Charlotte Harbor Conference

“Sound Science in 2004”
October 5-6, 2004

Mote Marine Laboratory
Keating Marine Education Center
1599 Ken Thompson Parkway ~ Sarasota FL 34236
Charlotte Harbor Conference

"Sound Science in 2003-2004"
Program

E.D. Estevez, Organizer

Mote Marine Laboratory
Keating Marine Education Center
1599 Ken Thompson Parkway ~ Sarasota FL 34236

October 5-6, 2004
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Dedication

The Charlotte Harbor Program was funded by the Mote Scientific Foundation in recognition of William R. Mote's enthusiasm for the sea and desire to promote its wise stewardship. Mr. Mote had a personal interest in southwest Florida and made it possible for the Laboratory to conduct numerous seminal studies of Charlotte Harbor.

"When you get right down to it, we've been taking from the sea for a long time, and it's time we start giving back more than we take."

W.R.M.

The scientific staff of Mote Marine Laboratory and our partners in research respectfully dedicate this review of 2003-2004 research in Charlotte Harbor to Mr. Mote.
Preface

This October conference marks the conclusion of a year of sound research in Charlotte Harbor, Mote Marine Laboratory’s third year of field study in a long-term, multidisciplinary investigation of the Harbor.

The scientific objective of the Charlotte Harbor Program is to understand and predict how natural and human-caused changes to freshwater quantity and quality will affect the structure, function, and condition of the estuary and its valued ecosystem components. These research questions developed in 2000-2001 guide the study:

- How do freshwater inflow and its constituents structure the ecology of the estuary and regulate its productivity and what will be the long-term consequences of flow alterations?
- How do riverine and other algal blooms affect the onset, duration, and extent of hypoxia?
- What is the role of natural perturbations, particularly hypoxia, in controlling the distribution and abundance of estuarine plants and animals?
- What processes mediate trophic links in the estuary’s food-web, and how strongly are hydrological and chemical factors made manifest in secondary production, especially of fishes and other top carnivores?
- What estuarine areas are important to large mobile fauna, including endangered species, and how do natural and anthropogenic stressors affect the quality of the areas or health of the species?

Conference lectures and posters will describe a remarkable diversity of discoveries by Mote scientists and research partners. This work promises to write new chapters in the book of what is known about Charlotte Harbor, and thereby enrich public appreciation as well as scientific understanding of the region’s most productive and beautiful natural resource.

The challenge for next year’s work will be to develop and expand upon our research partnerships, and further coordinate the many sampling and measurement programs developed in 2003-2004. Scientists have developed viable systems of study within their respective disciplines and now the time has come to link the systems in space and time. Success in the coming year will set the stage for integrating our studies to understand causes and their effects among disciplines, a necessary accomplishment as we seek to achieve reliably predictive capabilities.

On a personal note, I wish to thank all of the staff and volunteers at the Laboratory and our partners in research for bringing so much enthusiasm to this Harbor program. I have especially appreciated the excitement of collaboration and discovery that has been evident both in Sarasota and at the Field Station, and wish each investigator a safe and productive new year of research.

E.D. Estevez
2004 has been a challenging year. As we work to bring perspective and meaning to our Charlotte Harbor research the science community of southwest Florida has struggled under the burden of a season of hurricanes in much the same way the region itself has been affected. Damage and even the complete loss of research infrastructure parallel the damage and loss of homes, businesses, and schools that comprise the whole fabric of our lives.

Efforts to restore our research capabilities are ongoing, even during this conference, and will continue for months to come. As Florida scientists we are improvising and helping one-another to regain our abilities to do our jobs in service to society, but the process is imperfect because we must learn by doing.

As a result of the challenges that individuals and institutions have been working to overcome, this Conference Program may contain some errors and omissions. But as much as it is a summary, the Program is also a celebration of our spirit and our intent to get back to work sooner rather than later. We will make sure the program as posted on the web after the conference will be free of mistakes. In the interim, we appreciate your patience and cooperation, and thank participants for their extraordinary efforts to make the conference possible.
Tuesday October 5 Morning Presentations

Moderator: Bob Hueter

0915 Estevez, E. Welcome and Opening Remarks


0950 Culter, J. and J. Leverone. "C.S.I. Charlotte Harbor: Was Benthic Mortality Due to Low Oxygen or Low Salinity?"


1050 Break


1230 Lunch
Tuesday October 5 Afternoon Presentations

Moderator: Ken Leber


150p Barlas, M., L. Keith, and M. Peterson. "Manatee Winter Use of A Natural Warm Water Site at Warm Mineral Springs, Florida."

210p Leverone, J. "Restoration of Bay Scallop Populations in Pine Island Sound: Competent Larval Release Strategy."


250p Heupel, M.R., A. Barker, and B.G. Yeiser. "Examination of Movement Patterns of Sharks in Pine Island Sound and the Caloosahatchee River."

330p-530p Poster Session

(Names of NSF-REU intern mentors are underlined.)

Barber, A. and J. Leverone. "The effects of Karenia brevis on filtration and clearance rates in four species of juvenile bivalve mollusk."


Broderick, E. and B. Robbins. "Vallisneria americana: How Does the Garden Grow?"


Gagner, B. and J. Culter. "Tolerances of select Charlotte Harbor benthic invertebrates to hypoxic conditions."

Hansen A. and G. Kirkpatrick. "Detecting the red tide, Karenia brevis."


Lavelle, C. and J. Gelsleichter. "Using liver slices and hepatocyte cultures for in vitro vitellogenin induction in Atlantic stingrays."
Miller, T. Tucker and J. Foote. "Research on the effects of beach nourishment and upland lighting on the nesting preferences of the loggerhead (Caretta caretta) sea turtle in Sarasota County."


Thornton, B. and A. Adams. "Evaluation of PIT (passive integrated transponder) tagging as a method for tracking the movements of juvenile common snook, Centropomus undecimalis."


430p - 530p Conference Social

**Wednesday October 6 Morning Presentations**

**Moderator: Rich Pierce**


0930 Locascio, J. and D. Mann. "Effects of Hurricane Charley on Fish Sound Production."


1030 Pednault-Willett, K. "Hurricane Charley's Visit to J.N. "Ding" Darling National Wildlife Refuge Complex."

1050 Break


1230 Lunch

**Wednesday October 6 Afternoon Presentations**

**Moderator:** Ernie Estevez


150p Staugler, E. "Florida Sea Grant, A Partnership of Partnerships - Along the Coast, in the Harbor, and in the Community."

210p Locascio, J. and D. Mann. "Seasonal and Interannual Variation in Fish Sound Production in Charlotte Harbor."


310p Niebuhr, D. "Rapporteur's Summation of the Conference and Interpretation"
Research Sponsors

Mote Scientific Foundation

American Elasmobranch Society
American Society for Engineering Education
Appleby Foundation
Charlotte Harbor National Estuary Program
Chicago Zoological Society
Conservancy of Southwest Florida
Disney Wildlife Conservation Fund
Earthwatch Institute
Florida Fish and Wildlife Conservation Commission
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PADI Project Aware Foundation
Raymond Mason Foundation
Rutgers University
Sanibel-Captiva Conservation Foundation
Satellite PTT
Science Consortium for Ocean Replenishment
South Florida Water Management District
Southwest Florida Water Management District
U.S. Geological Society
University of South Florida
US Fish and Wildlife Service
YSI, Incorporated
# Research Partners

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<tr>
<td>Charlotte Harbor Environmental Center/Charlotte County Cooperative Extension Program</td>
<td>Elizabeth Staugler</td>
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<td>Chicago Zoological Society/Brookfield Zoo</td>
<td>Stuart Strahl</td>
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<td>The Conservancy of Southwest Florida</td>
<td>Jeffrey R. Schmid</td>
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<td>Dauphin Island Sea Lab &amp; University of South Alabama</td>
<td>John Valentine</td>
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<td>Eckerd College</td>
<td>Greg Brooks, D. Duncan, and Rebekka Larson</td>
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<td>Florida Department of Agriculture</td>
<td>R. Sherman Wilhelm and Paul Zajicek</td>
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<td>Florida Department of Environmental Protection</td>
<td>Charles Kovach, Keith Laakonnen, Judy Ott and Bob Repenning,</td>
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<td>Florida Gulf Coast University</td>
<td>Mike Savarese, Greg Tolley, and Aswani Volety</td>
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<td>Florida Fish and Wildlife Conservation Commission</td>
<td>Bruce Ackerman, Luiz Barbieri, Dave Blewett, Margie Barlas, Paul Carlson, William S. Arnold, Alex Costidis, Bill Curnow, Kristen Fick, Mindy Foley, Andy Garrett, Patti Haase, Steve Geiger, Elsa Haubold, Kari Higgs, Chuck idelberger, Lucy Keith, Kevin Madley, Andy May, Anne Meylan, Bob McMichael, Tom Pitchford, Gregg Poulakis, Sentiel Rommell, and Phil Stevens</td>
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<td>Harbor Branch Oceanographic Institution</td>
<td>Greg Bossart</td>
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Charlotte Harbor Conference  
"Sound Science in 2003-2004," October 5-6, 2004
Horn Point Lab - University of Maryland

Iowa State University

J.N. "Ding" Darling National Wildlife Refuge

Lowry Park Zoo

Mystic Aquarium & Institute for Exploration

National Oceanic and Atmospheric Administration

National Marine Fisheries Service

Randell Research Center

Rutgers University

Sanibel-Captiva Conservation Foundation Marine Laboratory

South Florida Water Management District

Southwest Florida Water Management District

U.S. Department of Agriculture

U.S. Geological Survey

University of Florida

University of South Florida

University of California, Davis

Evamarie Koch

Donna Surge

Kendra Pednault-Willett and Susan White

Dave Murphy

Tracy Romano

Mary Culver, Mark Finkbeiner, Mark Fonseca, Anna Sellas, Patricia Rosel, Barbara Taylor, Karen Martien, Mike Rink, and Teri Rowles

Blair Mase and Sarah Gomez

Karen Walker and John Worth

Oscar Schofield

Steve Bortone and Jaime Greenawaldt

Tomma Barnes, Bob Chamberlain, and Peter Doering

Chris Anastasiou, Kris Kaufman, David Tomasko, and Sid Flannery

Terence Evens

Tom Smith, III and Chuck Holmes

Kendal Harr

Bob Weisberg, Lianyuan Zheng, and David Mann

Jeff Scott
Seminars


Ingrao, D. 2004. Spread of green mussels along the southeast coast of the United States. Boca Grande Cleanup Diver’s Meeting, Fantasea SCUBA.


Heupel, M.R. As time goes by: examining the long-term movements of fish and their importance to the design of MPAs. American Association for the Advancement of Science Meeting. Seattle, Washington, Feb. 12-16, 2004 (Invited Speaker).


Tucker, A.D. Charlotte Sun-Herald, Charlotte Harbor study enforces ecological links. 10/09/03


Tucker, A.D. Fort Myers News-Press. Eyes wanted for sea turtles, 11/29/03


Tucker, A.D. Charlotte Sun-Herald. Public asked to help record sea turtle sightings, 12/01/03.


