KISSIMMEE RIVER
HEADWATERS REVITALIZATION PROJECT

ANNEX D

FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. BOX 2676
VERO BEACH, FLORIDA 32961-2676

June 30, 1994

Colonel Terrence C. Salt
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Attn: Planning Division

Re: Kissimmee Headwater Lakes Revitalization Project

Dear Colonel Salt:

Pursuant to a Scope of Work, the Chief of your Planning Division requested the U.S. Fish and Wildlife Service (Service) provide a Fish and Wildlife Coordination Act (FWCA) Report on the Kissimmee Headwater Lakes Revitalization Project. This project is integral with the plan to restore the Kissimmee River (Canal 38). Both components of this study were authorized by Section 1135 of the Water Resources Development Act of 1986. This FWCA Report is submitted pursuant to our Fiscal Year 1993 Transfer Funding agreement and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

The Kissimmee Headwater Lakes Revitalization provides the necessary storage and discharge characteristics to restore flow to the Kissimmee River, while also providing partial restoration of ecosystems in the Headwater Lakes.

To achieve the full potential for restoration of wetlands in the Headwater Lakes Revitalization Project, the Service recommends that the three major levees along the shores of Lakes Kissimmee, Hatchineha and Cypress be breached. The local sponsor, the South Florida Water Management District, will need to acquire all lands behind these three levees that lie below the 54-foot topographic contour in addition to the lands already targeted for acquisition.

Although the selected water regulation schedule is the best we can identify after a series of iterative evaluation of model outputs, it should not be considered as immutable. After several years of operation, the cooperating agencies should re-evaluate the operational rules, particularly to determine if longer periods of inundation between the 52.5 and 54-foot topographic contours can be realized without increasing risk of flood damages. Corps hydrologists have recently suggested lowering the upper controlling elevation of the selected 400C150RR schedule from 52.5 feet to 52 feet. Our analysis indicates that any further reduction of high water levels from the currently selected plan would virtually eliminate all currently projected benefits to wetlands and wetland-dependent wildlife in the upper basin. We strongly urge the Corps not to reduce the duration of water levels above 52.5 feet below those modelled for the 400C150RR alternative.

As a possible future refinement of the project, we also recommend that we study the feasibility of constructing a water control structure/lock at the northern end of Canal 36 (south of Lake Cypress). This structure would allow separate water regulation of Lake Cypress, which presently has water levels severely below historic conditions.

The Service also recommends that the Federal government take action to restore the Kissimmee River by backfilling Canal 38 to the fullest extent possible to achieve restoration of the river's original functions and values. This will mitigate damages caused by the channelization of the river. We also continue to strongly recommend that the Paradise Run reflooding and other flow-through measures in Pool A be incorporated in the Final Feasibility Report as project design features to maximize ecosystem restoration, as described in our 1991 FWCA Report for the Kissimmee River.

The draft FWCA report was circulated for review and comment by the participating agencies. The Florida Game and Fresh Water Fish Commission generally concurred with our draft and provided additional recommendations. The enclosed Final FWCA Report represents the Secretary of Interior's report to Congress as required by Section 2(b) of the FWCA. This report should accompany the Final Feasibility Report and Environmental Impact Statement when it is submitted to Congress.

Thank you for the opportunity to participate in this important ecosystem restoration effort. The Service views the implementation of this project as a step towards fulfilling the restoration goals of the South Florida Ecosystem Task Force.

Sincerely yours,

Robert T. Pace
Acting Field Supervisor

cc:
FG&FWFC, Tallahassee, FL
FG&FWFC, Vero Beach, FL
FG&FWFC, Kissimmee, FL
DEP, Tallahassee, FL
SFWMD, West Palm Beach, FL
FWS, Jacksonville, FL
FWS, Atlanta, GA

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. BOX 2676
VERO BEACH, FLORIDA 32961-2676

February 1, 1994

Mr. A.J. Salem
Chief, Planning Division
U.S. Army Corps of Engineers
Jacksonville District
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

On January 24, 1994, Mr. Robert Pace of my staff attended an "In-Process Review Conference" for the Kissimmee Headwater Lakes Revitalization 1135 project. He presented the results of the Service's community-level evaluation of the latest two alternatives in the iterative testing of proposed lake regulation schedules. We have been quite pleased to date with the approach of the HEP team members (led by Lou Toth of the SFWMD) in guiding design of this environmental project. We stated on January 24th that in our opinion the agencies had enough data to select a preferred alternative, based on the general behavior of the water routing models. We believe it is now time to move ahead with the species models on the preferred alternative so the Corps will be able to meet its planning deadlines.

On the basis of Mr. Pace's presentation, Richard Bonner proposed that the agencies concur on selection of the 400C150RR as the preferred alternative. There were no objections to this motion, but the agencies agreed to meet in Vero Beach in February to ensure that all parties agreed on the justification for this selection.

Enclosed are draft copies of what will be sections of our Fish and Wildlife Coordination Act report. The first section describes the approach taken to evaluate the water regulation schedules. The second section will be inserted in the "Future with Project" section of our FWCA report, summarizing the results of the general evaluation methodology. An as yet unnumbered table also summarizes these results.

Please forward copies of these materials to Gerald Atmar and Mike Smith, who are expected to meet with us in February on this matter. Your continued cooperation on this important restoration project is greatly appreciated. If you have any questions, please call Mr. Pace at (407) 562-3909.

Sincerely,

David L. Ferrell

David L. Ferrell
Field Supervisor

cc: (w/encl)
Ed Moyers, FGFWGC, Kissimmee
Larry Parent, FGFWFC, Tallahassee
Lou Toth, SFWMD, West Palm Beach
Patricia Sculley, SFWMD, West Palm Beach
Bill Helferich, SFWMD, West Palm Beach

ACKNOWLEDGEMENTS

The authors of this report are Robert T. Pace and Joseph D. Carroll, Senior Field Biologists.

We greatly appreciate the instruction and guidance of Arnold Banner, who introduced Mr. Pace to the concepts and practice of GIS analysis. He also provided assistance directly related to completion of this project.

We appreciate the encouragement of David Ferrell, our Field Supervisor, who has strongly supported development of GIS capabilities in the Ecological Services program of the Fish and Wildlife Service.

Fred Schaeffer, of our Vero Beach Field Office, provided invaluable support in keeping our computer hardware running and technical advice.

The members of an interagency review panel provided guidance and information throughout the analysis: Ed Moyer and Larry Perrin, Florida Game and Fresh Water Fish Commission; Gerald Atmar and Mike Smith, Corps of Engineers; Lou Toth and Patricia Sculley, South Florida Water Management District.

Paul Holt (Corps of Engineers) and Carl Horton (formerly with the South Florida Water Management District) assisted in development of the topographic/bathymetric data. The GIS data provided by personnel at the Florida Game and Fresh Water Fish Commission, Tallahassee, were used extensively in this analysis.

Finally, we must acknowledge the patience and assistance of the species experts we consulted in developing the species models. Those from the Florida Game and Fresh Water Fish Commission include: Ed Moyer, Jim Rodgers, Steve Nesbitt, Paul Gray, and Diane Eggeman. Brian Toland, now an employee of the U.S. Fish and Wildlife Service, also worked for the Game Commission when this evaluation started. Rob Bennetts of the University of Florida's Cooperative Fish and Wildlife Research Unit, James Layne of the Archbold Biological Station, and Herb Kale of the Florida Audubon Society also provided information and advice.

EXECUTIVE SUMMARY

The Kissimmee Lakes Revitalization Project provides the water storage and discharge characteristics to restore the Kissimmee River, while also providing a wider range of water fluctuation in the Kissimmee Chain of Lakes. We strongly recommend that the Corps implement design features as described below to maximize the environmental benefits achievable from this proposal.

The presently recommended revised lake schedule will provide seasonal flooding of greater duration for elevations between about 51 feet and 52.5 feet. Restoration of short hydroperiod wetlands is expected between elevations of 52 feet and 52.5 feet. We have predicted restoration of about 5939 acres of additional marsh relative to the present for the basic project without breaching of levees. If all three levees adjacent to the shorelines of Lakes Kissimmee, Hatchineha, and Cypress are breached (as recommended by the Service), about 7236 acres of marsh would be restored. The selected water regulation schedule would also provide routine low water levels (<47 ft.) of greater duration, which means greater overall fluctuation of water levels. The resulting increased hydrologic dynamics in the lakes is considered beneficial across the entire ecosystem.

Among the 10 evaluation species, 6 species are predicted to benefit significantly from the proposed new schedule. Compared to the future without the project, the predicted increase in availability of suitable habitat ranges from about 10% to 35%, depending on the species and the range of alternative futures considered. The 6 species include the Florida duck, ring-necked duck, snail kite, great egret, snowy egret, and wood stork. For the remaining species; Audubon's crested caracara, bald eagle, sandhill crane, and largemouth bass; we do not predict any major change in habitat availability. If any change occurs, the models point to a possible slight increase for these species.

As indicated in Section XII of this report, the Service has concurred with the Corps' determination that the proposal is not likely to adversely affect any Federally-listed threatened or endangered species. We predict the project is likely to benefit the endangered snail kite and wood stork.

The following summarizes our recommendations:

I. DESIGN AND OPERATION OF THE PRESENTLY PROPOSED PROJECT

- Periodic extreme drawdowns should be superimposed on the normal regulation schedule. This action is an essential habitat management tool for the entire lake ecosystem, particularly with respect to the sport fishery. The frequency and timing of these drawdowns should be fully coordinated to minimize adverse effects on nesting of snail kites.

- Spoil material excavated during widening of C-36 and C-37 should be confined to the existing spoil banks within the right-of-way. If filling of wetlands beyond the toe of the existing spoil mounds is unavoidable, the Corps should develop, during detailed project design, a plan to compensate for these losses.

- The Service continues to support the proposed Level II Backfilling Plan for the Kissimmee River restoration, a project adjacent to, and hydrologically connected with, the Kissimmee Headwater Lakes Revitalization Project.

II. ADDITIONAL PROJECT FEATURES RECOMMENDED TO MAXIMIZE ENVIRONMENTAL BENEFITS

- Lands up to 54 feet in elevation located behind the three levees at Lakes Hatchineha, Kissimmee, and Cypress should be added to the ongoing fee title acquisition of lands around the lakes. The levees should then be breached to hydrologically connect existing wetlands with the lakes and allow additional restoration of wetlands. This will result in the full potential of habitat restoration available in the upper basin and provide additional areas to buffer flood risks during storm events.

- The Service recommends that the Corps evaluate the feasibility and benefits of adding a water control structure/lock at the northern end of C-36 to enable separate water regulation of Lake Cypress at levels closer to the historic condition. Lake Cypress appears to be more adversely affected by water levels held below historic conditions, as exhibited by reduction of the littoral fringe and dense growth of aquatic weeds. Although separate regulation of this lake was not proposed in our Scope of Work, the Service is confident that separate regulation at levels higher than Lakes Hatchineha and Kissimmee would greatly enhance the environmental benefits of the currently proposed plan. We would be willing to prepare a Scope of Work to quantify these additional environmental benefits.

III. PROJECT MONITORING AND CONTINUED EVALUATION

- The Interagency Review Team that convened to prepare this evaluation should continue to meet after implementation of the new water regulation schedule. This will allow evaluation of its effectiveness in reaching restoration goals for the upper basin and the Kissimmee River. Environmental monitoring studies should be planned and funded. Iterative testing of modified water regulation schedules should be conducted if it appears that the project is not fully realizing potential benefits. In particular, the review agencies should revisit the issue of attempting to provide flooding of longer duration between elevations of 52.5 and 54 feet in the upper basin, if this can be achieved without increasing flood risks upstream.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. IDENTIFICATION OF PURPOSE, SCOPE AND AUTHORITY

Funding for the proposed Federal action is authorized by Section 1135 of the Water Resources Development Act of 1986. The primary purpose of the proposal is environmental quality, including restoration of fish and wildlife resources of the Kissimmee River Basin, including the Kissimmee Chain of Lakes (upper basin) and the Kissimmee River (lower basin). In response to a request from the South Florida Water Management District (SFWMD), the Congress directed the Corps of Engineers (Corps) to consider a restoration plan for the Kissimmee River, leading to selection of the Level II Backfilling Plan. The authorization calls on the Corps to provide a feasibility report and to implement the backfilling of Canal 38 of the Central and Southern Florida Flood Control Project. The selected plan calls for partial backfilling of the canal, and leaves the northern end (Pool A and part of Pool B) as well as the southern end of Pool E unfilled for flood control purposes.

The Section 1135 Kissimmee Headwater Lakes Revitalization Project is necessary to provide the volume and timing of water discharges to enable restoration of the Kissimmee River. Lakes Kissimmee, Cypress and Hatchineha are the larger lakes that would fall under a revised schedule; water levels in smaller Tiger Lake and Lake Rosalie would also be directly affected. The FGFWFC is currently constructing a project to allow regulation of Lake Jackson apart from the other lakes. Therefore, Lake Jackson was removed from the study area; it would only be affected indirectly by this project in that water levels on Lake Kissimmee could, during higher stages, affect the tailwater conditions at the new Lake Jackson structure.

II. ACKNOWLEDGEMENT OF COORDINATION AND CONCURRENCE OF FLORIDA GAME AND FRESH WATER FISH COMMISSION

Appendix A is a letter, dated June 6, 1994, from the Florida Game and Freshwater Fish Commission (FGFWFC), which concurs in the findings contained in this report. The Service agrees with the FGFWFC's additional recommendations, and we have added to the recommendations in Section XIV. Other letters from the Florida Department of Environmental Protection commenting on the Draft FWCA Report are included as Appendices B and C.

III. DISCUSSION OF RELEVANT PRIOR STUDIES AND REPORTS

The Kissimmee River was dredged as a Federal project in the 1960's resulting in a wide canal from the Kissimmee Chain of Lakes to Lake Okeechobee. In the late 1970's the State of Florida petitioned the Corps to restudy the channelized Kissimmee River, identified as Canal 38 (C-38). After resolutions were passed by Congress in 1978, the

Corps responded with reconnaissance and feasibility reports and an environmental impact statement. These documents established that the original Federal project had severely depleted fish and wildlife resources. These reports reviewed several alternative restoration plans. The report released in September 1985 concluded that there was "no Federal interest" in restoring the Kissimmee River, even though the report indicated that implementing many of the alternatives studied would result in significant benefits to fish and wildlife resources. The conclusion that no Federal action was justified was based on interpretation of the 1983 Principles and Guidelines of the Water Resources Council.

In December 1991 the Corps of Engineers submitted a Final Integrated Feasibility Report and Environmental Impact Statement on Environmental Restoration of the Kissimmee River. This report recommended backfilling of Canal 38 in Pools B, C, D, and E to restore the ecological integrity and fish and wildlife values of the Kissimmee River ecosystem.

A. <u>Prior Fish and Wildlife Service Reports</u>

Because the Kissimmee Chain of Lakes and the Kissimmee River are closely related biologically and administratively, the following listing of Service involvement considers both areas.

1. <u>FWCA Report, December 17, 1958</u>

A major report, entitled "A Detailed report of the Fish and Wildlife Resources in Relation to the Corps of Engineers Plan of Development, Kissimmee River Basin, Florida", was released by the Fish and wildlife Service in 1958. The report comprehensively described the fish and wildlife resources of the entire Kissimmee River basin, both the Chain of Lakes and the Kissimmee River. Particular emphasis was placed on the importance of the recreational use of the river, primarily for largemouth bass fishing, and the significance of the river basin for wintering waterfowl. These findings were based on more than a year of field surveys conducted throughout the basin. The report quantified existing public use of the river for fishing and hunting, and predicted that there would be a reduction in sport fishing and a loss of 40 percent of the waterfowl habitat.

As mitigation, the Service recommended seasonally varying the water levels in the headwater lakes, and substituting a leveed floodway for most of the canal. These recommended modifications were not implemented, and the river was subsequently channelized.

2. Kissimmee River Restudy Planning Aid Report, August 1979

In August 1979, the Service prepared a Planning Aid Report comparing the pre-project conditions with 1979 conditions in the lower basin. That report noted the loss of over 75 percent of the original wetlands and over 50 percent of the original river channel. The report concluded that mitigation efforts in the form of "fish breeding" canals did not offer significant compensation for fish and wildlife resource losses caused by channelization. The Service concluded that overall habitat values declined 90 percent, and offered various restoration and management alternatives for investigation by the Corps.

3. Habitat Evaluation Procedure Report, August 1984

This report described fish and wildlife habitat values evaluated by an interagency Habitat Evaluation Procedures (HEP) team in 1979 and 1980. The report discussed the methods, assumptions, models, and results of the HEP analysis. Baseline conditions were established from surveying the existing system, and results were presented for pre-project conditions and the restoration alternatives.

4. Fish and Wildlife Coordination Act Report on Restudy, March 1986

This report recommended that the Federal government take action to mitigate damages to fish and wildlife resources resulting from the construction of the Kissimmee River Flood Control Project. The Service preferred the alternative of backfilling the C-38 Canal to achieve as complete a restoration of the river's original functions and attributes as is consistent with reasonable flood protection and navigation. The partial backfill alternative, a flow-through marsh proposal in Pools A and B, and the Paradise Run proposals were all supported by the Service.

