Environmental Indicators Update

Charlotte Harbor National Estuary Program
Technical Report 08-1
May 19, 2008

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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
Cities of Sanibel, Cape Coral, Fort Myers, Punta Gorda, North Port, Venice,
Fort Myers Beach, and Winter Haven
and the Southwest Florida Regional Planning Council.

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Introduction

History

The original Environmental Indicators Technical Report (2005) was developed to establish indicators and targets to assess the health of the Charlotte Harbor estuaries and watersheds. The Technical Advisory Committee (TAC) of the Charlotte Harbor NEP developed a subcommittee structure to address each of the priority issues within the CCMP.

- fish and wildlife habitat loss
- hydrologic alterations and
- water quality degradation

The three subcommittees reviewed the Quantifiable Objectives for their priority issue and created a list of indicators meant to address each Objective. This effort incorporated the efforts of the Charlotte Harbor Environmental Center to develop indicators in 2001 (see "Proposed Environmental Indicators and Management Goals for the Peace and Myakka Rivers", 2001 available from the Charlotte Harbor Environmental Center). The subcommittees also determined gaps in current monitoring and analysis programs for which the program and its partners will need to follow up in the future.

The Environmental Indicators are being revisited to reflect the revised CCMP (2007) Quantifiable Objectives, increased knowledge on the effective use of indicators, and new monitoring and reporting that has filled previous gaps. Indicator numbers such as WQ-a and FW-t do not reflect CCMP action numbering.

In most cases, reporting of environmental indicator measures is desirable by basin (Figure 1), although in some cases seagrass segment (Figure 2) reporting or use of other strata may also be of interest. The desired segmentation schemas are defined for each individual indicator. The following are the names of the Charlotte Harbor basins and seagrass segments:

> **Basins** = Peace River Basin; Myakka River Basin; Coastal Venice Basin, including Dona and Roberts Bays; Lemon Bay Basin; Charlotte Harbor Proper Basin; Pine Island Basin; Tidal Caloosahatchee Basin; and Estero Bay Basin
> **Seagrass Segments =** Coastal Venice and Lemon Bay; East Wall, West Wall, Middle Region, Placida Region and South Region of Charlotte Harbor; Tidal Myakka, Tidal Peace and Tidal Caloosahatchee Rivers; Pine Island Sound; Matlacha Pass; San Carlos Bay and Estero Bay.

When other segmentation schemes are referred to a list of segment names will be provided in the text.

The program has intentionally left out a definition of "long-term" or a baseline date when using this term in any of the targets that do not include a date. It is not the intent of the program to use the approval date of this document as the starting or baseline date.

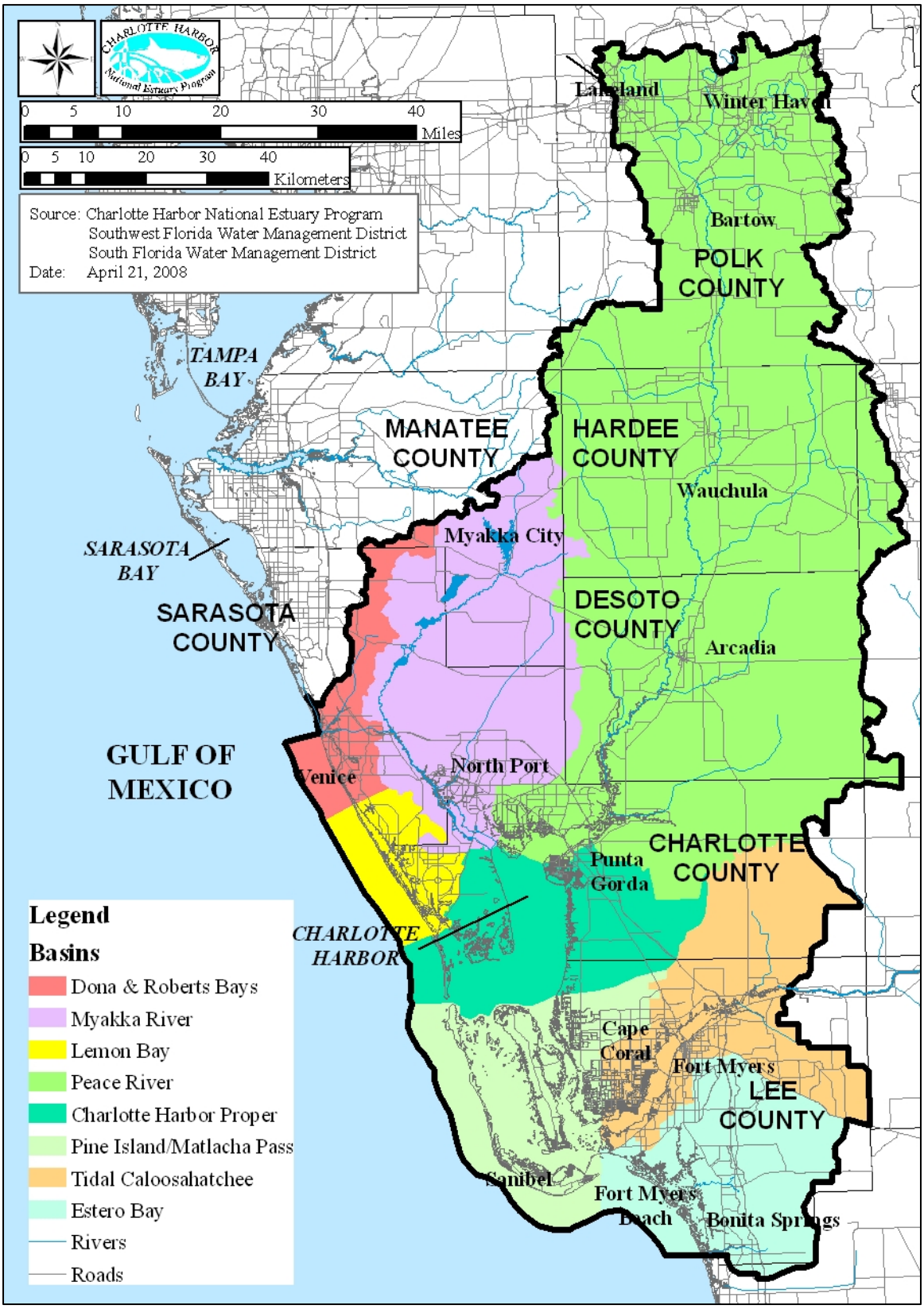


Figure 1. Charlotte Harbor Basins map.

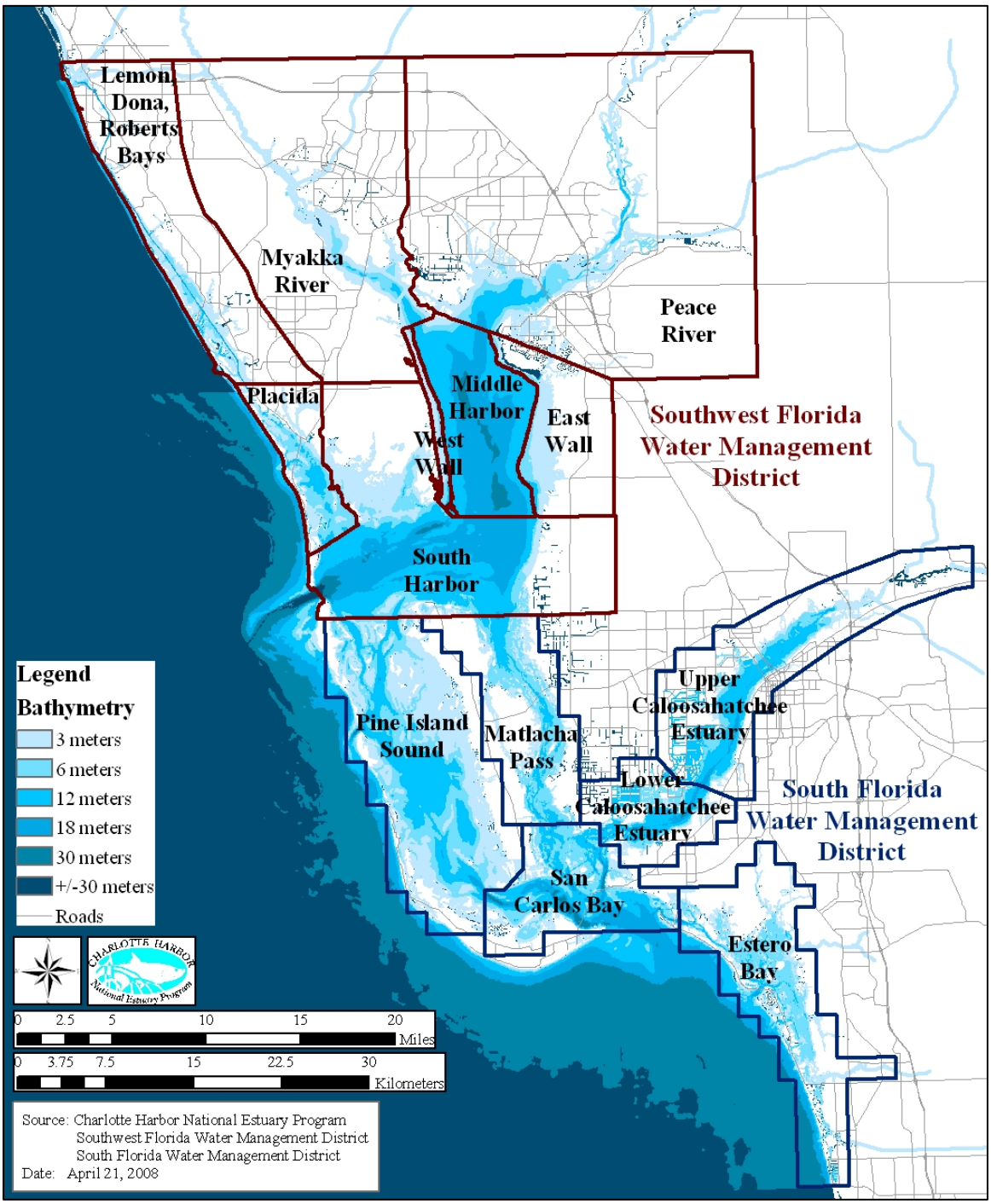


Figure 2. Charlotte Harbor Seagrass Segments

Water Quality

Goals of the CCMP include that our partners maintain or improve water quality from year 2000 levels; develop and meet site specific criteria (dissolved oxygen, chlorophyll *a*, turbidity/total suspended solids, salinity, and pesticides) to protect living resources; reduce severity and extent of harmful algal blooms (HABs); achieve water quality that meets shellfish harvesting standards throughout Class II waters.

WQ-1: Maintain or improve water quality from year 2000 levels. Bring all impaired water bodies into a watershed management program (such as Reasonable Assurance or Basin Management Action Plan) by 2015. Remove at least 2 waterbodies from the impaired list by improving water quality by 2015.

WQ-a: Water bodies (identified by water body IDs) on the Department of Environmental Protection's Planning or Verified Lists for impairments (see surface water quality criteria as listed in 62-302.530 in Appendix B)

Summary: The Florida Department of Environmental Protection produces an impaired water bodies list every two years by county. The list is evaluated for errors by Lee, Sarasota, and Manatee County staff. The CHNEP program staff compiles a list of all impaired water bodies within the study area

Available Products:

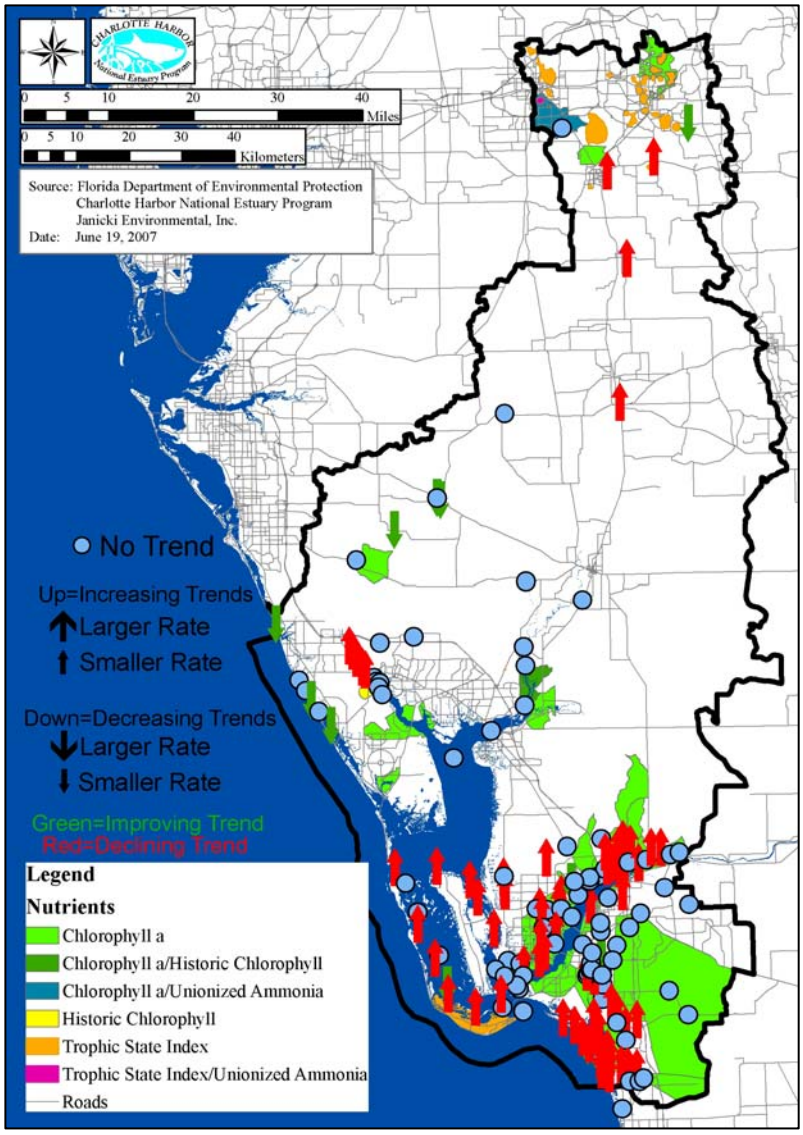
- Maps of FDEP WBIDs linked to specific impairments for classes of nutrients, dissolved oxygen, bacteria, metals, and mercury.

Gaps:

1) Assess accuracy and sufficiency of water quality data in Charlotte, Hardee, DeSoto and Polk Counties.

Target:

- Remove at least 2 water bodies from the impaired list by improving water quality by 2015.



WQ-b: Percent of water quality stations showing declining and/or improving trends by parameter by basin.

Summary: The CHNEP supports the completion of a triennial water quality status and trends report, currently contracted to Janicki Environmental. Analyses in this report are done on water quality parameters throughout the study area for which there are sufficient data sources.

Available Products:

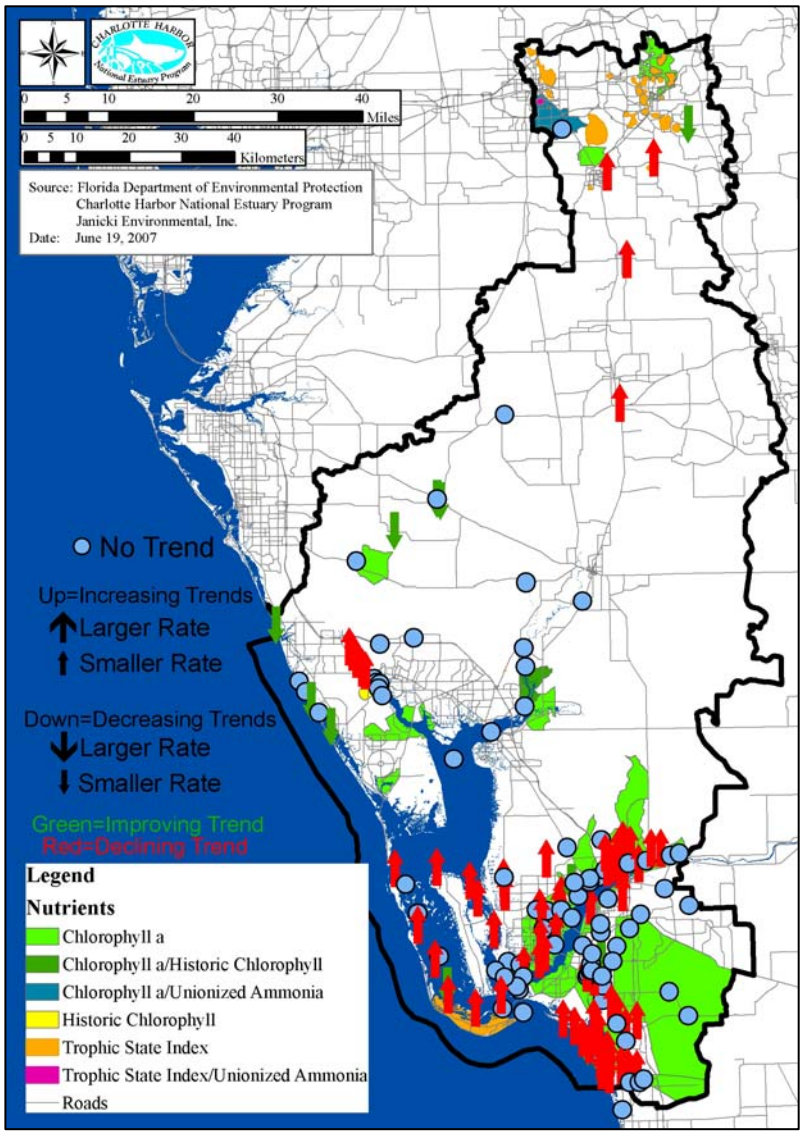
- Trends analyses for parameters other than metals by table and by map, except for metals.

