Sustainable Ecosystems Institute

South Florida Ecosystem Restoration Multi-Species Avian Workshop

Scientific Panel Report

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SUSTAINABLE ECOSYSTEMS INSTITUTE

South Florida Ecosystem Restoration: Multi-Species Avian Workshop

Scientific Panel Report

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NOTE: A CD with copies of the scientific presentations and a transcript CD are available from SEI.

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A. Introduction

Sustainable Ecosystems Institute, at the request of the Department of Interior and the South Florida Ecosystem Restoration Task Force, convened a multi-species avian summit to advance the science and restoration effort for the Everglades. The overall goal of this effort is to develop a common understanding of the science and make it available to all parties, including decision makers. As part of this process SEI established a panel of experts who were charged with evaluating technical issues and synthesizing information. A first workshop was designed to present the relevant science and to evaluate information available.

On March 17-18th 2003 in Key Largo Florida, SEI assembled the panel of experts, scientists whose work has contributed to our knowledge of the species and system, and decision-makers and other interested stakeholders. The facilitated workshop was carried out according to the SEI process to allow a full and up to date presentation of the science, and a debate of the science in an open forum (the workshop). Four bird species were identified as the focus of this initial multi-species approach, the Wood Stork, Snail Kite, Cape Sable Seaside Sparrow and Roseate Spoonbill.

The panel and presenters were asked to focus on several key questions:

- Are there trade-offs or potential conflicts among the management needs of the four species? If so, under what conditions are they likely to occur and how can they be ameliorated?
- Restoration will change the landscape. In this transition to a more natural ecosystem will some species be more vulnerable, others more resilient? How will they respond and how might we ameliorate the risks?
- How good is our information and what other information is needed?

Panelists were asked to evaluate uncertainty and risk. Specifically they were asked to look at the strength of the data and conclusions, and whether uncertainties were stated or assumed. Understanding levels of uncertainty and risk can provide decision-makers with a clear picture of the decision space and a better understanding of possible outcomes and consequences.

The panelists heard thirty-four presentations on the science and restoration of these four species in a multi-species context. An extensive question and answer session followed the presentations. The panelists found that the research was of high quality and relevant to the issues of Everglades restoration.

This report represents the findings of the panel. It is intended as the basis of a second workshop which will focus on making the scientific information available to all parties, and which will consist of a detailed question and answer workshop between panel scientists and decision-makers.

B. Multi-species/Habitat Approach

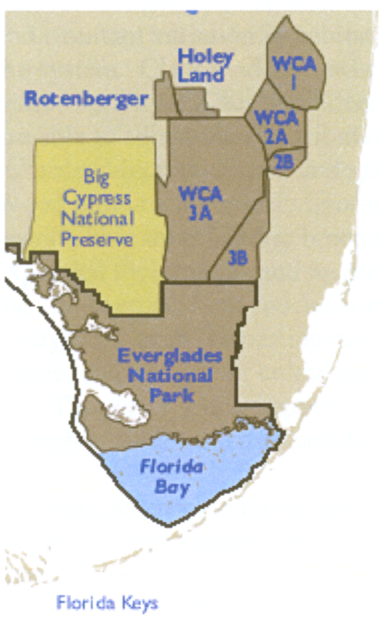
Following the ESA of 1973, the major thrust of conservation and restoration efforts inevitably has been directed at the various single species identified under the Act as being at risk; thus restoration efforts typically have been closely focused on the listed species, with other biotic components given secondary consideration. Ecosystem restoration, however, necessitates a multi-species approach, aiming at providing adequate habitat, with its inclusive resources, for all component species. The Panel recognizes the value of this broader perspective, as exemplified by the Multi-Species Recovery Plan for Southern Florida, and enthusiastically endorses its application to the wetlands of the Everglades region and specifically the Comprehensive Everglades Restoration Plan (CERP). While a multi-species perspective may be the only viable approach to evaluating CERP and its outcome, the Panel were instructed specifically to consider several target species, species of disparate ecologies and requirements that had been identified for particular attention (three are federally listed: Wood Stork, Snail Kite, Cape Sable Seaside Sparrow; one is listed under the State's Endangered Species Act: Roseate Spoonbill; one, Cape Sable Seaside Sparrow, is a locally endemic subspecies).

