

**Florida Bay and Adjacent
Marine Systems
Program Management Committee**

**List of Current or Recently
Completed Florida Bay Projects**

February, 2003

This document is an annotated compilation of the research and monitoring projects supported by member agencies of the Florida Bay and Adjacent Marine Systems Program Management Committee in or directly related to Florida Bay. It is intended to provide programmatic information to our standing Science Oversight Panel, agency managers, and the scientific community. Hopefully, this document will serve as a point of reference for future programmatic science planning regarding Florida Bay.

This listing does not include descriptions of other agency-funded environmental monitoring and research projects that are state-wide or regional in geographic scope. There are also activities being undertaken in connection with CERP, such as the Southern Estuaries component of the RECOVER Monitoring and Assessment Plan, which will generate scientific data and model output to supplement the studies and data sets described herein and facilitate RECOVER assessment of overall ecosystem restoration progress.

Florida Bay and Adjacent Marine Systems Program Management Committee Contacts

John Hunt, co-chair
Florida Fish & Wildlife Commission
2796 Overseas Highway
Suite 119
Marathon, FL 33050
(305) 289-2330

Peter Ortner, co-chair
NOAA/AOML/OCD
4301 Rickenbacker Causeway
Miami, FL 33149
(305) 361-4374

National Park Service

Project Title: Analysis and synthesis of existing information on higher trophic levels in Florida Bay.

Principal Investigators: Joan Browder and others (NOAA/NMFS/SEFC)

Project Dates: Begin: 07/12/99 End: 09/30/02

Project Description: This study will develop statistical models from existing data sets on Florida Bay fish and invertebrate communities, relating animal abundance to habitat variables and environmental variables. Statistical models will be developed for a set of performance measures to represent the response of community structure to environmental change, particularly changes in freshwater flow that may result as a consequence of Everglades restoration.

Total Project Cost: \$107,400 FY02 Cost: \$60,000

Project Title: Monitoring CERP related changes in hydrologic parameters within the mangrove zone of northeast Florida Bay: Impacts on resident fishes, SAV's, and roseate spoonbills.

Principal Investigators: Jerry Lorenz (National Audubon Society)

Project Dates: Begin: 10/01/01 End: 09/30/02

Project Description: This study will monitor the distribution and abundance of Florida Bay mangrove zone flora and fauna as a means of assessing the ecological effects of hydrologic changes in Taylor Slough, including those from ecosystem restoration actions. Data collected will be integral to the adaptive management process of CERP.

Project Cost: \$223,600

Project Title: Salinity Simulation Models for North Florida Bay, Everglades National Park.

Principal Investigators: Frank E. Marshall (Cetacean Logic Foundation, Inc.)

Project Dates: Begin: 09/16/01 End: 09/30/02

Project Description: The purpose of this project is to develop seasonal autoregressive integrated moving average (SARIMA) models to simulate the salinity in the embayments of North Florida Bay within Everglades National Park (ENP). The SARIMA process will be used to develop multi-variant transfer functions that predict salinity at the following five ENP monitoring stations: Joe Bay, Little Madiera, Terrapin Bay, Garfield Bight, and North River. These models will use hydrologic variables (stage and discharge) that are estimated by the South Florida Water Management Model (SFWMM), also known as the "2x2" model, and long term wind, water level, and rainfall time series. Additional transfer functions will be

developed to predict salinity at several stations in more open parts of Florida Bay, probably Duck Key, Butternut Key, Whipray Basin, and Buoy Key.

Project Cost: \$35,800

Project Title: Marine Monitoring Network, Everglades National Park.

Principal Investigators: Kevin Kotun (Everglades National Park)

Project Dates: Begin: 1998 End: Ongoing

Project Description: The Marine Monitoring Network (MMN) currently includes 33 permanent stations, 18 in Florida Bay and 15 in estuaries of the Gulf Coast. These MMN stations measure physical aquatic parameters in Park estuaries and provide data to assess long-term trends. The information will be used to define statistical relationships between salinity and runoff and to assess the impacts of water management decisions. Instantaneous water level measurements are made every 10 minutes at all 33 stations. Hourly rain totals are collected at 31 stations, bottom specific conductance (@25C) is measured hourly at 33 stations, and surface water temperature is measured hourly at all stations. Data is also collected from four stations operated cooperatively by the South Florida Water Management District (SFWMD) and SFNRC in Barnes Sound and Joe Bay. The Everglades National Park MMN is supported by the National Park Service and SFWMD.

Project Cost: ~ \$220,000 per year

Project Title: Predictive models based on throw-trap data to evaluate the long-term effects of salinity and other factors on the structure and function of forage fish and crustacean communities in Florida Bay.

Principal Investigators: Darlene Johnson/Joan Browder (NOAA/NMFS/SEFC)

Project Dates: Begin: 10/01/02 End: 09/30/03

Project Description: The objectives of this study are to examine the effect of habitat and environmental conditions on the forage fish and crustacean communities in bank, basin, near key habitats in western Florida Bay, to explore the potential for, and develop, seagrass associated forage fish and shrimp performance measures based on the analyses, and extend the analyses to all of Florida Bay.

Project Cost: ~\$90,000

Project Title: Florida Bay Program Support.

Principal Investigators: South Florida Natural Resources Center, Everglades National Park

Project Dates: Begin: 10/01/97 End: Ongoing

Project Description: Provide logistic support for the Florida Bay Interagency Science Program. Provide operational funds for Florida Bay Interagency Science Center.