Tucker, A.D. 2003. Sea Turtle Research at Mote, University of Miami and College of Charleston visiting marine science graduate programs.


Tucker, A.D. Sarasota Herald Tribune. Researchers want help spotting turtles, 11/25/03


## Interns

| Barry University                          | Roody Pierre-Charles                  |
| College of the Ozarks                    | Katie Brueggan                        |
| Coastal Carolina University              | Pam Madden                             |
| Cornell University                       | Lauren Abdelmessih                    |
| Eckerd College                           | Bridget Thornton                      |
| Grand Valley State University (Michigan) | Ryan Decker                           |
| Loyola University                        | Gary Kirkilas                          |
| Northland College                        | Allison Hansen                        |
| Roger Williams University                | Candice Lavelle                       |
| Universidade Federal do Rio Grande do Sul (Brazil) | Katia Groch                   |
| University of California, Berkeley       | Trevor Miller                          |
| University of California, Santa Cruz     | Holly Taylor                           |
| University of Houston                    | Sara Mouzi                             |
| University of North Carolina, Raleigh    | Christine Hodgdon                     |
| University of North Carolina, Wilmington | Andrea Barber                          |
| University of South Florida              | Breanna Fulcher                       |
| University of the Virgin Islands         | Emily Broderick                       |
| Western Washington University            | Brooke Gagner                         |
Dissolved Oxygen Dynamics in Charlotte Harbor and its Contributing Watershed, in Response to Hurricanes Charley and Frances

David Tomasko1, Chris Anastasiou1, Charles Kovach2, and Philip Stevens3

1Southwest Florida Water Management District
2Florida Department of Environmental Protection
3Florida Fish and Wildlife Conservation Commission

Water quality monitoring programs have been conducted in the Peace and Myakka Rivers, and also in Charlotte Harbor, since the 1970's. In the Peace and Myakka Rivers, dissolved oxygen (DO) levels have been recorded at gaged locations throughout the watershed. In Charlotte Harbor, the intent and design of water quality monitoring programs has changed over time, but dissolved oxygen data are available for surface and bottom waters for most of the Harbor. In August of 2004, the pathway of Hurricane Charley tracked a line up through Charlotte Harbor and northward, roughly following the course of the Peace River. The high winds that accompanied the passage of Hurricane Charley defoliated a large swath of the watershed, resulting in high organic loads to the Peace River, which in turn were the most likely cause of extremely high biological oxygen demand (BOD) values in the water column. This high BOD load is thought to be mostly responsible for an unprecedented decline in DO levels throughout the Peace River in the days following the passage of Hurricane Charley. In turn, these low DO waters affected the Harbor itself. While substantial portions of the bottom waters of the Harbor regularly experience wet season hypoxia (DO < 2 mg / liter), the hypoxic event following Hurricane Charley affected the surface waters of the Harbor, as well. Throughout the Peace River and Charlotte Harbor, DO levels appeared to be in recovery from the impacts of Hurricane Charley, until the landfall of Hurricane Frances. The high rainfall associated with Hurricane Frances was associated with a subsequent deterioration of water quality in the Peace River, although recent data suggest a second recovery of DO values has occurred.

Contact: Dave Tomasko, Southwest Florida Water Management District, Tampa Service Office, 7601 U.S. Highway 301, Tampa, FL 33637, Phone: (813) 985-7481, dave.tomasko@swfwmd.state.fl.us
C.S.I. Charlotte Harbor: Was Benthic Mortality Due to Low Oxygen or Low Salinity?

James K. Culter and Jay R. Leverone
Mote Marine Laboratory

Studies on the effects of seasonal hypoxia (low dissolved oxygen) on benthic infaunal communities in Charlotte Harbor have been ongoing since 2002. In 2002, declines in species richness, abundance and diversity were observed two months after the onset of hypoxia, and only three species were present during the height of that hypoxic event.

During 2003, bottom water oxygen levels started to fall in late June and hypoxia was well established by mid-July. Communities along the western shore showed the most immediate and dramatic drop in all faunal parameters. Faunal abundance in the middle of the Harbor and near the mouth of Alligator Creek was greatly reduced by August. The fauna during the summer was dominated by a few tolerant annelid species; *Streblospio benedicti*, *Paramphinome* sp. B and *Oligochaeta* spp. (*Paramphinome* sp. B also survived extended hypoxia during 2002).

This year (2004), Charlotte Harbor supported a rich and diverse benthic fauna through June, prior to the onset of summer hypoxia. Benthic sampling and hydrographic profiling were conducted ten days and again one month after the passing of Hurricane Charley (August 13). Bottom waters on August 23 were anoxic in the upper Harbor, but had returned to normoxic conditions (> 4 mg/ml O₂) by September 8. Mean bottom salinity was 14.6 PSU on August 23 and 12.0 PSU on September 23. The water column was more strongly stratified on August 23 (surface to bottom differential of 10.3 PSU) than September 8 (surface to bottom differential of 5.3 PSU). The increase in freshwater inflow to the upper Harbor as a result of Hurricane Charley resulted in decreased salinity, reduced stratification and higher oxygen levels.

Preliminary analysis of post-hurricane benthic samples reveals mortality of select benthic species. With Harbor salinities dropping to 10 PSU, the question must be raised whether the observed mortality is associated with reduced oxygen, salinity, or a combination of the two. Laboratory studies on oxygen tolerances of select resident species, literature reviews on salinity ranges of estuarine invertebrates and field data on oxygen and salinity following Hurricane Charley are being evaluated to discern which factor(s) contributed to the mortality of benthic fauna in Charlotte Harbor.

Contact: Jay Leverone and Jim Culter, Mote Marine Laboratory, 1600 Ken Thompson Pkwy, Sarasota, FL 34236, Phone: (941) 388-4441, Fax: (941) 388-4312. J. Culter, jculter@mote.org, J. Leverone, jleveron@mote.org
Charlotte Harbor Seagrasses: Temporal Trends and Hurricanes

Brad D. Robbins, Michelle Gittler, and Ana Mari Boyes.

Mote Marine Laboratory

Large-scale disturbances such as hurricanes are arguably the most destructive natural phenomena known and have the potential to be a major structuring force in subtropical seagrass systems. The modern paradigm concerning hurricanes and seagrasses is that the regular occurrence of hurricanes may be necessary to maintain the health of seagrass ecosystems, especially with regard to the distribution of sediments and disease outbreaks (e.g. NOAA scientists working in Florida Bay have hypothesized that hurricanes are necessary to maintain an appropriate level of accumulated nutrients and sediments). The passage of a hurricane may also allow local structuring forces (e.g. hydrodynamics) to further impact the seagrass system. For example, the fragmentation of a large seagrass meadow into small isolated patches by a hurricane may result in the eventual loss of seagrass altogether. Because of the relative scarcity of hurricanes and the more scarce impacts on seagrass ecosystems, these events and their relationship with seagrasses are little studied. However, the recent passage by Hurricane Charley through Charlotte Harbor provides a unique opportunity to examine the relationship between hurricane disturbance and seagrass dynamics.

Contact: Brad Robbins, Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota FL 34236, Phone (941) 388-4441, Fax (941) 388-4317, robbins@mote.org
A Preliminary Simulation of Hurricane Charley Storm Surge

Bob Weisberg and Lianyuan Zheng
College of Marine Science, University of South Florida

The surge generated by Hurricane Charley (Category 4) is simulated using FVCOM. The 3-hourly storm track, its central pressures, maximum wind speeds, and storm radius are provided by NOAA National Hurricane Center (NHC). Based on these information, we construct Prototypical Hurricane wind speed and pressure fields to force the model. The FVCOM includes flooding/drying processes and fully three-dimension. Model-predicted elevations at Big Carlos Pass, Ft. Myers are reasonable agreement with observation on both magnitudes and phases. Model results suggest that the surge is approximately 2.5 m occurs at Punta Gorda. The relatively small surge induced by Hurricane Charley in the Charlotte Harbor is due to: 1) rapid speed of storm center movement; 2) approach direction from South to North and transition up to estuary; 3) small storm radius; and 4) landfall near the low tide.
Detection of Optical Brighteners in High Humic Waters: Successes and Cautions

L. Kellie Dixon1, Holly M. Taylor2, Elizabeth M Staugler3, and Jon S. Perry1

1Mote Marine Laboratory
2University of California Santa Cruz, Oakes College
3Charlotte Harbor Environmental Center

The quantitative and qualitative presence of laundry additives, optical brightener dyes, were explored as a tool for the detection of wastewater in canals adjoining residential areas served by on site treatment and disposal systems (OSTDS, septic tanks). The optical brighteners are fluorescent compounds which absorb UV light and fluoresce in the visible range, and are exclusively indicative of human waste streams, unlike more conventional bacterial analyses. Humic substances, however, also fluoresce under similar excitation and emission wavelengths and the use of fluorescent techniques for the detection of laundry additives in the southwest Florida region must distinguish between the two sources in order to be useful as a screening tool.

A passive method used with success elsewhere deploys undyed fabric in the field for a number of days and qualitatively evaluates recovered fabric for fluorescence. We evaluated a quantitative approach to this method using reproducible illumination conditions and a spectroradiometer to measure resulting fluorescence from fabric exposed in the field as well as in the laboratory to known concentrations of detergent with additives. Fluorescence of fabric was quantitative with OB concentration in laboratory exposures, but field conditions, biofouling, and fabric degradation of the lightweight (but highly absorbent) material used make quantitative use with field deployed fabric questionable.

Additionally a field screening method was developed using dual fixed wavelength fluorometers in a flow thorough mode. Fidelity of OB fluorescent response under varying dilutions of laboratory water, seawater, and high humic freshwater from a single source was confirmed. Humic fluorescence and normalized fluorescence, however, can vary with concentrations, source, and age. In addition, fluorescent response can be quenched by dissolved oxygen and has further reported variations with both pH and temperature. The possible magnitude of these effects on canal surveys in Charlotte Harbor is presented.

Contact: L. Kellie Dixon, Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota FL 34236, Phone (941) 388-4441, Fax (941) 388-4312, lkdixon@mote.org
Movers and Shakers: Monitoring Cownose Ray Movements Within Charlotte Harbor

Angela Barker and Michelle R. Heupel
Mote Marine Laboratory

Cownose rays (*Rhinoptera bonasus*) occur throughout the coastal Gulf of Mexico and are abundant residents of Florida estuaries, including Charlotte Harbor where they are present throughout the year. Historical data indicate that *R. bonasus* are more abundant within this estuary during the spring and summer months, but they have been observed, at least to some extent, in all seasons. Although frequently encountered, little data exist regarding *R. bonasus* movement patterns or habitat use. Acoustic hydrophones deployed in Pine Island Sound and the Caloosahatchee River were used to monitor an approximate area of 110 km². Between July 2003 and September 2004, 18 *R. bonasus* (49-92 cm DW) were fitted with external acoustic transmitters and passively tracked over periods ranging from 2-89 days. A total of 12 males and 6 females were tracked, including both mature and immature animals. The longest uninterrupted track was for a mature female and lasted 40 days. Activity spaces for each animal were calculated using kernel estimators (95%, 50%) and ranged between 16 km² and 59 km². The majority of tagged animals had 50% kernel areas near the edges of grass flats and steep depth gradients. Animals caught and tagged together displayed similar activity spaces (Figure 1), but varied relative to length of time spent together. The effects of certain abiotic factors (diel periodicity and salinity) on the movement patterns of *R. bonasus* will be discussed.

