

Mapping the Characteristics and Condition of the Charlotte Harbor Coastal Shoreline using Volunteer Boater Observations and Photointerpretation



**Charlotte Harbor National Estuary Program
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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 4,400 square mile study area. Many of these partners also financially support the Program, which, in turn, affords the Program opportunities to fund projects such as this. 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
Peace River/Manasota Regional Water Supply Authority
Polk, Sarasota, Manatee, Lee, Charlotte, DeSoto, and Hardee Counties
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Introduction

The coastal shoreline condition mapping project was developed to fill a gap in available data that was identified in the Charlotte Harbor National Estuary Program (NEP) environmental indicators report (ref.). A list of environmental indicators was developed to aid in assessing the relative condition of the estuary, and surrounding environment, and to measure progress of the Charlotte Harbor NEP Comprehensive Conservation Management Plan implementation. The type of shoreline can indicate the level of protection against major storms and pollution, and the amount and quality of habitat available for fish, other aquatic organisms, and birds. Complete shoreline condition data was not available for the Charlotte Harbor area, but could be used in multiple capacities including; coastal planning, environmental management, and recreational interests.

The Charlotte Harbor NEP coastal study area includes all of coastal Charlotte and Lee Counties, and a portion of Sarasota County, several thousand miles of shoreline. These shorelines are “managed” on two levels; large scale by state, county and city regulations, and small scale by property owners and developers. Understanding the effects of both levels of management is essential. The cumulative effect of personal property management of shorelines may lead to large scale landscape changes, which in turn affect the quality of habitat and the functionality of the shoreline. In addition scientific studies and future decisions by regulatory agencies will also be aided by the large scale view of shoreline condition.

In order to address both scales, a two-fold program was developed. For one aspect of the project a volunteer boater survey was developed to enlist the assistance of many of the resource users. The Charlotte Harbor estuary is highly valued for on-the-water recreation, by paddlers, anglers, and boaters, many of which are looking for opportunities to assist in ensuring the protection of the natural beauty and fisheries resources. Due to the vast extent of the “natural” shoreline, and the need for a large scale assessment, the second portion of the program involves a photointerpretation mapping approach.

Goals and Objectives

The goal of this project was to develop a shoreline condition map, for the coastal areas within the CHNEP boundary (Figure 1), that could be used as a tool for decision makers, scientists and resource users. The additional objectives that are related to this goal are:

- Provide data to assist in decision making related to estuary protection and restoration
- Identify shoreline habitat use patterns
- Identify lands suitable for protection
- Determine the impact of new coastal development
- Promote understanding of watershed issues
- Identify wetlands suitable for restoration
- Determine the impact of point and non-point pollution
- Identify areas vulnerable to future hurricanes and sea level rise



Figure 1. The Charlotte Harbor National Estuary Program study area includes coastal regions in Sarasota, Charlotte and Lee Counties.

Methodology Development

Review of Completed Shoreline Mapping Projects

Shoreline mapping in the Charlotte Harbor coastal area has been limited in the past to addressing large scale needs for basic shoreline maps, and emergency planning, with the exception of some localized maps especially in Sarasota County. A state-wide map was produced by the Florida Wildlife Research Institute in 2003 and was called Florida's Environmentally Sensitive Shoreline. This map (available from the Florida Geodetic Library) was a large scale assessment of the shorelines, and included information on presence/absence of mangroves and hardened shoreline. However, the map was not intended for local habitat characterization or other localized assessments.

The Sarasota County shoreline is the one local area that has been mapped in part by several different projects. In 1988 a study was funded by Sarasota County and conducted by Mote Marine Laboratory (Evans and Evans 1988). This study was a follow-up to earlier work by Evans et al. and allowed for an assessment of change over time. The categories used in these studies were the backbone for those chosen in the CHNEP shoreline survey, along with those used by the Sarasota Estuary Program's mapping project.

Additionally Sarasota County Resource Protection staff began a survey in 2004 to document the presence of mangroves, their general height (by category), and if the mangroves had been trimmed. This project was done by assessing individual parcels along the developed open bay and main tributary shorelines throughout the county. The project was repeated in 2006, county staff planned to repeat the study in 2007. This study formed the backbone of the volunteer portion of the CHNEP shoreline survey.

Stepping outside of the local area, other examples were found and used in the development of this project. A report by the Virginia Institute of Marine Science (Berman and Hershner 1999) to the EPA summarized the development of protocols for shoreline situation reports in Virginia. Some general ideas for protocol development were taken from this document as well as from the Adopt a Stream shoreline survey protocol in Massachusetts. The Adopt a Stream program provided great background on the use of volunteers for shoreline surveys.

