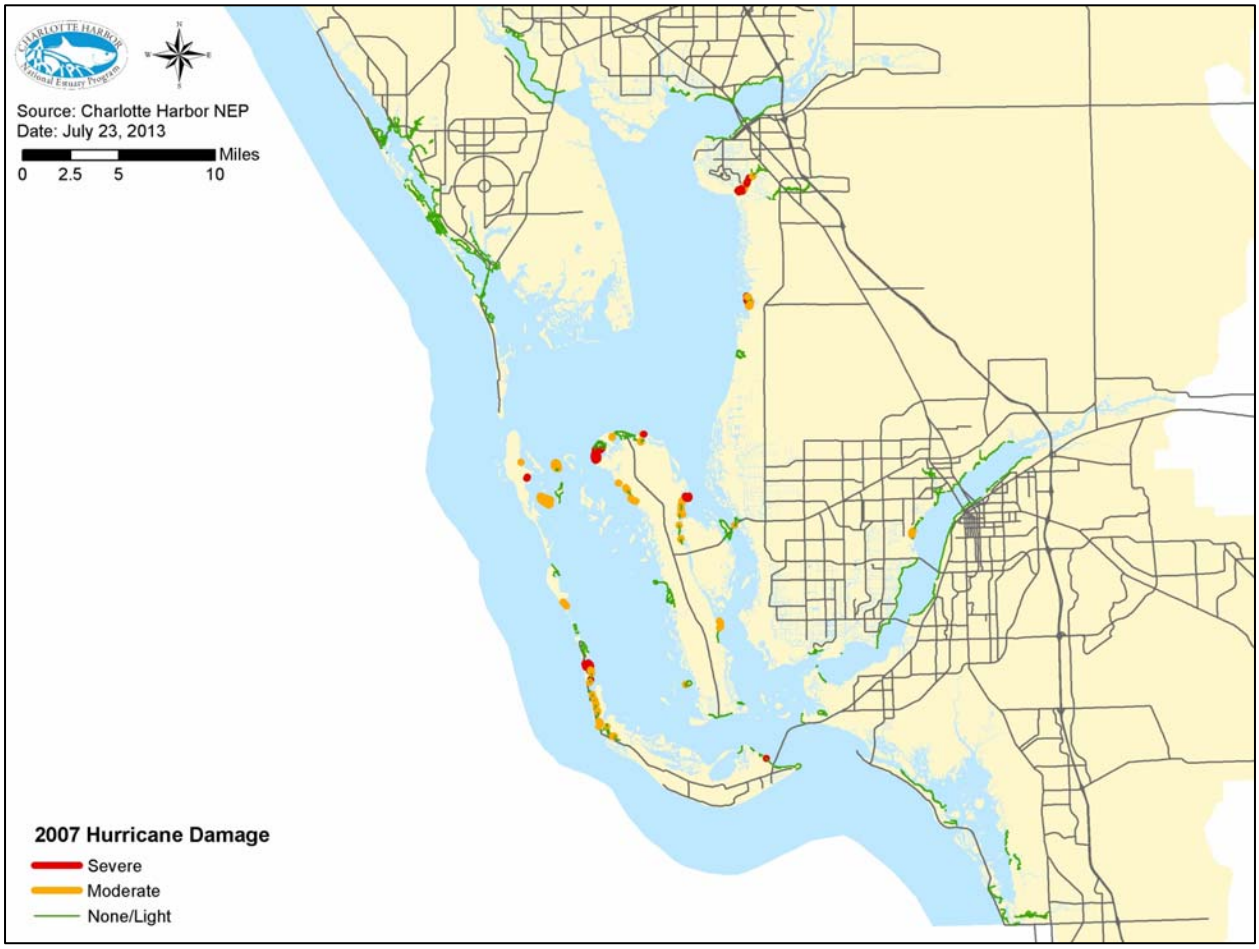
The extent of invasive exotic vegetation has increased between 2010 and 2013. The increases are most notable on the shorelines of Lemon Bay and Alligator Creek, associated with the presence of Brazilian pepper.



