

The South Florida Ecosystem Restoration Task Force

Plan for Coordinating Science Update

July 2008—June 2010

PURPOSE OF THIS REPORT

The South Florida Ecosystem Restoration Task Force (Task Force), assisted by the Science Coordination Group (SCG), developed the *Plan for Coordinating Science: A Framework for Strategic Coordination* in 2008 to enhance agency coordination and cooperation, and communicate strategic-level science priorities and system-wide assessments for restoration success. The fundamental strategies described in the 2008 Plan remain sound and the objectives unchanged, therefore, no major revisions of the Plan are recommended at this time. Since the last report to Congress, efforts have shifted more from planning a science coordination strategy to implementing and applying the concepts described in the 2008 Plan. This report provides a synopsis of the framework in the 2008 Plan, and summarizes key science coordination activities that have taken place over the last two years. The complete 2008 Plan can be found at <http://www.sfrestore.org/documents/index.html>.

BACKGROUND

South Florida Ecosystem restoration involves a large and complex combination of initiatives intended to return the degraded ecosystem to a more natural and sustainable condition. The historic ecosystem comprised an 18,000 square-mile region of subtropical uplands, wetlands, and coastal waters; it extended from the Kissimmee Chain of Lakes south of Orlando through Lake Okeechobee, southbound through the Greater Everglades marshes onward to the Florida Bay and the reefs southwest of the Florida Keys and the Dry Tortugas.

Restoration efforts will take decades and require the resolution of complex science, engineering, management, and policy issues by many federal, Native American, state, and local organizations. Managers in these organizations will have to make numerous project-specific and restoration-wide decisions as restoration proceeds. This will include evaluating options and predicting results; implementing selected options; comparing actual results to expectations; and continually improving the strategies, project designs, and operations to incorporate new information and lessons learned into future decisions.

The U.S. Congress established the intergovernmental Task Force in 1996. The Task Force provides strategic coordination and a system-wide perspective to guide the separate restoration efforts being planned and implemented in south Florida. One of the duties of the Task Force is to coordinate policies and programs, and exchange information among the member organizations responsible for the restoration, preservation, and protection of the South Florida Ecosystem. The Task Force applies a system-wide approach that addresses issues holistically, recognizing that the various levels of federal, state, local and tribal governments have distinct jurisdictions and responsibilities that can be coordinated but not shared. The Task Force has no overriding authority to direct its members. Instead the Task Force's coordination role complements the implementation roles of its members involved with restoration, including restoration-related science. To ensure that science is incorporated into decision making as effectively and efficiently as possible, and to address GAO's and Congressional recommendations to improve science coordination, the Task Force created the SCG in December 2003. The SCG supports the Task Force's efforts to coordinate the science related aspects of policies, strategies, plans, programs, projects, activities, and priorities and to respond to Congressional directives to improve science coordination based on Government Accountability Office (GAO) and National Academy of Sciences (NAS) recommendations.

The Plan for Coordinating Science is a reference document that can be used by all the Task Force organizations to help guide their science planning. The identification of strategic science needs, as a

basis for strengthening scientific contributions to restoration planning, implementation, and assessment, is one additional source of information for use by member agencies as they plan future science activities.

SUMMARY OF 2008 PLAN FOR COORDINATING SCIENCE

Four premises guided development of the 2008 Plan:

- **Uncertainty is Certain** – The complex nature of the subtropical systems in south Florida and due to human alteration, responses are difficult to predict.
- **Proceed with Restoration** – Because natural systems are continuing to deteriorate, active and aggressive restoration initiatives should proceed even in the face of some scientific uncertainty.
- **Indicators improve Confidence** – A highly prioritized and focused science program with carefully defined system-wide ecological indicators should over time reduce current levels of scientific uncertainty, and improve confidence in the correctness of restoration plans.
- **Adaptively Manage** – The combination of a program of adaptive management with a program of focused science that includes research, monitoring, predictive tools, and system-wide ecological indicators will provide the most effective long-term strategy for moving forward with restoration initiatives.

