The Everglades Vulnerability Analysis: Integrating Ecological Indicator Responses to Inform Restoration

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The Comprehensive Everglades Restoration Plan (CERP) aims to restore natural hydrologic processes throughout the Florida Everglades by changing the quantity, quality, timing, and distribution of water. An interdisciplinary, interagency scientific and technical team, REstoration COordination and VERification (RECOVER), conducts systemwide analyses to inform CERP and track progress toward a restored ecosystem. RECOVER uses models to evaluate how ecological indicators will respond to hydrologic changes resulting from CERP projects. However, the current set of models generate outputs at different spatial and temporal scales, and uncertainty associated with model outputs is not available or considered. RECOVER identified the need for the development and application of an ecosystem vulnerability model that would enable integrative analysis of ecological indicator responses to multiple stressors and restoration actions that operate on a wide range of scales.

In collaboration with the U.S. Geological Survey and the National Park Service, the Everglades Vulnerability Analysis (EVA) was developed using Bayesian networks (BNs), which connect several disparate models to provide an integrated system-wide understanding and predictive ability for the Everglades ecosystem. The EVA currently consists of four BN modules: vegetation type, American alligator nesting potential, wading bird colony size, and sawgrass peat accumulation. Each BN module within the EVA predicts indicator responses on a unified spatial and temporal scale to facilitate comparison between indicators and incorporates uncertainty within module outputs to calculate vulnerability scores based on user-defined ideal states. By quantifying the level of uncertainty inherent to indicator responses, the EVA can help RECOVER understand what uncertainty exists for each indicator across the ecosystem and where to direct future monitoring to reduce uncertainty to an acceptable level. The EVA will enable RECOVER to inform CERP with an integrated, systemwide evaluation of indicator responses to CERP implementation and will provide insight on responses and relative vulnerability of areas, species, or systems to climate-related long-term changes such as sea-level rise.

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