**Figure 1.** Do rays tagged together stay together? Area bordered in red displays overlap between two immature male cownose rays that were caught from the same school. There is a 50% overlap of activity space over an 8 day period.

Contact: Angela Barker, Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota FL 34236, Phone (941) 388-4441 angela@mote.org
Correlation of Hydrographic Conditions and Phytoplankton Chlorophyll in Charlotte Harbor, 2001 - 2004

Gary Kirkpatrick, Barbara Berg, Chris Higham, and Brad Pederson.

Mote Marine Laboratory

Twenty-four surveys of Charlotte Harbor were conducted from 10/2/01 to 8/8/04 in an effort to link phytoplankton community structure to hydrographic features. Between 10/2/01 and 10/17/02 four stations in the central channel of the lower bay were sampled for chlorophyll biomass, temperature and salinity. From 5/15/02 to 8/04/04 these same parameters were collected at 12 stations throughout the Harbor. A comparison of chlorophyll biomass to temperature showed weak correlation. Correlation between chlorophyll biomass and salinity was stronger, but a comparison of chlorophyll biomass to water density (a function of temperature and salinity) showed the strongest correlation.

This suggests that applying the simplest rules, such as low salinity means high biomass, may not yield the best results. It must be noted that this analysis does not account for the influences that water circulation and water column structure may have on chlorophyll biomass. Observations of red tide distribution in the Harbor will be discussed in relation to these findings concerning hydrographic features.

Contact: Gary Kirkpatrick, Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota FL 34236, Phone (941) 388-4441, Fax (941) 388-4312, gkirkpat@mote.org
Geochemical Evolution in Charlotte Harbor

Richard Pierce¹, Dana Wetzel¹, Michael Henry¹, Phillip Mercurio¹, Patricia Blum¹, Greg Brooks², Rebecca Larson², Charles Holmes³

¹Mote Marine Laboratory
²Eckerd College
³US Geological Survey

The goal of this project is to establish geochemical changes with time (depth) in sediments from Charlotte Harbor, to determine the present status of chemical pollutants in Charlotte Harbor and to establish trends for assessing impacts from future development/alteration activities. A total of 18 sediment cores were collected throughout the estuary during June 16 & 17, 2004 and 7 cores on July, 7, 2004, focusing within and around the hypoxic zone, the confluence of the Myakka and Peace Rivers, and in the Caloosahatchee River. Each core was sub-sampled for chemical contaminant analysis (PAH, pesticides, PCB) by Mote scientists. Sediment description and radiometric age dating (e.g., lead-210, cesium-137 and beryllium-7) are provided by scientists from Eckerd College and the U.S. Geological Survey. Samples are analyzed for radiometric dating to provide rates of sediment accumulation and timing of events over the past 100 years. These data are linked to results of contaminant analyses to determine the history of anthropogenic contamination. Additionally, C-14 dates are being conducted on select portions of some of the cores in order to provide a chronological framework, and determine natural sediment accumulation rates during the pre-anthropogenic development of the system. Results from the previous year's study indicated mixed sediment PAH profiles (surface to bottom) in the upper Harbor, requiring further correlation with grain size and deposition rates for each core that is being accomplished this year. Chlorinated hydrocarbons were not detectable in most core samples, indicating very little historic influx of these contaminants through out the past 100 years. This year, a special sequence of metal speciation analyses is being provided in an attempt to assess the geochemical evolution of the hypoxic zone. Because the absence of oxygen creates a chemically reducing environment, the oxidation state of metals will reflect those conditions. Specifically molybdenum (Mo) and rhenium (Re) are two redox indicator metals that are monitored in this study.

Contact: Richard Pierce, Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota FL 34236, Phone (941) 388-4441, Fax (941) 388-4312, rich@mote.org
A Remote PIT Tag Antenna System in a Mangrove Stream in Charlotte Harbor to Observe Snook Movements.

R. Kirby Wolfe
Mote Marine Laboratory

Both juvenile and adult snook rely on euryhaline streams that flow into Charlotte Harbor. These habitats are very complex and extensive making accurately studying snook movements difficult with traditional sampling methods. One method that can help understand the seasonal and diurnal uses of habitat by fish is tagging. Methods of tagging fish are divided into two basic categories: internal tags and external tags. Tagging projects are traditionally set up around the limitations of the tagging method used. For example, external marking methods are normally one of the least expensive methods of tagging and they give anglers the opportunity to help with the projects by allowing them to help collect data. The drawback of most external tags is that they can hinder the fishes movement and often fall out. Internal tagging methods limit the impact of the external environment while limiting the ability for researchers and anglers to visually identify fish that have been marked. There are three basic types of internal tags: passive, active, and hybrid. Active tags are tags that send out a signal that can be picked up by a receiver allowing researchers to track the movements of the fish. These tags are battery powered so the life of the tag depends on the size of the battery which limits the size of fish that the tagged. Passive internal tags consist of a tag that has an individual code number that typically must be read by removing the tag from the fish, which usually requires the fish to be sacrificed. These tags are very small so they can be placed in very young fish without harm. A third tagging method is Passive Integrated Transponder tags (PIT tags). These tags are small electronic circuits encapsulated in glass that are implanted into the fish. They do not have their own energy source so they are not limited by battery life and they have individual numbers that can be read externally by charging the circuit with a radio wave. PIT tags are limited by the power of the external energy source and the sensitivity of the receivers. They are larger than some other internal tags which limits the size of the fish that can be tagged.

We used PIT tags and a remote solar powered antenna array that spanned a mangrove creek allowing us to log tagged fish that pass through the array. This system allows the monitoring of fish movements through the creek twenty-four hours a day seven days a week. By sampling this creek and surrounding creeks with traditional net sampling and handheld PIT tag readers we are able to clarify how these creeks are used by common snook.

Contact: Kirby Wolfe, Center for Fisheries Enhancement, Mote Marine Laboratory, Charlotte Harbor Field Station, PO Box 2197, Pineland FL 33945, Phone (239) 283-1622, kwolfe@mote.org

Charlotte Harbor Conference
"Sound Science in 2003-2004," October 5-6, 2004
Manatee Winter Use of A Natural Warm Water Site at Warm Mineral Springs, Florida

Margie Barlas, Lucy Keith, and Mindy Peterson

1University of New England, Marine Science Center
2Florida Fish and Wildlife Conservation Commission
3Lee County Natural Resources Management

Warm Mineral Springs (WMS) is the only known natural warm-water manatee aggregation site in southwest Florida. Winter use of this site by manatees was first documented in 1993, and photo-identification of distinctive scar patterns has been used since that time to monitor visits by individual manatees. This study examined whether WMS was the primary or sole warm-water site used by the manatees documented there. We also studied manatee attendance patterns in relation to time of day, ambient water temperature, and tidal state. For four consecutive winters beginning in 2000, satellite-linked radio-transmitter tags were deployed on a total of 11 wild and 4 rehabilitated manatees. A data-logging VHF radio receiver station at the primary aggregation area from January to April each year recorded attendance of tagged manatees every 30 minutes. The number of manatees using WMS has increased over the past decade. In 1993, 33 manatees were documented at WMS with a highest single-day count of 18 animals. During winter 2002-2003, 148 different manatees were documented with a single-day high count of 74. Previous research indicates that manatees in other parts of Florida use multiple warm-water refugia, yet WMS manatees have rarely been sighted elsewhere in winter. Two of 15 tagged manatees (13%) used other warm-water refugia during tracking bouts within a winter season. Of manatees identified only through photo-identification, 5 of 33 cataloged animals (15%) used other warm-water sites across winter seasons. Manatees were present at WMS on 80% of days sampled between November 15 and March 15, but sampling was more intense during cold weather so this does not reflect use over the entire winter. Individual attendance patterns at WMS often showed continuous presence over multiple consecutive days rather than brief periods during the night or day. Tidal state was an important factor influencing the timing of manatee movement into and out of the creek; manatees were apparently unable to enter or leave during low tides because of emergent sandbars. WMS is the only known warm-water refuge in Florida where tidal state is a limiting factor for manatee access. This feature will influence management decisions for the enhancement of WMS as specified outlined in the Florida Manatee Recovery Plan.

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Restoration of Bay Scallop Populations in Pine Island Sound: Competent Larval Release Strategy

Jay Leverone
Mote Marine Laboratory

A recreational bay scallop fishery existed throughout Pine Island Sound until the late 1980s, when populations disappeared, save a small relict population in North Pine Island Sound. Restoring bay scallops has been used as a justification for possible water management strategies in Pine Island Sound. A successful restoration project would be valuable in evaluating the success of changes in water releases to the Caloosahatchee River and possible Sanibel Causeway configurations on estuarine ecosystem integrity. Last fall (2003), a novel approach to bay scallop restoration, releasing competent larvae into a contained water column, was undertaken in Pine Island Sound, Fl. Late stage pediveliger larvae were released into three industrial containment booms within a shallow seagrass meadow. A fourth boom served as a control. Each boom isolated the water column and enclosed an area of 75 m². Five spat collectors were placed within each boom; five additional collectors were placed outside the booms. Spat settled on seventy-nine percent of collectors within treatment booms. None were found within the control or outside the booms. Juvenile scallops, surveyed in Feb 2004, were found in all treatments while being absent from the control. Mean juvenile density was 0.71 ± 0.31 m⁻¹ with a mean shell height of 20.1 ± 5.2 mm. Adult scallops were surveyed in Jul 2004. Mean adult density was greater than 150 / 600 m² (Table 1). Mean scallop size (shell height) ranged from 57.0 to 61.0 mm, indicating that the scallops had approached their maximum size. Scallop density at the restoration site was two orders of magnitude greater than the resident scallop population within Pine Island Sound. These results demonstrate that controlled release of competent larvae is a viable method of ultimately restoring bay scallop populations in Pine Island Sound.

Table 1. Results of Adult Bay Scallop Survey at Restoration Site (July 15, 2004). Scallop Densities Compared to Average Density From Pine Island Sound (June, 2004).