Fundamentals Sound, relevant, and timely scientific information coupled with adaptive management, can make a major contribution in establishing objectives, assessing objectives, and supporting decisions. Restoration science, for the purposes of the 2008 Plan, includes research, modeling, monitoring, evaluation and assessment.

- **Research** – To generate new knowledge of and technologies required to better understand specific or collective functions of the ecosystem
- **Modeling** – To predict ecosystem response to changing conditions, including the ecological effects that projects or project options may have on the ecosystem (e.g., project alternative evaluations)
- **Monitoring** – To establish pre-restoration baseline conditions and to assess and evaluate the performance of individual projects, the combined effect of multiple projects, and impacts of natural phenomena (e.g., droughts, tropical storms, freezes)
- **Evaluation and Assessment** – To determine if ecosystem responses are as predicted during implementation

The 2008 Plan addresses the area consisting of the lands and waters within the boundary of the South Florida Water Management District, including the Everglades, the Florida Keys, and the contiguous near-shore coastal waters of South Florida.” The Plan describes mechanisms the Task Force has available to help coordinate the restoration science and activities that enhance the collection, use, management and communication of that science. The Plan also describes the process to identify the most strategically significant science issues, using conceptual ecological

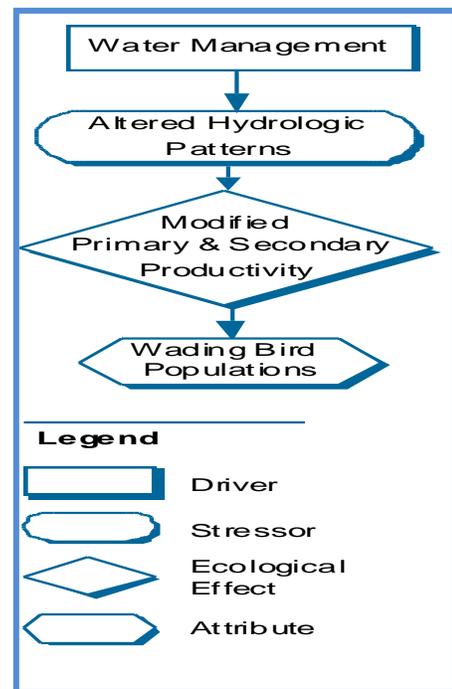
models (CEMs) and a set of eleven system-wide ecological indicators to provide a “big-picture” assessment of the successes. The SCG used an “expert-panel” approach to identify both the system-wide indicators and the science needs and gaps.

Conceptual Ecological Models CEMs are planning tools to help guide and focus scientific activities in support of South Florida Ecosystem restoration and to help develop hypotheses for scientific inquiry (see: Wetlands December 2005, “Volume 25, NO. 4, pages 795-1002”). There are CEMs that cover individual sub-regions within the South Florida Ecosystem and a CEM for the Total System. The South Florida Ecosystem CEMs illustrate the links among environmental stressors, including human sources, and ecological responses to explain how and why natural systems in south Florida behave as they do, and how they have changed.

The number of potential assessment, communication, research, modeling, and monitoring needs was substantially reduced by using the CEMs as a filter to evaluate the science needs, and system-wide ecological indicators for the South Florida Ecosystem. A central component of restoration science coordination is the evaluation of whether ongoing science efforts are addressing the science needs in scope and timeliness to support ecosystem-wide restoration goals. To identify gaps in the needs the SCG looked at existing science programs and initiatives, and compared those with each science need. If an existing program or project was meeting an identified need, there was no gap. The outcome of this review is included in Appendix B of the 2008 Plan.

The CEM components include:

- **Drivers** – The major external driving forces, such as hydrology and climate that can have large-scale influences on natural systems.
- **Stressors** – The physical, chemical, or biological changes that occur within natural systems that are brought about by the drivers, causing significant changes in the biological components, patterns, and relationships in natural systems.
- **Ecological effects** – The biological responses caused by the stressors.
- **Attributes** – Subsets of the biological components of a natural system, such as wading birds, that are representative of the overall ecological condition of a system.

