"BEHEMOTH" WETLAND RESTORATIONS

CASE STUDIES AND LESSONS LEARNED

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

St. Johns River Water Management District

25 YEARS PHOSPHATE MINE RECLAMATION RESEARCH: AN EXAMPLE OF CO-EVOLUTION OF SCIENCE, INDUSTRY, AND REGULATION.

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This paper is a review and summary of 25 years of Phosphate reclamation research conducted by the Center for Wetlands, University of Florida and funded by the Florida Institute of Phosphate Research. Topics to be covered include: early research on the ecological benefits and economic costs of "mucking" wetlands, studies of survival and growth rates for wetland tree species, methods for constructing ecosystems and landscapes, hydrologic characteristics and vegetative components of constructed wetlands, measuring restoration and reclamation success, enhancing succession of forested wetland ecosystems, self-organization of constructed wetland ecosystems, and constructing successional trajectories to evaluate success. Data, analysis, results, and conclusions and recommendations from a variety of studies funded by the Institute and carried out over a period of years by faculty and students of the Center will be reported.

RIVER FLOODPLAIN RESTORATION IN THE UPPER OCKLAWAHA RIVER BASIN

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In the 1920s, more than nine miles of the historic Ocklawaha River channel and more than 3,000 acres of riparian wetlands were drained and converted to farmland at Sunnyhill Farm. St. Johns River Water Management District's primary goal for the Sunnyhill Wetland Restoration Project is restoration of this historic river and floodplain wetland system. The plans for the full-scale restoration are to remove accumulated sediments in the river channel, recontour the river channel to restore water flows similar to natural historic patterns, and remove ditches and levees to restore uninterrupted floodplain wetlands. Culvert structures will be used to divert some of the flow from the C-231 Canal (existing Ocklawaha River) into the historic river channel, and to maintain an appropriate hydrological regime for restoration. Restoration issues that will be addressed in this presentation include defining and restoring historic hydrological conditions, water quality management, and vegetation management.

WETLAND RESTORATION FOR WATER QUALITY IMPROVEMENT IN THE OCKLAWAHA RIVER BASIN, FL

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The Upper Ocklawaha River Basin including Lake Apopka covers about 2100 km^2 of central Florida and contains 8 major lakes joined by natural and man-made channels. The major cause of degraded water quality in these lakes was increased phosphorus loading from stormwater after conversion of >100 km^2 of riparian wetlands to agriculture in the early to mid 1900s. P loading increased up to 7-fold over background. Starting around 1990, the St. Johns River Water Management District began the purchase of these farms with State, Federal, and local funding for restoration of wetlands. The primary goal is to reduce P loading to the lakes, and important secondary goals are habitat for fish and wildlife and recreational opportunities. About 50 % of the areas have been reflooded in interim management. Remaining areas are dry and fallow. Final restoration plans may include wetland treatment areas, habitat restoration with passive flooding through reconnection to lakes, active water-level control behind levees, and recontouring to raise land elevations. Primary problems to overcome include restoration of wetland hydrology at lowered land elevations (peat oxidation), high P release from agricultural soils, and pesticide residues. These problems are not unique to large wetland restorations, but large scale limits the palette of cost-effective solutions. Improving water quality already is evident in the most-degraded lakes.

INITIAL SUCCESSES FOLLOWING PHASE I OF KISSIMMEE RIVER RESTORATION

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The South Florida Water Management District and the U.S. Army Corps of Engineers are conducting one of the largest river restoration projects in the world on the Kissimmee River in south-central Florida. If successful, this project will reestablish ecological integrity to 70 km of river channel and 110 km^2 of floodplain wetlands. Phase I of this project (June 1999-February 2001) included demolishing a water control structure, backfilling 12 km of canal, and carving 2.5 km of new river channel to reconnect 22 km of continuous river channel. Backfilled portions of the canal and degraded spoil mounds on the floodplain are revegetating with native species through natural colonization processes. Since July 2001, continuous flow has been maintained through the reconstructed river channel. Already, the restoration evaluation program has quantified several indicators of success in the river channel including reduced thickness of organic deposition, reduced vegetation cover, increased concentrations of dissolved oxygen, and increased use by shore birds and a guild of passive filter feeding insects. Lessons learned thus far include the importance of clearly defining the restoration goal early, forging partnerships with stakeholders, having strong leadership, incorporating scientific evaluation, and adopting a watershed perspective.