Shoreline Survey Steering Committee

A steering committee made up of volunteers, resource managers, and scientists came together to develop the methodology to be used in the CHNEP shoreline survey.

Committee Members

- Ted Sliwinski – Port Charlotte Kayakers
- Bob Leonard – Charlotte County Coastal Conservation Association
- Melynda Schneider – Charlotte Harbor Aquatic Preserves
- Celia Stearns – Charlotte Harbor Aquatic Preserves
- Norma Zyosec – Coastal Wildlife Club
- Wilma Katz – Coastal Wildlife Club
- John Aspiolea – Charlotte Harbor Preserves State Park
- Carla Kappmeyer – Charlotte Harbor Preserves State Park
- Jay Garner - Charlotte Harbor Preserves State Park
- Karen Bickford – Lee County and Friends of Charlotte Harbor Aquatic Preserves
- Missy Christie – Charlotte County Natural Resources
- David Allen – Port Charlotte Kayakers
- Chrystal Murray - Citizen
- Howard Berna – Sarasota County
- Ralph Montgomery – PBS&J

The steering committee was provided with background information about the various studies mentioned above and the CHNEP goals and objectives. The committee felt strongly that this study would be beneficial to organizations planning restoration projects, to identify exotic vegetation, to identify habitat types, to use as an indicator, for educational purposes, and for modeling sensitive areas. Due to the numerous uses of the data the committee recommended the survey be repeated as often as possible, but at least every 5 years to assess changes.

One of the main tasks of the committee was to determine which categories of data was most critical to collect, and what methods should be used to ensure accuracy and ease of data collection by volunteers. The following were data types that were considered:

- Shoreline Composition
- Adjacent Landuse/Landcover
- Shoreline Stability
- Shoreline Protection/Stabilization
- Water Access/Recreational Facilities
- Bank Condition
- Submerged Habitat Condition
- Ownership
- Pollution Indicators

Numerous points of concern were identified by the steering committee and taken into consideration during the protocol development:

- Validity of data
 - Everything should be clearly described and data sheets easy to use (circle or check appropriate categories) to eliminate as much user error/bias as possible.
 - Different people may evaluate similar sightings differently.
 - Difficulty in determining hurricane impacted trees
- Participation – can we get enough people?
 - Survey results should be oriented towards mangrove restoration.
 - Keep survey simple/general enough to keep the public engaged
 - Availability of GPS for volunteers.
- Volunteers should not be placed in compromising positions – such as reporting illegal violations.
- Other concerns?
 - Ownership is probably not important – can be obtained through public records.
 - Involvement of high school students may be problematic, unless they become involved with parents/relatives, or a school coordinator.

Field Testing

Volunteers were used to field test the original methodology and datasheets. Following comparison and evaluation of volunteer data, changes were made to datasheets and data collection methods to reduce the possibility for error and to reduce volunteer time in the field. Additionally, it was determined that the majority of volunteer effort would focus on developed areas, although some volunteers would generally survey the natural shoreline areas as a form of “ground-truthing” for the photo-interpretation portion of the project. The final field datasheets and methodology was field tested by the CHNEP staff.

Volunteer Boater Methodology

Study Areas

The volunteer portion of this study was conducted in the coastal regions of Charlotte and Lee Counties. Sarasota County was already covered by the county project. A few

“natural/undeveloped” areas were surveyed in Charlotte County for exotic vegetation and hurricane damage, these areas included Turtle Bay, the Hog Island region, Charlotte Harbor west wall, Charlotte Harbor east wall (near Pirate Harbor), and Coral Creek.

The developed areas surveyed (Figure 2) included those parcels along the open water or tributaries to the estuary, and did not include canals. The following areas were included:

Charlotte County

Alligator Bay
Alligator Creek North
Alligator Creek South
Alligator East of 41
Capstan Cut
Coral Creek
Charlotte County Gasparilla Island
Gottfried Cr.
Kettle Harbor
Lemon Bay Buck to Lemon Creek
Lemon Bay North of Tom Adams Br.
Lemon Bay Oyster Creek to Buck Creek
Lower Myakka
Old Knights Pass
Oyster Creek
Peace NW of 41
Peace NE of 41
Peace SE of 41
Peace SW of 41
Pirate Harbor
Placida Harbor NE
Placida Harbor West
Rocky Creek
South of Stump Pass
SW of Tom Adams Bridge

