Charlotte Harbor National Estuary Program

presents the

Charlotte Harbor Watershed Summit
State of Our Watersheds and Estuaries

March 30 & 31, 2011

Charlotte Harbor Event & Conference Center
Punta Gorda, Florida
Charlotte Harbor National Estuary Program

presents the

Charlotte Harbor Watershed Summit

State of Our Watershed and Estuaries
March 30–31, 2011

Sponsors

The CHNEP is pleased to receive sponsorship support for this Summit from the following organizations, agencies and businesses.

Mosaic ($2,500) ~ CF Industries ($2,000)

Mote Marine Laboratory ($1,000)
Peace River/Manasota Regional Water Supply Authority ($1,000)
Southwest Florida Water Management District Manasota and Peace River Basin Boards ($1,000)

Jelks Family Foundation ($500) ~ Scheda Ecological Associates ($500)

Myakka Conservancy ($300) ~ Janicki Environmental, Inc. ($250)

Caloosahatchee River Citizens Association (CRCA) ($100) ~ Florida Native Plant Society Mangrove Chapter ($100) ~ Sierra Club Calusa Chapter ($100) ~ Southwest Florida Watershed Council ($100)

Program Supporters

The CHNEP is a partnership of citizens, elected officials, resource managers and commerical and recreational resource users working to improve the natural environment of Florida from Venice to Bonita Springs to Winter Haven. A cooperative decision-making process is used to address diverse resource management concerns in the 4,700-square-mile study area.

The CHNEP financial partners are the 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, Southwest Florida Regional Planning Council, the counties of Polk, Sarasota, Manatee, Lee, Charlotte, DeSoto and Hardee, and the cities of Bonita Springs, Fort Myers Beach, Sanibel, Fort Myers, Cape Coral, Punta Gorda, North Port, Venice and Winter Haven.
Charlotte Harbor Watershed Summit: State of Our Watershed & Estuaries

AGENDA

Day 1: Wednesday March 30, 2011

8:00 Registration and Coffee

8:30 Welcome and Announcements: Lisa Beever, CHNEP

8:40 Session 1: What are Our Watershed Conditions and Restoration Activities? (pages 5 - 7)
Chair: Greg Blanchard, Manatee County
8:40 State of the Charlotte Harbor Estuaries and Watersheds - Lisa Beever, CHNEP
9:00 Overview of the Southwest Florida Water Management District's Activities with the Charlotte Harbor Watershed - Lizanne Garcia, SWFWMD
9:20 Local Government Watershed Planning and Management: Filling a Need in a Regional Approach - Mike Britt, Winter Haven Natural Resources
10:00 Cooperative Conservation Blueprint Strategies for Southwest Florida - Christine Small, Endeavours Together, LLC

10:20 Break

10:40 Session 2: What are Our Hydrologic Conditions? (pages 8 - 10)
Chair: Joanne Vernon, Charlotte County
10:40 Salinity Regression Modeling, Development and Uses for Biological Evaluations in the Myakka River - L.K. Dixon, Mote Marine Laboratory
11:00 Changes in Freshwater Inflow to the Lower Myakka River and Development of Related Resource Management Strategies - Michael S. Flanner, SWFWMD
11:20 Hydrologic Conditions that Influence Streamflow Losses in a Karst Region of the Upper Peace River - Patty Metz, USGS, et al.

12:00 Lunch

1:20 Session 3: What are Our Water Quality Conditions? (pages 11 - 13)
Chair: Keith Kibbey, Lee County
1:40 Mixing Behavior of Colored Dissolved Organic Matter (CDOM) in the Caloosahatchee Estuary, Florida - Peter Doering, SFWMD, et al.
2:00 A Two-Year Study Evaluating Captiva and Sanibel's Nearshore Water Quality, Emphasizing Nutrients and Microbial Concerns - Mark Thompson, SCCF, et al.
2:20 Sources and Sinks of Nutrients to the Caloosahatchee River and the Gulf of Mexico - A.N. Loh, FGCU, et al.

2:40 Break

3:00 Session 4: What are Our Water Quality Management Activities? (pages 14 - 17)
Chair: Rhonda Evans, USEPA
3:00 Nutrient Water Quality Targets for Southwest Florida Impaired Waters: Characterizing Unimpaired Conditions with Historical Data - Jeffrey Talbott, FGCU, et al.
4:00 Significant Nutrient Removal by Swale Drainage - Allan Willis, PBS&J, et al.
4:20 SWFWMD Lake Hancock Outfall Wetland Project - Janie Hagberg, SWFWMD

4:40 Break
Day 1: Wednesday March 30, 2011 (continued)

4:50 Session 5: Watershed and Estuary Conditions Poster Presentations and Discussions with Authors (pages 18 - 28)

5-1: What are Our Watershed Conditions and Restoration Activities?
5-1 Sarasota Co. Survey of Phosphorus in Soil and Beach Sands - Jon Perry, Sarasota County
5-1 Bringing History to Life: Linking Water, History & Technology - Amanda Dominguez, Sarasota County, et al.

5-2: What are Our Hydrologic Conditions?
5-2 Computation of Residence Time for the Caloosahatchee Estuary - Chenxia Qiu, SFWMD, et al.

5-3: What are our Water Quality Conditions?
5-3 Water Quality Impairments within the CHNEP Boundary - Jennifer Thera, FDEP South District, et al.
5-3 Using Stable Nitrogen Ratios to Examine Sources of Nitrogen within a Residential Community - Nora Eagan Demers, FGCU
5-3 Effectiveness of Anti-Fouling coatings in Southwest Florida's Estuarine and Marine waters, with Emphasis on Real-Time Observing Systems - Nicole Martin, SCCF, et al.

5-4: What are Our Water Quality Management Conditions?
5-4 Pollutant Loading Estimate Development for the Water Quality Target Refinement Project - Ray Pribble, Janicki Environmental

5-6: What are Our Marsh and Aquatic Vegetation Conditions?
5-6 Effect of Aeration on Algae and Dissolved Oxygen in Ponds - Katie Thorp, Bonita Middle School

5-7: What are our Invertebrate, Plankton and Shellfish Conditions?
5-7 Ten Years of the Southwest Florida Frog Monitoring Network: Natural Cycles and Human-Driven Changes - Edwin Everham, FGCU, et al.
5-7 Monitoring colonial Nesting Birds in Estero Bay Aquatic Preserve - Cheryl Clark, FDEP Estero Bay Aquatic Preserves, et al.

5-8: What are Our Fishery Conditions?
5-8 Fish Community Assemblages in the Peace River - M.E. Call, FWC, et al.
5-8 Distribution & Abundance of Introduced Fishes in Florida's Charlotte Harbor Estuary - C.F. Idelberger, FWC FWRI, et al.
5-8 Phyllanthus fluitans: A Newly Reported Invasive Species in Florida - Michael Sowinski, FWC

5-9: What are Our Habitat Restoration Activities?
5-9 Review of the Rate of Phosphate Mine Reclamation in Florida - Michelle Sims, FDEP Mining & Minerals Regulation, et al.

6:20 Adjourn Day 1
Day 2: Thursday March 31, 2011

8:00  Registration and Coffee
8:30  Welcome and Announcements: Lisa Beever, CHNEP
8:40  Session 6: What are Our Marsh and Aquatic Vegetation Conditions? (pages 29 - 31)
     Chair: Tom Ries, Scheda Ecological
  8:40  Climate Change Vulnerability Assessment and Adaptation Opportunities for Salt Marsh Communities in Southwest Florida - Whitney Gray, SWFRPC, et al.
  9:00  A Two Year Assessment of Macroalgal Population Dynamics, Distribution and Habitat Characterization around Southwest FL Barrier Islands, with Special Attention to past Macroalgal Bloom Events - Eric Milbrandt, SCCF, et al.
  9:40  Ten Year Results of Seagrass Monitoring in the Charlotte Harbor Aquatic Preserves - Melynda Brown, FDEP Charlotte Harbor Aquatic Preserves
10:00  SAV in the Caloosahatchee River Estuary: The Effect of Both Natural and Anthropogenic Freshwater Inflow - Beth Orlando, SFWMD, et al.
10:20  Break
10:40  Session 7: What are Our Invertebrate, Plankton and Shellfish Conditions? (pages 32 - 34)
     Chair: Erin Rasnake, FDEP South District
  10:40  Macroinvertebrate Communities of Four Tidal Creeks on the East Wall of Charlotte Harbor - Albert Walton, FDEP South District, et al.
  11:00  Freshwater Inflow and Prey Production for Young Estuarine-Dependent Fishes in the Caloosahatchee River and Estuary - S.G. Tolley, FGCU, et al.
  11:40  CHNEP Shellfish Restoration Needs Summary - Judy Ott, CHNEP
12:00  Lunch
1:20  Session 8: What are Our Fishery Conditions? (pages 35 - 38)
     Chair: Amy Timmers, FWC FWRI
  1:20  Factors Affecting Fish Community Structure at Babcock Ranch, Charlotte and Lee Counties, Florida - David Ceilley, FGCU, et al.
  1:40  Fish Assemblages in the Oligohaline Zone of the Peace River during Periods of Extreme Freshwater Inflow Variation - P.W. Stevens, FWC FWRI, et al.
  2:00  Comparative Ecology of Euryhaline and Freshwater Predators in a Large Coastal Plain River and the Effects of Chance Events - D.A. Blewett, FWC FWRI, et al.
  2:20  Community-initiated "Kids Cup" tournament evaluates fate of red drum Sciaenops ocellatus in Charlotte Harbor, Florida - Elizabeth Staugler, FL Sea Grant Charlotte County, et al.
3:00  Break
3:20  Session 9: What are Our Habitat Restoration Activities? (pages 39 - 42)
     Chair: Curtis Porterfield, Polk County
  3:20  Habitat Restoration in Charlotte Harbor - Stephanie Powers, SWFWMD
  3:40  A Watershed Analysis of Permitted Coastal Wetland Impacts and Mitigation Methods within the CHNEP - James Beever, SWFRPC, et al.
  4:00  Cattle Dock Point Mitigation Project - Dianne Rosensweig, Scheda Ecological, et al.
5:00  Closing Remarks: Lisa Beever, CHNEP
5:15  Conclude 2011 Watershed Summit
### Session 5 Poster Presentation Locations

| 5-1: Watershed Conditions and Restoration Activities | 5-2: Hydrologic Conditions |
| 5-3: Water Quality Conditions | 5-4: Water Quality Management Activities |
| 5-6: Marsh and Aquatic Vegetation Conditions | 5-7: Invertebrate, Plankton and Shellfish Conditions |
| 5-8: Fishery Conditions | 5-9: Habitat Restoration Activities |

**MYAKKA ROOM A**

- 5-1: Dominguez
- 5-2: Qiu
- 5-3: Perry
- 5-4: Hackett
- 5-5: Denison
- 5-6: Thorp
- 5-7: Everham
- 5-8: Sowinski
- 5-9: Sims

**MYAKKA ROOM B**

- 5-3: Thera
- 5-3: Ketover
- 5-3: Demers
- 5-3: Martin
The Charlotte Harbor National Estuary Program (CHNEP) adopted the Comprehensive Conservation and Management plan (CCMP) update in March 2008. Two months later, CHNEP updated its Environmental Indicators Technical Report. EPA requires each of the 28 NEPs in the country to produce a “State of the Bay” report or report card. Using survey techniques, CHNEP identified 12 environmental indicators that best represented the state of the Charlotte Harbor estuaries and watershed. Unfortunately, some of the top indicators had no data or analysis available to represent in a State of Charlotte Harbor report. In order to create the report, CHNEP issued several contracts to fill the data and analysis gaps. This work included:

- Fish and Wildlife Conservation Commission (FWC) Fisheries Independent Monitoring (FIM) for Lemon Bay,
- Pre-development vegetation maps for Charlotte and Manatee Counties,
- Water clarity tracking, and
- Pollutant loads.

In addition, several datasets were collected and analyses were conducted by CHNEP staff. This work included:

- Historic land cover maps so that changes could be identified over time,
- FIM abundance and diversity analysis over time,
- Shoreline condition analysis from CHNEP volunteer data, and
- Restoration projects that have been implemented by partners.

Though CHNEP is producing a traditional hard cover report, we are developing more timely ways to serve the information. Our partnership with the University of South Florida will result in an on-line water atlas. Because much of this work will be featured throughout the watershed summit, the author will feature projects which do not have separate presentations.

Overview of the Southwest Florida Water Management District’s Activities within the Charlotte Harbor Watershed

Lizanne Garcia1, lizanne.garcia@WaterMatters.org

1Southwest Florida Water Management District, 7601 US Highway 301 North, Tampa, FL 33637

Recognizing that Florida had to do more to protect and restore its priceless surface waters, the Florida Legislature created the Surface Water Improvement and Management (SWIM) Program within the State’s Water Management Districts in 1987. The Legislation required the Water Management Districts develop a Priority Waterbody List and identified Tampa Bay as one of the Southwest Florida Water Management District’s priorities. Due to its environmental significance, Charlotte Harbor was included on the Southwest Florida Water Management District's (SWFWMD) SWIM Priority list and the first SWIM Plan was prepared in 1993. In 1995, Charlotte Harbor was designated by the United States Environmental Protection Agency as an “estuary of national significance” and accepted into the National Estuary Program, one of four in the State of Florida and one of only 28 in the entire United States. The Charlotte Harbor National Estuary Program (CHNEP) was established in 1996 as a partnership of citizens, elected officials, resource managers, commercial, and recreational resource users working to improve the ecological integrity of the Greater Charlotte Harbor Watershed. The SWFWMD has participated in funding the CHNEP and provided a representative to sit on the Management and Policy Committees since 1997. Since 1997, the District and the CHNEP have completed several studies to increase the understanding of the Charlotte Harbor watershed as well as projects that address the three priority issues for Charlotte Harbor which are (1) Hydrologic alteration; (2) Water quality degradation; and (3) Fish and wildlife habitat loss. The Winter Haven Chain of Lakes (WHCL) lies within the SWFWMD’s boundaries of the Charlotte Harbor Watershed. These 19 interconnected lakes in and around the City of Winter Haven in north-central Polk County are also a SWIM Priority Waterbody. A SWIM Plan was prepared for the WHCL which identified nutrient enrichment and destruction of natural systems as priority problems. The SWFWMD has worked cooperatively with the City of Winter Haven to improve water quality in the WHCL since the first SWIM plan for the WHCL was prepared in 1990. An overview of projects within the Charlotte Harbor watershed including the Winter Haven Chain of Lakes will be presented.
The management of land and the management of water are inextricably linked. An adequate job of one cannot be performed without considerations for the other. Yet, in most of Florida, these two interdependent responsibilities receive little focus compared to their importance to each other. Local agencies, which are responsible for land use planning, public water supply, wastewater treatment and stormwater management, generally have little consideration for regional water management concerns. The opposite is also true… regional water management policies can overlook potential benefits from local water management strategies. For the past two years, the City of Winter Haven has taken an ‘out of the box’ look at water and discovered that there are many opportunities at the local level to be involved in watershed management. Local land use plans should consider regional watershed objectives for water supply, water quality, flood control and natural systems restoration as direction for planning future land use. Working with developers in permitting new growth in a proactive fashion can benefit economic growth as well as watersheds historically impacted by past land management practices. Water supply, reuse water and stormwater can also be managed in a way to offset discrepancies in the local watershed’s hydrologic budget and benefit regional objectives. The City of Winter Haven’s Sustainable Water Resource Management Plan for the Peace Creek Watershed is a case study in determining the best opportunities for linking local land and water management practices to further both local and regional goals for water resource management. Winter Haven is taking a lead role within the Peace Creek Watershed, which is at the headwaters of the Peace River Watershed and the Groundwater Basin that serves the Southern Water Use Caution Area. This watershed has 10 local governments involved in local water management and contains many lakes and rivers that do not meet minimum flows and levels. Forty percent of the watershed’s lakes are on the impaired waters list. A proactive approach for integrated water resources management at the local scale will ensure long-term benefits for all aspects of water at the regional scale.