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th></th>
<th></th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Control</td>
</tr>
<tr>
<td>Total Number</td>
<td>24</td>
<td>19</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Mean Size (mm)</td>
<td>57.0</td>
<td>58.7</td>
<td>61.0</td>
<td>60.7</td>
</tr>
<tr>
<td>S.D.</td>
<td>7.83</td>
<td>8.79</td>
<td>3.16</td>
<td>3.06</td>
</tr>
<tr>
<td>Scallops / 600 m²</td>
<td>192</td>
<td>152</td>
<td>136</td>
<td>24</td>
</tr>
</tbody>
</table>

Contact: Jay Leverone, Mote Marine Laboratory, Benthic Ecology Program, 1600 Ken Thompson Parkway, Sarasota FL 34236, Phone (941) 388-4441, jleverone@mote.org
Fish Nursery Habitats in Charlotte Harbor, Florida

Philip W. Stevens, David A. Blewett, Gregg R. Poulakis, and Patrick Casey

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Charlotte Harbor Field Lab

The majority of economically important fishes in Florida use estuaries, particularly during early portions of their life histories. The specific locations and conditions within the estuary where juvenile fish are abundant differ among species. An ongoing Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Fisheries-Independent Monitoring program conducted in Charlotte Harbor, Florida is useful for determining factors that define fish nursery habitat (areas where young fish find food and refuge and are typically found in abundance). The distribution, seasonality, and habitat use of juvenile gag Mycteroperca microlepis, red drum Sciaenops ocellatus, and common snook Centropomus undecimalis in Charlotte Harbor provide examples of how location, timing, and essential habitat requirements vary among species. Small juvenile gag (<100 mm SL) are found during spring in polyhaline seagrass beds in Gasparilla Sound and Pine Island Sound. Larger juvenile gag (up to about 250 mm SL) remain in high-salinity areas of the estuary until fall, when they egress to nearshore habitats in the Gulf of Mexico, probably cueing on the passage of cold fronts in November. Post-settlement red drum (<40 mm SL) are found throughout the estuary in seagrass beds, tidal creeks, and rivers from October to January. As they reach 125 mm SL they are most abundant at the mouths of major rivers (e.g., Peace and Myakka rivers), and they disperse throughout the estuary as they reach maturity. Small juvenile common snook (<150 mm SL) are found almost exclusively in remote mangrove creeks and ponds during fall and winter, which differs from other estuaries in Florida where small juvenile snook are found primarily in freshwater tributaries. Larger juvenile snook (151-350 mm SL) are found at specific locations along estuarine shorelines (e.g., entrances to creek networks and marsh ponds) as they move out of their initial nursery sites. Thus, juvenile fishes use a wide variety of locations and habitats throughout the year in Charlotte Harbor. Understanding fundamental requirements for juvenile fishes (which can often change through ontogeny) should provide a framework for future research that focuses on the sensitivity of fish nurseries to environmental perturbations.

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Examination of Movement Patterns of Sharks in Pine Island Sound and the Caloosahatchee River

Michelle R. Heupel, Angela Barker, and Beau G. Yeiser
Mote Marine Laboratory

A series 69 acoustic receivers were deployed within the Caloosahatchee River and lower Pine Island Sound to monitor the movements of elasmobranchs within that region. A total of 37 elasmobranchs of four species were fitted with transmitters within Pine Island Sound. The four species monitored within the region included: 19 bonnethead sharks (*Sphyrna tiburo*), 8 blacktip sharks (*Carcharhinus limbatus*), 8 bull sharks (*Carcharhinus leucas*) and 2 lemon sharks (*Negaprion brevirostris*). At least three bonnethead sharks fitted with transmitters in 2002 and 2003 returned to the region in 2004 and were monitored for the duration of their residence. No other individuals from other species monitored within Pine Island Sound in previous years returned in 2004. The movements and home range of returning individuals were similar across years. In addition, 16 bull sharks were fitted with transmitters in the Caloosahatchee River in 2004 and 8 bull sharks fitted with transmitters in 2003 were monitored within the river during the summer months. Two data sets will be examined in this presentation, the use of Pine Island Sound by bonnethead sharks and the movement patterns of juvenile bull sharks within the Caloosahatchee River. Preliminary data suggest that salinity levels within the Caloosahatchee River may affect how sharks use the river and how far upstream they will travel. Bull sharks appear to show a preference for salinities ranging from 5-15 ppt and will move up or down the river to remain within this range (Figure 1). Comparisons between use of the river by one-year-old sharks and newborn sharks will also be presented.

![Figure 3. Distance of two bull sharks (*Carcharhinus leucas*) up the Caloosahatchee River as measured from the mouth of the river in relation to salinity level (dotted line) at the Cape Coral Bridge (located mid-river). Decreases in the distance up river generally correlate with decreases in salinity for both individuals.](image)

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Response of Elasmobranchs to Hurricane Charley

Michelle R. Heupel, Angela Barker, and Beau G. Yeiser
Mote Marine Laboratory

A series of 69 acoustic receivers deployed in lower Pine Island Sound and the Caloosahatchee River were used to monitor the presence and movements of sharks within this region. All 69 receivers were left in place as Hurricane Charley approached and made landfall along the Gulf coast of Florida. During the week prior to and after the storm 12 sharks of four different species were continuously present within the Pine Island Sound portion of the acoustic array. Eight of these individuals (including representatives of all four species) were present in the study site in the 24 hours prior to Hurricane Charley making landfall in Punta Gorda. The Hurricane made landfall at approximately 15:45 on August 13, 2004 and passed directly over the study site. As the storm passed the barometric pressure within the region declined dramatically (Figure 1). Barometric pressure decreased approximately 50 mb in the 12 hours prior to landfall. The sharpest point of decrease was a 32 mb decline in the hour prior to landfall (14:53-15:53). All monitored sharks exited Pine Island Sound prior to the storm making landfall and left over a 12 hour time period. The first individuals left the study site early on the morning of August 13th (00:30) and the last individual left at 11:45. This response is similar to previously reported responses by elasmobranchs to severe storm events. However, sharks monitored within the Caloosahatchee River portion of the acoustic array showed no obvious response to the storm. Reactions of all monitored sharks will be discussed and compared to previously reported responses by sharks to storm events.

Figure 1. Barometric pressure recordings for Fort Myers and Punta Gorda as Hurricane Charley made landfall. Data provided by the National Weather Service.

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Effects of Hurricane Charley on Fish Sound Production

James Locascio* and David Mann*

*USF College of Marine Science
**Mote Marine Laboratory

Hurricane Charley passed almost directly over an acoustic datalogger in Charlotte Harbor, FL that was being used to record fish sound production. Prior to the hurricane, fish sound production was dominated by sand seatrout (*Cynoscion arenarius*) (Figure 1). Fish sound production began around dusk and lasted for several hours each night. The hurricane passed through Charlotte Harbor around 16:00 hours, prior to the normal time the fish would start calling. The hurricane noise was predominately low frequency (0-100 Hz) with some energy up to 500 Hz. The first fish call was heard about 1.5 hours after the hurricane passed, and there was no detectable decrease in either the intensity or duration of the chorus on the night of the hurricane. On the three nights following the hurricane, fish sound levels actually increased and the fish called earlier than any of the previous nine nights.

![Figure 1. Composite spectrogram of sounds recorded in central Charlotte Harbor from 8/5/2004-8/17/2004. A fish chorus is evident nightly with peak energy from 500-600 Hz. The hurricane can be seen on August 13 as acoustic energy between 0-300 Hz.](image)

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*Charlotte Harbor Conference*
"Sound Science in 2003-2004," October 5-6, 2004
Tropical cyclones (aka hurricanes) are common in equatorial regions, and may play an important role in fish assemblage dynamics in coastal waters. Despite documentation of hurricane effects on shallow marine and estuarine habitats and their associated biota, however, there is no consensus on the importance of hurricanes to structuring coastal fish communities. Factors contributing to inconsistent findings of hurricane effects on fishes include insufficient temporal and spatial coverage. Few studies possess the multiple-year data that are necessary to place the hurricane event into the appropriate temporal context. Given the variability that is naturally inherent in fish assemblages (abundance, species composition, fish size), studies that merely show before- vs. after-hurricane snapshots may provide false results. In contrast, multiple-year data sets allow investigators to place the hurricane in the context of natural variability, and thus result in a more accurate assessment of hurricane effects. Furthermore, many studies rely upon data from a single site, whereas data from multiple locations is needed to incorporate the natural patchiness of hurricane disturbance. Given the patchiness of hurricane effects on fishes and their habitats, data from multiple locations is essential for estimating the spatial extent and variability of any impacts, and the applicability of research findings. In light of the disparate findings on hurricane effects on coastal fishes, and the fortuitous nature of these 'natural experiments', it is important to document responses of coastal fish assemblages to hurricanes to develop a better understanding of such disturbances.

Previous multiple-year research projects of coastal fishes that were impacted by hurricanes provide examples of strategies for studying and analyzing effects of hurricane Charley on fishes of Charlotte Harbor. For example, examination of the effects of hurricane Marilyn on fish assemblages using the typical before vs. after 'snapshot' approach found a significant hurricane effect on fish abundance. However, time-series analysis of the multiple-year dataset revealed a long-term decline in fish abundance that occurred irrespective of the hurricane. In another case, sites with little impact from hurricane Lenny were used as standards for comparison with sites that suffered notable hurricane effects in a Time (multiple years) x Space (6 sites) analysis. The non-impacted sites provided estimates of natural variability in fish assemblages, against which fish assemblage data from the impacted sites was compared, which showed that the studied fishes were resistant to the effects of the hurricane. Similar research and analysis strategies are applicable to Charlotte Harbor research that was ongoing prior to and continued after hurricane Charley.
Adapting an Estuarine Indicator Protocol for Assessing the Effects of Hurricane Charley on Mangrove Forests

Jaime M. Greenawalt, Eric C. Milbrandt, and Stephen A. Bortone

Sanibel-Captiva Conservation Foundation Marine Laboratory

Estuarine indicators are used as monitoring and assessment tools throughout the waters surrounding the Gulf of Mexico. The best indicators are not especially sensitive, but are ecologically significant and are therefore ideal for evaluating the ecological impact of disturbance. Indicator-monitoring program protocols are designed to take statistically significant 'snapshots' of environmental factors at a specified scale in both space and time. Temporally these 'snapshots' range from continuous to annual or bi-annual; and may be irregular, random, or periodic. Spatially, they may include one study site or replicates within an estuary, but rarely include multiple estuaries. With regard to biological organization they include measures at the level of the individual, species fitness and abundance, population dynamics, or communities. An irregular but intense natural phenomenon, such as a hurricane, can reset the successional clock and significantly alter the structure of communities. Following Hurricane Charley, pre-existing mangrove monitoring sites were revisited to assess the initial structural impact from the storm on Sanibel and Captiva Islands. Comparison of canopy cover shows a significant decrease immediately following the storm. There were also spatial gradients in both the severity of impact and the potential for recovery. Size frequency analysis of non-impacted, impacted and severely damaged trees, greater than 1.5 m, demonstrated the extent of Charley's destruction. The recovery of the forest depends not only on the mortality of large trees, but on the number of recruits that can establish and grow in the gaps. The density of recruits and young of the year plants shows high spatial variability. The number of recruiting plants is likely an important feature in determining the rate of recovery. In the future 'team' efforts with scientists in estuaries with varying levels of storm impact would provide a more robust dataset for thoroughly assessing the impact of irregular natural phenomenon.