5. Fish and Wildlife Coordination Act Report, October 24, 1991

The Fish and Wildlife Service endorsed the restoration of the Kissimmee River and provided substantial evidence for improved habitat conditions for fish and wildlife, if restoration was achieved through backfilling C-38.

6. Planning Aid Report, Kissimmee Headwater Lakes Revitalization, February 25, 1994

By letter dated November 16, 1992, the Service provided a Plan of Study (Scope of Work) and cost estimate to evaluate the Kissimmee Headwater Lakes Revitalization Project and provide a Final Fish and Wildlife Coordination Act Report. On February 25, 1993, we provided a Planning Aid Letter for this project; this report provides our official response under the Coordination Act.

IV. LOCATION AND DESCRIPTION OF STUDY AREA

The Kissimmee Chain of Lakes is located in central Florida, south of Orlando, and it forms the upper end of a hydrologic system sometimes referred to as the Kissimmee/Okeechobee/Everglades system (Figure 1). The study area was selected to include the lakes that are regulated together under normal conditions--Lakes Cypress, Hatchineha, Kissimmee, Rosalie, and Tiger. Lake Jackson is currently held at the level of Lake Kissimmee, but the FGFWFC intends to regulate this lake separately from Lake Kissimmee. The water level in all of these above-named lakes remains below the 54-foot contour, except in extreme floods. Lakes Marian, Weohyakapka, Tohopekaliga and East Lake Tohopekaliga are also part of the Kissimmee Chain of Lakes, but because these are regulated at higher water levels, they will not be directly affected by the proposed water regulation schedules.

The Kissimmee Chain of Lakes is located in the Osceola Plain, a geologic feature east of the Lake Wales Ridge. A smaller ridge to the east separates the 1,633 square mile upper basin from the northward flowing St. Johns River basin. The present headwater lakes were probably once the deeper portions of a vast marsh complex. The original flow of water has been highly modified by manmade flood control canals. Lake Marion Creek and Reedy Creek are the remaining natural inflows to Lake Hatchineha. Rosalie Creek and Tiger Creek are also relatively short natural water bodies between Lake Rosalie and Tiger Lake and between Tiger Lake and Lake Kissimmee, respectively. The remainder of the waterways between the lakes in the study area and those connecting outside the study area have been channelized. These include Canoe Creek (C-34), South Port Canal (C-35), Hatchineha Canal (C-36), Short Canal (not part of C&SF system), and two channelized sections of the Kissimmee River: C-37, between Lake Hatchineha and Lake Kissimmee, and C-38, the long, wide canal between Lake Kissimmee and Lake Okeechobee. Several water control structures surround the lakes, but the main structure of significance in this report is S-65, which releases water from Lake Kissimmee, through C-38, to Lake Okeechobee, about 56 miles downstream.

Figure 2 illustrates the boundaries of the study area. State Road 60 forms the southern and southeastern edge, while the Florida Turnpike forms the northeastern boundary. The total area is approximately 213,625 acres (86,453 hectares). Although the effects of the project will be limited to the periphery of the lakes, the Service believes it is important to assess the environmental impacts within the surrounding landscape. For example, the lake shorelines are excellent foraging habitat for wading birds, but the extensive acreage of wetlands outside of the lake shorelines must also be considered to assess the effects of the project on the species within the surrounding landscape.

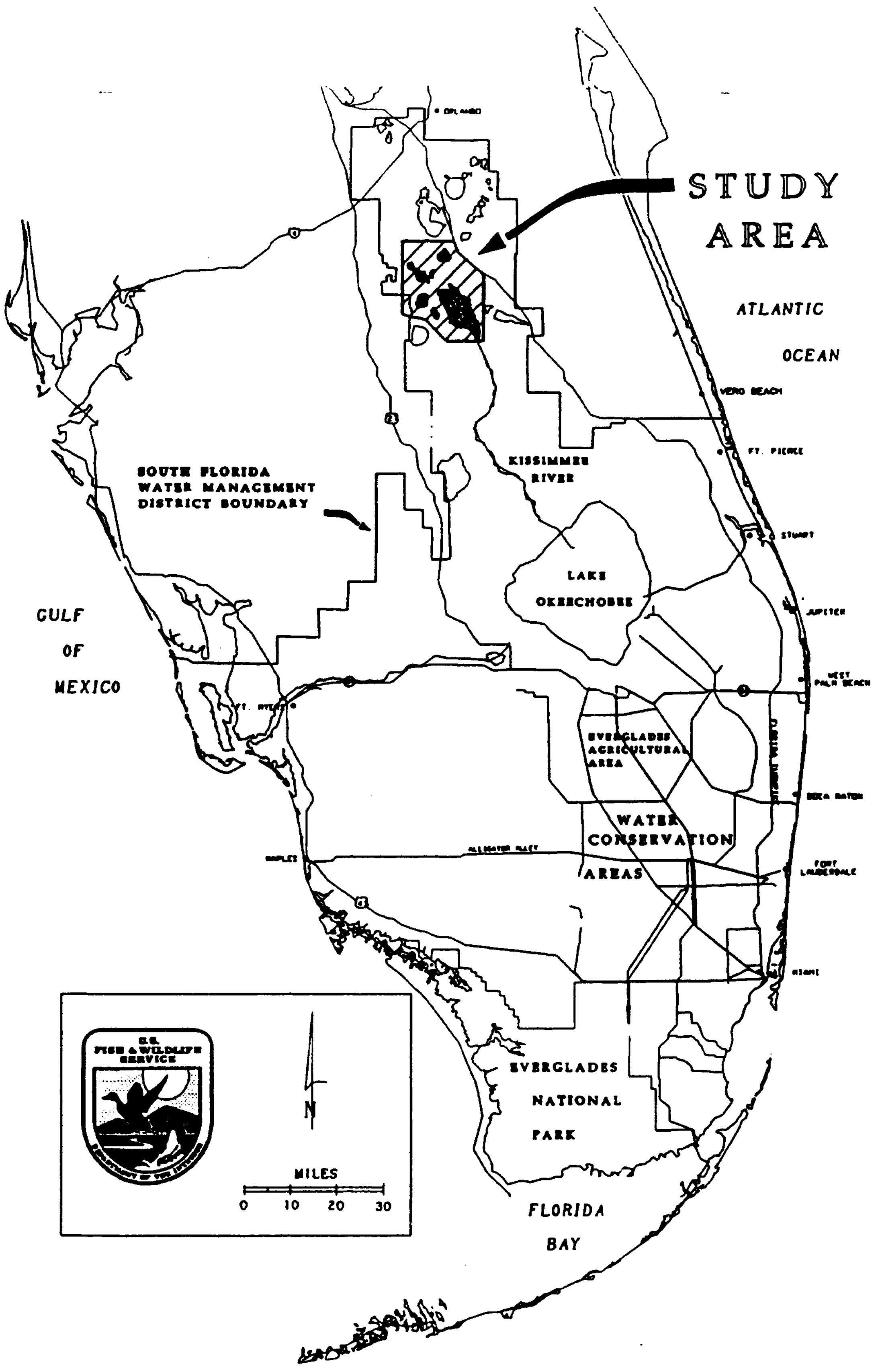

FIGURE 1 - LOCATION OF THE STUDY AREA WITHIN THE KISSIMMEE/OKEECHOBEE/EVERGLADES WATERSHED

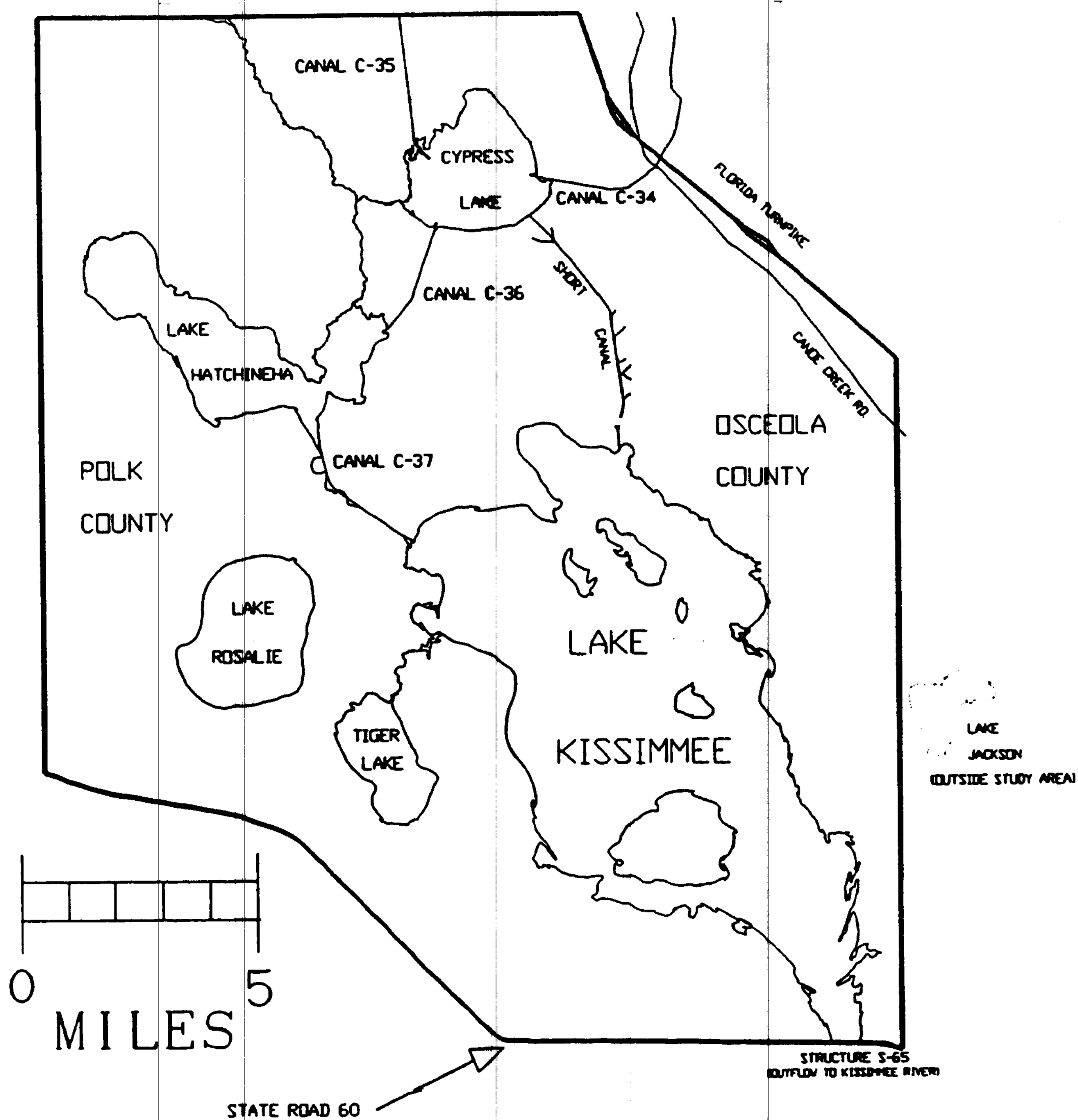

FIGURE 2 - LIMITS OF ENVIRONMENTAL STUDY AREA. KISSIMMEE HEADVATER LAKES

V. SUMMARY OF PLAN SELECTION PROCESS AND IDENTIFICATION OF EVALUATED ALTERNATIVES

The proposed project is largely alteration of the existing water regulation criteria, which is non-structural; however, to achieve the intended water storage in the lakes and discharge characteristics in the Kissimmee River without increasing flood risk, the Corps has determined that structural modifications will be required for canals and water control structures.

Regarding the non-structural aspects, Section VII.B.1. of this report describes the iterative testing process used to select the water regulation schedule. We provide the results of our analysis of the last two modelled alternatives in Section XI.A. of this report; the agencies have concurred on selection of a regulation schedule designated 400C150RR.

Early in plan formulation the Corps considered enlarging the Short Canal between Cypress Lake and Lake Kissimmee (Figure 2) to provide more rapid response to flood conditions. However, based on response from the Service and the Corps' own internal review, this proposal was rejected. The short canal is presently quite small and is surrounded by extensive wetlands. Large volumes of dredge spoil would have to be disposed in adjacent wetlands if traditional canal design were contemplated. Both agencies concurred that excavation of a flood control channel in this area would have unacceptable environmental impact.

Since rejection of the Short Canal design theory, the Corps has investigated widening of Canals C-35, C-36, and C-37 and increasing the capacity of water control structure S-65 to provide additional flood control response capacity. The Service's then recommended widening the canals on one side only, because widening on the existing center line would increase possible impacts on natural areas and increase turbidity effects within the canal and in wetlands outside of the existing spoil banks. Because the canal banks and spoil mounds are vegetated and stabilized, we recommended that one side of the canal remain undisturbed by widening to one side of the center line. After reviewing right-of-way information, the Corps and the SFWMD determined that if they widened to one side, road access requirements led them to select widening of the canals to the east.

The environmental studies in this report identify and evaluate the following five alternative future scenarios:

- Alternative Future 1 -- Adoption of the proposed water control schedule without breaching shoreline levees;
- Alternative Future 2 -- Proposed schedule with breaching of levee south of Lake Hatchineha;

- Alternative Future 3 -- Proposed schedule with breaching of levee north of Cypress Lake;

- Alternative Future 4 -- Proposed schedule with breaching of levee east of Lake Kissimmee;

- Alternative Future 5 -- Proposed schedule with breaching of all three levees (full restoration of all potential areas).

Each recommended breaching of a levee is considered to be an increment on the basic plan; however the Service strongly recommends that the project sponsors take full advantage of all restoration potential in the upper basin. All of these alternative futures were compared to the future without the project, which as stated in Section VIII.B. of this report, is assumed to be substantially the same as the present condition.

VI. EXPLANATION OF FISH AND WILDLIFE CONCERNS AND PLANNING OBJECTIVES

A. Fish and Wildlife Concerns

Fish and wildlife resources of concern and of major Federal interest include migratory birds (especially waterfowl and wading birds), and Federally-listed threatened and endangered species (bald eagle, wood stork, snail kite, Audubon's crested caracara) These wildlife species are, to varying degrees, dependent on wetland habitats in the study area. The Service also advocates public uses of fish and wildlife, including the observation of wildlife, hunting and sport fishing.

The primary planning objective of the Service is recovery and mitigation of habitat supporting these species. Distribution, timing, and volume of water flow to approximate, or at least approach, historic patterns are the principal concerns at the present phase of planning ecosystem restoration. Water quality issues also need to be addressed in the long term to ensure adequate habitat quality in both the upper and lower basins.

Hydrologic conditions were altered by construction of the Kissimmee River Flood Control Project. Water is released from the lakes in sudden pulses when the existing regulation schedule is exceeded. The approved maximum water level is seldom reached because the schedule allows it only late in the year, after the peak of the normal rainy season. Flood control measures instituted since about 1965 have restricted water levels to an extremely narrow range. This lake level stabilization has reduced the size of the littoral zone marshes, reducing the total area for recruitment of forage to the in-lake fishery. Foraging areas for waterfowl and wading birds have also been reduced.

The static condition of the lakes appears to be adversely affecting vegetation in the littoral zone. Short hydroperiod marshes have been displaced by pasture grasses and invaded by shrubs. After decades of restrictive water regulation, even woody vegetation appears affected; although we have no statistics on wetland change during this period, observations indicate a net loss of cypress trees in the upper littoral zone. This is particularly true of Lake Cypress. Lake Cypress was historically upstream of Lakes Hatchineha and Kissimmee, but all three lakes are now held at a flat pool. This exaggerates the effects on the littoral fringe of Lake Cypress. The Service is providing a recommendation that an additional study be conducted to determine the feasibility of constructing a water control structure with a navigational lock at the northern end of C-36, just downstream of Cypress Lake.

Although year-to-year low water levels contribute to the dynamics of the lakes, extreme drawdowns are considered essential on a periodic basis to achieve their beneficial effects on vegetation and organic berms. Deposition of a band of organic material around the lakes' shorelines is exacerbated by narrow restriction of lake levels. At least three factors are involved in this phenomenon. First, if annual low water levels recede to about the same level in most years, deposition of silt is concentrated at that elevation. Secondly, if water levels are not allowed to descend drastically during droughts, as they did under unregulated conditions, vegetation becomes overly dense, impeding the movement of animals, particularly fish that serve as food for other species. Finally, the buildup of dense vegetation has a synergistic effect by accelerating the rate of additional organic material in the same bands of vegetation.

Both the static condition of the lakes and nutrient inputs have contributed to proliferation of nuisance vegetation. Water primrose and cattails are among the emergent nuisance plants that propagate to an unnatural degree in static conditions. Submersed and emersed floating aquatic plants, such as the exotic *Hydrilla* and the native American lotus (*Nelumbo lutea*) also proliferate beyond historic abundance. Lake level stasis is thought to promote formation of floating batteries. Patches of aquatic plants, primarily fragrant water lily and spatterdock, with associated peat and starchy roots, lift up from the bottom and float to another location where they lodge. In addition, *Scirpus cubensis* forms thick mats of vegetation which support colonization by many species of undesirable plants. Battery formation can in turn cause formation of patches of higher islands in the marshes of the littoral zone.