Gaps:

1) Metals trends assessment.
2) Areas with insufficient data for trends analysis.

Target:

- No more than 10% of water quality stations shall show a declining trend.



WQ-2: Develop and meet site specific alternative criteria which are protective of living resources for dissolved oxygen, chlorophyll a, turbidity/total suspended solids, and pesticides by 2015.

WQ-c: Parameters that affect living resources and are not sufficiently addressed by state water quality standards and the Watershed Resources Act.

Summary: The CHNEP's Technical Advisory Committee and their Water Quality and Quantity Objectives Subcommittee (WQQOS) worked with FDEP to consider dissolved oxygen site specific criteria for the Myakka that reflected lower expected dissolved oxygen indicative of subtropical systems. Based on analysis of reference sites, no site specific criteria for dissolved oxygen were recommended. In 2006, CHNEP adopted interim numeric targets for chlorophyll *a*, turbidity, and colored dissolved organic matter (CDOM) which are protective of seagrass, based on light attenuation. The CHNEP is also supporting Mote Marine Laboratory with their investigation of ecoestrogens within area waters and potential accumulation in certain fish species.

Available Products:

- Numeric Water Quality Targets for Lemon Bay, Charlotte Harbor and Estero Bay, Florida, CHNEP Technical Report 06-3.
- Identities and Ecological Effects of Ecoestrogens Present in the Tidal Caloosahatchee River, report by Mote Marine Laboratory for CHNEP.

Gaps:

1) Create a heavy metal monitoring program for sediments conducted every 5 years.
2) Create a more extensive groundwater quality monitoring program.
3) Establish monitoring program for emerging contaminants including pharmaceuticals and Personal Care Products (PPCPs).
4) Determine nutrient influence on phytoplankton community dynamics.
5) Determine the cumulative effect of pollutant loading, including emerging contaminants, nutrients, non-algal suspended matter and other pollutants.
6) Develop exceedance criteria for numeric CHNEP water quality targets using the plane of constant attenuation.
7) Determine if subbasins in Lemon Bay, Charlotte Harbor and Estero Bay are meeting exceedance criteria.
8) If subbasins are not meeting exceedance criteria, develop load reduction goals and management strategies to address exceedances.
9) Develop partial attenuation coefficients for the CHNEP water quality optical model reflecting spatiotemporal variability of absorbance and scattering components in the water column.
10) Modify numeric water quality targets to incorporate quality of light considerations and seagrass light requirements.

Targets:

- To be determined based on each site specific criteria.

Parameters Which May be Considered Under WQ-b

Biological
Enterococci
Algal Blooms--frequency, duration and extent as well as quantitative and qualitative determination of taxa (See WQ-c below)
Total light attenuation--fractions due to color, chlorophyll a and non-chlorophyll turbidity
Stream Condition Index/BioRecon where appropriate
Lake Condition Index
Fish Species Index
SAV abundance
Stream-side and shoreline vegetation changes in Charlotte Harbor, Lemon and Estero Bays and the Peace, Myakka and tidal Caloosahatchee rivers and major tributaries, first and last occurrence.
Benthic organisms

Non-biological
Salinity ranges at specific locations
Isohaline locations
Sediment heavy metal content, especially in conjunction with adjacent oyster bars and likely depositional areas
Pollutant loads--annual loads and yields of basins of TN, TP and TSS
Trophic State Index-using TP, TN and chlorophyll *a* with and without phosphorous
Hypoxia--extent, duration and severity of hypoxic episodes; relationship with stratification
Emerging contaminants—anthropogenically derived chemicals (e.g., ecoestrogens, pharmaceuticals, personal care products, fire retardants, gasoline additives, herbicides and pesticides)

WQ-3: Reduce severity, extent, and duration of harmful algal blooms (HABs), including macro-algae, phytoplankton, and periphyton through the identification and reduction of anthropogenic influences, by 2025.

WQ-d: Taxonomic composition, severity (cell count), extent, and duration of red tide blooms

Summary: Toxic dinoflagellate species frequently occurring in southwest Florida include *Karenia brevis* (red tide). Typically the cyanobacterium *Trichodesmium* precedes or co-occurs with *K. brevis* at bloom initiation, and its presence may condition the surrounding water, enhance growth and reduce grazing pressure. Bloom initiation is followed by population growth, mortality, and advective loss, then by bloom maintenance, and finally by dissipation by advection or mixing of water masses. The physical integrity of the water mass appears to be the key factor controlling growth and maintenance of *K. brevis* blooms. Offshore populations of the dinoflagellate can be transported inshore with winds and inoculate inshore waters. Nutrient availability in the nearshore waters may contribute to the duration and intensity of blooms. Although *K. brevis* is more concentrated in surface waters, it is distributed throughout the water column down to >50 m depths. Nutrient enrichment of coastal waters is thought to at minimum contribute to the maintenance of *K. brevis* blooms while the causes of bloom initiation and cessation are still not well understood. Red tide data are systematically gathered by NOAA and others, with a long-term dataset managed by FWRI.

Cell counts of *Karenia brevis* the red tide organism are collected by a volunteer monitoring program coordinated by FWRI and through a separate program run by Mote Marine Laboratory. The Lee County Environmental Lab began collecting weekly red tide samples (Summer 2006) at 6 beaches throughout the county to provide consistent samples throughout the year. The Charlotte County Parks, Recreation and Cultural Resources Division collects weekly samples at two locations in coastal Charlotte County. Sarasota County Health Department collects weekly samples at six beaches. The Florida DEP – CHAP collects samples monthly at five estuarine locations. Weekly red tide status reports are provided by FWRI depicting the spatial distribution of samples and cell counts of *K. brevis*. Blue-green algae cell counts are conducted by the SFWMD in the Caloosahatchee River and San Carlos Bay when problems are apparent. Lee County Environmental Lab also receives quantitative description of water color/quality from several Lee County Parks and Recreation facilities, when quantitative description warrants further investigation quantitative water quality samples are taken and analyzed. Additionally the Lee County Olga water plant and the Peace River Manasota Regional Water Supply Authority collect daily water samples to test water quality, which includes some analysis of algae cell counts.

Available Products:

- FWRI database of HAB counts and locations.
- Weekly red tide status reports at: http://www.floridamarine.org/features/view_article.asp?id=12373.

Gaps:

1) Establish consistent sampling for red tide and HAB in the study area.
2) Establish consistent freshwater HAB sampling in the Caloosahatchee, Peace, and Myakka Rivers.
3) Prepare annual and mean monthly maps of red tide severity and extent within the study area.

Targets:

- Reduce nutrient loading, therefore reducing the potential anthropogenic impact on duration and extent of near shore red tide blooms.
- Monitor red tide events and continue to broaden understanding of anthropogenic impacts.

WQ-e: Taxonomic composition, severity (cell count), extent, and duration of blue-green algae blooms

Summary: There are about 20 species or groups of freshwater or freshwater-estuarine blue-green algae, also known as cyanobacteria, occurring in Florida waters that are toxic or potentially toxic. The toxic or potentially toxic cyanobacteria that are known to bloom frequently in Florida are *Microcystis aeruginosa, Anabaena circinalis, A. flos-aquae, Aphanizomenon flos-aquae, Cylindrospermopsis raciborskii,* and *Lyngbya wollei*. *Microcystis, Anabaena, Cylindrospermopsis* and *Lyngbya* have been documented in the Charlotte Harbor watershed. Cyanobacteria can exhibit severe neuro-, cyto-, and hepato-toxicity to a variety of mammals (including humans), birds, aquatic mammals, fish, and invertebrates (including zooplankton). Harmful Cyanobacteria Blooms (HCBs) accumulate as buoyant surface-dwelling, high biomass blooms. They impart negative aesthetic values and cause taste and odor problems. These blooms rapidly "crash" in response to sudden physical perturbations (e.g., rapid drop in temperature, sudden destratification and water column turnover or reduced sunlight associated with weather). When crashes occur, excessive oxygen consumption as the biomass decays can lead to anoxic/hypoxic conditions. This chain of events has been responsible for major estuarine fish and shellfish kills and loss of habitat for benthic fauna.

Conditions which favor HCB development and persistence include: 1) enhanced P and N loading; 2) increases in water retention time; 3) water column stability; 4) relatively high dissolved organic matter content; and, 5) for nitrogen-fixing genera, molar N:P input ratios < 15:1. Typically, blooms develop in oligohaline tributaries experiencing periods of excessive spring N and P loading (via runoff, wastewater discharge, etc.), followed by decreased flushing, persistent vertical stratification, and surface water temperatures >20°C. Buoyant noxious species have photoprotective pigments that allow them to survive at the water surface where they can remain for weeks to months. Grazing pressure by macrozooplankton has little impact on either initiating or controlling cyanobacterial blooms. Trophic interactions and ecosystem structure are often radically altered in response to such blooms. While physiological and molecular knowledge of individual HCB species is good, knowledge of growth, reproductive, and trophic dynamics on the ecosystem level is at best fragmentary.

Available Products:

- FWRI database of HAB counts and locations.
- Bartleson (SCCF) study

Gaps:

1) Establish consistent sampling for periphytonous and phytoplanktonic blue-green algae density, composition, and spatial extent within the study area.

Targets:

- Reduce cyanobacteria cell counts to a natural background level.

WQ-f: Taxonomic composition, severity, extent, and duration of nuisance blooms of macro-algae and filamentous green algae blooms

Summary: Over the past several decades blooms of macroalgae have been increasing along many of the world's developing coastlines in response to nutrient enrichment associated with coastal eutrophication. In southern Florida, a diverse group of opportunistic macroalgal species outcompete, overgrow, and replace seagrass and coral reef ecosystems that are adapted to stable, oligotrophic conditions. Moreover, once they are established, the macroalgal blooms may remain in an environment for years to decades until the nutrient supply decreases. This is in contrast to phytoplankton blooms that are usually relatively short-lived (days to weeks).

Nuisance blooms of macroalgae and attached filamentous epiphytes reduce light availability to seagrasses, resulting in lower seagrass productivity, habitat loss from hypoxia/anoxia, and eventual die-off of sensitive species. Nutrient enrichment can cause high biomass algal blooms, which include the red algae *Laurencia intricata* and *Spyridia filamentosa*, the brown algae *Dictyota* sp. and *Sargassum filipendula*, and the green algae *Enteromorpha* sp., *Codium isthmocladum*, and *Halimeda* sp. Macroalgal blooms in South Florida, as well as other factors, have contributed to the marked decline in extent and vigor of seagrass ecosystems.

A few targeted studies have been done to identify the species present and spatial extent of drift algae in the Charlotte Harbor area. In addition drift algae presence, percent cover and general composition are recorded as part of the FDEP-Charlotte Harbor Aquatic Preserves annual seagrass monitoring program, and biannual monitoring program by the FDEP-Estero Bay Aquatic Preserve.

Available Products:

FDEP – CHAP and EBAP seagrass transect database 1999-2006.

Gaps:

1) Establish consistent sampling for macro-algae density, composition, and spatial extent within the study area.
2) Determine natural variation of macro-algae and green filamentous algae.

Targets:

- Reduce macro-algae biomass to a density that represents natural variation.
- Maintain a healthy species composition, composed of relatively less filamentous green algae.

WQ-g: Taxonomic composition, severity, extent, and duration of other toxic dinoflagellate HABs of concern

Summary: Other toxic dinoflagellate species frequently occurring in southwest Florida include *Gambierdiscus toxicus* (organism primarily responsible for Ciguatera fish poisoning). *Pfiesteria piscicida* may also be a concern in the future.

G. toxicus produces ciguatoxin precursors transformed into ciguatoxin, the causative neurotoxin, via herbivorous fish to carnivorous species, where they accumulate and persist over extended periods. *G. toxicus* is most common in shallow waters (3-15 m) primarily as an epiphyte on red and brown macroalgae associated with coral reefs and protected embayments. The temperature and salinity ranges of *G. toxicus* as 20-34^{o} C and 25-40 psu, respectively. In Florida, most cases of ciguatera are contracted in the summer, which is consistent with the elevated *G. toxicus* abundance observed during this period. It is difficult to explain the often rapid, localized changes in the concentration of this species based on a response to any one environmental factor (e.g., temperature, salinity, nutrients, etc.). Rafting on drift algae is considered to be a primary means of dispersal. Presently, no coordinated, systematic monitoring programs exist in the U.S.

Pfiesteria piscicida has not been found in Charlotte Harbor; however, it has been found in other Florida estuaries and is suggested as a potential cause of the fish lesions in the St. Lucie. The wide salinity/temperature tolerance of *P. piscicida* suggests that this species and its close relatives are probably widespread, at least in warm temperate/subtropical regions, acting as significant but often undetected sources of fish mortality and disease. This species has been documented in sediments or water from the mid-Atlantic to the St. Johns estuary in Florida. Recently, more subtropical, *Pfiesteria*-like species were identified, and they are noted by their ichthyotoxic qualities. The dinoflagellates consume bits of epidermal tissue and blood cells from affected fish while also engulfing bacteria, phytoplankton, and others. Most *Pfiesteria* and *Pfiesteria*-like associated fish kills have occurred in quiet, upper estuarine tributaries with poor flushing rates, where both fish secreta and toxins can accumulate and be more readily detected. During the past three years, *P. piscicida* has been implicated as the causative agent of ca. 50% of the major fish kills in large estuaries of the Albemarle-Pamlico system, the only region where rigorous sampling protocols have been established.

Available Products:

- FWRI database of HAB counts and locations.

Gaps:

1) Establish consistent sampling for phytoplankton cell counts, composition, and spatial extent within the study area.

Targets:

- .Maintain natural phytoplankton compositions, with no more than background levels of toxic dinoflagellates.

WQ-4: Meet shellfish harvesting standards year-round by 2025 for the following areas Lemon Bay Conditionally Approved, Gasparilla Sound Conditionally Approved, Myakka River Conditionally Approved, Pine Island Sound Conditionally Approved Western Section, Pine Island Sound Conditionally Approved Eastern Section, and Myakka River Conditionally Restricted.

WQ-h: Number and duration of shellfish harvesting closures by area by year.

Summary: There are six shellfish management areas within the Charlotte Harbor National Estuary Program study area. The FDACS determines on a daily basis throughout the year the harvest status (i.e. opened or closed) of each region, with the exception of the Myakka River. The Myakka River Conditionally Approved region is closed during July, August and September, and the Myakka River Conditionally Restricted is closed all year. Closures occur when there is high rainfall, high bacteria counts, or harmful algal blooms (e.g. red tide). Areas are re-opened when bacteria counts and/or harmful algal bloom cell counts are within an acceptable range. Data of number of days closed for each region from each year is provided by FDACS upon request.

Available Products:

- Department of Agriculture and Consumer Services, Bureau of Aquaculture Environmental Services, Shellfish Environmental Assessment Section maintains data on shellfish closures.

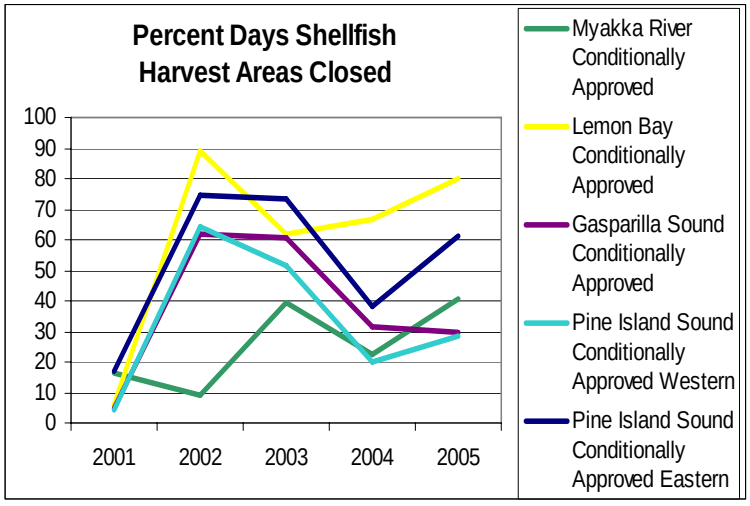
Gaps:

1. Some of the unclassified areas within shellfish harvest designated areas have never been surveyed and are therefore not conditionally approved.
2. Some of the prohibited areas within shellfish harvest designated areas have not been surveyed for decades.