A multi-species approach to restoration is potentially more complicated than a single-species approach, since there is a potential for restoration processes to benefit one species while being detrimental to others. We discussed this as a "trade-off" issue, and asked whether there were in fact identifiable trade-offs among target species in CERP--that is, would management necessary to sustain one of the four focal species result in an adverse impact on the population viability of one or more of the other species? A thorough evaluation of potential trade-offs requires that the impacts of restoration on habitat, i.e. vegetation and other resources, are predictable, and that the impacts of habitat change on component species are in turn predictable, and that the various linkages among species, direct or indirect, are also known. Detailed evaluation of this underlying understanding, in terms of existing and predicted hydrology regimes and their effects on plant community composition and structure, was considered outside the scope of this panel. We recognize, however, that the understanding of these foundations of the ecological system will be critical to the success of the Everglades restoration in providing for these four species. Assuming that the hydrology and habitat will be successfully restored, the Panel concluded that a multi-species approach in this case is facilitated by a lack of apparent trade-offs: project design and management for one or another target species will, ultimately at least, benefit all of them. We believe that this is the case not because of similarities among species in their habitat (food, foraging, breeding) requirements; indeed, the target species are diverse in these requirements. Rather, it is the case because a restored Everglades system with natural or near-natural water flows will support a wide range of conditions with broad spatial and temporal variability, within which we expect all target species to be accommodated. This is not to say that all species will benefit equally from natural water flows when

CERP is fully implemented. There likely will be intermediate and transition stresses that will vary among species, and different species will be required to adapt behaviorally in different ways and to different extents to restoration processes. The degree to which species accommodate to changes in the system, during transition and thereafter, will require documentation via extensive and intensive monitoring, and necessitate a flexibility of management response via adaptive management of the processes as they are put into operation.

C. Anticipated Impacts of CERP

The general approach of CERP is to attempt to restore the remaining areas of the Everglades to their natural historic condition, with the rationale that, if a natural hydrology is restored, then a balanced and complete ecological system will be re-established. Those areas likely to be especially altered by CERP and also critical to the four bird species on which we focused are Water Conservation Areas (WCAs) 3A and 3B, Everglades National Park (ENP) and Florida Bay(see accompanying figure); conflicts presently exist in the management of the four focal species in these areas. Prior to the development of CERP, management under the Experimental Program of Water Deliveries (EPWD) to Everglades National Park involved diverting much of the natural flow to these areas from the north either directly to the ocean, or into the western part of the system in order to avoid flooding private land along its eastern edge. This resulted in drier than historical conditions in the east (notably in the northeastern Shark River Slough region of ENP), reduced freshwater flows to southern ENP and Florida Bay, and occasionally wetter than historical conditions in the west (notably in WCA 3A and western Shark River Slough within ENP). A series of wet years in the mid-1990s produced exceptionally wet conditions in western Shark River Slough; as a result, the Cape Sable Seaside Sparrow population there declined precipitously, and emergency measures to protect it were adopted. The EPWD was replaced in 1999 by the Interim Structural and Operational Plan (ISOP), which produced management changes that exacerbated conflicts between the needs of the four focal species. Specifically, recent reduction of flows to protect the sparrow in the western Shark River Slough area has increased the pooling of water in WCA 3A, adversely affecting kite habitat, and further reduced flows into southern ENP and Florida Bay, adversely affecting storks and spoonbills.



In general, CERP promises to alleviate current conflicts by enabling sheet flow through WCA 3A and WCA 3B into Everglades National Park. Thus, sparrows in eastern ENP should benefit from wetter conditions compared to the EPWD conditions, and sparrows in western ENP likewise from more suitable, drier conditions, at least relative to the very wet conditions that sometimes existed under EPWD. Conditions for sparrows in western ENP, however, likely will be wetter than under the ISOP. Storks and spoonbills are expected to benefit from higher flows into southern ENP and Florida Bay, and kites from lower water levels in WCA 3A.