Lee County

Bokeelia
Bonita Beach
Burnt Store Marina
Caloosahatchee - NW Redfish Pt
Caloosahatchee 1
Caloosahatchee 2
Caloosahatchee 3
Caloosahatchee 4
Caloosahatchee 5
Caloosahatchee 6
Caloosahatchee 7
Caloosahatchee 8
Caloosahatchee NFM
(aka North Fort Myers tributary)
East Pine Island
East Sanibel
Imperial River
Lee County Gasparilla Island
Lower Fort Myers Beach
Lower Pine Island Sound
Matanzas Pass
Matlacha
Mid Fort Myers Beach
Mid Pine Island Sound
North Pine Island Sound
Northside Lower Caloosahatchee
Punta Rassa
Southside Lower Caloosahatchee
Spring Creek
(aka Coconut Point to Spring Creek)
St. James City
West Sanibel

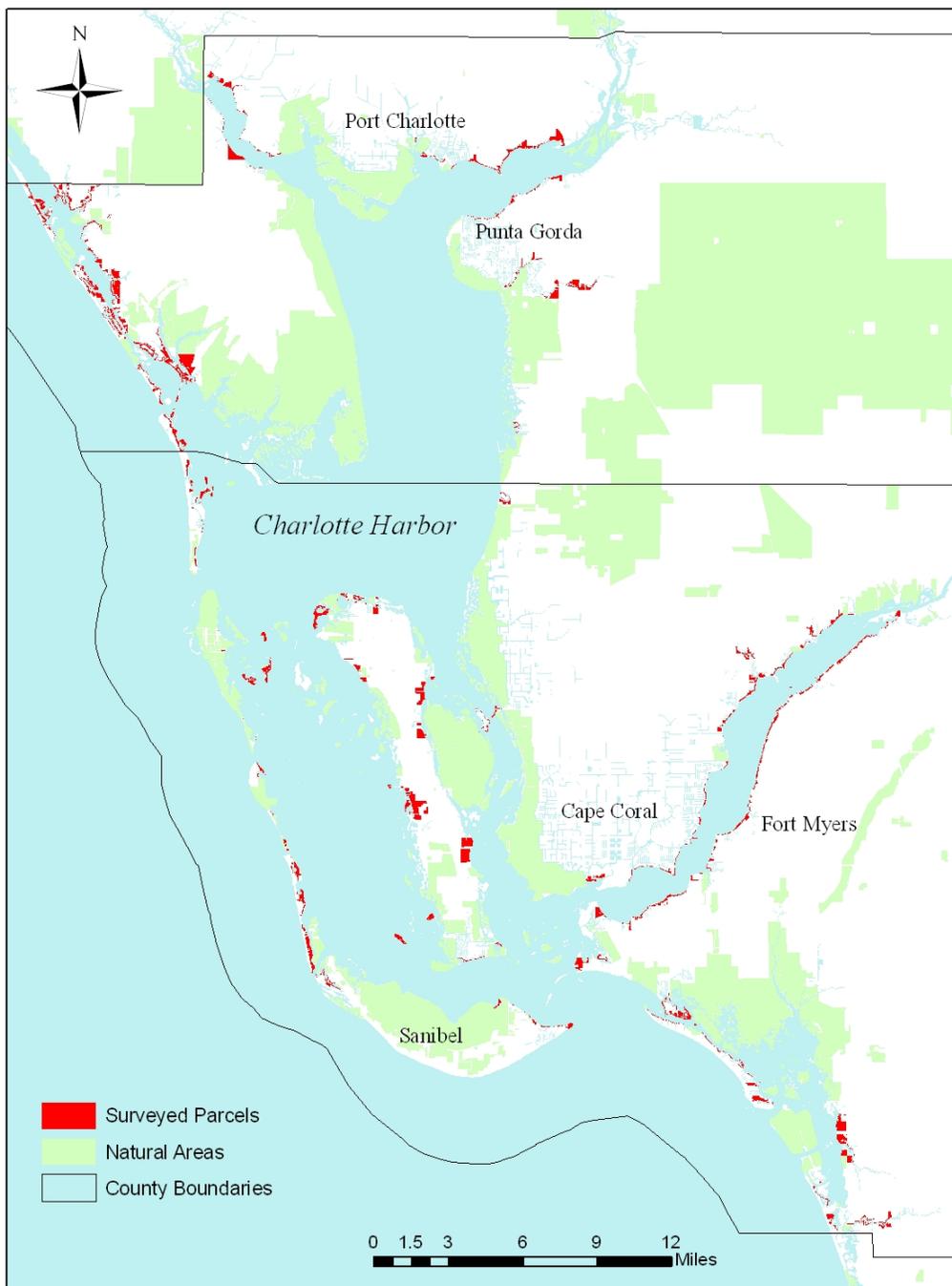


Figure 2. Areas within Charlotte (north) and Lee Counties (south) surveyed by volunteer boaters.