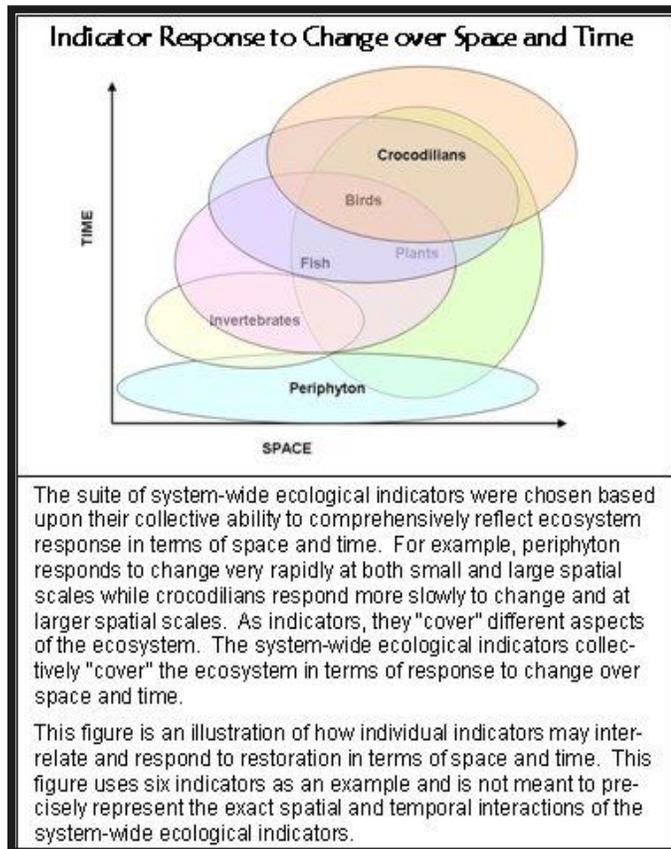


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Example of a Path within the Total System Conceptual Ecological Model

System-wide Ecological Indicators By selecting a suite of key organisms ecologically linked to the Everglades landscape and to one another, the Task Force has a tool that can be used to integrate underlying hydrologic, chemical, and biological data to synthesize a more holistic picture of restoration. The System-wide Ecological Indicators operate as individual attributes within the CEMs. The indicators provide a basis to measure improvements toward ecological targets and a consistent reporting system to provide an aggregated and simplified method to communicate the status of restoration success.

- System-wide Ecological Indicators*
- Fish & Macroinvertebrates
 - Wading Birds (Roseate Spoonbill)
 - Wading Birds (Wood stork, White Ibis)
 - Florida Bay Submersed Aquatic Vegetation
 - Florida Bay Algal Blooms
 - Crocodylians (American Alligators/Crocodiles)
 - American Oysters
 - Periphyton & Epiphyton
 - Juvenile Pink Shrimp
 - Lake Okeechobee Nearshore Zone
 - Invasive Exotic Species



In addition, the System-wide Indicators have become key communication tools, for the restoration science community and for managers and decision-makers. Periodic status reports provide detailed technical information on patterns and trends for the individual indicator organisms, which are translated and summarized graphically using red-yellow-green "stoplight" maps and symbols. The development of the System-wide Ecological Indicators is the first cross-agency science report and is serving as a framework for unifying other science documents and reports.

HOW THE TASK FORCE COORDINATES SCIENCE

The Task Force's concept of what it means to coordinate science at strategic science-planning and science-policy levels has evolved over time. Through the development and integration of tools like the System-wide Ecological Indicators and feedback from independent science review panels, the Task Force's ability to assess, synthesize, and report scientific information has improved dramatically, and the Plan provides a unifying and common framework for the agencies in science coordination.

The 2008 Plan describes seven basic mechanisms by which strategic level science is coordinated.

- 1) The Task Force and its Working Group (WG) and SCG hold regular meetings where agencies have the opportunity to collectively discuss and debate science issues of interest and concern.