Exotics Presence	2010 Greater than 30%	2010 Less than 30%	2010 None	Total Of Miles
2013 Greater than 30%	1	1	2	4
2013 Less than 30%	4	6	20	29
2013 None	3	8	120	131
Total of Miles	8	14	142	165

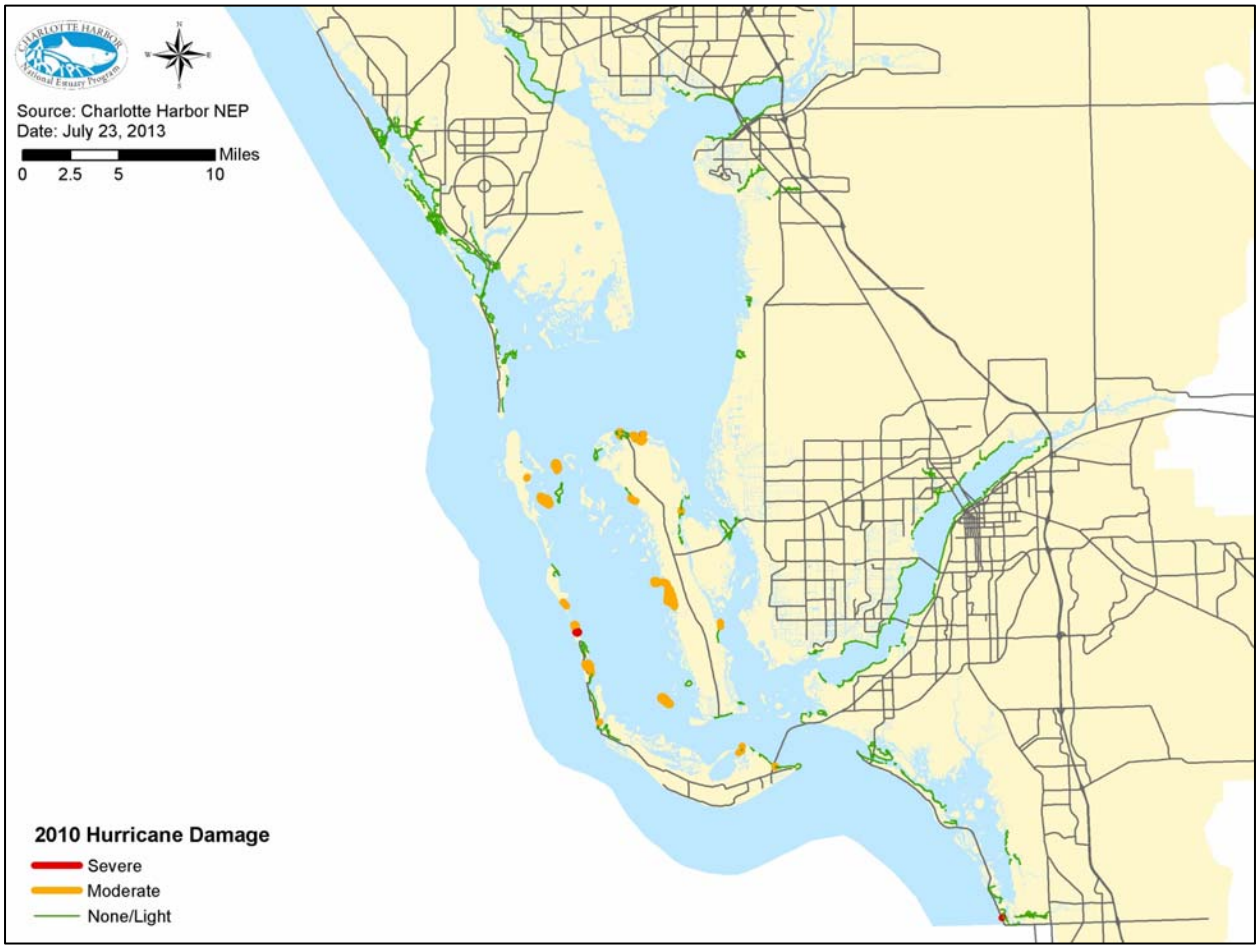
Hurricane Damage

In 2004, Hurricane Charley damaged mangrove forests and shorelines along its path. In 2007, damage associated with Hurricane Charley was evident. Approximately 4 miles (2%) of shorelines surveyed had severe damage. For the purposes of the survey severity of hurricane damage to the