

Unified SFER Monitoring Framework for Florida's Coral Reef

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Extensive modifications to the environment in South Florida over the last 150 years to “reclaim” land for agricultural, commercial, and residential development has altered the hydrology and ecology of inter-linked terrestrial, freshwater, and marine habitats. With a growing appreciation of the significant environmental and economic impacts of those historical modifications, and continued pressure from a human population that has now expanded to over 9 million residents, ambitious environmental restoration efforts began to take shape. These restoration efforts directly acknowledged, and aimed to reinvigorate, the role of abundant, clean freshwater as the lynchpin to the coexistence of a healthy South Florida ecosystem and a thriving society.

Everglades restoration, conducted primarily through the Comprehensive Everglades Restoration Plan (CERP), is the single largest restoration effort underway in the South Florida ecosystem. The CERP, authorized by the Water Resources Development Act (WRDA) of 2000, is implemented by a federal-state partnership to restore, protect, and preserve the region's water resources by addressing the quantity, quality, timing, and distribution (QQTd) of freshwater. It seeks to restore the natural hydrology of the region, combat invasive species, improve water quality, and restore, preserve, and protect natural habitats and species, while providing for other water-related needs of the region including water supply and flood protection. Non-CERP projects are also being implemented by federal, state, Tribal, and local partners that support and complement CERP and seek to improve the QQTd of freshwater within the ecosystem.

The South Florida Ecosystem Restoration Task Force (Task Force) has established three strategic ecosystem restoration goals. Goal 1 includes achieving ecologically appropriate benchmarks for freshwater QQTd in the Everglades and the coastal estuaries. Goal 2 specifies the protection and restoration of habitat throughout the South Florida ecosystem, including in nearshore coastal waters landward of the outer slope of Florida's Coral Reef (FCR), for the benefit of native species and populations. Meanwhile Goal 3 includes fostering the compatibility of the built and natural systems. Specifically for FCR and associated patch reef, hardbottom, and seagrass resources, the implementation of CERP projects and other region-wide restoration activities to improve hydrological benefits to nearshore coastal waters (Goal 1) may have significant impacts on the reef and its restoration potential (Goal 2) that alter the provision of ecosystem goods and services, like coastal flood protection and fisheries production (Goal 3).

However, without appropriate data to assess the relationship between Everglades restoration, FCR, and the coastal resilience of South Florida, future management and restoration activities may not be well informed or designed effectively to achieve these goals. There is a great deal of data collected along FCR and associated marine habitats in South Florida, and recently McEachron et al. (2022) were tasked with the development of standardized water quality measurement recommendations and a unified water quality map, encompassing the entirety of FCR. Unfortunately, most data collection efforts to date are not part of a unified network that is comparable regionally, nor are they incorporated into system-wide assessments of Everglades restoration progress. The Florida's Coral Reef Coordination Team (FCRCT) was established, in part, to help bridge these gaps.

This Framework reflects a comprehensive and iterative approach built around 10 coordinated actions to structure data collection efforts and the evaluation (and re-evaluation, as appropriate) of available evidence to answer the following questions:

- Can we detect changes in nearshore water quality across time and space as a result of Everglades restoration’s anticipated hydrological improvements, and appropriately distinguish those signals from other ‘pulse’ or ‘press’ disturbance dynamics?
- If so, how do those changes affect Florida’s Coral Reef and associated resources within the South Florida ecosystem?
- And, ultimately, do subsequent ecosystem responses manifest in measurable benefits for neighboring human communities?

PRIORITY FOCUS: INVENTORY EXISTING MONITORING PROGRAMS

Action 1. Inventory existing water quality monitoring programs along FCR and nearshore coastal waters of South Florida.

- Survey FCRCT agencies on existing water quality monitoring efforts.
- Integrate and validate with McEachron et al. (2022).
- Identify water quality monitoring programs and methodologies that may be particularly useful for long term analysis.

Action 2. Inventory existing biological or ecological monitoring programs related to FCR and associated resources within the South Florida ecosystem.