- 2) The Task Force produces its own science and restoration reports through its different teams such as the SCG.
- 3) The Task Force convenes individual workshops to deal with specific science topics, issues, or questions.
- 4) Task Force members participate in independent science meetings and conferences such as the Greater Everglades Ecosystem Restoration Conference (GEER).
- 5) The Task Force, through the SCG, develops tools, such as the system-wide ecological indicators, to assist the member agencies, the public, decision-makers, and others in better understanding the “big-picture” science and restoration issues and questions.
- 6) The Task Force utilizes independent panels of scientific experts to review and comment on the Task Force’s own science products.
- 7) The Task Force utilizes independently developed science and science policy reports to provide it with guidance and information about restoration science, science planning, and science policy.

Independent Scientific Review Panels The quality of restoration decisions is directly dependent on the quality of the supporting scientific information. Individual Task Force member organizations have programs addressing the quality of data from the point of initial gathering or research to synthesis for decision-making. Member organizations generally use standard quality assurance/quality control procedures for collecting and analyzing samples, maintaining laboratories, and managing data. Organizations generally also use traditional peer reviews to assure the quality of research proposals and publications. The Task Force also recognized the need to establish quality assurance/quality control procedures for scientific research and reports developed by and for the Task Force. The Task Force and SCG reached consensus to continue the use of independent science reviews (ISR) as the principal means to assure quality of Task Force documents that support restoration decision-making.

Topical Workshops The Task Force organizes and hosts individual workshops to deal with specific science topics, issues, or questions. These workshops provide an opportunity for interactions among scientists, managers, and policy-makers in order to discuss and understand complex science issues or questions that need greater elucidation for decision makers. Examples include the avian ecology and hydrologic modeling workshops.

Working Group and Science Coordination Group members also participate in topical workshops. The SFWMD, for example, convened a series of technical workshops to evaluate the hydrologic and environmental needs of the Everglades as part of the River of Grass planning process. For this evaluation, the Regional Simulation Model (RSM) was used to simulate, evaluate, and screen a variety of impacts on the Everglades ecosystem. These simulations, in concert with a new set of tools were used to identify ranges of restored Everglades performance and water needs. “Ever-Views” were used to display the stages and flows simulated within the Everglades system, and the Reservoir Sizing and Operations Screening (RESOPS) model was used to rapidly study various options for sizing storage reservoirs north and south of Lake Okeechobee with a variety of Lake Okeechobee operations.

Science Conferences and Workshops To expedite the sharing of preliminary data that are in the analysis phase, recently published, or not yet published and distributed to stakeholders, the Task Force also supports periodic south Florida science conferences and workshops. These events serve as venues for sharing ecosystem restoration and management-related research, monitoring, and modeling information, and encouraging science communication, integration, and coordination among principal investigators (PIs) and resource managers. Science information needs provide the

justification for a major conference on a 12-24 month recurring interval. Smaller, more focused topical workshops could occur on shorter intervals, or in response to unexpected events (such as major storms or construction of a restoration project).

Expected information-sharing benefits of Task Force-led conferences and workshops include the following:

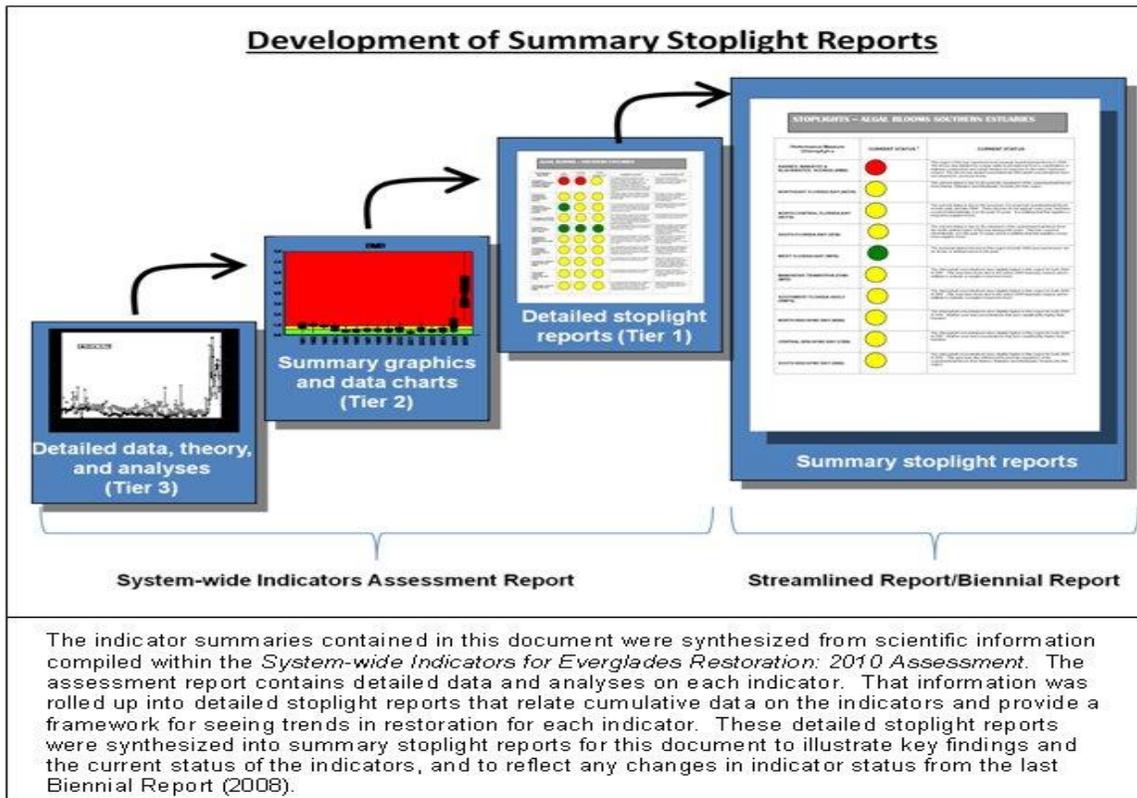
- **Advances in scientific understanding of ecosystem function and response** Conferences provide forums for learning and teaching, discussing or evaluating new ideas or methods, receiving feedback from peers, establishing collaborative associations, and answering priority science questions.
- **Communication, collaboration, and synthesis within and across disciplines** Conferences focused on South Florida Ecosystem restoration themes provide opportunities for interdisciplinary review and discussion of recent data, analysis, and application of findings from each science branch to assessment of restoration and related adaptive management decisions. For example, there was a special symposium on biogeochemistry, nutrients and contaminants of the Greater Everglades at the GEER conference in 2008. Twenty-six synthesis manuscripts resulting from the symposium are being published in critical reviews in *Environmental Science and Technology* (Fall 2010).
- **Early access and sharing of results for scientists and managers** Regularly occurring conferences and workshops encourage early sharing and discussion of provisional data and preliminary study results of studies.
- **“Adaptive assessment” of science approaches** The preview of results and interpretations in collaborative conference or workshop settings are a principal way that the science community practices adaptive assessment within the conduct of science. The insight and feedback gained in face-to-face meetings should lead to adjustments in approach, methods, or application of results that improves the quality of underway science projects.
- **Building consensus and defining the mainstream** The conference and workshop setting should be an objective venue for airing diverging hypotheses or interpretations.

Independent Reports The Task Force utilizes independently developed science and science policy reports to provide it with guidance and information about restoration science, science planning and science policy. The National Academy of Sciences convened the National Research Council (NRC) Committee on Independent Scientific Review of Everglades Restoration Progress (CISRERP). Their report, *Progress Toward Restoring the Everglades: The Second Biennial Review, 2008*, is one example.