Extreme drawdowns of several months duration allow drying of the built-up sediment load, and even without mechanical removal of the sediment berms, levelling of these berms by extended drying is beneficial to the exchange of water and animals across these berms after re-flooding. Extreme drawdowns help thin out the overly dense bands of vegetation that can develop in static systems. If mechanical removal of vegetation is not practical in a lake as large as Lake Kissimmee, a controlled burn can be an effective management tool in the shoreline exposed by an extreme drawdown. Natural oxidation and consolidation of sediments is beneficial even without mechanical removal of muck.

The FGFWFC has instituted programs to draw down the lakes on a periodic basis. They attempt to hold water down for at least 90 days, starting in mid-February; results will vary according to rainfall patterns during this period, which normally has low rainfall. Increased rainfall is normally anticipated in June, which is generally the latest lakes can be held down (Ed Moyer, FGFWFC, pers. comm.). For Lake Kissimmee, water levels should remain below 46 feet for a minimum of 90 consecutive days for effective treatment.

Extreme drawdowns were completed for Lake Tohopekaliga in 1971, 1974, and 1987; the last included muck removal. East Lake Tohopekaliga was drawn down in 1990, also with muck removal. (Both of these lakes are in the Kissimmee Chain of Lakes, but north of the limits of the study area for the project considered here.) A drawdown of Lake Kissimmee was completed in 1977; this did not include mechanical removal of muck, but was beneficial through the natural processes described above. A drawdown is planned for Lake Kissimmee in the next two to three years, if funds and permits can be secured.

Wegener and Williams (1974) describe the beneficial response of fish populations to the 1971 extreme drawdown of Lake Tohopekaliga. Standing crop of fish in the littoral zone increased from a high of 191 pounds per acre before the drawdown to 455 pounds per acre within two years after reflooding.

Compounding the adverse effects of overly restrictive water management, several levees have been constructed around the lakes, further restricting interchange of water and accelerating conversion of former wetlands to uplands. Figure 3 shows the locations of the three principal levees, north of Lake Cypress, south of Lake Hatchineha, and along the east shore of Lake Kissimmee.

Public access is always a concern for fishermen, froggers and hunters. The higher powering of airboats and other boats has made more and more land (including privately held land) accessible. Conflicts can arise between certain factions among recreational users and landowners. Development of recreational plans by the Corps should consider the balance between the limits on public access sought by landowners along the shoreline and the legitimate needs for public access to the natural resources.

B. Planning Goal

Optimize environmental improvements to the upper Kissimmee basin while reestablishing discharges to the lower basin that are necessary to restore the ecological integrity of the Kissimmee River

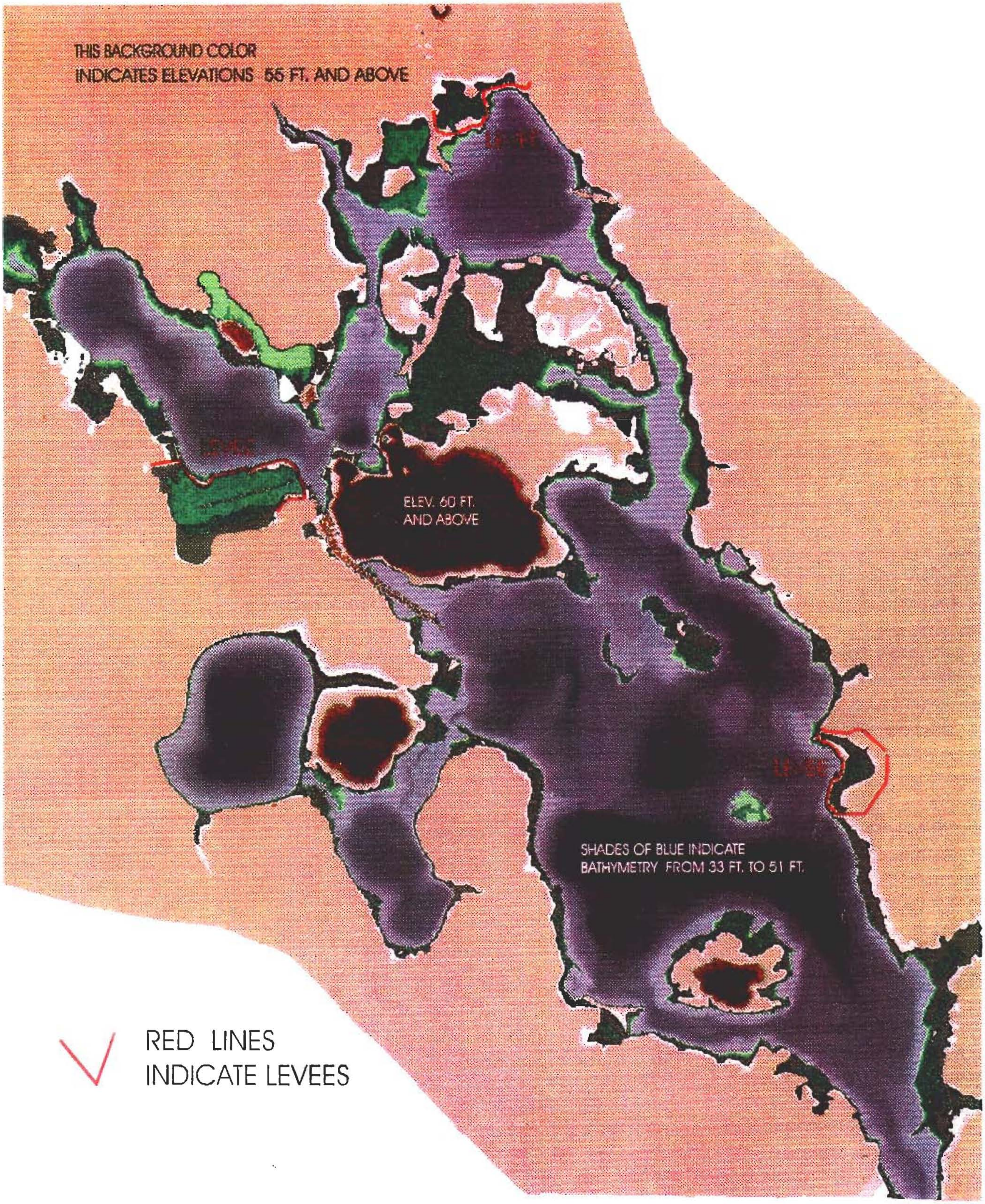

FIGURE 3 - TOPOGRAPHY/BATHYMETRY AROUND KISSIMMEE CHAIN OF LAKES AND LOCATION OF SIGNIFICANT LEVEES.

(POTENTIAL AREAS FOR WETLAND ENHANCEMENT ARE ISOLATED BY THESE LEVEES)

C. Planning Objectives

1. Provide necessary storage and regulation schedule modifications to approximate historical flow characteristics to achieve or exceed the benefits ascribed to Kissimmee River restoration.

2. Increase the quantity and quality of the wetland habitat in the upper basin lake littoral zones to benefit fish and wildlife.

3. Provide increased potential for recovery of endangered and threatened species, while not jeopardizing any listed species.

VII. DESCRIPTION OF EVALUATION METHODS

A. Data Used in the Evaluation

1. Vegetative Cover

Characterization of habitat suitability in this evaluation relies principally on a classified Landsat Thematic Mapper (TM) image. The study area was cut out from data provided by the FGFWFC. The FGFWFC classified vegetative cover in Florida into 22 categories (including barren areas and open water). Kautz et al. (1993) provide a description of the process of classification, definition of the habitat characteristics of each land cover type, and analysis of the results. Figure 4 shows the original Landsat image used as a basis for our analysis. Sixteen of the 22 land cover types used for Florida are present in the study area. The 5 most abundant cover types in the study area are the following:

TABLE 1 -- PREDOMINANT LANDCOVER CLASSES IN STUDY AREA

LANDCOVER CLASS	ACREAGE	PERCENT OF STUDY AREA
Grassland	48,900	22.9%
Open Water	39,373	18.5%
Dry Prairie	30,161	14.1%
Marsh / Wet Prairie	28,673	13.4%
Shrub / Brushland	13,860	6.5%

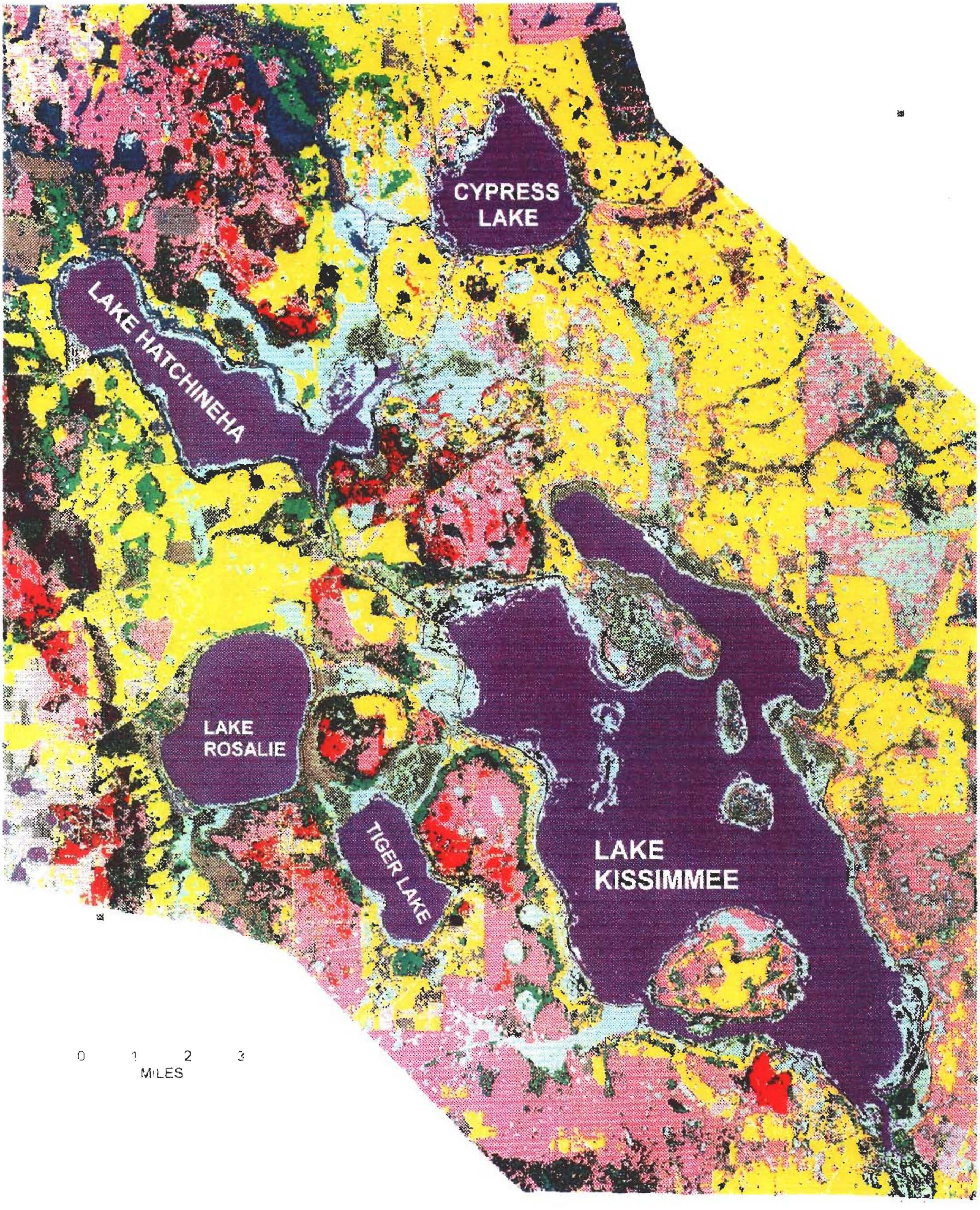

FIGURE 4 - COVER TYPES IN STUDY AREA, KISSIMMEE HEADWATER LAKES
(From FGFWFC classification of 1986 LANDSAT image)

LEGEND FOR VEGETATION CLASSES IN FIGURE 4
FLORIDA GAME & FRESHWATER FISH COMMISSION CLASSIFICATION

DRY PRAIRIE

PINELANDS

SAND PINE SCRUB

XERIC OAK SCRUB

MIXED HARDWOOD/PINE FORESTS

HARDWOOD HAMMOCKS AND FORESTS

FRESHWATER MARSH & WET PRAIRIE

CYPRESS SWAMP

HARDWOOD SWAMP

BAY SWAMP

SHRUB SWAMP

OPEN WATER

GRASSLAND

SHRUB AND BRUSHLAND

BARREN

Additional classes were derived from the 16 classes in the study area, based on National Wetlands Inventory data and projections of future with project conditions, as described below. Although the land cover data distinguishes several categories of woody wetland vegetation, it provides a single category for herbaceous marsh/wet prairie. Duration of flooding and water depth are the main variables used in our analysis of the lake regulation schedules, and the landcover data provide no indication of water regime for the wetlands or open water areas. Therefore, additional data sets, as described below, were used in conjunction with the vegetative cover to assess project effects.

2. Water Routing Model

The Hydrology Section of the Corps' Jacksonville District ran several iterative tests of water regulation schedules. The South Florida Water Management District was the principal designer and initial evaluator of the schedules. The Corps provided historic water level records (1929-42 and 1945-1958), observed conditions (1970-1988), and model outputs from the UKISS water routing model for a series of alternatives.

These data were exported as ASCII files and imported by the Service into a spreadsheet program. The use of these data in the evaluation of general ecological parameters and in species models is summarized in following sections of this report. The two principal variables were water levels in Lake Kissimmee and percent floodplain inundation in the Kissimmee River, which was estimated from discharges from Lake Kissimmee. A major assumption in our analysis is that all the lakes in the study area are treated as a single pool, i.e. water levels are assumed to be at the given level measures or modeled in Lake Kissimmee. In reality, water levels in the peripheral lakes, particularly Cypress, Rosalie, Tiger, and Jackson may be at times perched above the water levels in Lake Kissimmee. However, in the long term, environmental conditions in all the lakes are correlated with regulation of Lake Kissimmee (except for the probable future management of Lake Jackson as a separate entity).

A variety of statistics were extracted from the water records. The general evaluation of alternatives, as described in greater detail in a subsequent section of this report, used daily records, extracted on a seasonal basis, over an 18-year period of record. Where water regulation parameters were used as input in species models, a weekly average over the 18-year period of record was used in most cases, and specific water level variables were extracted from those data. Water elevation in turn had to be referenced to topography to provide a measure of water depth and/or hydroperiod at a given geographic point.

3. Topography and Bathymetry

A reliable topographic data set was not available prior to initiating this analysis. In the Scope of Work for this project, we anticipated that detailed topography (at least to 1-ft

contours, and preferably to 0.5-ft. contours) would be determined by photogrammetry for the entire study area. Certain portions of the study area had already been surveyed in detail, but contracts were not issued to provide detailed surveys of the remainder of the study area. Consequently, significant uncertainty in topography remains, particularly in the area between the three large lakes (Kissimmee, Tohopekaliga, and Cypress) and in the area west and northwest of Cypress Lake.

Despite these data gaps, all available bathymetric and topographic data were assembled from a variety of sources into a single line coverage. The major sources were: bathymetric contours from a 1954 Corps survey, detailed photogrammetric surveys of selected areas, scattered transects by the SFWMD, cross-sections at the major canals from the Corps, and the 55-foot and 60-foot contours from USGS quad sheets. A topographic surface was interpolated from the assembled line coverage using the TIN module in the ARC/INFO program. The resulting 30-meter grid of interpolated values was split into 0.5-ft intervals centered on the contour line. The image was then clipped at the 55-foot contour. Figure 3 shows the resulting map; the map contains some central areas with elevations of 60 feet or above, which are included only for graphic integrity, so as not to show up as "holes". The locations of principal levees in the study area were added. For purposes of the analysis, any elevations above 54 feet are irrelevant, because the effects of the project would not reach above that elevation.

Among the areas lacking topographic accuracy are several significant tracts of low elevation (roughly 52 to 54 feet) located behind levees. The main concern of the Corps and SFWMD has been to minimize the acreage of land acquisition lying below 54 feet. The topographic surveys were generally carried up to the nearest 54-foot elevation around the shore of the lake. Where the surveys encountered a levee at or above 54 feet, the low-lying areas behind the levee were either ignored or not surveyed in adequate detail. However, the Service has attempted to include these areas for possible restoration or enhancement of wetlands if the levees are breached.

4. National Wetlands Inventory

Water regime descriptors from the National Wetlands Inventory were used to supplement the generalized marsh/wet prairie category available from the FGFWFC's Landsat image. Polygons described as temporarily flooded, seasonally flooded, or semi-permanently flooded palustrine emergent wetlands were selected from the 9 quad sheets within the study area. A grid value was assigned as an attribute to each polygon in accordance with the above water regime designations, and the polygons were converted to a 30-meter grid. Any contiguous cells of generalized marsh in the Landsat image were considered to have the same water regime, and any generalized marsh category that did not correspond with a NWI water regime remained as generalized marsh. These marsh categories were used only for wetlands outside the hydrologic influence of the lake shores, i.e. above the 54-foot contour.