Target:

- Reduce the number and duration of closures within each region over time.

(Source: Department of Agriculture and Consumer Services, Bureau of Aquaculture Environmental Services, Shellfish Environmental Assessment Section)



Hydrology

Goals of the CCMP include that our partners identify and maintain a more natural seasonal variation in freshwater flows and levels in the Caloosahatchee and upper Peace and Myakka Rivers; restore and improve natural hydrology and historic subbasin boundaries and enhance to more natural hydrologic conditions those areas affected by artificial structures; identify reforms to land and stormwater/flood control practices.

HA-1: Identify, establish, and maintain a more natural seasonal variation (annual hydrograph) in freshwater flows and levels by the year 2010 for:

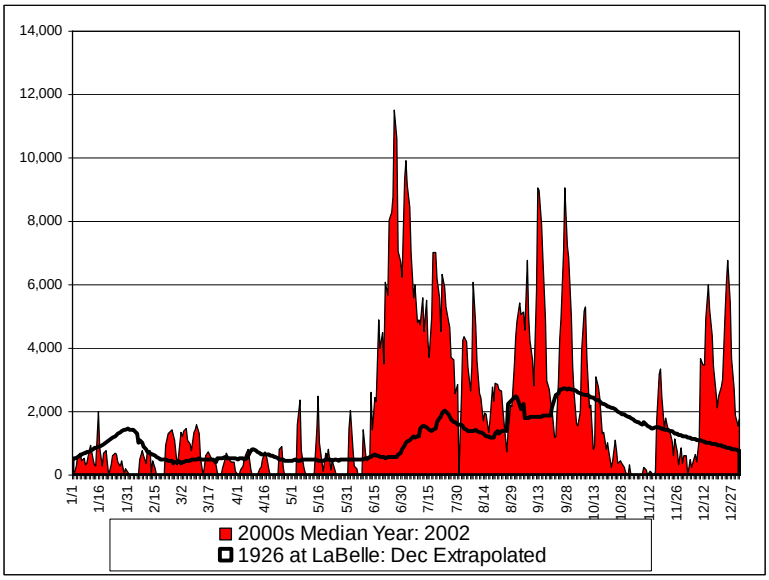
1. Caloosahatchee River;
2. Upper Peace River and its tributaries from Tenoroc to Zolfo Springs;
3. Myakka River (with special attention to Flatford Swamp; and
4. Estero Bay and its tributaries.

HA-a: Amount of time that freshwater flows remain within the natural seasonal variation for the Caloosahatchee River.

Summary: The SFWMD database DBHYDRO contains historic and current flow data for the Caloosahatchee River collected by US ACOE at S-79. Program staff has used these data to graphically look at trends in flow over the period of record. In addition, George B. Hills Co. collected daily flows near LaBelle during most of 1926.

Available Products:

- Daily flows at S-79, beginning 5/1/66.
- Daily flows at S-77, beginning 10/1/38.
- Daily flows at LaBelle, 1/1/26-11/28/26.



Gaps:

1) Determine the natural variation of flow in the Caloosahatchee and analyze the amount of time the flows are outside the range.

Target:

- Mean monthly minimum flow of 500 cfs and maximum flow of 2,800 cfs at S-79.

HA-b: Amount of time that freshwater flows remain within the natural seasonal variation for the Upper Peace River to Zolfo Springs.

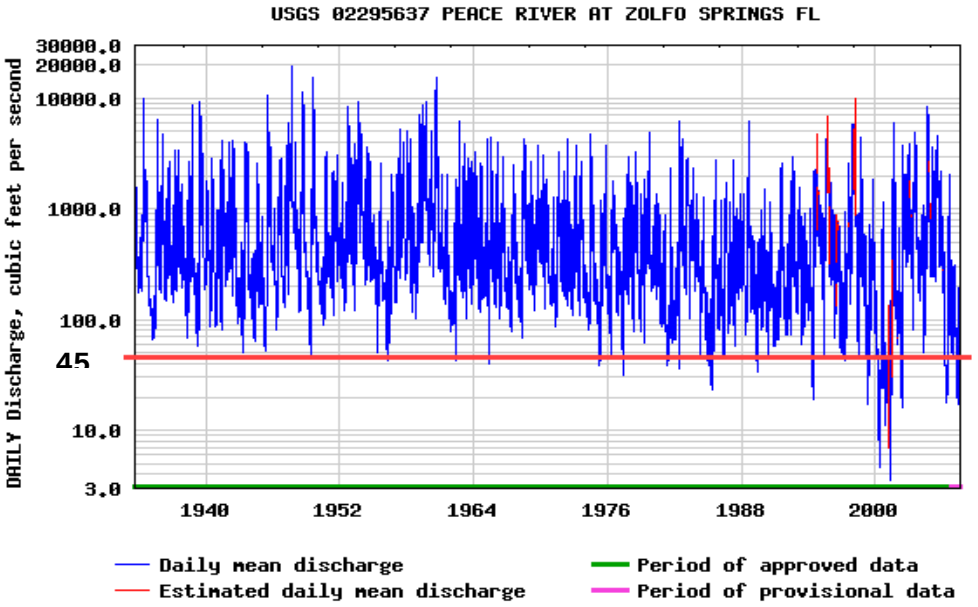
Summary: The USGS long-term flow gauges at Bartow (02294650), Fort Meade (02294898) and at Zolfo Springs (02295637) have been in use for collecting daily data since 1940, 1974 and 1934, respectively. Daily, monthly and annual means are available on line (http://waterdata.usgs.gov/fl/nwis/si) for each site. Minimum flows and levels (MFLs) have been set for 45 cubic feet per second at Zolfo Springs (and 27 cfs at Ft. Meade and 16 cfs at Bartow).

Available Products:

- Upper Peace River: An Analysis of Minimum Flows and Levels, August 26, 2002 draft. Southwest Florida Water Management District.
- Daily flows at Zolfo Springs, beginning 9/1/1933.
- Daily flows at Fort Meade, beginning 6/1/1974.
- Daily flows at Bartow, beginning 10/1/1939.
- SWFWMD's Florida Rivers Atlantic Multi-Decadal Oscillation (AMO) Report.

Gaps:

1) None identified.



Target:

- Restore sufficient flows to meet requirements of flow regimes—Fish Passage and Wetted Perimeter Inflection Point (17 cfs at Bartow, 27 cfs at Ft. Meade and 45 cfs at Zolfo Springs) by 2011.

HA-c: Amount of time that freshwater flows remain within the natural seasonal variation for the Upper Myakka River.

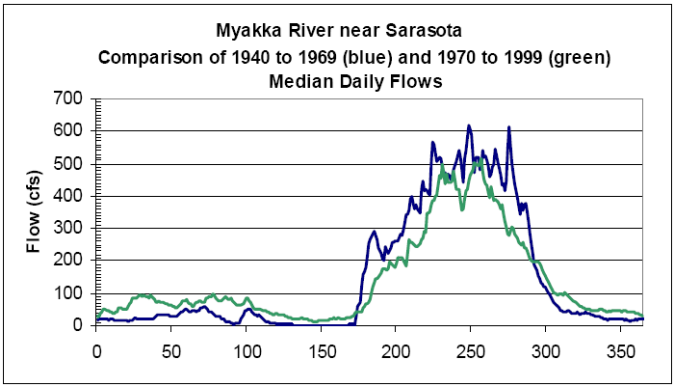
Summary: The USGS long-term flow gauge on the Myakka River near Sarasota (02298830) has been in use for collecting daily data since 1936. Daily, monthly and annual means are available on line (http://waterdata.usgs.gov/fl/nwis/si). In addition, the Southwest Florida Water Management District Proposed Minimum Flows and Levels for the Upper Segment of the Myakka River, from Myakka City to SR 72, available at: http://www.swfwmd.state.fl.us/documents/reports/proposed_myakka_mfl_final.pdf.

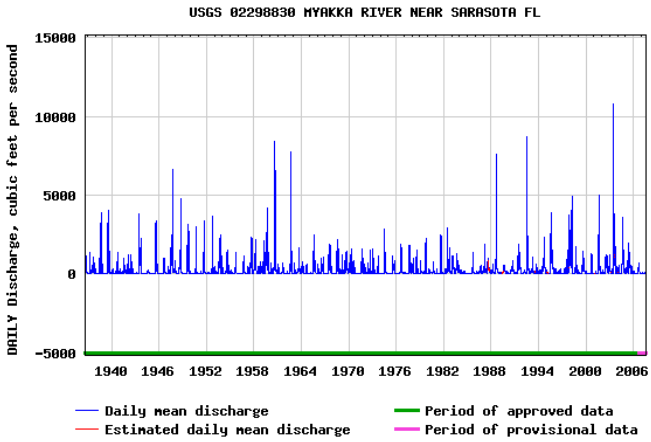
Available Products:

- Daily flows near Sarasota, beginning 9/1/1936.
- Proposed Minimum Flows and Levels for the Upper Segment of the Myakka River, from Myakka City to SR 72.

Gaps:

1) Determine the natural and desired period in which to expect zero flows for the Myakka River near Sarasota gage site.





Target:

- There has been an increase in low flows in the Myakka River. This increase has resulted in a previously non-perennial river becoming perennial. Historic flows went to zero on a regular and consistent basis. Therefore, a low flow threshold of 0 cfs is recommended for the USGS Myakka River near Sarasota, FL gage site.
- On two occasions since 1936, flows exceeded 8500 cfs (June 29, 1992 and June 24, 2003). Flows in excess of 8500 cfs indicate extreme conditions.
- The following are long-term compliance standards for Myakka River discharge at the Sarasota gage site (measured in cfs):

Period	10-yr Rolling Mean	10-yr Rolling Median	5-yr Rolling Mean	5-yr Rolling Median
April 20 to June 24	23	0	4	0
October 28 to April 19	28	4	15	3
June 25 to October 27	324	181	241	133

HA-d: Amount of time that freshwater flows remain within the natural seasonal variation for the Estero Bay tributaries.

Summary: The USGS long-term flow gauge on the South Branch of the Estero River (02291597) was in use for collecting daily data from 1987. Daily, monthly and annual means are available on line (http://waterdata.usgs.gov/fl/nwis/si) for the period of record. No flow data are collected through the present.

Available Products:

- Daily flows on the South Branch of the Estero River, beginning 2/3/1987.
- Daily flows on the North Branch of the Estero River (02291580), beginning 2/4/1987.
- Daily flows on the Imperial River (02291500), 1940-1954 and 1987 to present.
- Daily flows on Spring Creek (02291524), beginning 11/4/1987.

Gaps:

1) Determine the natural variation of flow in the Estero Bay tributaries and analyze the amount of time flows are outside the range.
2) Gauge at Hendry Creek and Mullock Creek.

Target:

- Historic base flow conditions are being developed as part of the Southwest Florida Feasibility Study. A set of minimal and maximal seasonal flows will be designated for the major tributaries of Estero Bay as part of the pre-development base map. These minimum flows and maximum flows will constitute the targets for this indicator.

HA-e: Oligohaline, mesohaline, and polyhaline locations in the Myakka, Peace and Caloosahatchee River.

Summary: The Charlotte Harbor Environmental Center posts monthly salinity gradient maps using data collected throughout the region, including data in the Caloosahatchee River collected by Lee County, beginning in 2004. There are also median monthly salinity maps.

Available Products:

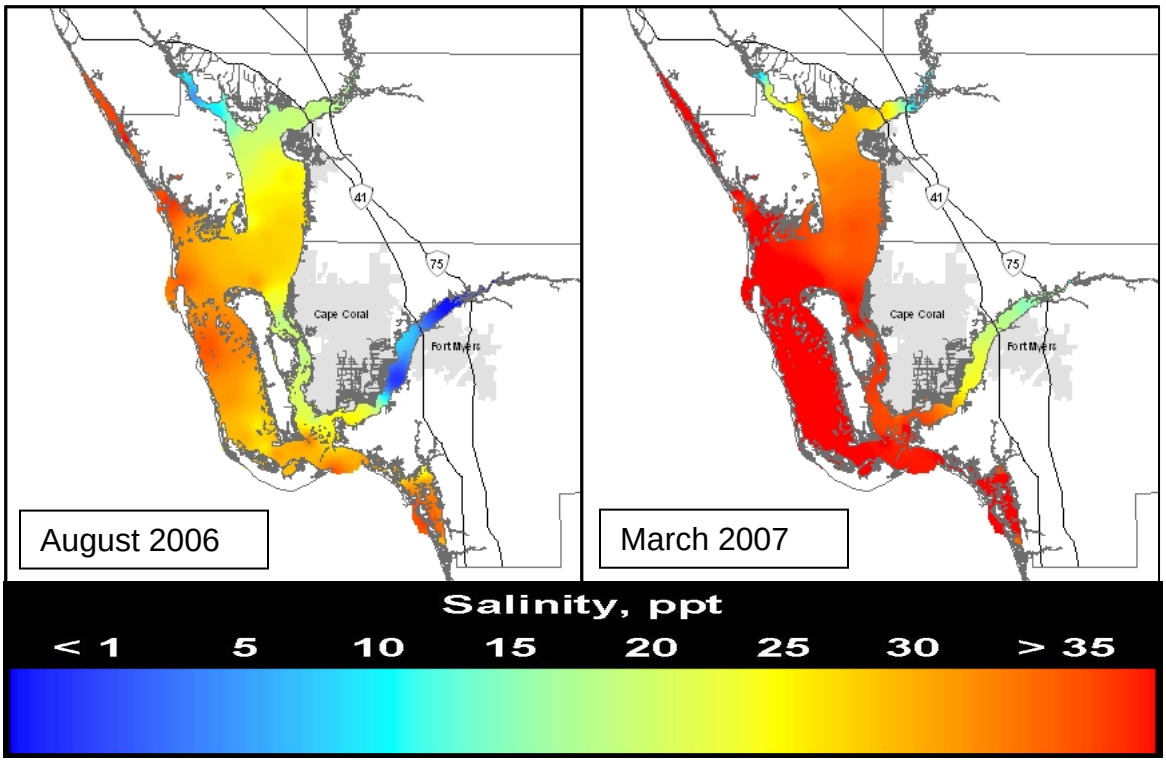
- http://www.checflorida.org/WRC/HTML/Waterquality/WQmaps/index.html.
- CCMP vision maps for wet season and dry season salinity, based on oligohaline, mesohaline, and polyhaline zones.

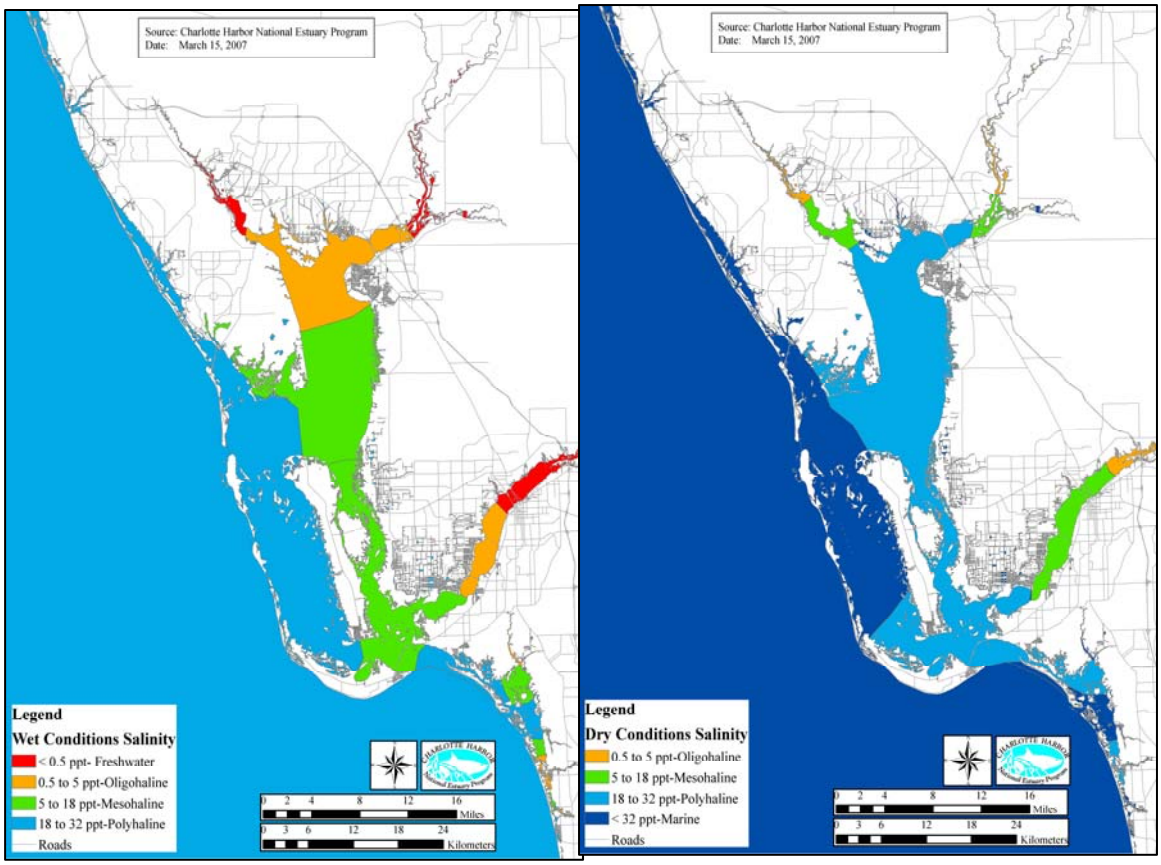
Gaps:

1) Adopt indicators for river oligohaline, mesohaline, and polyhaline zone health.

