Join us where the rivers meet the Gulf of Mexico

Charlotte Harbor Watershed Summit

February 7-9, 2002

IMPAC University
Punta Gorda, Florida

Technical Symposium: Thursday and Friday

Public Conference: Saturday

Hosted by

CHARLOTTE HARBOR National Estuary Program

Charlotte Harbor National Estuary Program
4980 Bayline Drive, 4th Floor
North Fort Myers FL 33917-3909
941/995-1777 ~ Fax 941/656-7724
www.charlotteharbornep.org ~ chnep@swfrpc.org
Robert Rudolph, Director (rrudolph@swfrpc.org)
Catherine Corbett, Environmental Projects Manager (ccorbett@swfrpc.org)
Maran Hilgendorf, Public Involvement Specialist (mhilgendorf@swfrpc.org)

The Charlotte Harbor National Estuary Program is a partnership of citizens, elected officials, resource managers, and commercial and recreational resource users working to protect the greater Charlotte Harbor estuarine system by improving the water quality and ecological integrity of the 4,400-square-mile watershed. The partnership works as an advocate for the estuarine system by building consensus that is based on sound science and assessment.

The Charlotte Harbor study area encompasses both the estuarine system and its watershed. The estuaries are, from north to south, coastal Venice, Lemon Bay, Gasparilla Sound, Charlotte Harbor, Pine Island Sound, Matlacha Pass, San Carlos Bay and Estero Bay as well as the Myakka, Peace and the tidal portion of the Caloosahatchee rivers. The watershed includes all or part of Charlotte, DeSoto, Hardee, Highlands, Lee, Manatee, Polk and Sarasota counties.

Thanks to the following people who served on the Summit Committee.

Anna Bowditch, Charlotte Harbor Advisory Council
Al Cheatham, Charlotte Harbor Environmental Center
Edwin Everham, Florida Gulf Coast University
Rebecca Hensley, FWC Florida Marine Research Institute
Jon Hubertz, Charlotte Harbor Marine Research Team
Keith Kibbey, Lee County Environmental Laboratory
Joe King, Polk County Natural Resources
Molly Krival, "Ding" Darling Wildlife Society
Leah Lauderdale, Farmland Hydro
Lloyd Lueptow, Charlotte County resident
Katy McKenney, Caloosahatchee River Citizens Association
Misty Nabers, Gasparilla Island Conservation & Improvement Association, Inc.
Commissioner Ronald Neads, DeSoto Board of County Commissioners
Annette Nielson, Florida Department of Environmental Protection
Rich Novak, Charlotte Count Sea Grant Extension
Ellen Peterson, Sierra Club – Calusa Chapter
Kathi Rader-Gibson, Florida Native Plant Society
Bobbi Rodgers, Charlotte Harbor Environmental Center
Jim Sampson, CF Industries
James R.E. Smith, Charlotte County resident
Chris Smith, Cargill Fertilizer
Stuart Stauss, Sanibel Island resident
Dave Tomasko, Southwest Florida Water Management District
Phong Vo, US AgriChem
Toni Yard, FWC Florida Marine Research Institute

The Charlotte Harbor NEP is pleased to host the . . .

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The Charlotte Harbor National Estuary Program, using a cooperative decision-making process based on sound science, developed a *Comprehensive Conservation and Management Plan* (CCMP) that identifies the region's priority environmental issues – water quality, hydrology, and fish and wildlife habitat loss – and actions to solve them. When the CCMP was completed and accepted in 2001, it marked the beginning of action to restore and protect the estuary and its watershed.

The **Charlotte Harbor Watershed Summit** is an important step in the NEP process of bringing public and private stakeholders together to discuss ongoing studies and critical environmental issues facing the region. It is an opportunity to discuss current and emerging issues affecting the Charlotte Harbor watershed.

The technical symposium is Thursday and Friday, February 7 and 8, and the public conference is Saturday, February 9, at IMPAC University in Punta Gorda. Presentations given on the first two days will be more technical and scientific than presentations given on Saturday. Research posters will be on display during the technical symposium. Agencies, businesses and organizations will also provide information about our watershed and their role in protecting it, especially during the public conference.

The Charlotte Harbor NEP is pleased to receive sponsorship support for the Watershed Summit from the following organizations, agencies and businesses.

Summit Sponsors ($1,000)

- Mote Scientific Foundation
- Charlotte Harbor Environmental Center/Charlotte Harbor Fund

Lunch, Break and Activity Sponsors ($500/activity)

- WCI – Lunch on Saturday
- WCI – Vouchers for boat rides
- City of Punta Gorda – Reception Thursday night
- CF Industries – Thursday morning break
- Cargill Fertilizer – Saturday afternoon break
- Farmland Hydro LP – Saturday morning break
- IMC Phosphates Company – Friday morning break
- Florida Phosphate Council – Friday afternoon break
- US Agri-Chemicals Corp. – Thursday afternoon break
- Florida Environmental, Inc. – Thursday lunch

continued

Additional sponsorship support is provided by:

Technical Symposium Sponsors ($100)

- Janicki Environmental, Inc.

Public Conference Sponsors ($100)

- Caloosahatchee River Citizens Association (CRCA)
- The Charlotte Harbor Chapter of the Florida Native Plant Society
- Estero Bay Buddies
- Sierra Club - Calusa Chapter
- Southwest Florida Watershed Council
- National Wildlife Federation
- Friends of the Charlotte Harbor Aquatic Preserves

Additional support for the Summit is provided by:

- IMPAC University
- King Fisher Fleet
- Fishermen's Village
- Peace River Valley Citrus Growers Association

The Charlotte Harbor NEP receives support from:

- U.S. Environmental Protection Agency
- Southwest Florida Water Management District
- South Florida Water Management District
- Florida Department of Environmental Protection
- Florida Department of Community Affairs
- Florida Fish and Wildlife Conservation Commission
- Natural Resources Conservation Service
- Peace River/Manasota Region Water Supply Authority
- Counties of
    - Charlotte
    - DeSoto
    - Hardee
    - Lee
    - Manatee
    - Polk
    - Sarasota
- Cities of
    - Sanibel
    - Cape Coral
    - Fort Myers
    - Punta Gorda
    - Bartow
    - Venice
    - Fort Myers Beach
- Southwest Florida Regional Planning Council
- Central Florida Regional Planning Council
- and others

Agenda for the Technical Symposium

Please note that only presenters are listed here.
The abstract, which can be found on the page indicated, lists all authors.

Thursday, February 7, 2002

7:00 a.m. Registration
Refreshments provided by CF Industries

8:15 Our Charlotte Harbor Watershed - Creating the Charlotte Harbor National Estuary Program: Wayne Daltry, Southwest Florida Regional Planning Council

8:30 Issues Addressing our Southwest Florida Environment and the Role of the National Estuary Program: Richard W. Cantrell, Florida Department of Environmental Protection - South Florida District

Facilitator: Keith Kibbey, Lee County Environmental Laboratory

9:00 Characterizing Water Quality in the Charlotte Harbor Florida Estuaries Using a Trained Volunteer Corps: Judy Ott, FDEP Charlotte Harbor Aquatic Preserves (pg 13)

9:20 Status and Trends in Water Quality and Stream Discharge in the Peace and Myakka River Basins, 1970-2000: Gerold Morrison (pg 14)

9:40 A Paleo-Reconstruction of Water Quality in the Charlotte Harbor Estuary: R. Eugene Turner, Louisiana State University (pg 15)

10:00 Development of a Pollutant Load Reduction Goal for Charlotte Harbor: David Tomasko, Southwest Florida Water Management District SWIM Program (pg 16)

10:20 Break

Facilitator: John Ryan, Sarasota County

10:50 Use of the 1993-2000 Water Quality Monitoring Program to Evaluate Nutrient Limitations, Optical Properties, and Hypoxia for Charlotte Harbor: Christopher J. Anastasiou, Southwest Florida Water Management District SWIM Program (pg 17)

11:10 Microbiological Indicators for Water Quality and Human Health Assessments in the Charlotte Harbor Watershed: Joe King, Polk County Natural Resources (pg 18)

11:30 Seasonal Variability and Weather Effects on Microbial Fecal Pollution and Enteric Pathogens in the Charlotte Harbor Estuary: Raymond C. Kurz, PBS&J (pg 18)

11:50 An Evaluation of Groundwater Contributions to the Nutrient and Water Budgets of Artificial Stormwater Ponds in Lee County, Florida: John R. Cassani, Lee County Hyacinth Control District (pg 20)

12:10 **Lunch provided by Florida Environmental**

Thursday, February 7, 2002 *continued*

Facilitator: David Tomasko, Southwest Florida Water Management District SWIM Program

2:00 Combined Hydrodynamic and Water Quality Modeling for Charlotte Harbor: Jon Hubertz, J.E. Edinger and Associates, Inc. (pg 21)

2:20 A Three-Dimensional Model of Circulation, Salinity, and Water Quality of the Charlotte Harbor Estuarine System: Y. Peter Sheng, University of Florida (pg 22)

2:40 Investigations Into the Effects of Season and Water Quality on Oysters (*Crassostrea virginica*) and Associated Fish Assemblages in the Caloosahatchee River Estuary, Florida: Implications Of Altered Freshwater Inflow: Aswani K. Volety, Florida Gulf Coast University (pg 23)

3:00 Monitoring the Impact of Watershed Management On Southwest Florida's Estuaries: A Model Employing Oyster Physiology and Ecology: Michael Savarese, Florida Gulf Coast University (pg 24)

3:20 **Break provided by U.S. Agri-Chemicals Corp.**

Facilitator: Catherine Corbett, Charlotte Harbor National Estuary Program

3:40 Water Use and Hydrology Related to Phosphate Mining – The Rest of the Story: Greg Williams, IMC Phosphates Company (pg 26)

4:00 The Impact of Phosphate Mining on Water Resources in the Peace River Basin: John Garlanger, Ardaman and Associates, Inc. (pg 26)

4:20 Has the Flow of the Peace River been Reduced by Mining? Steve Partney, FDEP Bureau of Mine Reclamation (pg 27)

4:40 The Role of Instream Riverine Habitats in Establishing Minimum Flows for the Upper Peace River: Jonathan B.T. Morales, Southwest Florida Water Management District (pg 27)

5:00 The Morphometery of the Lower Peace River in Relation to Long-Term Responses of Riparian Vegetation Patterns to Natural Variations in Freshwater Inflows: Ralph Montgomery, Peace River/Manasota Regional Water Supply Authority (pg 29)

5:20 The Relationship of Freshwater Flows and Salinity in the Lower Peace River: Tony Janicki, Peace River/Manasota Regional Water Supply Authority (pg 30)

6:00 Evening Social at Bayfront Center provided by the City of Punta Gorda

Friday, February 8, 2002

7:30 a.m. Registration
Refreshments provided by IMC Phosphates Company

8:00 Welcome: Robert Rudolph, Charlotte Harbor NEP

Facilitator: Rebecca Hensley, FWC Florida Marine Research Institute

8:10 Establishing Freshwater Inflow Needs for Galveston Bay: Cindy Loeffler, Water Resources with Texas Parks & Wildlife (pg 31)
8:40 Central Estero Bay Hourly Dissolved-Oxygen Recordings: Thomas Winter, Ostego Bay Foundation *and* Estero Bay Marine Laboratory (pg 31)
9:00 Estero Bay Seagrass Substrate Analysis: Joseph Mallon, Florida Gulf Coast University (pg 33)
9:20 Central Estero Bay Sediment Depositional Rates: H.J. Mitchell-Tapping, Ostego Bay Foundation *and* Estero Bay Marine Laboratory (pg 34)
9:40 Reconnaissance of Chemical and Physical Characteristics of Selected Bottom Sediments of the Caloosahatchee River and Estuary, Tributaries, and Contiguous Bays, Lee County, Florida, July 20-30, 1998: Mario Fernandez, Jr., U.S. Geological Survey (pg 36)
10:00 Responses of Demographic, Morphological and Chemical Characteristics of Turtle Grass, *Thalassia testudinum*, to *El Nino* Runoff: An Unexpected Test of Indicators: Paul Carlson, FWC Florida Marine Resources Institute (pg 37)

10:20 **Break**

Facilitator: Peter Doering, South Florida Water Management District

10:40 Seasonal Changes in Seagrass Density and Associated Invertebrate Communities at Fixed Locations in San Carlos Bay: James Locascio, Sanibel-Captiva Conservation Foundation (pg 38)
11:00 Distribution and Abundance of Live and Dead Macro-Mollusks in the Tidal Peace River, Florida: Ernest D. Estevez, Mote Marine Laboratory (pg 39)
11:20 Species Composition and Spatio-Temporal Patterns of Seagrass Habitat Use by Fishes in the Charlotte Harbor Estuarine System, Florida: Gregg R. Poulakis, FWC Florida Marine Resources Institute (pg 40)
11:40 Relative Abundance and Trends of Selected Marine Fauna in the Charlotte Harbor Estuary: Rebecca Hensley, FWC Florida Marine Resources Institute (pg 41)
12:00 Fresh Water Fishes of Southwest Florida Rivers: Thomas H. Fraser, W. Dexter Bender & Associates (pg 41)

12:20 **Lunch**

Friday, February 8, 2002 *continued*

Facilitator: Rob Brown, Manatee County

2:00 Aquatic Nuisance Species of the Greater Charlotte Harbor Watershed: John R. Cassani, Lee County Hyacinth Control District (pg 43)

2:20 An Exploration of Methods for Characterizing Recreational Boating in Charlotte Harbor: Richard Flamm, Florida Fish and Wildlife Conservation Commission (pg 43)

2:40 A Two-Dimensional Model Application for Manatee Protection: Ivan B. Chou, ECT, Inc. (pg 44)

3:00 Establishing Baseline Seagrass Health Using Fixed Transects in Charlotte Harbor, Florida: Elizabeth Staugler, FDEP Charlotte Harbor Aquatic Preserves (pg 45)

3:20 **Break provided by Florida Phosphate Council**

Facilitator: Jim Sampson, CF Industries

3:40 The Hydric Pine Flatwoods of Southwest Florida: James Beever, Florida Fish and Wildlife Conservation Commission (pg 46)

4:00 Restoration Partners Project on Sanibel-Captiva Conservation Foundation Land: Frannie's Preserve Restoration Project: Dave Ceilley, Sanibel-Captiva Conservation Foundation (pg 47)

4:20 Deer Prairie Slough Restoration Project: Ditch Backfilling to Restore Historic Wetland Hydrology: Ron L. Van Fleet, Sarasota County (pg 48)

4:40 Florida Power Corporation Hines Energy Complex: A Model for Industrial Development in the Peace River Watershed: B. Randall Melton, Florida Power Corporation (pg 48)

5:00 Diverse Herbaceous Wetland Restoration in Hookers Prairie: Rosemarie Garcia, Cargill Fertilizer (pg 49)

5:30 **Sunset Cruise** on Charlotte Harbor: Meet at King Fisher Fleet at Fishermen's Village. Boat will depart promptly. The number of passengers will be limited to 90.

Agenda for the Public Conference

Saturday, February 9, 2002

8:30 a.m. Registration
Refreshments provided by Farmland Hydro LP

Come early to spend time with:

- Charlotte Harbor Watershed Summit Sponsors
- Environmental Agencies, Associations and Businesses
- Charlotte Harbor National Estuary Program
  - Goals and management plan
  - Grant programs
  - Public Information and Education Posters, Publications and More!

Artists Diane Pierce and Shelly Castle will be on hand to sign their Charlotte Harbor NEP posters. A new poster, a photograph of a hydric hammock – graciously donated to the Charlotte Harbor NEP by Clyde Butcher – will also be available.

9:15 **Welcome and Introduction:** Richard W. Cantrell, FDEP South Florida District

9:30 **Charlotte Harbor National Estuary Program Video**
Learn about the Charlotte Harbor ecosystem from the citizens, scientists, policy makers and others who value the estuaries.

10:00 **Estuaries: Where the Rivers meet the Sea**
Bill Hammond, Natural Context *and* Florida Gulf Coast University (pg 51)

10:45 **All Things Wild in the Charlotte Harbor Ecosystem:**
Vice Mayor Terry Cain, Fort Myers Beach

•Fishes: Rebecca Hensley and Gregg R. Poulakis, FWC Florida Marine Resources Institute (pg 52)

Dolphins, Manatees, Turtles and Sharks: Ernest Estevez, Mote Marine Laboratory

Terrestrial Wildlife: James Beever, Florida Fish and Wildlife Conservation Commission (pg 53)

Birds: Randy McCormick, Peace River Audubon (pg 54)

Droughts, Floods and Freezes: Impact to Wildlife in the Rivers: Jerry Carter, Florida Fish and Wildlife Conservation Commission

12:00 **Lunch provided by WCI**

Saturday, February 9, 2002 *continued*

1:45 **Water Resources, Uses and Concerns**
Commissioner Pat Glass, Manatee County

Balancing Water Use and the Environment: A Challenge for Southwest Florida: Carol Ann Senne, South Florida Water Management District Fort Myers Service Center

Myakka River and Peace River Watersheds: Water Resource Management Issues and Solutions: Steven A. Minnis, Southwest Florida Water Management District (pg 54)

Drinking Water Supplies: Sam Stone, Peace River-Manasota Regional Water Supply Authority (pg 56)

Restoration and Management for Lake Hancock/Upper Peace River System: Jeff Spence, Polk County Natural Resources (pg 57)

3:00 **Break provided by Cargill Fertilizer**

3:20 **Land Use in the Charlotte Harbor Watershed**
Commissioner Ronald Neads, DeSoto County

Habitation: Wayne Daltry, Southwest Florida Regional Planning Council (pg 58)

Agriculture: Craig Evans, Florida Stewardship Foundation (pg 59)

Phosphate Mining – Land Use Effects in the Peace River Basin: Lee Thurner, The Florida Phosphate Council (pg 60)

Natural Land Preservation in the Charlotte Harbor Watershed: Robert Repenning FDEP Charlotte Harbor Buffer Preserves (pg 61)

4:30 **A Citizens Guide to Watershed Management Efforts in the Peace and Myakka Basins** (pg 61)

- 4:30 Introduction and Overview: Al Cheatham, Charlotte Harbor Environmental Center
- 4:35 2001 Peace-Myakka Workshops - Format and Approach: Tiffany Lutterman Busby
- 4:40 2001 Peace-Myakka Workshops - Priority Watershed Management Issues: Gerold Morrison
- 4:50 Introduction to Panel Discussion: Al Cheatham
- 4:55 SWFWMD Watershed Management Programs: Dave Tomasko
- 5:05 FDEP Watershed Management Programs: Pat Fricano
- 5:15 US EPA Watershed Management Programs: Bob Howard
- 5:25 Panel Discussion and Q&A

Thank you for spending time with us to learn more about the value of and concerns in the Charlotte Harbor ecosystem. *Enjoy the sunset cruise with King Fisher Fleet, provided by WCI.*

Technical and Educational Posters and Exhibits

Coastal Charlotte Harbor Monitoring Network: Catherine Corbett, Charlotte Harbor National Estuary Program

Estero Bay Tidal Circulation Patterns: Dr. H.J. Mitchell-Tapping, Ostego Bay Foundation

Identification and Prioritization of Natural Resource Lands for Acquisition and Conservation: Debra Childs, URS Corporation

Abundance and Distribution of Juvenile Snapper (*Lutjanidae*) and Grouper (*Serranidae*) Species in Charlotte Harbor, Florida: Aaron Lando, FWC Florida Marine Resources Institute

Fish Health Monitoring in the Charlotte Harbor Estuary: Sandra Lavoie, FWC Florida Marine Resources Institute

Using Biomass Estimates to Identify Geographic Areas of Importance for Fish and Crustaceans in Charlotte Harbor, Florida: Laurel Brant, FWC Florida Marine Resources Institute

Fish Communities of the Tidal Portion of the Myakka and Peace Rivers: Chuck Idelberger, FWC Florida Marine Resources Institute Lake Lowery Flooding Solution - Interbasin Conflict: Robert Moresi, Moffatt & Nichol Engineers

Summary of Fish Tagging by the Fisheries-Independent Monitoring Program 1994-1999: William L. Curnow, FWC Florida Marine Resources Institute

Sustainability of Water Resources can be Achieved in Florida: Kurt O. Thomsen, Tetra Tech Inc.