The ability of the focal species to thrive under the conditions created by CERP depends on their capacity to shift their distributions and activities in response to the spatial rearrangement of habitats that CERP will bring about. The panel concurs with the consensus among the researchers that CERP will ultimately improve conditions for all four species. This conclusion is predicated on the assumption that CERP will result in sufficient amounts of all critical habitat types within the total system, an assumption widely viewed as valid, but with little supporting evidence, particularly with respect to short hydroperiod prairies. The validity of this key assumption is tied to several important uncertainties about the implementation of CERP and the ecosystem's response to changes in vegetation it will engender. Although no inherent conflicts exist between the management needs of the four species under CERP, the uncertainties generate a potential for adverse effects on individual species during the transition from current conditions to those created by a fully operational CERP. These possibilities are discussed further in the following section.

D. Vulnerability During Transition

1. Resilience of the Four Focal Species.

Resilience is the ability of a population to persist, and return to a viable size following a perturbation. Less resilient species more vulnerable to perturbations may be at risk under management that adopts a multi-species approach. The redistribution of habitat that CERP will surely entail represents a major perturbation, and it will test the resiliency of the four focal bird species to different degrees.

A priori, one expects avian species inhabiting the Everglades to possess resiliency, since annual variability in hydrological conditions and resultant variation in habitat availability is exceptionally high in the system. Clear evidence exists that Roseate Spoonbills, Wood Storks and Snail Kites are indeed resilient to such perturbations, and are able to adjust their distributions to changes in the location of suitable habitat over time and space. Although populations of both Wood Storks and Roseate Spoonbills have declined over the past 80 years within their historic breeding ranges, both species have expanded their ranges and increased from low points experienced in the 20th century; both species use habitat outside of the south Florida Everglades, both for nesting and during the nonbreeding season. Thus both species appear to be relatively vagile, and capable of colonizing new habitats as they become available (though with time lags of 5 – 10 yr). These two species appear to be well equipped to survive perturbations in south Florida, and resilient enough to withstand the transition to CERP as well as benefit from CERP's eventual habitat effects.

Snail Kite populations have increased considerably from mid-20th century lows. A large literature documents this species' narrow diet and the habitat selection behavior that facilitate its location of the specific conditions of hydrology and vegetation requisite for successful breeding. Because of a network of refugia throughout central and southern Florida, and the kite's ability to move rapidly between refugia, this species also appears resilient to transitional perturbations and likely will thrive after implementation of CERP. However, this resilience is owed in part to the species' use of many non-Everglades sites that collectively span a range of different climatic regimes, relative to south Florida, and thus it is unclear to what extent it is dependent on a south Florida component that might be unsuitable (under transition) for a period of years.

No clear evidence of the resiliency that characterizes the other three species exists for Cape Sable Seaside Sparrows. Because of a life history characterized by a short lifespan and high annual reproductive effort, sparrow populations may be affected by short-term fluctuations in habitat condition to a greater extent than the other focal species. In addition, this species requires a narrow range of hydrological conditions for successful breeding, and appears to be relatively (perhaps extremely) sedentary. No convincing documentation exists of the sparrows' ability to cope with shifts in the distribution of its habitat. While the discovery of new sparrow breeding locations is sometimes cited as evidence of a capacity for short-term distributional shifts, these records might merely represent populations that were previously overlooked. Intensive studies in recent years have yielded no firm evidence of long-distance movements or colonization ability.

Therefore, although we perceive CERP as positive for all four species overall, the Cape Sable Seaside Sparrow may lack the apparent resiliency of the other species and be especially vulnerable at particular locations and times as CERP is implemented. In particular, there is a potential for loss of sparrow populations from habitat that is currently suitable but will be rendered unsuitable under CERP, depending on a number of important uncertainties about CERP and ecosystem responses to CERP.