Target:

- Mean seasonal (wet/dry) isohalines should be spatially similar to those outlined in the CCMP vision and correspond with the following biological guidelines:
  (a) Maintain a monthly average salinity $\leq$ 10 ppt during the dry season at the Ft. Myers continuous salinity sensor; such that tape grass in the Beautiful Island area does not decrease below 20% coverage and blade length is $\geq$ 10 cm (values may be adjusted after current research (MML 2001) is evaluated). Salinity should not exceed 20 ppt for longer than one day at Ft Myers (SFWMD 2000); (b) Limit the occurrence of salinity <15 at the Cape Coral Bridge, so healthy seagrass density in the Iona Cove area is maintained (coverage $\geq$ 30% at 1 meter water depth and average blade length $\geq$ 10 cm); and (c) maintain salinity at Piney Point > 5 ppt, so that conditions are supportive for the recruitment, survival, and growth of juvenile oysters upstream of Shell Point during March – October (juvenile oyster growth $\geq$ 2.5 mm a month; recruitment $\geq$ 3 spats per substrate shell a month; and mortality < 20% per month).
  (b) Maintain an average monthly salinity $\geq$ 20-25 ppt, as measured at the Sanibel Causeway continuous sensor, so that historical seagrass density and coverage in the area is maintained (as determined from previous surveys and aerial photography).





The latest wet season and dry season salinity maps appears to be generally within our vision envelopes. A set of vision maps needs to be revised according to the CHEC legend colors.

HA-2: Restore, enhance, and improve where practical historic subbasin boundaries and natural hydrology for basins within the Charlotte Harbor NEP study area, with special attention to Outstanding Florida Waters, Class I waterbodies, and tributaries to Estero Bay by the year 2020.

HA-f: Net difference between the acreage of subbasins that no longer contribute flows to their historic receiving water bodies and the acreage of subbasins returned to historic receiving water bodies.

Summary: The current and historic subbasin boundaries were mapped through the Hydrologic Conditions Analysis, a contracted CHNEP project. The acreage of subbasins no longer contributing flow to their historic receiving water bodies will be calculated.

Available Products:

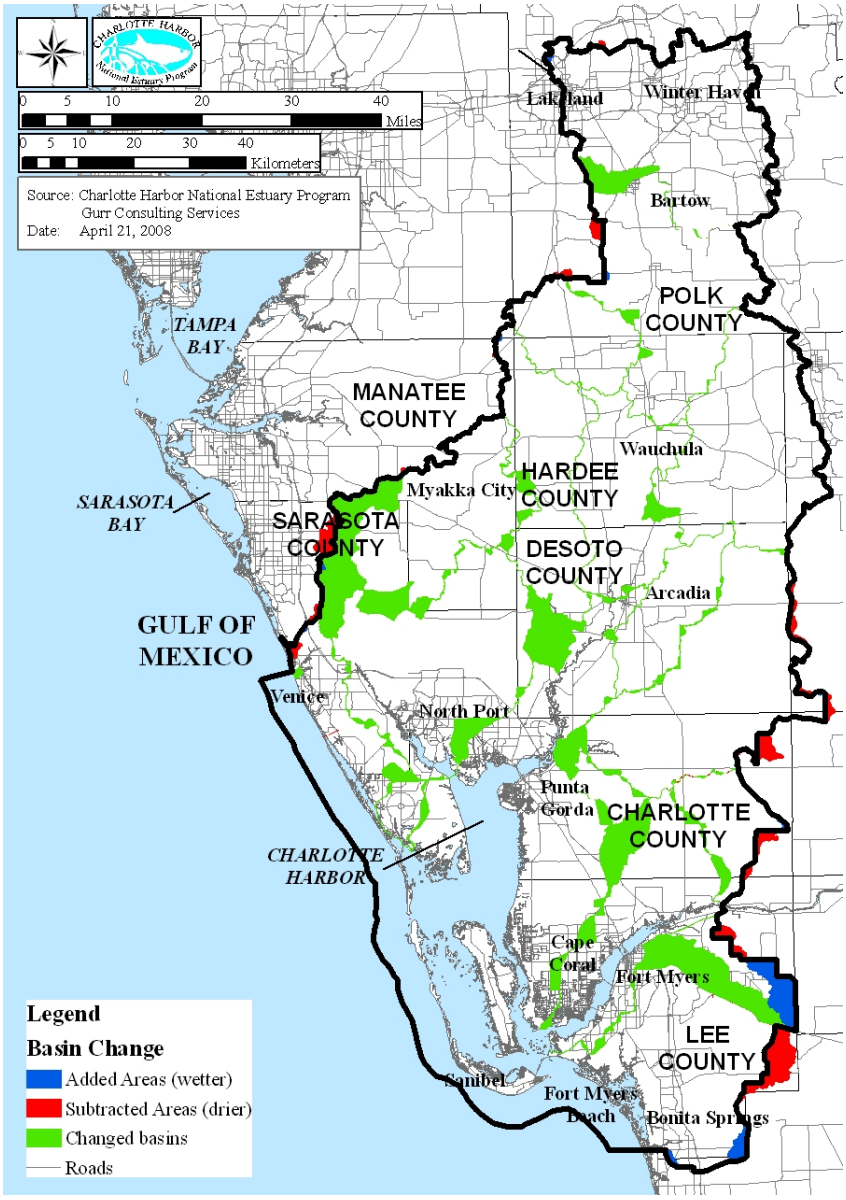
- Historic Basins Map

Gaps:

1) Mapping/GIS program to track changes in subbasin hydrology

Target:

- No new creation of internally drained or non-contributing lands.
- Reduce the acreage of internally drained or non-contributing basins by 25% by 2020.



HA-3: By 2020, enhance and improve to more natural hydrologic conditions waterbodies affected by artificially created structures throughout the Charlotte Harbor NEP study area including:

a) the Sanibel Causeway;
b) Myakka River;
c) the causeway between Lover's Key State Recreation Area and Bonita Beach;
d) the water control structure on the south end of Lake Hancock;
e) the structure on Coral Creek;
f) the Gator Slough canal collector system (Lee and Charlotte Counties);
g) Peace Creek canal system; and
h) Cow Pen Slough (Sarasota County).

Reduce negative hydrologic effects of artificially created structures such as weirs, causeways, dams, clay settling areas and new reservoirs.

HA-g: Acres of watershed restored and percentage of watershed improved by projects that demonstrate, through comparison of pre and post project hydrologic conditions improvements to more natural hydrologic conditions the aforementioned structures.

Summary: Several projects are underway to improve natural hydrologic conditions affected by artificially created structures (e.g. Gator Slough Restoration, Lover's Key projects and Lake Hancock water control structure modification). USGS flow gauges are located near some of the affected areas and can be used for monitoring pre and post project conditions. Biological indicators may also be used to demonstrate improvements.

Available Products:

- USGS flow gauges as shown above under HA-a, HA-b, HA-c and HA-d.

Gaps:

1) Monitor hydrologic conditions near artificially created structures (e.g. weirs, bridges) to establish pre-restoration conditions.

Target:

- Completion of hydrologic improvements to all of the aforementioned structures that restore to more natural hydrologic conditions waterbodies affected by artificially created structures by the year 2020.

HA-4: By 2010, for each basin, identify the linkages between local, water management district, state, and federal governments' development permitting and capital programs affecting water storage, flood control, and water quality. By 2012, identify and recommend reforms through tools such as Comprehensive Watershed Management Plans. By 2015, implement the reforms.

HA-h: Reforms within government development permitting and capital improvements that improve hydrology and water quality.

Summary: Land and water management activities in the CHNEP are divided between local governments and regional agencies, the leading one being water management districts. Agreements among and between localities, and water management districts, are common. However, watershed plans to date have not had the depth of evaluation that the issues contained in the CCMP require. There are two major efforts underway that have an opportunity to remedy this—the Peace River Initiative by SWFWMD and the SWFFS by SFWMD. However, operational programs to implement these initiatives have not yet been proposed, other than an expected response to a list of projects. This objective has the intent to capitalize on the work done to date, and expected to be done to finish the initiatives, and to bring the major public agencies together in a sustainable program of land and water management. A similar effort in transportation planning has been relatively successful throughout the United States. The CHNEP would serve as a facilitator and performance auditor to such efforts.

The TMDL program is expected to further raise the issue of linkages between urban and rural development, and declining water quality, with the expectation of improved management systems to reverse the poor water quality situation.

Available Products:

- SWFRPC Resolutions on Fertilizers and Wastewater Treatment, resulting in changes to local ordinances.
- Analysis of growth management within the Estero Bay basin with recommendations underway.

Gaps:

1) Workable watershed management models for land and water management, with water quality and hydrology goals.

Target:

- Identified reforms that have been adopted and put into place.

Fish and Wildlife Habitat

Objectives of the CCMP include maintaining and conserving various habitats such as submerged aquatic vegetation, mangrove, oyster bar, intertidal unvegetated, freshwater wetlands, native uplands, and the water column to a quality and extent of natural variation; putting into conservation status 100% more land than that held in 1998; and achieving controllable levels of invasive exotic plants and animals. Indicators for each of these Objectives have been developed. Along with each indicator there is a stated target, an outline of existing monitoring, analyses and reporting, and gaps in monitoring, analyses and reporting.

CCMP Objective

FW-1: Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area:

a) native **submerged aquatic vegetation** should be maintained and restored at a total extent and quality no less than caused by natural variation.

b) maintain the existing extent and location within range of natural variability of **submerged and intertidal un-vegetated habitats** (especially mud flats and sand flats) and improve the habitat quality;

c) 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;

d) restore and maintain **saltwater marsh habitats** where feasible (e.g. public lands or undeveloped areas) and prevent loss or conversion of existing salt marsh habitats;

e) restore, maintain, and manage **freshwater wetland systems** in current extents and to a quality capable of maintaining all natural functions within the range or natural variability;

f) restore, manage, and improve the habitat quality of **oyster bars** in the Charlotte Harbor NEP area based on the existing historic data;

g) protect, enhance, restore **native upland communities** vital to the ecological function of the Charlotte Harbor NEP study area;

h) restore, manage, and improve the habitat quality of the **water column.**

FW-a: SAV acreage by seagrass segment

	Upper Charlotte Harbor							
Year	Lemon Bay	Placida	South Harbor	West Wall	East Wall	Middle Harbor	Myakka River	Peace River
1982		957	3,544	665	1,548	70	218	397
1988	1,055	1,416	3,710	580	1,372	50	161	158
1992		1,384	3,662	490	1,361	50	130	167
1994	1,067	1,344	3,659	671	1,416	60	189	196
1996	1,054	1,460	3,648	790	1,371	76	203	232
1999	1,049	1,503	3,340	699	1,452	62	191	109
2001	1,046	1,531	3,313	699	1,454	64	185	138
2003	1,110	1,625	3,488	646	1,315	43	118	106
Mean	1,064	1,402	3,545	655	1,411	60	174	188

	Lower Charlotte Harbor				
Year	Pine Island Sound	Matlacha Pass	San Carlos Bay	Caloosahatchee River	Estero Bay
1982	9,857	3,247	2,420	242	
1999	10,483	2,456	1,504	1	1,008
2002	10,647	2,784	1,768	42	975
Mean	10,329	2,829	1,898	95	991

Summary: Aerial photography and photo-interpretation of photography, resulting in GIS maps, occurs every two years through the SFWMD and SWFWMD. Data compilation, analyses and reporting are done by the SWFWMD, SFWMD and CHNEP staff.

Available Products:

- GIS coverages in the SFWMD area include 1982 (1991 Estero composite), 1999, 2002, and 2006.
- GIS coverages in the SWFWMD area include 1999, 2001, 2003, and 2006.
- GIS coverages in both areas that delineate seagrass segments
- GIS coverage for SAV by species in the Caloosahatchee in 1993.
- GIS coverages for seagrass by species in Estero Bay in 1991.
- Analysis of seagrass segments to 2003 published in Florida Scientist by Corbett at: http://www.chnep.org/info/FloridaScientist/flsc-69-2S-007.pdf.

Gaps:

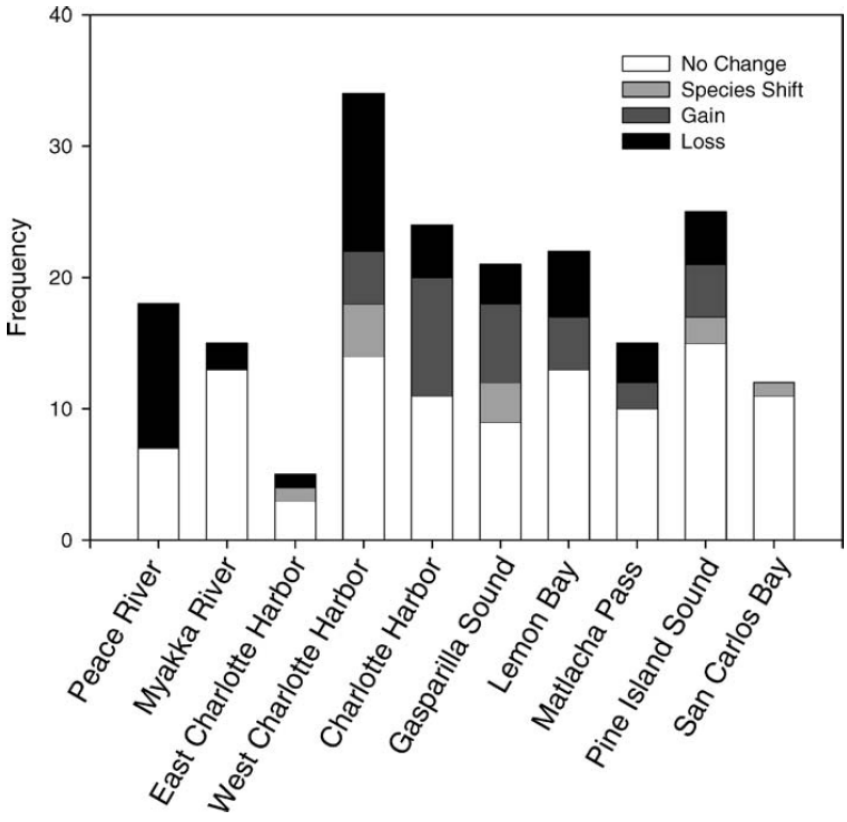
1) Create biennial freshwater SAV maps.
2) Develop a method for determining freshwater SAV acreage.
3) Compare SAV mapping results of digital photography to film photography: are macro-algae signals more recognizable?
4) Determine the historic spatial extent of freshwater submerged aquatic vegetation in the Caloosahatchee, Peace and Myakka Rivers.
5) Coordinate the Biennial Seagrass Mapping for total study area consistency.
6) Determine the historic coverage (funded and in progress) and depth distribution of seagrasses.

Target:

- No long-term net declines in submerged aquatic vegetation coverage by seagrass segment through period of record with the exception of causeway footprints and other permanent losses where water depth changes preclude seagrass growth.

FW-b: SAV species presence/absence, annual fall percent cover by species and deep edge by basin

Summary: The Charlotte Harbor Aquatic Preserves – DEP conducts 50 annual seagrass transect surveys throughout the Charlotte Harbor watershed. In addition the Estero Bay – DEP conducts 5 transect surveys in Estero Bay utilizing the same methodology. The NEP staff is assisting the DEP in setting up an annual summary report to address this indicator. Additionally, freshwater SAV monitoring in the Caloosahatchee River has been funded by the SFWMD since 1998.