Materials Provided

One volunteer packet was distributed for use on each boat, or in the case of kayakers per group of boats. This packet provided most of the materials needed to conduct the shoreline survey, including the following:

- 2 Clipboard Boxes
- Photo-interpretation Key (pictures of vegetation classifications)
- Pencils
- Extra Fine Point Sharpies
- Maps – region name at top of map
- List of Checkpoints and Site IDs
- General Information Datasheets
- Shoreline Condition Datasheets
- Points of Interest Datasheets
- Rubber bands – use to hold datasheets and maps down on clipboard
- Pre-addressed envelope to return data
- Boaters information provided by Lee County
- Charlotte Harbor NEP newsletter

Volunteer Data Collection

One of the biggest challenges in designing a volunteer shoreline survey was how to collect spatially accurate data without spending a lot of time in the field. We determined the best way to gather meaningful data would be to associate data with each parcel, as already mapped by both Lee and Charlotte counties. The maps provided to volunteers used aerial photographs along with parcel outlines and parcel labels to help volunteers keep track of where they were along the shoreline. Checkpoints were also marked on the maps and corresponding GPS coordinates were provided for the checkpoint locations. This way volunteers could use the checkpoints as references along the way.

Another list of GPS points for all of the parcels (site IDs) was also included. These GPS points however, were locations on land, but could be used for reference as needed. For example if the shoreline being surveyed was to the east, the GPS should indicate that you are directly east of the GPS point listed for the parcel shoreline being assessed.

The following data were collected for each parcel assessed:

Mangrove Quality

For each parcel mangrove presence/absence was categorized as not present, present but less than 30% of the shoreline, or present and greater than 30% of the shoreline.

If mangroves made up greater than 30% of the shoreline, information was recorded about the quality of the mangroves.

- 1) Height (ft): Estimated height of mangroves in feet <6, 6-10, 10-20, >20.
- 2) Trimmed: Determined if the mangroves have been trimmed down (hedged) from the top to create a hedge.

- 3) Degradation: Determined the severity of damage (primarily from Hurricane Charley) to the mangroves visible from the shoreline, using the categories 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).

Exotic Vegetation

Parcels with visible exotic vegetation of the species Brazilian Pepper, Australian Pine, or Seaside Mahoe, were noted by species present and also the general density of the exotic vegetation; less than 30% or greater than 30% of the shoreline.

Other Points of Interest

The Points of Interest Datasheet was provided to volunteers as a way to record interesting observations made along the shoreline. This datasheet was used generally for recording derelict vessels and in some cases debris.

Accuracy Assessment

A random selection of 70 sites in Charlotte County was revisited by local field scientists paired with volunteers. The original data observations were not available during the time of the visit. A comparison of the two datasets was made to assess the repeatability (accuracy) of the data collection.

Photointerpretation Methodology

This portion of the study was contracted to Photo Science, and methodology will be presented in detail in the final report expected in summer of 2008. Photo Science is using Geographic Information Systems technology to map the coastal shorelines of the entire Charlotte Harbor NEP study area, excluding canal systems. Recent aerial photography is being analyzed in order to classify shoreline type; in addition accuracy assessments and ground-truthing are being done in the field.

The following are the classification being used in the photointerpretation:

Vegetation/Natural Shoreline Features

- Mangroves – Shoreline where one or more of the mangrove species dominates.
 - Degraded – Describes mangrove shorelines where the signature clearly depicts dead/unhealthy mangroves, generally resulting from hurricane damage, but may also be a result of hydrologic alteration.
- Exotic – Shorelines with visible exotic vegetation of the species Brazilian Pepper, Australian Pine, or Seaside Mahoe.
 - Species – three separate fields to distinguish which species are present.
- Native Wetland Vegetation – Shorelines with wetland vegetation other than mangroves, including emergent aquatic vegetation, saltwater marsh grasses, freshwater marsh grasses, and wetland shrubs.
- Other Vegetation – Shorelines with vegetation that does not fit into any of the other classifications.