2. UNCERTAINTIES DURING THE TRANSITION TO CERP.

Hydrological targets of CERP are based on the Natural System Model, which attempts to project the historic condition of the system. In some locations these projections suggest habitat distributions that differ from present. If as a consequence CERP restoration increases the hydroperiods in marl prairie habitat currently occupied by sparrows, the habitat likely will be converted to a sawgrass-dominated marsh unsuitable for sparrows. Thus the accuracy of CERP's restoration targets has a potential to impact sparrows negatively, especially in the western Everglades where historic conditions are relatively poorly known.

A second area of uncertainty is hydrology during implementation of CERP. Although models have been used to predict the impact of CERP at full implementation, the transitional changes in hydrology and their resulting biological impacts, as some 60 individual projects are completed over 30 years, apparently have not been systematically assessed. Thus the panel is uninformed of the range of hydrological dynamics likely to occur from the present until the CERP design conditions are in place, and hence is unable to evaluate potential responses of focal species to specific transitional conditions. However, we see a potential, given this uncertainty, for transitional hydrological conditions to have adverse effects on some focal species, especially the less resilient sparrows.

A third important, general area of uncertainty is how the wetland vegetation and its biota will change as a function of hydrology. Ecological modeling of the Everglades system generally and the four focal species specifically has been performed, but certainly not all conceptual linkages between hydrology and ecology have been fully explored. Although relationships between hydrology and the biology of the focal species are understood in general, differences in scale between biological interactions (and therefore modeling) and the construction of the hydrological models often preclude detailed predictions. The hydrological regime directly affects focal species, for example in creating high quality foraging patches for storks and spoonbills by concentrating fish, and also indirectly, for example by changing vegetation sensitive to hydroperiod and thence bird habitat. Add effects of sea level rise, global climate change and the usual vagaries of weather to the mix, and the uncertainty surrounding the ecological conditions that CERP will create increases further.

While many of the relationships between hydrology and ecology that are critical to the focal species are well researched, and will facilitate making adjustments in management as CERP unfolds, translating output from the hydrological models of CERP into accurate ecological impacts remains highly tentative. Some ecological outcomes of CERP may force managers to face trade-offs between the needs of different species, as discussed next.

3. POTENTIAL MANAGEMENT DECISIONS DURING TRANSITION TO CERP.

The Cape Sable Seaside Sparrow appears to be the least resilient of the focal species, and it is possible that increased flows to southern ENP and Florida Bay will result in hydroperiods that are too long to maintain sparrow habitat at some of its current locations. Total sparrow habitat within the system may be reduced, and habitat in western Shark River Slough may be insufficient to maintain the population there. If this proves to be the case, managers will have to decide whether to make adjustments that reduce flows to the southern Everglades in order to protect sparrow habitat. However, another and potentially conflicting restoration objective is to bring larger freshwater flows to the coastal mangrove/sawgrass interface in order to reestablish nesting colonies of the Wood Stork in the coastal zone. The decision will be complicated by difficulties involved in accurately modeling the hydrologically and topographically diverse coastal zone, especially in relation to uncertainty about rising sea level.

The panel was presented with two different views of this trade-off. In one view, rapid drydown and relatively short hydroperiods (similar to the current hydrological regime) were argued to be appropriate for both storks and sparrows. Proponents of the other view argue that greater water depths and longer hydroperiods over much of the freshwater areas of the Everglades are necessary to restore desired flows to coastal habitat for both storks and Roseate Spoonbills. While a similar tradeoff potentially might apply to sparrows and spoonbills, there is compelling evidence of favorable foraging conditions for spoonbills depending on the same rapid winter-spring drydown that promotes sparrow reproduction.