Land Application of Biosolids in the Myakka River Basin: Boon or Bust? Michael J. Mylett, Sarasota County Pollution Control

Salinity and Turbidity Patterns within Estero Bay Aquatic Preserve, Lee County, Florida: Michael J. Byrne, U.S. Geological Survey

Seasonal Fluctuations in Water Quality in San Carlos Bay, Lee County Florida: Jim Locasciou, Sanibel-Captiva Conservation Foundation

Investigations of *Perkinsus Marinus* Prevalence, Health and Distribution of Oyster Reefs in Estero Bay, Florida: Craig Thompson, Florida Gulf Coast University

Fire on the Charlotte Harbor State Buffer Preserve: Carla Kappmeyer-Sherwin, FDEP Charlotte Harbor Aquatic and State Buffer Preserves

Educating Through Cartoons: Claudia Burns

The Role of Citizen Environmental Organizations in the Development of Watershed Plans, Chuck Padera

Installation And Education Of "Dump No Waste" Stormwater Inlet Markers In Polk County: William Harboe, Polk County Natural Resources

Backyard Wildlife Habitat for a Healthy Harbor: Sue Sturges, National Wildlife Federation

Charlotte County Natural Resources: Bill Byle

Hardee County Outdoor Classroom: Kayton Nedza

Characterizing Water Quality in the Charlotte Harbor Florida Estuaries Using a Trained Volunteer Corps

Judy Ott and Elizabeth Staugler, FDEP Charlotte Harbor Aquatic Preserves

The Charlotte Harbor Estuaries include six Florida Aquatic Preserves and more than 175,000 acres of exceptional submerged resources. Resources, watersheds & management issues vary throughout the diverse interconnected estuaries. Aquatic Preserve management focuses on resource management, research & education. Water quality information is essential for estuarine health characterization. Historically, comprehensive water quality monitoring throughout the system has been limited. In 1996 the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network began as a cooperative project with the Florida Department of Environmental Protection, Charlotte Harbor Environmental Center and Charlotte Harbor National Estuary Program. A corps of more than 70 trained volunteers monitor 19 parameters at 44 fixed stations synoptically once a month at sunrise on the first Monday. *In-situ* measurements are made of tide, water clarity, salinity, dissolved oxygen, pH and temperature. Lab analyses are conducted for TP, TN, Chlorophyll *a*, color and turbidity. The Florida Trophic State Index (TSI) is used to characterize estuary health based on the three-year data. Summaries and comparisons of the results for each estuary are presented. During 1998-2000, conditions in the Charlotte Harbor estuaries ranged from good to fair. These results represent the 1st system wide characterization of water quality. Data from the ongoing monitoring program will be used to complement other monitoring programs & direct resource management activities.

Sponsors: Charlotte Harbor Aquatic Preserves/FDEP, Charlotte Harbor Environmental Center, Charlotte Harbor National Estuary Program, Estero Bay Aquatic and Buffer Preserves/FDEP

Key words: water quality monitoring, Charlotte Harbor estuaries, Charlotte Harbor Aquatic Preserves, estuarine health, system wide water quality characterization, Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network

Judy Ott
Aquatic Preserve Manager
Charlotte Harbor Aquatic Preserves/FDEP
12301 Burnt Store Rd.
Punta Gorda FL 33955
941/575-5861
941/575-5863
judith.ott@dep.state.fl.us

Elizabeth Staugler
Environmental Specialist
Charlotte Harbor Aquatic Preserves/FDEP
12301 Burnt Store Rd
Punta Gorda FL 33955
941/575-5861
94l/575-5863
elizabeth.staugler@dep.state.fl.us

Status and Trends in Water Quality and Stream Discharge in the Peace and Myakka River Basins, 1970-2000

Gerold Morrison, Consultant, and Roberta Starks, Southwest Florida Water Management District

Using funds provided by several partnering organizations, a monthly water quality monitoring program was conducted at a number of long-term USGS gaging stations in the Peace and Myakka River basins from October 1997 through September 2000 to characterize current water quality conditions. As an aid in interpreting these recent data, long-term trends in water quality and streamflow occurring at the gaging stations between 1970 and 1998 were also assessed. This presentation gives a summary of status and trends in water quality and streamflow observed during the two time periods.

Statistically significant declining trends in dry-season discharge were observed at two stations on the main stem of the Peace River (at Bartow and Zolfo Springs) during the 1970-1998 period. Significant increasing trends in dry season flows occurred on three Peace River tributaries (Charlie Creek, Joshua Creek, and Horse Creek) and at the Myakka River-Sarasota gage. Increasing trends in annual mean discharge occurred at four stations (Saddle Creek at Structure P-11, Peace River-Ft. Meade, Joshua Creek-Nocatee, and Horse Creek-Myakka Head).

Specific conductance – a potential indicator of the magnitude of groundwater discharges to surface waters — exhibited significant increasing trends at four stations (Charlie Creek-Gardner, Joshua Creek-Nocatee, Horse Creek-Myakka Head, and Myakka River-Sarasota) during the 1970-1998 period. Declining trends in specific conductance occurred at three stations, all located in the northern portion of the Peace River basin.

Concentrations of NO_{2+3} –N increased significantly at the Horse Creek-Arcadia and Charlie Creek-Gardner gage sites during the 1970-1998 period. Significant declines in NO_{2+3} -N concentrations occurred at the Bartow, Ft. Meade, and Zolfo Springs gages on the main stem of the Peace River. Concentrations of ammonia nitrogen also declined significantly at several stations (Bartow, Ft. Meade, Zolfo Springs and Arcadia) on the main stem.

Phosphorus (PO_4 and TP) concentrations declined significantly at several sites in the Peace River basin (Horse Creek-Arcadia, and Peace River at Bartow, Ft. Meade, Zolfo Springs, and Arcadia), but increased significantly at a Peace River tributary site (Charlie Creek-Gardner) and at a long-term monitoring station located on the Myakka River (Myakka River-Sarasota).

The FDEP stream water quality index (WQI) was used to characterize existing water quality conditions at the stations monitored during the 1997-2000 study period. Average WQI values were calculated using five parameters (turbidity, total suspended solids, total organic carbon, nitrate+nitrite nitrogen, and total nitrogen). The Saddle Creek at Structure P-11 station, in the upper Peace River basin, exhibited the poorest water quality among the sites sampled, falling in the 75th to 95th percentiles of Florida streams for most parameters. Overall, six sites (all located in the Peace River basin) produced WQI values >60, indicative of “poor” water quality conditions. Four sites (Horse Creek near Myakka Head, Shell Creek near Punta Gorda, Myakka River at Myakka City, and Myakka

River near Sarasota) exhibited average WQI values that would be characterized as "good" (average WQI < 45) based on the FDEP classification system. The remaining sites were characterized as "fair" based on the WQI.

Sponsors: Charlotte Harbor Environmental Center, Inc.; Charlotte Harbor National Estuary Program; Peace River/Manasota Regional Water Supply Authority; Southwest Florida Water Management District

Key words and phrases: water quality, stream discharge, current status, long-term trends, Peace River, Myakka River

Gerold Morrison
Environmental Consultant
828 Glades Court NE
St Petersburg FL 33702-2780
727/526-7884
727/526-7884
gerold.morrison@att.net

Roberta Starks
Environmental Scientist
Southwest Florida Water Management District
7601 Highway 301 North
Tampa FL 33637
813-985-7481
813-987-6747
roberta.starks@swfwmd.state.fl.us

A Paleo-Reconstruction of Water Quality in the Charlotte Harbor Estuary

R. Eugene Turner, Louisiana State University

A suite of proxies for water quality were examined to use as indicators of change in the shallow subtropical estuary Charlotte Harbor, Florida. Sediment cores were collected in the region of mid-summer hypoxic zone and also upstream from a *Juncus sp.* marsh. Dating with 2l0Pb was sufficient to establish chronologies back to before major watershed changes (circa 1900). Trace metal analyses helped define transitions unrelated to water quality changes before 1900 in the marsh core and support the use cores from open water as suitable source material for other analyses. Sedimentary biogenic silica (BSi), carbon, nitrogen and phosphorus concentrations all increased concurrently with known or inferred changes in nutrient loadings. The behavior of trace metals and the distribution down-core of 12/l3C, l5N and 34S isotope signatures suggests an estuarine system that is responsive to the increased carbon loading from the nitrogen-limited phytoplankton community. These indicators include a direct relationship between phytoplankton pigments and BSi, variations in the quality of these pigments, heavier 343 with increased carbon loading, and sequestration of P, Al and Fe as carbon loading (hence more reduced conditions) increased.

An analysis of water quality data demonstrates that the declining freshwater discharges into the estuary observed from 1931 to the 1980s would lessen the likelihood of water column stratification. Stratification is directly related to

lower oxygen concentrations in bottom waters, and so the reduced freshwater discharge is not the probable causal agent encouraging the appearance or expansion of a hypoxia zone that covers up to 85 km^2 in summer. The oxygen consumption of water column and sediments are nearly equal (as of the 1990s) and sufficient to maintain these hypoxic conditions. Present nutrient loading is about three times above that before the l800s, suggesting that the present hypoxic conditions are not natural, but are the result of cultural eutrophication. Unless controlled, the anticipated doubling of the watershed's population from 1990 to 2020 will greatly increase the nutrient loading to this estuary, exacerbate hypoxic conditions and lead to much higher amounts of phytoplankton biomass and accumulation. Possible consequences of such postulated changes include those found elsewhere: harmful algal blooms, re-structured food webs (including that of a valuable recreational fisheries), and loss of seagrass habitats.

Sponsors: Southwest Florida Water Management District

Key words: water quality, Charlotte Harbor estuary, hypoxia, eutrophication, paleoindicators

Professor R. Eugene Turner
Coastal Ecology Institute
Stadium Road
Louisiana State University
Baton Rouge LA 70803
225/578-6454
Fax 225/578-6326
euturne@lsu.edu

Nancy N. Rabalais
Professor LUMCON
8124 Highway 56
Chauvin LA 70844
504/851-2836
Fax 504/851-2674
nrabalais@lumconedu

Development of a Pollutant Load Reduction Goal for Charlotte Harbor

David Tomasko, Southwest Florida Water Management District

Charlotte Harbor is generally considered to be a healthy estuarine ecosystem mostly in need of preservation, rather than restoration. Seagrass coverage appears to have remained relatively constant over the past 20 years, and water clarity varies mostly as a function of tannin levels, rather than phytoplankton concentrations. However, hypoxic conditions can exist in bottom waters of the Harbor, and the affected area can exceed 150 km^2 in size. Also, nutrient loads are expected to increase as the watershed continues to develop. A technique for prioritizing tributaries of the Peace River, in terms of retrofitting for nutrient load reductions, is presented.

Sponsors: Southwest Florida Water Management District, Peace River Basin Board, Manasota Basin Board, SWIM Program

Key words: Lake Hancock, Pollution Load Reduction Goal, hypoxia

David Tomasko
Senior Environmental Scientist
Southwest Florida Water Management District
7601 Highway 301 N
Tampa FL 33637
813/985-7481
Fax 813/987-6747
dave.tomasko@swfwmdstate.fl.us

Use of the 1993-2000 Water Quality Monitoring Program to Evaluate Nutrient Limitations, Optical Properties, and Hypoxia for Charlotte Harbor

Christopher J. Anastasiou, Southwest Florida Water Management District SWIM Program

Since 1993, the Southwest Florida Water Management District has been responsible for collecting and analyzing monthly water quality samples collected at fifteen stations throughout Charlotte Harbor and portions of the lower Peace and Myakka Rivers. Although there is a great deal of information available about status and trends in water quality for the harbor, to date, not much has been done to try and understand the underlying processes that drive these trends. The purpose of this study is to better understand the underlying biological and chemical processes that drive water quality conditions in Charlotte Harbor. To do this we will use non-traditional methods of water quality assessment. Optical models will be developed to define relationships among secchi disk depth, color, turbidity, chlorophyll *a*, and other potentially significant variables. We will also develop dilution curves for total nitrogen and dissolved inorganic nitrogen as they relate to salinity. Finally, we will compare stratification with respect to salinity and its relationship to bottom dissolved oxygen concentrations.

Sponsors: Surface Water Improvement and Management (SWIM) Program, SWFWMD

Key words: water quality, Charlotte Harbor, optical modeling, dilution curves, stratification, hypoxia

Christopher J. Anastasiou
Environmental Scientist
Southwest Florida Water Management District
7601 U.S. Hwy 301 North
Tampa FL 33637
813/985-7481, 813/987-6747
chris.anastasiou@swfwmd.state.fl.us

David A. Tomasko
Senior Environmental Scientist
Southwest Florida Water Management District
7601 U.S. Hwy 301 North
Tampa FL 33637
813/985-7181, 813/987-6747
dave.tomasko@swfwmdstate.fl.us

Microbiological Indicators for Water Quality and Human Health Assessments in the Charlotte Harbor Watershed

C. Joseph King, Polk County Natural Resources

It has been estimated that more than 2.5 billion people worldwide have inadequate drinking water and sewage systems. Approximately, 15,000 children die every day from water-borne pathogens according to the World Health Organization, 2001.

Indicator organisms are used for water quality assessments and, for determining concentrations of specific organisms that should not be exceeded to protect human health from pathogens causing illnesses. Most microbiological indicators are usually organisms that do not cause illness directly, but have demonstrated the ability to "track" and predict human pathogens, or the water quality criteria of concern. Indicators have been used for more than 100 years as regulatory tools and for qualitative evaluations of human health risks. Many indicator organisms currently utilized are not effective at tracking human pathogens and examples will be presented. Dozens of scientific studies have been published in the last 20 years suggesting that total and fecal coliform bacteria do not track human health pathogens of concern. The human pathogens that tend to survive best in the environment are the enteric viruses. Indicators need to be able to track accurately and predict these viruses over time and space. A survey of the best and poorest indicators will be presented and what this means to human health and water quality assessments. A survey of current literature and field studies to identify pathogenic indicators will be described. Additionally, bacteria-like organisms that are typically present in both fresh and marine waters can produce a variety of toxins that impact human (and animal) health. Several of these will be discussed and examples of exotic Florida species presented along with their potential impacts to environmental and human health.

Key terms: indicators, pathogens, tracking and predictions, enteric viruses, fecal, coliforms, toxins

C. Joe King
Lakes and Streams Manager
Polk County Natural Resources
4177 Ben Durrance Rd.
Bartow FL 33801
Joeking@polk-county.net

Seasonal Variability and Weather Effects on Microbial Fecal Pollution and Enteric Pathogens in the Charlotte Harbor Estuary

Raymond C. Kurz, PBS&J; Erin Lipp, University of Georgia; Joan Rose, University of South Florida; Robert Vincent, Charlotte County Department of Health

The objectives of this study were to assess the distribution and seasonal changes in microbial indicators and human pathogens in Charlotte Harbor shellfish and recreational waters and to determine those factors that may be important in the transport and survival of pathogens. Monthly water samples and quarterly sediment samples were collected over a one-year period at twelve stations distributed between the lower reaches of the Myakka and Peace Rivers.

Samples were analyzed for fecal coliform bacteria, *enterococci*, *Clostridium perfringens* and *coliphage*. Quarterly samples were also analyzed for the enteric human pathogens, *Cryptosporidium spp*., *Giardia spp*. and enteroviruses. Fecal indicator organisms were generally found in higher concentrations in areas of low salinity and high densities of septic systems. However, fecal-borne pollution became widespread during El Nino-fueled wet weather in the late fall and winter of 1997-1998. Between December 1997 and February 1998, enteroviruses were detected at 75% of the sampling stations; none were detected in other months. Enteric protozoa were detected infrequently and were not related to seasonal influences. Fecal indicators and enteroviruses were each significantly associated with rainfall, streamflow and temperature. Regression models suggest that temperature and rainfall could predict the occurrence of enteroviruses in 93.7% of our samples. Factors such as variability in precipitation, streamflow and temperature show promise in modeling and forecasting periods of poor coastal water quality.

Sponsors: Southwest Florida Water Management District, Charlotte County Department of Health, FDEP

Keywords: pathogens, estuary, El Nino, microbial indicators

Raymond Kurz, Ph.D.
PBS&J
330 S. Pineapple Ave., Suite 113
Sarasota FL 34236
941/954-4036, Fax 941/951-1477
rckurz@pbsj.com

Erin Lipp, Ph.D.
Dept. of Environmental Health Science
University of Georgia
206 Environmental Health Science Bldg.
Athens GA 30602
706/542-2454
erinlipp@yahoo.com
lipp@umbi.umd.edu

Joan Rose, Ph.D.
Department of Marine Science
University of South Florida
140 7th Ave. S., MSL 119
St. Petersburg FL 33701
727/553-3930
jrose@seas.marine.usf.edu

Robert Vincent
Charlotte County Department of Health
18500 Murdock Circle
Port Charlotte FL 33948
941/743-1266
Bob_Vincent@doh.state.fl.us

Ceasar Rodriguez-Palacios
Sarasota County
1301 Cattleman Rd., Rm. 218
Sarasota FL 34232
941/378-6142
crodrigu@co.sarasota.fl.us

Samuel Farrah, Ph.D.
Department of Microbiology and Cell Science
University of Florida
Box 110700, Bldg. 981
Gainesville FL 32611
352/392-5925
sfarrah@micro.ifas.ufl.edu

An Evaluation of Groundwater Contributions to the Nutrient and Water Budgets of Artificial Stormwater Ponds in Lee County, Florida

John R. Cassani and Ernesto Lasso de la Vega, Lee County Hyacinth Control District

The effectiveness of stormwater pollutant removal by wet detention basins is an issue of concern within the context of cumulative impacts and declining water quality in several coastal subwatersheds of Estero Bay, the lower Caloosahatchee River and other areas of the greater Charlotte Harbor watershed. Groundwater is often overlooked when evaluating the nutrient removal efficiency of wet detention basins and is frequently thought of as a diluting factor. However, results form recent studies have indicated that groundwater can magnify some pollutants, particularly nitrogen. We are currently evaluating groundwater flow volume and quality at two wet detention sites in Lee County, Florida to more thoroughly understand the contributions of groundwater to the water and nutrient budgets of stormwater wet detention systems typical of urban coastal areas in Southwest Florida. Groundwater is collected from scaled cylinders placed underwater in the sediment to a depth of 15 to 30 cm. Groundwater is collected periodically from removable plastic bags attached to the cylinder. One cylinder was placed at shallow, mid-depth and maximum depth locations in each of two wet detention basins. Preliminary results indicate that groundwater flow is positive, even during the driest months of an extended drought. Despite minimal seepage from groundwater during drought conditions, groundwater nutrient concentration was significantly higher than ambient water column concentration for total nitrogen and total phosphorus. Groundwater total nitrogen concentration was 2 to 91 times higher than the respective ambient surface water concentration. Groundwater total phosphorus concentration was 2 to 14 times higher than the respective surface water concentration. At one site near the Caloosahatchee River, groundwater exhibited elevated specific conductance at least twice as high as the ambient pond conditions, apparently reflecting the elevated salinity of the river.