Total Project Cost: \$550,000 (to date) FY02 Cost: \$101,000

Project Title: Fish utilization of fringe mangrove habitats in Biscayne National Park and adjacent waters.

Principal Investigators: Joe Serafy (University of Miami, RSMS)

Project Dates: Begin: 10/01/00 End: 09/30/02

Project Description: This project will provide quantitative data on the fishes inhabiting mangroves in Biscayne Bay, Card Sound, Barnes Sound, and northeast Florida Bay. This study will provide baseline data for evaluating the effects of Comprehensive Everglades Restoration Plan actions.

Total Project Cost: \$120,000 FY02 Cost: \$60,000

Project Title: Nitrogen and phosphorus limitation of primary productivity in Florida Bay.

Principal Investigators: James Fourqurean (Florida International University)

Project Dates: Begin: 01/07/02 End: 06/30/05

Project Description: It has been hypothesized that increased in freshwater flow into Florida Bay from ecosystem restoration actions will also result in increased nitrogen loading to the Bay. This study will assist in assessing the ecological effects of potentially increased nutrient loading to Florida Bay. This project will manipulate the availability of nitrogen and phosphorus to seagrass beds in selected regions of Florida Bay. It will measure the response of the major primary producers and consumers to this nutrient manipulation, and determine if nitrogen limits primary productivity.

Project Cost: \$225,000

Project Title: Development of a Landscape-scale Seagrass Model for Florida Bay.

Principal Investigators: Thomas M. Smith and others (University of Virginia)

Project Dates: Begin: 10/01/99 End: 09/30/02

Project Description: A simple empirical model of seagrass growth and response to environmental conditions relating to salinity, temperature, light, and nutrient availability will be developed. Process based seagrass physiological and population models will also be developed.

Project Cost: \$212,467

Project Title: Coastal landscape, wetland, and tidal channel evolution affecting critical habitats of Cape Sable, Everglades National Park.

Principal Investigators: Harold Wanless (University of Miami)

Project Dates: Begin: 2002 End: 2004

Project Description: Portions of Cape Sable have undergone rapid geomorphic changes in response to sea level rise, major hurricanes, and anthropogenic channel incisions. To provide proper understanding of the nature and rates of future geomorphic changes in Cape Sable coastal habitats, this project will document the nature, rates, and causes of historical geomorphic changes. This study will integrate historical photographic analysis, paleoenvironmental and radiometric analysis of sediment cores, and monitoring of erosion/accretion processes.

Project Cost: \$158,300

Project Title: Performance measure development for salinities in northeast Florida Bay.

Principal Investigators: William Nuttle (Cadmus Group)

Project Dates: Begin: 10/01/01 End: 09/30/03

Project Description: This project will develop and assist in implementing hydrological and ecological performance measures for the mangrove coast and nearshore estuarine areas of Everglades National Park. Wetland hydrology and estuarine salinity models will be developed to extend the results of regional hydrologic simulations with the 2x2 model into the coastal zone. These models, in turn, will support application of ecological models to assess the effect of alternative regional hydrology scenarios on ecosystem components in Florida Bay and along the west coast of the Park.

Total Project Cost: \$200,000 FY02 Cost: \$100,000

Project Title: Physiological Performance Measures and Tolerance Limits of Estuarine Indicator Species in South Florida.

Principal Investigators: Gary Rand (Florida International University)

Project Dates: Begin: 10/01/01 End: 09/30/03

Project Description: This project will develop relationships between salinity and indicator estuarine/marine species (red drum, snook, spotted sea trout, grunts, pinfish, mangrove snapper, pink shrimp), particularly for juvenile and larval phases. These relationships will provide the basis for developing ecological indicators and ecosystem restoration performance measures for Florida Bay and other south Florida estuaries, particularly regarding changes in freshwater inflow.

Total Project Cost: \$289,200 FY02 Cost: \$145,000

Project Title: Mangrove modeling of landscape, stand-level, and soil-nutrient processes.

Principal Investigators: Robert Twilley (LSU) and Tom Doyle (USGS)

Project Dates: Begin: 07/12/99 End: 09/30/04

Project Description: Development of stand and landscape-scale models of coastal and riverine mangrove forests in the Taylor and Shark rivers in South Florida. Linked models provide for simulations of mangrove community structure, tree demographics, biomass, and productivity responses to environmental conditions. Project includes field and greenhouse studies to support model development effort, development of a user interface to conduct simulations and model integration and refinement.

Total Project Cost: \$780,000 FY02 Cost: \$241,000

National Oceanic and Atmospheric Administration

Project Title: Florida Bay Inner Basins Circulation and Exchange Study.

Principal Investigators: Tom Lee, Elizabeth Johns, Vassiliki Kourafalou

Project Dates: Begin: 2002 End: 2004

Project Description: This project is a two-year continuation study of the circulation and exchange processes that regulate the residence times and flushing rates within interior basins of Florida Bay.

Project Cost: \$630,000 FY02 Cost: \$315,000

Project Title: Nitrogen and Phosphorus Mass Balance Models and Nutrient Biogeochemistry in Florida Bay.

Principal Investigators: Jeffrey Cornwell, Michael Kemp

Project Dates: Begin: 2002 End: 2004

Project Description: This project will provide both a well-constrained nutrient mass balance model that includes both external and internal loading/cycling terms and new rate measurements that are critical for development of process-based models of nutrient cycling.