B. General Evaluation of Water Regulation Schedules

1. Background of Iterative Testing

Between August 1993 and November 1993, an iterative testing process was conducted using schedules recommended by the South Florida Water Management District (SFWMD). Hydrologists in the Corps' Jacksonville District ran the UKISS hydrologic routing model and provided the results to the SFWMD, the Service, and the FGFWFC for review of the output. Although the SFWMD was the principal designer and reviewer of the schedules, they conferred with all four agencies in a series of meetings to review the model outputs and to fine-tune the schedules. In this iterative process, a total of at least 21 regulation schedules were reviewed. The last two alternatives, T1000HISRR and 400C150RR, were evaluated by the Fish and Wildlife Service, using a series of criteria judged to measure ecologically significant factors. We describe below the theory and assumptions underlying the general ecological evaluation of these schedules and their comparison with the historic (pre-project) condition and the recently regulated conditions (1970-1988).

The primary criterion used by the team members in reviewing the hydrologic outputs was the percent of time that the Kissimmee River floodplain would be expected to exceed a given percentage inundation and the discharge characteristics at structure S-65. This analysis looked at both the percentage of time over the full period of record, and the percentage of time by month, that at least 1%, 15%, 40%, 75%, 95%, or 100% of the floodplain would be inundated. Estimates of the percent floodplain inundation were based on the relationship (in the river's pre-channelization condition) between stages at the Fort Kissimmee station and the extent of floodplain inundation. Stages at Fort Kissimmee were in turn derived from discharges at S-65 modeled for each of the alternative schedules. Evaluation of the effects on the Kissimmee River and comparison of stage exceedence curves for Lake Kissimmee were the basis of the iterative evaluation and re-design of lake regulation criteria.

Because higher water levels in the Kissimmee River floodplain ultimately depend on drainage from the Chain of Lakes, trade-offs must be reconciled. Early in the testing process, it was determined that attempting to provide historic discharges to the Kissimmee River throughout the year would lower the high end of the stage exceedence curves for Lake Kissimmee, relative to the presently regulated condition. As this was considered unacceptable for the Chain of Lakes, the evaluation team continued to seek distribution of discharges for the Kissimmee River in keeping with the typical wet season/dry season pattern characteristic of central and southern Florida, while not lowering the frequency of higher stages in the lakes. To avoid reduction of the higher water levels in the Chain of Lakes, the regulation schedule alternatives were eventually modified by inserting both a 150 cfs zone and a transitional zone with discharges between 400 cfs and 150 cfs.

2. Assumptions and Description of Community-level Evaluation

Because habitat changes can favor one species and be adverse to another species, species-by-species modeling, as presented in another section of this report, often may identify trade-offs in the effects of a proposal on species of particular concern. This may help wildlife managers set priorities for actions beneficial to a given species or perhaps set limiting factors on the scope of project alternatives if a given alternative is unacceptably detrimental to an important species. However, greater emphasis is now being placed on development of community-level evaluations, especially for measures of ecosystem restoration.

We have used several parameters available from the hydrologic data to assess the overall dynamics and productivity of the last two modelled alternatives, the observed 1970-1987 regulated condition (one using the full record, and another version with the 1977 extreme drawdown excised) and historic conditions prior to regulation. All of the water routing models used inputs from the 18-year period between 1970 through 1987. In evaluating the historic pre-project condition, an 18-year period was selected to keep the evaluation equitable. According to the USGS, regulation of the lakes began in July 1964. The pre-project water records supplied by the Corps were 1929-1958. Because historic records were incomplete in 1943 and 1944, the most recent available full-year periods summing to 18 years were 1939 through 1942 (4 years) and 1945 through 1958 (14 years).

A description of the general evaluation technique and its assumptions follows. The evaluation is divided into two parts -- the first part assesses performance of the observed and proposed hydrologic regimes in the Chain of Lakes, and the second assesses them from the perspective of achieving restoration of the Kissimmee River floodplain.

The present regulation schedule of the lakes has been criticized by wildlife managers as being too restrictive of water levels in a narrow range, without the degree of fluctuation in high and low water levels before regulation. Maintaining water levels within narrow limits has several detrimental effects. Figure 5 shows a graph prepared in 1957 that predicted compression of the elevations at which certain wetland plant species would grow in response to the anticipated more restrictive water regulation following construction of the project. Indeed, water levels are considerably more static today than in the pre-project condition, but we are unaware of any follow-up studies to confirm that such changes have occurred or are in the process of occurring. The most obvious effect is that hydrologic conditions suitable for growth of productive wetland vegetation are concentrated to a narrow band. Areas that used to sustain herbaceous wetlands at higher elevations are now less frequently flooded and/or have been displaced by upland

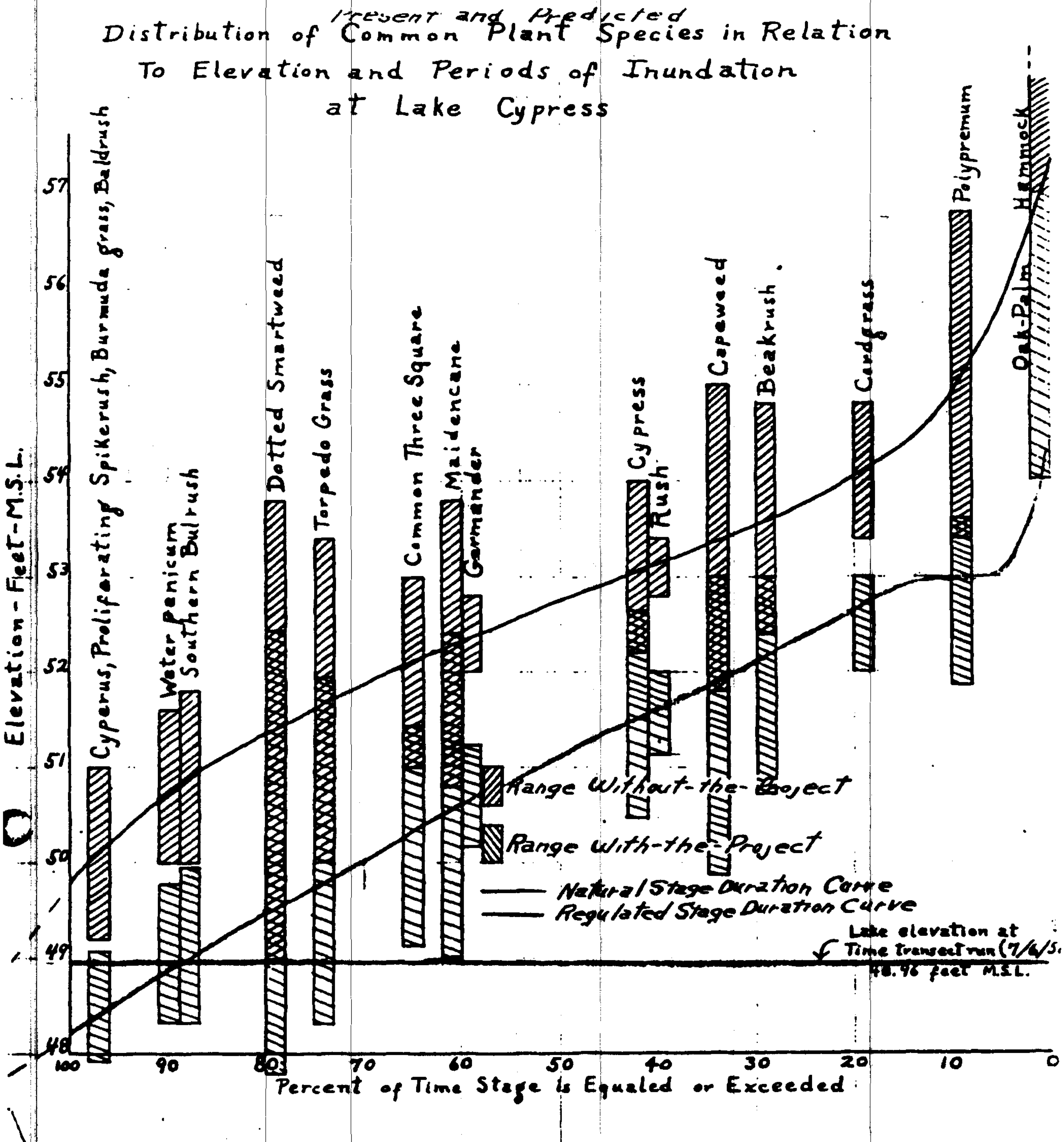

FIGURE 5 - PREDICTION OF CHANGES IN VEGETATION DUE TO REGULATION OF LAKES.
(FROM USFWS' 1957 COORDINATION ACT REPORT)

vegetation. Longer-lived wetland plants such as cypress trees (particularly at Cypress Lake) are now less frequently flooded, and part of the cypress fringe has been lost (Ed Moyer, pers. comm.) Greater fluctuation in water levels expands the distance across which a given species can encounter conditions matching its preferred hydroperiod. Generalist species, including non-native aquatic plants, are expected to dominate in closely regulated conditions, reducing the diversity of the wetland. Therefore, both total area and diversity of wetland vegetation are reduced by the more restrictive water regulation schedules.

Based on the ecological criteria described above, the evaluation assumes that measures of high water periods, routine low water periods, and overall variability in water levels are all indicators of general productivity and health of the lakes.

Screening of the water model outputs for the earlier schedule alternatives was based on inspection of the stage-exceedence graphs. Those alternatives exhibiting higher stages at the upper end of the curve (above the 1970-1988 observed values) were preferred for further consideration. Although this was considered adequate for initial screening of the alternatives, the Service decided to conduct a more detailed analysis of several more refined alternatives in the latter stages of selection. The stage-exceedence curve will only indicate the percent time over the period of record that a certain water level is exceeded; it does not indicate the duration of each occurrence. That is, several one-day or two-day periods of water over 52.5 feet will contribute to the percentage of time exceeding that value in a stage exceedence curve, but these short periods of flooding will have little biological significance. We decided that the average durations of flooding and drying events is more significant, because they will correlate with the suitability of flooded areas as wildlife habitat and with the beneficial effects of routine low water levels.

Three quantitative criteria were examined through use of a spreadsheet program, using the output of the hydrologic models provided by the Corps. The first criterion is the average duration, in days, of water levels greater than 52.5 feet, the presently regulated maximum of the lakes. The second criterion is the average duration of water levels lower than 49 feet, the presently regulated minimum (what we are calling a routine drawdown). The third criterion is the coefficient of variation of the daily records over 18 years, which provides a measure of overall variability of water levels from the mean. All of the above measures were used in the ranking formula as an index of success in achieving restoration in the Chain of Lakes.

Four additional criteria were used to measure performance of the alternatives in achieving restoration of the Kissimmee River. Although the criteria used for the upper basin did not consider seasonality, we considered seasonality important in evaluation of the lower basin. Data for the wet season (June 1 - Oct. 31) and for the dry season (January 1 - May 31) were extracted to separate sections of the spreadsheet throughout the 18-year period of record. Again, the <u>duration</u> of events was considered biologically more significant than simply the percentage of time over the period of record. (For example, a percentage of time with a certain level of floodplain inundation could consist of many short periods of inundation, but a longer average time period above a certain level of inundation would provide more opportunity for animals to use these areas as habitat.) The spreadsheet accounted for the end of each seasonal period to avoid the possible error of a period that met the criterion erroneously being extended to the next seasonal period. For example, floodplain inundation exceeding 90% until October 31 of one year and picking up again in June 1 of the next year should not be considered a single event of long duration, but rather two separate events meeting the criterion.

We considered it important that the project provide high levels of floodplain inundation during the wet season months (June through October), providing a more natural (i.e. rain-driven) pattern of floodplain inundation. The fourth criterion (first lower basin criterion) measured the average duration, in days, during the June through October wet season when floodplain inundation covered 90% or more of the floodplain. The fifth criterion also started with daily records in the wet season, and measures the duration of periods of very low flow (< 200 cfs). Examination of the model outputs led us to select 200 cfs as indicative of low flow that might lead to adverse conditions in the Kissimmee River; first, 200 cfs is below the level at which water is contained fully within the river banks (0% floodplain inundation) and secondly, periods of less than 200 cfs were found to be relatively infrequent. The wet season months are also the period of high water temperatures, when fish kills due to oxygen depletion are more likely to occur. Oxygen depletion generally occurs during extended periods of no flow or very low flow. High values for this criterion are undesirable and should correlate with a greater risk for harmful situations involving oxygen depletion. The sixth criterion determined the average duration of greater than 25% floodplain inundation in the January - May period. We considered it important that some lower level of floodplain inundation occur in the dryer months, but we felt it would be unrealistic to set a high level of inundation as a goal for this period. The seventh criterion measured the duration of periods with less than 200 cfs flow at S-65 between January 1 and May 31 for the period of record. Although we considered reduction of periods of low flow to be a valid overall goal, we do not consider avoidance of low flow as important in the dry season because water temperatures are lower at that period, and oxygen depletion is less likely.

3. Calculation of Overall Score for Alternatives

A formula was devised to provide an overall ranking of the final two alternatives and to compare these alternatives with the period of record. The preceding section describes the 8 criteria used to calculate the overall ranking. The overall ranking (R) equals the weighting factor (W) for each criterion times the individual ranking value (r) for each criterion, summed across the 7 criteria:

$$R = W_{C1} \times r_{C1} + W_{C2} \times r_{C2} + \ldots W_{C7} \times r_{C7}$$

The individual ranking value (r) for each criterion is a value from 0 to 1, based on the range of values observed for the alternatives and the observed values in the reference periods of record. For criteria 1, 2, 3, 4, and 6, high values are more desirable, and r is calculated as follows:

$$r = \frac{X}{X_{max}}$$

where X_{max} is the highest value for each criterion among the alternatives or the periods of record.

For criteria 5 and 7, lower values are more desirable, and r is calculated as follows:

$$r = 1 - \frac{X}{X_{max}}$$

Evaluation team members assigned weighting factors, based on the following premises that account for institutional priorities::

- The preliminary review of water regulation schedules had already been based on evaluation of the timing and volume of discharges to the Kissimmee River. Although we considered it appropriate to include lower basin criteria in the final selection of a preferred schedule, we decided it was important to give greater weight to the factors originally intended for the Kissimmee Headwater Lakes Revitalization Project -- higher water levels and greater water level fluctuation.

- For the lower basin criteria, we considered that delivery of water to the Kissimmee River during the wet season months was more important than providing floodplain inundation and avoidance of low flow in the dry season.

Therefore, among the 7 criteria, the average number of days with water levels above 52.5 feet (criterion 1) and the overall variability in water levels (criterion 3) were considered most important to the evaluation for the Chain of Lakes, and were assigned a weighting factor of 2. The effects on the lower basin during the dry season (criteria 6 and 7) were considered relatively less important, and were assigned a weighting of 0.5. The other 3 criteria (numbers 2, 4, and 5) were considered to be intermediate in importance, and were assigned a weighting factor of 1.

On February 18, 1994, the four review agencies met in Vero Beach to approve documentation for the evaluation methodology described above. Agency comments were incorporated in the evaluation methodology prior to issuance of the Draft Fish and Wildlife Coordination Act Report.

C. Methods to Estimate Extent and Location of Wetlands to be Restored

1. Introduction

A major benefit of the Kissimmee Headwater Lakes Revitalization Project is the opportunity to restore wetlands that have been degraded or eliminated by too restricted water fluctuations and/or construction of levees holding back water from low-lying areas. An important assumption in our analysis is that the waterward edge of the marsh around the lake shores will not change as a direct result of the proposed change in the water regulation schedule. The rationale for this assumption is that the wetland plants (mainly cattails and bulrushes) at the waterward edge of the marsh are highly tolerant of extended periods of deep flooding. We consider that the outer edge of the marsh would recede in response to higher water levels only if the existing vegetation were drowned out by prolonged periods of extremely high water. However, the higher water levels for the proposed alternative are approximately one half foot higher than at present and are not held high for extended periods of time. In addition to the somewhat higher levels, the proposed schedule would also provide lower average water levels, resulting in greater overall fluctuation. We consider that consistently higher water levels would cause a recession in the waterward edge of the marsh, but since that is not the case, we predict no change for the waterward edge, while the upland edge of the marsh will be extended by the seasonally higher levels, resulting in a net increase in marsh acreage. The following sections describe how we determined the average elevation of the existing marsh/upland edge and how we predicted the extent of additional acreage of wetlands to be restored by the higher water levels.

2. Topographic Range of Wetlands (With and Without the Project)

Two analytical approaches were used to compare the existing extent of wetlands with projected future conditions. The main objective was to determine the elevation at which marshes or wet prairie transition to grasslands or dry prairie. The first analysis (using GIS) centered on delineation of the wetland/upland transition as sensed by the Landsat image used to define vegetative cover in the study area. The second analysis was performed in a spreadsheet program and was based on the regulatory definition for wetland hydrology.