ADVANCING SCIENCE COORDINATION FROM PLANNING TO IMPLEMENTATION

Since the last report to Congress, the Task Force teams have increasingly moved from planning a science coordination strategy to implementing and applying the concepts described in the 2008 Plan. Tools such as CEMs and System-wide Ecological Indicators provide a foundation for identifying critical restoration science priorities, summarizing scientific information, and integrating results across disciplines or from numerous partners in agencies and academia. In particular, the ecological indicator assessment process fosters collaboration and has begun to streamline the preparation of restoration status reports. CEMs and indicators are also being developed for additional components of the south Florida ecosystem, helping to assure an integrated approach. Feedback from managers, workshops and independent reports has targeted synthesis of new scientific knowledge, as well as emerging themes, such as the effect of climate change and invasive exotic animals on restoration.

System-wide Ecological Indicators The System-wide Ecological Indicators for Everglades Restoration were published in a special issue of the peer reviewed journal, *Ecological Indicators*, in 2009, signaling broad acceptance of the approach in the scientific community. Since 2008, the broader community of indicator scientists working in cooperation with the SCG and Restoration, Coordination and Verification teams (RECOVER), have updated the indicator status and stoplight communication tool incorporating new monitoring data. Current stoplight assessments are in the, *System-wide Indicators for Everglades Restoration, 2010 report*. The results of the update have been incorporated into related status reports for both technical and general audiences.



Strategy and Biennial Report The current stoplight assessments from the *System-wide Ecological Indicators for Everglades Restoration, 2010 report* have been included in the *2010 Strategy and Biennial Report*. This approach effectively communicates and links the complex underlying science and data in a way that is universally understood. These assessments provide a current and last status of the ecosystem’s health and overtime will provide a means to measure its response to the suite of restoration projects and system-wide operational changes.

System Status Report Published by RECOVER, the *System Status Report (SSR)* addresses the overall status of the ecosystem relative to system-level hypotheses, performance measures, and restoration goals. The 2009 SSR provides an integrated assessment of RECOVER’s *Monitoring and Assessment Plan (MAP)* and non-MAP data, spanned multiple spatial scales, and in some cases decades worth of information. Because of the broad intergovernmental coordination, the SSR incorporates elements of the “stoplight” indicator update and the SSR provides the detailed underlying, data, theory, and analysis used by the System-wide Ecological Indicators for Everglades Restoration, 2010 report.

The 2009 SSR is available on an interactive web page that allows managers, stakeholders and scientists with varying interests and degrees of technical expertise to easily find the information they need (http://www.evergladesplan.org/pm/ssr_2009/ssr_main.aspx#).

This combination of indicator reports will provide managers with information they need to adjust restoration activities at both large and small scales.

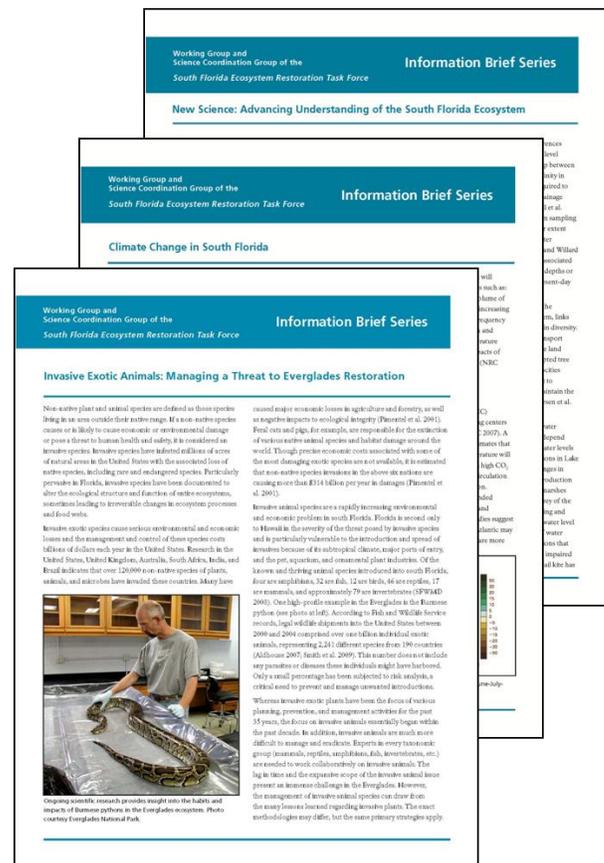
South Florida Environmental Report As a result of on-going scientific coordination the *2010 South Florida Environmental Report* (SFER) also incorporates elements of the “stoplight” indicator format and uses the detailed underlying data, theory, and analysis provided in the SSR. This approach furthers our goal of making the most efficient use of science resources to support the various reports and management activities required in south Florida. The SFER report is available at <http://www.sfwmd.gov/portal/page/portal/xweb%20about%20us/agency%20reports>.