Project Cost: \$250,000 FY02 Cost: \$125,000

Project Title: Nutrient Cycling by Seagrasses and their Epiphytic Consortium in Florida Bay: Experimental Research in Support of a Seagrass Ecosystem Model.

Principal Investigators: Marguerite Koch, Christopher Madden, Melody Hunt

Project Dates: Begin: 2002 End: 2004

Project Description: This project will quantify seagrass and epiphyte P uptake kinetics in the field, establish the importance of P availability in N sequestration by seagrasses, examine the ability of seagrasses and their epiphytic consortium to take up nutrients (TN and TP) released from photooxidized DOM, etc.

Project Cost: \$178,000 FY02 Cost: \$89,000

Project Title: From Source to Sink: Assessment and Monitoring of Dissolved Nitrogen Cycling Within Florida Bay.

Principal Investigators: Cynthia Heil, David Hollander, Patricia Glibert

Project Dates: Begin: 2002 End: 2004

Project Description: Research will focus on the current ecological significance of DON and DIN cycling in Florida Bay, links between DON/DIN inputs from the Everglades watershed and phytoplankton community structure in the Bay, and the development of potential monitoring tools for evaluating the effects of Everglades restoration on N sources and cycling within Florida Bay.

Project Cost: \$200,000 FY02 Cost: \$100,000

Project Title: Dissolved Organic Nitrogen in the Florida Coastal Everglades: Molecular Biogeochemistry, Bioavailability, and Potential Contribution to the Microbial Loop.

Principal Investigators: Rudolf Jaffe, Joseph Boyer, Susan Dailey, Dan Childers

Project Dates: Begin: 2002 End: 2004

Project Description: This study will focus on the determination of the molecular characteristics of DOM and DON and assess the bioavailability of these materials in transects ranging from C-111 canal and Taylor Slough to the central part of Florida Bay.

Project Cost: \$320,000 FY02 Cost: \$160,000

Project Title: Nutrient Mass Fluxes Between Florida Bay and the Florida Keys National Marine Sanctuary through Florida Keys Passes.

Principal Investigators: Ned Smith, Joseph Boyer

Project Dates: Begin: 2002 End: 2004

Project Description: This study is designed to quantify and compare nutrient fluxes through two major Keys tidal channels over annual, seasonal, and tidal cycle and to characterize the response to weather-related events.

Project Cost: \$328,000 FY02 Cost: \$164,000

Project Title: Regional Assessment of Sponge Dynamics and Sponge Fishery Impacts.

Principal Investigators: Mark Butler

Project Dates: Begin: 2002 End: 2004

Project Description: This PI will conduct a series of field and laboratory studies and simulation modeling to better understand commercial sponge population dynamics, to determine the impact of the sponge fishery on sponge communities, and to examine the effect of salinity change on sponge and octocoral survival in shallow hard-bottom habitat within the FKNMS.

Project Cost: \$135,000 FY02 Cost: \$83,000

Project Title: Reef Fish Community Dynamics and Linkages with Florida Bay.

Principal Investigators: James Bohnsack, Jerald Ault

Project Dates: Begin: 2002 End: 2004

Project Description: This research will continue to quantify coral reef fish community changes through visual census. Research will document trends in reef fish size and abundance within and outside no-take zones and test specific hypotheses predicting continuing changes in reef fish communities as a result of no-take protection.

Project Cost: \$300,000 FY02 Cost: \$150,000

Project Title: Upstream Larval Supply to Florida Bay – the Dry Tortugas Connection.

Principal Investigators: William Richards, Cynthia Yeung, Maria Criales, David Jones

Project Dates: Begin: 2002 End: 2004

Project Description: The objectives of this research are to understand the role of eddy processes in higher trophic level dynamics near the Dry Tortugas and the efficacy of the recruitment pathway connecting the Dry Tortugas with Florida Bay over the Southwest Florida Shelf.

Project Cost: \$300,000 FY02 Cost: \$150,000

Project Title: Development of Spatially-Explicit Models to Predict Growth-Potential of Age-0 Gray Snapper, *Lutjanus friseus*, in Florida Bay During Restoration of Freshwater Flows.

Principal Investigators: Jonathan Hare, Lawrence Settle, Mark Wuenschel

Project Dates: Begin: 2002 End: 2004

Project Description: This research will examine patterns of growth in juvenile gray snapper and develop a bioenergetic model of growth that is a function of temperature, salinity and fish size.

Project Cost: \$160,000 FY02 Cost: \$80,000

Project Title: Population Studies, Abundance, Habitat Use, Trophic Descriptions, and Reproductive Status of Marine Turtles Inhabiting Florida Bay.

Principal Investigators: Barbara Schroeder, Allen Foley, Blair Witherington

Project Dates: Begin: 2002 End: 2004

Project Description: This study will continue long-term population monitoring of individual growth rates, foraging-site fidelity, residency rates, health status, and trends in abundance of sea turtles in Florida Bay. It will also elucidate the trophic role of loggerheads as apex predators, provide detailed descriptions of loggerhead habitat use and behavior, and examine sexual maturity and reproductive frequency of adult-sized loggerheads inhabiting Florida Bay.

Project Cost: \$60,000 FY02 Cost: \$30,000

Project Title: Modeling Pink Shrimp Recruitment from Florida Bay.