The GIS-based analysis started with the coverages containing the contour lines for the bathymetry and topography of the study area. As previously stated, some areas were surveyed in detail and others were not, requiring extensive interpolation, particularly in low-lying areas distant from lake shorelines. Therefore, we searched for areas where most or all of the 1-foot bathymetric and 0.5-foot topographic contours were present, where these lines ran generally parallel, and where the slope was gradual to better determine at what elevation the wetland/upland transition took place. In this way we intended to select areas with as accurate data as possible and with regularly sloping shorelines (i.e. without islands, peninsulas, embayments or natural berms). We also sought to distribute these areas throughout the study area. However, more complete and accurate contours were available for Lake Kissimmee than for Lake Hatchineha and Cypress Lake, and we avoided selecting areas in Tiger Lake or Lake Rosalie, because these lakes have relatively steep shorelines. Nine areas were selected, drawn in over the contour line coverage, and transferred over the Landsat image. In the Landsat image, we digitized the transition between the marsh/wet prairie vegetation type and the adjacent uplands (usually grassland or dry prairie) in the nine selected sections of shoreline. The resulting lines were rasterized and superimposed on the raster version of the topography/bathymetry. The topographic data used here had been interpolated to 0.1 feet by the SFWMD. We were confident in using this level of interpolation along selected shorelines, but not over the entire study area. (Interpolation to 0.5-foot contours were used for all other GIS analyses, including prediction of future wetland extents and habitat suitability in the species models.) By overlaying the two files, we could determine the elevation of each grid cell along the wetland/upland transition. These data were exported to a spreadsheet and to a statistical program. A total of 395 grid cells were analyzed in the 9 areas distributed geographically as follows: 2 areas in the southern half of Lake Kissimmee; 3 in the northern half of Lake Kissimmee; 2 adjacent to the Short Canal, between Lake Kissimmee and Cypress Lake; 1 at the northern end of Lake Hatchineha; and 1 along the northeastern shore of Cypress Lake. The mean elevation of the upland/wetland transition line on the 1986 Landsat image was 51.96 feet ($\pm$ 0.1, 95% confidence limit).

The current Federal manual for delineation of jurisdictional wetlands uses three diagnostic parameters: vegetation, soils, and hydrology. Our analysis assumes that if suitable hydrology is restored over suitable soils, characteristic wetland vegetation will follow. Consideration of soils enters our analysis later in this section, when we estimate the likely quality of the additional wetlands to be produced by the new water regime. Our spreadsheet-based wetlands analysis, however, considers only the hydrologic criterion, comparing water level readings for the full 18-year period of record for both the selected alternative, 400C150RR, and the observed period of record (1970-1988). By examination of the stage exceedence curve for the preferred alternative, relative to the observed, evaluation team members noted that the two lines crossed at about a 51-foot elevation, and that by "eyeball" it appears that the preferred alternative runs somewhere between a quarter and a half foot higher than the observed (Figure 6). In the section of this report dealing with the community-level comparison of the schedules, we presented the biological reasoning behind the use of duration of flooding and drying events, rather than the stage exceedence curves, as ecological indicators. The Federal wetlands manual stresses that the duration of continuous periods of inundation and/or saturation is more important in defining wetlands than the total number of days per year with inundation or saturation.

The minimum hydrologic regime for defining wetlands is generally accepted as continuous saturation for at least 5% of the growing season. Assuming that the growing season is year-round in the study area (the most rigorous standard), this equates to 18 days of continuous saturation. In our analysis, we have required 18 consecutive days of water levels at the surface (i.e. saturation) to define suitable hydrology for production of wetlands. We set up a spreadsheet, similar to those used in the general evaluation of the water schedules, that measured the average duration of flooding or drying events. However, rather than measure an average duration above or below a particular elevation, we determined at what elevation (in the 0.01-foot increments provided by the UKISS routing model) the observed and preferred alternative water models produced (on average over the 18-year period of record) saturation of more than 18 continuous days duration. The observed 1970-1988 period had an average duration of 18.2 days saturation at an elevation of 52.19 feet; while the 400C150RR alternative provided an average duration of 19.25 days saturation at 52.87 feet. The 52.19 feet for the observed period is slightly above the elevation where the transition between wetlands and uplands was sensed in the Landsat image, but given the level of precision in the topographic data, they agree quite well, at roughly 52 feet elevation. The difference (52.87 - 52.19 = .68 feet) between the two elevations for the observed and proposed alternative at which wetlands are expected to be produced also generally corresponds with the approximate half-foot difference between the upper ends of the stage exceedence curves for the observed and preferred alternative.

3. Prediction of Future Wetland Conditions

Based on the above figures, we generalized to project the future extent of wetlands under the proposed water regime. Because large portions of the study area lacked detailed topographic contours, extensive interpolation was required, and we were not willing to accept interpolation beyond half-foot intervals. Interpolation to finer increments would be too inaccurate for most of the study area. Therefore, 0.5-foot increments were used for both the projection of future wetland conditions and the species models. We generalized the findings of the previous analysis and assumed that the present upper end of the wetlands is approximately 52 feet and that the future upper end of wetlands would be 52.5 feet. Because the stage exceedence curves cross at about 51 feet elevation, and

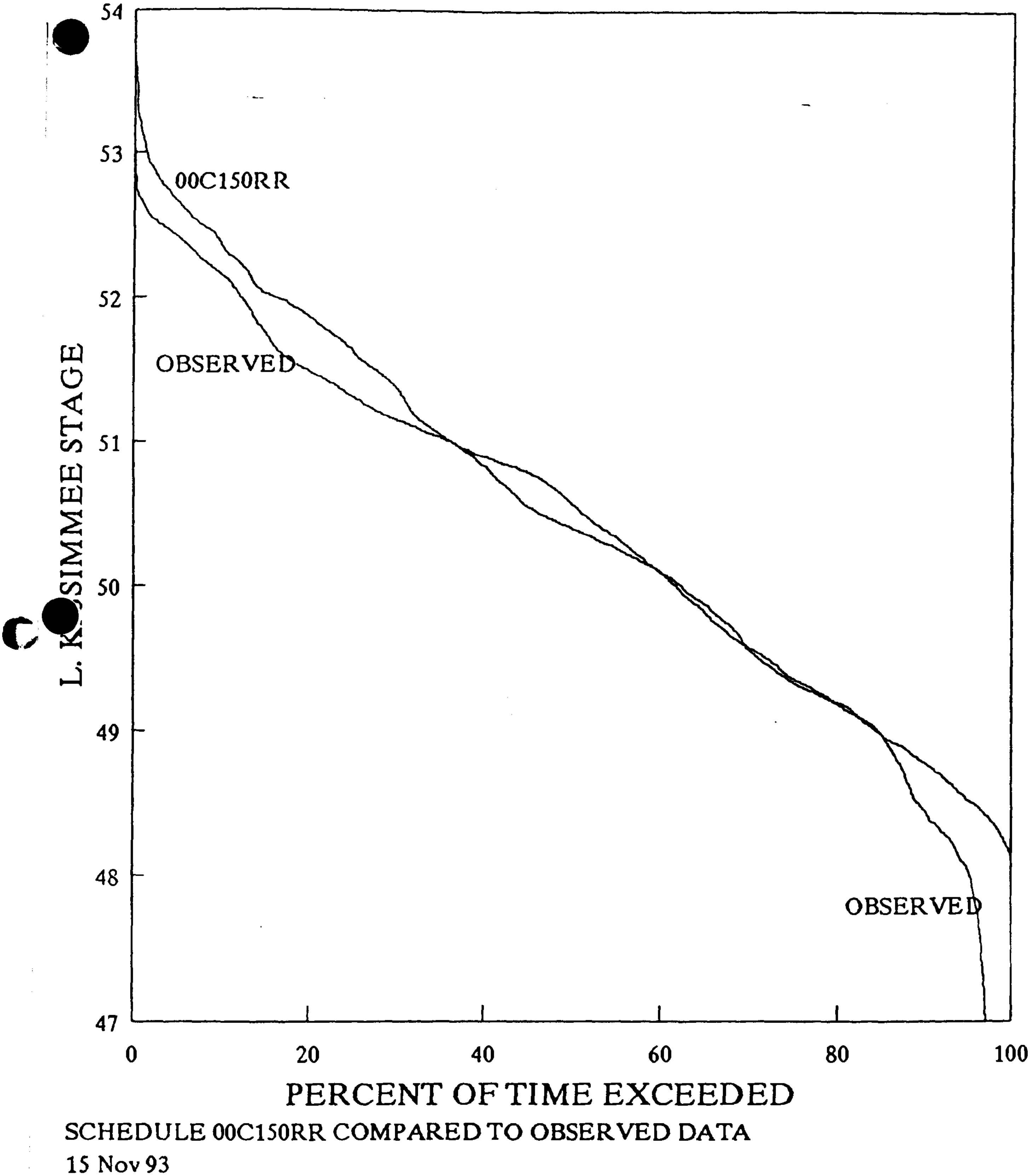

FIGURE 6 - STAGE EXCEEDENCE CURVES FOR OBSERVED PERIOD (1970-1987) AND PROPOSED 400C150 SCHEDULE. NOTE THAT THE PROPOSED SCHEDULE IS ROUGHLY 0.5 FEET HIGHER THAN THE OBSERVED AT WATER LEVELS EXCEEDING 51 FEET.

because the geographic coordinates for the topographic data could be somewhat imprecise, we selected an elevation zone between 51 and 52.5 feet as the zone across which the higher water stages would restore wetlands (hereinafter called the "transitional zone").

Overlaying the present vegetative cover on the half-foot topography, we based our projection of future habitat conditions on several assumptions:

1. All marsh within the transitional zone will remain marsh. (See explanation in subsection a., entitled "Introduction", above.) As would be expected, existing marsh was the dominant vegetative cover in the transitional zone, accounting for 36.9% of the total area in the transitional zone.

2. Open water in this zone most likely indicates deeper water and these areas are expected to remain as open water. However, deep water would not generally be expected to occur along the upper edge of the marsh unless it were excavated and impounded. Indeed, less than 1% of the total transitional zone is open water in the present condition.

3. All shrub or forested wetland classes (cypress swamp, hardwood swamp, bay swamp, shrub swamp) in the transitional zone would not be altered by the change in hydrology. Although the increase in water fluctuation would most likely be beneficial to the productivity of these habitats, we do not anticipate a change in gross habitat structure. These 4 classes combined accounted for 16% of the transitional zone in the present.

4. Xeric communities (oak scrub, sand pine scrub) and hardwood upland covers (hardwood hammocks, mixed hardwood/pine forests) generally should not occur in the transitional zone. Any occurrence of these covers in that zone may be the result of remote sensing errors and/or inaccuracy in the topographic data. These classes remained unchanged in the future scenarios. No sand pine appeared in the zone, and oak scrub was sensed in only 0.37% of the zone.

5. Grasslands and shrub/brushland vegetation types are likely to have invaded areas that were wetlands when water levels were higher prior to operation of the original flood control works in 1958. Field observations confirm that wax myrtle and *Sesbania* are invading former marshes, and wet pasture (which most likely was classified as grasslands, rather than wet prairie) is very common around the lakes in low-lying areas that historically supported marshes. Soils in these areas are most likely amenable to formation of wetlands. We therefore predicted these cover types would be likely to produce wetlands of higher habitat value. Grassland was the second most abundant cover type in the

transitional zone, comprising 22.4% of the total area. Shrub/brush was also quite abundant in the zone, making up 8.3% of the area.

6. Areas sensed as dry prairie, pineland, or barren may be converted to wetlands under the new water regime, but these are considered somewhat less susceptible to conversion than grasslands or shrub/brushland. The distinction between wet prairie and dry prairie is gradual, and pine forests can exhibit understory vegetation grading from upland species, through a mixture of facultative wetland species, to a predominance of facultative or obligate wetland species. Soils in both of these transitional habitats are likely to exhibit patchiness on a finer scale than what is normally portrayed as a map unit by the Soil Conservation Service. Lenses of less permeable layers may be found within an area that was sensed as dry prairie, which normally does not have prolonged saturation within 10 inches of the surface. The distribution of these patches within pinelands or dry prairie is not known on a fine scale; soil distribution, like the remote sensing of vegetative cover, is a probabilistic endeavor. In reality, we will probably end up with patches of upland that will be converted to wetland within areas that will remain essentially unchanged from present conditions. Because our species models multiply area times a relative habitat suitability index (HSI), the results will be equivalent if we ignore this indeterminate patchiness and generalize these areas within the transitional zone as "likely moderate quality wetlands". Dry prairie represented 9.9% of the transitional zone, while pineland and barren classifications amounted to 2.3% and 1.4%, respectively.

Using the above relationships, future habitat conditions were predicted for the base project and the three incremental alternatives involving breaching of levees to allow additional restoration of wetlands.

D. The HEP Team, Evaluation Species, and Features Common to all Species Models

Planning and guidance for the evaluation of the proposed project on selected species of fish and wildlife were provided by the same interagency team (Corps, Service, FGFWFC, SFWMD) that evaluated the water routing outputs to select a recommended water control schedule. The first task of the HEP team was to select the evaluation species. The following species were selected:

1. Great egret
2. Snowy egret
3. Wood stork
4. Florida duck
5. Ring-necked duck

6. Snail kite
7. Bald eagle
8. Florida sandhill crane
9. Audubon's crested caracara
10. Largemouth bass

The above species were selected upon consensus of the HEP team, based on the following factors:

- (Federally-listed species (wood stork, snail kite, bald eagle, caracara);

- Wading birds are considered to be sensitive indicators of ecological integrity (great egret, snowy egret, wood stork);

- Species of economic importance to hunting and fishing (Florida duck, ring-necked duck, largemouth bass);

- A State-listed species that is relatively abundant in the study area as compared to other portions of the State (caracara).

Periodic meetings of the HEP team were held to advise the Service regarding development of the evaluation. The HEP team recommended the appropriate species experts to contact in developing the models. These species experts are cited below in the narratives for each species.

The foundation of the modelling was habitat suitability, similar to the Habitat Evaluation Procedures (HEP), in that we used the convention of assigning a habitat suitability index (HSI) of 0 to 1, multiplying by the acreage at that suitability, and summing these habitat unit (HU) values for each species in each of the future scenarios. However Geographic Information System (GIS) technology was used to develop, test, and run the species models. We used both vector-based GIS (PC ARC/INFO, and Generic CAD) and a raster-based (grid cell) program (EPPL7) to prepare data for use in the models. However, the final model runs were all performed in EPPL7, using a 30-meter grid cell size. By using log files (analogous to a macro file), we could string together a series of GIS commands to automate a routine for each model. Using the search and replace capabilities of Wordperfect on DOS text files, we were able to modify each routine to represent either the present (assumed to be the future without project condition) and a series of alternative future scenarios.

The models were all based on two main themes -- landcover (habitat types) and bathymetry/topography. The bathymetry/topography was, in most cases, mapped in 0.5-foot increments. (Interpolation to 0.1-foot increments was used in one portion of the analysis for the snail kite, as described below.) For marsh/wet prairie above the 54-foot elevation (the prairie wetlands) the National Wetlands Inventory water regime designation was used. However, some marshes of unknown hydroperiod remained as generalized marsh in the prairie. For wetlands in the littoral zone, spreadsheets were used to calculate the hydrologic feature of interest for each species in 0.5-foot increments from the water model outputs. This feature was usually the percent time at a certain water depth of significance to the species for that elevation. (Calculating the percent time when water exceed the substrate elevation, regardless of depth provides the hydroperiod.)

Several of the models used a stepwise approach, assigning an initial habitat suitability to a grid cell, then if a condition in another portion of the model was met at the same geographic coordinate, the model could add, subtract or multiply a value according the model instructions. Because EPPL7 deals only with integers between 0 and 255, we needed to export the grid cell counts as ASCII files to a spreadsheet, standardize the HSI to a 0 to 1 range by dividing the grid cell value by the maximum possible value, and multiply by the corresponding acreage for that class of grid cells.

E. General Information and Model Structure for the Evaluation Species

1. Snowy egret and great egret

Experts consulted: Jim Rodgers, FGFWFC; Brian Toland, USFWS; Herb Kale, Florida Audubon Society

The snowy egret *(Egretta thula)* and great egret *(Casmerodius albus)* are among the wading birds that were severely affected by plume hunters in the early 1900's. More recently, water management practices have reduced the number of breeding birds in the southern Everglades relative to historic records (Ogden, 1994). Closer to the study area, channelization of the Kissimmee River has most likely adversely affected wading birds on a regional level; some reduction of wading bird numbers in the adjacent upper basin is a likely consequence, although we are unaware of any studies documenting this. Neither species is listed by the Federal government; the State lists the snowy egret as a Species of Special Concern. Both species feed and nest in the study area, using colonial wading bird rookeries. Both species use visual hunting methods while stalking their prey in shallow waters.

The models for the snowy egret and great egret are similar in structure. The models have a feeding component and nesting component. The feeding component, in turn, is subdivided into selected littoral zone habitats and all other suitable habitats at higher elevations.

First, we calculated in a spreadsheet the percent time each 0.5-foot elevation zone was flooded with up to 18 inches of water or up to 12 inches of water, using weekly average water levels throughout the period of record for the period between February 1 and July 31, which is considered to encompass the full extent of both species' breeding seasons. These values were calculated for the observed period (excluding the 1977 extreme drawdown) and for the selected alternative. (The depth calculation for a given 0.5-foot elevation band was built into the spreadsheet formulas.) The 12-inch water depth is generalized as the maximum feeding depth for the snowy egret, while the longer-legged great egret can presumably feed in water up to 18 inches deep. (Both species are capable of feeding from floating mats of vegetation, but we think the above generalizations are valid overall.)