Key words: groundwater, nutrients, stormwater

J.R. Cassani
Ernesto Lasso de la Vega
Lee County Hyacinth Control District
POB 60005
Fort Myers FL 33906
941/694-5844
jcassani@peganet.com

Combined Hydrodynamic and Water Quality Modeling for Charlotte Harbor

John Edinger and Jon Hubertz, J. E. Edinger Associates, Inc.

A dissolved and particulate water quality constituent model is linked dynamically with a three dimensional, finite difference, curvilinear grid hydrodynamic and transport model for Charlotte Harbor.

The Water Quality Dissolved Particulate Model (WQDPM) extends the U.S. Environmental Protection Agency's (EPA) Eutro5 model to include particulate forms of 11 state variables as well as the dissolved forms and zooplankton grazing that passes excreted constituents as particulates. Inclusion of both the particulate and dissolved constituents as state variables eliminates one of the basic limiting assumptions in Eutro5, i.e., that the ratio of the dissolved to the particulate form of a constituent is a constant. Elimination of this assumption allows the particulate and dissolved constituent concentrations to change independently as the biochemical processes are simulated through time.

Mean Gulf of Mexico tides and July through October inflows from the Peace and Myakka rivers are input to the modeling system along with Gulf salinity. These inputs allow examining the circulation, salinity distribution and flushing times for upper Charlotte Harbor where hypoxia is observed.

Mean Gulf of Mexico tides and annual river inflows along with EPA water quality data are used as input to the modeling system which predicts their interactions and distribution throughout the estuary. The water quality input concentrations to the model are sufficient to produce the low bottom water dissolved oxygen (DO) conditions that are known to exist in Charlotte Harbor. The circulation and transport, as described by the hydrodynamic transport model, is sufficient to place this DO minimum in the correct location and also indicates a residence time in agreement with observations.

The model is run using extreme river inflow nutrient and dissolved oxygen concentrations from the EPA database to determine the sensitivity of the estuarine water quality to river inflow water quality. Results at one EPA station show that the surface dissolved oxygen decreases by about 1 mg/l, and all of the nutrient concentrations increase. The percentage change in estuarine concentrations is about 1/4 the percentage change in the river inflow concentrations for both the dissolved oxygen and the major nutrient components.

A simulation without the planktonic processes is performed to demonstrate their role in maintaining the nutrient and dissolved oxygen concentrations. These simulations are performed for the mean inflow constituent concentrations. The resulting constituent concentrations at the EPA station are compared to those with the processes operating. It is found that the NH_3 and PO_4 concentrations get very high due to their releases from the sediment and lack of assimilation by phytoplankton. The dissolved oxygen gets very low due to lack of production by phytoplankton. The results of this simulation show that the planktonic processes play a key role in maintaining the observed DO levels of upper Charlotte Harbor, and the resulting particulate organics play a key role in maintaining the nitrogen and phosphorous levels.

Key words: water quality, hydrodynamics, numerical model, flushing time, dissolved oxygen

Jon M. Hubertz Ph.D.
J. E. Edinger Associates, Inc.
Florida Regional Office
2733 Deborah Drive
Punta Gorda FL 33950-8182
Voice & Fax: 941/505-4079
hubertz@isni.net
www.JEEAI.com

John Edinger
J.E. Edinger Associates, Inc.
Suite 609, 983 Old Eagle School Road
Wayne PA 19087-1711
610/293-0757

A Three-Dimensional Model of Circulation, Salinity, and Water Quality of the Charlotte Harbor Estuarine System

Y. Peter Sheng and Kijin Park, University of Florida

A three-dimensional model of circulation, salinity, and water quality in the Charlotte Harbor Estuarine System has been developed. The model is based on the three-dimensional curvilinear-grid hydrodynamic model CH3D originally developed by Sheng (1987, 1989) and the CH3D-based integrated modeling system, CH3D-IMS, developed by Sheng et al. (1996a, 1996b, and 2001) for numerous estuaries in Florida (e.g., Sarasota Bay, Tampa Bay, Indian River Lagoon, and Florida Bay) and outside Florida (e.g., Chesapeake Bay and James River). The Charlotte Harbor model includes a circulation model that simulates the three-dimensional flow field and salinity distribution in the estuarine system, plus a 3-D sediment transport model and a 3-D water quality model. The curvilinear grid model allows the use of a high resolution boundary fitted grid to accurately represent the complex shorelines and islands in Charlotte Harbor. A robust turbulence closure model is used to allow accurate simulation of turbulent mixing throughout the water column. The water quality model includes a nitrogen model, a phosphorus model, a dissolved oxygen model, a phytoplankton model and a zooplankton model. In addition, a wave model is included in the sediment transport model to allow simulation of sediment resuspension due to current and wave actions. The Charlotte Harbor model resolves the entire water column plus the sediment column with an aerobic layer on top of an anaerobic layer. Nutrient exchange due to diffusion and resuspension through the sediment-water interface is included in the model.

The model domain includes the entire estuarine system: Charlotte Harbor, Pine Island Sound, San Carlos Bay, Caloosahatchee, Peace and Myakka Rivers, Estero Bay, a large offshore region, and all the major tributaries. The model grid is very fine to represent the numerous islands, including the islands of the Sanibel Causeway and the Estero Bay. The 3-D circulation and salinity model has been validated using the detailed data of water level, currents, and salinity measured throughout the estuary in 1986 by USGS. After satisfactory model validation, the model was used to investigate the effect of causeway islands on the flow and salinity distribution in San Carlos Bay and Pine Island Sound. The model results indicate that the islands had little effect on the salinity distribution in the area, although the residual flow in the immediate vicinity of the islands were affected. The model has also been used to investigate the impact of various management options (e.g., increased/reduced discharge in Caloosahatchee and reduced freshwater inflow from Peace River).

The 3-D water quality model has been validated with the 1996 water quality data and is currently being used to examine the 2000 data. In addition, the model was used to quantify the flushing time of various segments of the estuarine system. The Charlotte Harbor model can be used to determine pollutant load reduction goal (PLRG), total maximum daily load (TMDL), and minimum flow and levels (MFL) for the entire estuarine system.

The presentation will include the model validation, various model applications, and results of a 3-D particle trajectory model.
Acknowledgment: This study has been supported by the South Florida Water Management District with Tomma Barnes as the project manager.

Y. Peter Sheng
Coastal & Oceanographic Engineering
University of Florida
352/392-6177
353/392-1280 fax
pete@coastal.ufl.edu

Kijin Park
Coastal & Oceanographic Engineering
University of Florida

Investigations Into the Effects of Season and Water Quality on Oysters (*Crassostrea virginica*) and Associated Fish Assemblages in the Caloosahatchee River Estuary, Florida: Implications of Altered Freshwater Inflow

Aswani K. Volety and S. Gregory Tolley, Florida Gulf Coast University, and James T. Winstead, U.S. Environmental Protection Agency

A suite of biological and ecological responses of a Valued Ecosystem Component species, *Crassostrea virginica*, was used to investigate ecosystem-wide health effects of watershed alterations in the Caloosahatchee River estuary, Florida. The influence of water quality and season on disease prevalence and intensity, gonadal condition, recruitment potential, and growth of oysters, and on the habitat suitability of oyster reefs for fishes and macrobenthos were examined. Oysters (10) were sampled monthly at each of five locations within the Caloosahatchee River estuary: Piney Point, Cattle Dock, Kitchel Key, Bird Island, and Tarpon Bay. Higher temperatures and salinities favored the oyster parasite Perkinsus marinus, and histological analyses revealed the presence of several additional parasitic or commensalistic organisms. Comparison of mortality among sites indicated that juvenile oysters tolerated salinities of 15-38 ppt. Spat recruitment was higher at sudtidal (1-5 spat/shell; Piney Point, Bird Island, and Tarpon Bay) than at intertidal locations (Kitchel Key, and Cattle Dock), where sparse oyster distribution and swift currents appeared to limit settlement success. The late peak in gametogenesis (August-September) observed at all sites may have resulted from reduced salinities during May-July or may imply that oysters spawn twice per season. Most of the oysters showed the presence of the protozoan parasite *Nematopsis spp*., hydroid polyps *Eutima spp*., the diagenetic trematode parasites *Echinostoma spp*. and *Bucephalus spp*., and larvae of the cestode *Tylocephalum spp*. Oysters are intermediate hosts for these parasites, with mud crabs, birds, and sting rays serving as primary hosts. Xanthid and porcellanid crabs were the dominant macrobenthos associated with oyster reefs in the lower estuary with estimated densities ranging from 2.9-5.1 and 0.4-6.0 individuals per liter of oysters respectively. Reef-resident fishes included *Opsanus beta*, *Chasmodes saburrae*, *Gobiosoma bosc*, and *Gobiesox strumosus* with associated densities lower than those of the dominant macroinvertebrates. Overall, results suggest that periodic freshwater releases may benefit oysters by lowering the salinity and thus the intensity of parasite infection (*Perkinsus marinus*). It should be cautioned that the long-term effects of low salinity on oysters have not been investigated.

Sponsor: This study was made possible by a grant from the South Florida Water Management District administered through Florida Atlantic University and the Florida Center for Environmental Studies.

Key Words: oysters, macroinvertebrates, reefs, fishes, *Perkinsus marinus*, watershed alteration, Caloosahatchee River

Aswani K. Volety and S. Gregory Tolley
Division of Ecological Studies
Florida Gulf Coast University
10501 FGCU Boulevard South
Fort Myers FL 33965
941/590-7216
941/590-7200
avolety@fgcu.edu

James T. Winstead
U.S. Environmental Protection Agency
Gulf Ecology Division
1 Sabine Island Drive, 32561
Gulf Breeze FL 32561

Monitoring the Impact of Watershed Management on Southwest Florida's Estuaries: A Model Employing Oyster Physiology and Ecology

Michael Savarese and Aswani K. Volety, Florida Gulf Coast University

Water management practices within Southwest Florida have drastically altered the patterns of freshwater delivery to estuaries. Many of these estuaries are targeted for restoration, yet the prealteration conditions are unknown. This research employs the eastern oyster, *Crassostrea virginica*, as an indicator species of ecosystem health. The patterns of oyster distribution, growth and productivity, recruitment, and susceptibility to disease are used to monitor estuarine health and to target conditions for restoration. We present data from three altered (Caloosahatchee River, Henderson Creek, Faka-Union Canal) and one pristine estuary (Blackwater River) within Lee and Collier Counties. Our results suggest that a combination of a few oyster physiologic and ecologic responses serves as good measure of entire system response.

In Faka-Union, an estuary that receives excessive freshwater during the rainy season because its watershed has been enlarged, reef distribution, regions of maximum living density, and the foci of oyster productivity are displaced seaward relative to pristine estuaries. Henderson Creek, an estuary receiving pulses of nutrient-rich freshwater because of a crude weir design, has populations with higher productivities and densities. Two demographic patterns of productivity are consistently discernible: one of greater variance, indicating a wider age distribution, and a second skewed toward smaller individuals, an indication of greater juvenile mortality. The first pattern persists where pulsed release or protracted inundations of freshwater occurs. The alternative pattern dominates in natural settings. The persistence of small oysters with few older individuals, seen in the latter, is related to the net effect of recruitment, growth rate, and susceptibility to the disease-causing parasite *Perkinsus marinus*.

Higher salinity and temperature increase *P. marinus* prevalence in adult oysters within all estuaries. Ironically, excessive freshwater input or freshwater pulsing favors disease resistance. However, despite the lower disease prevalence among adult oysters at upstream locations, juveniles in these water-managed estuaries experience heavy mortality due to freshwater releases. Similar patterns are seen in recruitment. Although spat recruit effectively to upstream locations within the managed estuaries, few of those individuals survive to reach adulthood.

Our technique is easily applied to other altered estuaries in Southwest Florida, though further testing of the model is recommended and planned. The skewed demographic pattern, described above, is readily discernible and indicative of the ill-effects of excessive freshwater. In estuarine settings where marine conditions unnaturally predominate, oyster mortality and disease prevalence are comparable measures of water management effects.

Sponsors: This study was made possible by grants from the South Florida Management District, the National Fish and Wildlife Foundation, Florida Gulf Coast University, and the Florida Center for Environmental Studies.

Key words: oyster, estuarine health, management & restoration, Southwest Florida
Michael Savarese and Aswani K. Volety
Division of Ecological Studies
Florida Gulf Coast University
10501 FGCU Boulevard South
Fort Myers FL 33965
941/590-7165
941/590-7200
msavares@fgcu.edu

Water Use and Hydrology Related to Phosphate Mining - The Rest of the Story

Greg Williams, IMC Phosphates Company

This presentation will summarize hydrology and water use dynamics at IMC's existing phosphate mining operations in Polk, Hillsborough, Manatee and Hardee Counties. Special emphasis will be placed on conditions of excessive rain (El Nino, 1997-1998) and drought (1999-2001) as well as more normal hydroperiods.

Relationships between rainfall, discharge and groundwater pumping will be included. These relationships were determined by using actual measured rainfall, pumping quantities, discharge volumes and capture areas for IMC's current mining areas. Special emphasis will be placed on the mining lands in the Peace River Watershed. Conclusions drawn from this extensive set of hydrologic monitoring have been used to predict the hydrology of IMC's proposed future mining areas. This presentation focuses on the eight year period 1993-2000.

A summary of water conservation measures over the past twenty-five years will also be included.

Sponsors: Florida Phosphate Council and IMC Phosphates Company

Key words: phosphate mining, water use, hydrology, stream flow, groundwater pumping, drought

Greg Williams
Environmental Manager
IMC Phosphates Company
PO Box 2000
Mulberry FL 33860
863/428-3964
Fax 813/634-9763
ggwilliams@imcglobal.com

The Impact of Phosphate Mining on Water Resources in the Peace River Basin

John Garlanger, Ardaman and Associates, Inc.

Average annual streamflow of the Peace River at Arcadia has decreased from 1,317 cubic feet per second (cfs) for the 30-year period ending in 1963 to 881 cfs for the 30-year period ending in 1998. The decrease in average annual streamflow at Arcadia caused by the difference in average annual rainfall between the two 30-year periods ending in 1963 and 1998 is 387 cfs. The decrease in average annual streamflow at Bartow, Zolfo Springs and Arcadia resulting from the cumulative effect of all man-made activities in the basin and all natural changes in ET plus deep recharge for the same two periods will be presented.

This presentation will provide the analyses that were used to distinguish between rainfall and anthropogenic effects on streamflow and will compare the changes in evapotranspiration and induced recharge in the basin resulting from phosphate mining with the changes resulting from other land uses, including agriculture and commercial and residential development. The potential impact of mining and clay settling areas on baseflow to tributary streams and on natural recharge to the Floridan aquifer will also be addressed.

Key words: Phosphate mining, Peace River, hydrology, stream flow, and groundwater pumping

John Garlanger, Ph.D., P.E.
Principal
Ardaman and Associates, Inc.
8008 South Orange Avenue
Orlando FL
jgarlanger@ardaman.com

Has the Flow of the Peace River been Reduced by Mining?

Steve Partney, FDEP Bureau of Mine Reclamation

The progression of mining and reclamation through the Peace River is shown via a succession of maps through time, before and after reclamation became mandatory. The river gauge data is then shown for four tributaries to the Peace River, demonstrating that the hydrologic performance of mined and reclaimed basins is not substantially different from unmined basins.

Steve Partney, P.E.
Professional Engineer Administrator
FDEP Bureau of Mine Reclamation
Collins Building
2051 East Dirac Drive
Tallahasee FL 32310

The Role of Instream Riverine Habitats in Establishing Minimum Flows for the Upper Peace River

Jonathan B.T. Morales, Martin H. Kelly and Michael S. Flannery, Southwest Florida Water Management District

The Southwest Florida Water Management District has been legislated to establish minimum flows and levels for surface water bodies within its jurisdiction. Minimum flows are the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. The District proposes to base its minimum flows criteria in part on the inundation of riverine habitats, riparian floodplains and hydric soils. Habitats in these zones represent several components in the ecology of watercourse. These habitats incorporate the subtotal of species occurrence in physical space, from the population up to the community level of organization. They represent permanent structures that can exist over time and space and are thus quantifiable and easily monitored. They also provide the template by which other functional features of the ecosystem are distinguished, as well as provide other information consistent with the physico-chemical characteristics of larger drainage systems.

The emphasis of this study is to document the types of instream habitats found in the Upper Peace River. A second objective of this study is to relate these various instream habitats to the flow regime based on the period of record furnished by the USGS. These findings will form part of the basis of the rules to be incorporated in designating minimum flow rules for the Upper Peace River. The lateral and vertical distributions of various microhabitats were quantified at representative sections of the Upper Peace River, the Peace Creek Canal and Saddle Creek extending south to Zolfo Springs. These instream habitats include sand, bedrock, depositional zones, wood snags, leaf litter, exposed roots, and aquatic macrophytes. These habitats were flagged along study transects perpendicular to the river channel through the top of either bank. Elevation surveys were then conducted on these marked habitats. A total of 48 instream transects were done (three replicates among sixteen sites that were stratified over four major vegetation zones). The nearest USGS flow and stage data (measured since 1930 in some gages) were compared to these various habitats while simulated water levels using HEC-RAS were applied to habitats at sites distant from the USGS gages.

We will provide data that quantify the frequency and duration of inundation of habitats in the river. These habitat-flow relationships will be examined for within and between year patterns over the period of stream flow records for the Upper Peace river. The latter is significant due to major historical flow changes in the hydrology of the Peace River. Other permutations of flow to habitat inundation include the magnitude and timing of events that could have implications to determining minimum flow and level rules.