Peace River Greenway Initiative From the Headwaters to the Gulf…. 
Julie Morris¹, jmorris@wildlandsconservation.org
Dave Sumpter¹, dsumpter@wildlandsconservation.org

¹Wildlands Conservation, 245 North Tamiami Trail Suite D. Venice, FL 34285

In comparison with Florida’s beautiful coastline, its vast northern forests, picturesque river systems, unique sandy ridges, and the Everglades, there has been much less attention paid to the Peace River as a state resource throughout Florida’s conservation history. This inattention is reflected in the scarcity of protected lands that occur near and along the river, as well as a shortage of directives aimed at protecting this critical natural resource. Wildlands Conservation, Inc., a nonprofit organization based out of Venice, Fl, is working to develop a voluntary, partnership-based Peace River Greenway Initiative. Our overall goal is to facilitate a corridor of protected lands, from Charlotte Harbor northward to the Green Swamp in Polk County, where the headwaters of the Peace River begin. The Peace River is the principal freshwater source for Charlotte Harbor, Florida’s second largest estuary. The Peace River is a critical life line of central Florida – it is an essential source of water supply for thousands of Floridians, and it is the watershed of the Bone Valley region. Charlotte Harbor and southwest Florida's health is directly related to the health of the Peace River. A healthy, protected, Peace River is critical in light of the fact that the region’s primary land uses over the past century have been phosphate mining and agriculture. The Peace River corridor is not only regionally significant, it also provides one of the few viable options for functionally connecting conservation lands in the south and north Florida, from the Everglades to the tip of the Florida panhandle. We are currently working with landowners along the lower Peace River in Desoto County to explore various means for conserving their lands. This area is part of SWFWMD’s Lower Peace River Conservation Corridor Initiative and is a Wildlands Conservation Florida Forever project. Our Florida Forever Project: The Peace River Refuge, currently encompasses approximately 4000 acres along both sides of the River, from Arcadia southward. We are also working with other landowners throughout the region, to assist them in conserving their lands for critical water and habitat protection in this rapidly growing region. Protecting lands from Charlotte Harbor to the Green Swamp will require the use of many land preservation tools including fee-simple acquisition, conservation easements, creation of landowner incentives for protection, and careful, collaborative coordination among stakeholders ranging from agencies, scientists, and conservationists to agricultural, industrial, and developmental interests. We are coordinating with landowners, private industry, several state agencies, regional planning councils, county governments and conservation groups in the region, to ensure that this valuable resource is protected and enhanced for future generations. Conservation of the peace River is critical to our fishing industry, our water supply, our flood protection, our cultural heritage and the sustainability and integrity of Natural Florida.
The Southwest Florida Blueprint area goal is to produce by the end of 2012 a broadly supported stakeholder-recommended 15 to 20-year regional connectivity implementation plan with tangible benchmarks, such as identifying where and how conservation (on public and private lands, including working agriculture) will be accomplished in 20 years, 10 years, 5 years and 1 year. Taking on this challenge is the Southwest Florida Blueprint Working Group whose purpose is to build a broad partnership and agreement between landowners, local governments, regional planning agencies, regional, state and federal resource management agencies, businesses, non-profit organizations and citizens. The State of Florida needs a Cooperative Conservation Blueprint (Blueprint), a common vision to help address what the state will look like, from a conservation perspective, 25, 50, and 100 years into the future. The ultimate purpose of a state Blueprint is to provide a consensus statewide guiding vision that identifies Florida’s most vital natural lands while maintaining important working landscapes, a sustainable economy and agriculture opportunities. The aim of the Blueprint process is ultimately to focus resources and management on common priority lands and waters, efficiently and effectively. The idea to create a guide and set of tools that everyone agrees upon and can be easily used, came from expert input during the development of “Florida’s Comprehensive Wildlife Conservation Strategy” in 2004. More information is at: http://myfwc.com/WILDLIFEHABITATS/Legacy_strategy.htm. The Cooperative Conservation Blueprint is a priority action (Strategy pg 46-47). The idea also came at about the same time from the Century Commission for a Sustainable Florida http://www.centurycommission.org/. The Florida Legislature created the Century Commission in 2005 to envision and plan for Florida’s future. In May 2007, the Critical Lands & Waters Identification Project (CLIP) Phase I documented the initial efforts to unify existing excellent natural resource GIS work in Florida into a single statewide database. CLIP 1.0 is a GIS tool to identify statewide conservation priorities. CLIP database development has continued: CLIP version 2.0 is anticipated for release in the summer of 2011. The Blueprint project began as a statewide endeavor in 2004, but today there is a pressing need to bring the effort down to a more localized and meaningful scale for on-the-ground more detailed analysis and implementation. The purpose of the regional pilot approach is to create and test specific conservation incentives, add local spatial data to the statewide CLIP database, and to work with identified landowners and other planning partners. The Southwest Florida Blueprint Regional Pilot focuses on Collier, Lee, Hendry, Glades, Hardee, Desoto, Highlands and the eastern portions of Charlotte and Sarasota Counties. In 2011 and 2012 we propose to build upon the work within the region to create and implement a unified ecological connectivity (corridors) implementation plan for Southwest Florida. Other elements of Blueprint work are focusing on new incentives for conservation, such as on water supply and water storage, both directly related to Charlotte Harbor National Estuary priorities.
As part of the minimum flows and levels assessment for the Myakka River in Sarasota County and Charlotte County, Florida, a variety of modeling efforts were used to evaluate the effects of potential freshwater withdrawal scenarios. The Southwest Florida Water Management District (SWFWMD) funded the development of salinity regression modeling as a function of flows and other explanatory variables. Using the body of existing salinity data and river kilometer location, selected isohaline (1, 2, 4, 8, 16, 20, and 24 PSU) locations were interpolated and modeled at surface and bottom as a function of simulated time-specific tidal conditions, weather terms (barometric pressure, wind direction and stress parameters), and the daily flows and a variety of weighted flows of the Myakka River near Sarasota, FL (U.S.G.S. 02298830), Myakkahatchee Creek, and the Peace River. Peace River flows were included as potential terms due to the influence on downriver boundary conditions. Optimum flow terms were generally a variably weighted flow term which incorporated riverine volume upstream of the computed isohaline location. Under low flows, flow weighting was extended up to 45 days; under high flows, flow weighting used only a few days. The regression $r^2$ values of the 8 PSU and lower isohalines were 0.80 or better (n~70-100). Regressions were similarly constructed for salinity at selected fixed locations. All regressions were validated by application to a subset of in situ data which were withheld from regression development. Results were comparable to 3-D hydrodynamic model simulations. Time series of isohaline positions under both existing flows and simulated flow reductions were used to evaluate the linear distances and areas of critical habitats (benthic, freshwater marsh, forested wetlands) exposed to salinity intervals, to compute the projected change in available habitat, and to allow SWFWMD to refine maximum potential flow reductions to minimize habitat alterations.
Changes in Freshwater Inflow to the Lower Myakka River and Development of Related Resource Management Strategies
Michael S. Flannery¹, sid.flannery@swfwmd.state.fl.us

¹Southwest Florida Water Management District, 2379 Broad St. Brooksville, FL 34604

The Lower Myakka River is an important nursery area for many estuarine dependent fish and invertebrate species in Charlotte Harbor and freshwater inflow is a dominant force affecting the biological productivity of the tidal river system. Recent studies have documented that the quantity of freshwater inflow to the Lower Myakka River has changed over time due to anthropogenic factors. Based on these findings, resource management strategies are now being evaluated to address both existing and future factors that could influence the timing and volume of freshwater inflow to the lower river. Two physical alterations in the Myakka River watershed have acted to reduce inflow to the lower river. The Blackburn Canal, for which construction was completed in 1959, primarily acts to divert water from the river west to the Dona/Roberts Bay system near Venice. A succession of modifications to the Cowpen Slough sub-basin prior to the early 1960s also diverted drainage areas that formerly flowed to the Lower Myakka to Dona/Roberts Bay. Conversely, it is well documented that changes in land and water use in the upper Myakka River watershed have acted to increase flow to the lower river from the upper river sub-basin. Recent hydrologic data and modeling analyses indicate that the excess flows from the upper river sub-basin typically exceed the flow losses from the Blackburn Canal and Cowpen Slough modifications during times of low and medium flows, but the downstream flow losses can exceed the upstream excess flows during periods of high flows. The reduction of excess flows in the upper river sub-basin is desired in order to restore the hydrologic and ecological characteristics of upstream freshwater wetland areas that have been impacted by the excess flows. As part of a minimum flows analysis of the Lower Myakka River, the SWFWMD has evaluated the effects of removing these excess flows on the salinity characteristics and abundance and distribution of key fish and invertebrate species in the lower river. These results indicate the ecological effects of removing the excess flows will be most pronounced in the spring dry season, which is a period of high nursery use of the tidal river. The potential to alleviate the effects of removing the excess flows by other management actions in the watershed will be evaluated.

Hydrologic Conditions that Influence Streamflow Losses in a Karst Region of the Upper Peace River
Patricia Metz¹, pmetz@usgs.gov
Bill Lewelling², bill.lewelling@swfwmd.state.fl.us

¹U.S. Geological Survey, 10500 University Center Drive, Suite 215, Tampa, FL 33612-6427
²Southwest Florida Water Management District, 6750 Fruitville Road, Sarasota, FL 34240-9711

The Peace River is one of the largest watersheds in Florida, extending from central Florida's phosphate mining district to the southwest coast, where it discharges into Charlotte Harbor. The upper reach of the Peace River, is described as a groundwater recharge area, reflecting a reversal from historical groundwater discharge patterns that existed prior to the 1950s. The upper Peace River channel and floodplain are characterized by extensive karst development, with numerous fractures, crevasses, and sinks that have been eroded in the near-surface and underlying carbonate bedrock. With the reversal in groundwater head gradients, river water is lost to the underlying groundwater system through these karst features. A 5-year investigation was conducted to evaluate the hydrologic conditions that influence streamflow losses in this karst region. The study indicates that about 10 prominent karst features in the low- and high-water channel of the upper Peace River provide the paths through which large amounts of streamflow drain to the underlying aquifers. Seepage run data indicate that on average, the upper Peace River loses water at a rate of 17 cubic feet per second (11 million gallons per day) to karst features along a 2-mile section of the river. Streamflow losses varied throughout each year of the study, and were related to seasonal fluctuations in groundwater levels. The largest streamflow losses occurred at the beginning of the summer rainy season (May and June), when groundwater levels were low and large volumes of water were needed to replenish unfilled cavities and void spaces in the underlying aquifers.
The Peace River Manasota Regional Water Supply Authority (Authority), with cooperative funding assistance from the Southwest Florida Water Management District (District), recently completed a Source Water Feasibility Study which evaluated potential surface and ground water sources to meet projected future potable water demands in the Authority’s four-county service area, much of which is included within the boundaries of the Charlotte Harbor National Estuary Program. Surface water reservoir sites in the upper Myakka River, Shell and Prairie Creeks, and the Dona Bay watersheds were evaluated. Treatment processes, intake locations, water transmission mains, potential environmental effects, and permitting issues were examined. Conceptual criteria included a minimum 1,000 acre reservoir footprint for each possible source. Estimated water supplies were based on 100 percent reliability using streams and the reservoir sizes and intake capacities evaluated. Historic and current surface water flows, minimum flows and levels (MFLs), and existing water supply permits were used to estimate the potential available water supply in the three watersheds. The potential for hydrologic and ecologic restoration were major considerations during the conceptual develop of the Feasibility Study’s assessment and comparative evaluation of water supply projects within each of the three watersheds. For example, extensive tree mortality in the Flatford Swamp and other portions of the Upper Myakka River/Flatford Swamp has been attributed to increased water levels and/or extended hydroperiods during the dry season due to agricultural groundwater discharges, while wet season flows are not significantly different from that expected considering normal annual variations in rainfall. Consequently, the potential for water withdrawals for future water supply could offer opportunities for ecological restoration, particularly during the dry season. In order for a public water supply in the Upper Myakka to be a part of the recovery plan for the impacted areas in the watershed, the excess water must be diverted from the Myakka River downstream of the Flatford Swamp and upstream of the Crowley Nature Center and the Myakka River State Park. Similarly, the Feasibility Study included an evaluation of water withdrawal opportunities from Cow Pen Slough for water supply while at the same time reducing documented excessive freshwater discharges to Dona Bay and enhancing hydrologic restoration. Freshwater diversions for consumptive use would reduce the fresh water flow into Dona Bay better mimicking historical conditions. This would be consistent with the District’s Cow Pen Slough MFL, and would contribute to the oyster habitat restoration goals set forth in the Dona Bay Watershed Management Plan. Excessive freshwater inflows and associated ecological issues are not apparent in the Shell and Prairie Creeks watershed, in contrast to Dona Bay and the Upper Myakka River watersheds. However, during the dry season agricultural discharges of high conductivity groundwater are a major concern, influencing both aquatic populations and the City of Punta Gorda’s water supply.
Since 1976, a long-term Hydrobiological Monitoring Program (HBMP) has been conducted in the lower Peace River/upper Charlotte Harbor estuarine system. The focus has been primarily directed towards assessing the magnitude of changes resulting from the Peace River Water Treatment Facility’s freshwater withdrawals relative to the downstream physical estuarine environment and effected biological communities. The HBMP has also sought to assess seasonal and longer term changes in flows and other parameters, such as water quality, relative to changes in the upstream watershed and the overall “health of the estuary”. Analyses of long-term water quality data from both “fixed” station and “moving” isohaline stations have identified several important recent and longer term systematic changes (or trends) in water quality that have occurred upstream of the Facility that may influence both aspects of Facility operations and/or the biological communities of the estuarine system. While some of these changes can be explained by natural long-term cyclical patterns in watershed rainfall/flow patterns, in other instances anthropogenic influences seem to be the determining factors. Phosphorus concentrations in the lower Peace River/upper Charlotte Harbor estuarine system are naturally high due to the extensive natural phosphate deposits in major upstream watershed basins; with phosphorus concentrations seasonally reflecting both the spatial and temporal variation relative to freshwater inputs. The highest natural freshwater phosphorus concentrations are typically associated with seasonal low river flow, when the influences of ground water are more pronounced. Probably the most dramatic long-term water quality change in the lower Peace River /upper Charlotte Harbor estuarine system has been the marked decline since the 1970s of dissolved inorganic (and total) phosphorus concentrations. This decline followed implementation in the late 1970s of stricter environmental regulations and the subsequent decreases of both point and nonpoint discharges to surface waters from phosphate mining and processing. Long-term monthly water quality data indicates rapid declines in both the magnitude and variability of phosphorus levels following these changes in mining practices. However, recent water quality monitoring data show that phosphorus levels throughout the estuary have again dramatically increased. At the same time there seems to have also been corresponding increases in reactive silica concentrations in the lower river and upper harbor. Upstream watershed sampling suggest that these increases may be associated with the permitted closures of phosphogypsum stacks in the Whidden Creek basin. Time-series and statistical analyses further indicate that there has been long-term, progressive increases in the conductance of the water coming downstream to the Facility during the drier months of the year. This trend has been associated with increasing volumes of water (base flow) during the normally seasonal drier time intervals. Analysis of SWFWMD data indicates that the observed increases in conductance are associated with agricultural groundwater discharges from both the Joshua and Horse Creek basins.
Mixing behavior of colored dissolved organic matter (CDOM) in the Caloosahatchee Estuary, FL

Peter H. Doering¹, pdoering@sfwmd.gov
Zhiqiang Chen¹, zhichen@sfwmd.gov
Myra Ashton¹, mashton@sfwmd.gov
Beth A. Orlando¹, borlando@sfwmd.gov

¹South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406

Waters of the major rivers entering the Charlotte Harbor system (the Myakka, Peace and Caloosahatchee) are characterized by high concentrations of colored dissolved organic matter (CDOM). Along with turbidity and chlorophyll a, this CDOM can be a major attenuator of light in the estuarine water column. It is one of the key water quality parameters that influences temporal and spatial variability in primary production and utilization of nutrients. Thus, the behavior of CDOM during the estuarine mixing of fresh and salt water takes on biological significance. A recently adopted Total Maximum Daily Load (TMDL) for the Caloosahatchee Estuary seeks to achieve water clarity goals for seagrasses in San Carlos Bay by reducing chlorophyll a through nutrient load reduction. A two year study was initiated to examine (1) the estuarine mixing behavior of CDOM and (2) the contribution of CDOM, turbidity and chlorophyll a to light attenuation in the Caloosahatchee – San Carlos Bay region. Here we present data on the estuarine mixing of CDOM. Field measurements indicated both conservative (linear salinity-property plots), loss upon the mixing of fresh and salt water (concave salinity–property plots), and addition (convex salinity–property plots). Laboratory mixing experiments indicated that coagulation of CDOM into particulate matter did not occur and therefore could not account for losses observed in the field. Incubation experiments showed that CDOM from the Caloosahatchee was susceptible to photolysis by sun light and this process may account for the non-conservative mixing behavior observed in the field.