Principal Investigators: Joan Browder, Maria Criales, Steve Wong, John Wang, Mike Robblee, and Clinton Hittle

Project Dates: Begin: 2002 End: 2004

Project Description: This study continues development of a pink shrimp simulation model and performance measure. Specific objectives are to 1) clarify the effect of freshwater inflow and seagrass habitat on Florida Bay's pink shrimp nursery function; 2) determine the major influences of meteorological and oceanographic processes on various life stages of pink shrimp, and 3) improve the ability to predict recruitment to the Tortugas fishery in response to changes in water management.

Project Cost: \$360,000 FY02 Cost: \$180,000

Project Title: Long-Term Monitoring of Seagrasses in the Florida Keys.

Principal Investigators: Jim Fourqurean

Project Dates: Begin: 1996 End: Ongoing

Project Description: This program will 1) define the present distribution of benthic communities within the FKNMS, 2) provide high-quality, quantitative data on the status of the seagrasses within the FKNMS, 3) quantify the importance of seagrass primary production in the FKNMS, 4) define the baseline conditions for seagrass communities, 5) determine relationships between water quality and benthic community status, and 6) detect trends in the distribution and status of benthic communities.

Project Cost: ~ \$210,000 per year

Project Title: Real-Time Oceanographic Observations in the FKNMS.

Principal Investigators: Elizabeth Johns, Peter Ortner, Jim Hendee, Tom Lee, Villy Kourafalou

Project Dates: Begin: 2002 End: 2004

Project Description: This project will monitor, in real-time, flow through passages between Florida Bay and the Florida Keys, monitor the oceanographic properties and currents of the Dry Tortugas and surrounding waters, and create a web-based system for presenting real-time data and oceanographic data syntheses for South Florida coastal waters.

Project Cost: \$360,000 FY02 Cost: \$180,000

Project Title: Interdisciplinary Coastal Oceanographic Observations.

Principal Investigators: Peter Ortner, Elizabeth Johns, Tom Lee, Villy Kourafalou

Project Dates: Begin: 1995 End: Ongoing

Project Description: This project will continue coordinated measurements of coastal physics, biology, and chemistry and analytical interpretation of the coupled local, regional and remote processes influencing the transport and exchange of South Florida coastal waters and their suspended dissolved constituents.

Project Cost: ~ \$820,000 per year

Project Title: Program Management: South Florida Ecosystem Research and Monitoring Program (SFP).

Principal Investigators: Peter Ortner, Dawn Marie Boyer

Project Dates: Begin: 199? End: Ongoing

Project Description: Program management for SFP fulfills three primary functions: 1) facilitates or provides individual research, monitoring, and modeling project support and coordination; 2) supports and participates in the PMC process; and 3) supports, participates and represents NOAA within the SFER effort. The program office also supports small boat operations for SFP research projects.

Project Cost: \$173,000 per year

Fish and Wildlife Conservation Commission Florida Marine Research Institute

Project Title: Marine Turtle Biology, Life History, Ecology and Migrations.

Principal Investigators: Anne Meylan, Blair Witherington, Allen Foley

Project Dates: Ongoing Internally Funded Project

Project Description: Identify and characterize life history stages of marine turtle species that occur in Florida waters; identify habitats specific to life history stages. Collect population biology, ecology and behavior data. Involves capturing, measuring, collecting blood, tagging and releasing turtles in Florida Bay.

Project Cost:

Project Title: Evaluation of the nearshore hard-bottom habitats of the Florida Keys.

Principal Investigators: John Hunt

Project Dates: Begin: 03/01/02 End: 09/30/04

Project Description: Survey and describe the sessile flora and fauna of the nearshore hard-bottom from Biscayne Bay to the Marquesas Keys. The sponges, octocorals, corals, etc. will be identified to the species level and sizes measured. Survey and describe the macroinvertebrates and fish associated with the hard-bottom community. Conduct a one-year sampling to delineate the seasonal fluctuation of fish and invertebrates. Sponge tissue samples will be taken for stable isotope analysis.

Project Cost: \$149,333

U.S. Army Corps of Engineers

Project Title: Florida Bay and Florida Keys Feasibility Study.

Principal Investigators: Erwin Wunderlich

Project Dates: Begin: 03/02 End: 05/06

Project Description: The goals of the feasibility study are to evaluate Florida Bay and its connections to the Everglades, the Gulf of Mexico, and the Florida Keys marine ecosystem, to determine the modifications that are needed to successfully restore water quality and ecological conditions of the Bay, while maintaining or improving these conditions in the Keys' marine ecosystem. A major focus of the study will be to develop models (hydrodynamic, water quality, etc.) as needed to meet the above goals.

Project Cost: \$3,000,000 (50% of Total - The other 50% is paid by SFWMD)

United States Geological Survey Biological Resources Division

Project Title: Fish-Habitat Assessment Program (FHAP).

Principal Investigators: Dr. Michael Durako, University of North Carolina at Wilmington;
Dr. Margaret Hall, Florida Marine Research Institute

Project Dates: Begin: 1997 End: 2003

Project Description: Project objectives include the following: 1) To identify the species composition, distribution, and abundance of the dominant benthic macrophytes (seagrasses and macroalgae) and to assess the spatial and temporal changes in these parameters; 2) To determine which morphometric, physiological, biochemical, and dynamic characteristics are most useful as indicators of physiological status (i.e. healthy, stressed, or dying); 3) To assess the population dynamics, reproductive potential, and vigor of *Thalassia testudinum* and *Halodule wrightii*; and 4) To provide baseline data to monitor responses of these important benthic communities to current and future water management alterations or other restoration activities associated with CERP, the Federal/State Comprehensive Everglades Restoration Plan.