Sponsor: Southwest Florida Water Management District

Key words: minimum flows, instream habitats

Jonathan B.T. Morales, Ph.D.
Environmental Scientist
Southwest Florida Water Management District
2379 Broad Street (U.S. 41 South)
Brooksville FL 34604
352/796-7211 ext. 4273
352/754-6885 fax
jonathan.morales@swfwmd.state.fl.us

Martin H. Kelly, Ph.D.
Section Manager
Southwest Florida Water Management District
2379 Broad Street (U.S. 41 South)
Brooksville FL 34604
352/796-7211 ext. 4235
Fax 352/754-6885
Marty.kelly@swfwmd.state.fl.us

Michael S. Flannery
Senior Environmental Scientist
Southwest Florida Water Management District
2379 Broad Street (U.S. 41 South)
Brooksville FL 34604
352/796-7211 ext. 4277, 352/754-6885
sid.flannery@swfwmd.state.fl.us

The Morphometery of the Lower Peace River in Relation to Long-Term Responses of Riparian Vegetation Patterns to Natural Variations in Freshwater Inflows

Ralph Montgomery, Tony Janicki and Susan Janicki, Peace River-Manasota Regional Water Supply Authority

An area weighted, smoothed centerline was developed for the lower Peace River, from its mouth, upstream 44.0 kilometers to above its confluence with Horse Creek. Sonar based cross-sections were developed perpendicular to this centerline, at 0.5 intervals, between river kilometers 10.0 and 34.0. These cross-sectional data were combined with existing GIS coverages to obtain 0.5 kilometer estimates characterizing open-water surface areas; water volumes, shoreline lengths; and areas/types of adjacent wetland habitat, along the lower Peace River.

The river's increasing downstream braided physical structure combined with its greater width is clearly evident in the "funnel like" appearance of both cross-sectional area and shoreline plots. These factors result in marked increases, within specific segments of the lower river, in the extent of potential shoreline habitat available for emergent vegetation. GIS vegetation coverages were used to analyze the relative aerial extent of selected key vegetation associations in relation to the developed river kilometer centerline. Further, the cumulative percentages of key vegetation associations were analyzed in relation to the total shoreline vegetation between river kilometers 0.0 and 43.0.

Both mangrove swamp and saltwater marsh comprise very closely the same percentage of the total shoreline, and extend upriver approximately the same distance. This region of the lower river, near kilometer 20, also marks a fairly sharp transition in the increasing importance of bottom hardwood communities along the lower river. Extensive areas of cypress, by comparison, do not occur along the river until upstream of river kilometer 34.0.

The relative first and last occurrence of seven selected indicator emergent plant species were recorded during each often sampling events over the period 1977 to 1998. Seven common representative taxa were selected to attempt to graphically document the potential extent of long-term variability within these representative species. These taxa were selected based on their life history, relative importance along the river, and degree of sensitivity to changes in salinity. The long-term distributions of these selected taxa were analyzed in relation to both river kilometer, average measured month surface salinities along the lower river, and yearly median freshwater inflows from the three upstream gaged sources.

Analyses indicate that the first and last occurrences of many of these selected species have varied very little, while others have changed considerably back and forth over the extended period of this study. It is postulated that in some instance these changes have been the result of either the creation and destruction of bar and/or shoal areas along the river.

The Relationship of Freshwater Flows and Salinity in the Lower Peace River

Tony Janicki, Ralph Montgomery, and David Wade, Janicki Environmental, Inc.

The Peace River is a one of the critical water resources located in southwest Florida. Over the years, the Peace River and its watershed have been modified by human activities, including land use changes (e.g., mining, agriculture, and urbanization) and water withdrawals. Together these influences have the potential to significantly alter the salinity patterns, especially in the lower river. Salinity is one of the major factors that determine the spatial and temporal distribution of many aquatic organisms. Therefore, an understanding of the relationship between freshwater flows and salinity in the lower river is important, especially in light of the ever-growing need for water supplies. Recognizing the importance of this knowledge, the Peace River/Manasota Regional Water Supply Authority supported this work to quantify the impact of its surface water withdrawals by its Peace River Facility on salinity in the Lower Peace River.

Long-term physical and chemical water quality data have been collected both at “fixed” sampling sites between 1976-1989 and 1996-1998, and at “moving” isohaline based locations during the period 1984-1998, in the Lower Peace River and upper Charlotte Harbor. These data were used to analyze the salinity-flow relationships in the lower river. Multiple regressions with terms for freshwater flow corrected for the withdrawals by the Peace River Facility, antecedent downstream salinity, and location in the river (i.e., river kilometer). Different regression coefficients were calculated for wet/dry seasons and flow range. Independent models were estimated for surface and bottom waters in two river segments; upstream (between river kilometers 15 and 30) and downstream (between river kilometers 6 and 16). The models indicate that the response of salinity to changes in flow is not linear. In general, withdrawals result in incrementally greater changes in salinity during low flows, and proportionally smaller changes at high flows. The models also indicate that the effects of withdrawals by the Peace River Facility tend to be greater upstream than downstream (between river kilometers 14 and 18), and there is a portion of the river below the Facility that is nearly always fresh and never impacted by withdrawals.

Establishing Freshwater Inflow Needs for Galveston Bay

Cindy Loeffler, Texas Parks and Wildlife Department

Freshwater inflows (FWI) from rivers, streams, and local runoff maintain the salinity gradients, nutrient loadings, and sediment inputs that in combination produce an "ecologically sound and healthy estuary." This report summarizes TPWD studies of the FWI needed to maintain the unique biological communities and ecosystems characteristic of a "healthy" Trinity-San Jacinto Estuary. Methods for determination of the quantity and quality of freshwater inflows needed to maintain our coastal margins have been developed by the State Bays and Estuaries Research Program [consisting of the Texas Water Development Board (TWDB) and Texas Parks and Wildlife Department (TPWD) as mandated by the Texas Water Code. In this report, the effectiveness of different computed inflow regimes (MinQ and MaxH) predicted by optimization modeling are critically evaluated. This analysis uses fisheries survey results from the TPWD Coastal Fisheries Resource Monitoring Database to validate the computer simulations. Observed abundances of estuarine fishery species are empirically evaluated against FWI regimes proposed from the theoretical models. Comparison of modeling results with observed fisheries survey data results in a FWI recommendation that will realistically maintain the "biological health and productivity" of the Trinity-San Jacinto Estuary. The Texas Parks and Wildlife Department, along with the Texas Water Development Board and the Texas Natural Resource Conservation Commission, continues to promote efforts to implement freshwater inflow needs, most notably through participation in the Galveston Bay Freshwater Inflows Group and Senate Bill 1 Regional Water Planning.

Cindy Loeffler
Texas Parks and Wildlife Department
Resource Protection Division
4200 Smith School Road
Austin TX 78744
cindy.loeffler@tpwd.state.tx.us

Central Estero Bay Hourly Dissolved-Oxygen Recordings

T.C. Winter, H. J. Mitchell-Tapping and J. C. Mallon, Estero Bay Marine Laboratory/Ostego Bay Foundation

Dissolved-oxygen (DO) concentrations and other physical water quality parameters were measured at hourly intervals in central Estero Bay, Florida from June 1996 to July 2001. A programmed continual digital recorder was deployed in a major *Thalassia*, *Syringodium*, and *Halodule* seagrass meadow in the shallow waters (~one meter depth) at Starvation Flats of this marine preserve. Over 24,000 measurements were recorded.

Forty-four percent of the hourly measurements yielded DO values below 4.0 milligrams per liter (mg/L), the Florida Department of Environmental Protection standard. The more dynamic Chesapeake Bay Resource Habitat Requirements for DO were also applied to a six month period of the Estero Bay data. The results yielded the same disappointing results, e.g., all six of the monthly mean values fell below the Chesapeake Bay monthly mean standard of 5.0 mg/L.

One hundred fifty-two of the 1012 complete data days were analyzed hour-by-hour in 7-15 day periods. (The remaining days were evaluated by plots of daily averages, minima, and maxima.) A number of interesting phenomena were observed. For example, the dry season DO background continua are of the order of 4 mg/L higher than the wet season. DO diels (value peaks) appeared when the sun was not in a position to cause photosynthesis. Sixty-seven percent of the days revealed predawn DO diels and 8% revealed evening DO diels (between 2000-2200 hours). Most of these diels were of smaller amplitude than the afternoon DO diels attributed to photosynthesis. The period Fall 1999 - July 2001 revealed the minimization and even disappearance on many days of these afternoon diels. But these afternoon diels returned to normal magnitude in mid-summer of this past year.

The bay's water temperature and salinity exercised no appreciable effect on the hourly DO values, although the trend of increasing DO values during lower temperatures was evident. Daily temperature differentials, ranging up to over 6o C on some days, were evident. Freshwater surges, presumably due to the streams flowing into this portion of the bay, appeared at the instrument site during periods of high rainfall. These surges were manifested by both the lowering of the overall salinity and the appearance of marked salinity decreases in correlation with the local tides.

Possible causes for the above phenomena are suggested. It appears that the water surface/atmosphere diffusion source of DO plays a much stronger role than had been previously thought.

It is concluded that frequent measurements during each day (in this case, hourly) are essential to understanding the bay's morphology; that the bay's water quality falls significantly below standards, as suspected from the marked decline in sea grass over recent years; and that a challenge is presented to better understand the features revealed by the analysis of hourly data collected over the past few years.

This study is on-going. It is hoped that future investigations will improve understanding of the long-term DO patterns that will be helpful to bay management decisions governing the health of this estuary.

Thomas C. Winter, Jr.
Estero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274, wint201@aol.com

Hugh J. Mitchell-Tapping
Estero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274, hmt@peganet.com

Joseph C. Mallon
Estero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274, jerzjo59@cs.com

Estero Bay Seagrass Substrate Analysis

Joseph C. Mallon and Hugh J. Mitchell-Tapping, Estero Bay Marine Laboratory/Ostego Bay Foundation

As different seagrass species appear to concentrate in different areas, the authors proposed that the substrate grain-size was related to the growth of different seagrass species as well as responsible for grass-free areas. It was hypothesized that if the sediment supply, water depth, currents, wind and wave energy, and sampling techniques are the same at each core site, any effects of suspended-particle trapping by seagrass should be discernible in the size-frequency distributions of accumulated sediment. The sediment grain-size of the uppermost 3 in. of cores were taken in different seagrass beds in the Estero Bay Aquatic Preserve. The sites were selected as having relatively pure stands of each species of seagrass. Site A at Bunche Creek near the northernmost portion of the Preserve; site B at Starvation Flats located in central part of the bay; site C near Marker 2 Flats on the bayside of Big Carlos Pass; site D near Black Key near the central eastern shore. Tidal range in the Preserve is about 2 ft, and current velocity and direction over the seagrass meadow were determined by a General Oceanics flowmeter and tethered drift buoys. Cores were taken using a manual stainless steel corer with a clear plastic liner and a corecatcher. For all core sites, water depths were less than 3 ft in water depth. As seen from an oblique, low-altitude aerial photograph, seagrass beds cover most of the visible bottom, except for small irregular-shaped grass-free “blow-out” patches. No bed forms were seen in seagrass or sandy areas. The sandy areas bordering the beds were slightly deeper, about 3 to 4.5 ft. Sample marker stakes were set at measured intervals along a randomly selected transect that traversed the seagrass meadow to guide surveying and sampling operations. Each core location was recorded using a GPS Garmin III, supported by compass bearings to shore structures and to navigational markers. At Site A, a Halodule site near the mouth of Bunche Creek, immediately north of Bunche Beach near the northernmost point of the Estero Bay Aquatic Preserve, two transects were laid out at right angles to each other and cores were taken at 50 ft intervals along each transect. Cores were collected across a large *Thalassia-Halodule* meadow at Site B at Starvation Flats near Big Carlos Pass in Estero Bay and in the grass-free areas bordering the meadow. At Site C, a bed containing mainly Halodule with minor amounts of *Thalassia* on the bayside of Big Carlos Pass, located between an unnamed mangrove key opposite Coon Key, and Marker#R2 in the center of the channel divide of the Pass, 12 cores were taken about 50 ft apart along two transects at right angles to each other. At a *Thalassia* location at Site D, located close to Black Key near the Estero River on the landward eastern-side of the Bay, cores were taken about 100 ft apart using the same procedures as at the other three sites. Core recovery ranged from 20.25 to 9.25 inches in length at Starvation Flats but only 10.5 to 6.5 inch-long cores could be recovered at Site B at Bunche Creek. At each site, the cores were split in two and the top 3 inches was selected, packaged, and allowed to dry in the sun. The rest of the core was preserved in boxes for future studies. In the laboratory, the cores were split and an aliquot was then selected from each core section. Each aliquot was then weighed, sieved, and then weighed again. A set of 6.75 x 3 in. Hubbard #3076 four-sieve kit (sizes #5: gravel, #10: coarse sand, #60: sand, #230: silt, and the pan: clay) was used to separate and grade the samples. Each weighed pan size was calculated as a percent of total weight. The sieve data was recorded and plotted using a computer database program. Each pan size was also analyzed under a microscope. The sediment was composed mainly of mud-sized quartz and carbonate particles composed of clean, clear, sub-rounded to angular, very fine-grained quartz with skeletal particles from gastropods, micro-pelecypods, and foraminifera, and some organic fragments. A statistical analysis of the sieved data showed a variation in average grain-size. The coarser quartz and larger shell-fragment particles were more abundant in the bare-sand areas and sand-size particles common in *Halodule* beds, while the mud-size grains were more abundant in the Thalassia-associated sediments. Mud-sized particles are present to various degrees in all samples. Sediments from *Thalassia, Halodule, Syringodium*, and bare sand areas are similar in content but differ in grain-size. Sorting is poor, reflecting the gravel and mud components. Average skewness (symmetry of distribution) is positive, indicating an excess of fine particles, while average kurtosis indicates excessive peakedness, as compared to a Gaussian distribution. Estero Bay substrate is are primarily a mixture of sand, silt and clay, and have a mud content that ranges from 0 to 39%. The only significant difference found between the sites is that Thalassia sediments contained more silt than the other seagrass species and the grass-free areas.

Acknowledgments: The authors thank the Ostego Bay Foundation and Estero Bay Laboratory Baywatch Volunteers who aided in the field and laboratory work in this study, especially, C. Baker, K. Fowler, B. Hudson, A. Martin, N. Minder, G. Powell, A. Poulos, S. Stanbaugh and T. Winter.

Key words: seagrass, sediment, particle size, Estero Bay

Joseph C. MallonEstero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274
jerzjo59@cs.com

Hugh J. Mitchell-Tapping
Estero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274
hmt@peganet.com

Central Estero Bay Sediment Depositional Rates

Hugh J. Mitchell-Tapping, Thomas Winter and Joseph C. Mallon, Estero Bay Marine Laboratory/Ostego Bay Foundation

Many researchers consider that seagrass blades trap fine-grained sediment by reducing tidal-current velocity, thereby permitting gravity settling of suspended particles, while an absence of seagrass eliminates the settling effect. Eiseman and Benz (1975) reported seagrass biomass increases in summer and decreases in winter. The same authors also thought that this seasonal decrease in seagrass biomass might lower the amount of trapped sediment. However, Lynt (1966) reported no sediment grain-size change between August and February for *Thalassia*-associated sediments in Buttonwood Sound, Florida.

To research this concept, this study performed sediment deposit measurements using a sediment trap deployed, from August 1999 to September 2001, in the Starvation Flats seagrass meadow in Central Estero Bay. The trap was located in small sandy patch within the large *Thalassia-Halodule* meadow. The bottom of the tray was placed a few centimeters above the sediment-water interface, and was deployed for periods ranging from one week to one month duration. Sediment was recovered by washing the particles into cotton sample-bags which was then allowed to drain and dry in the sun before weighing. The data was then recorded in a database and graphed using the statistical scientific software Grapher3(tm). The result showed that there was a great variation in sediment depositional rates between the wet and dry seasons of southwestern Florida, and is not as constant as some researchers have proposed (Hoskin, 1983). This variation may be due to greater wind velocity and fetch, causing resuspension of the sediment grains rather than increase of particle supply from the Gulf of Mexico. Over the deployment time, sediment flux data ranged from a low of 93 g/m^2/diem to over 1,100 g/m2/diem. The metered maximum tidal ebb flow velocity over *Thalassia-Halodule* beds averaged 1.5 in./sec., moving towards Big Carlos Pass and out into the Gulf, as expected in this tidal-dominated bay. During wintertime, the vegetation growth is slowed, or dies-back, with the lowering of water temperature and so allows particles to be resuspended and resettled from within the seagrass areas. Deposition from suspended Gulf of Mexico particles and local resuspension is probably the source for the grains settling in the trap in Estero Bay as there are only small tidal creeks supplying suspended biological particles into the Bay during major storm runoff. Microscopical examinations of the mineralogy of the silt-size particles, found in the sediment trap, showed a composition of quartz particles and foraminifera, with rare occurrences of shell micro-fragments. The particles are very similar to those suspended quartz grains found in plankton trawls which are taken regularly in the Bay.

Acknowledgments: The authors thank the Ostego Bay Foundation/Estero Bay Laboratory Baywatch Volunteers and ECC and FGCU students who aided in the field and laboratory work in this study.

Key words: sediment, depositional rates, Estero Bay, seagrass beds, quartz grains, mineralogy

Hugh J. Mitchell-Tappin
13910-202 Eagle Ridge Lakes
Fort Myers FL 33912
941/768-5274
hmt@peganet.com

Thomas C. Winter, Jr.
Estero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274
wint201@aol.com

Joseph C. Mallon
Estero Bay Marine Laboratory/Ostego Bay Foundation
P.O. Box 008275
Fort Myers FL 33908
941/768-5274
jerzjo59@cs.com

Reconnaissance of Chemical and Physical Characteristics of Selected Bottom Sediments of the Caloosahatchee River and Estuary, Tributaries, and Contiguous Bays, Lee County, Florida, July 20-30, 1998

Mario Fernandez, Jr., Marci Marot and Charles Holmes, U.S. Geological Survey

This report summarizes a reconnaissance study, conducted July 20-30, 1998, of chemical and physical characteristics of recently deposited bottom sediments in the Caloosahatchee River and Estuary. Recently deposited sediments were identified using an isotopic chronometer, beryllium-7 (7Be), a short-lived radioisotope. Fifty-nine sites were sampled in an area that encompasses the Caloosahatchee River about three miles upstream from the Franklin Lock (S-79), the entire tidally affected length of the river (estuary), and the contiguous water bodies of Matlacha Pass, San Carlos Bay, Estero Bay, Tarpon Bay, and Pine Island Sound in Lee County, Florida.