mangroves visible from the shoreline, was defined as none (no apparent damage), light (lush foliage, little recognizable damage), moderate (the majority of trees are alive, but have broken limbs, more green than brown or about the same), severe (the majority of trees are dead, unquestionably more brown than green).



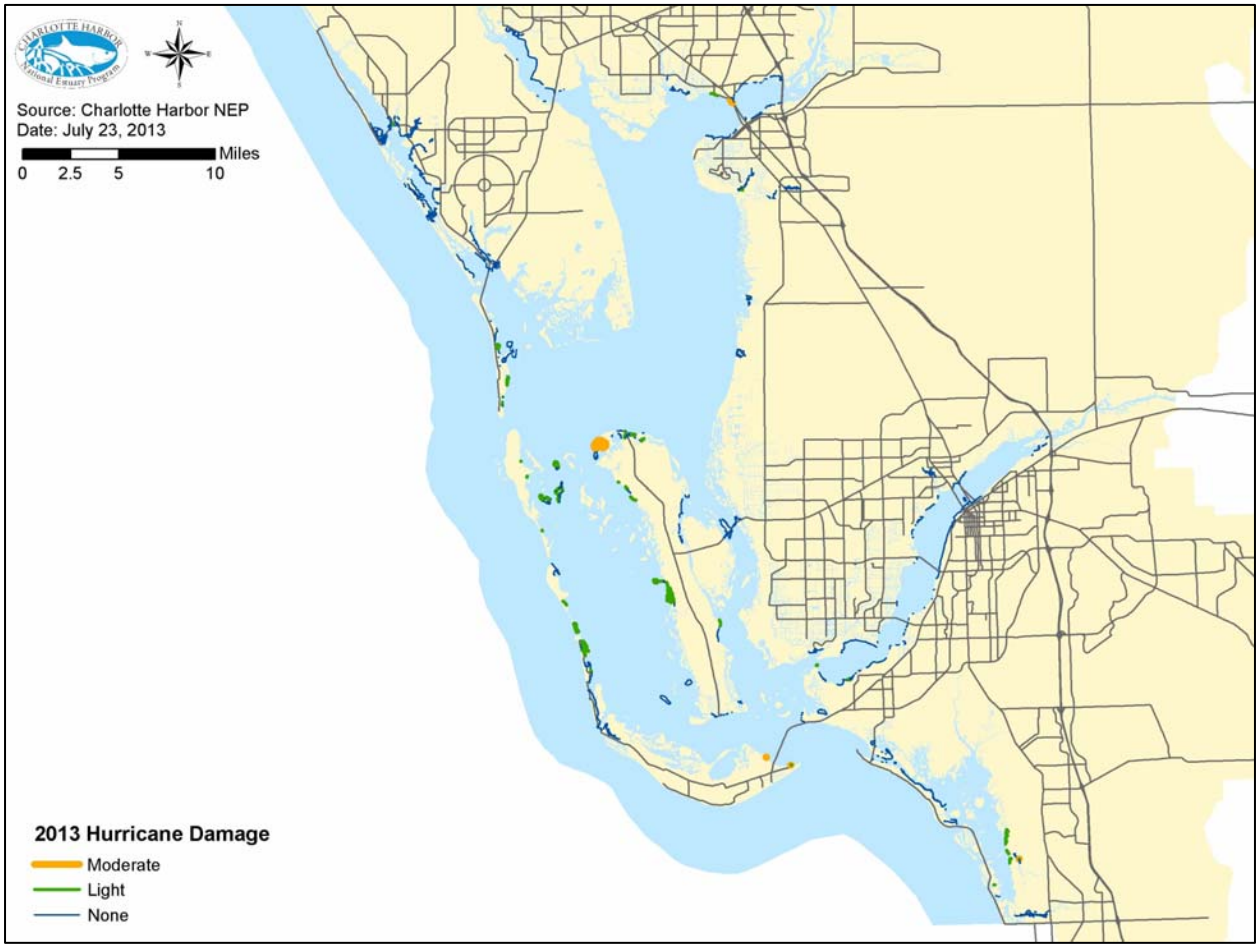
2007 Hurricane Damage	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Severe	4	2.2%	25	0.6%
Moderate	7	3.7%	98	2.2%
None/Light	189	94.1%	4256	97.2%
Total	**201**		**4,379**	