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Hurricane Charley Visits J. N. "Ding" Darling National Wildlife Refuge Complex

Kendra Pednault-Willett and Jason Hanley

J.N. "Ding" Darling National Wildlife Refuge

The J. N. "Ding" Darling NWR Complex includes a mosaic of lands and waters located on Sanibel Island and several other islands throughout Pine Island Sound, Matlacha Pass, and in the Cape Haze section of Charlotte County. Refuge habitats are primarily composed of mangrove and seagrass estuary, fresh water marshes, and West Indian hardwood hammocks. Hurricane Charley's impact on the refuges' habitats and future research projects and needs will be discussed. Primary areas of concern include mangrove regeneration and restoration, impacts to wading bird nesting islands, exotic plant control and the implications to on-going management of these resources.

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Spatial distributions of turtles within Charlotte Harbor were compiled from directed searches and netting efforts by the Sea Turtle Program, a new initiative with Earthwatch Institute and the Conservancy of Southwest Florida, and from opportunistic sightings recorded by Mote personnel involved in other Charlotte Harbor projects. Location data are plotted on GIS layers assembled from FMRI spatial data on bathymetry, benthic habitat type, and in relation to FMRI's spatial data on sea turtle strandings. Kemp's ridley, loggerhead, and green turtles are documented in the harbor, and leatherback turtles show up offshore in the fall. Kemp's ridleys captured thus far are relatively small (40 cm) which underlines that southwest Florida's estuaries are vital developmental habitat to a critically endangered species, which at maturity will migrate back to Mexican coasts to nest. We report on food die-backs (horseshoe crabs) that were noted after Hurricane Charley. Ongoing studies will include acoustic and satellite telemetry to track local habitat use and seasonal movements.

**Figure 1.** Sightings contributed by various research groups.

**Figure 2.** Spatial distribution of sea turtle sightings through August 2004.

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Research Experience for Undergraduates in Mote Marine Laboratory's Charlotte Harbor Initiative: A Summary of the Two Year Program

James Gelsleichter and Barbara Kirkpatrick

Mote Marine Laboratory

Over the last two years, the National Science Foundation has funded the Research Experience for Undergraduates (REU) in Mote Marine Laboratory's Charlotte Harbor Initiative. The REU experience is targeted for minority students who are under-represented in science and engineering. Mote's REU program specifically recruits students who are Native Pacific Islander since this group is under-served in comparison to other minorities. Unlike other internships where students primarily assist researchers in field collection and sampling tasks, the REU program requires each student, under the mentorship of a scientist, to create their own abstract, design the research plan, conduct the data collection, analyze the results and produce a scientific paper and presentation. The entire process is completed over 10 weeks. Eighteen students completed the REU program at Mote over the last 2 years. Thirteen Mote scientists have functioned as mentors to these students. The program has been highly competitive and has received over numerous applications for the 18 positions.

Since the National Science Foundation's purpose for funding this program is to encourage minority students to seek employment in science related fields and/or continue to graduate school, the PI's believe that student's perceptions regarding their REU experience may be just as important as the scientific education that occurs. An evaluation program was designed and implemented to measure student self-evaluation of skills and behaviors at the beginning of the internship and on exit. In both years, students believed their skills and behaviors were greatly improved upon completion of the internship. Mentors also completed an evaluation of the intern, designed with survey items dovetailing with the intern instrument, at the completion of the 10 weeks and were compared to student exit evaluations.

By assessing completion of intern research projects, intern self evaluations and mentor evaluations, the 2 year program can be deemed a successful, career strengthening experience for these students.

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Charlotte Harbor Conference
"Sound Science in 2003-2004," October 5-6, 2004
Analyses of Long-Term Relationships between Riparian Vegetation Patterns and Freshwater Inflows in the Lower Peace River Estuary, 1976-2002

Ralph T. Montgomery
Post Buckley Schuh & Jernigan

The primary objective of the conducted analyses were to determine the efficacy and effectiveness of long-term investigations designed to identify potential adverse affects to emergent lower Peace River vegetation and riverine wetlands that might potentially be associated with freshwater withdrawals by the Peace River/Manasota Regional Water Supply Authority's water treatment facility. Over twenty-seven years of monitoring, the vegetation studies have sought to determine the magnitude of vegetative community's spatial and temporal responses to natural variations resulting from extended periods of both drought and flood along the lower Peace River. The primary goal of these investigations has been to provide a basis for assessing potential methodologies by which to differentiate between long-term natural changes in riverine vegetative patterns and those that might potentially be induced by facility withdrawals. The overall objective of the vegetative monitoring study elements has been to provide a basis for determining the relationships between vegetation patterns and freshwater flows by observing the relative spatial positions and community structure of the freshwater and salt-tolerant plant communities in the salinity transitional zone of the lower river. The basic assumption has been that a permanent shift of more salt-tolerant plants upriver could be an indication that withdrawals were impacting lower river corridor wetlands, assuming that the effects of natural variability (drought) or other anthropogenic causes could be isolated in the analysis.

Since 1976, at approximately two-year intervals, the spatial first and last occurrences of indicator plant taxa have been recorded along the banks of the Peace River downstream of the facility. Analyses of these long-term data indicate that this information has not been highly effective in determining the potential influences that might be associated with withdrawals. Some species had shown very little variation even following extended periods of high and low flows, while the spatial locations of other taxa have varied considerably as the result of the creation or destruction of shallow shoals along the edges of the river during periods of high flow. The causes of other observed changes were found to be less obvious and clearly indicated the difficulty in determining meaningful relationships between freshwater inflows and the long-term distributions of many of the riparian taxa that characterize the lower river.

GIS-based photointerpretation was further used to conduct change comparing and assessing differences in the spatial extent of dominant vegetation groupings along the lower Peace River following both extended periods of high freshwater inflow (1998) and the recent extended period of drought (2002). Although fairly substantial differences in the salinity structure characterized the two preceding periods, analyses showed little differences in the weighted centers of abundances of either the saltwater marsh or hardwood forest communities along the lower river. These results probably reflect the extensive period of time needed to substantially change the distributions of these communities. While visual observations noted some signs of stress in the hardwood forest community immediately near the river during the driest periods of the extended drought, seasonal periods of higher inflows maintained the relative long-term spatial distributions.
Small upstream movements in the weighted centers of abundances were, however, observed between the two periods in the distributions of mangrove and freshwater marsh vegetation along the lower river. To some extent, the upstream movement of mangroves may simply reflect the lack of the occurrence of any sustained hard freezes between the time periods rather than the occurrence of higher salinities during the drought. Historically, the mangroves in this region of the river have been subject to extensive natural die-offs resulting from periodic freezes.

The observed net upstream movement of the weighted center of abundance of freshwater marsh communities following extended wet and dry periods may more directly reflect the influences of increased salinities along the lower river during the extended drought that preceded the 2002 vegetation mapping.

In summary, a comparison of 1998 and 2002 aerial photography using GIS based forward-dating procedures indicates some small changes in the weighted centers of abundances of only two of the major riparian vegetation communities along the lower Peace River. The measured changes, however, were small in comparison to the differences in the spatial salinity patterns during the extended wet and dry periods that preceded the two selected vegetation surveys. Given these results, it is extremely doubtful whether any quantifiable changes in long-term vegetation patterns along the lower Peace River will ever be attributable to Facility withdrawals, since the magnitude of the predicted influences of Facility withdrawal are small relative to the normal ranges of daily and seasonal salinity variations that influence the spatial distributions of these riparian vegetation communities.

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Quantitative Assessment of Xenoestrogen Activity in Florida Waters Using the E-SCREEN Bioassay

James Gelsleichter¹, Heather Cox¹, and S. Mouzi²

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Due to their ability to impair hormone-regulated processes such as development, reproduction, and immune function, environmental pollutants that mimic the female hormone estrogen (i.e. "xenoestrogens") pose significant health risks to both terrestrial and aquatic organisms. Because of these risks, it is important to determine the sources and concentrations of these contaminants in the natural environment so that policies to reduce their release and effects can be developed. The need for such information is particularly critical for coastal ecosystems, which sustain extensive human and wildlife populations, but are increasingly threatened by environmental pollution. However, due to the large number of environmental xenoestrogens and the expense of conducting chemical-specific measurements, it is generally impractical to use analytical methods such as gas chromatography and mass spectrometry to determine exact concentrations of all of these compounds in large natural systems. In this project, we are evaluating the use of the E-SCREEN bioassay as an inexpensive approach for measuring total xenoestrogen activity in Florida surface waters with particular focus on the Charlotte Harbor estuary. The E-SCREEN bioassay is a cell culture technique that quantitatively measures the concentrations of estrogenic compounds by their ability to stimulate proliferation of estrogen-dependent MCF-7 human breast cancer cells. In this report, we discuss the effects that sample extraction can have on bioassay effectiveness and present our initial attempts to characterize xenoestrogen concentrations in Charlotte Harbor tributaries.

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Bottlenose dolphins are top-level predators in the Charlotte Harbor ecosystem and their numbers, reproductive rates, health, and body condition can be indicative of ecosystem health. Their distribution can be indicative of environmental features and prey distribution. We have conducted three years of semiannual photographic identification surveys since September 2001 to examine dolphin abundance and distribution from Lemon Bay and the mouths of the Peace and Myakka Rivers down to the Sanibel Island Causeway. We have completed six multi-week surveys during September/October 2001, February 2002, September 2002, February/March 2003, September 2003, and February/March 2004 along with four opportunistic mini-surveys (May 2002, July 2002, May/June 2003, May 2004), and 17 searches for dolphin "Toro" released from Mote's dolphin hospital after treatment for severe monofilament line entanglement. In addition, four days of unplanned surveys were conducted from 24-27 August 2004 after category 4 Hurricane Charley passed through the region on the 13th of August and caused widespread ecological disturbance. Two types of search effort were used to collect sighting information; (1) a 1 km grid transect design which included cross-harbor, edge, and contour transects and (2) opportunistic transects both within the defined study area and in the Gulf coastal waters and inshore areas to the north and south of the study area. We attempted to collect dorsal fin identification photographs of all dolphins in each sighting and information on location, group size, numbers of calves, numbers of young of the year, and activities, along with data on tidal state, salinity, temperature, wave height, Beaufort state, cloud cover, and glare. Photo-analysis is underway to identify individuals and to perform mark-recapture analyses to estimate abundance. These data will be compared to those from similar surveys conducted during 1990-96. Distribution of sightings and feeding locations will be examined relative to habitat features, prey distribution, and environmental features to see if feeding observations are indicative of related ecological parameters. Preliminary findings show relatively low numbers of dolphins in the upper harbor from Burnt Store Marina to the mouths of the Peace and Myakka Rivers during September surveys and during hypoxic events, and larger numbers of dolphins during winter when the waters were well mixed. Repeated sightings of at least 210 marked individuals show they are present year-round and at least 271 dolphins show long-term site fidelity of five years or longer. To date, 17 dolphins sighted in Charlotte Harbor have also been re-sighted in the Gulf, Sarasota Bay, and Tampa Bay to the north of Charlotte Harbor.