Bottom sediments were sampled for 7Be at 59 sites. From the results of the 7Be analysis, 30 sites were selected for physical and chemical analyses. Sediments were analyzed for particle size, total organic carbon (TOC), trace elements, and toxic organic compounds, using semiquantitative methods for trace elements and organic compounds. The semiquantitative scans of trace elements indicated that cadmium, copper, lead, and zinc concentrations, when normalized to aluminum, were above the natural background range at 24 of 30 sites. Particle size and TOC were used to characterize sediment deposition patterns and organic content. Pesticides, polychlorinated biphenyls (PCBs), and carcinogenic polycyclic aromatic hydrocarbons (CaPAHs) were determined at 30 sites using immunoassay analysis. The semiquantitative immunoassay analyses of toxic organic compounds indicated that all of the samples contained DDT, cyclodienes as chlordane (pesticides), and CaPAHs. PCBs were not detected.

Based on analyses of the 30 sites, sediments at 10 of these sites were analyzed for selected trace elements and toxic organic compounds, including pesticides, PCBs, and PAHs, using quantitative laboratory procedures. No arsenic or cadmium was detected. Zinc was detected at two sites with concentrations greater than the lower limit of the range of sediment contaminant concentrations that are usually or always associated with adverse effects (Florida Department of Environmental Protection's Sediment Quality Assessment Guidelines). Organochlorine pesticides were detected at four sites at concentrations below the reporting limits; there were no organophosphorus pesticides or PCBs detected. PAHs were detected at eight sites; however, only four sites had concentrations above the reporting limit.

Sponsors: U.S. Geological Survey in cooperation with the South Florida Water Management District

Key words: Beryllium-7, Immunoassay, DDT, Chlordane, PAH

Mario Fernandez, Jr.
Hydrologist
U.S. Geological Survey
600 Fourth Street South
St. Petersburg FL 33701

727/803-8747
Fax 727/803-2031
mfernand@usgs.gov

Marci Marot
Geologist
U.S. Geological Survey
600 Fourth Street South
St. Petersburg FL 33701
727/803-8747
Fax 727/803-2031
mmarot@usgs.gov

Charles Holmes
Research Geologist
U.S. Geological Survey
600 Fourth Street South
St. Petersburg FL 33701
727/803-8747
Fax 727/803-2031
cholmes@usgs.gov

Responses of Demographic, Morphological, and Chemical Characteristics of Turtle-Grass, *Thalassia testudinum* to El Nino Runoff in Four Florida Estuaries

Paul Carlson, Laura Yarbro, Kevin Madley, Herman Arnold, Manuel Merello and Gil McRae and Michael J. Durako, Florida Fish and Wildlife Conservation Commission Florida Marine Research Institute

Seagrasses are vital components of the nearshore ecosystem, providing food and shelter for many economically important fish and shellfish species. However, drastic declines in the distribution and abundance of seagrass and submerged aquatic vegetation (SAV) communities have occurred in many estuaries throughout the Gulf of Mexico, the United States, and the world over the past 50 years. In most cases, seagrass loss has resulted from concurrent declines in water quality. Because seagrasses are very responsive to decreased water clarity, they are excellent sentinel species for biological monitoring of estuarine and nearshore water quality, and considerable interest has focused on the development of ecological indicators to diagnose seagrass community health.

In this study, we examined the responsiveness of a suite of demographic, morphological, and chemical characteristics of one seagrass species, turtle grass (*Thalassia testudinum*), to several natural and human stresses. Turtle grass was selected as our indicator species because it is a long-lived perennial species which, because of a large investment in below round tissue, is very sensitive to declines in water clarity and other stressors. To evaluate the response of these parameters to declines in water clarity, we selected a group of five sampling sites along the West Florida coast which received much-higher-than-normal rainfall in the winter of 1997-1998. The rainfall, in turn, caused heavy nutrient loading at these sites, resulting in persistent phytoplankton blooms which provided an excellent opportunity to test the responsiveness of

Thalassia demographic, morphological and chemical characters to deteriorating water quality. All of the rainfall and most of the phytoplankton blooms occurred between our first and second field sampling seasons, so we were able to collect data before, during, and after the runoff impacts. The magnitude of the rainfall anomaly varied along the west coast of Florida, providing a range of nutrient and salinity impacts among our study sites.

The responses of several *Thalassia* morphological parameters were temporally and spatially consistent with light stress induced by El Nino runoff. However, some parameters lacked the discriminating power necessary to be useful indicators. Larger sample sizes might improve the power of those parameters in future studies, but, given our sampling program, *Thalassia* shoot density, blade width, blade number, and shoot-specific leaf area were the most promising measures of light stress. Spatial and temporal variation patterns of most chemical parameters- elemental ratios and stable isotope ratios- were not consistent among sites. The chemical parameters which exhibited the most spatially and temporally consistent variation, as well as discriminating power, were rhizome sugar, starch, and total carbohydrate concentrations. Because changes in shoot density, as well as water clarity, affect rhizome carbohydrate levels, a parameter based on *Thalassia* shoot density and rhizome carbohydrate levels together is probably more useful than either parameter alone as an indicator of seagrass health.

Paul Carlson, Laura Yarbro, Kevin Madley, Herman Arnold, Manuel Merello
Lisa Vanderbloemen, Gil Mc Rae
Florida Fish and Wildlife Conservation Commission
Florida Marine Research Institute
100 Eighth Avenue SE
St. Petersburg FL 33701
727/896-8626
Fax 727/823-0166

Mike Durako
Dept. of Biology
University of North Carolina at Wilmington

Seasonal Changes in Seagrass Density and Associated Invertebrate Communities at Fixed Located in San Carlos Bay

James V. Locascio, Sanibel-Captiva Conservation Foundation

The Sanibel-Captiva Conservation Foundation's Marine Lab conducted a monitoring program in San Carlos Bay from April, 2000 through April, 2001. Monitoring efforts were initiated in response to unseasonably high freshwater releases through Franklin Lock and Dam (S-79) beginning on April 27, 2000 and lasting approximately 5 weeks. Data on seagrass abundance (Blaun-Blanquet sampling protocol), associated macroinvertebrates, plankton, and water quality were collected on a monthly basis at three fixed locations. Preliminary results of seagrass, macroinvertebrate, and water quality data will be presented in the context of seasonal change and changes that may be associated with the freshwater releases which occurred April-May, 2000. Plankton samples have been achieved for future analysis.

Keywords: San Carlos Bay, Franklin Lock and Dam (S-79), seagrass, water quality

James V. Locascio
Marine Biologist
Sanibel-Captiva Conservation Foundation, Marine Lab
900 A Tarpon Bay Road
Sanibel FL 33957
941/395-4617
jloc@peganet.com

Distribution and Abundance of Live and Dead Macro-Mollusks in the Tidal Peace River, Florida

Ernest D. Estevez, Mote Marine Laboratory

Mollusks are valuable environmental indicators. To discover their species composition and distribution in the Peace River, live and dead mollusks larger than 3.0 mm were collected twice from subtidal and intertidal environments every half-kilometer from US 41 to Horse Creek. The first set was collected in May-June 1999 to reflect a cold/dry-season signal in 1998-99. A second set was collected in winter 2000 to reflect a weak warm- and wet- season condition during the first year of a continuing La Nina drought. Combined trips produced 1220 subtidal and 1152 intertidal samples containing approximately 17,000 specimens. About 30 species of mollusks were collected. Fourteen species accounted for more than 95% of all specimens. Half were estuarine in nature and occupied the river area below Interstate 75. From 1-75 to the Liverpool area the river supported a fauna of lower diversity, but typical of brackish-water environments. The upper end of the tidal river was dominated by *Corbicula fluminea*. *Corbicula* is an introduced, naturalized freshwater bivalve with a tolerance for low salinities. *Corbicula* was the only non-native species of mollusk, and also the single most abundant species, collected in the tidal Peace River. *Corbicula* was more abundant subtidally than intertidally and in both areas extended from Horse Creek down to river kilometer 13.0. Many species' ranges fell entirely within the tidal river. Salinity and habitat constraints were important determinants of range limits for some species. Ranges were never perfectly continuous, gaps in ranges were interpreted as natural features. Ranges were also determined for relic assemblages (shells of dead mollusks) of each species. In 1999 the fit between living and dead ranges was poor; in 2000 it was very good, signifying that living species presently occur where they have for decades, that dry periods have a strong effect on the footprint of relic assemblages, and that living populations take on the location and size of relic assemblages during dry periods.

Sponsors: Peace River/Manasota Regional Water Supply Authority.

Key words: Peace River, mollusks, rapid survey, Corbicula, taphonomy

Ernest D. Estevez
Director, Center for Coastal Ecology
Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota FL 34236
941/388-4441
Fax 941/388-4312
estevez@mote.org

Species Composition of Fishes and Spatio-Temporal Patterns of their Seagrass Habitat use in the Charlotte Harbor Estuarine System, Florida

Gregg R. Poulakis, David A. Blewett, Charles F. Idelberger and Michael E. Mitchell, Florida Fish and Wildlife Conservation Commission Florida Marine Research Institute

To date, a total of 258 fish species (86 families) have been reported within the Charlotte Harbor estuarine system (i.e., rivers and estuary including the passes, but not the nearshore Gulf of Mexico). Recent fish collections (1989-2001) and museum specimen confirmations contributed 42 species which had not previously been recorded from within the estuary. In addition to determining overall species composition, we analyzed data (1996-2000) from samples collected in a 21.3 m seine to determine the spatio-temporal patterns of seagrass habitat use by fishes in Charlotte Harbor. Two major seagrass fish communities were identified in these samples: (1) a mangrove shoreline community, and (2) a flats community. Seagrass communities along mangrove shorelines were distinguished most consistently (throughout the year) by *Menidia spp*. (silversides*), Mugil gyrans* (fantail mullet), *Eucinostomus harengulus* (tidewater mojarra), and *Floridichthys carpio* (goldspotted killifish). Seagrass communities on flats greater than 5 m away from shore were distinguished most consistently by *Bairdiella chrysoura* (silver perch), *Orthopristis chrysoptera* (pigfish), and *Cynoscion nebulosus* (spotted seatrout). Differences in habitat use were observed during the cooler dry months (December-May) and the warmer wet months (June-November). *Lagodon rhomboides* (pinfish), *Mugil cephalus* (striped mullet), and *Leiostomus xanthurus* (spot) were dominant in the mangrove seagrass habitat during the cooler dry months, and *Lucania parva* (rainwater killifish) *and F. carpio* were dominant in this habitat during the warmer wet months. *Lagodon rhomboides*, *L. xanthurus*, and *O. chrysoptera* were prevalent in the flats seagrass habitat during the cooler dry months, and *Microgobius gulosus* (clown goby) and *C. nebulosus* were prevalent in this habitat during the warmer wet months. In general, many species were collected in both habitats and were widely distributed in the estuary. Four abiotic parameters (salinity, water depth, temperature, and dissolved oxygen levels) were most closely correlated with the biotic community patterns. These results suggest that the seagrass communities along mangrove shorelines and those on flats away from shore support distinct, but not mutually exclusive, fish assemblages in Charlotte Harbor.

Acknowledgment: This work was supported in part by funding from Florida saltwater fishing license sales and the Department of the Interior, U. S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.

Key words: Fisheries-Independent Monitoring program, fish species list, seagrass fish communities

Gregg R. Poulakis
Fish Biologist
Florida Fish and Wildlife Conservation Commission (FWC)
Florida Marine Research Institute (FMRI)
Charlotte Harbor Field Laboratory

1481 Market Circle, Unit 1
Port Charlotte FL 33953-3815
941/255-7403
Fax 941/ 255-7400
gregg.poulakis@fwc.state.fl.us

Relative Abundance and Trends of Selected Estuarine Fish Species in the Charlotte Harbor Estuary

Rebecca Hensley, Florida Fish and Wildlife Conservation Commission Florida Marine Research Institute

The Fish and Wildlife Conservation Commission's Florida Marine Research Institute Fisheries-Independent Monitoring (FIM) program has collected data concerning fisheries resources in the northern portion of Charlotte Harbor estuary since 1989. The FIM program was initially developed to assess, by sampling with small-mesh seines and trawls, the recruitment of juvenile fish species into the estuaries. Beginning in 1996, the FIM program added larger mesh gears in order to target sub-adult and adult fishes. Using the sampling data concerning juveniles and small forage species and data concerning sub-adult and adult species, the relative abundances of the most important recreational and commercial inshore fish species were calculated. Relative abundances were determined using 1989 through 2000 catch-per-unit effort (CPUE) data to establish baseline values. Many species varied in abundance seasonally, annually, or both. Trends for important species, especially during recruitment, are described. Further analyses and research are required to improve the understanding of this estuary's fish fauna and ecology. Continued monitoring is necessary to determine any future changes in the way that fish populations use the estuary.

Acknowledgment: This work was supported in part by funding from Florida saltwater fishing license sales and the Department of the Interior, U. S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.

Keywords: Charlotte Harbor, estuarine fish abundance and trends

Rebecca Hensley
Florida Fish and Wildlife Conservation Commission (FWC)
Florida Marine Research Institute (FMRI)
Charlotte Harbor Field Laboratory
1481 Market Circle, Unit 1
Port Charlotte FL 33953-3815
rebecca.hensley@fwc.state.fl.us
941/255-7403, Fax 941/255-7400

Fresh Water Fishes of Southwest Florida Rivers

Thomas H. Fraser, W. Dexter Bender & Associates, Inc.

Various checklists of freshwater fishes have been made by watershed in Florida. A comparison of known fish species for the rivers of Florida by river systems was summarized in 1986 in the book, *Zoogeography of North American Fishes*. A phenetic cluster analysis (presence or absence of the species) grouped all of the river systems from the Kissimmee River south and around Florida to the Withlacoochee River as being different from rivers to the north on both sides of Florida.

Their analysis grouped the Lower Everglades, Peace and Alafia Rivers together. This grouping suggests that the Peace and Alafia Rivers have similar, but different composition of native fresh water fishes, than adjacent river system with their origin in the Green Swamp area. This hypothesis is the subject of study. Comparisons are made among the Withlacoochee, Hillsborough, Alafia, Little Manatee, Manatee, Myakka, Peace and the Kissimmee/Lake Okeechobee/Caloosahatchee Rivers from existing literature and identified material at the Florida State Museum.

Generally, larger river systems have more fish species and smaller systems have fewer species. However, this area of Florida was completely to partially under sea water in the past effectively cleaning the slate for fresh water fishes to re-invade. Peninsular Florida has fewer fish species than the northern and panhandle regions. Based on the proximity of the headwaters for three major rivers (Withlacoochee, Kissimmee and Peace Rivers) in the Green Swamp area, we should expect that species composition should be very similar.

A review of the native fishes among the watersheds suggests that the differences reported, but not discussed in 1986, are real. Possible causes for these differences, natural and anthropogenic, are examined. Natural causes affecting the presence of fish species include size of watershed (a gross measure of habitat variation), presence of specific habitats or requirements associated with habitats and historical movement from one watershed to another (stream capture, flooding). Anthropogenic causes affecting the presence of fish species include eutrophication, loss of spring flows, loss of surface flows, reduction in duration and frequency of flood plain inundation, spills of waste or biproduct, changes in pH and hardness of water, application or discharge of toxic materials, loss of submerged aquatic vegetation and introduction of exotic organisms.

While phosphate activities occur in the head waters of the Manatee and Myakka Rivers, more significant mining and/or processing plants have been present in the Peace and Alafia watersheds. This industry may be one of the dominant land uses that has affected species composition in these two watersheds. The phenetic grouping associating the Peace and Alafia with the Lower Everglades area suggests that range of habitats within the two rivers either have been reduced or that the fish species are ecologically extinct in these rivers.

Key words: native freshwater fishes; Withlacoochee, Hillsborough, Alafia, Little Manatee, Manatee, Myakka, Peace and Kissimmee Rivers; fish species composition and human alterations

Thomas H. Fraser
Senior Scientist
W. Dexter Bender & Associates, Inc.
2052 Virginia Avenue
Fort Myers FL 33901
941/334-3680, Fax 941/334-8714
tfraser@dexbender.com

Aquatic Nuisance Species of the Greater Charlotte Harbor Watershed

John R. Cassani, Lee County Hyacinth Control District

A substantial number of mostly non-indigenous aquatic species now occur in the Greater Charlotte Harbor watershed. The distribution, level of establishment, vector source and impacts to natural systems and local economies by aquatic nuisance species is often poorly understood and can be significant. A review of aquatic nuisance species, including plant, vertebrate and invertebrate species occurring now or anticipated to occur in the Charlotte Harbor watershed will be discussed with respect to their known distribution, level of establishment, potential vector source, means of spreading, and the potential impacts of their presence. Further consideration will be given to the establishment of a "reporting network" to help document and prevent the introduction, spread or potential eradication of invasive non-indigenous species.

Key words: aquatic, non-indigenous, exotic plants and animals

J.R. Cassani
Lee County Hyacinth Control District
POB 6000
Fort Myers FL 33906
Voice and fax: 941/694-5844
jcassani@tpeganet.com

An Exploration of Methods for Characterizing Recreational Boating in Charlotte Harbor

Richard Flamm, Florida Fish and Wildlife Conservation Commission; Charles Sidman, Florida Sea Grant; Jay Gorzelany, Mote Marine Laboratory, and Timothy Fik, University of Florida

These surveys provided the principle method for understanding some influences behind recreational boating as well as some empirical spatial use patterns. We combined elements of the three methods to generate a "value-added" blend of objective observation, independent local knowledge, and behavioral information. The integrated telephone/mail survey proved very flexible in terms of being able to generate multiple data themes that can be used to address a wide variety of management issues. For example, surveys revealed that Charlotte Harbor boaters tended to have destinations in mind and minimized their distances traveled on the water, and were primarily fishers. Also, boat ramps in Charlotte County and Lee County differed in how far boaters traveled to use them. The aerial surveys were more restrictive in their application, but proved the best method for empirically characterizing boating densities and were strong contributors for mapping travel corridors and popular destinations. Expert meetings were the most cost-effective method. They generated a good representation of general boating areas, but were less reliable for identifying intensity of use for specific locales. Mapping precision of activity areas was a concern, but could be improved by using several experts. The three methods were combined into a single characterization of recreational boating in Charlotte Harbor.

Sponsoring organizations: Florida Coastal Management Program of the Department of Community Affairs, SW Florida Inland Navigation District, Florida Fish and Wildlife Conservation Commission, Florida Sea Grant

Key words: recreational boating, survey methods, geographic information system

Richard Flamm
Florida Fish and Wildlife Conservation Commission
100 8th Ave. SE
St. Petersburg FL 33701-5095
727/896-8626 ext 1922
richard.flamm@fwc.state.fl.us

Charles Sidman
Research Associate
Florida Sea Grant
407 NSB, P.O. Box 110405
University of Florida
Gainesville FL 32611
352/392-6233
Fax 352/622-6233
cccf@ufl.edu
www.ufl.edu/

Jay Gorzelany
Deputy Program Manager, Marine Mammal Program
Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota FL 34236-1096
941/388-4441
Fax 941/388-4312
jaygorzy@mote.org
www.mote.org

Timothy Fik
Associate Professor
University of Florida
3141 Turlington Hall
P0 Box 117315
Gainesville FL 32611-7315
352/392-0495
fik@geog.ufl.edu
www.ufl.edu

A Two-dimensional Model Application for Manatee Protection

Ivan B. Chou, ECT, Inc.