Available Products:

- 1999-2004 analysis of 50 seagrass transects published in Florida Scientist by Greenawalt-Boswell et. al. at http://www.chnep.org/info/FloridaScientist/flsc-69-2S-024.pdf.
- 1999-2006 FDEP-CHAP & EBAP seagrass database.
- Seagrass annual data summary from the Charlotte Harbor and Estero Bay Aquatic Preserves seagrass transect monitoring program 1999-2006 by Celia Stearns. Data are summarized by year for the entire CHAP and EBAP areas, by region with all years combined, and within a region by year.

Gaps:

1) Determine the natural variation in seagrass bed characteristic
2) Consistent transect monitoring of freshwater SAV in the Peace, Myakka, and Caloosahatchee Rivers and in the Estero Bay, and Lemon Bay tributaries

Target:

- No long-term changes in species composition or bed length/deep edge by basin and seagrass segment as measured by fixed transects unless resulting from natural variation.

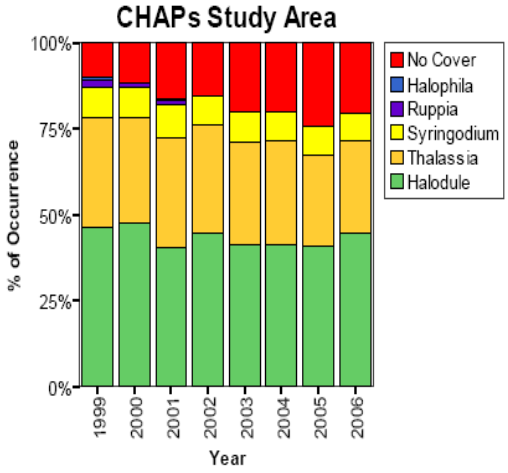


Figure 1.3. Percentage of occurrence of seagrass species and no cover over the period of record (1999-2006) for the entire Charlotte Harbor Aquatic Preserves study area.

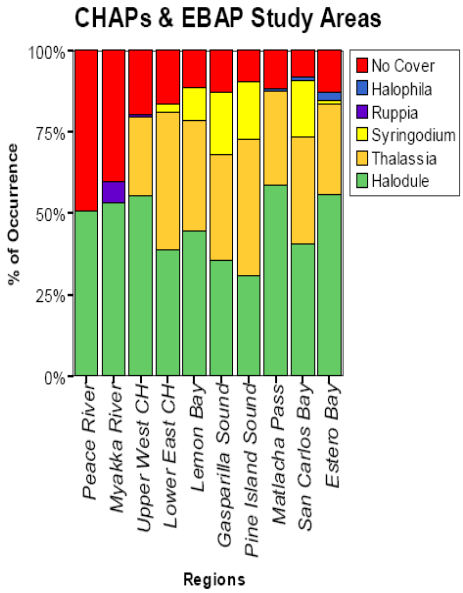


Figure 1.6. Percentage of occurrence of seagrass species and no cover for each region over the period of record for the Charlotte Harbor (1999-2006) and Estero Bay (2003-2006) Aquatic Preserve study areas.

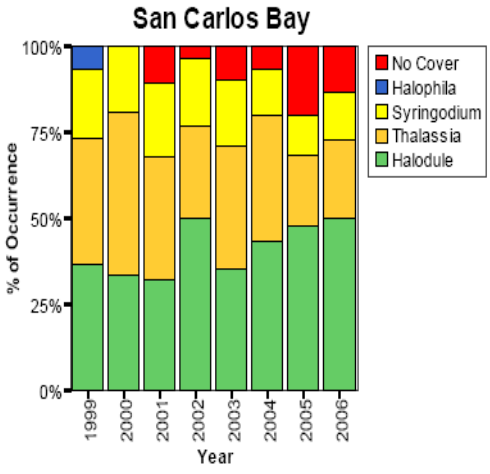


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Figure 1.7 (E-I). Percentage of occurrence of seagrass species and no cover for each region over the period of record (1999-2006) within the Charlotte Harbor Aquatic Preserves study area.

FW-c: Boat propeller scar acreage, severity and location by basin.

Summary: Aerial photography and photo-interpretation, resulting in GIS maps, occurs every two years through the SFWMD and SWFWMD. These maps were used to determine spatial extent and severity of prop scarring in the Charlotte Harbor watershed in 1995 and 2004 by FWRI and CHNEP.

Available Products:

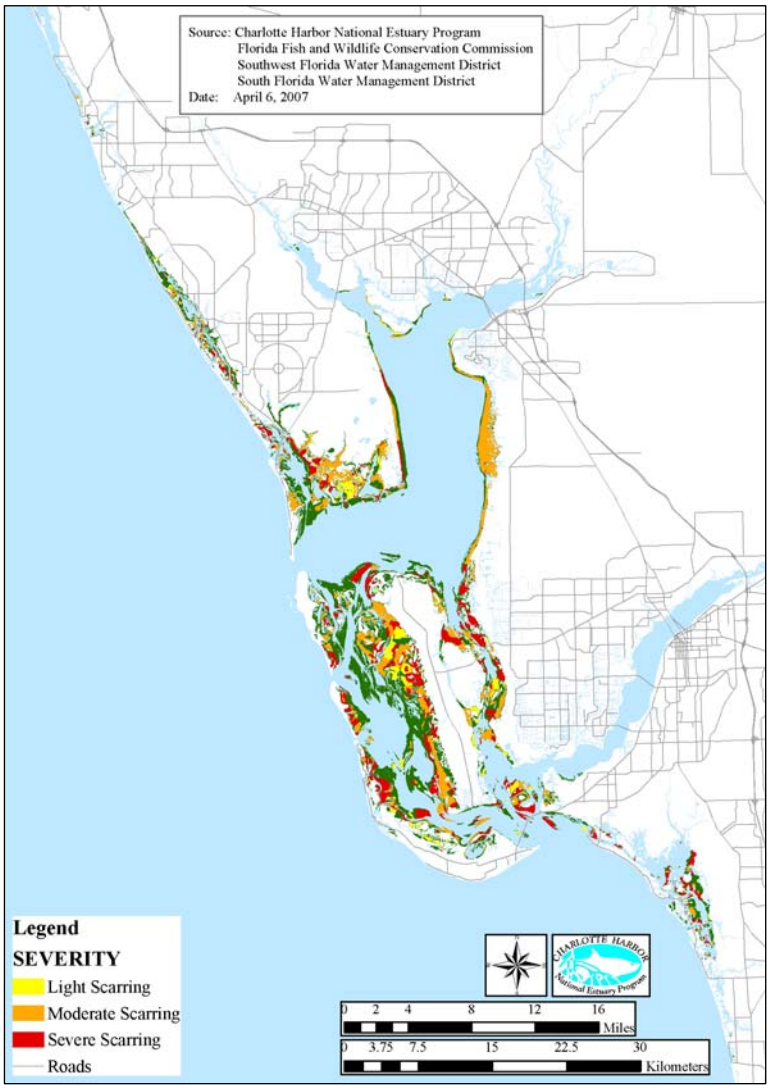
- 2 disk set prepared by FWRI and published by CHNEP, with an assessment of boat propeller prop scar changes between 1993 and 2003.
- GIS coverages for CHNEP study area of 1993 and 2003 prop scar severity.

Gaps:

1) Compare aerial photography used for prop scar analysis with lower elevation photography for accuracy assessment.

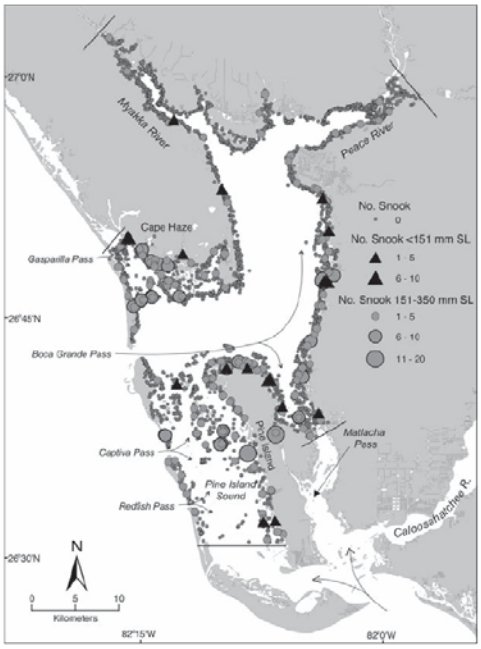
Targets:

- No net increase in acreage of propeller damage to seagrass beds from the 1992-1993 levels by the year 2010 by basin and seagrass segment.
- Reduction in all severely scarred areas to light scarring and reduction of 70 percent or more of the moderately scarred areas to light scarring by basin.



FW-d: Fish community composition by strata.

Summary: The FWRI Fisheries Independent Monitoring program currently conducts year round stratified random sampling of fish communities throughout most of the Charlotte Harbor estuarine study area. Current methodology began in 1996 in the Peace River, Myakka River, Charlotte Harbor, Gasparilla Sound, upper Matlacha Pass, and upper Pine Island Sound. Sampling in the lower portions of the study area including; lower Pine Island Sound/San Carlos Bay, lower Matlacha Pass, and the Caloosahatchee River began in 2003. Estero Bay sampling was initiated in 2005. The data are suited for analysis of multiple metrics that have been identified as indicators, including; taxonomic richness and diversity, abundance, trophic composition, and nursery function, and can be separated by habitat type (i.e. SAV, un-vegetated, and mangrove shoreline). Cumulative species composition curves could also be used as a graphical way to look at the data on an annual basis by strata.



Available Products:

- Database possessed by FFWCC – FWRI and requested by CHNEP.
- Annual reports for the SFWMD area.
- A series of peer-reviewed articles analyzing data from the program including: Variable Habitat Use by Juvenile Common Snook, Centropomus undecimalis (Pisces: Centropomidae): Applying a Life-History Model in a Southwest Florida Estuary published in the Bulletin of marine Science , 80(1):93-108:2007 (Graphic from the paper shown above) and Seasonal Variation in Fish Assemblages Within the Estuarine Portions of the Myakka and Peace Rivers, Southwest Florida published in Gulf of Mexico Science by Idelberger and Greenwood

Gaps:

1) Expand FWRI Fisheries Independent Monitoring Program to Lemon Bay
2) Annual reporting of taxonomic richness and diversity by basin and seagrass segment.

Target:

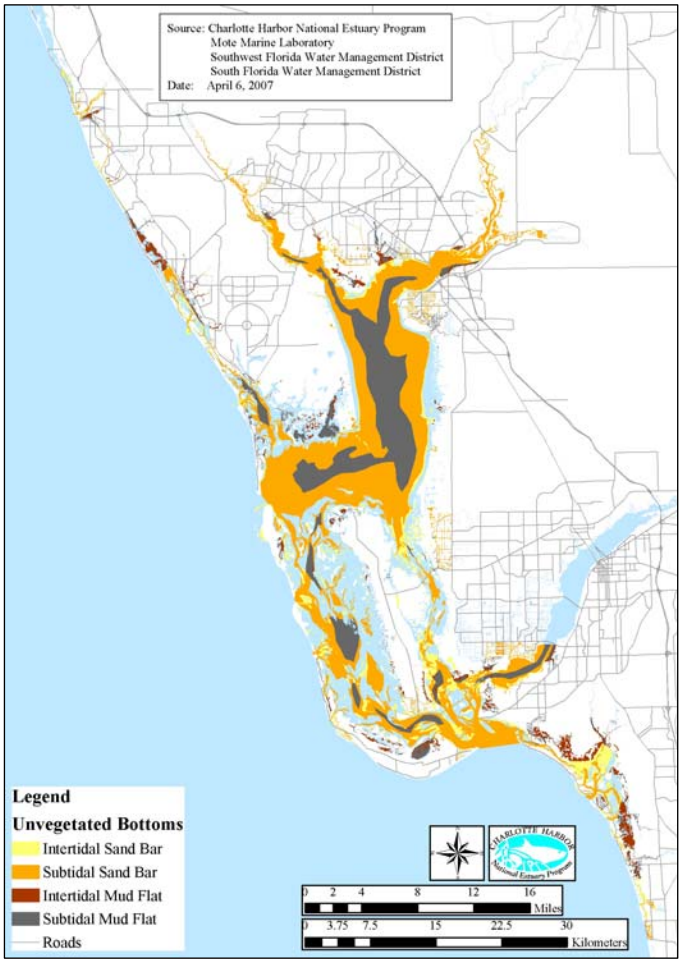
- No decline in fish species taxonomic richness and diversity by basin**.**

FW-e: Un-vegetated, soft and sandy intertidal and subtidal habitat acreage and location by basin

Summary: Biennial seagrass maps described previously allow for the interpretation of submerged and intertidal un-vegetated habitat extent. The CHNEP contracted with Avineon to compile benthic habitats using the 1999 SFWMD and SWFWMD aerial photographs taken for the purpose of seagrass mapping. From the Benthic Macro-invertebrate Abundance and Diversity study (MML 2007), mud and sand delineations were estimated.

Available Products:

- Shape file of benthic habitats including sub-tidal sand, sub-tidal mud, inter-tidal sand, and inter-tidal mud, based on SWD mapping and qualitative description of mud and sand areas for illustrative purposes.



Gaps:

1) Refine map of salt flats and mud flat separately to include ground-truthing and determine natural variation in habitat extents.

Targets:

- No long-term net declines in sand flat coverage by basin except as a result of natural variation or restoration.
- No long-term net declines in mud flat coverage by basin except as a result of natural variation or restoration.
- No long-term net declines in subtidal un-vegetated coverage by basin except as a result of natural variation or restoration.
- Maintain relative location of each habitat type, although variation in specific locations of each habitat is expected.

FW-f: Benthic index for mud flat, sand flat and subtidal un-vegetated by basin

Summary: The final report on the cooperative project between Mote and CHNEP on benthic macro-invertebrate indices for varying habitat types provides insight into the application and monitoring needs for these indicators (MML 2007). Sub-tidal samples are also available from SFWMD from 1986-1989 and 1994-1995 for the Caloosahatchee, San Carlos Bay, and Pine Island Sound areas.

Available Products:

- Abundance (organisms per square meter) and Diversity (Shannon-Weiner Log E) by habitat by strata for Summer 2004.
- Database from Mote Marine Laboratory study.
- Number of taxa by habitat by strata shown below.

Region	Habitat	Org per m2	Shannon-Weiner Index
Venice	Int Mud	22,377	2.27
Estero	Int Mud	37,215	2.39
Lemon	Int Mud	11,469	2.05
CharHarb	Int Mud	27,350	2.29
Myakka	Int Mud	48,925	0.63
Peace	Int Mud	23,661	1.99
Caloos	Int Mud	2,887	2.28
Pine Is	Int Mud	6,336	1.31
San Carlos	Int Mud	24,302	2.28
Venice	Int Sand	9,705	2.50
Estero	Int Sand	3,288	2.66
Lemon	Int Sand	5,695	2.96
CharHarb	Int Sand	4,411	1.97
Myakka	Int Sand	13,715	2.02
Peace	Int Sand	12,512	1.16
Caloos	Int Sand	4,491	2.40
Pine Is	Int Sand	18,046	1.51

Region	Habitat	Org per m2	Shannon-Weiner Index
Venice	Sub Mud	9,705	2.79
Estero	Sub Mud	15,800	3.48
Lemon	Sub Mud	43,231	3.11
CharHarb	Sub Mud	89,509	2.52
Myakka	Sub Mud	36,253	1.73
Peace	Sub Mud	225,698	1.67
Caloos	Sub Mud	10,106	2.30
Pine Is	Sub Mud	7,379	2.88
Mat Pass	Sub Mud	236,205	1.91
San Carlos	Sub Mud	22,457	2.36
Venice	Sub Sand	12,592	3.07
Estero	Sub Sand	4,652	1.97
Lemon	Sub Sand	35,050	3.44
CharHarb	Sub Sand	13,234	1.36
Myakka	Sub Sand	132,740	2.14
Peace	Sub Sand	60,715	1.34
Caloos	Sub Sand	10,106	2.54
Pine Is	Sub Sand	18,768	2.85

Gaps:

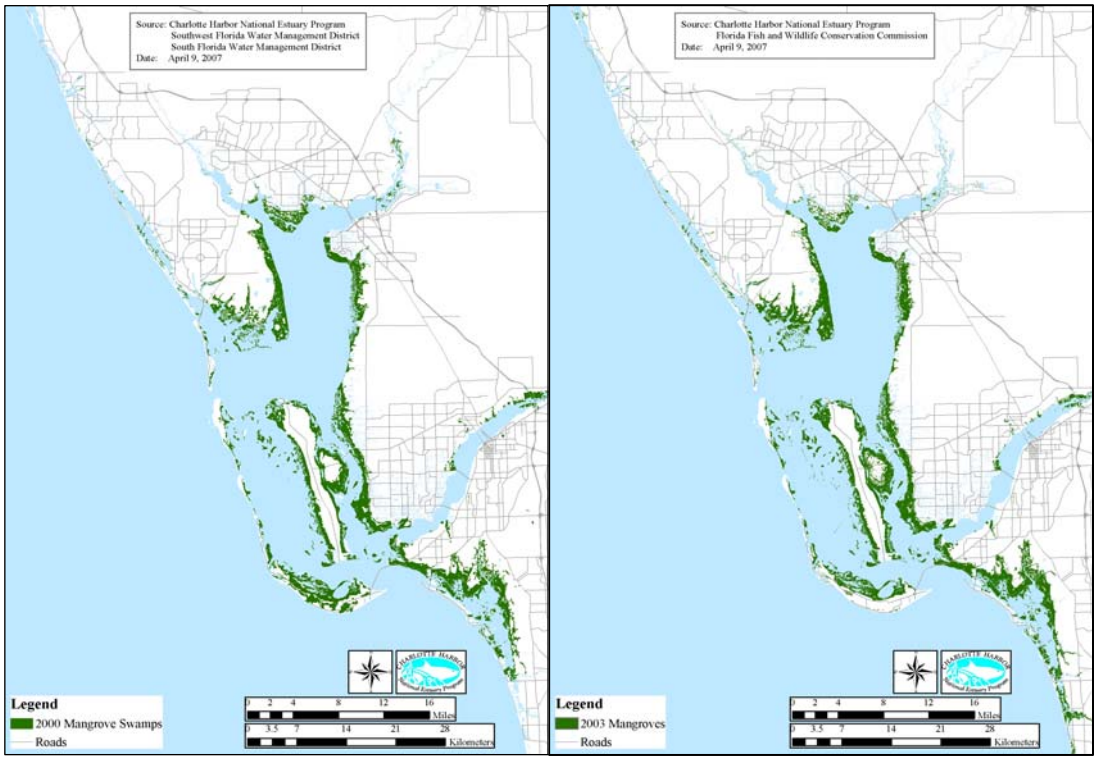
1) Create an area-wide benthic fauna monitoring program
2) Develop benthic index for mud and salt flats and subtidal unvegetated bottoms of Charlotte Harbor to be used as an indicator

Target:

- Maintenance and restoration of natural conditions for habitat quality of salt and mud flats and subtidal unvegetated by 2020. (Determination of benthic indices for mud and salt flats as well as subtidal unvegetated that will allow evaluation of the quality of the existing habitats by 2008 and routine monitoring of metrics within index by 2010.)