- Beach – Shoreline characterized by a low, gentle slope and composed of shell, fine sand, or silty sand exposed at mean high tide.

Man-made Shoreline Features

- Bulkhead – Man-made shoreline feature also known as seawalls, forming a solid vertical wall along the shoreline.
- Rip Rap – Man-made aggregation of boulders, rocks, or clean (not painted or cemented) rubble fairly consistent in size.
- Other Hardened – Shoreline that has been hardened through man-made efforts, but does not fit into the category of seawall or rip rap.
- Non-classifiable – Shoreline that can not be classified.

Preliminary Results

Volunteer Boater Observations

As of the end of October 4485 volunteer observations had been logged by over 110 volunteers (>\$45,000 in-kind services). This does not include all sections. However, a preliminary look at the data shows 33% of parcels have mangrove shorelines (>30% mangroves), of those with mangrove shorelines 34% are trimmed, while only 7% had moderate or severe damage. Thirteen percent of all parcels had some kind of exotic vegetation.



Figure 3. Volunteer observations around Matlacha demonstrates an area with little remaining mangrove shoreline and some exotic vegetation.

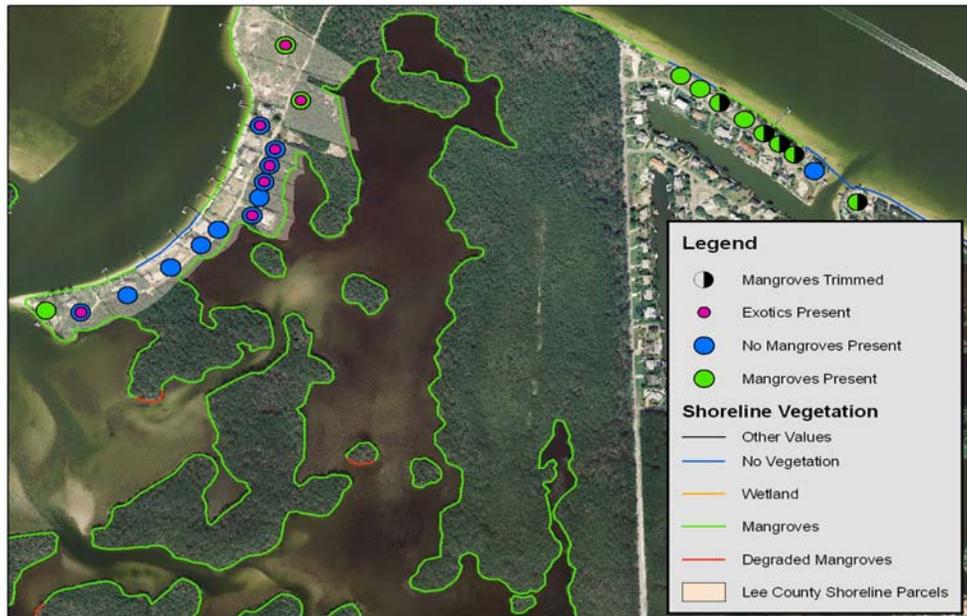


Figure 4. Volunteer observations from the eastern side of Sanibel Island show a mixture of shoreline types, including exotic vegetation, no vegetation, mangrove, and trimmed mangroves.

Volunteers reported a total of 20 derelict boats, along with a few reports of large pieces of debris, and a washed up idle speed zone sign. These reports were passed on to the appropriate county staff, with 11 derelict boats reported to Lee County and 9 reported to Charlotte County. Lee County staff was able to follow up on the reports, making field visits to the locations and dealing with each report as necessary. Charlotte County staff appreciated the reports, but currently lacks the resources to follow up.

Volunteer Data Accuracy Assessment

A comparison of the sub-sample of data collected at the same sites by volunteers and field scientists was made to assess the accuracy of the methods being used. Following the methodology presented above, there were eight categories of data for each site (e.g., mangrove height, mangrove degradation, and exotic vegetation presence). When comparing all eight categories, 47% of the observations matched in all fields, meaning the data recorded by separate observers was exactly the same. For any one category of data the percent of observations that matched was much higher as categorized below:

- 89% accuracy on presence/absence of mangroves
- 83% accuracy on Percent of mangroves
- 80% accuracy on Height of Mangroves
- 79% accuracy on Trim Status
- 97% accuracy on Hurricane Damage
- 90% accuracy on Exotic Vegetation Presence/Absence

This assessment of the volunteer data, along with comments from volunteers and field scientists, reveals there is a challenge in accurately matching observations to the correct parcel depicted on a map. Accuracy may vary from region to region depending on parcel size, depth of water, and ability to maneuver close to the shoreline.