By 2010, severe damage was documented on 3 parcels representing less than a mile of shoreline.



2010 Hurricane Damage	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Severe	0	0.1%	3	0.1%
Moderate	15	6.7%	82	1.7%
None/Light	206	93.2%	4867	98.3%
Total	**221**		**4,952**	

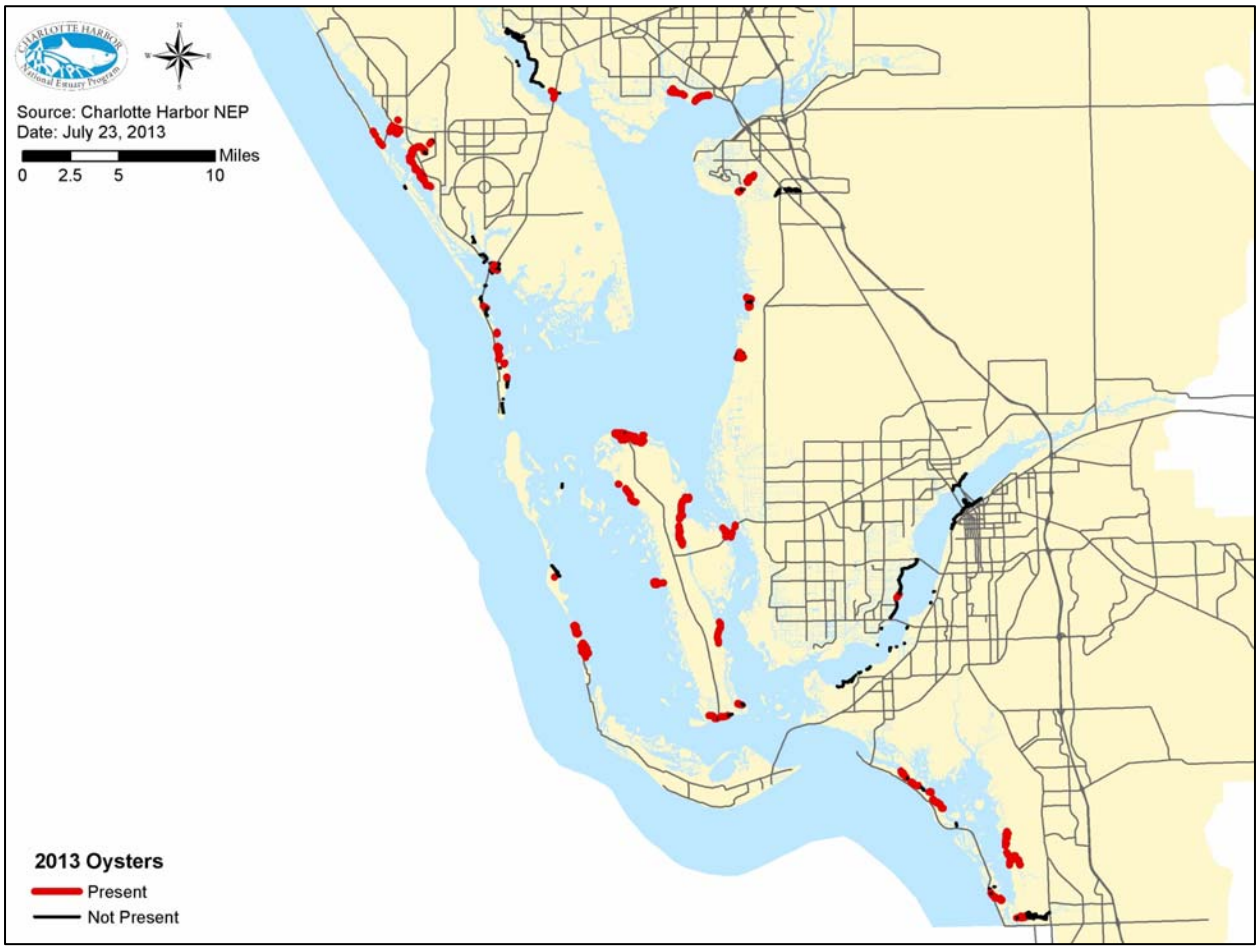
By 2013, no severe damage could be found. Moderate damage could still be found near Bokeelia, at the north end of Pine Island.