FW-g: Mangrove acreage and location by basin.

Summary: Landuse maps are created from aerial photography every 5 years by the water management districts and landcover maps are created by the FFWCC every 5-6 years. In addition the SWFWMD is contracting annual landuse land cover maps. The CHNEP staff can use FLUCCS codes and land cover maps to classify mangrove spatial extent and compare acreage over time.



Available Products:

- 2000 WMD Mangrove Land Use Shape File, including mangrove swamps.
- 2003 FFWCC Vegetative Communities Shape File, including mangroves.

Gaps:

1) Map mangrove systems by predominate species within existing programs

Target:

- No long-term net declines in mangrove coverage by basin from 1980 coverage except as a result of natural variation, restoration to natural hydrology (e.g. filling of mosquito ditches), or where construction impedes restoration of mangroves.

FW-h: Mangrove species composition for sample sites.

Summary: Some localized mangrove surveys are conducted on an annual basis. The Sanibel-Captiva Conservation Foundation (SCCF) marine laboratory conducts surveys on Sanibel and Captiva at 12 plots. Annual analyses and reporting occurs in the SCCF document State of our Coastal Environment. Sites throughout Charlotte County were surveyed in response to Hurricane Charley by Terry Tattar and David Scott, in cooperation with Seagrant and West Coast Inland Navigation District (WCIND). In addition other sites throughout the CHNEP study area have been surveyed in the past, and data is available for future comparison. These include sites in the mangrove forests of Cayo Costa , Gasparilla Island, and Estero Bay.

Available Products:

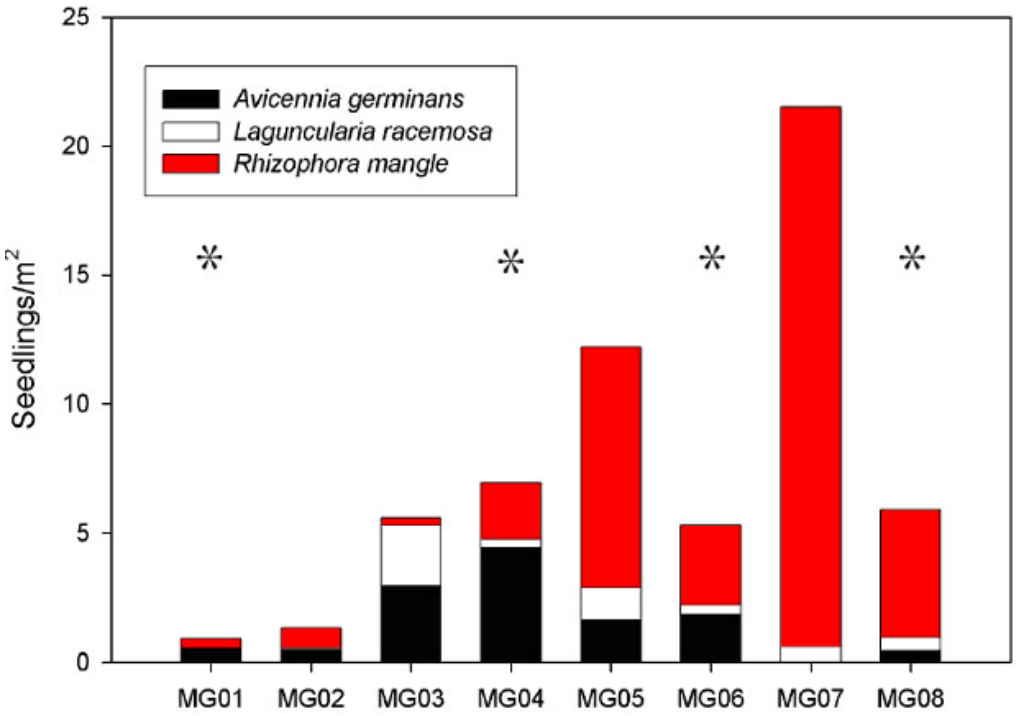
- SCCF State of our Coastal Environment annual report
- Cayo Costa Reports, 1977
- Milbrandt et al. 2006. Estuaries. 29(6A).

Gaps:

1) Expand mangrove species composition monitoring throughout entire CHNEP area, monitor transects every 5-10 years to evaluate mangrove species changes.

Targets:

- No long-term change in mangrove species composition, except as a result of natural forest succession.

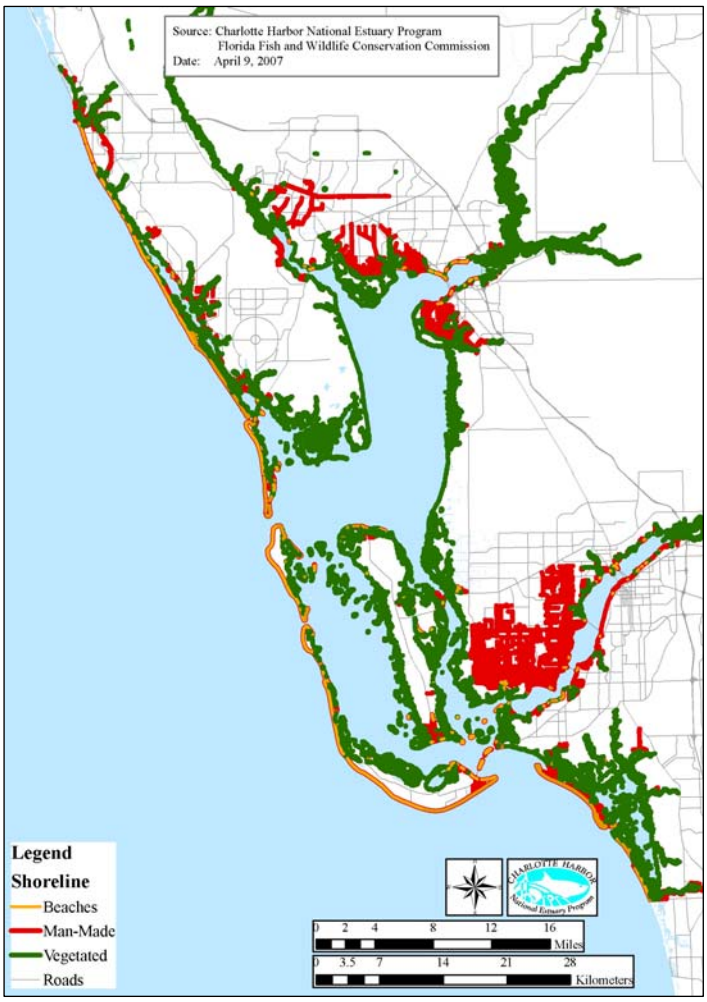


FW-i: Condition of mangrove shoreline (i.e. percent hedged mangroves, hardened shoreline, and damaged mangroves) by basin.

Summary: The CHNEP staff developed a volunteer based program to classify quality of shoreline type (e.g. damaged mangroves, hedged mangroves, or exotic vegetation) throughout the program study area. The output form of the data will be a GIS layer. Photo Science contracted in to create the GIS layer and to classify shoreline type (e.g. hardened shoreline, beach, or mangrove) using existing aerial photography. Prior to this effort the only existing shoreline classification map was from a statewide FFWCC project.

Available Products:

- Florida Fish and Wildlife Conservation Shoreline shape file.



Gaps:

1) Map shoreline treatments including hedged mangrove, windowed mangrove, uplifted mangrove, vertical seawall, riprap revetment, lawn, herbaceous wetlands, etc. (Contract let by CHNEP due Summer 2008 will address many of these categories)

Target:

- Restore 5 acres per annum of mangrove fringe to shorelines of study area, up to a total restoration of the 1982 estimate of 56,631 acres (Harris et al. 1983) minus those areas affected by hydrologic restoration or construction.

FW-j: Intertidal and high saltwater marsh acreage and location by basin

Summary: Land use maps are created from aerial photography every 5 years by the water management districts and land cover maps are created by the FFWCC every 5-6 years. In addition the SWFWMD is contracting annual land use and land cover maps. The CHNEP staff can use FLUCCS codes and land cover maps to classify acreage over time in a general "salt marsh" category. The FFWCC map appears more reliable for salt marsh acreage. For example, note the presence of tidal salt marsh on Shell Creek on the FFWCC map. The differentiation between high marsh and tidal marsh may be estimated based on its presence behind mangrove (high marsh) versus its presence on a tidal creek or river (tidal marsh).

Available Products:

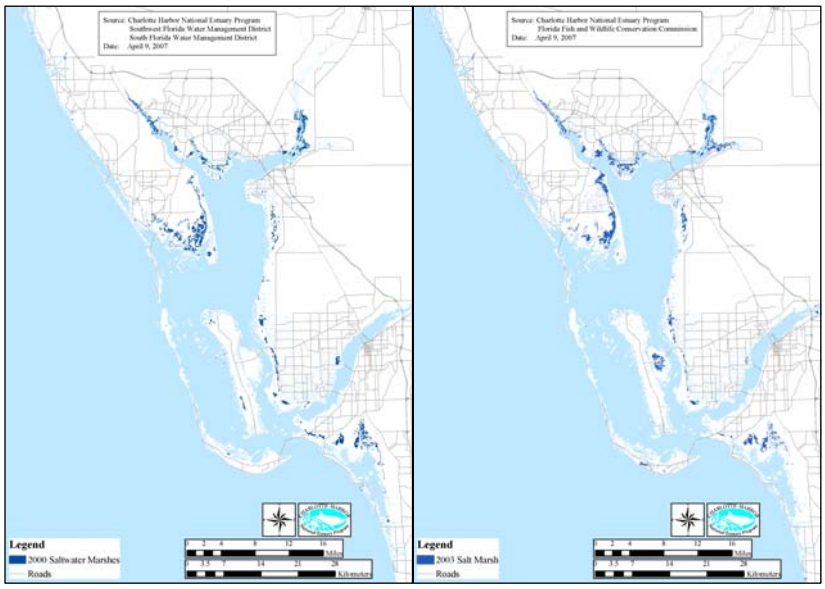
- 2000 Land Use map from Water Management Districts with Saltwater Marshes distinguished.
- 1986, 1997, 2003 Land Cover map from the Fish and Wildlife Conservation Commission with Salt Marsh distinguished.
- SFWMD Pre-Development Map south of Peace River, the SWFWMD Pre-Development Map of the Peace River basin, and the CHNEP Pre-Development Map of Sarasota County.

Gaps:

1) Differentiate between tidal and high marsh within existing land cover mapping programs
2) Determine natural variation in salt water marsh habitat extent
3) Predevelopment vegetation map for entire area to determine acreage changes

Targets:

- No long-term net declines in intertidal saltwater marsh coverage by basin except as a result of natural variation or restoration.
- No long-term net declines in high saltwater marsh coverage by basin except as a result of natural variation or restoration.



FW-k: Percent exotics within saltwater marshes by basin.

Summary: Most salt marsh acreage, especially high marsh, is within Preserve State Parks. Managers are responsible for removal of exotics and probably could give information regarding exotic invasion status and other conditions related to salt marshes in their care. Charlotte County conducted melaleuca mapping on Cape Haze, which includes salt marsh.

Available Products:

- CHNEP staff requested melaleuca map for Cape Haze.
- CHNEP staff requested information related to the salt marshes within the Buffer Preserve State Parks.

Gaps:

1) Create a monitoring program to determine the percent of exotic plants in saltwater marshes throughout the CHNEP area.

Targets:

- Achievement of controllable levels of Florida Exotic Pest Plant Council-defined nuisance, invasive exotic plant species on saltwater marsh habitat on public lands by 2020.

FW-l: Freshwater wetland acreage and type (i.e. isolated, connected) by basin.

Summary: Land use maps are created from aerial photography every 5 years by the Water Management Districts and land cover maps are created by the FFWCC every 5-6 years. In addition the SWFWMD is contracting annual land use land cover maps. The CHNEP staff can use FLUCCS codes and land cover maps to classify acreage over time in a general freshwater wetland category.

Available Products:

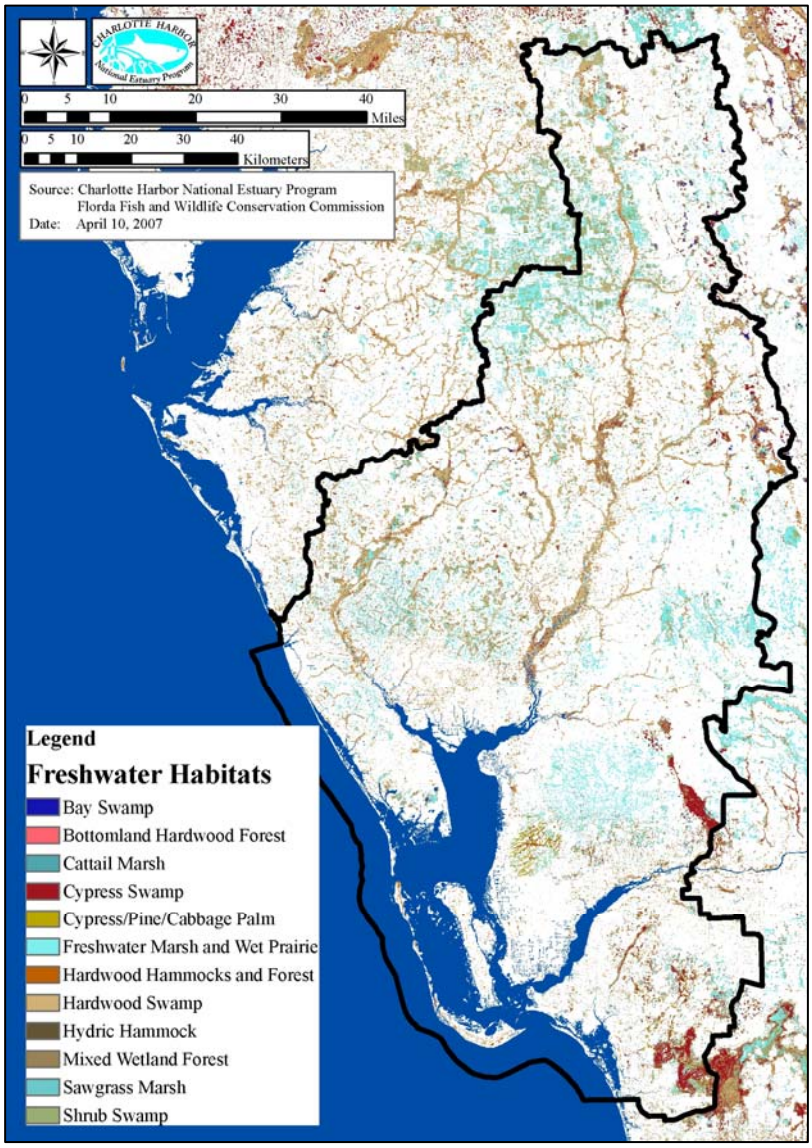
- 2000 Land Use map from Water Management Districts with Freshwater Wetlands distinguished.
- 1986, 1997, 2003 Land Cover map from the Fish and Wildlife Conservation Commission with Freshwater Wetlands distinguished.
- SFWMD Pre-Development Map south of Peace River, the SWFWMD Pre-Development Map of the Peace River basin, and the CHNEP Pre-Development Map of Sarasota County.