Project Cost: \$578,045 FY02 Cost: \$225,000

Project Title: A seagrass light monitoring network for Florida Bay.

Principal Investigator: Dr. Paul Carlson, Florida Marine Research Institute

Project Dates: Begin: 1999 End: 2003

Project Description: Project objectives include the following: 1) To measure light available to seagrass at eight sites across Florida Bay; 2) At these same eight sites, monitor seasonal and episodic changes in water clarity due to phytoplankton blooms and sediment resuspension; and 3) To contribute data to seagrass simulations model development.

Project Cost: \$160,134 FY02 Cost: \$49,000

Project Title: Simulation Model of Seagrass Communities in Florida Bay.

Principal Investigator: Dr. Chris Madden, South Florida Water Management District; Dr. Adrian Burd, University of Georgia

Project Dates: Begin: 1999 End: 2003

Project Description: Project objectives include: 1) Starting with existing seagrass models to develop a computer model for the growth and production of *Thalassia* and *Halodule* in Florida Bay; 2) To adapt the Florida Bay model for use in a landscape model, first for four selected reference basins in Florida Bay, and second in a landscape encompassing all of

inner Florida Bay; 3) To evaluate hypotheses on the origins and impacts of seagrass die-off in Florida Bay; and 4) To evaluate the response of the seagrass community in Florida Bay to alternative upland water management scenarios.

Project Cost: \$417,079 FY02 Cost: \$190,000

Project Title: Temporal dynamics of seagrass associated fish and invertebrate populations in Johnson Key Basin, western Florida Bay.

Principal Investigators: Dr. Mike Robblee, USGS, Biological Resources Division; Dr. Joan Browder, National Marine Fisheries Service; Mr. Clinton Hillte, USGS, Water Resources Division; Dr. Maria Criales, University of Miami

Project Dates: Begin: 1998 End: 2003

Project Description: Project objectives include: 1) Quantify seagrass associated fish and shrimp populations and community dynamics in Johnson Key Basin in relation to bank, basin and near-key habitat and environmental change including salinity; 2) Compare juvenile pink shrimp abundance in Johnson Key Basin with patterns of pink shrimp postlarval immigration to Florida Bay through the Florida Keys and from the Gulf of Mexico; 3) Quantify direction, velocity and volume of water flow at postlarval shrimp sampling sites in Florida Bay and the Florida Keys; and 4) contribute empirical data to the development of a pink shrimp landscape model.

Project Cost: \$614,975 FY02 Cost: \$177,000

United States Geological Survey Geological Division

Project Title: Geochemical Monitoring of Restoration Progress.

Principal Investigators: Kimberly Yates

Project Dates: Begin: 1999 End: 2004

Project Description: Monitoring changes in surface water geochemistry is critical for identifying and predicting ecological response to restoration in Florida Bay. Many basic estuarine processes directly impact water quality and vice versa. For example, calcification, photosynthesis and respiration directly affect dissolved oxygen, pH, dissolved inorganic carbon and a number of other chemical characteristics of the water column. Alternatively, changes in salinity, carbon speciation in the water column, and other water quality parameters affect rates of metabolism and growth of estuarine species and rates of carbonate sedimentation. These processes are sensitive to changes in water quality that result from flow modifications in the Everglades. Bay-wide geochemical surveys have been conducted bimonthly to establish baseline data from which to gauge restoration impacts.

Project Cost FY02: \$250,000

Project Title: Paleosalinity as a Key for success Criteria in South Florida Restoration.

Principal Investigators: G. Lynn Wingard

Project Dates: Begin: 2000 End: 2005

Project Description: The most critical issue in the Central Everglades Restoration Plan (CERP) is to restore more natural patterns of freshwater flow through the terrestrial ecosystem and into the estuaries and coastal areas. Seasonality of water delivery is critical to the reproductive cycles of many of the organisms within the environment. Calcareous organisms (mollusks and ostracodes) preserve the effect of annual and seasonal salinity changes and other data about the water in which they live, and analyses of the individual growth bands of mollusks will allow detailed comparisons of seasonal change over time in Florida Bay. There are three primary objectives to this project: 1) test and develop a methodology for extracting water chemistry data from selected calcareous shelled animals that grow within the water; 2) develop an understanding of the biology of the selected organisms so that the water chemistry data extracted from their shells can be put into temporal context; 3) apply this technique to shells found in sediment cores that span the last 100-300 years of South Florida history in order to determine the seasonal variation in salinity and water sources prior to significant human alteration of the environment. These data will provide resource managers with the necessary information to establish targets and performance measures as restoration of more natural timing and delivery of water proceeds.

Project Cost FY02: \$357,000

United States Geological Survey Water Resources Division

Project Title: Freshwater Flows into Florida Bay.