Sources and Sinks of Nutrients to the Caloosahatchee River and the Gulf of Mexico

A. N. Loh¹, anloh@fgcu.edu
L. L. Tomasello¹, lltomase@eagle.fgcu.edu
R.D.J. Ketover¹, rdketove@eagle.fgcu.edu
E.E. Everham¹ eeverham@fgcu.edu
M.L. Parsons¹ mparsons@fgcu.edu

¹Florida Gulf Coast University, College of Arts and Sciences, 10501 FGCU Blvd S, Fort Myers, FL 33965

Nutrients can enter the water column through benthic flux by regeneration and remineralization. In the Gulf of Mexico (GOM), benthic sources of nutrients are not yet quantified. Understanding these sources (and sinks) is necessary to provide greater insights into various biogeochemical processes. In order to quantify this source, triplicate sediment cores from two Southwest Florida GOM sites and one inshore site were collected bi-monthly over 24 months. These cores were incubated at ambient temperature over four hours. Water samples were collected for dissolved organic carbon, nitrogen and phosphorus, and dissolved inorganic nitrogen and phosphorus analyses every 45 minutes; three in the light and three in the dark. Chamber nutrient fluxes were extrapolated to represent daily fluxes of dissolved organic matter between the sediment and water column. Daily dissolved nutrient fluxes did not exhibit a clear trend and varied by chemical species and season. Preliminary results indicate that ammonium fluxes from the sediments may be an important source of nitrogen to the water column, particularly during the summer and early fall months. In addition, a budget evaluating the sources and sinks for the Caloosahatchee River Estuary will also be presented.
A Two-Year Study Evaluating Captiva and Sanibel’s Nearshore Water Quality, Emphasizing Nutrients and Microbial Concerns
Mark Thompson¹, mthompson@sccf.org
Loren D. Coen¹, lcoen@sccf.org
Richard Bartleson¹, rbartleson@sccf.org
Eric Milbrandt¹, emilbrandt@sccf.org
¹Marine Laboratory, Sanibel-Captiva Conservation Foundation, 900A Tarpon Bay Rd., Sanibel, FL 33957

Information presented here is the result of a 26 month (October 2008 through February 2011) monitoring effort supported by the Lee Tourism Development Council (TDC) through the Captiva Community Panel (CCP). The overall aim was to investigate Captiva and northern Sanibel’s inshore and nearshore (Beach, Gulf of Mexico, and Pine Island Sound) waters, including extensive groundwater assessments. The primary objectives of this research were to: (1) collect and compile extensive baseline water quality conditions; and (2) to assess the cause(s) of periodic regulatory “exceedences”, primarily fecal indicator bacteria (FIBs-indicators of sewage or runoff pollution). The monitoring design was based upon rainfall events, tidal phase, season, location of potential pollution sources, and potential groundwater/surface water interactions. Parameters monitored included nutrients, bacteria, CDOM, optical brighteners, chlorophyll \( a \), dissolved oxygen, turbidity and salinity.

The initial year of the study focused on providing compiled (from other efforts) and new baseline data on water quality conditions from which a modified Year 2 monitoring plan was developed then for more extensive source tracking efforts. In Year 2, samples testing positive for Enterococci bacterial contamination were further analyzed for bacterial species composition and statistically-evaluated (source tracking) for the probability of human vs. non-human sources using the Biolog® methodology and other source typing (molecular). The influence of groundwater as a potential pollutant source in surface waters was explored by sampling over 20 shallow aquifer groundwater wells, while concurrently sampling surrounding surface waters. Results suggest that most surface water regulatory excursions are associated with significant rainfall events (greater than 1.5 cm in 24 hours). In general, nutrient concentrations in surface water were not high relative to other Florida estuaries and were often within EPA proposed standards. Results also suggest that elevated bacterial concentrations likely originate from both human and non-human sources. The overall results are discussed briefly, with a focus on source tracking. For example, correlations were found between bacterial levels and other environmental conditions such as the accumulation of wrack on the beach. Additionally, a significant relationship between groundwater and surface water bacteria concentrations was not found, despite the influence of a shallow, tidally-influenced aquifer on the islands. The implications for Captiva and Sanibel are discussed with regard to past beach closures, rainfall events, fluctuations in populations and other potential concerns, along with recommendations for BMPs.
This research investigates development of numeric criteria for nutrients and dissolved oxygen in freshwater waterbodies, using as examples Total Maximum Daily Load (TMDL) targets for several impaired waters in the Everglades West Coast basin, in the southern portion of the CHNEP service area. FDEP developed targets applying a reference-waterbody approach which, like a historical-data approach, computes a numeric target to describe unimpaired conditions using data from an unimpaired waterbody – the same waterbody, in the historical-data case; and another waterbody, in the reference-waterbody case, necessary when insufficient historical data exist for the target waterbodies in an earlier unimpaired state. Both approaches make substantial assumptions about how to describe the unimpaired condition. In the waterbodies evaluated for this research – as in many regulatory decisions – agencies used some measure of centrality (mean, median, or similar) and another measure of variation around that central point (standard deviation, proportion, or similar) during a period assumed to be unimpaired. This assumes that understanding of long-term loading of nutrients is sufficient to characterize unimpaired conditions. However, it is well known that varying nitrogen concentrations, including weeks-long spikes in response to changes in human or meteorological changes, can produce problems such as short-term troughs in dissolved oxygen that can produce impairment of sometimes substantial duration. The reference-waterbody approach is confounded by the need to identify reference waterbodies similar to the target waterbody – a problem because similarity in readily noted characteristics such as latitude, land use cover, and flow volume may be inadequate. For example, watersheds with similar proportions of undeveloped land can produce widely differing nutrient loads; receiving waters’ differing biotic assemblages can differ in their tolerance for concentration, frequency and duration of maxima, and other numeric descriptors. Detailed biological characterization and sophisticated statistical descriptors of conditions are warranted. Biological study of target waterbodies is beyond the scope of this research, which instead computes numeric targets under a range of plausible assumptions about reference waterbodies to demonstrate the wide range of plausible resulting numeric targets. Findings demonstrate the impact of selected assumptions, often made with little scientific basis, on the resulting numeric target. Results provide information on prioritizing research or fieldwork toward factors that most strongly affect the outcomes. The research addresses an issue of immediate importance because ongoing agency programs aim to select TMDLs and implement remedies. Too-stringent targets create unnecessary expenditures, and insufficiently-stringent targets fail to protect ecosystems. This research enhances the understanding of watersheds and aquatic ecosystems within the CHNEP by demonstrating the variability in numeric chemical characteristics in healthy ecosystems and refining methods to select numeric targets for nutrients that will restore or preserve the health of aquatic ecosystems. The research focuses on freshwater systems tributary to the estuaries of CHNEP, which contribute pollutant loads and contribute to unhealthy estuarine systems in the CHNEP. The research can have a direct impact on the management of these waterbodies and how they are cared for in the future.
Over-enrichment of water bodies by nitrogen and phosphorus typically stimulates plant and microbial growth, and can result in biological and physical responses that adversely affect water quality and aquatic life. The USEPA is developing numeric nutrient water quality standards for Florida waters, including lakes and flowing waters, and estuarine and coastal waters. The goal of defining numeric nutrient water quality criteria levels for nutrients (i.e., nitrogen and phosphorus) is to protect the designated uses of water bodies as prescribed by the Clean Water Act. The USEPA nutrient criteria guidance recommends development of criteria for both total nitrogen (TN) and total phosphorus (TP) while not precluding the use of alternative causal or response constituents. Seagrass targets have been established as a CHNEP management tool to track changes in an important ecological indicator over time. These seagrass targets were designed to maintain and/or restore seagrass acreage to its historical extent. While the extent of seagrass in the CHNEP area may be governed by a variety of processes including erosion, salinity changes, biological perturbations, prop scarring, and sedimentation, water clarity is thought to be a principal controlling factor in the long-term health of seagrasses in the study area. Management-level water clarity targets that are related to the light requirements of seagrass have also been developed. Based on that evaluation, interim water clarity targets were proposed for a period when seagrasses in Charlotte Harbor were stable (2003-2007) and the distribution of water clarity is being used as a benchmark from which to compare future years. Thus, segment-specific seagrass and water clarity targets have been established for the segments of the CHNEP. Segment-specific target chlorophyll \( a \) concentrations, i.e., a desired chlorophyll \( a \) concentration that results in water clarity conditions that are protective of seagrasses have been estimated. In turn, segment-specific chlorophyll \( a \) thresholds, i.e., the chlorophyll \( a \) concentrations above which water quality is likely to degrade were estimated. After the chlorophyll \( a \) thresholds were estimated, the relationships between chlorophyll \( a \) concentrations and nutrient loads or concentrations were investigated. The data analysis methods employed were developed based on peer-reviewed literature, input from the many local scientists and natural resource managers studying southwest Florida estuaries, previous USEPA documents, and reviews by its Science Advisory Board on methods for establishing numeric nutrient criteria. The methods included a series of techniques that can be used to estimate statistically defensible relationships between chlorophyll \( a \) concentrations and nutrient concentrations and/or loadings. These techniques included several regression models and changepoint analysis. A number of data sources were used to develop the data base used to determine candidate numeric nutrient criteria for the estuarine waters of the CHNEP. These included ambient water quality data from numerous ambient water quality sampling programs, hydrologic and nutrient loading estimates, seagrass coverage, and bathymetry. The candidate numeric nutrient criteria for the CHNEP jurisdiction are presented and discussed.
Establishing an Evaluation Tool for Tracking Water Clarity Changes in the Estuaries of the CHNEP

Mike Wessel1 mwessel@janickienvironmental.com
Lisa Beever1 lbeever@swfrpc.org
Tony Janicki1 tjanicki@janickienvironmental.com
Judy Ott2 jott@swfrpc.org

1Janicki Environmental, Inc. 1727 MLK Jr. Drive North. St. Petersburg, FL 33704
2Charlotte Harbor National Estuary Program. 1926 Victoria Avenue. Ft. Myers, FL 33901

The Charlotte Harbor National Estuary Program (CHNEP) has established a foundation of objective, science-based, decision making tools for use as indicators of estuarine health and is furthering its goals under its Comprehensive Conservation and Management Plan to protect and restore water quality through rigorous analysis of its management tools. This study has furthered those objectives by developing a water clarity evaluation and tracking tool for CHNEP estuaries. The evaluation method uses the cumulative distribution of water clarity from a reference period when water clarity conditions in the CHNEP estuaries were associated with stable or increasing seagrass acreage. Benchmark points along the distribution were identified and the binomial test was used to compare annual water clarity distributions in future data collections to existing benchmarks. A grading system was developed to score the annual water clarity distributions on a scale between -2 and 2 and a color coded grade was assigned based on segment-specific goals for the protection of seagrass. In segments where seagrass protection targets have been previously established, a water clarity score suggesting that the distribution is similar to the benchmark would receive a grade of “Stable” (color coded as green) indicating conditions were sufficient for the protection of seagrass extent in the segment. However, the same score in a segment where a restoration target was established would result in a “caution” grade (color coded as yellow) indicating that the lack of improvement in water clarity may not be sufficient to restore seagrass extent in this segment. The resulting grades for each segment are tabulated and reported as management level grades readily available to the public via the CHNEP Water Atlas as well as in other CHNEP publications. The benchmarks and evaluation tool will be re-evaluated in 2012 to assess its performance relative to other metrics of estuarine health in an adaptive management approach to ensure the benchmarks and scoring algorithm are appropriate and relevant to the goals and objectives of the CHNEP Comprehensive Conservation and Management Plan.

Significant Nutrient Removal by Swale Drainage

Allan Willis1 ADWillis@pbsj.com
John Ryan2 jryan@scgov.net
Brett Cunningham3 bcunningham@jonesedmunds.com

1PBS&J, Integrated Water Resources, 4030 Boy Scout Blvd. Suite 700, Tampa, FL 33607
2Sarasota County Water Quality Planning, 1001 Sarasota Center Blvd., Sarasota, FL 34240

Multiple sites were monitored to determine what flow and load differences exist between neighborhoods served by curb and gutter versus swales. The 10-fold differences suggest the importance of using LID principles in better managing stormwater. To help refine pollutant loading estimates throughout Sarasota County, the County and SWFWMD monitored multiple medium-density residential areas to quantify the difference in pollutant loads (i.e. volume and concentration) between areas served by swales and areas served by curb and gutter. The sites were selected to be as similar as possible (e.g., soils, age of development, lawn care intensity, imperviousness, etc.) so that differences in results could be attributed primarily to use of curb and gutter versus swales. Conditions favorable to higher-confidence flow monitoring (e.g. consistent slope and no tailwater) and proximity of sites to each other were also considered in site selection. The monitoring results showed significant differences between the two types of stormwater conveyance areas in terms of direct runoff and total flow volumes and pollutant concentrations, resulting in approximately a 10-fold difference in the total loads for some pollutants. Additionally, the swaled areas demonstrated runoff response patterns characteristic of an area without any directly connected impervious area. The pollutant loads from the swaled areas would be substantially lower than those from a curb and gutter area with wet detention BMP treatment. The findings from this study are highly supportive of the low-impact development (LID) approach to watershed management and demonstrate the effectiveness of source control higher in the stormwater system--particularly those involving disconnecting impervious areas.
Southwest Florida Water Management District’s Lake Hancock Outfall Wetland Project
Janie L. Hagberg1, janie.hagberg@watermatters.org

1Southwest Florida Water Management District, 7601 U.S. Highway 301 North, Tampa, FL 33637