A second potential trade-off would ensue if water is retained in WCA 3A to keep sparrow habitats drier to the south, but with adverse effects on Snail Kites in WCA3. The kite depends on emergent woody vegetation for nesting, and very long hydroperiods result in a loss of woody vegetation, as well as a reduction of foraging habitat due to the formation of deeper sloughs. However, as sheet flow is reestablished and water storage facilities are constructed, reduced pooling of water in WCA 3A will be required, and potentially adverse effects on kites alleviated. Similarly, if it proved necessary to increase water depth and hydroperiod in the WCAs to engineer increased flows for stork breeding sites to the south, kites could be adversely affected. Overall, such tradeoffs between kites, sparrows and storks promise to become less an issue in the future, with CERP implementation, than they are now.

E. Addressing Uncertainty and Risk

As discussed above, it is clear that implementation of CERP is accompanied by numerous sources of uncertainty concerning its short- and long-term effects on the four focal bird species (Table 1). Multiple sources of uncertainty, however, are not unique to the Everglades restoration efforts. All restoration efforts directed at complex ecosystems have many sources of uncertainty including:

- The natural variation and inherent stochasticity of ecological systems (process uncertainty)
- Inaccurate measurement of the state of ecological systems (observation uncertainty).
- Abstract and simplified models used to predict the response of managed systems to management actions (model uncertainty)
- Fundamental misunderstanding of variables and the functional form of the model (model error)
- Uncertainty arising from the interpretation of incomplete data (subjective uncertainty)
- Uncertainty arising from changes in social values or restoration policy, including uncertainty about the location, size and timing of future stressors to the system (predictive uncertainty)

Because CERP is attended by all these sources of uncertainty, monitoring, assessment, and adaptive response are critical to successful Everglades restoration.

Adaptive management was designed to allow resource managers to act in the face of acknowledged uncertainty, designing management actions to reduce uncertainty over time while permitting change in response to surprising outcomes. Instead of making static, "precise" predictions in advance, adaptive management highlights a range of possible outcomes. It treats management as an element of the learning process rather than as an independent step that follows learning. Under the adaptive management paradigm, decisions are provisional and contingent upon how the system responds to management action. Adaptive management also is intended to increase the ability of managers to respond to new information.

Clearly an effective adaptive management process is critical to ensuring both the survival of the four focal species through the restoration process and their success once CERP is fully implemented, and indeed CERP has adopted an adaptive management strategy. The term adaptive management describes a spectrum of management choices, ranging from passive to fully experimental (active). The adaptive management strategy employed in CERP does not include large-scale management experiments, but is instead a passive approach in which learning is based on each incremental step in the implementation of the management plan. Adopting this approach rather than a more active one represents a decision to limit power to obtain additional knowledge in order to avoid costs (to the ecosystem) of obtaining that knowledge. The limits and advantages of the adaptive management strategy of CERP are thoroughly discussed in a Monitoring and Assessment Plan (MAP), and a review of that plan by the National Research Council's Committee on Restoration of the Greater Everglades Ecosystem. We will not repeat that discussion here, but will reiterate some important points that are especially pertinent to the fate of the four focal species during the implementation of CERP.

Implementing CERP in an adaptive manner requires several key elements:

- Explicitly defined management objectives. Clear objectives are an essential foundation for adaptive management. Without explicit objectives and measures of success, managers cannot know whether their actions are effective or require modification. Explicitly defining objectives also increases management accountability. The primary objectives for the four focal species are clear: to maintain viable breeding populations within the ecosystem, at specific locations (the coastal zone) in the case of spoonbills and storks. Other explicit objectives for these species and their habitats are described in the MAP. The biggest issue here is not a lack of objectives for the focal species, but whether these objectives will prove compatible with the larger, hydrological objectives that are the focus of CERP, that is, the restoration targets derived from the Natural System Model. This issue requires attention.

- An explicit model(s) of the system being managed. Like the objectives, baseline understanding of, and assumptions about the system must be made explicit to provide a foundation for learning. By specifying a model, or set of models, of how the system is expected to respond to management, the major uncertainties in understanding should become explicit. Models are most useful if they are cast as a set of alternative predictions of how the system will respond to management. The panel views improving models through learning as one of the processes most crucial to the success of CERP in providing for the four focal species. A variety of relevant models exist – the system-wide hydrological models that drive CERP, system-wide ecological models (the Across Trophic Level System Simulation model and Everglades Landscape Model), the conceptual models of ecological communities described in the MAP, and models of the biology of the four focal species – all of which must be revised constantly in response to incremental outcomes of CERP.