Gaps:

1) Determine natural variation in freshwater wetland habitat extent.
2) Map isolated versus connected wetlands
3) Map hydric pine flatwoods within existing programs

Target:

- No long-term net declines in freshwater wetlands coverage by basin except as a result of natural variation or restoration.



FW-m: Kilometers of freshwater 1st and 2nd order streams by basin.

Summary: Census Bureau Hydrography maps include first and second order stream classifications based on national reach data. Reaches of the Peace River are not included in the first or second order stream classification system, possibly because the reaches are intermittent.

Available Products:

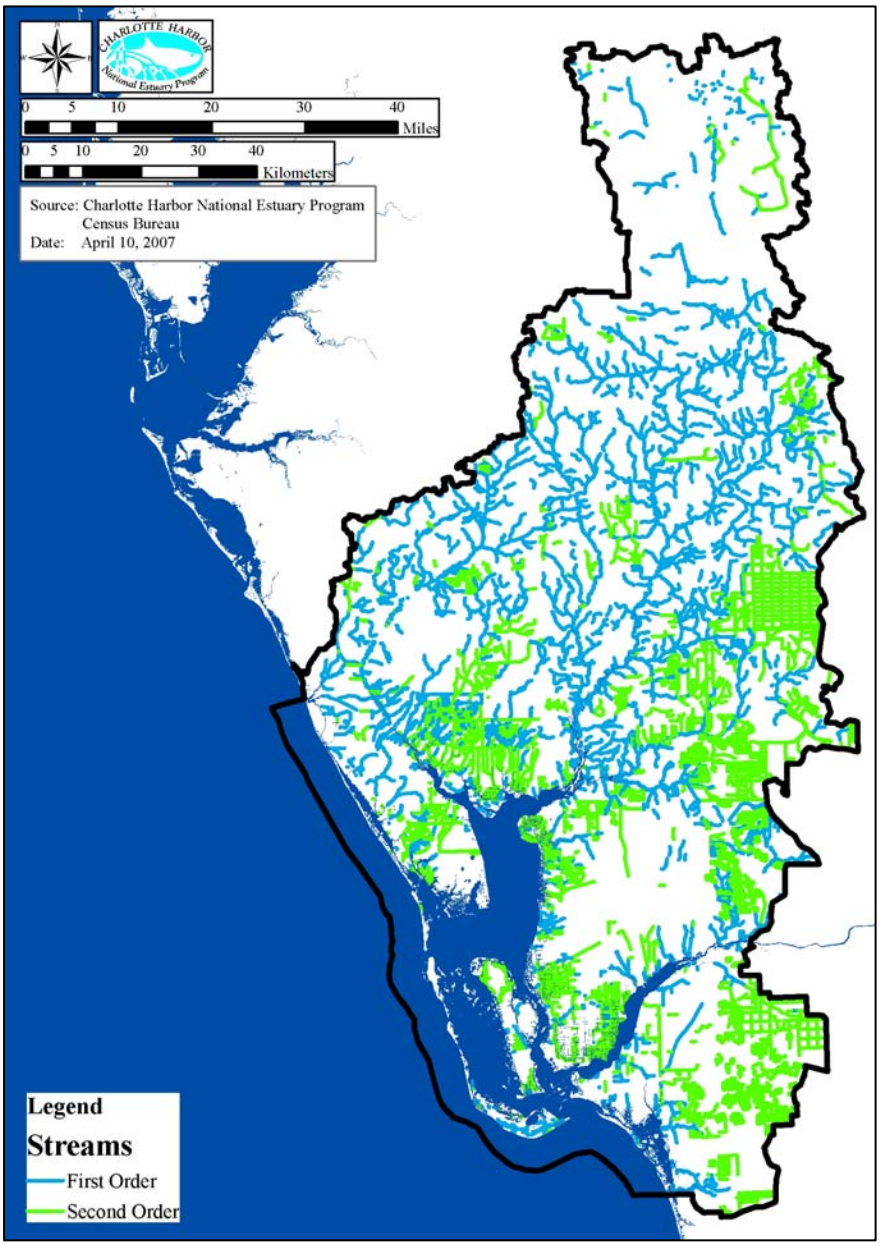
- Census Bureau Hydrography maps.

Gaps:

1) Refine/Validate map of 1st and 2nd order streams.

Target:

- No long-term net declines in the length of 1st and 2nd order streams contributing to each basin.



FW-n: Percent exotics within freshwater wetlands by basin.

Summary: If any work pertaining to this indicator is currently being conducted it is on a small scale, and has not been identified.

Available Products: None.

Gaps:

1) Create a monitoring program to determine the percent of exotic plants in freshwater marshes throughout the CHNEP area

Target:

- Controllable levels of Florida Exotic Pest Plant Council-defined nuisance, invasive exotic plant species on freshwater wetland habitat on public lands by 2020.

FW-o: Oyster bar acreage and location by oyster segment (seagrass segment plus Dona and Roberts Bay)

Summary: The extent and location of oyster bars is not mapped on a regular basis, however, the SFWMD and SWFWMD did map oyster bars in 1999, and the CHNEP historic coastal benthic habitat maps also include oyster bars. Recent advances in photo-interpretation may allow more frequent and reliable estimates of oyster bar distribution.

Available Products:

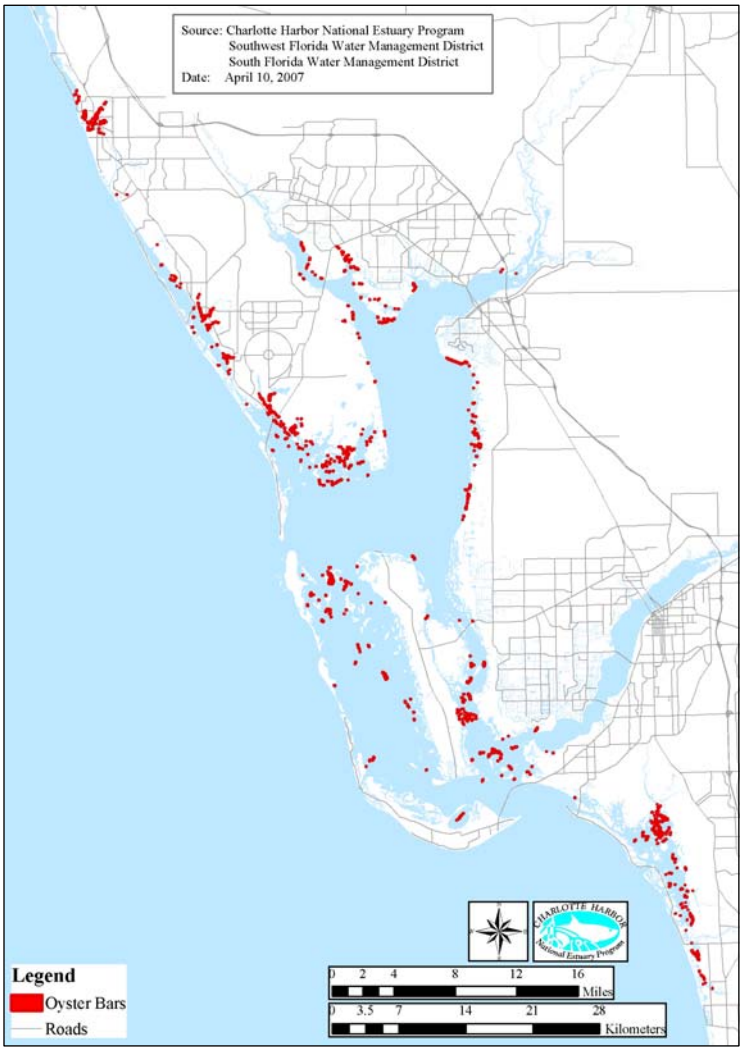
- Shape file of benthic habitats including oyster bars, based on SFWMD mapping and CHNEP project to include oyster bar maps in SWFWMD area.
- CHNEP shapefile for historic coastal benthic habitat, completed 2007.

Gaps:

1) Develop an accurate method for using aerial photography to map the extent of oyster bars.
2) Coordinated effort between mapping in both Water Management Districts.

Target:

- No long-term net declines in oyster bar coverage by basin through period of record with the exception of Intra Coastal Waterway, causeway footprints and other permanent losses as of 1999.



FW-p: Number of living oysters per sq. meter

Summary: Percent live:dead may be misleading since that changes seasonally (depending on the salinity), but they quickly rebound as new recruits come in. For this reason, number of living oysters per sq. meter may be a better indicator. In our area, it ranges from 500 - 3000 per square meter. Oysters in the Caloosahatchee continuously spawn between May and October. In about a month they will be about 1 cm or so big. Depending on when we get rains, freshwater releases, the juveniles are more prone to mortality and hence a big variation between years or even months depending on the flows. Florida Gulf Coast University (FGCU) currently conducts surveys of oyster bars in the Caloosahatchee estuary in cooperation with the SFWMD, including measures of percent living. Sarasota County conducts a similar monitoring program bi-annually in the Lemon Bay, and Dona and Roberts Bay portions of the CHNEP study area.

Available Products:

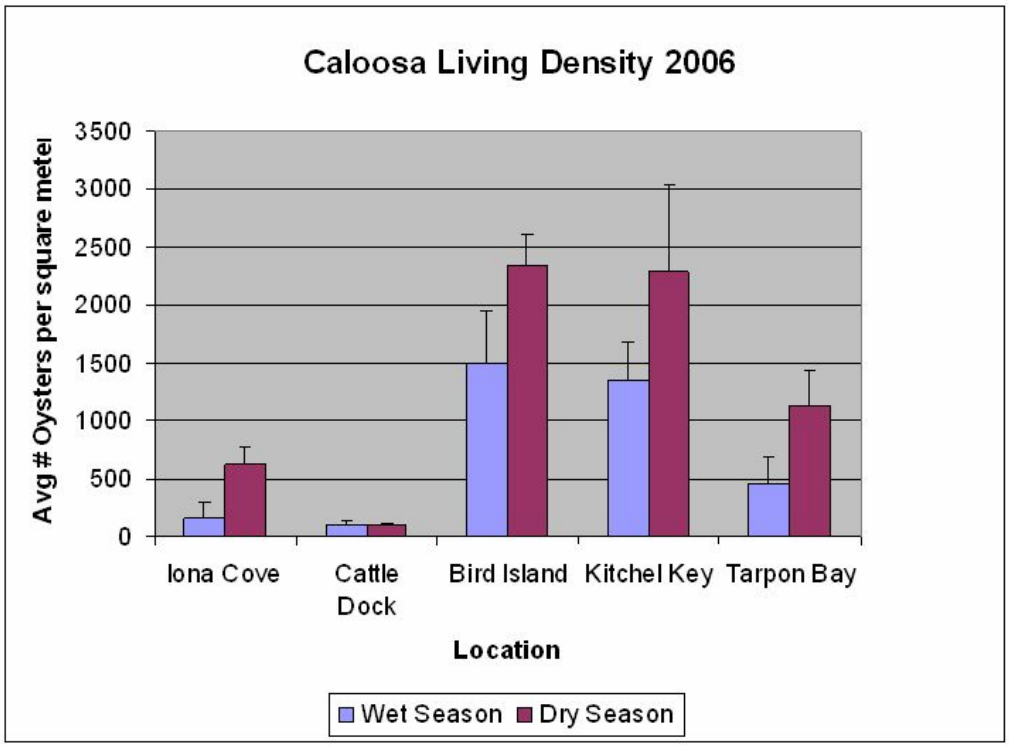
- Living oyster density in the Caloosahatchee.
- Sarasota County oyster monitoring data.

Gaps:

1) Develop oyster bar monitoring program for spat recruitment, percent living/dead and disease that is consistent throughout study area.

Target:

- Sixty - seventy percent live oysters on oyster bars (taken from Sarasota County draft oyster monitoring plan).



FW-q: Native upland acreage and location by basin and by type

Summary: Landuse maps are created from aerial photography every 5 years and landcover maps are created by the FFWCC every 5-6 years. The CHNEP staff can use FLUCCS codes to classify acreage over time by the existing types.

Available Products:

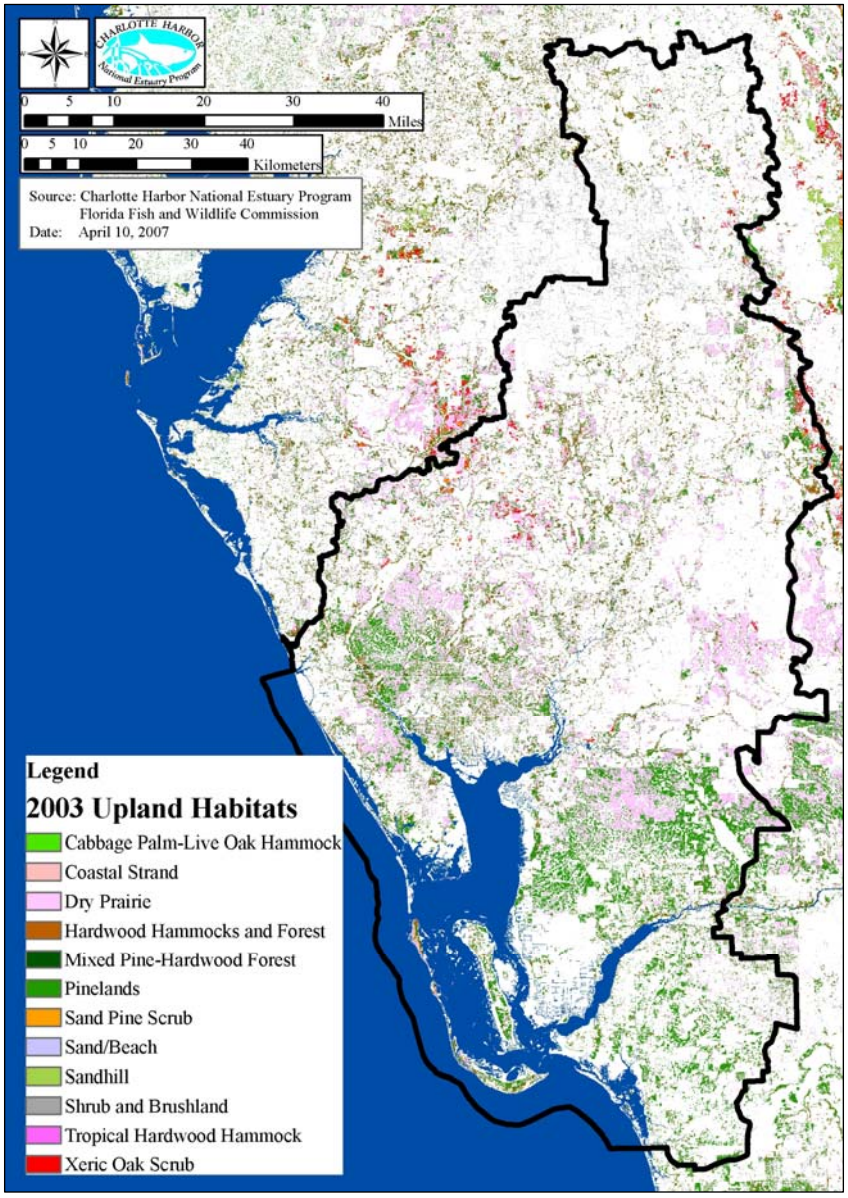
- 2000 Land Use map from Water Management Districts
- 1986, 1997, 2003 Land Cover map from the Fish and Wildlife Conservation Commission
- SFWMD Pre-Development Map south of Peace River, the SWFWMD Pre-Development Map of the Peace River basin, and the CHNEP Pre-Development Map of Sarasota County.

Gaps:

1) Determine the natural area and extent of upland habitat

Target:

- Maintain native community composition of upland communities.
- Preserve 25% (where still available) of native upland coverage by basin and by type.



FW-2: Achieve a 100 percent increase in conservation, preservation, and stewardship lands within the boundaries of the Charlotte Harbor NEP study area by the year 2025. The increase will be based upon 1998 acreages of existing conservation, preservation, and stewardship lands.

FW-r: Acreage in conservation status within study area and by basin.