Principal Investigators: Clinton Hittle

Project Dates: Begin: 1995 End: 2005

Project Description: The project objectives are to determine the quantity, timing and distribution of freshwater flow into Florida Bay and adjacent estuaries, determine baseline hydrologic conditions and provide information on hydrologic change during the restoration process. Flow, water level, and salinity data are collected at monitoring sites in estuarine creeks that connect Florida Bay with the Everglades. This project helps determine how freshwater flow affects the health of Florida Bay, a critical component of the CERP, and how changes in water management practices upstream (Taylor Slough and C-111 basins) directly influence flow and salinity conditions in the estuary.

Project Cost FY02: \$373,000

Project Title: SICS Modeling of Surface Water and Interactions with Ground Water.

Principal Investigators: Eric Swain

Project Dates: Begin: 2000 End: 2006

Project Description: The objectives of this project are to integrate field process studies, represent relevant factors affecting flow in the coastal Everglades, and test restoration alternatives. Field process studies developed all the major factors that affect flow and transport: evapotranspiration, frictional resistance, topography and more. These data were used to construct and test an initial surface-water model. The surface-water model was linked to a ground-water model and this integrated model is now being linked to output from regional models for the purpose of evaluating the potential effects of CERP projects on freshwater flows and salinity into Florida Bay.

Project Cost FY02: \$220,000

Project Title: Groundwater Flow and Transport for the SICS and TIME Models.

Principle Investigators: Eduardo Patino

Project Dates: Begin: 1999 End: Ongoing

Project Description: The objective of this project is to describe the salinity patterns in relation to freshwater inflows to the estuaries and tidal exchange with the Gulf of Mexico, to provide support for the USGS Tides and Inflows in the Mangroves of the Everglades (TIME)

model and to provide support to programs like the Everglades Long Term Ecological Research (LTER) and SIRENIA project.

Project Cost FY02: \$450,000

Project Title: Interrelation of Everglades Hydrology and Florida Bay Dynamics to Ecosystem Processes and Restoration in South Florida.

Principal Investigators: Ray Schaffranek

Project Dates: Begin: 1999 End: 2002

Project Description: This interdisciplinary synthesis project is designed to identify and document the interrelation of Everglades' hydrology and tidal dynamics of Florida Bay on ecosystem response to past environmental changes, both natural and human imposed. The project focuses on integrating historical, hydrological, and ecological findings of scientific investigations within the Southern Inland and Coastal System (SICS), which encompasses the transition zone between the wetlands of Taylor Slough and C-111 canal and nearshore embayments of Florida Bay.

Project Cost FY02: \$ 129,000

Project Title: Tides and Inflows in the Mangrove Ecotone (TIME) Model Development.

Principal Investigators: Ray Schaffranek

Project Dates: Begin: 1999 End: 2004

Project Description: This project is focused on development of the surface-water modeling component of a linked ground-water/surface-water model to simulate the interaction of tides, sheet flow, and aquifer leakage in the freshwater-saltwater mixing zone along the southwest Gulf Coast and Florida Bay boundaries of Everglades National Park. Regression techniques have been developed to correlate gaged and un-gaged culverts. Flow is being monitored in the wetlands to evaluate forcing effects and a paper documenting thermal convection-driven mixing processes has been written. The SWIFT2D model formulation is currently being extended to incorporate wind-stress sheltering, vegetative-resistance correlation, and energy-dependent evapotranspiration.

Project Cost FY02: \$125,123

Project Title: South Florida Information Access/Environmental Database and Digital Library.

Principal Investigators: Roy Sonnenshein

Project Dates: Begin: 1995 End: Ongoing

Project Description: The primary objectives of this project are to 1) provide a central location for the archival of all products and data collected as part of the UGS Place-based Studies program and related work for the restoration of the South Florida Ecosystem and 2) provide means for customers to obtain the achieved information.

Project Cost FY02: \$580,000

South Florida Water Management District

Project Title: Integrated monitoring and science in the southern Everglades.

Principal Investigators: D. Childers, C. Madden, D. Rudnick (plus LTER investigators)

Project Dates: Begin: 06/02 End: 12/04

Project Description: The primary goal of this project is to assess how changing management of fresh water affects the southeastern Everglades, including Taylor Slough, the C-111 Basin, and the mangrove ecotone of northeast Florida Bay. The project monitors nutrient inputs from S-332/S-332D structures and the C-111 canal, nutrient transport and availability in the wetland, and the status of macrophytes. Sampling at fixed sites along three downstream transects between canal structures and Florida Bay (one in Taylor Slough; two in C-111 Basin, including sites downstream of proposed C-111 Spreader Canal) include the following.

- Water Quality assessment. Monitor the amount and timing of input of total nutrients (autosampling TN and TP) and the more bioavailable forms (ammonium, nitrate, nitrite, and phosphate) into specific areas of the southern Everglades in response to restoration activities.
- Dissolved Organic Matter Dynamics: Chemically characterize the composition of dissolved organic matter (DOM) and measure DOM production and decomposition rates.
- Marsh Macrophytes: Monitor species composition and the biomass and the nutrient ratios of sawgrass and spikerush. Monitor sawgrass productivity.
- Marsh Soil and Periphyton: Measure periphyton biomass, production (including light-production curves), respiration, and nutrient ratios.
- Spatial Analysis and Modeling: In conjunction with the FCE-LTER, integrate information through development of nutrient budgets estimates and dynamic models.

Project Cost: \$990,000 (~ \$300,000 per year)

Project Title: Taylor Slough periphyton monitoring.

