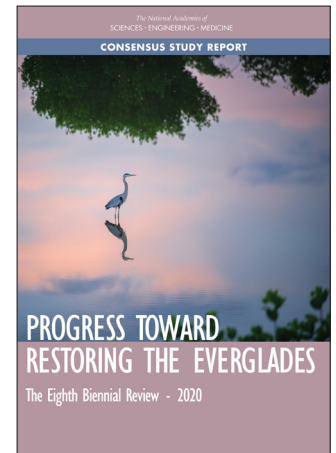




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Progress Toward Restoring the Everglades: The Eighth Biennial Review – 2020



During the past century, the Everglades has been dramatically altered by the diversion of its waters for flood management, urban water supply, and agricultural production. The remnants of the original Everglades now compete for water with urban and agricultural interests and are impaired by contaminated runoff from these two sectors. The Comprehensive Everglades Restoration Plan (CERP), a joint effort launched by the State of Florida and the federal government in 2000, aims to reverse the decline of the ecosystem. The multibillion-dollar project seeks to achieve ecological restoration by reestablishing the natural hydrologic characteristics of the Everglades, where feasible, and to create a water system that serves both the natural ecosystem and the human residents of South Florida.

In 2004 the National Academies of Sciences, Engineering, and Medicine established the Committee on Independent Scientific Review of Everglades Restoration Progress in response to a request from the U.S. Army Corps of Engineers, with support from the South Florida Water Management District (SFWMD) and the U.S. Department of the Interior, based on Congress's mandate in the Water Resources Development Act of 2000. This is the committee's eighth biennial report, which assesses restoration progress and identifies policy and scientific issues that may impact CERP progress.

OVERALL EVALUATION OF PROGRESS AND CHALLENGES

Over the past 2 years, CERP implementation has proceeded at a steady pace, with construction ongoing on six major projects (Figure 1) supported by historic levels of funding from state and federal partner agencies. The Combined Operating Plan has been completed, delivering significant benefits to Water Conservation Area 3 and Everglades National Park, and providing the opportunity to learn about system response to restoration. At the same time, the South Florida estuaries remain under threat from habitat degradation, water quality issues, and harmful algal blooms.

With several projects nearing completion, the CERP is pivoting from a focus on project planning and construction to an emphasis on operational decisions, evaluating restoration success, adaptive management, and learning. This transition requires a robust organizational foundation for science, systematic monitoring and assessment, effective communication, and new strategies to support decision making. Strong science leadership and appropriate staffing, more effective monitoring and analysis of the data, and improved synthesis and modeling could all help to enable this transition of CERP. Investing in science infrastructure would also improve the value of project data and lead to more effective environmental restoration.



FIGURE 1. Locations and status of CERP projects. Source: International Mapping Associates. Reprinted with permission; copyright 2021, International Mapping Associates.

RESTORATION PROGRESS

Following a period of historically low funding for the CERP (2012-2016), state and federal funding for the CERP has increased significantly in recent years, expediting the pace of project construction. In fiscal year 2020, funding exceeded the original CERP vision of \$200 million of state and \$200 million of federal funds annually for the first time since the program’s inception. With this increased funding, CERP projects can be completed more quickly, resulting in faster restoration benefits and potentially mitigating ongoing ecosystem degradation.

However, the 2019 Integrated Delivery Schedule (IDS), a tool used across agencies to guide project sequencing and budgeting, does not effectively communicate likely restoration priorities consistent with realistic funding constraints. The IDS is based on the fastest possible construction schedule and assumes average funding nearly double the budget in 2020. These assumptions fail to support the difficult decisions that must be made when future funding does not meet projections. In light of ongoing ecosystem degradation, when budgets are lower than projected, some projects should be prioritized based on time-dependent project benefits. The IDS could serve as a means to debate these challenging decisions with CERP agencies and stakeholders.

Signs of restoration progress are evident from three CERP project increments operating to date, but limita-

tions in monitoring, analysis, and communication of results have impeded quantitative assessment and communication of restoration benefits. Monitoring in areas that are operational—such as increments of the Picayune Strand and Biscayne Bay Coastal Wetlands—has provided qualitative evidence of the effects of implementation. However, assessments of restoration progress would be greatly improved with systematic analyses of quantitative results comparing early indicators of restoration to expected outcomes.

The Everglades remain vulnerable overall to continuing degradation. The Restoration, Coordination, and Verification (RECOVER) 2019 System Status Report noted the dire condition of the Everglades ecosystem, with a “fair” rating of conditions system-wide and “poor” conditions in the Southern Coastal Systems. With several large reservoirs under construction in the northern Everglades and the Combined Operational Plan in place in the southern part of the ecosystem, substantial restoration benefits are expected in the years ahead. Although the System Status Report provides a useful compilation of data, the lack of reporting of long-term trends and influencing factors limits its value to adaptive management and operational decision making. Future system status reports feature synthesis of the findings of more rigorous multivariate analyses, which would improve systems-level understanding that inform decision-making.

Combined Operational Plan

The Combined Operational Plan (COP) is a comprehensive water control plan for the operations of the recently completed non-CERP Modified Water Deliveries to Everglades National Park (Mod Waters) and C-111 South Dade projects, which the CERP builds upon. The COP is expected to provide substantial hydrologic and ecological benefits, increasing annual flow into Everglades National Park and rehydrating its wetlands, and more closely approximating historic flow patterns. The plan is also projected to reduce tree island inundation in WCA-3 and provide an additional 36,000 acre-feet per year to eastern Florida Bay.