Summary: Land purchases and conservation easements are documented by several entities, including; Sarasota, Lee and Charlotte Counties, Water Management Districts, Florida Natural Areas Inventory (FNAI), and the FFWCC, along with other non-profit agencies and governmental agencies. Data was compiled in 2003 by the Nature Conservancy, FWS and FFWCC, and a GIS file and database were created. The FNAI database is updated on a quarterly basis. CHNEP identified acreages by basin for 1998 and track acquisition through the Government Performance and Review Act (GPRA) annual reports.

Available Products:

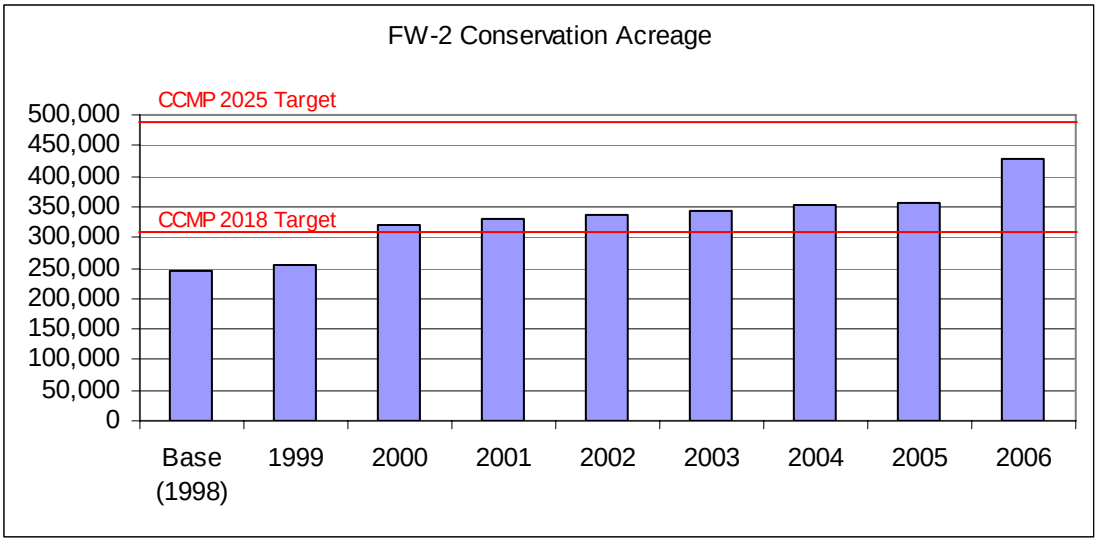
- Table of acquisition efforts by year since 1998 and by basin.

Gaps:

1) Prepare map of conservation easements within the Study Area.

Target:

- Increase of coverage for lands in conservation status by 100% over 1998 levels by study area to 487,846 acres.



FW-3: On conservation, preservation, stewardship, and other public lands achieve controllable levels of invasive exotic plants as defined by the Florida Exotic Pest Plant Council and exotic nuisance animals as defined by the Florida Fish and Wildlife Conservation Commission by the year 2020. Encourage and support the removal and management of invasive exotic plants and exotic nuisance animals on private lands.

FW-s: Invasive exotic plants acreage and location by basin by species on public and submerged lands.

Summary: The USGS reports non-indigenous aquatic species by watershed, the FEPPC lists all reported species by county, and the FNAI prepares a database of all exotic species surveys. These databases can be used to track the number of species established, new introduction of species and eradication of species. A general spatial distribution of species is also monitored. The CHNEP restoration needs inventory reflects those areas that require exotic removal. (see also FW-k and FW-n)

Available Products:

- Currently no data exists for exotic plant acreages and location on public land.

Gaps:

1) Develop a protocol with Florida Natural Areas Inventory for complete surveys for invasive exotic plants within study area public conservation lands and implement

Target:

- Controllable levels of invasive exotic plants as defined by the Florida Exotic Pest Plant Council by the year 2020 on public lands and submerged waters.
- No new introductions of invasive exotic plants as defined by the Florida Exotic Pest Plant Council.
- Reduce on public and submerged lands of the following invasive exotic plants by 2010:
    a) Brazilian pepper (*Schinus terebinthifolius*)
    b) Melaleuca (*Melaleuca quinquenervia*)
    c) Australian pine (*Casuarina* spp.)
    d) West Indian Marsh Grass (*Hymenachne amplexicaulis*)
    e) Japanese and Old World Climbing ferns (*Lygodium japonicum* and *L. microphyllum*)
    f) Air potato (*Dioscorea bulbifera*)

FW-t: Exotic, nuisance animal reports by species by basin on public and submerged lands.

Summary: The USGS reports non-indigenous aquatic species by watershed, and the FFWCC lists all reported species by county. These databases can be used to track the number of species established, new introduction of species and eradication of species. A general spatial distribution of species is also monitored.

A report that pulls together the exotic nuisance animals for our study area (Lee, Charlotte, Sarasota, Manatee, DeSoto, Hardee, and Polk Counties) from the Florida Fish and Wildlife Conservation Commission database would be helpful. Base data is at http://www.floridaconservation.org/critters/exotics/exotics.asp. The database can be searched by County and the link is located toward the lower part of this web page. The first entry is Giant Toad. If you click that link, the giant toad page comes up with information about the species, information on changes in extent by county, and literature citations. A volunteer could prepare the county list for the CHNEP counties and their corresponding species pages (without bothering to duplicate it for each county) into a word document.

Available Products:

- http://www.floridaconservation.org/critters/exotics/exotics.asp

Gaps:

1) Compile nuisance exotic animals for the study area from the FFWCC and USGS databases

Targets:

- Achieve controllable levels of exotic nuisance animals as defined by the Florida Fish and Wildlife Conservation Commission by the year 2020 on public lands and submerged waters.
- No new introductions of exotic nuisance animals as provided by the Florida Fish and Wildlife Conservation Commission and the USGS non-indigenous aquatic species.
- Reduction on public and submerged lands of the following exotic nuisance animals by 2010:
    a. Nile monitor lizard (*Varanus niloticus*)
    b. Monk parakeet (*Myiopsitta monachus*)
    c. Green iguana (*Iguana iguana*)
    d. Black spiny-tailed iguana (*Ctenosaura similis*)
    e. Green mussel *(Musculista senhousia*)

EPA Governmental Performance and Results Act (GPRA)
Matrix, Indicator Report

NEP NAME: Charlotte Harbor National Estuary Program

Indicator	In Use or Under Development?	CCMP Objective	Type of Monitoring for Each In Use@ Indicator	Entity Conducting/ Funding Monitoring	Parameters Being Monitored	Question the Indicator Will Help Answer
1. Water Quality	In Use.	**WQ-1**: Maintain or improve water quality from year 2000 levels. Bring all impaired water bodies into a watershed management program (such as Reasonable Assurance or Basin Management Action Plan) by 2015. Remove at least 2 waterbodies from the impaired list by improving water quality by 2015.	1. Water Quality Monitoring 2. Impaired Waters List 3. Water Quality trend assessment	1. All Partners 2. Florida Department of Environmental Protection 3. CHNEP	1. Water Quality Impairments. 2. Water Quality Trends.	1. How clean is our water? 2. Is water quality improving or declining?
2. Living Aquatic Resources	Under Development.	**WQ-2:** Develop and meet site specific alternative criteria which are protective of living resources for dissolved oxygen, chlorophyll a, turbidity/total suspended solids, and pesticides by 2015.	1. Water Quality Monitoring 2. Special Studies	1. All Partners 2. CHNEP and others	1. Parameters that affect living resources and are not sufficiently addressed by state standards.	1. Will our water sustain living resources?
3. Harmful Algal Blooms	Under Development.	**WQ-3:** Reduce severity, extent, and duration of harmful algal blooms (HABs), including macro-algae, phytoplankton, and periphyton through the identification and reduction of anthropogenic influences, by 2025.	1. HAB Counts and Locations 2. Cyanobacteria Counts 3. Nuisance blooms of macro-algae and filamentous green algae	1. FWC 2. Utilities 3. Newspapers	1. Red Tide 2. Blue-green algae 3. Nuisance blooms of macro-algae and filamentous green algae 4. Other toxic HABs	1. Are Harmful Algal Blooms excessive?
4. Shellfish Harvest	Under Development.	**WQ-4:** Meet shellfish harvesting standards year-round by 2025.	1. Shellfish harvest area closures	1. Department of Agriculture and Consumer Services	1. Shellfish harvest area closures	1. Are shellfish safe to eat?
5. Fresh-water flow Natural Seasonal Variation	In Use.	**HA-1:** Identify, establish, and maintain a more natural seasonal variation (annual hydrograph) in freshwater flows and levels by the year 2010 for: 1. Caloosahatchee River; 2. Upper Peace River and its tributaries; 3. Myakka River;	1. Flow gauges 2. Salinity data collection and analysis	1. U.S Corps of Engineers and USGS 2. Collection by various partners & spatial analysis by CHNEP and CHEC.	1. Amount of time that freshwater flows are within the natural seasonal variation for Caloosahatchee, Peace, Myakka, Estero 2. Isohaline locations in	1. Has freshwater flow changed from what would be expected from the natural situation?

		4. Estero Bay and its tributaries.			3 rivers.	
6. Historic Subbasins	Under Development.	**HA-2**: Restore, enhance, and improve where practical historic subbasin boundaries and natural hydrology for basins within the Charlotte Harbor NEP study area, with special attention to Outstanding Florida Waters, Class I waterbodies, and tributaries to Estero Bay by the year 2020.	1. Mapping of Historic Subbasins	1. CHNEP	1. Acreage restored to Historic Subbasins.	1. Do watershed areas drain to their historic waterbodies?
7. Artificial Structures	Under Development.	**HA-3:** By 2020, enhance and improve to more natural hydrologic conditions waterbodies affected by artificially created structures throughout the Charlotte Harbor NEP study area. Reduce negative hydrologic effects of artificially created structures such as weirs, causeways, dams, clay settling areas and new reservoirs.	1. Pre and post design assessments.	1. Sponsoring agency and CHNEP	1. Acreage restored.	1. Can artificial structures be improved to protect the environment?
8. Government Reforms	Under Development.	**HA-4:** By 2010, for each basin, identify the linkages between local, water management district, state, and federal governments' development permitting and capital programs affecting water storage, flood control, and water quality. By 2012, identify and recommend reforms through tools such as Comprehensive Watershed Management Plans. By 2015, implement the reforms.	1. Evaluation and Appraisal Reports (EARs) 2. Comprehensive Watershed Plans 3. Ordinances and Rule Changes	1. Local Government 2. Local Government 3. Government, all levels.	1. Reforms.	1. How have governments reformed to improve hydrology and water quality?
9. SAV Extent & Quality	In Use	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: b) native **submerged aquatic vegetation** should be maintained and restored at a total extent and quality no less than caused by natural variation.	1. Mapping of Seagrass every 2 years. 2. Seagrass transects every quarter 3. Mapping of Prop Scars every 8 years. 4. Independent Fisheries Monitoring	1. Water Mgmt Districts 2. FDEP 3. CHNEP and FWRI 4. Fish & Wildlife Conservation Commission	1. Seagrass acreage by seagrass segment 2. Seagrass fall % cover by species, deep edge. 3. Prop scar acreage, severity, location 4. Fish Community Composition.	1. Are SAV extents changing over time? 2. Is the habitat value of SAV changing over time?
10. Submerged and Intertidal Habitats Extent & Quality	In Use	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: b) maintain the existing extent and location within range of natural variability of **submerged and intertidal un-vegetated habitats**	1. Mapping of Intertidal and Submerged Habitats every 2 years. 2. Benthic Macro-invertebrate abundance and diversity assessment. 3. Independent Fisheries	1. Water Management Districts 2. CHNEP and Mote Marine Laboratory 3. Fish & Wildlife	1. Submerged and intertidal Unvegetated Habitat extent. 2. Benthic Macro-invertebrate abundance and diversity. 3. Fish Community Composition.	1. Are Submerged and intertidal Unvegetated Habitat extents changing over time? 2. How productive and diverse are Submerged and

		(especially mud flats and sand flats) and improve the habitat quality;	Monitoring.	Conservation Commission		intertidal Unvegetated Habitats?
11. Mangrove Extent & Quality	In Use	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: c) 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;	1. Mapping of Mangrove Habitats every 5 years. 2. Satellite imagery of mangrove habitat every 5 years. 3. Mangrove Transects. 4. Tidal shoreline volunteer program. 5. Independent Fisheries Monitoring.	1. Water Mgmt Districts 2. Fish & Wildlife Conservation Commission 3. SCCF 4. CHNEP 5. Fish & Wildlife Conservation Commission	1. Mangrove Acreage and Location. 2. Mangrove Species Composition for Sample Sites. 3. Condition of mangrove shoreline. 4. Fish Community Composition.	1. Are Mangrove Habitat extents changing over time? 2. How productive and diverse are Mangrove Habitats?
12. Saltwater Marsh Extent & Quality	In Use.	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: d) restore and maintain **saltwater marsh habitats** where feasible (e.g. public lands or undeveloped areas) and prevent loss or conversion of existing salt marsh habitats;	1. Mapping of Saltwater Marsh habitat every 5 years. 2. Satellite imagery of Saltwater Marsh habitat every 5 years.	1. Water Mgmt Districts 2. Fish & Wildlife Conservation Commission	1. Saltwater Marsh Acreage and Location. 2. Saltwater Marsh Species Composition for Sample Sites.	1. Are Saltwater Marsh extents changing over time? 2. How productive and diverse are Saltwater Marsh Habitats?
13. Freshwater Wetland Extent & Quality	In Use.	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: e) restore, maintain, and manage **freshwater wetland systems** in current extents and to a quality capable of maintaining all natural functions within the range or natural variability;	1. Mapping of Freshwater Wetland every 5 years. 2. Satellite imagery of Freshwater Wetland every 5 years. 3. Mapping of 1st and 2nd order streams	1. Water Mgmt Districts 2. Fish & Wildlife Conservation Commission 3. Census Bureau	1. Freshwater Wetland Acreage and Location. 2. Freshwater Wetland Species Composition for Sample Sites. 3. Kilometers of 1st and 2nd order streams	1. Are Freshwater Wetland extents changing over time? 2. How productive and diverse are Freshwater Wetland Habitats? 3. Are first order streams changing in extents?
14. Oyster Bar Extent & Quality	In Use.	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: f) restore, manage, and improve the habitat quality of **oyster bars** in the Charlotte Harbor NEP area based on the existing historic data;	1. Mapping of Oyster Bars every 2 years. 2. Surveys of Oyster Bar density	1. South Fl Water Mgmt District 2. Florida Gulf Coast University	1. Oyster Bay Acreage and Location. 2. Oyster Density	1. Are Oyster Bar extents changing over time? 2. Are the oyster bars healthy?
15. Native Upland Extent & Quality	In Use.	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: g) protect, enhance, restore **native**	1. Mapping of Native Upland habitat every 5 years. 2. Satellite imagery of	1. Water Mgmt Districts 2. Fish & Wildlife Conservation	1. Native Upland Acreage and Location.	1. Are in tact native uplands sufficient to protect ecological functions?

		upland communities vital to the ecological function of the Charlotte Harbor NEP study area;	Native Upland habitat every 5 years.	Commission		
16. Water Column Extent & Quality	In Use.	**FW-1:** Meet the stated objectives for the target extent, location, and quality of the following habitats in the Charlotte Harbor NEP study area: h) restore, manage, and improve the habitat quality of the **water column.**	1. Independent Fisheries Monitoring.	1. Fish & Wildlife Conservation Commission	1. Fish Community Composition.	1. Is the water column healthy enough to sustain diverse and abundant fish communities?
17. Lands Under Steward-ship	In Use.	**FW-2**: Achieve a 100 percent increase in conservation, preservation, and stewardship lands within the boundaries of the Charlotte Harbor NEP study area by the year 2025. The increase will be based upon 1998 acreages of existing conservation, preservation, and stewardship lands.	1. GPRA Habitat Reporting	1. CHNEP	1. Acreage of Lands in Conservation Status	1. Has the amount of land managed for environmental purposes increased?
18. Invasive exotic plants and exotic nuisance animals	Under Developmen t	**FW-3:** On conservation, preservation, stewardship, and other public lands achieve controllable levels of invasive exotic plants as defined by the Florida Exotic Pest Plant Council and exotic nuisance animals as defined by the Florida Fish and Wildlife Conservation Commission by the year 2020.	1. Exotic Nuisance animals presence by county 2. Independent Fisheries Monitoring. 3. Exotic Plant Species Surveys	1. FWC 2. FWC 3. Florida Natural Areas Inventory	1. Invasive exotic plant acreage by Basin on public and submerged lands. 2. Exotic Nuisance Animal Reports by Basin on public and submerged lands.	1. Has the extent of damaging exotic plants and animals expanded?

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