LESSONS LEARNED FROM LARGE-SCALE WETLAND DESIGN, CONSTRUCTION AND OPERATION

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The use of large-scale constructed wetlands is increasing for ecosystem restoration purposes, and the knowledge base of their planning, design, construction and operation is growing. The South Florida Water Management District is implementing the Everglades Construction Project as a principal component for restoration of the Everglades ecosystem. The Everglades Construction Project consists primarily of six free water surface stormwater treatment areas (STAs) that range in size from 8900 acres to almost 17,000 acres. These large-scale wetlands are designed to improve the quality of water flowing into the Everglades, while also improving the timing and distribution of those inflows. Four STAs are operational, and scientists and engineers are closely monitoring vegetation, hydraulics and nutrient removal performance. While the species composition of the vegetation communities is dynamic and ultimately self organizing, there are specific management practices that can be utilized during initial flooding and normal operations to encourage desirable community types, e.g., submerged aquatic versus emergent vegetation. During engineering design, critical attention needs tobe given to ensuring both overland flow and structure hydraulics, and operational plans need to give operators flexibility in carrying out the operational goals. During the first eight years of operation, the STAs have removed over 200 tons of phosphorus that would have otherwise entered the Everglades. Individual performance varies among the treatment areas depending on such factors as inflow loads, vegetation type, and age of the wetlands. Annual flow-weighted mean concentrations have varied from 16 parts per billion to over 100 ppb, and collectively averaged about 35 ppb, well below the original target of 50 ppb. Lessons learned from the planning, design, construction and operations of the Everglades Construction Project are presented for others that face similar restoration challenges.

IRL COASTAL WETLAND REHABILITATION AND COLLABORATIVE RESEARCH TO IMPROVE MANAGEMENT

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Estuarine wetlands in the Indian River Lagoon (IRL) system have been severely impacted. Approximately 40,000 acres (75%) were impounded for mosquito control, mostly during the 1950's and 60's. Most of these impounded estuarine wetlands are located within the Merritt Island National Wildlife Refuge (MINWR) and Kennedy Space Center. In addition, over 2,300 acres were severely impacted by dragline ditching. The primary objectives of the IRL Coastal Wetlands project include 1) restoration / rehabilitation of impacted wetlands and 2) appropriate management of reconnected wetlands.

The primary emphasis has been impoundment reconnection with over 27,500 acres of these wetlands reconnected or enhanced. Reconnection by culverts, however, is recognized as only the first step in restoring the ecosystem functions of these impounded wetlands. Appropriate management is critical. In order to optimize the benefits of reconnection and provide appropriate management, the MINWR staff has been facilitating a broad research effort (now called the Wetlands Initiative at MINWR) led by SJRWMD to directly compare the effects of various restoration and management strategies on a comprehensive list of wetland functions, flora, and fauna. The team has been successful at gathering experts and funding to conduct this 5 year study. The Initiative has 18 participating agencies and researchers with major support provided by EPA, USFWS, USGS, NASA, Florida DEP, and SJRWMD.

Restoration of dragline-impacted wetlands is also occurring. A Lagoon-wide implementation plan is being developed. A land-acquisition effort is underway to accomplish both of these restoration goals where private land ownership has slowed progress.

EVERGLADES RESTORATION, SCIENCE AND POLICY, THE GOOD, THE BAD…THE UGLY

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The Good: The Water Resource Development Act (the Act) of 2000 approved the Comprehensive Everglades Restoration Plan (CERP) as "a framework for modifications and operational changes to the Central and Southern Florida Project that are needed to restore, preserve, and protect the South Florida ecosystem…". The Act was the culmination of 100 years of Everglades degradation and at least, 10 years of litigation. If you ignore the legalese, contingencies, exclusions, and limitations then one can see that the Act has a good soul and means well.

The Bad: The science that was the basis for the Act was good but mostly hydrologic. The biological and ecological performance measures, used to evaluate alternative plans, were mostly qualitative. We now find ourselves having to conduct scientific "catch-up" to make sure that plans are sound and likely to succeed. Tools for success include the Adaptive Assessment Approach, Pilot Projects, and research like the Loxahatchee Impoundment Landscape Assessment (LILA).