Heated discharges from the cooling systems of electrical power generating plants create warm-water refuges for manatees during the fall and winter months. Populations of manatees have grown dependent on these manmade havens for protection against winter temperature extremes. Under normal power plant operating conditions, these endangered mammals are afforded a stable thermal environment; however, when the power plants experience periodic downtime for scheduled maintenance or for other unanticipated events, the habitat-supporting warm water discharges cease. If these downtimes occur during very cold winter periods, the rapid reduction of water temperature may cause thermal shock to these mammals.

To design an optimal manatee protection program during power plant downtime, a two-dimensional hydrodynamic and water quality model (CE-QUAL-W2) was used to evaluate the effectiveness of various supplemental power plant discharge management options. The study results indicated that the volume of discharge would be more important than the discharge temperature in maintaining a steady manatee habitat due to the effects of thermal stratification.

Key words: 2-D modeling, stratification, manatee protection, power plant discharge

Ivan B. Chou, P.E.
Principal Engineer
ECT, Inc.
3701 NW 98th Street
Gainesville FL 32606
352/332-0444
Fax 352/332-6722
bchou@mindspring.com

Establishing Baseline Seagrass Health Using Fixed Transects in Charlotte Harbor, Florida

Elizabeth Staugler and Judy Ott, FDEP Charlotte Harbor Aquatic Preserves

Charlotte Harbor, Florida consists of seven interconnected estuaries, comprising six Florida Aquatic Preserves. This estuary system is very large, diverse, and extremely productive. Even though the Charlotte Harbor estuaries are in generally good health, increasing coastal and watershed pressures may lead to stress and degradation of the submerged resources if not managed properly. In the Charlotte Harbor Aquatic Preserves, seagrass is being used as an indicator of current and future estuary health, by linking water quality and habitat health. Long-term fixed transect monitoring is being used to detect changes in seagrass health, based on changes in water quality, and by detecting changes in depth distribution and species composition. This type of monitoring will provide the basis for determining and implementing appropriate management practices. Monitoring began in 1999 and includes species composition, Braun Blanquet cover class, blade length, sediment type, epiphyte load, water quality, & light attenuation. Measurements are taken from a 1 m^2 quadrant. This presentation describes the baseline results of seagrass data collected during the 1999-2000 sampling period. The summary includes species presence, percent cover, depth distribution, and epiphyte loading, determined from annual monitoring surveys conducted at 50 fixed transects located throughout the Harbor. Continued monitoring will be needed to more accurately determine water quality & seagrass health relationships. This project is on going and expected to continue long term.

Sponsors: Charlotte Harbor Aquatic Preserves/Florida Department of Environmental Protection

Key words: seagrass, fixed transect, baseline results

Elizabeth Staugler
Environmental Specialist
Charlotte Harbor Aquatic Preserves/FDEP
12301 Burnt Store Rd.
Punta Gorda FL 33955
941/575-5861
Fax 941/575-5863
Elizabeth.Staugler@dep.state.fl.us

Judy Ott
Aquatic Preserve Manager
Charlotte Harbor Aquatic Preserves/FDEP
12301 Burnt Store Rd.
Punta Gorda FL 33955
941/575-5861
941/575-5863
Judith.Ott@dep.state.fl.us

The Hydric Pine Flatwoods of Southwest Florida

James Beever, Florida Fish and Wildlife Conservation Commission

The hydric pine flatwoods of southwest Florida have typically been unrecognized as a valuable habitat for diverse reasons. The lack of recognition of this habitat has resulted in conflicting regulatory and resource management of this habitat, with a subsequent disproportionate loss of this habitat. The unique habitat value to the plant and animal of the hydric pine flatwoods of southwest Florida is that the same habitat functions as both a wetland and an upland. The relatively predictable nature of this hydrologic transformation allows for an abundant diversity of plant life including both wetland and upland annuals, which supports a diverse invertebrate fauna, and subsequently diverse vertebrate fauna. Presently, 981 plant species (328 monocotyledon. 596 dicotyledon, 4 gymnosperm, and 53 pteridophyte species) have been identified from or are documented as present in the hydric pine flatwoods of southwest Florida. Of these documented plants, 635 (650/u) have been confirmed during field observations in the course of this study. Seventeen endangered. and 67 threatened plant species are documented. Of these 84 listed plant species, 51 have been confirmed. To date, 30 mammal, 137 bird, 38 reptile, 14 amphibian, and 21 fish species have been identified from the hydric pine flatwoods of southwest Florida, including 5 endangered species, 5 threatened species, and 10 species of special concern.

James W. Beever III
Office of Environmental Services
Southwest Florida Field Office
Fish and Wildlife Conservation Commission
29200 Tuckers Grade
Punta Gorda FL 33955
941/575-5765

"Restoration Partners" Project on Sanibel-Captiva Conservation Foundation's (SCCF) Land: Frannie's Preserve Restoration Project

David W. Ceilley, The Conservancy of Southwest Florida, and Bradley Smith, Sanibel-Captiva Conservation Foundation

The Frannie's Preserve restoration involves the acquisition and restoration of 167 acres of rare and unique barrier island coastal uplands and freshwater wetlands that had been invaded by invasive exotic plants, primarily Brazilian pepper and Australian pine trees. SCCF purchased this property along the Sanibel River in 1999 through private fundraising of 3.0 million dollars. Restoration by the Habitat Management & Ecology program began in March 2000 with financial support from the USFWS's South Florida Coastal Ecosystem Program ($24,500) and Partners for Fish and Wildlife Program ($9,000), the Charlotte Harbor National Estuary Program ($20,000), the 5-Star Restoration Partners/Gulf of Mexico Program ($5,000) and the USDA Natural Resource Conservation Service ($8,363) and approximately $110,000 from SCCF. Contributing partners included staff from the J.N. Ding Darling National Wildlife Refuge and the City of Sanibel and volunteers from the Conservation Foundation.

The 4-phased restoration effort included:

1. Removal of Brazilian pepper (*Schinus*) from wetland marshes using track-hoes with root-rake.
2. Australian pine (*Casuarina*) removal from spoil piles along ditches and the Sanibel River.
3. Removal of all *Schinus* and *Casuarina* from upland hammocks, and savanna/scrub inhabited by gopher tortoises (*Gopherus polyphemus*).
4. Replanting of native tropical hardwood trees and shrubs, installation of nest boxes for cavity nesting birds and bats, wetland enhancement through the creation of deepwater refugia, and implementing a prescribed fire regime.

Baseline and one-year post-restoration plant and wildlife surveys have been conducted and the results will be presented. Additional research is planned in order to evaluate the effects of exotic plants on native flora and fish and wildlife community structure.

David W. Ceilley
Senior Biologist
The Conservancy of Southwest Florida
1450 Merrihue Drive
Naples FL 34102
941/403-4225
Fax 941/262-5872
dceilley@conservancy.org

Deer Prairie Slough Restoration Project: Ditch Backfilling to Restore Historic Wetland Hydrology

R.L. Van Fleet, W. Reuschel and M. Jones, Sarasota County Environmental Services

Sarasota County Environmental Services (SCES) is restoring the historic hydrology and ecology of Deer Prairie Slough, a tributary of the Myakka River in Sarasota County. The Slough was ditched in the early 1950s to drain the area for agriculture. Approximately 12 miles of Slough ditches still exist on public lands. The Deer Prairie Slough Restoration Project will enhance approximately 1,370 acres of hydric/mesic hammock and 740 acres of herbaceous marsh by eliminating approximately 8.4 miles of ditches. Benefits of this project include improving and increasing wetland wildlife habitat, reducing exotic plant coverage, improving water quality to on-site and downstream locations including estuarine habitats, and reducing flood pulses by increasing water storage and water retention times of on-site wetlands. Ditch backfilling for the wetlands in Phase I (6.7 miles) was completed between April and June 2001, prior to the 2001 wet season. Most of the shallow ditches (approximately 2 ft in depth and 20 ft in width) were filled in with available on-site spoil material. One of the project objectives was to create more natural grades with extremely gradual slopes. The temporarily disturbed restoration areas were intended to voluntarily recruit desirable wetland plants. The initial changes in wetland hydrology and vegetation will be summarized. This project received grant funding from the Charlotte Harbor National Estuary Program and the Southwest Florida Water Management District.

Keywords: wetland restoration, ditch backfilling, hydrological restoration

Florida Power Corporation Hines Energy Complex: A Model for Industrial Development in the Peace River Watershed

B. Randall Melton, Florida Power Corporation

Headquartered in St. Petersburg, Florida, Florida Power Corporation has provided electric service in central and northern Florida, and today is the energy provider to more than 1.4 million customers who live within the company's service area. Florida Power is the principal subsidiary of St. Petersburg-based Florida Progress Corporation.

The FPC Hines Energy Complex is the company's newest electric generating facility and is located on County Road 555 about seven miles south of Bartow. The site is 8,200 acres of previously mined phosphate lands and waste disposal areas. The first 500-Megawatt power unit began operation in early 1999 and Florida Power has received approval to build the second unit beginning this year. The site is licensed for four more units, for a total generating capacity of 3,000 Megawatts, and is scheduled to be completed in the year 2020.

Environmental stewardship has been integral to the siting, permitting and construction of the Hines Complex. The site for this facility was chosen in the early 90's by an Environmental Advisory Group consisting of well respected public officials, educators and environmentalists, in addition to company officials. The major characteristic which made this site environmentally desirable was its highly impacted condition due to previous mining and waste disposal activities. Development in this location was seen as a way to avoid the need to disturb a coastal or inland greenfield site.

The development of the Hines Energy Complex has included a series of environmental innovations which have been implemented by FPC. These include the use of clean-burning natural gas, the use of alternative water sources for cooling and process water supply, drainage enhancements to the Peace River Watershed, reclamation of mandatory and non-mandatory lands on the site and a zero-discharge design for the associated wastewater facilities.

B. Randall Melton, Principal Technical Specialist
Florida Power Corporation
263 13th Avenue South/PO Box 14042-BB1A
St. Petersburg FL 33733-4042
727/826-4290
Fax 727/826-4216
b-randall.melton@pgnmail.com

Diverse Herbaceous Wetland Restoration in Hookers Prairie

Rosemarie Garcia, Cargill Fertilizer, Inc.

Hookers Prairie, in Polk County, Florida, serves as the headwaters of the South Prong of the Alafia River. Phosphate mining activities have been conducted in the water basins which serve this area for more than a quarter of a century. Since 1975, reclamation of the mined areas has been regulated by the State of Florida. In addition to replacing the wetlands which were mined, acre for acre, Cargill Fertilizer has developed an expertise in creating wetlands with diverse desirable herbaceous and forested components. These components are functioning in a coordinated fashion. Initially, permit regulations drove the development of a methodology to create sawgrass marshes on the mined perimeter of Hookers Prairie. The keys to successful establishment included precise contouring, effective muck application, water management, superior sawgrass supply, careful planting, and constant nuisance species control. The reclaimed sawgrass marshes, which now measure over 1,000 acres, have islands and open water habitat as well as a dense cover of sawgrass. The water quality equals or exceeds standards and supports a diversity of faunal species. These acres are not isolated from the remainder of Hookers Prairie and have survived the climatic stresses of El Nino, and the current drought as well as wildfires.

As mining continues in Hookers Prairie, the goal has shifted to the development of a more diverse herbaceous component. The sawgrass core still remains, but it is surrounded by more than a dozen other desirable species. These species have been introduced by plantings, mucking, use of rhizomes, and direct seeding. Nearly 400 acres now display the signature of numerous emergent and submerged species in addition to sawgrass. A forested component is being developed upslope of the marsh system. Since these wetlands are adjacent to mining activities of a neighboring mining company, successful reclamation has required a partnering effort to ensure the return of a functional hydrologic pattern to Hookers Prairie.

Sponsor: Cargill Fertilizer, Inc.

Key words: sawgrass, *Cladium jamaicense*, reclamation, phosphate mining, wetlands, Hookers Prairie

Rosemarie C. Garcia, Senior Biologist
Cargill Fertilizer, Inc.
3900 Peeples Road
Fort Meade FL 33841-9715
863/428-4265, Fax 863/285-6306, Rosemarie_Garcia@cargill.com

The Power of the Estuary on the Human Endeavor and the Human Response

William F. Hammond Ph.D., Florida Gulf Coast University College of Arts and Sciences

To the biologist estuaries are seen as the cradle of life. To the tens of thousands of boaters, and fishers they are the precious gems that make southwest Florida bays and estuaries the prizes of her or his semitropical lifestyle. Our Southwest Florida estuaries are among the most productive in the world. Charlotte Harbor, Pine Island Sound, San Carlos Bay, Estero Bay are shallow basins of wind and tide — sloshed water which mixes the richness of sea water with the nutrient laden runoff from upstream freshwater rivers and creeks, all bathed in a semi tropical sunshine that pulses energy from surface to bottom.

Tropical sunlight feeds the chlorophyll-laden meadows of sea grasses, macro algae, mangroves, and phytoplankton converting solar energy to chemical energy that flows right up the food chains onto human tables. These are the ingredients of the wellsprings for abundant life. Manatees and sharks seek out the fresh water flows along with blue crabs, snook, and a myriad of microscopic planktonic fish larvae, oysters, and crustacea that follow the chlorophyll blooms carried by winds and tides up the estuaries. All seek just the right blend of salinity and nutrients to sustain their critical life stages. The vast abundance of all sea life in the Gulf of Mexico depends on the millions of years of historic patterns of rhythmic tidal and seasonal runoff flows of the estuarine. This is exactly why the southwest Florida counties have always been a leader in the statistical records in pounds, tons, and dollars generated by finfish, shrimp, crab, and shellfish landings ever since such statistics were kept in Florida. The earliest human settlers recognized this abundance. We find charcoal from their camps in the ancient river channels near the continental shelf and in the remnants of more recent post glacial times on the edges of our current bays. It is estimated the ancient Calusa people worked less than six hour a day to meet all their social, political, and economic needs. (Just who is the advanced civilization?) Sail, powerboats and railroads brought people to resettle these estuaries once the native people had been driven from the gene pool of Homo sapiens. Towns like Punta Gorda, Ft. Myers, Naples, Matlacha, Sanibel, all planted roots for their human settlers along the shorelines of these great estuaries of abundant life. Lumber mills, cattle shipping, fishing villages, and phosphate mining are a few of those legacies not to mention an abundance of human real estate developments followed to this pattern to this day.With exponential growth in the human settlements the bays are showing signs of stress from nutrients, non point source pollutants, increasing sewerage loads, reduced freshwater flows, and rhythms of freshwater discharge that are far out of the rhythmic historic sequences of flows in the past. Today’s challenge is to find ways to help the abundance of new residents most of whom have no sense of place in estuarine southwest Florida find those powerful connections. It takes a citizenry that is connected to the wonderful attributes of this great place and the critical natural support systems to sustain our estuaries and southwest Florida ecosystems. It is an informed citizen that will elect leaders who are committed to move from not-so-smart growth management policies and plans of the past to those we recognize as sustainable SMART Growth practices. Growth management policies that place emphasis on sustainable growth practices, incentives for sound development practices, can sustain economic support systems. Such innovations will provide thoughtful alternatives and sort out how to prevent the mining of freshwater for water supply wants, impacting critically important estuarine waters, over extending mining of phosphate in critical upstream habitats, and building in flood plains that are no longer allowed to flood and renourish the cleansing hydric forests that line their banks. Proper incentives that encourage sound development practices must supplement basic regulations that provide basic protections for these resources and assure a sustainable future for our estuaries. In southwest Florida we have done a better than average job of protecting our estuaries (as a string of court cases attest to). The Charlotte Harbor Task Force initiated by ECOSWF and enjoined with Governor Graham and the southwest Florida counties laid a framework for development and for basic protections for the Charlotte Harbor ecosystem. The Charlotte Harbor National Estuarine Program now leads the way for local governments, businesses, government agencies, and citizens to not only protect our estuarine bays but to work to restore many of the functional components of the estuary that have been impacted. This is possible in our southwest Florida community because we care. We have a country blessed by many thoughtful laws and democratic processes, strong leaders, and a citizenry that loves this critical estuarine system and will act with a unity of purpose to assure it is sustained for those yet to come, our children, grandchildren and great grandchildren. The estuary is very forgiving and resilient it just needs advocates from all corners of the citizenry (without consideration of past stereotypes) to speak and act on its behalf. In our own way, In our own time! Each of us can do that!

Bill Hammond
Florida Gulf Coast University
College of Arts and Sciences
10501 FGCU Blvd. South
Fort Myers, FL 33965-6565
941/590-7210
whammond@fgcu.edu

Fishes

Rebecca Hensley, FWC Florida Marine Research Institute

The Fish and Wildlife Conservation Commission’s (FWC) Florida Marine Research Institute (FMRI) has several facilities throughout the state to help monitor the status of the marine resources along Florida’s more than 8,000 miles of coastline. Staff at these facilities support a long-term sampling program that documents ecosystem changes, evaluates natural and manmade disturbances, and provides data used in making management decisions.

To better monitor Charlotte Harbor, Florida’s second largest estuary, the Charlotte Harbor Field Laboratory was created in 1989. This facility houses one section of the Fisheries Independent Monitoring (FIM) program, which assesses an array of forage, nontarget, recreational and commercial fish species. The initial monitoring efforts were directed at small and recruiting (or young-of-the-year) species, but in 1996, sampling was expanded to include larger individuals.

More than 250 different fish species have been documented in Charlotte Harbor. Small forage species (including anchovies, pinfish, mojarras, Atlantic threadfin herring, scaled sardines, rainwater killifish, silver perch) generally make up at least 80 percent of the total catch. Anchovies are usually the dominant species caught in Charlotte Harbor and can compose more than 40 percent of the total catch. The most numerous recreationally and commercially important species in Charlotte Harbor include spot, sand seatrout, and blue crab. Snook, red drum, and spotted seatrout are examples of other species that are caught but are not as numerous.

Key words: Charlotte Harbor, estuarine fish abundance

Rebecca Hensley
Florida Fish and Wildlife Conservation Commission (FWC)
Florida Marine Research Institute (FMRI)
Charlotte Harbor Field Laboratory
1481 Market Circle, Unit 1
Port Charlotte FL 33953-3815
rebecca.hensley@fwc.state.fl.us
941/255-7403
Fax 941/255-7400

Regional Wildlife Habitat Planning in the Charlotte Harbor National Estuary Program Region

James W. Beever III, Florida Fish and Wildlife Commission

The need for regional wildlife habitat planning is critical in the Charlotte Harbor National Estuary Program region because of high rates of population growth and habitat removal. To date, 50 mammal, 317 bird, 56 reptile, 29 amphibian and 446 fish taxa have been identified from the Charlotte Harbor National Estuary Program region, including 10 endangered species, 14 threatened species, and 24 species of special concern. In order to help maintain regional species viability and diversity, the commitment to regional wildlife habitat planning, has been adopted in the Southwest Florida Regional Comprehensive Plan and in several local government comprehensive plans. The Charlotte Harbor National Estuary Program Regional Wildlife Habitat Plan includes identification and protection of large preserves linked by coastal, riverine, and large mammal wildlife corridors. Implementation techniques to protect identified wildlife habitat include regulation, acquisition, and incentive programs. The difficulties of establishing the plan include resolving multiple-use land conflicts, the applicability of conservation biology theory to real world situations, and the need for accurate, basic information on regional biology.