SYNTHESIS

After ten years of ongoing monitoring and research on the south Florida ecosystem since the initial CERP authorization, a large body of new scientific information has been published in peer-reviewed journals, technical status reports such as those described above, and other Task Force member-agency databases. The SCG and WG have focused on activities to help identify the most strategically significant restoration science issues, as well as new science and management challenges not addressed by CERP.

At the request of the Task Force, the SCG and WG developed a series of concise information briefs, directed at non-technical audiences, on invasive exotic animals, climate change, and new science in the context of South Florida Ecosystem restoration. The briefs synthesize a tremendous amount of complex information from scores of organizations into short, plain-language documents. The process of developing the briefs significantly improved the WG and SCG members’ understanding, communication, and coordination of these challenging issues and provides a solid foundation for more advanced discussions and follow-on actions. The Briefs are available at <http://www.sfstore.org/documents/index.html>.

Related Ongoing Synthesis The SCG/WG information briefs complement and help to inform several interdisciplinary science projects now underway to synthesize new scientific information and incorporate it into restoration initiatives. These include efforts focused on science of freshwater flows, linking knowledge gained to restoration objectives, and goal-setting for the coastal south Florida. All are supported by federal and state Task Force member agencies, with participation from agency and academic scientists. The SCG routinely receives presentations during regular meetings and is actively tracking these projects to help ensure consistency and to



provide a forum for information sharing to keep restoration managers, scientists, and members of the public engaged and updated.

The Department of the Interior’s Critical Ecosystem Studies Initiative (CESI) has funded a team of scientists working on freshwater Everglades to undertake the *Synthesis of Everglades Restoration and Ecosystem Services (SERES)*. The first phase is defining key science questions that have relevance to decision makers. The second phase is a review and synthesis of recent Everglades science pertinent to the refinement of long-term restoration goals and targets in south Florida. The final phase is examining a range of proposed restoration options, and describing the potential consequences of these actions to the natural and built system.

RECOVER is coordinating a CERP synthesis effort or *Scientific Knowledge Gained* document, which summarizes the large body of monitoring and research, engineering advances, and modeling tools pertinent to the Everglades and south Florida ecosystem that have become available since 1998. More information can be found at http://www.evergladesplan.org/shared-definition/sd_2010.aspx

The National Oceanic and Atmospheric Administration (NOAA) is the lead agency supporting the *Marine and Estuarine Goal Setting for South Florida (MARES)*, a science-based approach to defining characteristics and processes of a South Florida coastal marine ecosystem that is both sustainable and capable of providing the diverse ecological services upon which society depends. Conceptual models envisioned for MARES will incorporate not only natural science and processes but also human dimensions science and societal processes. These models, public meetings, and agency briefings will be used to identify Quantitative Ecosystem Indicators (QEIs). These QEIs will then be integrated into a South Florida coastal ecosystem report card which will assist natural resource and environmental management of South Florida by providing a common reference with respect to overall ecosystem health and by measuring change in response to the management actions taken by the participating federal and state agencies. The South Florida coastal ecosystem report card has been modeled after the Task Force’s spotlight Indicator report helping to create a common format for reporting on ecosystems in south Florida and increase effective communication.