Flood risk management is the primary constraint to increased restoration benefits from the COP and is likely to pose a major limitation to increased CERP flows in the central Everglades, without additional flood risk mitigation. Despite large investments in land acquisition and flood mitigation projects, flood risk management in a residential area located west of the eastern protective levee continues to limit restoration benefits from the COP. Efforts to expedite additional flood risk management strategies will be critical to providing new water to the remnant Everglades.

The COP offers a remarkable opportunity to learn about restoration, inform the design and operation of CERP projects, and increase the benefits of the COP through adaptive management. COP monitoring data can also reveal gaps in understanding of the ecosystem and its response to restored hydrology, including beginning to test the fundamental assumption that “getting the water right” will result in the desired ecological restoration.

Scientific expertise is essential to support COP adaptive management, but lack of staff support and dedicated resources could limit the potential benefits of the adaptive management program. It will be important that modeling tools and staff be made available to analyze and learn from the COP results, determine which outcomes represent significant deviations from expectations, and make programmatic linkages to share decision-relevant information from other CERP projects.

ESTUARIES

The Everglades’ estuaries remain under threat from water quality issues, seagrass die-off, and harmful algal blooms (Figure 2). The CERP will help address freshwater inflow concerns in the estuaries, but meeting stakeholder and public expectations for improved estuarine conditions, such as healthy seagrass meadows, improved oyster habitat, and control of harmful algal blooms, will require water quality improvements that extend beyond what the CERP alone can achieve. Non-CERP efforts to improve water quality will also be needed, along with additional hydrologic restoration beyond that planned to date for the CERP, such as reducing high-volume flows derived from local watersheds in the northern estuaries. If the collective impacts of hydrology and water quality in meeting restoration goals are not well understood, CERP water management projects may be unfairly blamed for failing to meet expected outcomes.

In light of improved ecosystem understanding and modeling capabilities, CERP goals for the southern estuaries should be revisited and clarified. Freshwater flow targets were not linked to spatially specific ecological goals in CERP planning because pre-drainage flows were not well understood and model predictions were poor along the coastal boundaries. Improved analysis of what can be achieved through the CERP is essential to manage stakeholder expectations and, if appropriate, motivate additional non-CERP efforts.

CERP and non-CERP agencies will need an advanced set of predictive tools, developed and implemented through effective coordination among scientists and managers, to better support critical water management decisions ahead. High-priority science and modeling needs include:

- Spatially explicit water quality models and a sustained program of observation and research to build toward a predictive harmful algal bloom modeling toolkit for the northern estuaries.
- Watershed loading and water quality models to predict effects of salinity, water quality, and light limitation on the viability of seagrass in Biscayne Bay.



FIGURE 2. Algal bloom in the St. Lucie River Estuary in June 2016. Source: Eric Hasert, Treasure Coast Newspapers.

- Spatially explicit and mechanistic biological models, supported by appropriately scaled and sustained monitoring programs for the northern estuaries.
- Predictive tools to identify thresholds and tipping points in all the estuaries, such as the complex factors associated with algal blooms and seagrass die-off.
- A southern Everglades transition-zone observational and modeling program that couples regional hydrologic models, including groundwater–surface water exchange, with spatially explicit estuarine hydrodynamic and salinity models.

Climate change and sea-level rise will have major effects on the estuaries, and those effects need to be better understood to inform management decisions and develop strategies that will provide long-term restoration benefits. Increasingly mechanistic and spatially explicit models will serve to credibly predict impacts from climate change stressors. This information can be used to examine the long-term performance of projects and identify possible adaptive management strategies to increase ecosystem resilience.

SCIENCE SUPPORT FOR DECISION MAKING

As the CERP pivots from a focus on planning and advancing individual projects to operations and management of the partially restored system, science—especially systems thinking and analysis—is becoming even more important to support decision making. New and

renewed strategies for monitoring, modeling, and synthesis can strengthen this science support. For example, strategic monitoring to target the information most needed by decision makers would focus resources and make monitoring data more useful in decision making. An expanded use of models could enhance assessments of restoration progress and evaluations of future scenarios and vulnerabilities. Further, developing a list of priority synthesis topics annually would advance synthesis in a coordinated way and increase system understanding for management needs.

A nimble organizational infrastructure for science is also needed to support the CERP’s transition toward operations and adaptive management. This infrastructure should include three key elements:

- Adequate staffing of appropriately trained scientists that can respond to management needs by analyzing, synthesizing, and communicating evolving relevant scientific information.
- Continuity of expertise to support adaptive management throughout the life cycle of restoration projects, bringing technical expertise developed during planning to bear on data analysis and assessment of restoration progress toward goals.
- Strong science leadership to provide an efficient and direct linkage between decision makers who need timely summaries of ongoing work and emerging issues, and the scientists conducting research, modeling, and monitoring.

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[For More Information . . .](#) This Consensus Study Report Highlights was prepared by the National Academies of Sciences, Engineering, and Medicine based on the Consensus Study Report *Progress Toward Restoring the Everglades: The Eighth Biennial Review - 2020* (2021). The study was sponsored by the Department of the Army, the U.S. Department of the Interior, and the South Florida Water Management District. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the Consensus Study Report are available from the National Academies Press, (800) 624-6242; <http://www.nap.edu> or via the Water Science and Technology Board web page at <http://www.nationalacademies.org/wstb>.

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