- Formal evaluation of outcomes. Adaptive management cannot be implemented without some mechanism for comparing the outcome of decisions to selected (preferably quantitative) performance measures. Typically this means systematic data collection through a monitoring program designed and implemented prior to the management action in order to provide a baseline for comparison. Monitoring should focus on indicators (e.g., demographic rates, habitat amount) of achievement of the management goals. This element is addressed by the performance measures and monitoring program described in the MAP, evaluation of which was outside the scope of the Panel. In the case of the four focal species, further information will result from additional endangered species monitoring.

- A series of alternative management options and a framework for incorporating learning into future decisions. In a passive adaptive management system such as is employed in CERP, the management decision which currently has the greatest empirical support is implemented, whereas in an active adaptive management system there is a direct comparison of competing alternatives. In either case, there must be an institutional mechanism for feeding information gained back into the management process. Without this mechanism, learning will not improve future management performance. Incorporation of learning can occur through a direct cycle of decision, learning, and modification with respect to each single management choice. Alternatively or in addition, information gained from monitoring a specific choice can feed into later decisions on similar choices. Adaptive management is feasible (and useful) only where a series of related or similar decisions will be made over time, allowing learning from the earlier decisions to be incorporated into the later ones. One concern about the adaptive management strategy of CERP is whether it is sufficiently flexible to be effective. Because anticipated outcomes of CERP are based on the fully implemented system, it is not clear to what extent outcomes of individual projects can lead to changes in the design of later projects. Lack of flexibility will hinder resolution of conflicts between the needs of the four species that arise during the transition to CERP. Every effort should be made to improve flexibility so that conflicts can be resolved through an effective adaptive management process.

Besides developing an effective adaptive management process, the other means to address uncertainties that may result in adverse effects on individual species during the transition from current conditions to those created by a fully operational CERP, is to acquire more information about the transition. The Panel understands that the Restoration, Coordination and Verification team (RECOVER) currently is developing interim targets (at 5-year intervals) for key performance measures, three of which (Recovery of threatened and endangered species and supporting habitats; Wading bird nesting patterns; Spatial extent of habitat type) are directly linked to the focal species. As part of this exercise, projected hydrology will be simulated at 5-year intervals, providing the assessment of expected conditions during the transition that has previously been lacking. We heartily endorse these activities, which promise to greatly improve the available information about potential for trade-offs between the focal species and adverse impacts on individual species during transition. We further recommend that managers, based on this information, develop a strategy for handling such impacts and the trade-offs they involve as they arise during the restoration process. This strategy should include adaptive management, but might also involve policies about levels of impacts that will necessitate measures to protect individual species, and what those measures might be.

F. Conclusions

1. The Panel recognizes that many relevant data have been collected on the system relative to the present and projected future status and biology of the target bird species. The presentation, analysis and synthesis of these data were a major focus of the workshop, and an important source of updated material for the Panel. While there remain, inevitably, gaps in the database (some of which might be filled by further analysis of existing data), there has been considerable progress in the last few years (measured, for example, by the advance of Cape Sable Seaside Sparrow studies since last reviewed by the AOU committee in 1999). Research has been targeted in directions that provide relevant information for Everglades restoration. Although outside the scope of this panel, the prediction of hydroperiod and the elucidation of the relationship between hydroperiod and vegetation are critical to the future success of these species. Our analysis is predicated on the assumption that the hydrological models underlying CERP are accurate. To better understand the potential for conflicts between the four focal species, it would be useful to thoroughly evaluate these models, particularly if they are

changed in any significant way. It is also important to further elucidate anticipated changes in vegetation and its distribution under CERP, and the influence of vegetation on breeding and feeding opportunities in the target bird species. Confident prediction of species' responses to CERP is ultimately limited by our understanding of these important relationships. Overall, and despite data gaps and analytical shortcomings, the Panel characterizes the existing ecological "best available science" as detailed, comprehensive, and of high quality.