The Southwest Florida Water Management District (District) plans to construct a 1,000-acre treatment wetland at the south shore of Lake Hancock. The primary goal of the project is to reduce nitrogen loads discharging from the lake to the Upper Peace River and ultimately Charlotte Harbor, an estuary of national significance and a State of Florida Surface Water Improvement and Management (SWIM) Program priority water body. Lake Hancock is a 4,500-acre nutrient enriched lake located in central Polk County. Discharges from the lake to Lower Saddle Creek join with Peace Creek to form the headwaters of the Peace River. Historical data has shown that the Lake Hancock watershed contributes the greatest nitrogen load on a per acre basis to the Peace River when compared to other major tributaries and associated drainage basins along the river. The project is specifically identified in the Charlotte Harbor National Estuary Program’s Comprehensive Conservation and Management Plan (CCMP) and in the Charlotte Harbor SWIM Plan as a priority action to address water quality degradation. Many of the sub-basins along the Upper Peace River are identified as impaired per the Florida Department of Environmental Protection’s Total Maximum Daily Load (TMDL) Program. One of the quantifiable objectives of the CCMP is to remove at least two sub-basins from the impaired list by 2015. This project will help meet this goal by removing an estimated 174,000 pounds of nitrogen annually in discharges from the lake. Design is complete and permits have been secured. The District advertised the request for bid (RFB) in January 2011 and construction should begin mid-year. The project should be operational in late 2013.
“Our soils are loaded with phosphorus!” How many times have we heard that? It’s certainly something we’ve taken for granted. Unfortunately, there isn’t a whole lot of data to along with it. In 2009, the Florida Department of Environmental Protection (FDEP) conducted a spatial analysis to identify areas with expected higher phosphorus as part of their attempt at setting numeric nutrient criteria. The result created 6 nutrient regions, a.k.a. Weaver Regions, each with unique nutrient criteria. Two of these regions, the Bone Valley (higher phosphorus) and the Peninsular (lower phosphorus) actual split Sarasota County with the Bone Valley covering approximately ¾ of the county and the Coastal Lemon Bay Watershed as part of the Peninsular Region. These results prompted the County to set out and survey the stream banks and beach sands for phosphorus to see if the data created a pattern similar to the results presented by FDEP. Seventy-six samples, 63 creek banks and 13 beach samples were collected and analyzed for total phosphorus. Most of the sites co-occupied ambient water sampling sites to allow for additional analysis. The resulting map certainly opened the door for inclusion of the Lemon Bay Watershed as part of the Bone Valley as some of the highest concentrations in the County were found there. In fact many of the highest values were found within the coastal basins. Unfortunately, this is also in contrast to another effort to develop nutrient criteria, this time by the US Environmental Protection Agency (EPA). EPA also divided the state into 6 regions, similar to FDEP, though they exclude all of the coastal basins from the West Central (FDEP’s Bone Valley) Region, again where the highest values from this survey occur. This work and that of other agencies using drilling cores and even the discrepancies between EPA and FDEP warrants further investigation prior to creating a framework with which to set nutrient criteria.

Southwest Florida Coastal Watersheds: A Collaborative Integration of Research, Education, and Policy Outreach.

Julie Morris¹, morris@ncf.edu
Jennifer Shafer², jennifer@shafer-consulting.org

¹New College of Florida, 5800 Bay Shore Rd., Sarasota, FL 34243
²Shafer Consulting, LLC, P.O. Box 2879, Sarasota, FL 34230

The primary goal of this interactive session will be to ask participants for input and guidance related to the planning and implementation of a “New Florida Initiative” (State University System) funded project. New College of Florida (Sarasota)* and Florida Gulf Coast University (Fort Myers)* are working together to develop effective strategies that can be used to integrate and disseminate empirical research related to the sustainability of southwest Florida coastal watersheds. The potential audience for the various forms of this integrated information includes K-12 and post-secondary students, agricultural and industrial stakeholders, local, regional, and state watershed managers, academics, and elected policy makers. The three related objectives of the collaborative Southwest Florida Coastal Watersheds project are: (1) To identify and prioritize research gaps (where is additional research most needed?), (2) To determine points at which there may be disconnects between regional policies and current environmental data, and (3) To identify and prioritize content for K-12 and informal adult science education. We recognize that similar or related initiatives, perhaps with more localized geographical foci, are currently underway across the region. As a first step in this 18-month project, we seek to highlight, coordinate, and merge these efforts by facilitating sharing and collaboration among various contributors. To that end we will solicit information, insights, and guidance from session participants that can be used in the planning and implementation of the project. This partnership is funded by the New Florida Initiative of the Florida State University System and aims to link together academics (faculty, staff, students, researchers) and local and regional watershed managers.
As Florida’s continues to welcome new residents, and more people refer to the state as home, it is vital to maintain a connection with the past. In order to understand the current state of our watershed we need to understand our past and how we have arrived at this current state. Through preserving the memories of longtime residents and highlighting the important relationships that Floridians have with Florida’s natural resources, both natives and newcomers can begin to understand Florida’s history. Sarasota’s Oral History Project is a way of celebrating Sarasota’s rich history and the long standing connection between its residents and the water. The goal is to provide a glimpse into what life in Sarasota was like in years past through the eyes of those who lived it. In addition, the program will help to preserve those memories so that future generations will be able to understand and appreciate the many facets of Sarasota County’s origins and all that makes it the unique community that it is today. Through a collaborative effort between Sarasota County’s Water Resources, the Sarasota County History Center and New College of Florida, historical photographs have been combined with interviews to create captivating sound slides as well as extensive transcripts. By utilizing current technology and packaging history into short and visually pleasing time capsules, history lessons that appeal to the masses have been created. It is in these short video clips that our history is brought back to life with an emphasis on the importance of our natural environment. View the oral histories at www.SarasotaOralHistory.com.

Computation of Residence Time for the Caloosahatchee Estuary

Chenxia Qiu2, cqiu@sfwmd.gov
Detong Sun1, dsun@sfwmd.gov

1South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406

The CH3D Hydrodynamic Model (Qiu et al., 2006) was applied to simulate residence time in Caloosahatchee Estuary. The Estuary was divided into eight (8) different zones or segments. For each segment, an initial condition of 100 concentration is assigned and 0 for any other areas in the model domain. A total of 10 simulations under various discharge at S-79 were conducted for each segment. Two kinds of residence time were reported, e-folding time, i.e., days to reach 37% ($e^{-1}$) of the initial mass and days to reach 20% of initial mass. The results indicated that in the very downstream area of the estuary in the Gulf, residence time is about 1 day. Response to freshwater inflow is insensitive, indicating that the residence time is dominated almost entirely by tidal flushing. In the most upstream of the estuary, residence time is more than 10 days when flow is less than 500 cfs, suggesting slow tidal flushing rate at this location. When freshwater inflow increases to above 1000 cfs, residence time drops less than 2 days quickly, becoming freshwater discharge dominated. In the middle estuary, residence time ranges from less than 2-3 day at flow larger than 5000 cfs to above 10 days when there is no flow, showing an area that is mostly affected by both tidal flushing and freshwater inflow.
Protection and restoration of our freshwater and coastal ecosystems is critical to support the economy, human health, and standard of living of the Charlotte Harbor region. Point source standards have been put into place to improve water quality, however increases in pollutant loadings from nonpoint sources continue to degrade our waterbodies and cause them to become impaired (i.e. not meet water quality standards). The Florida Department of Environmental Protection, as part of the Total Maximum Daily Load (TMDL) program, assesses the waterbodies within the state and determines those that are not meeting state water quality standards. Both biological data and chemical water quality data from the state’s water quality database (STORET) are evaluated using the impaired water’s rule (Chapter 62-303 F.A.C) methodology. Once determined as impaired, a TMDL, which is the maximum amount of a pollutant that a waterbody can assimilate without causing exceedances of water quality standards (or restoration target), is calculated. Water quality impairments and waterbodies with existing TMDLs within the Charlotte Harbor National Estuary Program boundary are presented.

Effects of Tidal Flushing on Benthic Remineralization of Organic Matter in Mangrove Stands in Estero Bay

R.D.J. Ketover¹, rdketove@eagle.fgcu.edu
A.N. Loh¹, anlohi@fgcu.edu

¹Florida Gulf Coast University, 10501 FGCU Blvd. S., Fort Myers, FL 33965

The dynamics of nutrient cycling in mangrove ecosystems vary greatly depending on region, tidal exchange, salinity and other factors. In this study, we determined the fluxes of dissolved organic carbon, nitrogen and phosphorus, and dissolved inorganic nitrogen and phosphorus at the benthic boundary layer in two mangrove stands experiencing different tidal flushing. In situ benthic microcosm chamber experiments were conducted quarterly. Samples were collected every 45 minutes over the course of four hours with three time points in the light and three in the dark. Chamber nutrient fluxes were extrapolated to represent daily fluxes of organic matter between the sediment and water column. Preliminary results show that both sites were nitrogen-limited and act as sinks for dissolved organic nitrogen, dissolved phosphate and ammonium. Both sites were also sources of dissolved organic phosphorus into the water column. The well-flushed site also acts as a sink for dissolved organic carbon, while the poorly-flushed site acts as a source. For dissolved nitrate, the well-flushed site acted as a sink while the poorly-flushed site acted as a source.
Using Stable $\delta^{15}$N Ratios to Examine sources of Nitrogen within a Residential Community

Nora Egan Demers$^1$ ndemers@fgcu.edu

$^1$Department of Biological Sciences, Florida Gulf Coast University, 10501 FGCU Blvd. S. Fort Myers, FL 33965

I report on a spatial study of stable nitrogen isotope ratios in the residential community of San Carlos Park, Lee County, FL, USA. The study benchmarks the water quality of the storm-water drainage system in this community of nearly 8000 single-family and duplex homes with onsite septic tanks. The work is the first step in a multi-year restoration effort undertaken in partnership with local government, civic organizations and other participants. The goal of the project is to assess and monitor the effectiveness of implementing “soft” best management practices (BMP’s). The methods included monitoring basic water quality standards, determining stable nitrogen isotope ratios in macro-algae and sediments. This report focuses on our effort to determine the influences of various anthropogenic nutrients, mainly septic and fertilizer, to the outstanding Florida waterway that leads to the Estero Bay. We undertook this project during the summer and fall of 2007, and early spring of 2008. San Carlos Park is a large (approximately 2,366 acres) (Section 46, Township 25, Range 08) single-family, residential community constructed in the 1960’s, prior to current storm-water treatment requirements. Most of the homes are on individual septic systems, and storm-water runoff from the San Carlos Park community is funneled to a single outflow system (Lee County monitoring site 46B-9GR), into the Mullock Creek headwaters. Lee County’s long-term data set at this site dates back to 1992. Mullock Creek is on the Florida Department of Environmental Protection’s impaired waters list for dissolved oxygen and Chlorophyll a. Mullock Creek flows directly into Estero Bay, an Outstanding Florida Water, west of U.S. 41. A number of sources are contributing to the excess nutrients released at the Mullock creek outfall at San Carlos Park. Currently the area’s storm water is under the control of the East Mullock Drainage District, a severely under-funded entity. In addition, the apparently innate American desire for green lawns causes us to add too many nutrients and herbicides to our lawns, the excess of which is being transported into the failing storm-water system, and over 85% of the residences use OSTP’s. Another confounding factor is that the local community golf course receives the treated wastewater from the wastewater treatment plant and uses that water to irrigate the golf course, a common practice in our region. Samples of sediments, aquatic plants and water were obtained from various locations within this heavily urbanized community. They were compared to water quality and samples obtained at other sampling sites in the county which exemplify agricultural drainage, relatively pristine, and residential communities with central sewer. Understanding these relationships amongst these data and using them to calibrate models used to determine Total Maximum Daily Load (TMDL) criteria are integral to chart the course for real watershed conservation, restoration and stewardship.
Effectiveness of Anti-Fouling Coatings in Southwest Florida’s Estuarine and Marine Waters, with Emphasis on Real-Time Observing Systems

Nicole Martin¹, nmartin@sccf.org
AJ Martignette¹, amartignette@sccf.org
Loren D. Coen¹, lcoen@sccf.org
Jeff Siwicke¹, jsiwicke@sccf.org
Eric Milbrandt¹, emilbran@sccf.org

¹Marine Laboratory, Sanibel-Captiva Conservation Foundation, 990A Tarpon Bay Rd., Sanibel, FL 33957

Fouling is the accumulation and growth of aquatic organisms on submerged surfaces subjected to larval recruitment. The most common method used to prevent marine and estuarine larvae from attaching to surfaces is the use of various anti-fouling formulations. These coatings were designed to be used primarily on hard surfaces (e.g., ship hulls and dock/navigation pilings). Fouling also can reduce the operation time and quality of data from real-time sensors deployed in aquatic settings. Two main anti-fouling coatings are currently used: (1) ablative; and (2) hard paints. The Sanibel-Captiva Coastal Conservation Foundation’s (SCCF) Marine Lab currently uses E-Paint at its six River, Estuary and Coastal Observation Network (RECON, http://recon.sccf.org/) real-time, sensor arrays deployed in the waters from Lake Okeechobee throughout the Caloosahatchee River and estuary to the Gulf of Mexico. In estuarine to marine waters, four of the locations are subject to regular and high levels of invertebrate fouling. The goal of this study was to compare and contrast eight readily available, anti-fouling coatings at three RECON stations (Gulf of Mexico, Redfish Pass and Shell Point), along with one in Tarpon Bay. Replicate settlement plates (each ~1.58 cm on a side) were deployed at the above four locations. At the three RECON sites, four PVC frames each held six plates (n = 24), each deployed for a total of four months. Of the eight treatments (coatings) assessed, three were of the “hard” type and four “ablative” and one was experimental. For the RECON samples, each coating was replicated (n = 2) per site, with an untreated “control” plate on each frame. Plates were sampled monthly using digital photography out of water. In contrast, at the Tarpon Bay site, nine frames (six plates/frame, n =54) were deployed. There were six treatments, five coatings: (1) two hard; (2) three “ablative”; and (3) a “control” on a given frame. Three frames were sampled and replaced every two weeks, for a total of nine samples (18 weeks). The arrangement of treatments on the plates in a given frames and site was determined by random number assignment. We used the Coral Point Count Program (CPCe) and Excel to analyze digital plate images, quantifying percent cover by plate and taxa. Taxa were broken down into six categories: barnacles, amphipod tubes, biofilm, tunicates, macroalgae and other invertebrates. Differences among the sites and paints were quite striking and are discussed in depth by time, site and coating. Utilizing the correct coating paint type at a given site with specific environmental conditions (e.g., salinity, light, flow, etc.) is essential in preventing fouling while also minimizing down-time for redeployment. It is hoped that the results of this nearly four month study can be used by SCCF and by other groups with deployed sensors in tropical, subtropical and warm temperate waters thus reducing excessive fouling and related problems.
One of the quantifiable objectives of the CHNEP CCMP is that “…native submerged aquatic vegetation should be maintained and restored at a total extent and quality no less than caused by natural variation…” Seagrass coverage is related to light availability, which is dependent on water clarity. Water clarity in turn is dependent upon several factors, including chlorophyll $a$ concentrations, which are related to external loadings of nutrients (nitrogen and phosphorus) to the estuary. As part of the project to develop water clarity targets in the CHNEP, pollutant loadings were developed for the 1995-2007 period. Nutrient loads, along with color and turbidity, are the primary influences on water clarity in the system. The loading and water quality data, along with the seagrass data, allow pollutant loading targets to be established. The loadings and water quality data are currently being used to develop proposed Estuarine Numeric Nutrient Criteria for submission to EPA, with the criteria taking the form of both nitrogen and phosphorus concentrations and loadings. Loading sources included atmospheric deposition directly to the water surface of each segment, nonpoint source runoff, septic tank contributions, and domestic and industrial point sources. Loads were developed for TN, TP, BOD, and TSS. During the 1995-2007 period, annual TN loads to the entire CHNEP system ranged over an order of magnitude, from 2100 tons in 2007 to 18,300 tons in 2005, with higher loads occurring during higher rainfall years. Within each year, wet season (June-September) loads were higher than dry season loads, as expected. The CHNEP includes 14 bay segments, with different land uses within their watersheds and very different watershed and water surface sizes. The largest watersheds, those of the Tidal Peace, Myakka, and Caloosahatchee rivers, provided the greatest proportion of the loads. The largest source of TN and TP loads to the system was nonpoint sources (approx. 70% of the total), with industrial point sources providing the next largest loads (approx 20-30%). The watershed loading data were used to develop the TN Delivery Ratio, a measure of the mass of TN delivered in a given volume of water. Higher delivery ratio and higher segment watershed to segment surface area ratio for a given segment implies higher potential for adverse impacts. The Tidal Peace River, Dona and Roberts Bays, and the Tidal Myakka River have the highest segment watershed to water surface area ratios, and have relatively high TN Delivery Ratios, indicating these segments have relatively high potential for adverse impacts from nutrient loadings.
The USEPA is developing numeric nutrient water quality standards for Florida waters, including lakes and flowing waters, and estuaries and coastal waters. The schedule for estuarine and coastal water criteria has been recently modified and requires USEPA to propose estuarine and coastal waters nutrient criteria and downstream protective values in Florida by November 14, 2011 to allow for peer review by the Science Advisory Board and to allow for public comment, followed by USEPA revision of the proposed numeric nutrient criteria. Numeric nutrient water quality criteria define levels of nutrients (i.e., nitrogen and phosphorus) protective of the designated uses of water bodies from over-enrichment, as prescribed by the Clean Water Act. Over-enrichment of water bodies by nitrogen and phosphorus typically stimulates plant and microbial growth, and can result in biological and physical responses that adversely affect water quality and aquatic life. The USEPA nutrient criteria guidance recommends development of criteria for both total nitrogen (TN) and total phosphorus (TP), the primary causal constituents, and for chlorophyll-a and water clarity, the primary response constituents, while not precluding the use of alternative causal or response constituents. In response to recent discussions with USEPA, potential empirical methods for developing numeric nutrient criteria for southwest Florida estuaries were identified and are presented. The methods discussed build on research developed by the Tampa Bay, Sarasota Bay, and Charlotte Harbor National Estuary Programs and on previous USEPA work and reviews by its Science Advisory Board. USEPA and others have identified three analytical approaches for the development of nutrient criteria: the reference condition approach, stressor-response analysis, and mechanistic modeling. As implied by the name, the reference condition approach is based on determining criteria based on a group of reference waterbodies. The reference waterbodies are selected from among a group of like waterbodies (e.g., the same class of waterbodies) that represent minimally disturbed conditions and have similar characteristics (e.g., black-water streams). The stressor-response approach consists of developing relationships between nutrient concentrations or loads and biological responses. The biological responses should be related to the “designated use of a waterbody (e.g., a biological index or recreational use measure) either directly or indirectly, but ideally quantitatively”(USEPA). After quantitative relationships have been developed, the nutrient criterion that is protective of the specific designated uses can be determined. The mechanistic modeling approach is used to predict specific constituents based on a series of equations and algorithms that represent physical, chemical, biological, and ecological processes. Mechanistic models tend to integrate information on the interactions of major ecosystem processes to derive quantitative estimates of effects and maybe valuable in interpreting the stressor-response relationship. However, their first-order approximations can underestimate the variability and uncertainty in the predictions. USEPA has explicitly stated that any of the methods described above may be used individually or some combination of methods may be used to derive numeric nutrient criteria. For southwest Florida estuaries where sufficient data are available, the stressor-response approach is preferable for delivering a weight-of-evidence that can be used in the development of appropriate numeric nutrient criteria.
Water Quality Evaluation of the Impacts of Aeration on Wet Detention Ponds in Southwest Florida