2013 Hurricane Damage	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Moderate	3	2.1%	9	0.3%
Light	19	11.9%	98	3.2%
None	134	86.0%	2951	96.5%
Total	**156**		**3,058**	

Oysters

Oyster presence was first assessed in 2010. Unfortunately, the 2010 database included a true/false field for oyster presence. If no oysters were confirmed for the shoreline or if oyster presence was unknown, "false" was recorded as the field value. Therefore, values for 2010 oyster presence will not be reported here.

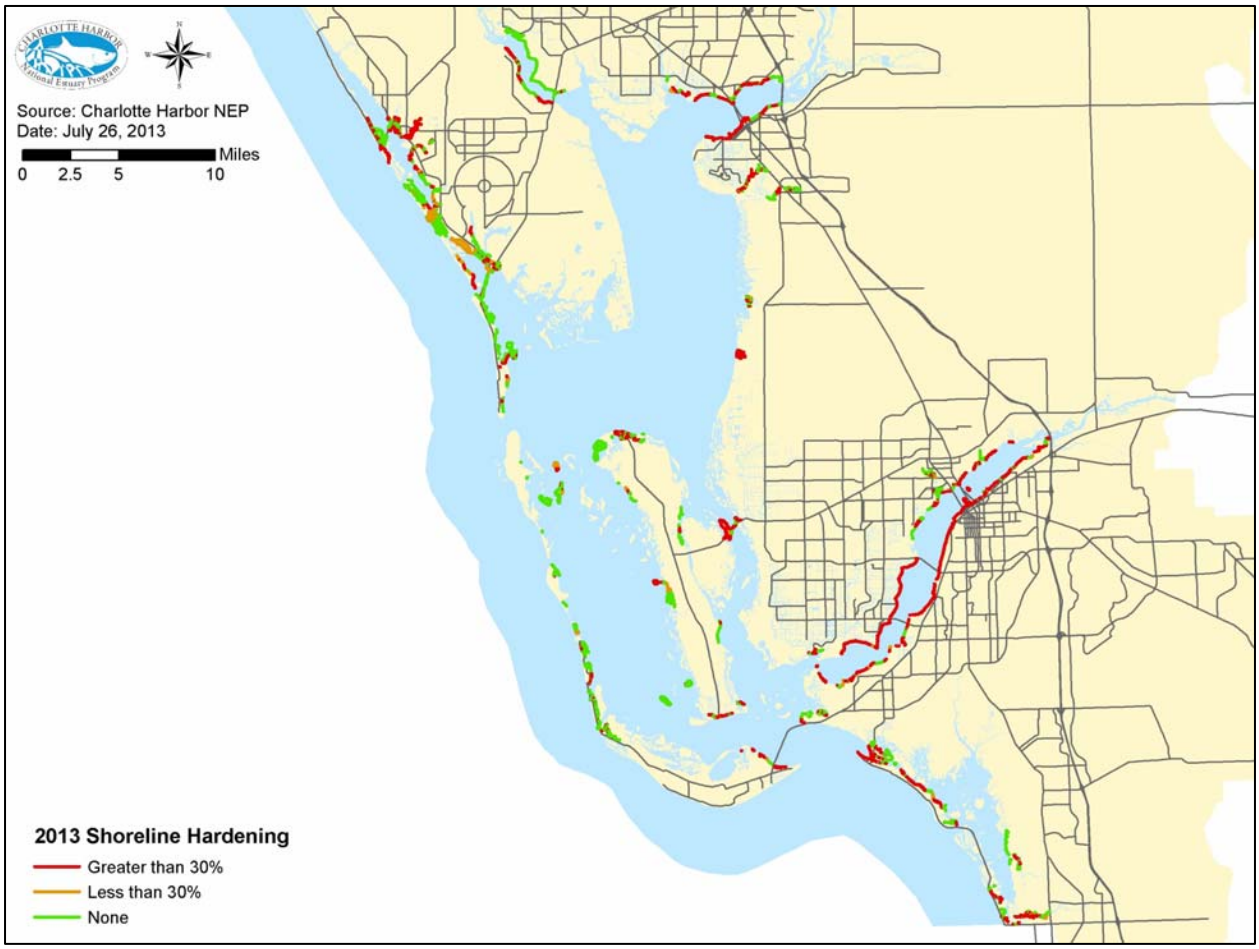


Oyster presence could not be confirmed for 126 miles (64%) of shoreline. Confirmed presence and absence were each in 36 miles (18%) of urban shoreline.

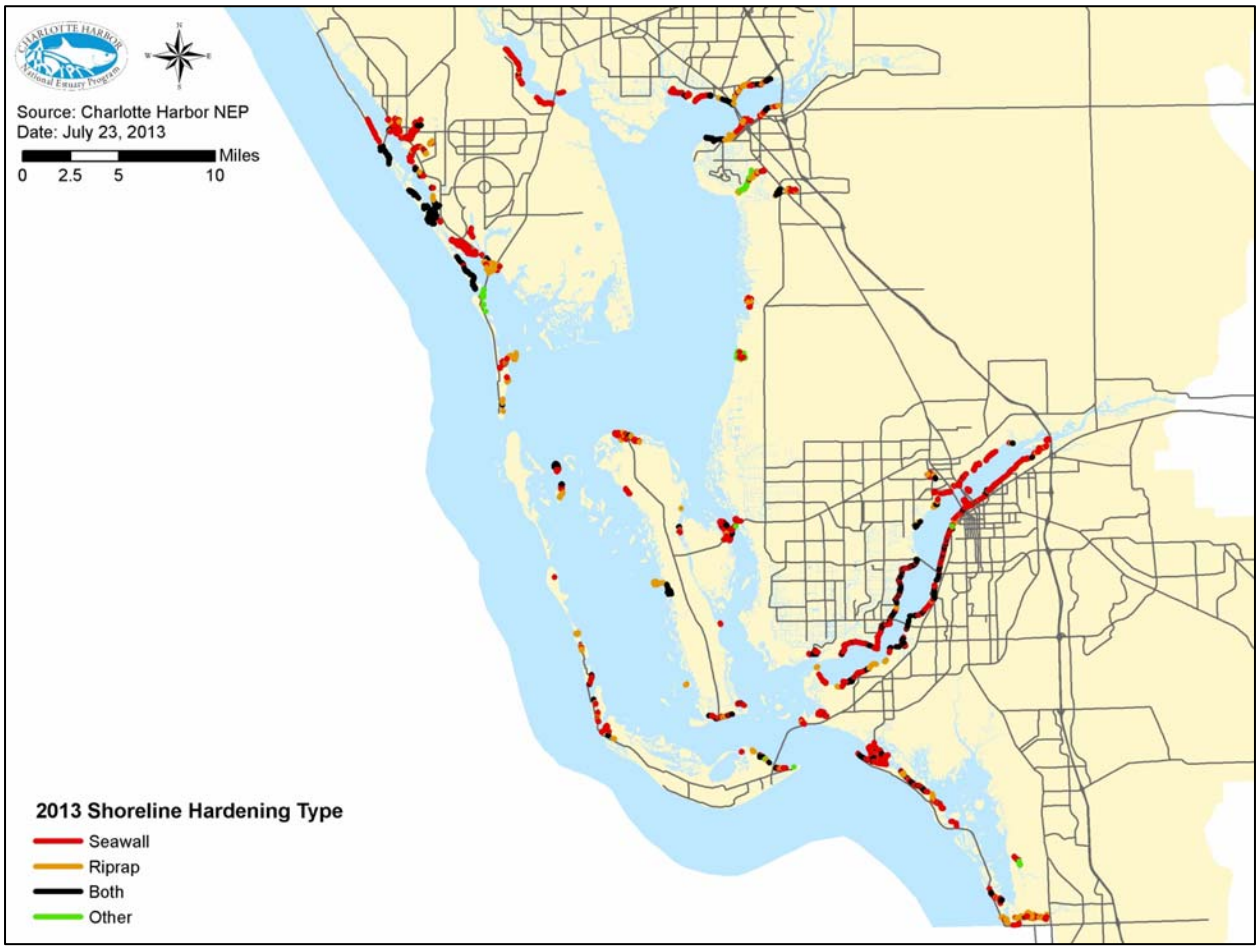
2013 Oysters	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Yes	36	18.2%	644	14.9%
No	36	18.1%	720	16.6%
Null	126	63.7%	2969	68.5%
Total	**198**		**4,333**	