COORDINATING AND COMMUNICATING SCIENCE			
Putting It All Together	2009 System Status Report	System-wide Ecological Indicators for Everglades Restoration, 2010 report	SCG/WG New Science Information Brief
Audience	Scientists, Project Teams, Managers, Decision-makers, NRC/GAO, Public	Scientists, Managers Decision-makers, NRC/GAO, Public, Congress/OMB	Project Teams, Managers Decision-makers, NRC/GAO Public, Congress/OMB
Content and Product	<i>What & Why</i> <ul style="list-style-type: none"> ✓ Web-based tool ✓ Detailed system-wide data analysis 	<i>What & Why</i> <ul style="list-style-type: none"> ✓ Indicators status report ✓ Metric-based Assessment 	<i>What</i> <ul style="list-style-type: none"> ✓ 4-page information Brief ✓ Synthesis & communication tool at system-wide level
Coordinating Science, Reporting and Communicating	Provides detailed data for System-wide Ecological Indicators, 2010 report	Included in 2010 Strategy and Biennial Report	Synthesized and communicated science since 1999 in coordination with ongoing synthesis initiatives
Responsible Group	RECOVER Team	Indicator Scientists via SCG	SCG
*This table illustrates the coordination and communication among a few key scientific efforts that have been completed			

EMERGING THEMES

Recognizing the Value of Ecosystem Services in Restoration Ecosystems provide a variety of goods and services such as flood risk reduction, water supply, food and fiber. Some of the services provided by healthy ecosystems are more difficult to quantify such as nutrient recycling, regulation of climate, and maintenance of biodiversity. It is the physical, biological, and chemical processes at work in natural ecosystems that provide these ecosystem services which are of value to society. Many of these goods and services are traditionally viewed as free benefits to society, or "public goods". Lacking a formal market, these natural assets are traditionally absent from society's balance sheet; their critical contributions are often overlooked in public, corporate, and individual decision-making. There have been efforts to develop a methodology to monetize ecosystem benefits; however, further work is needed to account for total economic benefits and relative costs associated with everglades restoration efforts.

There have been multiple efforts ongoing that seek to identify the intrinsic values provided by ecosystem services attributed to everglades restoration activities. These activities will help to inform decision makers and change behaviors to more environmentally sustainable practices. With improved understanding of the values of ecosystem services provided by restoration activities, decision makers can develop policies and practices to change behavior and positively affect ecosystem service production and sustainability. The SERES and MARES projects are examples of these types of activities in south Florida.

Another example, the Florida Ranchlands Environmental Services Project (FRESP) is seeking to promote the use of market mechanisms to induce private landowners to install and operate conservation practices that will provide ecosystem services. Ranchers are given the opportunity to provide environmental services like water retention and improved water quality in ways that save taxpayers money, provide additional revenue, preserve rural communities and enhance wildlife habitats. The project is setting guidelines to measure environmental benefits, register and record these benefits, and implement verification protocols to ensure that the benefits provided are real. The purpose is to help build a unified, transparent market system where private landowners can actively participate in emerging markets for ecosystem services and investors can trust that they're purchasing a real conservation benefit.

Climate Change Coordination Understanding the implications of climate change related to restoration of the Everglades is critical because of the exceptionally flat terrain in south Florida and the susceptibility of native plants and animals to changes in temperature, humidity and precipitation. Equally important a workshop at the 2008 Greater Everglades Ecosystem Restoration conference concluded that it is likely that Everglades restoration will be an important aspect of our adaptation response to climate change. Addressing these challenges and opportunities requires a coordinated intergovernmental approach.

Building upon the coordination provided by the preparation of the Climate Change Information Brief, the Task Force has asked that the Science Coordination Group develop a conceptual model to systematically analyze and organize the critical aspects of climate change related to Everglades restoration. The decision to use a conceptual model to help coordinate this effort was based on the previous success of using CEMs as planning tools to help guide and focus scientific activities in support of South Florida Ecosystem restoration and to help develop hypotheses for scientific inquiry.