- Survey FCRCT agencies on existing monitoring efforts.
- Identify biological or ecological monitoring programs and methodologies that may be particularly useful for long term analysis.

PRIORITY FOCUS: DEFINE AN EFFECTIVE MONITORING PROGRAM TO DETECT CHANGES ON FCR ATTRIBUTABLE TO EVERGLADES RESTORATION

Action 3. Develop a list of appropriate parameters for monitoring FCR and associated resources within the South Florida ecosystem.

- Assess what data may be necessary to statistically detect changes to FCR and associated resources within the South Florida ecosystem from hydrological restoration of the Everglades and related alterations in freshwater surface and groundwater flows, specifically:
 - What should be sampled?
 - Where should sampling occur?
 - At what frequency should sampling occur?

- What tools or methods are available to capture this information?
- The degree to which each parameter provides critical value to evaluation and decision making?
- Prioritize appropriate parameters for FCR and associated resources monitoring according to the relative value of such information and the costs to obtain and maintain it.
- Ensure standard operating procedures from the Florida Department of Environmental Protection are met, where appropriate.

Action 4. Identify Everglades restoration projects, water management activities, and operational schedules that may influence nearshore water quality and the biological or ecological characteristics of FCR and associated resources within the South Florida ecosystem.

- Categorize the potential for CERP and non-CERP projects and operations to impact FCR individually and cumulatively.
- Understand the timing of potential impacts based on the Integrated Delivery Schedule.

Action 5. Propose Conceptual Ecological Models (CEMs) and Hypothesis Clusters (HCs) for FCR and associated resources within the South Florida ecosystem.

- Revise existing CEMs for FCR and associated resources, and identify drivers/stressors/effects/attributes potentially affected by Everglades restoration.
- Develop HCs for FCR and associated resources demonstrating how restoration is anticipated to affect ecosystem components and relationships.
- Consider the need for integrated modeling tools to support CEM and HC validation.

Action 6. Propose Ecological Indicators (EIs) for FCR and associated resources within the South Florida ecosystem.

- Evaluate how existing System-wide EIs may relate to FCR and associated resources.
- Identify other potential EIs for FCR for further evaluation.

PRIORITY FOCUS: IDENTIFY MONITORING GAPS

Action 7. Define pragmatic changes to existing monitoring programs or implement data solutions that would improve data interoperability and enhance utility, while preserving original program aims.

- Work with existing monitoring programs to identify needs and discuss what adjustments can be accommodated without making unwieldy and cost-prohibitive modifications to

program design or implementation, or compromising the original objectives of those programs.

- Evaluate potential data solutions where program changes may not be feasible.

Action 8. Assess the extent to which pragmatic changes to existing monitoring programs would yield an effective monitoring effort across FCR and nearshore coastal waters within the South Florida ecosystem.

- Conduct a gap analysis to determine what is still needed to detect Everglades restoration signals that cannot be captured by existing programs, even after adjustments within those programs are accounted for.

PRIORITY FOCUS: DEVELOP, TRACK, AND SUPPORT IMPLEMENTATION OF CONSENSUS RECOMMENDATIONS

Action 9. Issue FCRCCT consensus recommendations to unify and enhance monitoring efforts.

- Draft consensus recommendations.
- Present consensus recommendations for approval through appropriate Task Force mechanisms.

Action 10. Facilitate implementation.

- Identify opportunities for new resourcing and partnerships that enable utilization or expansion of existing monitoring efforts or inception of new monitoring efforts in line with FCRCCT consensus recommendations.
- Devise strategies and schedules with key agency partners to fill remaining monitoring gaps.
- Highlight implementation progress through appropriate Everglades restoration reporting products.
- Work with the State of Florida to incorporate FCRCCT consensus recommendations into Florida's Reef Action Plan, as appropriate.
- Work with key agency partners to ensure that applicable monitoring requirements associated with permits and grant agreements reflect FCRCCT consensus recommendations, as appropriate.