Shoreline Hardening

Shoreline Hardening and hardening type were not included in the 2007 survey because the information was captured by the contractor for the CHNEP. Shoreline hardening and hardening type were added to the 2010 survey and continued with the 2013 survey. However, more detailed review of the 2010 data is needed to capture the difference between sites with no hardening and sites with no data, due to data entry issues associated with the 2010 database. Therefore, only shoreline hardening results from 2013 are presented here.



2013 Hardening	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Greater than 30%	105	45.2%	3229	60.9%
Less than 30%	20	8.5%	451	8.5%
None	108	46.4%	1625	30.6%
Total	**232**		**5,305**	



2013 Hardening Type	Sum of Miles	Percent of Miles	Number of Parcels	Percent of Parcels
Seawall	66	52.4%	2,171	58.8%
Riprap	21	16.8%	475	12.9%
Both	33	26.5%	985	26.7%
Other	5	4.3%	61	1.7%
Total	**125**		**3,692**	

Uses of the Tidal Shoreline Survey Information

The primary purpose of the volunteer tidal shoreline survey information is to track the status and trends of shoreline condition where those conditions are the most volatile: the urban shoreline.

Information regarding urban shoreline can introduce property owners to alternative and more environmentally friendly ways their regional neighbors are using to manage their shoreline. Such techniques include limiting mangrove trimming, using uplift and windowing mangrove trimming techniques instead of hedging, removing invasive exotic vegetation from their shoreline and not hardening their shoreline.

During the course of the 2013 survey, representatives from NOAA requested the data to assist with their efforts to protect smalltooth sawfish habitat, and for "getting a better idea where the primary constituent elements exist for their recovery and conservation."

General areas that have been identified persistently by volunteers as having trimmed mangroves of less than 6 feet in height can be used to focus compliance checks by the Florida Department of Environmental Protection.

Significant locations where exotic invasive vegetation exists was identified. This information can be used to target volunteer invasive exotic removal efforts.