Ninety-three blubber/skin biopsy samples have been collected from 88 different dolphins (65 males, 21 females, and two unknown gender waiting on analysis) within the estuary and nearshore Gulf waters outside the passes. Eleven of these have been examined for organochlorine contaminant concentrations, providing suggestions of lower levels than in Sarasota Bay dolphins. The remaining samples have been delivered to the National Institute of Standards and Technology for contaminant analyses, and funding has been obtained for these analyses. Of the 88 sampled dolphins, 60 have been identified and catalogued and have from 1 to 25 sightings in the Charlotte Harbor estuary and nearshore Gulf waters. Biopsy samples are also being used in a genetic model analysis examining stock structure of dolphins from Tampa Bay, Sarasota Bay, Charlotte Harbor, and the Gulf of Mexico. Preliminary results indicate significant fine-scale structuring of the population units, supporting previous work and reinforcing the concept of species management at the level of bay systems.

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Florida Sea Grant - A partnership of partnerships: along the coast, in the Harbor, and in the community

Elizabeth Staugler
Florida Sea Grant, Charlotte County Cooperative Extension Program

Sea Grant is a partnership of educational institutions, state and federal agencies, businesses, and citizens. 30 university-based Sea Grant programs make up the national Sea Grant program, which is administered by NOAA. The Florida Sea Grant program is hosted by the University of Florida, Institute of Food and Agricultural Services (IFAS). The goal of the Florida Sea Grant program is to promote the "practical use and conservation of coastal and marine resources to create a sustainable coastal economy and environment." This is accomplished through the combined efforts of Sea Grant research, education, and extension. The Florida Sea Grant program focuses on ten program areas, marine biotechnology, boating and waterways, aquaculture, water quality, seafood safety, coastal habitats, fisheries, coastal storms, marine education, and graduate education. Statewide fifteen institutions actively participate in Florida Sea Grant programs and research. The Sea Grant extension program's primary mission is the transfer of scientific research to the public to create an informed citizenry. The extension program is a partnership between the University, the local government, and the public. Sea Grant Extension Agents work out of participating county offices where they seek to identify community needs. Sea Grant Extension Agents for the Charlotte Harbor area are found in Manatee, Charlotte, and Lee counties. Some of the extension programs in Charlotte Harbor include the development of boaters guides and artificial reefs, catch a release methods, the REDstart program, and the Clean Marina Program.

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Seasonal and Interannual Variation in Fish Sound Production in Charlotte Harbor

James Locascio¹ and David Mann¹,²

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Fish sound production associated with courtship and spawning was documented at several locations in Charlotte Harbor, Florida during 2003-2004. Continuously deployed underwater acoustic recorders were programmed to record 10 seconds of sound every 10 minutes within the frequency range of 0-3333 Hz. Acoustic data processed with a Fast Fourier Transform (FFT) showed the relative concentration of acoustic energy within individual 100 Hz wide frequency bands. Analysis of processed data allowed us to identify species and patterns of sound production on diel and seasonal scales. Recorded sounds were predominantly from three Sciaenid species: silver perch (Bairdiella chrysoura), sand seatrout (Cynoscion arenarius), and spotted seatrout (Cynoscion nebulosus).

Results of autocorrelation demonstrate pronounced diel periodicity in fish sound production with significant lags occurring at 24 hour periods. Nightly fish choruses began in February and increased gradually in maximum sound pressure levels and duration over the following five months. A decrease in chorusing in late July at sites in the upper portion of the harbor is presumably associated with increased freshwater inflow and resulting hypoxia. Data on sound propagation experiments conducted in the harbor were also analyzed.

Figure 1. Sound pressure levels in the 300-400 Hz band showing the seasonal onset and gradual increase in chorusing activity of spawning fishes in Charlotte Harbor.

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Historic Clues: Early Oyster Reef Dispersion and Elevation in Charlotte Harbor; Feasibility Study

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The historic distribution of oysters is poorly known for many estuaries in Florida including Charlotte Harbor. Elsewhere, historic maps have been based on the economic benefit of commercial oyster beds or their liability as an obstacle to navigation. Such maps tend not to depict the complete range of oyster dispersion across the entirety of an estuary. Recently, however, an interesting set of US Coast and Geodetic Survey topographic maps ("t-sheets") has been under study as a potential reference upon which an historic map of oyster distribution might be created for Charlotte Harbor. The sheets in question were compiled from aerial photographs taken December 1939 and supplemented by other surveys to July 1943. Each was produced at a scale of 1:10,000 and depicted oyster reefs. Remarkably, many reefs were annotated as either bare or awash at mean low water (Geodetic Datum: North American 1927). NOAA contractors georeferenced, vectorized, projected, and produced metadata for these historic t-sheets for the Charlotte Harbor area in April, 2002. We printed the t-sheets at a scale of 1:10,000 or greater and carefully examined the printed maps to identify reefs. Reef locations were then digitized from the t-sheets, yielding a shapefile with latitude and longitude, and attribute data as were noted on the maps.

In order to test the feasibility of using the t-sheets to construct an "historic" map of Harbor oyster reefs, a total of 18 sheets is being processed as described above and composited into a single Harbor image. At present, part of Hog Island and Tippecanoe Bay are missing, but for the remaining Harbor composite, reefs are being categorized as awash, bare, or unknown. Potential reefs are being scored with respect to probable certainty, and a record is being made for every reef to describe the clarity of its image. Work to date suggests that historical (1939-1943) oyster maps can be produced for the Harbor region. Based on preliminary processing, it appears that the majority of reefs occurred in western or coastal waters of the Harbor area as opposed to eastern or inland waters. If this pattern is supported by further study and field work it may signify that freshwater stress, hypoxia, or both stressors have historically limited oyster reef development in up-Harbor areas. Next steps include field verification of mapped and unmapped reefs, and re-surveys of reef elevations for selected subsets of both bare and awash reef-types. This latter effort may provide useful data relative to oysters' ability to "track" sea level rise in southwest Florida, estimated since 1939 to be approximately 14 cm (5.6 in). This work was supported by Mote Scientific Foundation.

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Charlotte Harbor Conference
"Sound Science in 2003-2004," October 5-6, 2004
Distribution and Habitat Partitioning by Immature Bull Sharks (Carcharhinus leucas) in Charlotte Harbor

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The distribution and habitat partitioning of bull sharks in the lower section of greater Charlotte Harbor was examined using the results of longline surveys in the Caloosahatchee River, San Carlos Bay and lower Pine Island Sound. There were significant differences in mean size between each of these three areas, indicating the occurrence of size-based habitat partitioning. The young are born in the Caloosahatchee River in June and July. After approximately one year the animals move into San Carlos Bay, and at the age of approximately two years they are found in lower Pine Island Sound. Habitat partitioning may reduce intraspecific predation risk for the youngest animals. Regression tree analysis was used to examine the influence of environmental parameters on the catch rates of immature bull sharks. Temperature was the only parameter identified that had a significant influence on the catch rates of immature sharks, suggesting a seasonal cycle in occurrence. Temperature and salinity were both important in predicting the catch rates of less than one year old bull sharks. Highest catch rates of this group were predicted at salinities between 7 and 17.5 ppt when temperature was above 29°C (Figure 1). The reason for this salinity preference is unknown, but we hypothesize that it helps minimize the energetic requirements of osmoregulation while enabling the habitat partitioning that reduces intraspecific predation. The hypothesis that young bull sharks have a salinity preference is surprising given that it has been demonstrated they can osmoregulate over a broad range of salinities, including freshwater.

Figure 1. Regression tree of environmental parameters for < 1 year old bull sharks in the Caloosahatchee River and lower Pine Island Sound.

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Charlotte Harbor Conference
"Sound Science in 2003-2004," October 5-6, 2004
The effects of *Karenia brevis* on filtration and clearance rates in four species of juvenile bivalve mollusk

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Little is known concerning the effects of the toxic dinoflagellate, *Karenia brevis*, on juvenile shellfish. Feeding responses of four important shellfish species (*Mercenaria mercenaria*, *Argopecten irradians*, *Perna viridis*, and *Crassostrea virginica*) exposed to *K. brevis* were calculated. *K. brevis* exposure treatments consisted of three concentrations (10, 100, and 1,000 cells ml\(^{-1}\)) and two culture preparations (lysed and whole). Feeding responses included filtration, clearance, and weight-specific clearance rates. A significant \((p < 0.05)\) effect of concentration and culture preparation on clearance rates in *M. mercenaria* was found. There was no significant \((p > 0.05)\) effect of *K. brevis* concentration or preparation on clearance rate for juvenile *A. irradians*, *P. viridis*, or *C. virginica*, although minor responses were observed.

Exposure to toxic algal species during the juvenile phase may disrupt normal feeding behavior resulting in poor growth and maintenance (Nielson and Stromgren 1991). Decreased growth and increased mortality in juvenile bivalves may lead to economic losses due to negative impacts on shellfish industries (Lesser and Shumway 1993).

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The influence of habitat features on manatees' selection of a winter refuge in Charlotte Harbor, Florida

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The availability and adequacy of industrial and natural warm-water refugia for Florida manatees (*Trichechus manatus latirostris*) in winter will change dramatically in the foreseeable future. The Florida Manatee Recovery Plan (U.S. Fish and Wildlife Service 2001) advocates using data collected on attributes of secondary winter refugia that are attractive to manatees to develop a series of additional sites for manatees as a safeguard in the event that warm-water discharge at one or more primary refugia ceases to exist. In Charlotte Harbor, a secondary winter refuge exits at the Matlacha Isles canal system. This site is used each winter by at least 100+ manatees, whose summer habitat extends at least from central western (Pinellas County) to southwestern (Collier County) Florida. Thus, Matlacha Isles represents a winter habitat of regional importance to manatees.
This study attempted to assess and characterize habitat features of importance to manatees in winter. We examined abiotic features of the Matlacha Isles canal system and compared them to those of two nearby canal systems that are not frequented by manatees during the winter. Sampling assessed water temperature, salinity, tidal flushing, canal depth, and boat traffic within all three canal systems. Additionally, movements and habitat use by manatees were documented during winter months at and near the Matlacha Isles canal system. Results show that water temperatures within Matlacha Isles are up to 5 degrees warmer than those in either the non-used canal systems and nearby Matlacha Pass. Heat retention within Matlacha Isles may be associated with greater depth and lower tidal flushing. When manatees occupy Matlacha Isles in moderately cold weather, they leave the canals at night to forage in Matlacha Pass and return early in the morning. During extreme or prolonged cold weather, Matlacha Isles may provide inadequate warmth for manatees; during such times, most or all animals travel to the nearby Florida Power & Light Company plant on the Orange River. Preliminary results do not seem to show a correlation between either salinity or boat traffic and manatee presence within Matlacha Isles. Findings from this study may allow resource managers/conservationists to develop a more informed approach to creating sanctuaries or refuges and could have a significant impact on manatee conservation statewide.