Both species are capable of exploiting wetlands of suitable depth across a wide range of hydrologic regimes, and they feed readily in both the littoral zone and the smaller prairie wetlands. Elevation bands in the littoral zone exhibiting suitable water depth for 25% or more of the period of record were assigned highest value, and those with 10%-24.9%, 5%-9.9%, and >0%-4.9% were assigned progressively less suitable values. These frequencies were selected for both ends of the hydroperiod continuum, i.e. those wetlands that are generally too deep except for short periods of time and those that are frequently exposed. Deep water areas that always exceeded the suitable feeding depths are assigned no habitat value.

Habitat classes were overlain on hydrologic suitability to refine and "filter" the values in the littoral zone. Forested and shrub wetlands were assigned low values regardless of where they might occur in the elevation bands. Existing marsh and marsh to be restored in future scenarios that is likely to be of high habitat value was given value in accordance with the graduated scale of hydrologic suitability described in the preceding paragraph. Open water or marsh projected to be likely of moderate value in future scenarios was given reduced value by subtracting a constant from the corresponding elevation band.

Forested and shrub wetlands above the littoral zone were assigned the same low value as for those occurring in the littoral zone. Marshes higher than the selected elevation bands were assigned values in accordance with the water regime attributes from the National Wetlands Inventory data. Temporarily flooded marshes are exploited by these wading birds, but due to their infrequent availability, they were assigned relatively low value, slightly higher than for the forested and shrub wetlands. For seasonally flooded and semi-permanently flooded marshes, size classes were significant in assigning habitat values. Feeding areas are most accessible around the perimeter of the marsh in the prairies, and wading birds are most often observed feeding near the perimeter. The center of a marsh may not always be accessible to wading birds during periods of high water. Smaller wetlands have a high edge/area ratio. Semi-permanently flooded wetlands were ranked higher than seasonally flooded wetlands, due to the greater time period they are inundated. Within these water regimes, the marshes less than 2 acres in size were rated higher than marshes between 2 and 10 acres, which were rated higher than marshes covering more than 10 acres. In this ranking scheme, semi-permanently flooded wetlands less than 2 acres in size were assigned highest habitat value in areas above the littoral zone, equivalent to the value given the highest rated elevation band in the littoral zone.

The final step in the model introduces the nesting component. The rationale is based on the energetic demands of providing food to nestlings. Bancroft et al. (1994) state:

> When nesting, wading birds are constrained to feed relatively close to the colony site; therefore, successful colonies must be located in areas that provide adequate food for their 10- to 14-week nesting cycle.

The average foraging distance from the rookery varies among species using the same rookery and for a single species among different rookeries (ibid.). We have selected a 7-kilometer radius as an average for both species. Rookery locations, indicating which species occur at each rookery, were available in our GIS data set (originally obtained from the FGFWFC's Non-Game Program). The great egret uses 6 nesting sites in the study area, while the snowy egret uses only one (a colony south of Lake Rosalie supporting nesting of both species). (See Figure 7.) Although the sites of colonial wading bird colonies can shift in response to changing environmental conditions, they are relatively faithful to historic nesting sites (ibid.) We are assuming that the water regulation changes are not so radical as to cause abandonment of a currently used colony or formation of a new colony. In the long term, shifts in colony sites are likely to occur with or without the proposed water regulation schedules. Unfortunately, data are not available on the average number of breeding birds of each species using a rookery. All suitable foraging sites in the study area are used outside the nesting season, and non-breeding birds continue to use all available foraging sites during the nesting season. Therefore, the model retains value for all foraging sites outside the 7-kilometer radius, and doubles the value of all sites within the radius.

In previous versions of wading bird models, we have used slightly different models for wading birds that incorporated an 800-meter radius around nesting colonies where no development should occur to avoid disturbance of the nesting colony. Fortunately, none of the present nesting colonies are within 800 meters of proposed canal widening or the S-65 water control structure, the only structural aspects of the this project. Therefore, the 800-meter disturbance radius has been dropped from the models for this evaluation.

2. <u>Wood stork</u>

<u>Expert consulted: Jim Rodgers, FGFWFC</u>

The wood stork *(Mycteria americana)*, a large long-legged wading bird, is Federally-listed as an endangered species. The species breeds in Georgia and as far north as coastal South Carolina, but the majority of the United States population resides in peninsular Florida. The colonial nesting sites are located in both estuarine coastal areas and in freshwater sites at inland portions of Florida. Wood storks are considerably more conservative than other wading birds, such as herons and egrets, in the persistence of traditional nesting colonies. Two rookeries have persisted in the study area for many years, one at Reedy Creek and one on the south shore of Lake Rosalie. Another large rookery (230 nests) was discovered by Dr. Rodgers from a 1993 aerial survey north of Lake Hatchineha, near the Dead River.

Wood storks use thermal drafts to reach high altitudes before they depart from the vicinity of the rookery in search of food. Their daily feeding range is large, up to 80 miles from the rookery (Ogden et al. 1978). This means that nesting storks can readily reach any suitable nesting areas within the study area from any of the nesting colonies in the study area or from several outside the study area. For this reason, distance of potential foraging sites from nesting colonies was not included in the wood stork model. This differs from the models used for the egrets. The Fish and Wildlife Service has established guidelines for protection of wood stork colonies from disturbance (Ogden, 1989). As with the egret colonies in the preceding models, structural works associated with this project are not expected to occur within the primary or secondary zones. Therefore, the primary and/or secondary zones, which would most likely be used in a generalized species model, were not included in this application.

Aside from the lack of a multiplier accounting for proximity of foraging sites to nesting colonies, the wood stork model is structured the same as the models described above for the two species of egrets. However, the relative habitat values assigned to the wetland classes and the bathymetric zones were altered to reflect the difference in feeding ecology between the stork and the egrets. Unlike the visual hunting techniques of the egrets, the stork uses a tactile or "grope-feeding" strategy. The stork is more dependent on fish as prey, is less able to exploit recently flooded areas, and prefers wetlands that are drying down after a more prolonged period of inundation, where fish are concentrated. Storks feed in the littoral zone of the lakes primarily when receding water levels isolate pools behind berms along the shoreline. Linear rises, which may represent ancient beaches, are readily visible along the lakes, particularly Lake Kissimmee. However, in order to determine precisely at what water levels such isolated pools are formed or rejoined with the main part of the lake by rising water levels, detailed bathymetry/topography on the order of 0.1-foot contours would be needed (Rodgers, pers. comm.). Such detailed contours are not available for the lakes. In general, the isolated wetlands in the prairie are much more frequently used by storks than the littoral zone.

In view of the above, the preferred bathymetric zones identified for the stork were more narrow than for the egrets and were assigned only a moderate maximum habitat value when compared with the maximum possible value in the prairie. The upper end of the preferred littoral zone occurred where flooding up to 18 inches depth occurred at least 10% of the period of record; any elevations higher than this were considered to be flooded at a frequency that would not allow full exploitation by the prey base, and would be less subject to concentration of prey during receding water levels. Any wetlands situated at elevations above the 10% cut-off zone, up to an elevation of 52.5 feet, were assigned relatively low habitat value. The lower end of the preferred bathymetric zone was also considered more restrictive for the wood stork, and was set at that contour at which the preferred depth occurred at least 3% of the time. Although storks are known to use the littoral zone during extreme drawdown events (Rodgers, pers. comm.), we assumed that such events are infrequent enough so as not to affect the overall habitat suitability for the stork.

As noted above, the preferred wetland types in the prairie were assigned maximum values more than twice the maximum value in the littoral zone to reflect the species' preference to feed in those areas. Because storks prefer a seasonal drying to concentrate prey, seasonally flooded wetlands were rated higher than semi-permanently flooded wetlands, which also distinguishes this model from the models for the herons. While the egret models focused on the higher edge/area ratio of the smaller prairie wetlands, the stork model assumed that prairie wetlands less than 2 acres in size would be less suitable for storks than wetlands 3-10 acres or those over 10 acres. The reasoning is that storks are more able to exploit the lower central areas of the larger wetlands, which have concentrated prey from a larger initial area, and that the prey in these initially larger wetlands is also more likely to be of a size suitable for capture by wood storks.

3. Florida duck

Experts consulted: Paul Gray, FGFWFC; Brian Toland, USFWS

The Florida duck is considered to be a separate subspecies of the mottled duck *(Anas fulvigula)*. It is a year-round permanent resident through most of peninsular Florida and is important as a game species.

The Florida duck breeds primarily between mid-March and mid-May, but will attempt renesting through July. Nesting occurs in a variety of covers, including dense grass or dense shrubs in uplands near the water's edge or even in agricultural fields. (Kale and Maehr, 1990) Tall upland grasses and the borders of agricultural fields are abundant

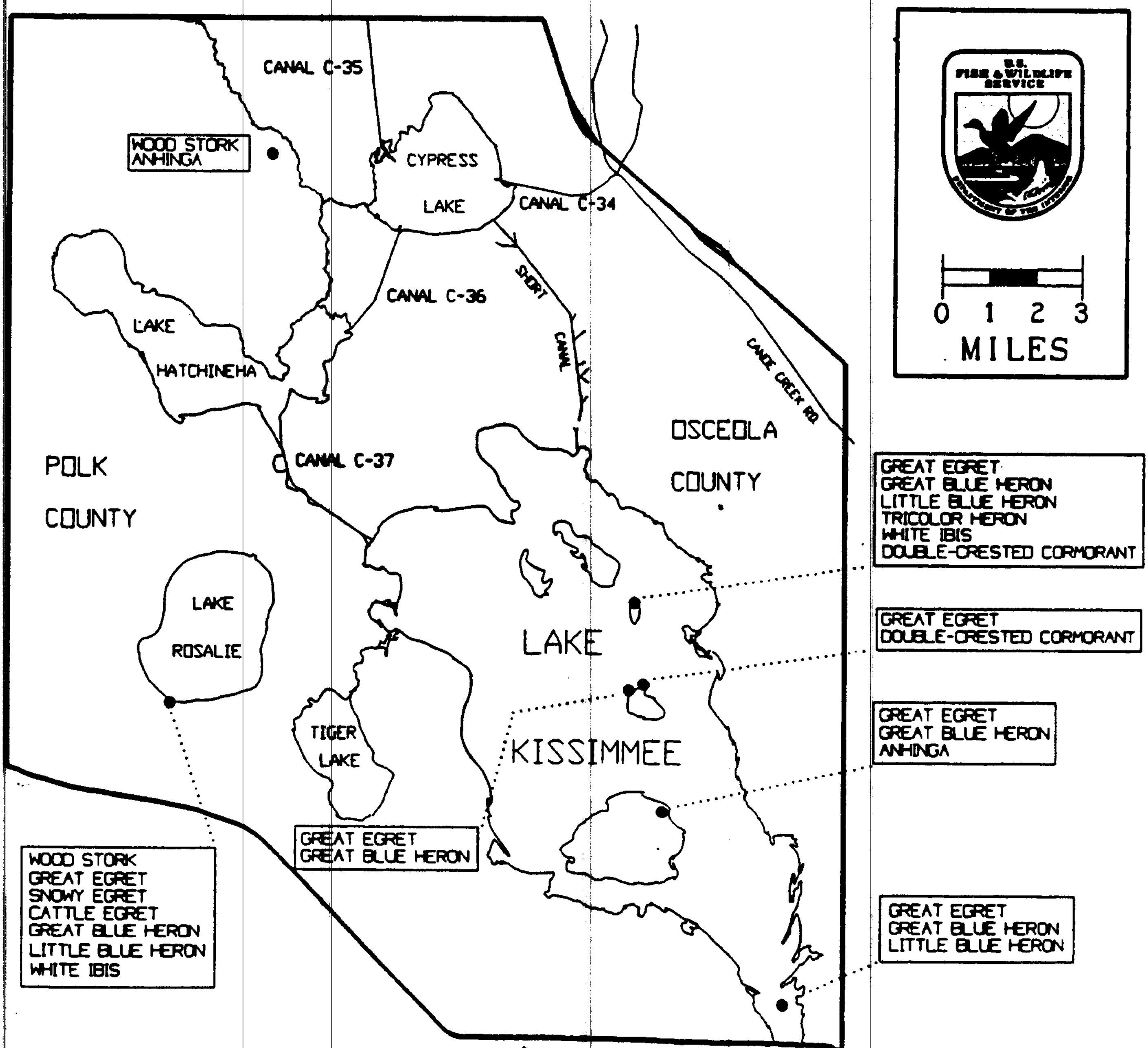

FIGURE 7 - SPECIES OF WADING BIRDS NESTING AT ROOKERIES IN STUDY AREA

around the Kissimmee Chain of Lakes, and because the species can use several different cover types for nesting, we consider nesting habitat not to be a limiting factor. Paul Gray concurs that suitable nesting habitat probably is abundant in the study area,particularly since nesting can occur as much as a mile from water. Also, the cover type data produced by FGFWFC are the principal basis of the models, and these data do not distinguish between tall grasses and grazed or mowed areas.

Based on the likely non-limiting nature of breeding habitat in the study area, we have limited the habitat suitability model to account only for feeding habitat. Florida ducks dabble in shallow waters. Similar to the wading bird models, we used a spreadsheet to determine the percent time the 0.5-foot depth contours were flooded with water up to 18 inches deep. A dabbling duck is considered to have a somewhat narrower preference for wetlands of slightly longer hydroperiod than the snowy egret or great egret, because the latter two species have broader diets and are more able to exploit recently flooded, shorter hydroperiod wetlands. Therefore, we selected those contours with 0-18 inch depths for 25% or more of the period of record as highest initial suitability. Elevations below the previously designated range of elevations and having appropriate water depth for 10-24.9% of the period were assigned moderate initial suitability. Areas within 90 meters of the marsh/open water edge and within the suitable depth zones were given twice the initial value, while the remainder of the suitable depth zones retained their initial values. The resulting values were "filtered" for the appropriate categories in the landcover layer: marsh or open water; any unsuitable landcover types were assigned no value. Finally, for elevations above the littoral zone, any open water, or semi-permanently flooded marsh larger than 2 acres, or undifferentiated marsh was given a relatively low suitability value.

4. Ring-necked duck

Experts consulted: Brian Toland, USFWS

The ring-necked duck *(Aythya collaris)* is the most abundant species of wintering waterfowl in both the upper and lower Kissimmee basins and is an important game species. The ring-necked duck arrives in late October and remains in the Kissimmee lakes region through the end of March (B. Toland, pers. comm.); it does not breed in Florida. During fall migration, ring-necked ducks begin arriving in Central Florida in October and remain in the Kissimmee Lake region into March. This species does not breed in Florida.

Ring-necks are classified as diving ducks and typically feed in waters less than 6 feet deep (Bellrose, 1980.) Traditionally in Florida, ring-necks use deep marsh habitats characterized by floating-leaved and aquatic-bed types of wetland vegetation. Seeds of fragrant water lily and watershield are considered preferred foods. In recent years, the distribution of ring-necked ducks appears to be determined primarily by the presence and abundance of "topped-out" hydrilla beds. The location of *Hydrilla* mats around the shorelines of the lakes varies considerably from year to year, and the natural fluctuation is compounded by active aquatic weed control efforts. (D. Eggeman, pers. comm.) Therefore, no particular segment of shoreline can be predicted to be of greater value for feeding of ring-necked ducks, except for the physical characteristics of slope. That is, a greater or lesser area of the appropriate depths for feeding of diving ducks will be found along the lake shore, depending on slope, and the alteration of lake levels may also slightly alter the area of suitable water depths.

The model for this species is greatly simplified because of the nature of migratory species to respond to year to year variations in the location of food resources. First, we extracted weekly average water levels for the observed period and the selected alternative during the October through March period the species is expected to be present. The spreadsheet calculates the percent time for each 0.5-foot bathymetric zone that water depth would be between 3 and 7 feet. High initial suitability was assigned to those bathymetric zones having suitable depth more than 50% of the period of record, while those zones with suitable depth between 25% and 49% of the time were ranked slightly lower in suitability. If grid cells in these bathymetric zones coincide with cells within 60 meters of the open water/marsh edge, they were assigned double their initial value. All open water cells retained these values, while all cells in the original landcover that were sensed as marsh were reduced by a fixed value.

5. <u>Florida snail kite</u>

<u>Experts consulted: Jim Rodgers, FGFWFC; Brian Toland, USFWS; Rob Bennetts, Univ. of Florida</u>

The Florida snail kite, or Everglades kite, *(Rostrhamus sociabilis plumbeus)* is listed as endangered by both the Federal and State governments. Once widespread through peninsular Florida, the species' range in the United States has been reduced to an area from just south of Orlando to the southern Everglades. Around 1964, the Florida snail kite population was estimated to be as low as 25 to 60 individuals. Although population estimates have consistently exceeded 400 birds since the 1980's, the 1964 estimate clearly indicates that the species is highly vulnerable.
Natural cycles in rainfall produce fluctuations in both mortality rates and reproductive success. The "boom or bust" fluctuations in the species' population levels are to some extent part of the natural history of a species with specialized habitat needs. However, human modification and manipulation of the natural hydrologic fluctuations could put the snail kite at risk of extinction if adverse actions were to occur coincidentally at several of the essential habitat sites, particularly during a prolonged period of drought.