Tim J. Denison¹, tdenison@johnsoneng.com
Michael L. Lohr², mlohr@johnsoneng.com
David W. Ceilley², dceilley@fgcu.org
Edwin M. Everham III², eeverham@fgcu.edu

¹ Johnson Engineering, Inc., 2122 Johnson Street, Fort Myers, FL 33901
² Florida Gulf Coast University, Inland Ecology Research Group, Fort Myers, FL 33965

Since the beginning of Florida’s stormwater treatment program in the early 1980s, a fundamental principle has been to limit the depth of wet detention systems so that anaerobic conditions do not occur in either the water column or the pond sediments. In Lee County, Florida, the site of this study, the County’s Land Development Code requires ponds greater than twelve feet deep to have aerators to prevent low dissolved oxygen conditions or stratification of the water column. This study compared dissolved oxygen levels and other water quality data in aerated and non-aerated wet detention ponds of various depths. Four ponds were selected from a series of wet detention ponds within The Brooks residential development in Bonita Springs, Florida. In the fall of 2004, a variety of water quality data was collected from the ponds using submersible data sondes, portable multi-parameter meters and traditional grab sampling for laboratory analysis. The study was conducted in two 15-day phases. In each phase, aerators in two of the four ponds were turned off and the other two were left on as usual. During the two phases, water quality data was continuously recorded by the data sondes which were suspended two feet above the bottom of each pond. A portable multi-parameter meter was used to record measurements at one-foot intervals throughout the water column to determine the dissolved oxygen levels at various depths and the presence of stratification. In addition to the monitored data, grab samples were collected from each of the ponds at the same depth as the data sondes. The grab samples were laboratory analyzed for pH, specific conductance, turbidity, ammonia nitrogen, total Kjeldahl nitrogen, nitrate + nitrite, orthophosphorus, total phosphorus and chlorophyll-a. The four ponds monitored as part of this study were interconnected with each other and several other ponds that functioned as a wet detention system with a common outfall control structure. However, the water levels during this fall, 2004 study remained too low to provide discharge from the wet detention system. As a result, there was little or no flow through the series of ponds. In 2006, the study was repeated but took place in late summer, during southwest Florida’s rainy season, which provided high water levels and discharge from the outfall structure. The focus of the 2006 study was to evaluate the water quality of the ponds in this dynamic flow state, which allowed them to act in conjunction with other interconnected ponds as part of the overall wet detention system.

Effect of Aeration on Algae and Dissolved Oxygen in Ponds

Katie Thorp, Bonita Middle School 8th Grade
Recipient CHNEP 2011 Science Fair Award from the Thomas Alva Edison Kiwanis Science and Engineering Fair

Some of the lakes in Stoneybrook were displaying signs of algae growth or eutrophication. Eutrophication can use an excess of dissolved oxygen, which fish need to survive. Dissolved oxygen, or DO, is the amount of oxygen in the water. One method used to address eutrophication is the installation of aerators or fountains. The purpose of the experiment is to see which mechanism works best: aerators, fountains or nothing? The experiment began by using the sampling tool to collect a cup of water from each of the lakes. Then the probe of the DO200 is put into the cup to get the dissolved oxygen reading. Next go to the northernmost, southernmost, easternmost, and westernmost points of the lake and collect the algae that float on the top of the lake at each location. Combine all of the algae from the lake and put it on a screen outside for a day. When it is dry put the algae on a scale to weigh it. This procedure was repeated for six lakes. In conclusion, my hypothesis was valid. The lakes with aerators had the most dissolved oxygen and the most algae. As air temperature went down so did the dissolved oxygen level, with the exception of the month of October because copper sulphate had been applied to the lakes. After completing my analysis, I concluded that the more dissolved oxygen a lake has the more fish it can support. Therefore, lakes in developed areas will better support an ecosystem if aerators are installed.
Ten Years of the Southwest Florida Frog Monitoring Network: Natural Cycles and Human-driven Changes
Edwin M. Everham III1, eeverham@fgcu.edu
John Cassani2, jcassani@comcast.net

1Florida Gulf Coast University, 10501 FGCU Blvd. S. Ft. Myers, FL 33965
2Lee County Hyacinth Control District, PO Box 60005, Ft. Myers, FL 33936

Amphibians have been shown to be important indicators for environmental change, particularly changes in water quality. The Southwest Florida Frog Monitoring Network was established in 2000 to collect long-term data on frog communities within the watersheds of Southwest Florida. Routes of 12 stops each are monitored monthly during the rainy season (June – September). Environmental data on wind, temperature, humidity, and sky conditions are collected at each stop, as is information on habitat changes. Data on all frogs heard calling during a three minute period are recorded using a three-level intensity code. We report on the data from the first ten years of monitoring, examining changes in populations of individual species across the region. We calculated measures of biological diversity, community classification, and community ordination, as techniques for exploring the factors that explain the differences in frog communities among sites and over time. These factors may include: natural cycles of frog populations, altered habitats through local and global human actions, and the impacts of invasive species. Changes in frog communities may provide opportunities to detect the environmental implications of altered hydroperiods and landscape changes in our watershed, and possibly the positive responses to restoration efforts. This type of citizen scientist database provides opportunities for investigating trends in environmental change over the landscape.

Monitoring Colonial Nesting Birds in Estero Bay Aquatic Preserve
Cheryl Parrott Clark1, Cheryl.Clark@dep.state.fl.us
Heather Stafford1, Heather.Stafford@dep.state.fl.us

1Florida Department of Environmental Protection, Estero Bay Aquatic Preserve, 700-1 Fort Myers Beach, FL 33931

The colonial nesting bird program is aimed at detecting trends in wading and diving bird populations; tracking movement of colonies within the bay and surrounding watershed; and engaging and educating the public. Estero Bay is a shallow water estuary fed by five minor tributaries and the Gulf of Mexico. The estuary contains many natural communities including mangrove islands, seagrass beds and oyster bars that make it an attractive environment for wading and diving birds to forage and nest. Nesting surveys in Estero Bay began in 1977 and a variety of survey techniques have been employed throughout the years. Since 2008 Estero Bay Aquatic Preserve staff and volunteers have conducted monthly nest count surveys, from January through September, with assistance from Audubon of Florida and the Town of Fort Myers Beach. Direct counts are conducted by boat using a double observer technique to identify nests and categorize by species and nesting stage. Wading and diving bird nesting appears to be declining in Estero Bay; May nest counts show a 59% decrease from 1983 (N=624) to 2010 (N=256); April nest counts show a 68% decrease from 1998 (N=621) to 2010 (N=199) and peak nest counts have shown a 28% reduction in nesting success over the past three years, from 2008 (N=531) to 2010 (N=383). Changes in nesting numbers should include species level analyses in order to obtain a more detailed view of population trends in the bay. Species such as the Brown Pelican (Pelecanus occidentalis) have shown 64% decline between 2008 and 2010; 2008 (N=207), 2009 (N=107), 2010 (N=75). However, some species like the Great Blue Heron (Ardea Herodias) have shown a 62% increase in peak nesting numbers between 2008 and 2010; 2008 (N=63), 2009 (N=66), 2010 (N=102). Shifts in species composition and peak nesting times may be associated with changes in weather and food availability, as well as increased human disturbance. More data are needed to determine if these trends will continue. Future analyses of nesting data should include data collected by Charlotte Harbor Aquatic Preserves and J.N. “Ding” Darling National Wildlife Refuge for Pine Island Sound, Matlacha Pass and Tarpon Bay which would enable us to look at nesting success on a larger geographical scale.
Fish Community Assemblages in the Peace River

M.E. Call¹, Marvin.Call@myfwc.com
D. Sechler¹, Dawn.sechler@myfwc.com

¹Florida Fish and Wildlife Conservation Commission, 3900 Drane Field Rd, Lakeland, FL 33811

The Peace River is the largest softwater stream in southwest Florida. The development and implementation of minimum flows and levels (MFLs) by the Southwest Florida Water Management District identifies a paucity of data associated with abiotic (e.g., depth, salinity) and biotic factors (e.g., fish species abundance, macrophyte coverage) and their influence on fish community assemblages in the Peace River. We determined fish population characteristics (e.g., species richness, diversity) and habitat suitability indices and curves. In addition we investigated whether fish assemblages differ across river section, season, year, and across a suite of environmental variables. Fish sampling was conducted via boat electrofishing during spring (February-May) and fall (September-December) 2008 through spring 2010 fish. Each fish was identified to the lowest possible taxa, measured in total length (mm), weighed (g), and returned to the water. Quantified microhabitat measurements were made including physical (e.g., woody debris counts) and chemical (e.g., salinity) parameters within each transect. Overall we found that fish species in the Peace River utilized similar moderately complex habitats. Fish assemblages differed (p=0.05, R=0.42) in each section of the river (e.g., upper) but do not differ across seasons, nor years. In addition, the strongest correlations of community structure with physiochemical variables and habitat metrics occurred for the lower and middle sections (p>0.745), of the river, indicating less dynamic changes in available habitat compared to the upper section. Subsequent studies are needed to drive responsible management decisions in order to prevent further degradation to the Peace River, and ensure that diverse fish communities persist.

Distribution and Abundance of Introduced Fishes in Florida’s Charlotte Harbor Estuary

C.F. Idelberger¹, chuck.idelberger@myfwc.com
S.E. Erickson¹, sarah.erickson@myfwc.com
C.J. Stafford², chris.stafford@myfwc.com

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Laboratory, 585 Prineville St, Port Charlotte, FL 33954
²Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave SE, Saint Petersburg, FL 33701

A growing number of non-native fishes have been introduced into Florida waters in recent years, yet little information has been available on their distribution and abundance in southwest Florida. The ichthyofauna of the Charlotte Harbor estuary, Florida, was intensively sampled from 1989 through 2007. We collected eight introduced fish taxa: African jewelfish (Hemichromis letourneuxi), blue tilapia (Oreochromis aureus), brown hoplo (Hoplosternum littorale), grass carp (Ctenopharyngodon idella), Mayan cichlid (Cichlasoma urophthalmus), sailfin catfishes (Pterygoplichthys spp.), spotted tilapia (Tilapia mariae), and walking catfish (Clarias batrachus). These fishes were found principally in tidal rivers, especially the Caloosahatchee River. Other introduced species, such as Asian swamp eel (Monopterus albus), blackchin tilapia (Sarotherodon melanotheron), and pike killifish (Belonesox belizanus), are known to occur in neighboring bay systems but have yet to be reported in the Charlotte Harbor estuary. Continued monitoring will help us detect additional species that are introduced to the estuary, expansions in the ranges of documented species, and assemblage-level changes.