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*Thalassia testudinum:* "Growing" a new technique

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Historically seagrass researchers have used a blade hole-punch technique developed by Zieman (1974) to measure seagrass growth. Although this technique provides adequate growth measures, it also has inherent drawbacks. Specifically, hole-punches are often difficult to find, shoots may not be completely hole-punched, blade degradation and/or loss may occur because the hole-punch disrupts the blade's structural integrity, and/or the uncertainty associated with knowing whether the "oldest" blade is the same blade upon harvest as when marked. In an attempt to reduce these drawbacks, we developed a new technique using color-coded clips to mark blades rather than punching a hole. A major advantage to the blade-clip method is that does not physically damage the plants and individual blade growth can be measured. We compared the two techniques experimentally. Seagrass shoots were haphazardly selected with in a small transect area (~6m in length and 0.5m wide) in New Pass, Sarasota Bay, FL, and marked with polypropylene ribbon to facilitate plant recovery. Shoots were then either hole-punched (n = 30 per week) or clipped (n = 30 per week) and harvested over a six-week period. Processing of shoots included measuring total blade length (tip to base) and old growth (defined as blade material above a clip or hole-punch). New growth was then calculated by subtracting old growth from total growth for each blade. We found that although the blade-clip technique was more labor intensive in the field than the hole-punch, this difference was offset by the reduced processing time required in the laboratory. We also found that the growth measurement techniques were comparable with no significant differences found.

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**Vallisneria americana: How does the garden grow?**

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*Vallisneria americana* is a dominant freshwater submerged plant within many of Florida's rivers. Anecdotal observations suggest that *V. americana* restricts its vertical growth until some horizontal maximum (i.e., adequate belowground structure) has been achieved. An ongoing experiment was developed to understand the growth dynamics of *V. americana* from a south Florida river. Five rosettes were collected from 6 sites within the Caloosahatchee River and two rosettes from each site were randomly assigned to a 24" planter and planted in a static pond. Rosettes were monitored weekly for survival as well as the presence of new "daughters". The number of blades per rosette, blade width and length, the length of all stolons and the direction "daughter" rosettes lie in relation to mother rosettes were measured. Over the first eight weeks of this ongoing experiment, we found the plants exhibited an initial decrease in mean blade length after planting, but then experienced a slow increase in mean blade length over time as well an increase in number of blades per rosette. The more rosettes that are replanted tend to give off more "daughter" rosettes. In addition, we found that while mother rosettes died in some of the planters, the "daughter" rosettes continued to grow and multiply.

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**Effects of bottlenose dolphin, *Tursiops truncatus*, sounds on the acoustic behavior of spawning spotted sea trout, *Cynoscion nebulosus***

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Many predators use acoustic-mediated hunting techniques. This is especially true in marine environments, where visibility can be limited. One such predator is the bottlenose dolphin, *Tursiops truncatus*, which uses passive listening to detect soniferous prey. In order to avoid detection by such predators, sound-producing prey must be able to alter their acoustic behavior. This paper examines the effects of two types of dolphin sounds, whistles and echolocation clicks, on the acoustic behavior of spotted sea trout, *Cynoscion nebulosus*. Several other stimuli, including the disturbance call of Atlantic croaker, *Micropogonias undulatus*, were played back as well. Stimuli were played back to nocturnal spawning choruses. Playbacks of dolphin clicks and disturbance calls of Atlantic croaker caused a significant decrease in sound production by spotted sea trout. No other stimuli caused any significant difference. The low frequency components of echolocation clicks fall overlap the probable hearing range of sea trout while whistles occur at a higher frequency. Therefore, clicks may be audible to sea trout while whistles are not. Thus, acoustic behavior could be altered in response to one dolphin sound but not another. Atlantic croaker, like sea trout, are members of the family Sciaenidae. Both species are
common prey for bottlenose dolphins. Therefore, it is understandable that a disturbance call produced by one prey species would be likely to affect other, heterospecific, prey in the same area.

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Tolerances of Select Charlotte Harbor Benthic Invertebrates to Hypoxic Conditions

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Research on hypoxia (low dissolved oxygen) tolerances of benthic invertebrates is sparse and has been primarily conducted in temperate latitudes. There has been little research conducted on subtropical invertebrates and no laboratory research on the effects of hypoxia for Charlotte Harbor, FL. benthic invertebrates. Hypoxia is a common occurrence in the upper Charlotte Harbor due to salinity stratification resulting from freshwater inflows from the Myakka and Peace Rivers during the summer months. Three species of Charlotte Harbor invertebrates are representative of the crustaceans (Palaemonetes pugio), polychaetes (Pectinaria gouldii), and brachiopods (Glottidea pyramiditata) found in the estuary system were selected for study. The tolerances of these three species to hypoxic conditions were examined. Dissolved oxygen levels were artificially reduced through the addition of nitrogen into a closed chamber. Results showed that Palaemonetes pugio was the most sensitive invertebrate, followed by Glottidea pyramiditata, and then Pectinaria gouldii. Behavioral activities from decreasing dissolved oxygen levels were also observed and correlated to a specific hypoxic level. It was found that Pectinaria was better able to slow down its activity and respiration. Thus Pectinaria was better able to conserve its oxygen supply, which in turn corresponded to its higher tolerance to hypoxia.

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Detecting the red tide, Karenia brevis

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During times of a red tide bloom, Karenia brevis can create a series of adverse effects that impact the aquatic ecosystem and local economy due to massive fish kills, shellfish contamination, and public health concerns. Current methods for detecting Karenia brevis lack the ability to forecast a bloom prior to dangerous cell concentration levels. The BreveBuster is an automated system designed to discriminate Karenia brevis from other algae through the utilization of a similarity index. Laboratory cultures consisting of four species of algae (Karenia brevis, Tetraselmis impellucida, Dactyliosolen fragilissimus, and Gyrodinium inractum) and field samples were analyzed by microscopic enumeration, high
performance liquid chromatography (HPLC), CHEMTAX, and BreveBuster similarity index values. A linear relationship of the similarity index value and percent biomass contributed by the four species of algae was found. A confidence interval was also established to determine the BreveBuster's ability to measure the amount of chlorophyll a contributed by each species. Further applications of this linear relationship and confidence interval will allow the phytoplankton community dynamics to be monitored. During times of increasing Karenia brevis levels, public warnings will allow for proper mitigation efforts to be initiated and the effects of the bloom to be reduced or eliminated.

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Do sharks roam the refuge? Examination of shark movement patterns within the J.N. "Ding" Darling Wildlife Refuge

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A series of seven acoustic receivers were deployed within the J.N. "Ding" Darling National Wildlife Refuge to monitor the presence and movement of elasmobranchs within refuge waters (Figure 1). Receivers were deployed in conjunction with a larger study of elasmobranch movements within lower Pine Island Sound. During this combined study a total of 48 elasmobranchs of six species were fitted with acoustic transmitters in Pine Island Sound. In addition to individuals fitted with transmitters during 2004, at least three sharks fitted with transmitters in 2003 returned to the study site and were monitored. During the course of the 2004 summer season a total of nine sharks were detected within refuge waters. Four of these individuals were bonnethead sharks (Sphyrna tiburo). Bonnethead sharks monitored within the refuge ranged in size from 70 - 107 cm total length. Two of these sharks were male, and two were female. One of the male sharks was originally captured in 2002 and one of the females was originally captured in 2003. The remaining five sharks were all immature bull sharks (Carcharhinus leucas) ranging in size from 144 - 184 cm total length. Four of the five bull sharks were female, with only a single male entering the refuge. Although cownose rays (Rhinoptera bonasus) and southern stingrays (Dasyatis americana) were fitted with transmitters and have been observed in refuge waters, no tagged rays were recorded. Presence within the refuge by both shark species was short-term and typically only lasted for a few hours. No sharks were detected within Tarpon Bay (stations DD1 and DD2 - Figure 1). Station DD7 at the western edge of the refuge was only visited by one of the bull sharks. The majority of detections were recorded at stations 3 - 5 in the center of the refuge. Bonnethead sharks were never recorded at station 3, and only one individual was recorded at station 4 suggesting that bonnethead sharks were less likely to travel into backwater areas. The time spent within the refuge was typically a small proportion of the total time and total area used by individual sharks. However, these results do show that sharks are using refuge waters and that bull sharks may use refuge waters as a potential feeding area.
Bottlenose dolphin-fishery interactions in the Charlotte Harbor Estuary: A review and a tale of three survivors

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Marine mammals interact with fisheries worldwide; the impact of such interactions is greater for species with a coastal distribution. Through stranding efforts, conducted opportunistically from 1985-2000, and systematically during 2001-2004, we responded to sick, injured or dead bottlenose dolphins in the Charlotte Harbor estuary and adjacent waterways. During 1985-2000, seven dolphins were impacted by fishing gear. In addition, three cases have been documented from 2001-2004, during the time of intensive response effort. Types of fishing interactions were not mutually exclusive and included monofilament and rope entanglement of appendages (8), ingestion of fish trailing recreational fishing line and lures (2), and knife wounds (2). Of the ten cases, fishery interactions caused the death of one animal, secondarily impacted five others, and four animals were treated on site or taken to Mote’s rehabilitation facility before complications arose. Case histories for three of the fishery interaction “survivors” are presented here. In 1992, “Matt” an adult male dolphin, was entangled in rope associated with a crab trap in Matlacha Pass. After fishermen noticed the entanglement, they were able to remove the crab trap associated rope and free the animal. Unfortunately, “Matt” was badly injured and was unable to swim. As a result, the dolphin was taken to Mote’s rehabilitation facility, recovered in just over a month and released near his initial stranding sight. “Matt” was observed on multiple occasions over two years post-release and appeared healthy, though he was observed to take fish from commercial fishermen. More recently, in 2003, “Placida,” a young female dolphin in Placida Harbor, was observed with monofilament trailing from presumed boat propeller wounds on her peduncle and cutting into her flukes. After careful monitoring, the decision to intervene was made to remove the gear and assess the resulting wounds. Upon capture, the fishing gear was removed, the wounds...
were cleaned, antibiotics were administered and the dolphin was released. “Placida” has been sighted multiple times over the nine months since her treatment and her wounds have healed well. In Bull Bay, “Toro,” another young female, was found trailing monofilament from her dorsal fin and right pectoral flipper early this year. After observing this dolphin’s condition, a capture effort was mounted to remove the monofilament entangled in the dorsal fin and pectoral flipper. Upon capture, the pectoral flipper entanglement was far more severe than expected, and the dolphin was taken to Mote’s rehabilitation facility. After almost three months of rehabilitative care, “Toro” was released back into Bull Bay. Though her wounds healed very well and she was able to retain the use of her pectoral flipper, she has been observed in close proximity to recreational fishing boats. In all these cases, we believe these dolphins would not have survived without intervention. In the past few years, we have received increasing reports of animals with some type of fishery or other human interaction in the Charlotte Harbor area. This worrisome trend has also been observed in other estuarine systems in Florida (e.g. the Indian River Lagoon). We recommend enhanced educational campaigns to curb discards of unwanted fishing gear and its deleterious effects on marine wildlife. The Stranding Investigations Program hopes to be able to continue to provide intervention before such fisheries interactions become lethal.