The study area is located near the north-central limits of the species' range and is one of several essential areas for the survival and recovery of the species. The study area does not include Lake Tohopekaliga or East Lake Tohopekaliga, the two northernmost principal breeding areas for the kite. However, Lake Kissimmee (and to a lesser extent, the other lakes in the study area) is an essential nesting and feeding area for the species.

The kite feeds exclusively on apple snails *(Pomacea)*. The snails must be located at or near the water's surface, which requires the presence of some emergent vegetation. However, dense vegetation is not suitable as a feeding area, because the snail kite feeds by sight. Therefore, the kite requires a delicate balance between open water areas and emergent vegetation to feed effectively.

Snail kites exhibit a high level of nest failure and abandonment, and research on the species has been unable to determine all the causes of this phenomenon. However, water levels appear to account for at least a portion of the relative success or failure of breeding years. Obviously, extreme drought will result in a poor reproductive year. This is not only due to a reduction in food availability, but also to shifting of nest site selection in response to lower water levels. Even moderate year-to-year differences in water levels in Lake Okeechobee have been shown to affect nesting success (Rodgers, 1992). Several researchers have observed that kites will build more nests on herbaceous vegetation closer to the center of water bodies when water levels are low, and they will build more nests on woody vegetation closer to the periphery of the water body when water levels are higher. Dr. Rodgers has demonstrated a significant correlation between higher water levels, nesting in shrubs, and successful fledging of kites at Lake Okeechobee (ibid.). His observations at Lake Kissimmee suggest that the same correlation applies there. Presently, nearly all kite nests in Lake Kissimmee are in herbaceous vegetation. Nests built on herbaceous vegetation (usually cattails) are subject to being toppled over by wave action, by wind storms, or when water supporting the cattails recedes. When kites nest in woody vegetation, shrub swamps, primarily willow or wax myrtle, are the principal nesting sites; however, nests can occasionally be found in sapling cypress or even cabbage palms. Nests built in woody vegetation are much more secure and exhibit higher success. Although we cannot be certain that higher water levels in Lake Kissimmee during the February-March early nesting period would induce a higher percentage of kites to nest in woody vegetation, the evidence is compelling.

We have taken several approaches to determine the possible effect of this project on the snail kite. First, we needed to be assured that the proposed water regime did not increase the likelihood of abrupt declines in water level during the nesting season. Kites select nesting sites over water, and if the water completely dries out beneath the nest site, increased rates of nest collapse and/or predation generally occur. We used a spreadsheet to calculate when extreme drops in water level would occur in the kite nesting season. First, we extracted February through July weekly average water levels from the 17-year period of record (excluding 1977). Assuming initiation of nest construction over water

1.5 feet deep (a typical average), the water level should not drop more than 1.5 feet in the preceding 6-week period. Such an extreme drop is highly detrimental to kite nesting, and the spreadsheet confirmed that it occurs infrequently. Any abrupt human-induced removal of water of this magnitude could be considered an "incidental take" of snail kites as described in Section 7(b)(4) of the Endangered Species Act. In the observed period (excluding 1977) 94% of the weeks in the February-July period were suitable by this criterion. For the selected 400C150RR schedule, 96% of the weeks were suitable. Therefore, the normal operational schedule (excluding periodic extreme drawdowns for fishery habitat development) for the selected alternative should not pose any additional risk of "take", and possibly reduce its likelihood.

The second assessment we performed involved average water levels near the beginning of the nesting season. According to Dr. Rodgers' research, higher initial water levels in the February-March period in Lake Okeechobee lead to more successful nesting. His observations indicate that higher water levels at that time induce kites to nest at interior portions of the littoral zone, rather away from the disturbance of boat traffic and more likely in woody vegetation rather than herbaceous vegetation. We extracted February-March weekly average water levels and averaged them across the 17 years of record for the observed period and the selected alternative. The observed period (again excluding 1977) had an average water level of 50.57 feet, while the selected alternative had an average water level of 50.36 feet in that period. (Although the selected alternative raises water levels roughly 0.5 feet on an annual basis, that rise apparently does not occur during the February-March period when snail kites normally select net sites.) This 0.2-foot difference is quite small, and was found not to be statistically significant ($P=0.261$); the number of weekly average values compared was 138 weeks. Despite the lack of statistical significance, we proceeded to determine what a 0.2-foot difference would mean in the area of marsh and shrub marsh that would be theoretically available to the kites for nesting. We used the 0.1-foot interpolation of bathymetry produced by the SFWMD and the areas of documented kite nesting in the study area. This limited the area of interest to a narrow band, mostly around Lake Kissimmee, where nearly all of the kite nesting has occurred. The area of marsh below the February-March average water level for the present condition is 2850.8 acres, and for the future condition with the selected schedule, it would be 2809.9 acres. The area of shrub swamp is 1040.1 acres, and for the future with the selected alternative, it would be 1009.2 acres. If we assume that shrub swamp is twice as valuable as marsh for successful kite nesting, and compare the relative availability of nesting habitat, we find that the future with the proposed schedule would provide approximately 98% of the nesting habitat of the present condition. Although this change is, as expected, quite small, we reduced the values produced in the snail kite model by 2% to account for this potential change in nesting suitability. Despite this downward adjustment, the results of the overall habitat suitability model still indicate a significant increase for the proposed schedule (See later section of this report.)

The above analyses indicate that nesting suitability is not likely to change substantially. Therefore, the emphasis of the model used in this analysis was on foraging habitat suitability. We first identified bathymetric zones with suitable hydrology for production of apple snails. Apple snails need long hydroperiod wetlands; drying of occupied habitat will force kills the snails to aestivate, and extended drying may kill them. Therefore, we eliminated shorter hydroperiod wetlands as suitable habitat. Using daily water level readings from the 17-year period of record, we determined at what elevation inundation averaged 80% of the time period. The observed hydrology and the selected alternative were essentially equivalent, both rounding off to an elevation of 49 feet. This was designated in the present and all alternative futures as the upper end of suitability for kite foraging. To determine the lower end, we determined the percentage of time for inundation up to 2 feet deep, selecting those where this condition exceeded 25% of the period of record. We determined that for the observed values, the lower end of this zone occurred at 48 feet, while for the selected alternative, this occurred at 47.5 feet.

Similar to the Florida duck model (both these species prefer shallow waters with a mix of marsh and open water), we selected an area within 90 meters of the border of marsh and open water. Considering that the satellite image classifies an area as either open water or marsh, the kite's preferred 30%-40% open water/emergent vegetation mix is likely to occur in this edge zone. The initial suitability value for the bathymetric conditions described in the previous paragraph was doubled if the marsh/open water edge zone coincided at that grid cell, otherwise the initial value was retained. Next, we determined the interspersion marsh/open water in the original satellite image; those having high values indicated a predominance of marsh in a 5-cell window, and those having low values indicated a predominance of open water. By discarding the upper 25% and lower 25% of resulting values, we selected those areas with an interspersion of marsh and open water. Where these cells coincided with the previous suitability values, the values were doubled, otherwise the values were retained. Finally, where the resulting values coincided with known nesting areas the values were again doubled. As with the egret models, foraging habitat within a short distance of the nest is considered more valuable.

6. Bald eagle

Experts consulted: Steve Nesbitt, FGFWFC; Herb Kale, Florida Audubon Society

The bald eagle *(Haliaeetus leucocephalis)* is listed as endangered in Florida by both the Federal government, and as threatened by the State; the Service is currently considering "down-listing" the eagle from endangered to threatened in Florida and other portions of the species' range. Given that the number of nesting eagles has increased in Florida over the last few years, if the eagle is to be reclassified as threatened, Florida is a likely State for that designation. The banning of DDT in 1972 is thought to be a major factor in the partial recovery of the species, but this positive factor is countered by continued destruction of wetlands and Florida as a whole, and especially the study area, is a stronghold for the species, exhibiting the greatest concentration of breeding pairs in the United States, outside of Alaska. However listing as threatened would still provide protection under the Endangered Species Act, and eagles are also covered under the Bald Eagle Protection Act (16 U.S.C. 668-668d)

As of 1993, Osceola County had 81 active bald eagle nesting territories concentrated in the upper Kissimmee Chain of Lakes, with a cluster of active nests (OS25, OS26, OS27) on Brahma Island in Lake Kissimmee. Polk County had 80 active bald eagle territories in 1993, with most of them close to the Kissimmee Chain of Lakes. Figure 8 shows the location of active eagle nests (as of 1992) in the study area. Future land use patterns around the Kissimmee Chain of Lakes are crucial to the continued recovery of the species on a National scale. The breeding pairs of eagles in the study area may include some year-round resident birds, but the majority are migratory pairs that come to Florida to breed in the winter months.

The species model for the bald eagle selects habitat types within 2 miles of the active (as of 1992) bald eagle nests in the study area. Two miles encompasses the majority of foraging flights from a nest site (Bureau of Land Management, 1973). As with the wading bird rookeries, the eagles show fidelity to certain territories, but over the long term, nesting sites will change. The nests are generally located at some distance from the shorelines of the lakes in prominent pine trees or cypress trees. We do not anticipate that the change in water schedules will have a direct impact on selection of nest trees.

In the vicinity of the Kissimmee Chain of Lakes, fish comprise about 80% of the eagle's diet. Most of these are "rough fish" such as gizzard shad and catfish (Nesbitt, pers.comm.) A variety of other prey items, including small mammals and birds, comprise the remainder of the species' diet. Many of the birds taken by the eagle are "upland" birds, such as crows and cattle egrets. Although aquatic birds, particularly coots and gallinules, are occasionally taken as prey, we estimated that they would contribute no more than 10% of the diet. Therefore, we ranked open water, regardless of depth, as highest habitat value. Semi-permanently inundated marsh over 3 acres in size and undifferentiated marsh were assigned habitat value at one tenth the value of open water, and all other non-forested native cover types were assigned one twentieth the value of open water. Most foraging flights by bald eagles during the nesting season occur within 2 miles of the nest tree (BLM, 1973). We therefore selected the habitat types mentioned above within 2 miles of all active nesting trees in the study area, updated to 1992.

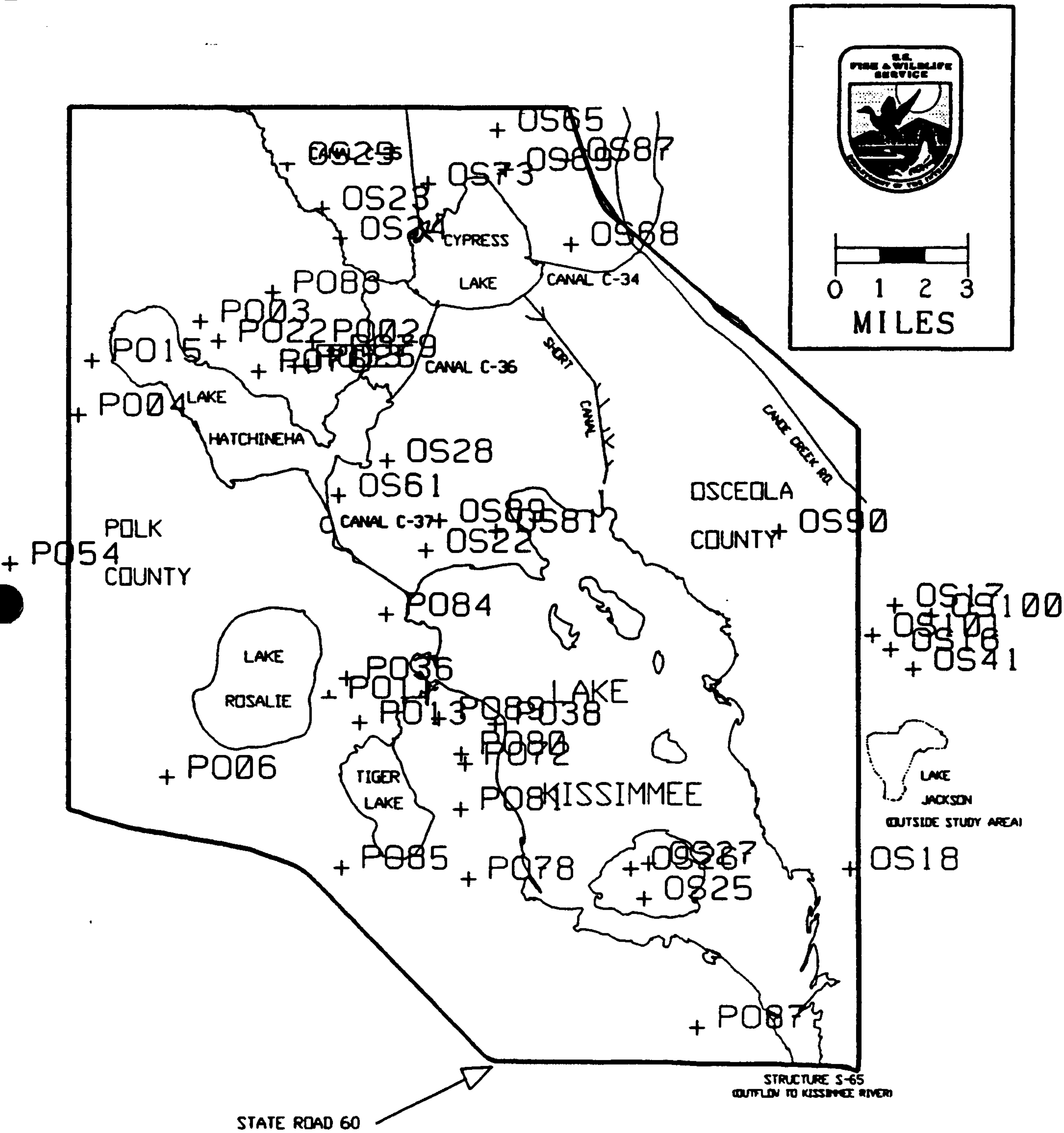

FIGURE 8 - LOCATION OF ACTIVE BALD EAGLE NESTS IN STUDY AREA

7. Sandhill crane

Expert consulted: Steve Nesbitt, FGFWFC

The sandhill crane *(Grus canadensis)* is represented in Florida by two subspecies, the non-migratory Florida sandhill crane *(G. canadensis pratensis)* and the greater sandhill crane *(G. c. tabida)*, which migrates to Florida in late fall through early winter. When both subspecies are present, it is difficult to distinguish between them by casual observation. The Florida subspecies is listed by the State of Florida as threatened; the Service has listed the Mississippi sandhill crane subspecies as endangered, but the Florida subspecies is not Federally-listed.

Sandhill cranes mainly use open grasslands and marshes as feeding areas. The species model assigns highest habitat values to grasslands. Marshes were assigned a range of moderate habitat values, and for those portions of marshes within a 2-cell distance of a border with grasslands, habitat values were increased by adding a constant value.

8. Audubon's crested caracara

Expert consulted: James Layne, Archbold Biological Station

Audubon's crested caracara *(Polyborus plancus audubonii)* is listed by the State and Federal governments as threatened. Layne (1985), based on 1973-1978 surveys, found about 150 active territories (300 adults) and about 100 immature birds, for an estimated total population between 400 and 500 individuals in Florida. Layne (pers. com.) finds that the total population and range of the Florida population has remained stable since the 1980's.

The Florida population is restricted to open grassland and palmetto north and west of Lake Okeechobee. It is geographically isolated from other populations of the subspecies, which are found in northern Baja California, southwestern Arizona, southern Texas south to Panama, and also in Cuba and the Isle of Pines.

The caracara is an opportunistic feeder on both living prey and carrion, combining characteristics of predatory raptors and vultures. The caracara competes with the latter for carrion.

The study area is roughly the northern limit of the Florida population's documented range, as it is rarely observed north of Orlando. Within the study area, the Three Lakes Wildlife Management Area, located near the southeastern corner of Lake Kissimmee, is highly valuable habitat, but all suitable habitat types in the study area are considered in the model.

Native grasslands, the preferred habitat for the caracara, are extremely scarce in Florida. Most of this habitat has been converted to improved pasture, sod farms, citrus groves, or commercial/residential areas. Although caracaras can use improved pasture for feeding, it is suboptimal habitat. Continued operation of large ranches in the Kissimmee prairie, particularly those ranches with large tracts of native rangeland is critical to the continued survival of the caracara. Other land uses, such as housing or groves will not support caracaras in the long term. Fire is used as a management tool on larger tracts of native rangelands. Lack of fire in remnant native prairies on smaller private lands may be adversely affecting caracara habitat. Native grasslands and saw palmetto thickets in dry prairies are fire-maintained communities. Caracaras will use areas with widely separated trees, but if they succeed to denser stands of pine, oak, or cabbage palm, they become less suitable.

The model assigns highest suitability to dry prairie, and slightly less suitability to grasslands. Marshes were assigned values below the grassland, with less permanently flooded areas superior to longer hydroperiod marshes, both in the littoral zone and in the prairie.