James W. Beever III
Florida Fish and Wildlife Commission
29200 Tuckers Grade
Punta Gorda FL 33955

Some Birds and Their Habitats in the Charlotte Harbor Ecosystem

Randy McCormick, Peace River Audubon Society

Birds fill extremely important ecological niches in the Charlotte Harbor ecosystem, but they often serve an important human sociological function as well. Birds can be an effective catalyst in the process of linking human awareness to the larger, non-human ecological community. There are several qualities that birds exhibit that have the ability to interest, and even enchant, people. Also, birds are one form of wildlife that we can experience and enjoy wherever we are. They are in our neighborhoods, at our parks, on our beaches, even in our shopping center parking lots. It is because of this closeness, this availability, that they can be such a convenient link to the rest of the non-human world.

As we gain interest in birds we often expand our awareness to include knowledge of their habitat. Birding can be an exceptional segue into the important relationships between wildlife and the various ecological communities they inhabit. Red-cockaded woodpeckers and a multitude of other cavity nesters are directly associated with pine flatwoods in the greater Charlotte Harbor area. Scrub jays are linked with healthy scrub oak habitat. Wood storks and swallow-tailed kites are dependent upon freshwater wetlands. Oystercatchers and black skimmers need intact expanses of estuarine and coastal habitat. Starlings and house sparrows love nothing more than a large strip mall! The important thing is that we use birds to create and expand personal relationships to the natural world and then extend our appreciation to include the healthy habitat that all wildlife requires.

Randy McCormick, President
Peace River Audubon Society
P.O. Box 510760
Punta Gorda, FL 33951-0760
Phone and fax: 863/993-3288
debrandy@hotmail.com

Myakka River and Peace River Watersheds: Water Resource Management Issues and Solutions

Steven Minnis, Southwest Florida Water Management District

In 1992, the Southwest Florida Water Management District’s (District) Governing Board designated a 5,100 square-mile area as the Southern Water Use Caution Area (SWUCA). A water use caution area is where water resources are or will become critical in the next 20 years. SWUCA water resource concerns include advancing coastal saltwater intrusion in the Floridan aquifer and the decline of lake levels along the Highlands Ridge in Highlands and Polk counties, where most of the Floridan aquifer recharge occurs.

SWUCA encompasses the entire Peace River and Myakka River watersheds. This area includes all of Manatee, Sarasota, Hardee, and DeSoto counties and portions of Hillsborough, Charlotte, Polk and Highlands counties.

Following a significant public input process, the District’s Governing Board approved a SWUCA rule in 1994. The objectives of the rule were to significantly halt saltwater intrusion into the Floridan aquifer along the coast, stabilize lake levels in Polk and Highlands counties, and limit regulatory impacts on the region's economy and existing legal users.

The rule was intended to gradually reduce existing permitted quantities because the Floridan aquifer level was already below the proposed minimum level. A minimum level is the limit at which further withdrawals would cause significant harm to the water resources. The rule also would have allowed the voluntary redistribution of existing permitted quantities to new users and locations within SWUCA.

Numerous parties filed objections to the proposed rule and portions of the existing rule, leading to an administrative hearing. The administrative law judge's Final Order was issued in March 1997. The Final Order upheld the District's minimum Floridan aquifer levels and the science used to establish them, along with the phasing of conservation measures. However, the ruling also found certain provisions invalid. A number of parties, including the District, appealed the ruling to the Second District Court of Appeals. The Second District Court of Appeals ruling upheld the District's conservation measures.

Pinellas County applied to the Florida Supreme Court to seek reconsideration of the appellate court ruling. The District prevailed when the Florida Supreme Court refused Pinellas County's attempt to review the Second District Court of Appeals ruling, effectively ending any further appeals to the case.

During this lengthy appeals process, the District began a reassessment of the SWUCA resource concerns and management strategies based on updated information. Groundwater pumping had not increased in SWUCA as had been previously anticipated. Also, groundwater levels had not progressively decreased but were instead close to the previously proposed minimum level.

While awaiting the court appeals, the District Governing Board approved a conceptual management strategy to gain public input on a revised management approach. Meeting the SWUCA management goals, which remain largely unchanged, will require a coordinated, regional effort that includes incentives and projects that investigate, correct and prevent harm to the water resource; regulatory initiatives; development of alternative sources; and widespread education efforts.

In 1997, the Florida Legislature amended the Water Resources Act to clarify the water management district's responsibilities relating to water supply planning and water resource development. The legislation required the District to prepare a Water Supply Assessment to evaluate water demands projections to the year 2020 and compare these demands to the availability of known water sources. In those areas where existing or reasonably anticipated sources of water and conservation efforts will not be adequate to meet current or future water supply needs, a Regional Water Supply Plan (RWSP) must be prepared to further investigate water resource and supply development opportunities.

The SWUCA management approach includes not only completion and implementation of the RWSP, but the establishment of minimum flows and levels and any accompanying recovery and prevention strategy.

The District has initiated several resource management approaches to address the resource issues in the Myakka River and Peace River watersheds. The Falkner Farms Surface Water Exchange Project and the Shell Creek, Prairie Creek, Joshua Creek Back-Plugging Program are two strategies, which will improve and/or maintain ground water and surface water resources in the watersheds. These private/public partnerships are examples of resource management solutions that will enhance water resources in the Myakka River and Peace River watersheds.

Steven Minnis, Senior Community Affairs Coordinator
Southwest Florida Water Management District
6750 Fruitville Road
Sarasota FL 34240941/377-3722

Southwest Florida's Public Supply Water Resources and Treatment: Past, Present, and Future

Sam Stone, Peace River Manasota Regional Water Supply Authority

In Southwest Florida, public water utilities have provided water to the public using various types of water resources, requiring different types of treatment. Primarily the water resources used were confined to shallow ground water, deep ground water, and surface water from streams and rivers. Increased population growth over time, and the resulting need for additional volumes of water to meet public demand, typically caused utilities to change to other sources of water. New sources usually also required additional more complicated types of treatment. Over the years increased pumping of some resources caused water quality to decline. This decline in water quality usually resulted in utilities changing to other sources or changing to additional treatment. Finally, new and more stringent drinking water regulations also caused utilities to change water resources or the type of treatment required to deliver safe water to the public.

Today and into the future many of the same issues will have an impact on where future water supplies will come from and the type of treatment required to provide safe water to the public. Population growth is expected to continue in the region and the competition for water is expected to also increase as more groups compete for less available water within the region. Drinking water regulations continue to be developed and are becoming more stringent as technology and health effects science improves.

Relatively new just in the past decade, are new regulatory or legislative requirements to be implemented by the Southwest Florida Water Management District (SWFWMD). One issue is related to the Southern Water Use Caution Area (SWUCA), which will limit any new ground water use in the region to slow down salt water intrusion. Another is the requirement to set minimum flows and levels in various lakes, streams, rivers, and aquifers. The implementation of these rules may result in no additional use of a particular water resource to maintain current levels or a decrease in use of a particular water resource to allow recovery of a water source to some previous safe level.

Finally the SWFWMD has completed a Regional Water Supply Plan through the year 2020. This plan determines what water demands will occur in the region, and provides a possible list of water alternatives to help meet those needs through 2020. All of these emerging issues will have an impact on where available water resources are, how much volume is available, the type of treatment and ultimately the cost to the public for future water supplies in the region. These issues will therefore require long term planning by local public supply utilities, requiring the public to become informed about the issues and a part of the decision-making process.

Samuel S. Stone
Environmental Affairs Coordinator
Peace River Manasota Regional Water Supply Authority
8998 SW County Rd 769
Arcadia FL 34269863/993-4565
sspeariv@cyberstreet.com

Restoration and Management Plan for Lake Hancock/Upper Peace River System

Jeffrey F. Spence, Polk County Natural Resources

Lake Hancock is a 4,519 acre lake in central Polk County and is part of the watershed that constitutes the headwaters of the Peace River. The lake is a regional system of statewide importance for wildlife habitat, drainage, natural resource recreation, and potable water supply. The maximum water depth is 4.5 feet above an organic sediment layer (muck), which is up to 5.5 feet thick with an estimated volume of 18 million cubic yards. The lake has been extensively impacted in the past by man's activities, which has resulted in extremely degraded water quality and an imbalanced fish population. Poor quality water from discharges have been observed at the Peace River/Manasota Water Supply Authority Potable Water Facility, just north of Charlotte Harbor. Improvement of Lake Hancock's water quality is a quantifiable objective of the Charlotte Harbor National Estuary Program's *Comprehensive Conservation and Management Plan*. Numerous restoration efforts have been initiated over the past three decades, none of which have been implemented. In 1999 the Polk County Board of County Commissioners directed staff to establish a committee of impacted and concerned parties to develop a plan of action. The group has reached consensus on the goals for the restoration effort, which are:

1. Improve the quality of the water discharged form Lake Hancock by reducing Total Maximum Daily Loads (TMDLs),
2. Preserve and, where feasible, enhance the natural greenway/wildlife corridor (Peace River Green Swamp) through Polk County,
3. Maintain the exceptional wildlife values on Lake Hancock,
4. Enhance the diversity of the fishery, and
5. Provide habitat compatible public access for nature-based recreational activities and commercial fishing.

Polk County's approach involves land acquisition, wetland restoration, in-lake restoration, and management. Acquiring land around Lake Hancock through the County's Environmental Lands Program has been established as a high priority for achieving these goals. The Circle B Bar Ranch was acquired cooperatively by Polk County and the SWFWMD in December 2000. This 1,000 ± acre site includes the northern outfall of Saddle Creek and the outfall of Banana Creek, two of the three surface water inflows to Lake Hancock. Such acquisitions will allow for the creation of wetland treatment systems on the inflows to the lake, and will provide a greenway with improved wildlife habitat for establishing a natural corridor through central Florida. In December 2000 Polk County contracted with the Engineering firm of Camp Dresser & McGee (CDM) to develop a restoration and management plan for Lake Hancock and the Upper Peace River system. A draft of the plan will be summarized at the Summit. Funding for this project has been made available through a Surface Water Restoration Grant from the State of Florida's Water Advisory Panel, March 2000. The grant is administered by contract with the Florida Department of Environmental Protection.

Jeffrey Spence
Polk County Natural Resources Division
4177 Ben Durrance Road
Bartow FL 33830
863/534-7377

Robert Kollinger, Project Manager
Polk County Natural Resources Division
4177 Ben Durrance Road
Bartow FL 33830
863/534-7377
robertkollinger@polk-county.net

Charlotte Harbor Watershed Habitation

Wayne Daltry, Southwest Florida Regional Planning Council

When man arrived 10,000 years ago (Human Pre-History, Charlotte Harbor Symposium, March 1997, Dr. Robin Brown), the first actions that society undertook was to try to make the place habitable! Air conditioning, mosquito control, and drainage, as well as public works projects all have their analogues in that society.

The success of these efforts enabled population to grow to approximately 40,000 when the Spaniards first came in the early 1500s. Due to the Spanish practice of downsizing, permanent population in the area dropped to 0, and the ephemeral population left few records. Resettlement came with the Seminole migrations, and population may have climbed to 1% of the numbers existing before pre-Spaniard influence. United States interests pre and post statehood led to a downsizing of the Seminole population for the needs of as of yet unarrived population migration from the North. Fifty years after the Seminole wars, the population of the area had climbed to 15,000, less than half of what it was 400 years previously.

Population levels did not reach pre-Colombian estimates until prior to WWI. The nature of habitation to achieve those levels followed a basic pattern-a commercial/transfer node, with supporting residences, government, worship, education structures, the site being determined by transportation convenience and interconnection-a place where a railroad met a port, or two rail lines crossed, or a port was served by beaten paths connecting to an agricultural hinterland. Hamlets and villages would radiate out from the town on such unpaved tracks, and would be identified by having a store, a church, a social building, and a school-usually one room. As transportation improved , many of

these hamlets died out because transportation lag diminished and business and residents moved to town for more opportunities, leaving the rural areas to the individual farm or ranch, or the unique industry-phosphate mining, for example.
And so it was when Central/Southwest Florida was rediscovered. From 40,000 plus in 1910, we were 400,000 in 1960-and 1.6 million in 2000.

Wayne Daltry, Director
Southwest Florida Regional Planning Council
4980 Bayline Drive, 4th Floor
North Fort Myers FL 33917-3909
941/656-7720
Fax 941/656-7724
wdaltry@swfrpc.org

Ensuring a Viable Future for Florida's Rural Lands

Craig Evans, Florida Stewardship Foundation

Four Points to Keep in Mind:
1. Without profit, there will be no agriculture
2. ... and no forestry
3. Land use tends to follow economics
4. Land intensification results primarily rom economic decisions

How Much are Natural Resource Values Worth? There is great irony in the way we view our land and its value for different uses. While natural habitats that are rare and fragile are considered priceless by society, our market economy gives them a low value.

Some priceless natural resources that will not increase your property value.
• Wetlands
• Wildlife Habitat
• Presence of Threatened & Endangered Species
• High Food Production Capability
• Clean Drinking Water
• Clean Air
• Productive Fisheries
• Biological Diversity
• Scenic Views
• Biological, Botanical and Scientific Opportunity
• Soil Conservation
• Soil Creation
• Carbon Sequestering
• Flood Control
• Traditional Rural Character

In fact, these resource may actually reduce your property value. This presentation will explore why, as a direct result of the way in which land is appraised and valued in Florida, we almost predetermine that the last crop will be asphalt. It also will discuss:

Tools for Creating Vibrant Rural Areas. BASIC PREMISE: Tools are needed that will address problems, not just the symptoms to problems

• Rural Land Protection Tools that Work, But Need Improvement
• New Rural Planning Tools
• Conservation Payments Tied to Natural Values.
• Recent legislation that has been passed (in the Florida Legislature) and is pending (in the U.S. Congress) that will carry out a new "rural vision" for Florida.

Craig Evans
Florida Stewardship Foundation
621 NW 53rd Street, Suite 240
Boca Raton FL 33487
561/995-1474
info@fl-stewardship.com

Phosphate Mining: Land Use Effects in the Peace River Basin

Lee F. Thurner, Florida Phosphate Council

Phosphate mining is a significant land use in the Peace River Basin, with some fifteen percent of the land in the basin directly involved in past or expected future mining activities.

The current and future effects of this mining on the landscape within the basin are discussed in a brief photo essay. Its effects on the hydrology of the region, and therefore on the water supply to users downstream, are examined through presentation of data which help to answer questions about groundwater use, stream flow, aquifer recharge, water quality, and other water issues.

Sponsor: Florida Phosphate Council, Inc. (1435 East Piedmont Drive, Suite 211, Tallahassee FL 32308, 850/224-8238)

Lee F. Thurner
Retired Vice President of Mining Operations
IMC Phosphates Company
2464 Sierra Lane
Punta Gorda FL 33950
941/575-9876
lthurner@aol.com

The Value of Natural Land Preservation

Robert Repenning, FDEP Charlotte Harbor Aquatic and State Buffer Preserves

Large portions of the Charlotte Harbor watershed have been set aside in their natural state. The reasons for these acquisitions are varied but together represent a big step towards protecting Charlotte Harbor. Land set aside and maintained in a natural state provides green space, recreational opportunities, wildlife and fisheries habitat, drinking water reservoirs, well field protection, air quality maintenance, and surface water quality protection.

Land preservation has occurred through acquisition, donation, mitigation and fee simple agreements. Federal, state, and local governments, private land conservancies, and the generosity of individual and corporate donations are means used for land acquisition. While the method of acquisition varies the overall impact to the community is the same — a better place to live.
The fear of loss of tax revenue from lands being taken off the tax rolls is more than paid for by the benefits that green space provide the community and the increased property value of adjacent lands because of neighboring green space.
The Charlotte Harbor community has identified land preservation as a goal in the Charlotte Harbor National Estuary Program *Comprehensive Conservation and Management Plan*. The partnerships that make up the NEP are currently coordinating a comprehensive look at what lands have been acquired and where gaps exist that if filled, would better serve in protecting the Harbor. The overall NEP habitat goal is to increase the acreage of land in conservation, preservation, and stewardship over the 1998 acreage by 25% by 2018.

Robert Repenning
Program Coordinator
Department of Environmental Protection
Charlotte Harbor Aquatic and State Buffer Preserves
12301 Burnt Store Rd.
Punta Gorda FL 33955
941/575-5861
941/575-5863
Robert.repenning@dep.state.fl.us

A Citizens Guide to Watershed Management Efforts in the Peace and Myakka River Basins

Alton Cheatham, Charlotte Harbor Environmental Center, Inc.

The field of environmental resource management is going through a time of fundamental change. For much of the 20th century environmental resources were viewed as commodities, and public and private organizations spent large sums on projects designed to control and develop those resources for economic purposes. The last several decades, however, have brought greater emphasis on environmental quality and integrated resource management.

In the case of water and watershed resources, projects undertaken in the first half of the 20th century typically focused on the construction of water control infrastructure: dams, reservoirs, canals, pump stations and the like. In recent decades the U.S. Congress - through the federal Clean Water Act and related legislation - has called for a change in focus, emphasizing the restoration and maintenance of the physical, chemical and biological quality of the nation's waters (e.g., "fishable and swimmable" waters) as priority national goals.

In 1999, the National Research Council (NRC) issued a report recommending "watershed management" as the preferred approach for achieving these goals. The approach suggested by the NRC includes the following steps.

1. identify each watershed's priority resource management issues, and select specific, quantifiable objectives for their resolution;
2. define the appropriate temporal and spatial scales for addressing the priority issues;
3. identify all relevant stakeholders, and provide each an opportunity to

participate in the decision making process;
4. identify tradeoffs among the alternative solutions;
5. identify shared values guiding the selection of alternatives; and
6. select and implement the best management actions to balance among tradeoffs.

Fortunately, a number of regional, state, and federal agencies are already involved in active watershed-based management programs that include the Peace and Myakka River basins. Agencies involved in these efforts include the Southwest Florida Water Management District, the Florida Department of Environmental Protection, the Charlotte Harbor NEP, the Gulf of Mexico Program, and the U.S. Environmental Protection Agency, among others.

This session of the Public Conference will give interested citizens an overview of some priority watershed management issues in the Peace and Myakka River basins - based on a series of technical workshops held in the basins during 2001 - and of several watershed-based programs that are currently working to address those (and other) management issues in the region.