Phyllanthus fluitans: A Newly Reported Invasive Species in Florida

Michael Sowinski¹, Michael.sowinski@myfwc.com

¹Florida Fish and Wildlife Conservation Commission, 2001 Homeland-Garfield Road, Bartow FL 33830

On August 27th 2010, Dr. George Wilder, botanist and herbarium curator at the Naples Botanical Garden in Naples Florida, discovered Phyllanthus fluitans (red root floater) growing in a canal attached to the Peace River in Desoto County west of Fort Ogden. After contacting the Florida Fish and Wildlife Conservation Commission (FWC), FWC Invasive Plant Management Section biologist Michael Sowinski found scattered populations of the plant over the next two months in roughly twenty-six river miles of the Peace River from just south of the initial discovery point to approximately five miles north of the Town of Arcadia. A large infestation was discovered in a channel located just north of the junction between the Peace River and Horse Creek. In October and November, Southwest Florida Water Management District staff, funded by the FWC, sprayed all Phyllanthus fluitans plants observed in the river with the herbicide Knockout (active ingredient being diaquat dibromide). If Phyllanthus fluitans is not successfully controlled it has the potential to become a problem species such as water fern (Salvinia minima), water lettuce (Pistia stratiotes), and water hyacinth (Eichhornia crassipes).
Ecology, Hydrology and Engineering for Mangrove Forest Restoration in Estuaries of Southwest Florida

Dorothea P. Zysko\textsuperscript{1}, dorothea@ecologygroupinc.com
Joshua R. Evans\textsuperscript{2}, josh@jrevansengineering.com
Roy R. Lewis, III\textsuperscript{3}, LESrll3@aol.com

\textsuperscript{1}The Ecology Group, Inc., P. O. Box 512856, Punta Gorda, FL 33951
\textsuperscript{2}JR Evans Engineering, 8891 Brighton Lane, Suite 115, Bonita Springs, FL 34135
\textsuperscript{3}Coastal Resources Group, Inc., PO Box 5430, Salt Springs, FL 32134

Great potential exists to reverse the loss of mangrove forests worldwide through the application of ecological, hydrological and engineering approaches, including careful cost evaluations prior to design and construction. Mangrove forest restoration projects commonly fail to achieve significant plant cover either because there is a misunderstanding of mangrove forest hydrology, or, acceptance of the false assumption that simply planting mangroves is all that is required to establish a fully-functional mangrove ecosystem or both. Even restoration projects that meet a restoration goal within 3 to 5 years often fail to provide adequate habitat for fish and invertebrates. Through this mangrove restoration project within the Rookery Bay National Estuarine Research Reserve (RBNEER) in Marco Island, Florida, we document the importance of assessing the existing ecology and hydrology of natural extant mangrove ecosystems and of applying this knowledge to protect existing mangroves and to prevent continuing mangrove die-off. Previous research has documented the general principle that mangrove forests worldwide exist largely in a raised and sloped platform above mean sea level and are inundated at approximately 30% or less of the time by tidal waters. More frequent flooding causes stress and death of these tree species. Prevention of such damage requires application of the same understanding of mangrove hydrology. A fully successful restoration design must mimic tidal stream morphology and hydrology along an estuarine gradient across a heterogeneous mixture of mangrove ecosystem communities. The use of Hobo Data Loggers and subsequent hydrologic data analysis and modeling uses in the restoration design is discussed. An Ecological Mangrove Restoration (EMR) training program is being conducted as part of the project outreach. We also discuss how fish and mangrove ecosystems are coupled in time and space, offer several restoration strategies that match these couplings, and provide simple sequential checklist of design tasks to use to prevent most failures (including application of the Ecological Mangrove Restoration methodology). Tidal hydrology must be carefully designed to incorporate fish habitat, including tidal creeks, to provide access and low tide refuge for mobile nekton because the mangrove forest floor is generally flooded by tidal waters less than 30 percent of the time. Although this restoration project is located in an estuary in Collier County, the science associated with successful mangrove restoration demonstrated in this project is applicable in any geographic region with mangrove forest systems. The USFWS has provided the initial funding for this RBNEER project and the City of Marco is a partner. A group of stakeholders including the environmental permitting agencies and local residents have been engaged in project discussions and restoration design and many will participate in the EMR training program.

Review of the Rate of Phosphate Mine Reclamation in FL

Michelle Sims\textsuperscript{1}, Michelle.sims@dep.state.fl.us
Orlando Rivera\textsuperscript{1}, Orlando.rivera@dep.state.fl.us

\textsuperscript{1}FDEP-Bureau of Mining and Minerals Regulation, 2001 Homeland Garfield Rd., Bartow, FL 33830

The Department of Environmental Protection’s Bureau of Mining and Minerals Regulation is the state’s lead agency in the regulation of mine reclamation. Currently, all mining in Florida is subject to reclamation requirements. Reclamation standards are set forth in Chapter 378, Florida Statutes. Of the commodities mined in Florida, phosphate mining is the most land intensive. All phosphate lands disturbed from July 1, 1975, are subject to mandatory reclamation requirements. Reclamation standards for phosphate lands are detailed in Chapter 62C -16 of the Florida Administrative Code (F.A.C.). Approximately 2,534 acres of land were mined for phosphate in 2009. The Rate of Reclamation Report from 1975 to 2009 is in accordance with the subsections 62C-16.0075(6)(a-i), F.A.C. Please note that figures indicate that seventy-one percent (71%) of the land mined for phosphate since July 1, 1975 have been reclaimed. An overview of the Rate of Reclamation and discussion of the meaning of reclaimed and released will be provided.
The salt marsh communities of Southwest Florida are perhaps some of the most unique and rare salt marsh systems in the United States. The mild subtropical climate of Florida supports a combination of temperate salt marsh vegetation and tropical mangroves that intermix to form an important transitional ecotone between land and sea. The salt marsh offers numerous ecosystem services including recreational, commercial, and aesthetic values to man. It provides the foundation of life to a variety of resident and transient organisms, especially the six federally listed and 23 state-listed animal species found there. Almost 66 percent of the remaining salt marsh habitat in Southwest Florida is protected through public ownership or regulatory restrictions. This habitat, however, continues to be lost due to human-induced, permitted, impacts such as dredge and fill operations, alterations of hydrology, and pollution. The Charlotte Harbor National Estuary Program is in the process of an inventory and mapping of the physical extent of six types of salt marsh present within the CHNEP Study Area. We then identify significant potential effects on these salt marsh ecosystems from anticipated climate change. Opportunities for avoidance, minimization, mitigation and adaptation that could be implemented will be identified. An interactive GIS mapping product depicting the project outputs will be uploaded to the CHNEP website for use by researchers and the public. Natural functions that provide ecosystem resiliency will be identified along with policy, land stewardship and structural options. The presentation will give an update on the progress of the project to date, including documentation of the plant and animal species encountered, and a comparison of current to historic aerial photographs showing the changes in extent and topographical range of selected salt marshes between the 1950s historical records and current conditions. The project implements the CHNEP Comprehensive Conservation and Management Plan (CCMP) Priority Action SG-Q: Build capacity for communities and their local leadership to mitigate and adapt to the effects of climate change through joint efforts. Partners include the Southwest Florida Regional Planning Council, the Charlotte Harbor National Estuary Program and USEPA.
A Two Year Assessment of Macroalgal Population Dynamics, Distribution and Habitat Characterization Around Southwest Florida Barrier Islands, with Special Attention to past Macroalgal Bloom Events

Eric C. Milbrandt¹, emilbran@sccf.org
Loren D. Coen¹, lcoen@sccf.org
Richard D. Bartleson¹, rbartleson@sccf.org;
Keleigh Provost¹, keleigh.provost@gmail.com
Mike Parsons², mparsons@fgcu.edu

¹Marine Laboratory, Sanibel-Captiva Conservation Foundation, 900A Tarpon Bay Rd., Sanibel, FL 33957
²Coastal Watershed Institute, Florida Gulf Coast University, Fort Myers, FL 33965

Shifts in seaweed species composition can be a useful indicator of coastal eutrophication and pollution. A review of scientific literature, technical reports, and anecdotal information concerning macroalgae and the potential areas favorable for growth indicated that prior to this study, information on macroalgal populations was extremely limited as was detailed historical bloom information from 2003-2008. The work presented here is part of a larger study with the University of Miami, Nova Southeastern University, University of New Hampshire, the Dauphin Island Sea Lab and Woods Hole Oceanographic Institution to determine the role of land-based runoff, groundwater discharges, and hydrodynamics in large-scale macroalgal strandings with funding by Lee Co., the City of Sanibel and WCIND. New and detailed information about macroalgal populations and associated habitats was collected and analyzed beginning in June 2008 and concluding in July 2010. First, no major events occurred during this 24 month study. Thirteen stations were sampled bimonthly, distributed around the Sanibel causeway, inshore, including lower Pine Island Sound, nearshore and offshore. Quantitative assessments of macroalgae (transects), the attached epibiota, and underwater video were recorded. A total of 96 species in 12 sampling events were collected and validated (Dr. Dawes, USF) during the study period. Macroalgae was frequently abundant in two primary habitat types around Sanibel and Captiva Islands and Fort Myers Beach; inshore near the Sanibel Causeway, and offshore (mostly North Sanibel/Captiva) on limestone reef (hard-bottom) outcroppings. Each area contained a somewhat unique suite of species, as determined from a multivariate (PRIMER) analysis of the bimonthly samples. The two distinct algal communities differed seasonally when there was the maximum algal abundance. For inshore communities, the maximum abundance occurred between January and May. For offshore (nearshore and offshore) areas, the maximum abundances occurred from June to September. These differences were probably driven partly by temperature and light availability. Macroalgae stranded on Fort Myers Beach in March 2010 were similar to species found around the Sanibel Causeway and in San Carlos Bay. A subsequent, but relatively small macroalgal event at Tarpon Bay Beach in November 2010, more closely resembled the species derived from an offshore, hardbottom-associated community. Both habitat types appear to be able to produce macroalgae in sufficient quantities for localized ‘events’ to occur. For all stations, the abundance and identity of attached and benthic invertebrates was determined. There was a significant negative relationship between macroalgal abundance and the abundance of one major potential top-down agent (sea urchins), suggesting that some degree of biological control may be important.

Charlotte Harbor 2010 Seagrass Mapping Status and Trends

Kristen A. Kaufman¹, Kristen.kaufman@swfwmd.state.fl.us

¹Southwest Florida Water Management District, Surface Water Improvement and Management Program, 7601 US Highway 301 North, Tampa, FL 33637

The Southwest Florida Water Management District (District) Surface Water Improvement and Management (SWIM) Program has monitored the status of benthic resources in five contiguous estuaries for over twenty years. Seagrass extent and distribution are surveyed biannually using aerial mapping techniques. The objective of the mapping effort is to produce spatially and thematically accurate GIS coverages that are then used to estimate total seagrass area for each waterbody. Based on results from the 2010 mapping effort, coverage in Charlotte Harbor was 7,327.6 ha, a 4.2 % increase over the 2008 recorded area. Seagrass coverage in Lemon Bay increased 6.1% over 2008 estimates, for a total coverage of 1,229.8 ha. The 2010 mapping results will be presented within the context of previous mapping data and water quality conditions within each estuary.
Ten Year Results of Seagrass Monitoring in the Charlotte Harbor Aquatic Preserves
Melynda Brown¹, Melynda.A.Brown@dep.state.fl.us

¹Florida Department of Environmental Protection, Charlotte Harbor Aquatic Preserves, 12301 Burnt Store Rd, Punta Gorda, FL 33955

The FDEP Charlotte Harbor Aquatic Preserves office has been conducting seagrass monitoring since 1999 throughout Gasparilla Sound-Charlotte Harbor, Lemon Bay, Pine Island Sound, Matlacha Pass and Cape Haze Aquatic Preserves. Fifty fixed field transects are monitored annually in the late summer to capture seagrass at its greatest abundance. Each transect defines the beginning and end (deep edge) of a seagrass bed. Seagrass species, abundance, shoot count, blade lengths, epiphytes, water depth, and sediment are recorded at set stations along the transects. Ten years worth of data collected at all 50 sites depicts current regional and area wide status, as well as changes throughout the years. Overall, Halodule wrightii and Thalassia testudinum are the two species consistently representing a majority of the seagrass coverage across the area. Halodule wrightii is the only seagrass species found in all the estuarine areas. Syringodium filiforme, Ruppia maritima and various Halophila species are also present, but not consistently found, in certain estuaries. Shoot count, total and species abundance have generally been stable or increasing throughout the area, especially since the hurricane seasons of 2004 and 2005. The Myakka River and Peace River areas show the lowest occurrence, abundance and density of seagrass. The transects in Gasparilla Sound represent some of the most abundant seagrass beds and in 2009 had the highest shoot count (density) for Halodule wrightii, Syringodium filiforme and Thalassia testudinum seagrass species. Since 2005, the mean deep edge of the seagrass bed across all regions has been increasing, or getting deeper, with seagrass in San Carlos Bay growing in the deepest water. Other observations throughout the years include landward advancement of seagrass in relation to the station marked in 1999 for the beginning of the seagrass bed. Seagrass scarring by boat propellers has also become highly frequent in certain areas which can affect the data when a propeller scar crosses a transect. This seagrass monitoring program is an important method to document seagrass characteristics over time. It will be important to continue this program in conjunction with other seagrass mapping efforts and to correlate seagrass data with water quality monitoring data in order to assess the estuarine health of the Charlotte Harbor Aquatic Preserves.

SAV in the CRE: The Effect of both Natural and Anthropogenic Freshwater Inflow
Beth A. Orlando¹, borlando@sfwmd.gov
Peter H. Doering¹, pdoering@sfwmd.gov

¹South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406

Submerged Aquatic Vegetation (SAV) plays an important part in the health and well-being of aquatic ecosystems whether it be as a nutrient filter, as habitat, or as a feeding or nursery ground for commercially valuable aquatic species. The services provided by healthy SAV play integral roles in the economy of coastal areas. In 1998, seven SAV dependent species were responsible for approximately 53 million dollars total revenue in Monroe County Florida alone (*, **). Knowing the distribution and trends of SAV and how freshwater input (both natural and managed) can affect these trends and aid coastal resource managers in their planning and management activities. However, methods for gathering this data can be costly and time consuming, particularly over large areas. The use of hydroacoustic technology for monitoring SAV coverage improves spatial coverage at minimum cost. Using this method spatial and temporal changes in seagrass abundance can be measured and interpreted with respect to prevailing environmental conditions. I n this thirteen year study (1996-2009), hydroacoustic techniques were used to assess the spatial and temporal fluctuations in the seagrass coverage of the Caloosahatchee River Estuary in relation to freshwater inflow, annual rainfall (wet and dry years) and extreme weather events (El Nino, La Nina).
The Florida Department of Environmental Protection collected benthic macroinvertebrate samples and associated water quality data in four tidal creeks along the eastern shore of Charlotte Harbor. The intent of this study was to characterize the benthic macroinvertebrate community within these creeks, and determine if conditions in the contributing watersheds affect benthic macroinvertebrate community structure downstream. Two creeks, North and South Silcox Creeks, receive mostly natural runoff from the Charlotte Harbor Preserve State Park, while the other two, Yucca Pen and Culvert Creek, receive more anthropogenically altered runoff from developed areas south of the preserve. Mote Marine Laboratory has been conducting studies of fish assemblages in these creeks, and the benthic macroinvertebrate sampling was intended to complement the fish community data by investigating another subset of the biological community that may be affected by environmental conditions due to watershed alterations. The differences among the benthic macroinvertebrate community structures at the sample sites were strongly affected by the variety and type of microhabitats at the site and possibly by the amount of water exchange between the creeks and the harbor. Overall, effects of the degree of development in the drainage basin were difficult to detect due to the complexity of these tidal creek systems.
To understand how variable freshwater inflow influences prey production for estuarine-dependent fishes, we examined spatiotemporal trends in zooplankton (including hyperbenthos), phytoplankton, benthic microalgae, and various water quality parameters along the estuarine portion of the Caloosahatchee River. During dry months the estuary remained brackish to marine and was well mixed. During wet months a salt wedge was prominent near the river mouth; the upper 3/4 of the estuary was entirely fresh; and the low salinity zone (LSZ), represented by the 2 psu isohaline, extended well downstream. In contrast, during the dry season the LSZ, a region that in other estuaries has been found to serve as important nursery habitat for early life history stages of certain fishes, was trapped upstream of the W.P. Franklin Lock and Dam and isolated from the estuarine portion of the river. Also during periods of high freshwater inflow, minimum dissolved oxygen levels measured from vertical profiles were consistently low in bottom waters upstream. Zooplankton densities were higher and biodiversity greater late in the dry season, and community structure differed between seasons. Abundance-weighted locations of capture for a number of zooplankton taxa exhibited significant (both positive and negative) relationships with freshwater inflow. During the wet season, freshwater copepods, cladocerans, and larval midges all exhibited centers of abundance in the upper tidal Caloosahatchee. These species are known to feed on phytoplankton or on phytoplankton grazers. During the dry season, a number of estuarine species, including estuarine-dependent fishes and important prey of fishes such as mysids and isopods, moved upstream into the narrow portion of the tidal river from centers of abundance farther downstream. Although these organisms may experience greater overall dispersion as a result of this movement, such gains in habitat extent may be offset by losses in habitat volume due to the inherent geomorphology (i.e., funnel shape) of tidal rivers. By concentrating aquatic organisms in a reduced volume of habitat, habitat compression increases competitive interactions among and within species and enhances predator-prey encounters in the same habitat. This can result in habitat overlap, higher predation rates, decreased prey availability, and reduced growth rates. Furthermore, based on the results of spatial abundance quantile analysis, it appears that juvenile bay anchovy and their prey Americanysis almyra are blocked from moving farther upstream during the dry season by the presence of the lock and dam. This pattern indicates additional habitat compression for these organisms, as their upstream distribution is truncated. In addition to changes in center of distribution in response to variable inflow, some taxa exhibited significant changes in total abundance in response to lagged inflow. The majority of these responses were negative, indicating reduced system-wide abundances at higher levels of inflow. These contrasting patterns, habitat compression during periods of low inflow and potential advective washout during periods of high inflow, have significant implications for the management of freshwater inflow in the Caloosahatchee River and estuary.
Oyster *Crassostrea virginica* Health, Reproduction and Larval Recruitment as Indicators of the Influence of Managed Freshwater Inflows in the Caloosahatchee Estuary