2. There are strong indications that restoration to near- or nearer-natural water flows through the system will ultimately benefit not one or a subset but all of the target species. This conclusion signifies that there are no obvious trade-offs in the sense of projected actions benefiting one or some species of the multi-species complex while being deleterious to others. This conclusion is reached by consideration of the range of ecological requirements of individual species, which generally differ, and the likelihood that they all will be met and be well represented in the restored ecosystem under more natural water flow regimes. The natural variations in topography of the region will permit, under full CERP conditions, a wide range of water depths, distribution, and hydroperiods, and therefore a potential to support a wide range of vegetation with inclusive and diverse foraging and breeding conditions. Biotic elements of the system beyond the target species, including components of considerable interest such as hammocks or tree islands, also are expected to benefit from restored water flows, as indeed is the biota in general.

3. While ecosystem manipulations at the proposed scale can never be wholly without risk, the Panel sees CERP as a necessary step to take the present, degraded system to an improved level of functionality. Such improvement may take time, and the process involves a degree of unpredictability (though, we believe, no major risk in ultimate outcome). We identify the transition period to full CERP conditions as especially uncertain, as during this period species must respond to the transition by shifts in habitat use and adjust spatially and temporally to changing foraging and breeding opportunities. We emphasize that elements of uncertainty are deeply embedded in the transition process, and that many of these, while identifiable in a general fashion, cannot be resolved. These include elements extrinsic to system manipulation, such as hurricanes, system operation for human needs and the vagaries of year-to-year weather variables, and others intrinsic to system components and their responses to altered water flows. Included here are the uncertainties attached to restoration targets, to hydrology during the transition from present to completion of CERP and the ability of system operations to meet flow targets on a day-to-day basis, to the priority of restoration constrained by competing water management goals, to vegetation changes, and to species' responses to these changes. Especially problematic are anticipated spatial shifts in suitable habitat for Cape Sable Seaside Sparrows, whose dispersal potential is as yet poorly understood. The sparrow, unlike the other species, appears to lack the resiliency to readily adjust to shifts in habitat distribution over space and time.

4. Uncertainties during the transition process and thereafter must be countered by extensive and careful monitoring of species' responses, and by adaptive management of those process elements under management control to ameliorate negative impacts. Monitoring results will need immediate "real-time" evaluation, such that potential negative impacts can be identified and redressed promptly. Species' vulnerability to change will be lessened if change is brought about slowly and with attention to the dispersion of critical resources and the potential of target species to track them. Success in providing for these species during the restoration and beyond depends on the design of CERP being sufficiently flexible

that the passive adaptive management strategy employed can be effective. Monitoring to provide data to support learning about the system is essential, but ability to improve subsequent management performance based on this learning depends on flexibility in the construction and operation of the system. The ability to adapt based on the response of the system to management will increase ability to resolve conflicts between the needs of the four focal species.

We note that there is a range of more radical and remedial measures that might be considered at future times, e.g. active translocation of Cape Sable Seaside Sparrows, direct vegetation modification, etc., should direct intervention seem required or if species' responses are other than those anticipated. We consider such measures unnecessary at the present time, but such contingencies should be kept in mind. Overall, we expect that the inherent mobility of the avian species, their behavioral adjustments to variation in habitat quality and its spatial variability, and their general adaptability to variation in strongly seasonal wetlands, will enable them to cope with CERP without direct intervention.