Additional information, including a Citizens Guide summarizing the results of the 2001 Peace-Myakka technical workshops, are available on the Charlotte Harbor Environmental Center web site (www.checflorida.org).

Project Sponsors: The Charlotte Harbor Fund, U.S. EPA-Gulf of Mexico Program and Charlotte Harbor National Estuary Program

Key words: watershed management, indicators, management goals, collaboration, consensus, Peace and Myakka Rivers
Alton Cheatham
Chief Executive Officer
Charlotte Harbor Environmental Center, Inc.
10941 Burnt Store Road
Punta Gorda FL 33955
941/575-5495
Fax 941/575-5497
alc47@ewol.com
www.checflorida.org

Gerold Morrison, Ph.D.
Environmental Consultant
828 Glades Court NE
St. Petersburg FL 33702
727/526-7884
Fax 727/526-7884
gerold.morrison@att.net

Tiffany Lutterman Busby
Environmental Management Consultant
4211 U.S. Highway 1 South, #53
St. Augustine FL 32086
904/824-7808
Fax 904/826-0444
tlbusby@aug.com

Tom Singleton
Watershed Planning and Coordination Section
Florida Department of Environmental Protection
2600 Blair Stone Road, MS 3565
Tallahassee FL 32399
850/921-2369

Estero Bay Tidal Circulation Patterns

H.J. Mitchell-Tapping, T.J. Lee and C.R. Williams
Estero Bay Marine Laboratory/Ostego Bay Foundation
Fort Myers Beach FL 33908
hmt@peganet.com
941/768-5274

Key words: circulation pattern, Estero Bay, inlets, null-points

Tidal current circulation is of utmost importance to Estero Bay in that it plays a dominant role in transporting, flushing, and diluting various contaminants from their sources to seaward locations and is the first step toward developing a management plan for estuarine resources. The circulation patterns within the bay system are highly dependent upon the cross-sectional areas and the locations of the inlets connecting the bay to the Gulf of Mexico. Estero Bay tides have a tidal period of 12.25 hours and a range of approximately 0.94 times the open coast range at Naples, with an average range during ebb of 1.77 ft., while in the Gulf the range is 1.87 ft (Suboceanic Consultants, 1978). In the past, the bay has had eight or more tidal inlets: from north to south: Matanzas Pass (affects only the northwestern area); Hurricane Pass (closed) leads to Hurricane Bay; Mid Island Pass (closed) leads to Hell Peckney Bay; Big Carlos Pass (affects only the north and north-central central area); Little Carlos Pass (closed); New Pass (affects only the southern and south-central central area) Big Hickory Pass; Little Hickory Pass (closed); Little Carlos, Big Hickory and Little Hickory Passes have a historical record of periodic closure. The amount of water that flows through the various passes during each tidal cycle varies significantly, with Big Carlos and Matanzas Passes having the largest tidal prisms.

The locations of the null zones within the system have a significant effect on the biota and the flushing characteristics of the different segments within the bay and therefore the water quality. The most significant input flow in that area comes from stormwater runoff from the Ten-mile Canal-Mullock Creek, Estero River and Imperial River, with only very minor occasional amounts of stormwater runoff passing through Matanzas Pass.

This study has spent many hours investigating the current patterns and have determined that there are changes in the location of ebb and flow null zones in the bay that have shown different flushing capabilities of the tidal currents. The interaction between the tidal waves entering in the various bay inlets creates a complex circulation pattern characterized by areas of strong currents near the passes and null zones in the bay between inlets. The null zone is characterized by near-zero tidal flow and direction. The location of the null zone depends significantly on the location and configuration of the passes, and may shift dramatically if a new pass is opened or an existing pass is closed, such as Big Hickory Pass.

There are four proposed major segments in the bay which are further divided into subdivisions. Some of these lettered subdivisions are based on tidal-current circulation patterns. We have mapped the major boundaries for each segment of the bay based on tidal current null-circulation patterns by observing the drift direction of hundreds of buoys, attached to submerged crab pots, and with home-made indicators. Null-points may vary and actually be a wider zone at certain times of the year due to changes in tidal height, stormwater runoff quantity, and opening and closing of inlets. This study also determined water-quality subdivisions as determined by water quality changes that are due to different drainage runoff areas. Segment 1 is influenced by the circulation of the tidal current pattern controlled by Matanzas Pass for tide ingress and egress and also by the main drainage flow input areas from southwest and southern South Fort Myers. In this segment, there are two major tidal current null-points, one in Hurricane Bay and another stretches across the bay from Estero Island and into Hell Peckney Bay as far as Dog Key (between segments 1 and 2: a bird rookery island is present near to this null-point). Segment 2 is influenced by the circulation current pattern controlled by Big Carlos Pass. This segment is also influenced to a greater and lesser degree by runoff from Ten-mile Canal, Estero river, small creeks, and the northeastern part of Hell Peckney bay. A null-point exists between segments 2 and 3 (also with a nearby bird rookery). Segment 3 is influenced by the current pattern controlled by New Pass, and is influenced by runoff from Spring Creek. Segment 4 is influenced by the current pattern controlled by Big Hickory Pass. This segment is divided into two sub-divisions, 4a and 4b, based on the tidal current patterns in the Bay from Hogue Channel and of input from the Imperial River into Fish Trap Bay. There is also a null-point between the waters from Wiggins Pass and Big Hickory Pass, south of Bonita Beach Road bridge in Little Hickory Bay in Collier County. One important result of this study of the circulation patterns and null zones shows that no pollution in one sector could affect the waters of other sectors of the bay. For example, an oil spill in Matanzas Pass area could not affect the waters of central Estero Bay. Other results show the importance of circulation patterns and null zones to the biota of the bay.

Identification and Prioritization of Natural Resource Lands for Acquisition and Conservation

Debra Childs, GIS Manager
URS Corporation
One North Dale Mabry Highway, Suite 700
Tampa FL 33609
813/875-1115
Fax 813/874-7424
debra_childs@urscorp.com
www.urscorp.com

Sponsor: Manatee County, Office of the County Administrator

Project Manager: Charlie Hunsicker, Ecosystems Administrator, in coordination with the Manatee County Environmental Land Management and Acquisition Committee (ELMAC)

Key words: conservation, acquisition, GIS, Manatee County, resource value, ranking

The Manatee County "Identification of Natural Resource Lands" project seeks to identify and prioritize important natural resource lands for the purpose of conservation and acquisition. The project approach involves combining screening-criteria data in a Geographic Information System (GIS) model. This method provides an objective, quantitative and standardized means of identifying natural resource value. The model structure offers the flexibility of considering both overall ranking and component rankings, and is scalable for further prioritization.

The County and the Environmental Land Management and Acquisition Advisory Committee (ELMAC) previously developed screening criteria to evaluate individual sites. The criteria were interpreted for use in this county-wide model using existing GIS data, and spatial overlay methods. The four criteria used to rank lands based on their natural resource value are habitat rarity, habitat quality, surface water resource protection, and connectivity. Each of the four criteria is composed of multiple 'sub-criteria', and each sub-criterion has its own ranking. Overall criteria rankings are calculated using a weighted average of the components. Site specific (parcel) assessments are made using an area-weighted average of rankings within the parcel.

Model development included input, review, refinement, and approval of data sources and methods by local experts and the ELMAC. Data sources used in the model include: aerial photography, land use and land cover, habitat and land cover, bio-diversity hotspots, focal species, streams, surface water classification, basins, floodplains, wetland type, existing conservation lands, and parcels. Results indicate that the model effectively ranks land according to natural resource value. Phase II of the project will further prioritize lands according to more human-based values such as assessed land value, development potential, and other factors related to ease of acquisition.

Abundance and Distribution of Juvenile Gray Snapper (*Lutjanus griseus*) in Charlotte Harbor, Florida

Aaron Lando
Florida Fish and Wildlife Conservation Commission (FWC)
Florida Marine Research Institute (FMRI)
Charlotte Harbor Field Laboratory
1481 Market Circle, Unit 1
Port Charlotte FL 33953-3815
aaron.lando@fwc.state.fl.us
941/255-7403
Fax: 941/255-7400

Acknowledgment: This work was supported in part by funding from Florida saltwater license sales and the Department of the Interior, U.S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.

Keywords: Charlotte Harbor, snapper, juvenile fish habitat

Since April 1989, the Florida Marine Research Institute's Fisheries Independent Monitoring Program (FIM) has been monitoring the status and relative abundance of fish and selected invertebrate species in Charlotte Harbor, Florida. The FIM program, using various gear types (i.e., seines and trawls) has collected data on many juvenile gray snapper (*Lutjanus griseus*). Between Jan. 1996-Dec. 2000 young-of-the-year (YOY) gray snapper recruited to the estuary from July to November with the peak of recruitment occurring in October. Larger juvenile gray snapper (> 70 mm SL) appear at greatest frequencies from June through October. The majority of gray snapper captured in the estuary were collected in seagrass and mangrove habitats located near the passes in Gasparilla and Pine Island Sounds where salinities are consistently higher.

Fish Health Monitoring in the Charlotte Harbor Estuary

Sandra Lavoie
Florida Fish and Wildlife Conservation Commission (FWC)
Florida Marine Research Institute (FMRI)
Charlotte Harbor Field Laboratory
1481 Market Circle, Unit 1
Port Charlotte FL 33953-3815
941/255-7403, SunCom 758-7404
Fax: 941/ 255-7400 sandra.lavoie@FWC.state.fl.us

Acknowledgment: This work was supported in part by funding from Florida saltwater fishing license sales and the Department of the Interior, U. S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.

Key words: Florida, Charlotte Harbor, fish health

As coastal development and the resultant degradation of aquatic ecosystems by the influx of nutrients and other pollutants increase, so does the occurrence of certain diseases in Florida fish populations. Since April 1998, the Fish and Wildlife Conservation Commission's Florida Marine Research Institute (FMRI) has been collecting and examining fish with external abnormalities as part of the Fisheries-Independent Monitoring (FIM) program. Fish that were included in these health studies had such abnormalities as bloody or red areas, scale loss or erosion, fin rot or erosion, skeletal abnormalities, tumors or masses of abnormal tissue, lesions or ulcers, parasites, "pop-eye," and broken lateral lines. All fish collected were sent to the Aquatic Health Group of FMRI in St. Petersburg for further examination. FMRI's state-of-the-art histology and electron microscopy laboratories provide a means of identifying pathogens and evaluating pathological changes in tissues. Between April of 1998 and December of 2000, 34 fish representing 15 species were sent from Charlotte Harbor to the St. Petersburg lab for examination. Eleven of those were catfish that were diagnosed as having symptoms (red lips) of a catfish virus. Forty-four catfish that were captured and released in 2000 were found to have symptoms of the virus. By continuing FIM collections and documentation, we will increase the quantity and quality of the baseline information needed to assess the health, of fish in our estuaries.

Using Biomass Estimates to Identify Geographic Areas of Importance for Fish and Crustaceansin Charlotte Harbor, Florida

Laurel Brant, Timothy C. MacDonald, and David Blewett
Fisheries Biologist
Florida Fish and Wildlife Conservation Commission (FWC)
Florida Marine Research Institute (FMRI)
Charlotte Harbor Field Laboratory
1481 Market Circle, Unit 1
Port Charlotte FL 33953
941/255-7403
Fax 941/2557400
dave.blewett@fwc.state.fl.us

Acknowledgment: This work was supported in part by funding from Florida saltwater fishing license sales and the Department of Interior, U.S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.
Key Words: Fisheries-Independent Monitoring (FIM), Geographic Information Systems (GIS), fish and crustacean biomass

The Fisheries-Independent Monitoring Program (FIM) identified geographic areas of importance for juvenile, sub-adult, and adult fishes and three selected crustaceans by combining the techniques used to analyze fisheries data with those used to analyze Geographic Information Systems (GIS) data. Fish and crustaceans were collected using 21.3-m bag seines, 183-m haul seines, and 6.1-m otter trawls in Charlotte Harbor from 1989 to 1997. To calculate biomass estimates we used individual lengths for fish species, carapace width for blue crabs and stone crabs, and postorbital head length for penaeid shrimp. Biomass estimates for all species in a sample were combined. Total sample biomass values were compared to the maximum value for each gear type, season, and year and then rescaled from 0 to 100. Data were interpolated between sample points (n=5,259) via the ArcView (3.0b) Spatial Analyst extension and universal linear krigging. A grid of estimated biomass values and a map of areas of importance for fish and invertebrates were produced in the Charlotte Harbor estuary. Biomass was also estimated for a subset of thirty 'selected species' considered important to Florida's commercial and recreational fishing industries. Geographic areas of high biomass of both fish and crustaceans were included as part of the cooperative Florida Blueways Project.

Fish Communities of the Tidal Portion of the Myakka And Peace Rivers

Chuck Idelberger
Florida Fish and Wildlife Conservation Commission
Florida Marine Research Institute
1481 Market Circle, Unit 1
Port Charlotte FL 33953
941/255-7401
Fax 941/255-7400
chuck.idelberger@fwc.state.fl.us

Acknowledgment: This work was supported in part by funding from Florida saltwater fishing license sales and the Department of the Interior, U. S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.

Keywords: Peace and Myakka Rivers, tidal riverine fish communities, southwest Florida

The Fisheries-Independent Monitoring program (Fish and Wildlife Conservation Commission's Florida Marine Research Institute) has been conducting intensive fisheries sampling in Charlotte Harbor since 1989. Fish communities in the tidal portions of two Charlotte Harbor tributaries, the Myakka and Peace Rivers, are of particular interest in light of past and potential environmental impacts from increased development, phosphate mining, and water withdrawal. Data collected with 21.3m seines and 6.1m otter trawls from 47 months of stratified-random sampling (February 1996-December 1999) were used to 1) describe the fish fauna and 2) examine the

variation in community composition between rivers, habitats (nearshore vs. offshore), seasons, and river location (upstream vs. downstream). Over 550,000 fish (representing 99 taxa and 41 families, in 846 samples) were collected. Anchoa mitchilli (bay anchovy) was by far the most numerous species taken, followed by Menidia spp. (silversides), Cynoscion arenarius (sand seatrout), Lucania parva (rainwater killifish), Eucinostomus harengulus (tidewater mojarra), and Gambusia holbrooki (eastern mosquitofish). Fish communities in the tidal portions of the Myakka and Peace Rivers were similar. Habitat (nearshore vs. offshore) and season were the most influential factors of those examined in determining community composition, followed by river location (downstream vs. upstream). Fish were more abundant and diverse in nearshore habitats than in offshore habitats. Seasonal community differences were defined by the different life cycles of individual species, particularly the more polyhaline fishes whose young utilize the study area as a temporary nursery. The tidal portions of the Myakka and Peace Rivers support substantial, diverse, dynamic fish communities in addition to serving as nursery areas for important sport and commercial species.

Summary of Fish Tagging by the Fisheries-Independent Monitoring Program

William L. Curnow, Kimberly B. Amendola, Brent L. Winner
Florida Fish and Wildlife Conservation Commission
Florida Marine Research Institute
1481 Market Circle, Unit 1
Port Charlotte FL 33953
941/255-7401
Fax 941/255-7400
bill.curnow@fwc.state.fl.us

Acknowledgment: This work was supported in part by funding from Florida saltwater fishing license sales and the Department of the Interior, U. S. Fish and Wildlife Service, Federal Aid for Sportfish Restoration Project Number F-43 to the Florida Fish and Wildlife Conservation Commission.

Key words: Florida, fish tagging, recapture rates, distance traveled, and days at large

Between January 1, 1994 and December 31, 1997, 8,945 fish representing 44 species were tagged and released in six Florida estuarine systems (Tampa Bay, Charlotte Harbor, Indian River Lagoon, Cedar Key, Choctawhatchee Bay, and Florida Bay) by staff of the Fisheries-Independent Monitoring Program (FIM). By June 30,1999, nine hundred and thirty of these fish were reported recaptured, the majority (81.4%) by anglers. The remainder of the 930 (18.6%) were recaptured during the FIM program’s standard estuarine sampling. Data collected on four target species were analyzed: sheepshead (*Archosargus probatocephalus)*, spotted seatrout (*Cynoscion nebulosus*), common snook (*Centropomus undecimalis*), and red drum (*Sciaenops ocellatus*). Recapture rates, distance traveled, and days at large were calculated for these four targeted species in each estuary. Rates at which anglers recaptured tagged fish in Tampa Bay, Charlotte Harbor, and the Indian River Lagoon were similar. Angler recapture rates for all areas ranged from 12.1% to 14.5% for red drum, 7.5% to 9.8% for snook, 1.8 % to 3.2% for sheepshead, and 1.5% to 3.8% for spotted seatrout. Most of the recaptures were made within ten nautical miles of the release site. Longest time at large was more than 1,000 days for snook and red drum, 540 days for sheepshead, and 420 days for spotted sea trout.

Sustainability of Water Resources can be Achieved in Florida

Kurt O. Thomsen, Ph.D., P.G.
Tetra Tech Inc.
71 N. Washington Road
Lake Forest IL 60045-2431
847/615-2473
Fax 847/615-2472
thomsek@ttemi.com or thomsenko@aol.com

Key words/phrases: water resources, sustainability, quality of life, water consumption, water capacity, water storage

Florida's water resource problems have concerned residents for many years. The recent drought has emphasized the fact that Florida's water problems are not improving. Florida's water resources are being depleted at a record rate. Reduced groundwater discharge to Florida rivers is beginning to impact Florida's ecology. Many studies have been completed over the years that have all reached the same conclusion - Florida's groundwater reservoir is being depleted at a rate far faster than it can be replenished. The population continues to grow, and more developments are commissioned, but no one knows how much water is required to sustain this growth. In the near future, the depletion of water resources will begin to affect growth, tourism, and the quality of life.

To manage Florida's water resources for sustainability, Florida's use patterns must shift from dependence on stored water to water that is replenished annually. Two things must be accomplished for this shift in water dependence to be implemented. First, the annual water consumption rate for a given area must be determined and second, the system affected by the annual replacement of water needs to be defined and its capacity determined. Once this is accomplished and consumption is compared to capacity, planners will know what needs to be done. If capacity is greater than consumption, then there is room for growth. If consumption is greater than the capacity, then there is no room for growth and planners will have to implement policy to maintain the status quo.

This paper describes a water resource management approach implemented by a group of small communities located in northeastern Illinois, this approach is very applicable to the situation in Florida. A committee of citizens was formed to establish water resource management policy, with the goal of sustaining a good quality of life. This committee implemented a five step process to attain the goal, including:

(1) providing training to familiarize the committee members with the characteristics of the area's hydrologic system,
(2) collect the data to establish baseline conditions,
(3) analyzing data and preparing data presentations,
(4) reviewing analyzed data and recommending changes to water management policy, and
(5) reviewing the changes and implementing the viable ones as the new water resource management policy.

Charlotte Harbor National Estuary Program

4980 Bayline Drive, 4th Floor

North Fort Myers FL 33917-3909

941/995-1777 ~ Fax 941/656-7724

www.charlotteharbornep.org ~ chnep@swfrpc.org