Aswani Volety¹, avolety@fgcu.edu
Patricia Goodman², pgoodman@sfwmd.gov
Lesli Haynes¹, lhaynes@fgcu.edu
Lacey Smith¹, lheine@fgcu.edu

¹Florida Gulf Coast University, 10501 FGCU Blvd, Fort Myers, FL 33965
²South Florida Water Management District, 3301 Gun Club Rd, West Palm Beach, FL 33406

Pre-drainage estuaries along the southwest coast of Florida received freshwater inflow primarily from direct rainfall and basin runoff. Watershed development and water management practices have altered these flows and impacted salinity and water quality in these systems affecting responses of valued ecosystem components such as oysters, *Crassostrea virginica*. Oyster responses including reproduction and recruitment are used to set water quality targets in SW Florida estuaries, and as indicators of restoration success of the Comprehensive Everglades Restoration Plan because they are benthic, sessile, filter feeding organisms making it is easy to recognize cause-and-effect relationships between water quality and organism responses. Physiological and ecological responses (disease susceptibility, spat recruitment, growth and survival and reproductive condition) of oysters were assessed, seasonally and spatially in relation to salinity and freshwater input into the Caloosahatchee estuary. Oysters in the Caloosahatchee estuary appear to spawn actively between Mar – Oct, a period that is concomitant with seasonal rainfall, upstream freshwater releases, watershed runoff, and consequently with reduced estuarine salinities. Reproduction results are corroborated by larval recruitment, which occurs between Apr – Nov. Lack of storage in the watershed allows very high volume fresh water discharges during the summer months result in flushing of larvae to downstream locations, where, during the drier winter months they are exposed to very high salinities and predation which is unfavorable for their survival. \( R^2 = -0.72 \). Prevalence and intensity of *Perkinsus marinus* infections increases with increasing salinity and decreases with high freshwater inflows into the system \( R^2 = 0.59 \), which may account for observed larval recruitment and adult survival trends. These results suggest that management actions such as small, periodic freshwater releases for durations of less than 2 weeks would result in lower disease prevalence and intensity, and higher juvenile oyster survival. Limiting freshwater releases to < 4000 CFS during late summer months would also limit flushing of oyster larvae to downstream locations where substrate is limited and create a more favorable salinity regime for spat recruitment and survival.

CHNEP Shellfish Restoration Needs Summary

Judy Ott¹, jott@swfrpc.org

¹Charlotte Harbor National Estuary Program, 1926 Victoria Ave., Fort Myers, FL 33901

CHNEP Hosted a Shellfish Restoration Needs Workshop in February 2011. Purposes of the workshop were to:

- To share the locations & types of existing oyster & scallop restoration projects.
- To develop maps & lists of oyster & scallop restoration needs within the CHNEP estuaries.
- To develop partnerships for potential future oyster & scallop restoration projects.
- To share a list of potential funding opportunities for future oyster & scallop restoration projects.

Identifying shellfish restoration needs helps implement the CHNEP Comprehensive Conservation & Management Plan (CCMP) includes Priority Actions relating to restoring native habitats and involving the public in habitat and wildlife issues & research, monitoring & restoration activities (FW-F, FW-P & S G-B). In addition, oyster & scallop habitats serve as environmental indicators within the CHNEP. Products from the Shellfish Restoration Workshop that will be summarized include:

- Base maps of historic & current scallop & oyster habitats for each estuary in CHNEP (Lemon Bay, Myakka/Peace/Upper Charlotte Harbor, Lower Charlotte Harbor/Cape Haze/Placida, Pine Island Sound, Matlacha Pass, Caloosahatchee/SCB, Estero Bay)
- Base maps & lists of scallop & oyster restoration projects (past, present & future) for each estuary in CHNEP.
- Compilation of potential partnerships and funding sources for future scallop and oyster restoration projects within the CHNEP.
- Next steps needed to implement scallop and oyster restoration within the CHNEP.
Fish and aquatic macroinvertebrate communities were monitored across the 91,000+ acre Babcock Ranch between October 2006 and February 2011. A total of 31 sites, including 24 water quality sampling stations were sampled three times per year to document species distribution seasonal fluctuations in community structure. These sites included cypress strands, cypress domes, marshes, small streams, and manmade drainage ditches and canals. Sampling methods were adopted from the baseline assessment of aquatic fauna for the Picayune Strand Restoration Project (PSRP 2005). Ten clear plastic fish traps (Breder 1960) were deployed for one hour at each site to sample fish communities. Supplemental fish sampling was also conducted using dip nets, seines, modified crayfish traps, and cast nets in order to build a complete species list for each site. A total of 26 fish species, representing 14 families have been collected including seven non-indigenous (exotic) fish species from four families. The most dominant species in terms of total abundance were the native eastern Gambusia holbrooki; Poeciliidae (eastern mosquitofish) and the invasive exotic Hemichromis letourneuxi; Cichlidae (African jewelfish). The invasive and highly aggressive H. letourneuxi is a riverine fish species that relies on stochastic events, such as floods for migration and spawning activity and to expand its distribution. Over decades, anthropogenic activities including construction of canals and agricultural drainage systems at Babcock Ranch have altered natural hydropatterns and facilitated the expansion of invasive fishes, especially H. letourneuxi. While disturbance and other factors aid invasive fish species, others environmental factors limit their distribution and abundance. These environmental factors include 1) limited cold tolerance of tropical and subtropical species that ultimately limits their northern distribution in peninsular Florida and 2) seasonal dry-down in wetland habitats. To better understand patterns of invasive fish movements and distribution across the Babcock Ranch watershed we developed a predictive model for the effects of hydrologic and cold weather events and their effects on fish community structure and distribution. The model is being field-calibrated using fish sampling data collected prior to and immediately after floods, seasonal dry-down, and three extended cold weather events between 2007-2011. Results indicate that manmade canals serve as thermal refugia for non-native cichlids during cold weather and seasonal dry-down. We observed non-native fish mortality in the native stream habitats during and after prolonged cold weather events resulting in significant (p<0.05) changes in fish community structure. The changes included the recovery of several native species and the extirpation of non-native cichlids from all stream sites in February 2010. However, wet-season flood events and hydrologic connection to manmade canals allowed for the re-establishment of the non-native H. letourneuxi and other cichlids in many marshes, swamps, and stream habitats. The in-situ cold tolerance of non-native cichlids in streams, canals and cypress strands is currently being investigated using water temperature dataloggers in an effort to refine the model and to develop habitat management and restoration strategies for native fish communities throughout the watershed.
Fish Assemblages in the Oligohaline Zone of the Peace River during Periods of Extreme Freshwater Inflow Variation

P.W. Stevens¹, Philip.Stevens@MyFWC.com
M.F.D. Greenwood², mgreenwood@icfi.com
D.A. Blewett¹, Dave.Blewett@MyFWC.com

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Laboratory, 585 Prineville St, Port Charlotte, FL 33954
²Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL 33701 – currently at ICF International, 630 K Street, Sacramento, CA 95814

Because unique physical, chemical, and biological processes occur at low salinity, maintenance or restoration of the oligohaline zones (0.5-5 psu) of coastal rivers is increasingly becoming an important goal of water managers striving to balance human consumption of water with the ecological integrity of estuaries. The objectives of this study were to compare fish community structure and species-specific abundances of the oligohaline zone to those of the lower river mouth in a southwest Florida river (i.e., Peace River) during periods of varying freshwater inflow. The abundances of several estuarine and coastal shelf transients captured by 21.3-m seine—sand seatrout Cynoscion arearius, tidewater mojarra Eucinostomus harengulus, red drum Sciaenops ocellatus, and spot Leiostomus xanthurus—were similar between river sections, which is consistent with the premise that the oligohaline zone is an extension of the juvenile habitat known to be important for transient fish in lower rivers. Estuary residents—such as mosquitofish Gambusia holbrooki, raintwater killifish Lucania parva, and sailfin molly Poecilia latipinna—were at least an order of magnitude more abundant in the oligohaline zone, the result of higher production at low salinity, greater marsh area, or less competition. Large-bodied fish assemblages of the oligohaline zone captured by 61-m seine included several piscivores—such as S. ocellatus, common snook Centropomus undecimalis, ladyfish Elops saurus, gray snapper Lutjanus griseus, and Florida gar Lepisosteus platyrhincus—and the abundance of piscivores was comparable to that of estuarine shorelines downstream. During a severe drought, the oligohaline fish assemblages became more similar to assemblages of the lower river mouth, and the abundances of the species that define the oligohaline zone were reduced. This study demonstrates that dramatic changes in the position of the freshwater-saline interface can lead to measurable biological changes.

Comparative Ecology of Euryhaline and Freshwater Predators in a Large Coastal Plain River and the Effects of Chance Events

D.A. Blewett, Dave.Blewett@MyFWC.com
P.W. Stevens¹, Philip.stevens@myfwc.com
M.E. Cal², Marvin.call@myfwc.com

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Laboratory, 585 Prineville St, Port Charlotte, FL 33954
²Florida Fish and Wildlife Conservation Commission, 3900 Drane Field Road, Lakeland, FL 33811

Common snook Centropomus undecimalis, a diadromous euryhaline predator, use river systems in south Florida, but the degree to which they compete with resident freshwater predators is unknown. The objectives of this paper are to determine the abundance, distribution, habitat, and diet of common snook in a southwest Florida river relative to freshwater predators, namely largemouth bass Micropterus salmoides, Florida gar Lepisosteus platyrhincus, longnose gar Lepisosteus osseus, and bowfin Amia calva. Large predators were electrofished in the mainstem of the Peace River during 2007-2010 and gastric lavage was used to acquire stomach contents. Common snook habitat and diet (predominantly brown hoplo Hoplosternum litorale and crayfish Procambarus spp.) was similar to resident freshwater predators, but their use of the river differed over time and space. Common snook were present throughout the entire river during summer and fall, moving upriver in response to high water levels, but were absent from the upper river during winter, when low water levels and cold temperatures prompted downriver movements. In contrast, resident freshwater predators were most abundant in the upper river and during winter. Seasonal rates of prey consumption between estuarine and freshwater predators also differed; common snook ate more prey during summer, whereas largemouth bass ate more prey during winter. A longer time record was available for common snook and largemouth bass in the lower river where electrofishing also occurred during 2004-2006, and shows that environmental events affected abundance patterns and potential interspecific competition. The abundance of largemouth bass was low after a hypoxic event associated with Hurricane Charley (2004) affected the population. Common snook were up to three times more abundant during 2004-2006 than in 2007-2010; increased flow, abundance of prey, and lack of interspecific competition possibly contributed to the high abundance. An extreme cold event during winter 2010 initially affected common snook abundance estimates in the river mainstem, but their abundance returned to pre-freeze levels by summer and fall.
Community-Initiated “Kids Cup” Tournament Evaluates Fate of Red Drum *Sciaenops ocellatus* in Charlotte Harbor, Florida

Elizabeth Staugler¹, staugler@ufl.edu
M. Heller², michael.heller@comcast.com
R. Allen³, captain@kingfisherfleet.com
N. Brennan⁴, nbrennan@mote.org
R. DeBruler⁵, roger.debruler@charlottefl.com
C. Neidig⁶, cneidig@mote.org
C. Armstrong⁷, cynthia.armstrong@pgnmail.com
K. Heym⁸, Kathy.Heym@SeaWorld.com
R. Yanong⁹, rpy@ufl.com
A. Saul⁸, angela.saul@myfwc.com

¹Florida Sea Grant, Charlotte County UF/IFAS Extension, 25550 Harborview Rd., Suite 3, Port Charlotte, FL 33980
²Water life Magazine, 217 Bangsberg Rd., Port Charlotte, FL 33952
³King Fisher Fleet, 1200 W. Retta Esplanade, Punta Gorda, FL 33950
⁴Mote Marine Laboratory, Center for Fisheries Enhancement, 1600 Ken Thompson Pkwy, Sarasota, FL 34236
⁵Charlotte County, Natural Resources Division, 25550 Harborview Rd., Suite 3, Port Charlotte, FL 33980
⁶Progress Energy Florida, Crystal River Mariculture Center, 15760 W. Powerline Street, FH34, Crystal River, FL 34428
⁷University of Florida Tropical Aquaculture Laboratory, 1408 24th Street SE, Ruskin, FL 33570
⁸Florida Fish and Wildlife Conservation Commission, SERF, 14495 Harllee Rd., Palmetto, FL 34203

Red drum (*Sciaenops ocellatus*) from three annual catch-and-release tournaments in northern Charlotte Harbor, Florida were evaluated to determine post-event dispersal and related mortality. These research-based tournaments (“Kids Cup”) were designed to allow community and youth stakeholders to participate in research and encourage resource accountability and awareness. During each event, slot size tournament-caught red drum were weighed, measured, fitted with dart tags (Hallprint, Victor Harbor, Australia), and released. Subsets of red drum (*n=20, 20, and 22 in 2007, 2008, and 2009*) were also surgically implanted with individually-coded acoustic transmitters (Vemco, Nova Scotia, Canada) and released. We used an array of stationary underwater receivers and mobile hydrophones to track post-tournament activity. For each tournament, we also conducted a 48 h post-event mortality study on subsets of the tournament fish (*n=15, each year*) held in five 1000-l tanks supplied with flow-through ambient water. Here, experimental treatments included red drum implanted with placebo transmitters, dart tags, and no tags. After this, all surviving red drum were fitted with dart tags (if not already tagged) and released. Trained volunteers assisted scientists during field procedures and project findings were relayed to community stakeholders via print media and an interactive website. Annual dart tag reporting rates were 20% (of 64 released), 10% (of 68) and 14% (of 44). In 2007, 90% of the acoustic-tagged red drum were heard post-release, but in 2008 and 2009, 100% of the acoustic-tagged red drum were heard after incorporating more detectable transmitters. Mean 48h mortality rates were 13% for fish implanted with placebo acoustic tags, 7% for dart-tagged drum and 0% for untagged drum, although means were not significantly different. Recaptures from receivers and anglers are providing information on release site fidelity and dispersal with respect to capture origins, and habitat-specific preferences such as their use of man-made canal habitats.
Abiotic Affinities, Spatiotemporal Distribution, and Movements of the Endangered Smalltooth Sawfish, *Pristis pectinata*, in a Southwest Florida Nursery