Principal Investigators: S. Hagerthy and S. Newman

Project Dates: Begin: 04/96 End: 12/04

Project Description: This project monitors the periphyton as water quality and ecological indicators of the effects of ongoing water management activities. The project started as part of the Biological Monitoring Program of the Experimental Water Deliveries Program (Test 7) and has continued as part of the C-111 Project. It includes monitoring fixed sites along six east-west transects that traverse Taylor Slough. The most northerly transect is downstream of S332D outflow and the most southerly transect is in freshwater marshes at the boundary of the Florida Bay mangrove zone. Measurements include the following.

- Taxonomic indicators. Periphytometers are used to assess spatial and temporal patterns in periphyton taxonomy on a quarterly basis. Surface water TP and TKN are collected concurrently with periphytometers.

- Ambient Periphyton Habitat Characterization. Ambient periphyton are collected from floating mat, benthic mat, and epiphyte habitats twice per year for taxonomic and tissue nutrient (N,P) analysis.
- In situ diel dissolved oxygen. Hydrolabs are deployed at six sites on a quarterly basis to assess spatial and temporal, including diel, patterns in basic water quality and productivity.

Project Cost: ~ \$100,000 per year

Project Title: Nutrient Exchange Between Florida Bay and the Everglades' Salinity Transition Zone.

Principal Investigators: J. Day, E. Reyes, J. Cable, D. Childers, D. Rudnick, C. Madden, F. Sklar

Project Dates: Begin: 1996 End: 2002

Project Description: The primary objective of this project has been to determine how changing freshwater flows and water levels affect the exchange of nutrients between the wetlands along the northern coastline of Florida Bay (including mangrove swamps, marshes, ponds, and creeks) and the Bay. The study began in 1996 and field measurements were made on a seasonal basis from May 1996 through June 2001. Final reports are currently being prepared under a no-cost extension. The main components of the project have included the following measurements and assessments.

- the seasonal and inter-annual variability of phosphorus and nitrogen inputs to Florida Bay from three creeks that contribute most of the channelized flow of freshwater to the Bay;
- the relationship between rates of P and N inputs to Florida Bay and rates of freshwater flow;
- the importance of the freshwater marshes of Taylor Slough as a source of nutrients for the transition zone and Florida Bay;
- the importance of transition zone marshes, ponds, and creeks as a source, sink, and transformer of nutrients that can cross the wetland-bay boundary;
- the importance of groundwater flow to nutrient movement through the transition zone;
- the relationship between plant productivity rates, hydrological conditions, salinity levels, and nutrient availability in the transition zone;
- synthesizing information on the effects of changing freshwater flow and water levels on nutrient cycling, nutrient transport, and productivity across the southern Everglades' transition zone.

Project Cost: \$1,050,000 FY02: \$56,000

Project Title: Florida Bay Water Quality Monitoring.

Principal Investigators: J. Boyer and R. Jones

Project Dates: Begin: 03/91 End: Ongoing

Project Description: This project monitors water quality monthly at sites in Biscayne Bay, Florida Bay, inland coastal waters of southwest Florida, and the shelf waters off of this coast.

Project Cost: ~ \$500,000 per year FY02: ~ \$650,000

Project Title: Northeast Florida Bay Coastal Seagrass Monitoring.

Principal Investigators: L. Hefty (Miami-Dade DERM)

Project Dates: Begin: 1996 End: Ongoing

Project Description: This project monitors SAV and water quality at sites in Manatee Bay, Barnes Sound, Long Sound, Joe Bay, and Little Madeira Bay. Sampling design and methods are comparable to the FMRI FHAP program's monitoring.

Project Cost: ~ \$70,000 per year

Project Title: Northern Florida Bay water quality mapping.

Principal Investigators: C. Madden and D. Rudnick

Project Dates: Begin: 1996 End: Ongoing

Project Description: A shipboard "DataFlow" system, which includes an array of sensors (GPS coordinates, temperature, conductivity, pH, DO, chlorophyll fluorescence, DOM fluorescence, light transmission) collects data at about 5 second intervals along a cruise track. The area from Long Sound to Whipray Basin, including coastal bays and lakes (Joe, Little Madeira, Taylor Ponds, Terrapin Bay, Seven Palm Lake) is typically mapped on a quarterly basis and following climatic and water release events. Grab samples for nutrients and chlorophyll are taken to calibrate and assess semi-continuous data relationships.

Project Cost: ~ \$25,000 per year

Project Title: Benthic nutrient fluxes and metabolism in northern Florida Bay and mangrove ecotone.

Principal Investigators: D. Rudnick and S. Kelly

Project Dates: Begin: 1996 End: 2002

Project Description: In situ benthic chambers have used to estimate the rate of nutrient and dissolved oxygen exchange between sediment and water. Both clear and dark chambers have been used in order to estimate both day and nighttime fluxes. Rates have been estimated for three Florida Bay Sites (Little Madeira Bay, south of Little Madeira Bay, Terrapin Bay, south of Terrapin Bay) and two ponds in the mangrove dominated ecotone north of Little Madeira Bay (Taylor Pond 1 and Argyle Henry Pond). Measurements were

made about seasonally from May 1996 through February 2001. Data analysis and synthesis with other projects is ongoing.

Project Cost: ~ \$30,000 in FY02

Project Title: High salinity and multiple stressor effects on seagrass communities of Florida Bay.