This data was not intended for regulatory purposes, but for the ability to assess the general quality of the shorelines in various areas throughout the Charlotte Harbor NEP study area. The data should be used to make general assessments about regions, for example Matlacha, Sanibel or Estero Bay, but should not be used to assess individual parcels. Future volunteer surveys may be more accurate if smaller scale maps of parcels are used during field assessments. The Charlotte Harbor NEP currently plans to repeat the volunteer survey in two years.

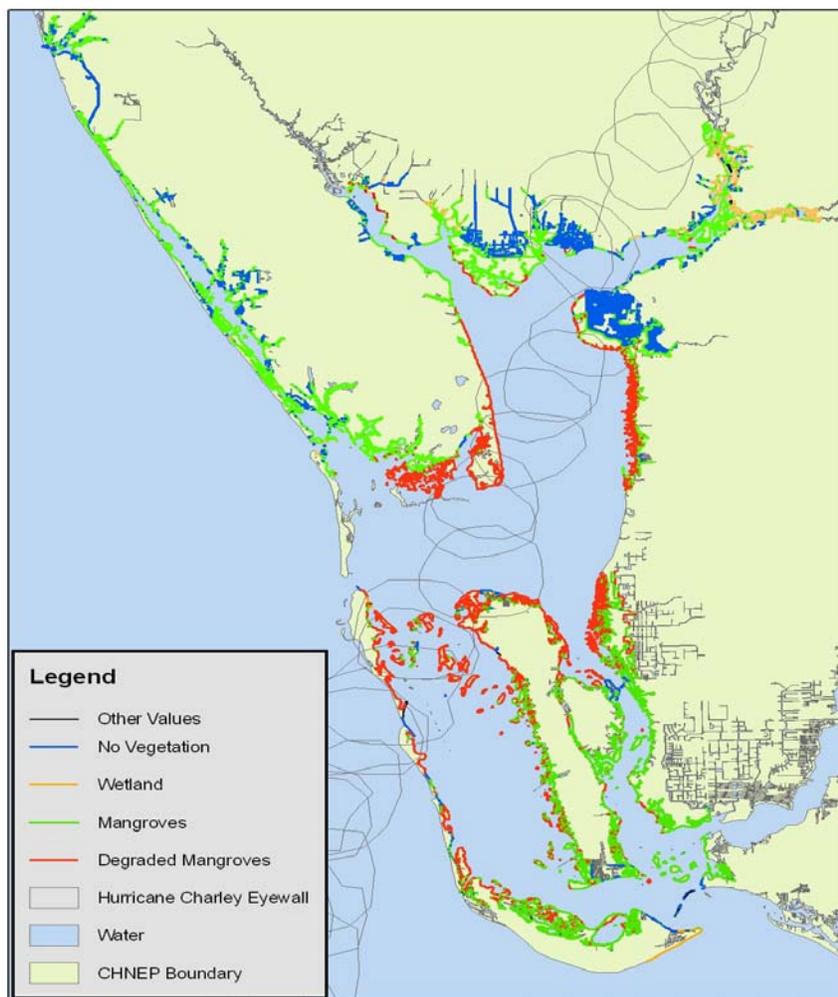


Figure 5. Preliminary shoreline photointerpretation shows those areas where mangroves are degraded in relation to the path of Hurricane Charley.

Photointerpretation

The photointerpretation is not completed at this time; however 1698 miles have been classified. This data is **very** preliminary as the ground-truthing and accuracy assessments are not complete. This preliminary assessment shows 73% of the mapped shoreline (1232 miles) consists of mangroves. Of the mangrove shoreline 34% (419 miles) are degraded. There are 397 miles of seawall (23%) and only 24 miles of rip rap (1.4%).

Completion of this project is planned for summer of 2008, the final report and map products will be available to the public through the Charlotte Harbor National Estuary Program (www.chnep.org).

References

Berman, M. and C. Hersher, 1999. Development of guidelines for generating shoreline situation reports establishing protocols for data collection and dissemination. Final Report. Environmental Protection Agency. Assistance ID No. CD 993725-01-0.

Evans, MW. And R.K. Evans. 1988. Sarasota County estuarine shoreline inventory: Final report. Sarasota County Planning Department. Mote Marine Laboratory Technical Report No.120.