Table 1. Uncertainties Associated with CERP Implementation (with Special Reference to Wood Stork, Snail Kite, Roseate Spoonbill, and Cape Sable Seaside Sparrow)

1) Bird Species
    a. Demographic resilience to changes in habitat amount and distribution
    b. Ability to locate and occupy newly created habitat
    c. Ability to increase following declines to small population size
2) Habitat
    a. Critical amount of suitable habitat
    b. Size and arrangement of habitat patches
    c. Necessary spatial redundancy of habitat to assure long-term persistence
3) Vegetation dynamics during the transition
    a. Influence of hydroperiod and stage on vegetation succession
    b. Ability of changes in hydroperiod to generate suitable habitat
    c. Rate and direction of change in vegetation following changes in hydroperiod
4) Models
    a. Accuracy of projected flows from the Natural Systems Model
    b. Accuracy of linkages between species habitat models and hydrologic models
    c. Accuracy of species-habitat relationships models
5) Natural
    a. Natural disturbance processes
    b. Deterministic trends in environmental drivers
6) Implementation
    a. Unique spatial and temporal patterns of vegetation response following a given implementation plan
    b. Response flexibility to cumulative monitoring inputs
    c. Political intrusion

Multi-Species Avian Ecology Workshop

March 17-18 2003 The Westin Key Largo Florida

Agenda

Monday, March 17th 2003

Opening Address:
Deborah Brosnan: *Multi-species Challenge in Everglades Restoration and the SEI Workshop Process*

The Everglades Ecosystem:

Peter Frederick: *Natural history*

Miccosukee Tribe, Joette Lorion: *Cultural history*

John Ogden: *Conceptual models of the ecosystem*

Dennis Duke: *Hydrological overview and recent restoration and management history*

Key Questions in Restoration:

Rock Salt, Representing the Department of Interior: *Central questions in Everglades Restoration*

Dexter Lehtinen, Representing the Miccosukee Tribe: *The Miccosukee Goals and Interests*

Mark Robson, Representing the Florida State Fish and Wildlife Commission: *Questions and issues in Everglades restoration*

Dennis Duke, Representing the U.S. Army Corps of Engineers. *"The CERP Overview" and "Army Corp's Goals and Interests for the Workshop"*

The Wood Stork:

John Ogden: Session Lead

Billy Brooks: *Review of status population trends and distribution of the U.S. Breeding population of Wood Storks*

Becky Hylton: *Regional movement patterns of Everglades Wood Storks*

Dale Gawlick and Gaea Crozier: *The foraging ecology of Wood Storks and their kin in the Everglades*

Lou Gross: *Ecological Models*

John Ogden: *Historical, current and predicted future nesting patterns of Wood Storks in the greater Everglades*

The Snail Kite:

Rob Bennetts, Session Lead: *Our current state of knowledge of survival, reproduction, movements, and habitat*

Phil Darby: *Life history and current state of knowledge of the apple snail*

Don DeAngelis (presented by Rob Bennetts). *Current modeling efforts of the Snail Kite (EVERKITE)*

Wiley Kitchens (presented by Julian Martin): *Current and future directions of the Coop Unit Snail Kite project*

Tuesday, March 18th 2003

The Capt Sable Seaside Sparrow

Jeff Walters, Session Lead: *AOU report and session objectives*

Tylan Dean: *Cape Sable Seaside Sparrow status and movement*

Sonny Bass: *Population Behavior*

Julie Lockwood: *Demography and Fire Response*

Stuart Pimm: *Cape Sable Seaside Sparrow Overview*

Will Post: *Alternative strategies for recovery*

Don DeAngelis: *Species Model-Impact of Restoration*

The Roseate Spoonbill

Jerry Lorenz, Session Lead: *Biological and Ecological Trends and the Status of the Roseate Spoonbill and IOP and Florida Bay and Other*

Rob Bennetts: *Future Research*

Ricardo Zambrano: *Status of Roseate Spoonbill*

Don DeAngelis: *Ecological models*

Multi-Species Ecosystem Approaches

Deborah Brosnan, Session Lead

Lorraine Heisler: *"A Multi-Species Context for Everglades Restoration"*

Terry Rice: *"A Multi-Species Recovery Plan That Complements Everglades Restoration Is A Must*

Lou Gross: *ATLSS and Uncertainty*

Frank Mazzotti: *Multi-species models and their role in decision support*

Panel, Presenters, and Audience Discussion