Patterns of oyster presence can help identify locations for oyster restoration.

Lessons Learned

The survey was conducted in 2007, 2010 and 2013 with different CHNEP coordinators each time. Each iteration included notable improvements to the methods and execution of the survey. Several identified improvements for future Volunteer Tidal Shoreline Surveys are listed below.

- When first asking for volunteers, ask past volunteers for suggestions to improve the details of the survey. They were very helpful in 2013.
- In 2013, about half of the volunteers had participated in one or both earlier surveys. About half of the volunteers paddled and the others used boats.
- Recreate *all* maps. This must be done. Use latest images available. Verify that all parcels in all regions are numbered and visible on the maps. Provide more GPS data points. Save the maps in a way so they are easier to distribute. The digital files for many of the current maps are too large to email.
- Determine and include whether the region is best done by boat or by a paddler.
- Consider using new technology. In 2013, most of the volunteers still preferred to use print-outs. Some volunteers reviewed the regions they were assigned through Google Earth before conducting the survey itself. With the Water Atlas, the volunteers will have access to prior surveys and may also wish to review prior findings before conducting the new survey.
- In 2013, the data form was streamlined. Thanks to Linda Britton for preparing a better version of the form to use next time. This change will make it easier on volunteers and reduce the amount of waterproof paper needed.
- Ask the volunteers to note if the parcel is undeveloped or if a homeowner constructed the home in a way that enhances mangrove presence.
- The Water Atlas data form worked but could be made easier for volunteers. One idea to explore is having volunteers save the data in an Excel file that staff can later import. Provide more lead time so the form is working before the training is held.
- The time given to volunteers to complete their surveys and input the data worked. The training was held January 12 and the deadline was February 22. The same amount of time is needed to for new volunteers to conduct surveys that previous volunteers failed to complete. Volunteers who weren't able to meet the initial deadline, for the most part, weren't able to complete it no matter how much time was provided.
- The training should be held twice: once in Lee and once in Charlotte Counties. They should be held at different times, e.g., Saturday morning and Tuesday evening. The Florida Paddling Trails Association (FPTA) training should not be included as part of the training. It made the day too long and most volunteers were knowledgeable on the natural environment. The volunteers who stayed appreciated the GPS training offered by the U.S. Coast Guard Auxiliary. The training must include an exercise using PowerPoint, coupled

with Automated Response Systems (to collect answers from participants) to determine the best answers for each parcel. The exercise should include samples on things such as determining mangrove presence, mangrove height, exotic identification and the depth of the shoreline. Some volunteers came expecting lunch and were disappointed that lunch was only provided to those who registered for all three sessions (FPTA, survey and GIS). This was stated in the announcement but there were too many options to be clear to all who participated. Refreshments were provided to all.

- In addition to the exercises, it needs to be determined how close the volunteers should be from the shoreline. It's easier to identify and include new sprouts in the survey when hugging the shore while paddling while they'd be impossible to spot from a boat at a greater distance.
- Allow volunteers to only take two regions at a time. If they are able and more help is needed, more regions can be assigned later.
- The packets worked fine but would have been better to have the forms in envelopes. After asking past volunteers, clip boards (instead of boxes) and pens were purchased. A few boxes were available but most preferred the clip board. The pens purchased weren't of the quality anticipated. Some volunteers objected to covering the cost of postage to return completed forms. Since the cost is so variable and some prefer to drop off the forms, one idea is to provide a book of stamps to each volunteer. Excess stamps can be considered by the volunteer as a "thank you" for their volunteer effort.
- While there was initial interest in a meeting to learn the survey results, the meeting was not well attended.
- Offer volunteers a letter that explains the project in case they are stopped by law enforcement or homeowners. One volunteer in 2013 asked for such a letter, was provided one and did need it.
- The audit of findings by Charlotte Harbor Aquatic Preserves was beneficial. Their findings would have been better if the volunteers had the opportunity to practice exercises during training and the distance from shore was standardized.

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