Principal Investigators: M. Koch, M. Durako, C. Madden

Project Dates: Begin: 04/02 End: 05/05

Project Description: The primary objective of this project is to quantify the effects of the dominant stressors (salinity, temperature, light attenuation and sulfide) on the Florida Bay seagrass communities. Experiments in mesocosms and microcosms will provide data such that mathematical relationships (response curves) can be formulated in order to parameterize the Florida Bay seagrass model (Madden 2002). Tasks include the following.

- Determine how high salinity affects seagrass plants *T. testudinum*, *Halodule wrightii*, and *Ruppia maritima* from Florida Bay, specifically measuring the impact on growth, photosynthesis (various indexes), carbon balance and survival.
- Determine the importance of and rate of osmotic adjustment in all three dominant Florida Bay seagrass species as a tolerance mechanism to reduce stress responses to hypersaline conditions. Quantify the length of time required for osmotic adjustment to increased salinities in the three dominant Florida Bay seagrass species. Time for osmotic adjustment experiments will be determined based on the timing of fresh water releases from the Everglades and realistic rates of salinity increase in the north central Bay basins.
- Determine how three other key stressors, sediment sulfide, high temperature, and low light, impact the ability of seagrasses to tolerate hypersalinity for the three dominant Florida Bay seagrass species.
- Quantify the effects of high and low salinity on survival and development of seeds and seedlings in *Thalassia* and *Ruppia*.
- Quantify stress response variables in situ (measuring various indicators of the plants' energetic and osmotic condition) at seagrass field sites, including a site exhibiting seagrass decline.

Project Cost: \$375,000 FY02: \$50,000

Project Title: Northern Florida Bay productivity patterns .

Principal Investigators: C. Madden and C. Donovan

Project Dates: Begin: 1998 End: Ongoing

Project Description: Oxygen production and respiration of seagrasses and algae are measured about quarterly at sites in Trout Cove, Little Madeira Bay, and Terrapin Bay. This includes the use of in situ dark and light chambers and light and dark bottle incubations.

Project Cost: ~ \$25,000 per year

Project Title: Florida Bay Seagrass Integrated Model (FSIM) development.

Principal Investigators: C. Madden and M. Hunt

Project Dates: Begin: 2000 End: 2004

Project Description: Unit models of seagrass communities are being developed to evaluate Florida Bay ecosystem dynamics as part of the Comprehensive Everglades Restoration Plan and for Florida Bay Minimum Flows and Levels determination. These unit models include three major seagrass species (Thalassia, Halodule, Ruppia) and are being calibrated to simulate five Florida Bay regions. The model tracks above-ground and below-ground carbon production, biomass, and nutrient dynamics as a function of light, salinity, nutrient availability, and sulfide stress. Based on changing environmental conditions and resultant biomass changes per species, community structure is predicted for each unit (regional) model.

Project Cost: ~ \$50,000 per year (SFWMD funds)

Project Title: Fate and effects of Everglades' dissolved organic matter in Florida Bay.

Principal Investigators: D. Rudnick, C. Madden and S. Kelly

Project Dates: Begin: 2002 End: 2004

Project Description: Experiments are being designed to: 1) measure rates of nutrient mineralization from wetland DOM and, 2) measure the effects of this DOM on phytoplankton. Fate experiments will include DOM from freshwater and saline marshes and decomposition in different regions of Florida Bay (both via pelagic and benthic decomposers). Effects experiments will evaluate direct DOM uptake and intermediate decomposition via microbial and photolytic processes.

Project Cost: ~ \$30,000 in FY02; expected about \$125,000 per year FY03-FY04.

Project Title: Florida Bay and Florida Keys Feasibility Study – Integrated Modeling.

Principal Investigators: D. Worth and D. Rudnick

Project Dates: Begin: 2002 End: 2004

Project Description: The Florida Bay and Florida Keys Feasibility (FBFKFS) will include the development and application of a set of simulation models. This includes models to evaluate upland hydrology and water quality, hydrodynamics in the Bay and Florida Keys, water quality, dynamics of seagrass and hard bottom (including coral reef) habitats, and animal population dynamics.

Project Cost: \$3,000,000 Total (SFWMD funds; expenditures only for planning in FY02)

Project Title: Florida Keys Tidal Restoration Project Monitoring Study.

Principal Investigators: D. Worth and C. Kennedy

Project Dates: Begin: 2002 End: 2004

Project Description: Baseline monitoring of sites in the Florida Keys (near Marathon) that may be restored by the construction of culverts or bridges will done prior to construction. This monitoring will include physical, water quality, and biological monitoring. Monitoring will continue at sites chosen for restoration activities.

Project Cost: total ~ \$400,000 (SFWMD funds; expenditures only for planning in FY02)

ENVIRONMENTAL PROTECTION AGENCY

Project Title: Water Quality Monitoring Project for the Florida Keys National Marine Sanctuary.

Principal Investigators: Ron Jones and Joseph Boyer

Project Dates: Begin: 1995 End: Ongoing

Project Description: This project monitors water quality parameters four times per year at 154 stations in the Florida Keys National Marine Sanctuary, which includes Florida Bay. Categories of water quality parameters are: physical, chemical (including nutrients) and biological (concentrations of chlorophyll a and alkaline phosphatase activity).

Project Cost: Split (\$250,000 EPA; \$100,000 SFWMD; \$100,000 Monroe County/Florida Keys Tourist Development Council