G. R. Poulakis¹, Gregg.Poulakis@MyFWC.com
P. W. Stevens¹, Philip.Stevens@myFWC.com
A. A. Timmers¹, Amy.Timmers@MyFWC.com
C. J. Stafford¹, Chris.Stafford@MyFWC.com
T. R. Wiley², tonya@havenworthconsulting.com
C. A. Simpfendorfer³, colin.simpfendorfer@jcu.edu.au

¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Laboratory, 585 Prineville Street, Port Charlotte, FL 33954
²Haven Worth Consulting, 3207 Ashe Creek Drive, League City, TX 7757
³Fishing and Fisheries Research Centre, School of Earth and Environmental Sciences, James Cook University, Townsville, Queensland 4811, Australia

Although the endangered smalltooth sawfish (*Pristis pectinata*) is known to use estuaries during its first 2–3 years, little is known about its life history and ecology while in its juvenile habitat. The purpose of this ongoing project is to monitor sawfish in the Charlotte Harbor estuarine system to characterize seasonality, recruitment, habitat use, and health. During the first five years of the study, we captured sawfish in 1.4% of our random 183-m haul seines and in 14.6% of samples that were non-randomly set. Sawfish stretched total lengths ranged from 671 to 2,172 mm (n = 137; mean = 1,248 mm). Sawfish were captured in all months, most commonly between February and September. Captures of neonates with rostral sheaths allowed refinement of the size range at birth (671–812 mm) and confirms the protracted timing of parturition (November–July) inferred from length frequency data. Although extensive sampling occurred throughout the estuarine system, most sawfish were captured at five locations. Logistic regression models identified various combinations of water depth, water temperature, dissolved oxygen, and salinity as influencing the probability of catching a sawfish. Electivity analysis showed that sawfish had an affinity for water < 1 m deep, water > 30°C, moderate to high dissolved oxygen levels (> 6 mg L⁻¹), and salinities between 18 and 30 psu. Higher catch rates of larger sawfish (> 1 yr old) were associated with shoreline habitats with overhanging vegetation (e.g., red mangroves). Movements of 23 sawfish were monitored along the main stem of the river and in 13 nonmain stem habitats (i.e., natural mangrove-lined creeks, semi-natural creeks, seawall-lined canals). Three-fourths (74%) of these sawfish used nonmain stem habitats, and many (39%) used these habitats more than 10% of the time. Generalized additive models and linear regression found that the distribution of sawfish was significantly related to 90-day lagged salinity; sawfish moved upriver with increasing salinity. When regressed separately for two size classes, the linear relationship between mean river position and salinity was stronger for < 1 yr old sawfish (60-day lag) than for larger sawfish (120-day lag). These results demonstrate the importance of this system as a nursery, provide specific abiotic affinities, and document habitat use patterns that will be useful in the development of management strategies for sawfishes and their habitats.
The Southwest Florida Water Management District (District) Surface Water Improvement and Management (SWIM) Program has partnered with the Florida Department of Environmental Protection (FDEP) Parks Service over the past decade to complete several habitat restoration projects on FDEP and District owned lands within the Charlotte Harbor watershed. Two large-scale projects, the Alligator Creek Habitat Restoration Project and the Coral Creek Ecosystem Restoration Project, are currently underway. These multi-year, phased projects encompass over 4,000 acres of land in Charlotte County, providing significant benefits to wildlife and fisheries. The Alligator Creek Habitat Restoration Project is located on a 1,600 acre site that is owned by FDEP and is located south of Punta Gorda abutting Charlotte Harbor. The project is now in Phase III of design. Previous phases included a total of seven projects, encompassing nearly 740 restored acres. Five additional projects are included in Phase III. Project goals for this phase consist of restoring the historic hydroperiod to approximately 90 acres of wetland and saltmarsh area, which has been severely impacted by anthropogenic activities. The Coral Creek Ecosystem Restoration Project is located on 2,600 acres of FDEP and District co-owned land. The land is managed by the FDEP. This multi-faceted project consists of hydrologic and habitat restoration of degraded and impacted wetlands on the Cape Haze peninsula. The project is also expected to provide water quality polishing for stormwater flows currently entering the project area from the Rotonda subdivision. A feasibility report for the entire site has been completed, which identifies seven phased project areas. Design and permitting have begun on the first, approximately 400 acre, phase and is anticipated to be completed in the spring of 2011. Construction of this phase will likely commence in the fall and be completed in 2012. Future project phases for Alligator Creek are not planned at this time. However, six additional phases of the Coral Creek project are conceptually designed. Including the two above mentioned projects, the SWIM Program has partially or fully funded over 40 research and restoration projects in the Charlotte Harbor watershed, leading to nearly 1,100 restored acres.
This project is a cooperative effort of the SWFRPC, CHNEP, and USEPA that identifies the regional impacts on coastal wetlands of the current environmental resource permitting process and program of compensatory wetland mitigation. It evaluates the successes of and problems with state and local mitigation strategies implemented in the CHNEP study area, focusing on coastal (marine and estuarine) habitats, including mangroves, salt marshes, sea grass beds, oyster hard bottom and tidal freshwater emergent shoreline. Management criteria and implementation success are assessed for both private and public mitigation lands. The result is an evaluation of the performance of three wetland functional assessment methods, WRAP, UMAM, and HGM, in the coastal wetlands of the Charlotte Harbor National Estuary Program watersheds; the distribution of mitigation; and in some cases the fate of long-term on-site mitigation. Recommendations for protocols and practices for improving the effectiveness of compensatory mitigation in coastal and estuarine habitats are examined. During the 2004-2008 study period 10,186 ERP Permit actions occurred in the total CHNEP boundary. Of these ERP Permit Actions 1,834 occurred on the coast of the CHNEP on the shoreline and/or in emergent estuarine wetlands. The majority of the total ERP Permit actions occurred in the Peace River, Caloosahatchee River, and Estero Bay watersheds. The majority of the Coastal Permit ERP actions occurred in the Caloosahatchee River, Pine Island Sound/ Matlacha Pass and Estero Bay Watersheds. All three wetland functional assessment methods function as designed and produce a result that is similar if not exact in its assessment of coastal wetlands but yield somewhat different mitigation results. While the total area of wetland acreage and functional decrease can appear relatively small over the 5 year period examined in comparison to the total extent of wetlands resources that continue to exist, it is important to understand that this permitted wetland elimination is gradually reducing the total extent of coastal wetlands in watershed of the CHNEP when it is the general perception both by the public and the regulatory entities that there is no wetland functional loss occurring in the balancing process of the use of functional assessment tools. There is also the process of relocating wetland functions out of impacted watersheds toward the singular watershed able to provide approved off-site mitigation in the category of coastal wetland habitats that are being impacted. While the functional assessment evaluation shows a mathematical balance sheet for the total service area that is equal to or better than parity for a project that utilizes a mitigation bank, with rare exception, there is a real loss of wetland acres and function in the donor watershed and an increase in function, but not necessarily new acres of wetlands created in the receiving watershed. This project implements the CHNEP CCMP Quantifiable Objective FW-2: Restore and maintain saltwater and freshwater wetland systems; and Priority Action FW-C: Restore freshwater and estuarine wetlands areas.
Shoreline Enhancement of Clam Bayou in Southwest Florida:
Combining Mangrove, Oyster reef, and Seagrass Restoration

Clam Bayou was hydrologically isolated from the bay for nearly 10 years prior to the 2006 construction of a box culvert. The culvert construction was funded by SFWMD, NOAA, the City of Sanibel, and restored tidal flows, but the shoreline succession lagged behind. Efforts to jump start the natural ecological processes were begun by SCCF in 2009 with funding from NACo and NOAA. Over 30,000 red mangrove (Rhizophora mangle) propagules were collected from July to November and planted directly in the upper intertidal (0.5m above MSL) along the shorelines of Clam Bayou in 2009-2010. The shoreline was mapped using a Trimble GPS and area restored was calculated in ArcGIS (ver. 9.2). Oyster reefs with fossilized oyster and other shell were constructed in the intertidal adjacent to planted shorelines in concert with a related effort supported by TNC/NOAA. Sampling trays were deployed to determine rates of oyster recruitment and to sample the invertebrates and other animals using the reefs as habitats. Sods of widgeon grass (Ruppia maritima) were propagated at the SCCF ML and were planted to supplement existing seagrass (mostly Halodule wrightii) in the subtidal. We present the results of construction and monitoring activities for this community-based restoration project, which has relied on volunteers and local agencies for all aspects. Lessons learned and challenges of this type of project are also presented. This comprehensive approach considers the interaction between planting of propagules, seedlings and seagrass sods and the adjacent construction of oyster reefs with fossilized.
Retrospective and Prospective Analyses of Coastal Systems Change
in Charlotte Harbor to Identify Restoration Priorities
Laura Geselbracht¹, lgeselbracht@tnc.org
Kathleen Freeman², kfreeman@tnc.org
Eugene Kelly², ekelly@tnc.org
Anne Birch³, abirch@tnc.org
Doria Gordon⁴, dgordon@tnc.org

¹The Nature Conservancy, 2408 NE 19 Avenue, Wilton Manors, FL 33305
²The Nature Conservancy, 222 S. Westmonte Dr. Ste. 300, Altamonte Springs, FL 32714
³The Nature Conservancy, 201 N. Riverside Drive, Suite B, Indialantic, FL 32903
⁴The Nature Conservancy, University of Florida-Dept. of Biology, P.O. Box 118526, Gainesville, FL 32611

Charlotte Harbor is one of the largest and least contaminated estuarine complexes in Florida; however, it has not been immune to anthropogenic impacts. Loss of habitat and habitat degradation due to the introduction of pollutants and excess nutrients, changes in water flows and coastal development have continued to alter the Charlotte Harbor ecosystem. In addition, it is expected that the system will experience substantial future impacts in the form of sea level rise (SLR) and other climate change effects. We conducted retrospective and prospective analyses of coastal wetland change in the Greater Charlotte Harbor system over a 160 year time frame to identify the locations, types and magnitude of wetland system changes that have occurred and are likely to occur. These analyses were conducted to guide the planning of restoration projects that would be most beneficial to the long term health of the Charlotte Harbor system. For the retrospective analysis, we compared the spatial extent of the harbor’s coastal wetlands systems over a 2,585,02 hectare area and 60 year timeframe using geospatial analysis. For the prospective analysis, we simulated changes to coastal wetland systems caused by slr over a 761,670 hectare area and 100 year timeframe using the Sea Level Affecting Marshes Model (SLAMM). The retrospective analysis found that harbor-wide, oyster reef and seagrass experienced the greatest loss (-99% and -26%, respectively) in spatial extent from 1945 to 2004/2006. Mangrove habitat over the same period remained roughly unchanged (+1%) and saltmarsh habitat expanded substantially (+47%), likely replacing adjacent freshwater wetland systems. These changes have been highly uneven spatially and temporally across Charlotte Harbor. Our prospective SLAMM analyses using 0.64 m, 1 m and 2 m slr scenarios predicted substantial changes over this century in the area covered by coastal wetland systems, including net losses of tideflat (-82%, -81%, and -99%, respectively) and swamp (-20%, -24%, and -33%, respectively). Mangrove forest registered a net gain of spatial extent under the 2 lowest SLR scenarios modeled (+31% and +37%, respectively), but a net loss under the highest SLR scenario modeled (-63%). Our results indicate that on a harbor-wide scale, oyster reef and seagrass beds should receive the highest restoration priority and identify how SLR will shape Charlotte Harbor in the future. Areas once suitable for oyster reefs may not be so in the future and seagrass beds may be more likely to expand into areas where tidal flats are submerging. The spatial SLAMM results provide a framework for detailed, site specific placement of restoration efforts with a greater likelihood of long-term success. The results of our study can be used to assist with the implementation of the following objectives identified in the Comprehensive Conservation Management Plan for the Greater Charlotte Harbor Watershed: restoration and conservation of fish and wildlife habitat. These results of this study will be of interest in the Charlotte Harbor area and across the Gulf of Mexico as a multitude of agencies, non-governmental organizations and private individuals strive to restore past and anticipated future ecological damage.
Charlotte Harbor National Estuary Program

**Policy Committee**

<table>
<thead>
<tr>
<th>Cities</th>
<th>Counties</th>
<th>Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Robert Howard, Co-Chair</td>
<td>Mr. Jon Iglehart, Co-Chair</td>
<td></td>
</tr>
<tr>
<td>Water Management Division</td>
<td>South District Director</td>
<td></td>
</tr>
<tr>
<td>U. S. Environmental Protection Agency, Region 4</td>
<td>Florida Department of Environmental Protection</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hon. Adrian Jackson</td>
<td>Hon. Christopher Constance</td>
<td>Ms. Patricia M. Steed</td>
</tr>
<tr>
<td>City of Bartow</td>
<td>Charlotte County</td>
<td>Central Florida Regional Planning Council</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Robert Howard</td>
<td>Mr. David Hutchinson</td>
<td>Dr. Philip Stevens</td>
</tr>
<tr>
<td>City of Bartow</td>
<td>Southwest Florida Water Management District</td>
<td>Florida Fish &amp; Wildlife Conservation Commission</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Connie Jarvis</td>
<td>Mr. Charles Dauray</td>
<td>Hon. Don McCormick</td>
</tr>
<tr>
<td>City of Cape Coral</td>
<td>City of Punta Gorda</td>
<td>Southwest Florida Regional Planning Council</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Melanie Grigsby</td>
<td>Mr. Ray Judah</td>
<td>Hon. Michael Gallen</td>
</tr>
<tr>
<td>City of Fort Myers</td>
<td>Lee County</td>
<td>Manatee County</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town of Fort Myers Beach</td>
<td>Sarasota County</td>
<td>Southwest Florida Water Management District</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hon. Linda Yates</td>
<td>Hon. Bob English</td>
</tr>
<tr>
<td>City of North Port</td>
<td>Polk County</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hon. Charles Wallace</td>
<td>Hon. Jon Thaxton</td>
</tr>
<tr>
<td>City of Punta Gorda</td>
<td>Sarasota County</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hon. Mick Denham</td>
</tr>
<tr>
<td>City of Sanibel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Kathleen Weeden</td>
</tr>
<tr>
<td>City of Venice</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Mike Britt</td>
</tr>
<tr>
<td>City of Winter Haven</td>
</tr>
</tbody>
</table>

**Management Committee Co-Chairs**

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Robert Howard</td>
<td>Mr. David Hutchinson</td>
</tr>
<tr>
<td>U. S. Environmental Protection Agency, Region 4</td>
<td>Southwest Florida Regional Planning Council</td>
</tr>
</tbody>
</table>

**Technical Advisory Committee Co-Chairs**

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Greg Blanchard</td>
<td>Mr. John Ryan</td>
<td>Ms. Elizabeth Staugler</td>
</tr>
</tbody>
</table>

**Citizens Advisory Committee Co-Chairs**

<table>
<thead>
<tr>
<th>Chair</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Warren Bush</td>
<td>Mr. Kayton Nedza</td>
</tr>
</tbody>
</table>

**Staff**

- **Dr. Lisa B. Beever**, Director
- **Ms. Elizabeth S. Donley, Esq.**, Deputy Director
- **Ms. Maran Brainard Hilgendorf**, Communications Manager
- **Ms. Judy Ott**, Program Scientist
Thank you for participating in the CHNEP Charlotte Harbor Watershed Summit. Please visit our website at www.CHNEP.org to find materials created as part of the Watershed Summit, including the abstracts, all the presentations as PDF files, links to the WebEx recordings (audio and PowerPoint) and links to videos on YouTube.

Charlotte Harbor National Estuary Program
1926 Victoria Ave, Fort Myers FL 33901-3414
239/338-2556, Toll-free 866/835-5785
www.CHNEP.org

Working together to protect the natural environment from Venice to Bonita Springs to Winter Haven