The Ugly: CERP has been divided into 86 projects, each mandated to produce a US Army Corps of Engineers Project Management Plan, Project Implementation Report, Design Documentation, Construction Plan, Operational Plan, State & Congressional approval, and a State-Federal Project Cooperation Agreement. To provide project oversight and insure coordination between projects we have Project Delivery Teams, Technical Review Teams, Science Review Teams, an Adaptive Assessment Team, a Water Quality Team, a Regional Evaluation Team, a Model Refinement Team, a Science Coordination Team, a RECOVER Leadership Group and a Comprehensive Evaluation Team. This bureaucratic complexity, designed to select the best plans and monitor success (or failure), is essential but needs to be simplified. The solution is to aggregate projects and combine projects that have been split into phases. This reduces the number of Everglades scientists needed to support this process, frees up resources for adaptive assessment, and creates a more integrated landscape management approach.

WETLAND RESTORATION IN THE UPPER ST. JOHNS RIVER BASIN

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The Upper St. Johns River Basin Project is large flood control and wetland restoration project that is being constructed in the headwater region of the St. Johns River. When complete, the project will have the capacity to use more than 160,000 acres of existing or former floodplain marsh for stormwater storage. When not storing floodwaters the project is being managed to restore and preserve historical wetlands. Strategies to restore basin wetlands focus on recreating the spatial and temporal aspects of the natural hydrologic regime, protecting water quality and reinstituting the natural role of fire. The focus of this paper will be on discussing lessons that we have learned to date about large-scale wetland restoration. Issues to be discussed include setting environmental goals, pitfalls of hydrologic modeling, the concept of sheet flow, canal plugs versus canal filling, exotic vegetation management, and the need for a long-term adaptive management philosophy.

HOW WATER FLOW RELATES TO WETLAND PROCESSES AND EVERGLADES RESTORATION, OR "GETTING THE WATER REALLY RIGHT" IN THE RIVER OF GRASS

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Historical analyses suggest that advective movement of water and sediments through the Everglades maintained the "corrugated" topography of the Everglades landscape. Drainage and compartmentalization of this landscape during the last century have reduced or eliminated water flow. In many areas, this has been accompanied by topographic homogenization and loss of plant community heterogeneity. We hypothesize that the advective transport of flocculent organic material (floc) links water flow, landscape maintenance, and vegetative pattern heterogeneity. Floc production is relatively slow, but appears to be greater that its decomposition rate. Without water flow, floc accumulates in deeper water habitats, reducing topographic relief and flow capacity. We are testing the hypothesis that increased water flow increases floc transport downstream, maintains deeper flow pathways (sloughs), and enhances landscape/topographic heterogeneity. Additionally, because the phosphorus content of floc is high **(**370-560 µgP gdw^{-1}**),** we hypothesize that restored downstream floc transport will restore an important energy subsidy to oligotrophic estuaries. We present long-term Cladium productivity data from the southern Everglades to demonstrate ecological responses to relatively rapid increases in hydroperiod, such as would be expected if increased flow scours out old marsh sloughs. Cladium annual production (AP) is quite low across the oligotrophic southern Everglades landscape (100 – 500 gdw m^{-2} y^{-1}). Furthermore, we found significant negative relationships between annual Cladium production and a) mean annual water level and b) mean Eleocharis stem density. Fifty percent of the interannual variation in *Eleocharis* stem density in these marshes was explained by mean annual water depth (positive relationship) and Cladium culm density (negative relationship). These data suggest that, if a restoration of flow to Everglades wetlands scours old sloughs and "re-corrugates" the landscape, ecological responses to these changes will be rapid, predictable, and non-disruptive. This coupling of physical and ecological studies of water flow may help shape Everglades Restoration efforts.

OPPORTUNITIES AND PITFALLS IN RECLAIMING MINED LANDS TO SAWGRASS AND DIVERSIFIED MARSHES

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Cargill Crop Nutrition has been actively involved in reclaiming surface mined lands to sawgrass marshes at its Hookers Prairie Mine in Bradley Junction, Florida. Project wetlands acres originally ranged in size from 11 acres to 140 acres. However, these wetlands now have all been connected to form a continuous unit of over 800 acres of sawgrass dominated wetlands. There were definite advantages to doing this large scale reclamation at an operational mine. Construction, water manipulation, maintenance and surveillance all benefited from the presence of operational influences. Further expansion of this wetland was assured with the issuance of the Life of Mine permit for Hookers Prairie. Now the emphasis has shifted to more diverse herbaceous habitat. We will discuss strategy changes that came with this redirection as well as some of the obstacles which have been overcome during the past two decades.