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Using liver slices and hepatocyte cultures for in vitro vitellogenin induction in Atlantic stingrays

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Vitellogenin is the precursor to egg yolk proteins produced in the liver after 17β-estradiol binds to the estrogen receptor. Both male and female oviparous animals have the ability to produce vitellogenin but it is found in low levels in males and immature females unless induced by estrogen or an estrogenic mimic. Many estrogen mimics are thought to be responsible for endocrine disruption and ultimately the inability for many species to reproduce successfully. The objective of this experiment was to examine if vitellogenin is an appropriate biomarker for estrogen pollutants in D. Sabina and potentially all other elasmobranches by subjecting cultured liver slices and hepatocytes to various 17β-estradiol concentrations and observing vitellogenin production. SDS-PAGE analysis showed no distinguishable difference in liver and media samples from liver slice culture and media samples from hepatocyte culture. Vitellogenin presence was detected in stingray liver slices as well as the hepatocyte culture media using western blotting with a swordfish vitellogenin antibody. However, no signs of induction were present because control samples and estradiol treated samples showed similar levels of reaction with the antibody using western blotting. Cell viability seems to be the reason for the lack of induction. LDH analysis suggested that the viability of cells substantially decreased over the culture period for tissue slice culture as well as hepatocyte culture.

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Research on the effects of beach nourishment and upland lighting on the nesting preferences of the loggerhead (*Caretta caretta*) sea turtle in Sarasota County

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When a sea turtle emerges from the ocean and crawls onto the beach to nest its environment overlaps with that of people more so than at any other point in its life. Consequently, at this point it is most vulnerable to human influences. Florida beaches are vital nesting grounds for *Caretta caretta* (loggerhead sea turtles) and Sarasota County represents the largest concentration of nesting turtles on the west coast. The Sea Turtle Program at Mote Marine Laboratory has been collecting and maintaining records of nesting sea turtles along the beaches of Sarasota County since 1990. This research project utilizes this wealth of data to determine the effects of beach nourishment on nesting *C. caretta* on Longboat Key. Longboat Key has been a frequently nourished beach since 1993 and as my treatment site is compared to the natural beaches of Siesta Key as a control. Using the street addresses that are attached to every nest record the nests of both keys have been given geographic coordinates and overlaid on a map of the Sarasota coastline to produce a spatial distribution of *C. caretta* nests and false crawls. This has allowed for the visual comparison of the beaches in question from 1991 to 2003 and through five beach nourishment projects. Nesting success, nesting frequency per km, and hatching success are also compared for the two beaches. Beach nourishment appears to have an impact primarily on *C. caretta* nesting success and frequency on Longboat Key. Both figures are significantly reduced on nourished beaches for two years following nourishment.

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Analyzing estrogenic activity in the Myakka River

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Environmental pollutants that imitate estrogen, a female sex hormone, are known to disrupt hormone-regulated functions such as development, immune, reproductive, and neurological processes in marine organisms and increase the frequency of breast and testicular cancer in humans. These xenoestrogens make their way to the water by both natural and commercial means. It is necessary to locate and absole this issue before these endocrine disrupters harm any more aquatic and terrestrial organisms. Samples to be tested for this study were collected in amber bottles from various sites down the Myakka River. These river samples were then extracted using a dichloromethane solvent and then transferred to dimethyl sulfoxide (DMSO) solvent. Following this, an E-SCREEN assay with concentrated river samples, blank samples, 17-β estradiol control and DMSO control was performed. Cell proliferation was identified using a Sulforhodamine B (SRB) substrate and read through an optical density reader at wavelength 490nm. Estrogen levels found in the
Myakka River were below the DMSO and 17β-estradiol maximum proliferation control values, thus concluding levels are not significant. Studies on estrogen levels will continue on various rivers and estuaries throughout southern Florida.

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Measuring septic system impacts to receiving waters using optical brighteners in Charlotte County, Florida

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Techniques were developed to detect Optical Brighteners (OB), fluorescent laundry additives, in selected residential canals of Charlotte County, FL, to determine where On-site Sewage Treatment and Disposal Systems (OSTDS) in the area may be failing. Canals were selected for sampling based on the known waste treatment technique of the homes. OB was measured with two approaches. The first employed absorbent, dye-free cotton pads that were placed in the canals for approximately 48 hours and then recovered. Pads were analyzed for UV fluorescence both visually and with a spectroradiometer to detect any absorbed OB. The second method used paired flow-through fluorometers to obtain a continuous record of fluorescence along selected canals. Tests of mixtures of OB, humic water and sea water indicated that the pad and the fluorometer method both had a quantitative response under lab conditions, increasing in fluorescence with increasing OB concentrations, provided that varying fluorescence due to humic substances was accounted for. Humics present in the water did not interfere with pad absorption of OB. However, in comparison to the fluorometer, the pad method was less sensitive and provided more variable results due to a range of natural organic mater in the field, biofouling, and pad degradation. Pad and fluorometer data were mapped using GPS coordinates and the resulting distribution of OB response indicates that some regions, including both sewered and OSTDS served areas, warrant further investigation. Analysis of OB retention times and the effect of seasonal fluctuation of residents on fluorometric readings is also recommended.

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Evaluation of PIT (passive integrated transponder) tagging as a method for tracking the movements of juvenile common snook, Centropomus undecimalis

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Essential nursery habitat for the juvenile common snook (Centropomus undecimalis) has not been well defined, in part because identification requires long-term tracking of habitat shifts accompanying different life stages. In this study, passive integrated transponder
(PIT) tagging was investigated as a possible method for tracking juvenile snook. Juveniles from an estuarine pond and creek system were fitted with PIT tags for individual identification. Some tagged snook were caged in situ to evaluate the effects of the tagging process and tag retention, and a control group of snook was retained under controlled conditions. An experimental antenna array was used to continuously monitor snook movements into and out of the study pond. Tag retention was 100% for both caged field and control populations. Tagging incisions closed within 6 days of tagging and were barely visible within 19 days. The tagging process had little effect on the health and behavior of the fish, therefore PIT tags are valid tools for tracking juvenile snook. Further results from increased sampling and monitoring by the antenna array will provide valuable data on juvenile snook movements.

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Immune System Parameters as Early Indicators of Environmental Stress-related Health of Charlotte Harbor Manatees

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While many manatees may die each year from the effects of cold weather and/or exposure to harmful algal blooms (red tide; Karenia brevis), a substantial number of additional manatees are rescued from the stress of sublethal exposure to cold or red tide toxins and are taken to authorized facilities for rehabilitation. With the risk that environmental stress-related physiological changes, including impaired immune function, can render animals more vulnerable to disease, this research is focusing on the identification of immune responses that can potentially signal compromised health well before outward signs of distress are apparent. Immune function parameters investigated include lymphocyte proliferation responses, production of nitric oxide (NO) by cultured leukocytes, and serum levels of tumor necrosis factor (TNF). Basic clinical parameters include total white blood cell counts, lymphocyte numbers, and levels of acute phase molecules, such as serum amyloid A (SAA) and haptoglobin. Compared with healthy free-ranging manatees, animals exposed to red tide toxins tend to have increased levels of circulating TNF and leukocyte NO, but reduced lymphocyte proliferation. Levels of circulating TNF, leukocyte NO, and lymphocyte proliferation are all reduced in animals exposed to cold stress. Total white blood cells and lymphocytes, however, are significantly greater in number in cold-stressed manatees compared to healthy free-ranging manatees. Preliminary results indicate significantly greater serum levels of both haptoglobin and SAA in animals exposed to cold stress but not in animals exposed to red tide toxins. A combination of serum TNF, leukocyte NO, lymphocyte proliferation, immune cell numbers, and acute phase molecules, suggests multiple immune parameters can provide unique insights into manatee health.
With recent success in cloning and sequencing of gene fragments for manatee iNOS, housekeeping genes (GADPH, S9, and actin), and cytokines IL-6, IL-4, IL-10, future studies will include the expression of specific immune function genes to evaluate the health of environmentally stressed manatees.

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Hepatic Fatty Acid Signatures: A New Forensic Tool for Florida Manatees and Other Marine Mammals

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Fatty acid signature analysis (FASA) has become an important tool by which marine mammal scientists gain insight into foraging ecology. FASA also is a promising biomarker by which marine mammalogists may be able to assess exposure to certain natural and anthropogenic stressors. Florida manatees are well studied, and an excellent necropsy program provides a basis against which to ground truth this promising tool. Chemical and statistical analyses to date indicate that (a) manatees exposed or dying due to exposure to brevetoxin demonstrate a unique fatty acid profile; (b) animals suffering long-term health stress (injuries or cold) have certain fatty acids not found in animals that die quickly; and (c) some animals assigned to the watercraft mortality category demonstrate the "brevetoxin fatty acid profile," but subsequent examination of necropsy reports indicated those animals were recovered during and likely exposed to red tide events, which could have impaired animals' ability to detect or avoid boats. This analytical approach provides a potentially important forensic tool to assist scientists and managers to understand cause of death or debilitation in manatees and could likely be applied to studies designed to better assess cause of death in other marine mammals.

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Dr. David H. Niebuhr is the Vice President of the Education Division at Mote Marine Laboratory. He earned his Ph.D. in Biological Oceanography at the Virginia Institute of Marine Science in 1999. Prior to his current position, Dr. Niebuhr was an assistant professor of biology and science education at Salem State College and the College of William and Mary where he taught undergraduate and graduate courses in biology to general science students and science teaching methods to elementary and secondary level preservice teachers. He has a broad background as an educator having worked as a high school teacher, a college professor, and as a field-based educator. Dr. Niebuhr is known for his enthusiastic and engaging style with his students and subject matter. His reputation as a teacher lead him to be selected to develop and teach science education programs as part of a joint US-China program sponsored by the National Oceanic and Atmospheric Administration. Dr. Niebuhr is a physical biologist and biochemist whose work in curriculum development has received national recognition, including an internet-based project with WHRO Telecommunications that was featured in the Corporation for Public Broadcasting Annual Report. He has lead several curriculum development projects for the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA), has authored several chapters of introductory science textbooks, and currently serves as the Chair of the Editorial Board for Current: The Journal of Marine Education.
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Mote Marine Laboratory is a 501(c)(3) nonprofit organization dedicated to excellence in marine, estuarine and environmental research and education. It is one of the few remaining independent marine research facilities in the United States. Founded in 1955 in Placida, Florida, by William and Alfred Vanderbilt, it was originally known as the Cape Haze Marine Laboratory. The name was changed to Mote Marine Laboratory in 1967 in honor of the family of a major benefactor, William R. Mote.