Finally, the model uses known caracara territories digitized from maps provided by Dr. Layne. These maps display the estimated extent of caracara territories in the study area for the period 1984-1988. These are the most recent data providing the borders of the territories; surveys in 1989 show only the estimated centers of territories. Because caracaras are known to have restricted ranges, the presence of habitat in recently occupied territories was heavily weighted in the model. Suitable habitat within documented territories was assigned triple the initial value, while the remaining potential habitat in the study area retained its original habitat value.

9. Largemouth bass

Expert consulted: Ed Moyer, FGFWFC

The largemouth bass *(Micropterus salmoides)* is a common species in Florida's natural lakes and in quarry lakes and other borrow areas. Its original distribution was in the southeastern United States, but it has been widely introduced throughout the United States. A Florida subspecies is recognized as *M. salmoides floridanus* (Ramsey, 1975). It is economically very important in Florida's freshwater sport fishery.

The population dynamics of the largemouth bass in the Kissimmee Chain of Lakes most likely depend on a complex combination of physical and biological factors. It is virtually impossible to derive a complete species model for the bass within the timeframe of this study, and water level fluctuations, the main variable in the evaluation of this project, would comprise only one portion of a complete model.

Layher and Maughan (1987) attempted to predict occurrence and standing crop of green sunfish in Kansas streams, based on physical aspects of the habitat and water chemistry, but found their models were not reliable predictors. They were able to better predict occurrence and standing crop of several fish species having more restrictive habitat requirements, and they postulated that the green sunfish models failed because of the difficulty in determining limiting variables for a species with broad tolerance for a variety of habitat conditions. The largemouth bass also has very broad habitat tolerance that makes predictive modeling difficult; complex predator/prey interactions may be more significant, but harder to discern, than physical habitat parameters.

Stuber et al. (1982) published an HSI model for largemouth bass in lakes that included 4 life requisites, described by combinations of 17 variables. The data collection requirements for this model are considerable; and even so, the authors conclude that, "these models will not necessarily represent the population of largemouth bass in the study area." They suggest that the models be used to compare the potential of different water bodies to support largemouth bass. In the present evaluation, the Chain of Lakes is assumed to be a single flat pool, which is close to reality.

Baca et al. (1992) studied 11 Dade County quarry lakes for largemouth bass populations and calculated an array of HSI values. However, they did not provide conclusions as to which of the variables best correlated with the quality of these lakes as bass habitat.

We have decided to use the HSI model by Stuber et al. as a basis for our analysis in terms of the relative contribution of variables to the model as a whole; however specific measures were altered to better fit Florida lakes. Because a wide range of physical attributes (e.g. turbidity, water temperature, dissolved oxygen) are expected to be unaffected by the project, we have used only those variables that would be affected, and have assigned them a relative weight in accordance with their contribution to the outcome of the published model. For example, the percentage of the lake's area less than or equal to 6 meters deep is used as a variable two times out of a total of 14 variables. However, virtually all the area of water in the study area is less than 6 meters deep. Most of the spawning of largemouth bass in these lakes occurs between 3 and 6 feet deep (Moyer, pers. comm.) Therefore, we assigned highest suitability to this depth range, using the present water schedule and the proposed. We selected the 0.5-foot bathymetric zones where water is 3-6 feet deep more than 50% of period of record. Slightly lower suitability was assigned to higher bathymetric contours, up to a maximum where water 0-1 ft deep is present more than 20% of the time. Still lower suitability was assigned to the deeper portions of the lake where water over 6 feet deep is present more than 50% of the time. The model then selected cells of open water within 60 meters of the marsh/open water edge; a constant value was added to the base value for those cells.

Water fluctuation appears in three of 14 variables in the Stuber et al. model. However, it appears that much of the interest in water fluctuation in the model deals with avoiding abrupt declines in more northerly steep-sided reservoirs. This is not a concern in the study area, where vast areas of shallow water are available, and flood control operations normally do not drop lake levels so quickly as to threaten spawning throughout the lake (Moyer, pers. comm.) As stated in our general analysis of the water schedules, greater fluctuation is considered to be an improvement over the current situation. We used the coefficient of variation of the current and proposed schedules, compared to the historic as an indication of lake dynamics.

The anticipated changes in the depth zone and water variability parameters discussed above were multiplied by a factor reflecting the contribution of these variables to the model as a whole. This was done to account for the fact that most of the physical factors in the model would not be altered directly by the schedule change. For the depth zone, this factor was 2/14, or 0.143; for the overall variability in lake levels, this factor was 3/14, or 0.214.

VIII. DESCRIPTION OF FISH AND WILDLIFE RESOURCES

A. Existing

The littoral zones of the lakes are the focus of this study and are among the significant resources in the Kissimmee River Basin. The distribution of plants is intricate and is a result of history of inundation, fire, grazing, nutrient input and soils. Flooding stage and duration is the dominant influence on composition.

The fluctuating waters portion of the littoral zone is important for overwintering waterfowl, which stop at these lakes during southward migrations. Coot, ring-necked duck, baldpate, pintails and blue-winged teal are the principal species. The native Florida or mottled duck also feeds in the shoreline marshes and breeds in the prairie within the study area. The common snipe is also present in these areas in the fall and winter months.

The littoral zone supports a wide variety of wading birds, including common and snowy egrets, great blue heron, tricolor heron, little blue heron, limpkin, and others. White and glossy ibis also feed here. These species are dependent on forage fishes produced in the littoral zone.

The largest consumptive use is the fishery. Based on creel data collected by the FGFWFC, effort expended fishing Lake Kissimmee over a five-year period (1987-1991) averaged 451,582 hours per year (Moyer et al., 1992).

The only creel survey in Lakes Hatchineha and Cypress was conducted in the spring of 1986. The total fisherman effort was 40,832 hours at Hatchineha and 18,007 hours at Cypress Lake (Moyer et al., 1986). As a comparison, fishermen in Lake Kissimmee fished for 213,921 hours during this same spring quarter (February 21, to May 15, 1986). Lakes Rosalie and Tiger are also popular with fishermen, but no creel census has been conducted on these waters.

The principal species sought by anglers on Lake Kissimmee is the largemouth bass. Bass anglers exerted 59% of the total fishing effort over five years (1987-1991). For the same period, black crappie and bream fishermen comprised 24% and 17% of the recreational effort, respectively. Miscellaneous species, such as channel catfish, brown bullhead, spotted sunfish and chain pickerel were also targeted at times. (Moyer et al., 1992).

Similar to Lake Kissimmee, fishermen in Lakes Hatchineha and Cypress spend most of their time fishing for bass, followed by crappie and various bream species (Moyer et al., 1986). However most fishing on Lake Tiger and Lake Rosalie is open water fishing for black crappie and bream.

Kingfisher Maps, Inc. has published a map of recreational areas and marinas with boating facilities (map entitled "Kissimmee Chain South"); they list 17 facilities within the study area. Hunting, fishing, airboating, and wildlife observation provide a significant proportion of the economy in this area.

The alligator is a dominant reptile in the region. The alligator scavenges for carcasses of birds and hunts for fish in the deep water canals and ponds within the marsh zone.

B. Future Without the Project

In the absence of the proposed project, we do not anticipate major changes in the fish and wildlife values for either the Kissimmee River or the Kissimmee Chain of Lakes. We assume the Corps will continue maintenance and operation of the navigational and flood control works. We also expect that the SFWMD and the Department of Environmental Protection (DEP) will continue programs for aquatic weed control.

The Corps and the SFWMD have confirmed with their model runs that the restoration goals for the Kissimmee River would not be adequately achieved under the present regulation schedule for the Chain of Lakes. The Kissimmee River would provide the limited fish and wildlife productivity as it does today without the restoration project. Compared to historic conditions, a great percentage of habitat values would remain lost.

In the upper basin, we believe the future would be similar to the recent past (1970's - 1990's). With or without the change in water schedules, extreme drawdowns will need to be scheduled to counteract the effects of narrow lake regulation and nutrient inflows.

Although urbanization is rapidly spreading southward from the upper end of the Chain of Lakes, near the towns of Kissimmee, St. Cloud, and the Greater Orlando Metropolitan Area, these activities are generally to the north of the study area. The infrastructure in the study area is not capable of supporting intensive residential or industrial development, and most likely will remain as such for several decades. We anticipate the dominant economic activities in the study area -- cattle ranches, sod farms, other agricultural enterprises, and recreation will continue to predominate in the study area.

IX. DESCRIPTION OF SELECTED PLAN

The selected 400C150RR schedule has been selected as the best available balance of benefits to restoration of the Kissimmee River and increased vitality of the aquatic ecosystem in the Chain of Lakes. The selected schedule differs from the present in that it has a maximum water elevation for flood control purposes of 54 feet, rather than 52.5 feet. It also delivers water to the Kissimmee River more on the basis of availability, rather than a fixed target elevation.

Current estimates by the SFWMD indicate that approximately 18,500 acres need to be purchased around the lakes to allow raising of water levels for this project, and about 4,750 acres had been purchased through 1991. The Service is recommending in this report that additional areas be purchased behind three levees surrounding the lakes. For purposes of this study, the Corps has asked that the Service consider that fee title or easements will be obtained on all lands to be reflooded.

The Corps' original estimation called for widening C-35 from a bottom width of 20 feet to 40 feet; C-36 from 60 feet to 80 feet; and C-37 from 90 feet to 160 feet. Since that time, the Corps has recommended doubling the present discharge capacity of water control structure S-65 (the outlet for Lake Kissimmee). As of this date, the Corps has now revised its canal widening plans to the following:

- Maintenance dredging of C-35; no widening
- Widening of C-36 from a present bottom width of 48 feet to a bottom width of 60 feet
- Widening of C-37 from a present bottom width of 70 feet to a bottom width of 90 feet

X. DESCRIPTION OF IMPACTS

The selected 400C150RR water regulation schedule more closely approximates a rain-driven formula, by varying discharges in accordance with water availability in the Chain of Lakes and seasonal rules more in accordance with the normal wet/season dry season rainfall pattern of Central and South Florida. This provides distribution of flows to the Kissimmee River closer to the seasonal patterns in the historic condition, while also providing greater fluctuation in the Kissimmee Chain of Lakes.

The increased storage capacity of the selected alternative relative to the present regulation will expand littoral zones around the lakes. The methodology to determine the anticipated increase in marshes at the upper end of the littoral zone is described in Section VII.C. of this report. Section XI.B. provides the results of our analysis.

The estimated increase in littoral marshes, in turn, causes changes in habitat suitability for the evaluation species. Section VII.D. of this report provides general information and a narrative of the model structure for each species. The results of our analysis are found in Section XI.C. of this report.

The Corps has stated that all spoil material will be disposed within the existing right-of-way. However, some native habitat, particularly wetlands are present within the right-of-way. We expect the Corps to make every effort to accommodate the spoil not only within the right-of-way, but also on existing spoil piles. If some filling of wetlands is determined to be unavoidable in the detailed design phase of this project, the Service recommends that the Corps identify appropriate compensation for any unavoidable losses of wetlands.

Table 2 indicates the potential impact of widening the canals if spoil material cannot be completely disposed on existing spoil mounds. The analysis assumes that fill would be disposed 30 meters (98 feet) beyond the existing toe of fill along the entire east side of C-36, and that fill would extend 60 meters (197 feet) beyond its present extent along the entire east side of C-37. These figures should be considered as the likely maximum possible impact of this construction; we recommend the Corps make every effort to dispose the spoil on existing spoil mounds.

XI. EVALUATION AND COMPARISON OF THE SELECTED PLAN AND EVALUATED ALTERNATIVES

A. Results of Community-level Evaluation

Table 3 summarizes the results of the community-level analysis described in Section VII.B.2. of this report. After the initial screening of alternatives, the study team narrowed the selection to two final alternatives, and this quantitative comparison was used to select between these. The table is divided into two areas; the top area compares the last two alternatives for which routing models were run by the Corps. The bottom area provides a comparative framework, relative to the historic (pre-project, 1939-1942 & 1945-1958) condition and the recent regulated condition (observed, 1970-1988). In a previous section of this report, we stated that comparison of the modelled alternatives with the observed condition may not be appropriate, because none of the models contained an extreme drawdown, which would deviate from the normal operational rules. Therefore, we have provided both the observed period of record and the period of record without the 1977 drawdown as bases of comparison. The agencies have agreed in principal that a periodic drawdown will be superimposed on the normal operational rules for the selected alternative.

The historic condition exhibits the most desirable values for 5 of the 7 criteria. The average number of days duration with greater than 90% floodplain inundation in the wet season is slightly higher for the 400C150RR alternative than for the historic, but this difference is not statistically significant (P=0.95). The 400C150RR alternative also exhibits shorter durations, on average, of low flow conditions in the wet season than the historic. Both of the modelled alternatives appear to improve on the recent (1970-1988) regulated condition of the lakes. The 400C150RR alternative rated slightly more desirable than the T1000HISRR alternative for 5 of the 7 criteria. Despite the selected 400C150RR alternatives' slightly shorter duration of water levels above 52.5 feet, it still produces a higher overall score than the T100HISRR alternative. The duration of water levels over 52.5 feet was assigned the highest weighting; however the 400C150RR alternative exhibited duration of routine drawdowns (water levels < 49 ft.) approaching those of the historic condition and greater overall variability, which resulted in its overall higher ranking.

TABLE 2 – MAXIMUM POTENTIAL EFFECT ON HABITATS FROM WIDENING C-36 (BETWEEN CYPRESS LAKE AND LAKE HATCHINEHA) AND C-37 (BETWEEN LAKE HATCHINEHA AND LAKE KISSIMMEE) – (WORST CASE SCENARIO; ACTUAL IMPACT COULD BE MUCH LESS)

LAND COVER CLASSIFICATION	ACRES AFFECTED BY C-36 WIDENING	ACRES AFFECTED BY C-37 WIDENING
GRASSLAND	8.0	17.5
SHRUB & BRUSH LAND	0.4	7.5
BARREN	0.0	2.2
TOTAL NON-NATIVE	8.4	27.2
MARSH / WET PRAIRIE	13.3	38.8
SHRUB SWAMP	2.0	21.9
CYPRESS SWAMP	0.2	4.9
HARDWOOD SWAMP	0.0	2.0
BAY SWAMP	0.9	0.4
TOTAL WETLANDS	16.4	68.0
MIXED HARDWOOD/PINE	0.0	4.4
HARDWOOD FOREST	0.0	2.0
PINELANDS	0.7	2.4
DRY PRAIRIE	1.6	1.1
OAK SCRUB	0.4	0.7
TOTAL NATIVE UPLANDS	2.7	10.6

Note: For C-36, analysis assumes spoil material would be deposited 30 meters beyond existing toe of spoil mounds along entire canal length.

For C-37, analysis assumes spoil would be deposited 60 meters beyond toe of existing spoil mounds.

TABLE 3 -- RANKING OF THE FINAL TWO WATER SCHEDULE ALTERNATIVES

		CRITERIA						
TOTAL SCORE	ALTERNATIVE	CRIT. 1	CRIT. 2	CRIT. 3	CRIT. 4	CRIT. 5	CRIT. 6	CRIT. 7
4.66	400C150RR	23.3	85.3	2.60	77.3	38.2	102.9	90.4
4.11	T1000HISRR	24.9	63.1	2.57	70.8	52.5	80.7	71.9

COMPARABLE VALUES FOR HISTORIC AND 1970-1988 OBSERVED

		CRITERIA						
TOTAL SCORE	PERIOD OF RECORD	CRIT. 1	CRIT. 2	CRIT. 3	CRIT. 4	CRIT. 5	CRIT. 6	CRIT. 7
7.07	Historic (1939-42; 1945-58)	64.3	87.5	4.35	76.5	50.3	114.9	4.0
2.90	Observed (1970-88)	4.9	38.7	3.08	31.0	56.4	50.3	41.4
2.56	Observed, w/o '77 drawdown	4.9	29.6	2.41	30.9	53.1	49.9	38.0

NOTE: REFER TO TEXT FOR EXPLANATION OF CRITERIA AND THE CALCULATION OF THE TOTAL SCORE

CRITERION 1 = Average duration (days) water levels exceed 52.5 ft. (Positively correlated, with weighting factor = 2)

CRITERION 2 = Average duration (days) water levels below 49 ft. (Positively correlated, with weighting factor = 1)

CRITERION 3 = Coefficient of variation of water levels over 18-year period. (Positively correlated, with weighting factor = 2)

CRITERION 4 = Average duration (days) with greater than 90% floodplain inundation in the wet season (June 1 - Oct. 31). (Positively correlated, with weighting factor = 1)

CRITERION 5 = Average duration (days) with less than 200 cfs flow at S-65, in the wet season. (Inversely correlated, with weighting factor = 1)

CRITERION 6 = Average duration (days) with greater than 25% floodplain inundation, Jan. 1 - May 31. (Positively correlated, with weighting factor = 0.5)

CRITERION 7 = Average duation (days) with less than 200 cfs flow at S-65, Jan. 1 - May 31. (Inversely correlated, with weighting factor = 0.5)

Based on the Service's presentation of these figures to the Corps and SFWMD at an interagency review conference in Jacksonville on January 24, 1994, the agencies concurred that the 400C150RR alternative is preferred and that species models would be run using this alternative.

B. Prediction of Future Wetland Conditions

Table 4 and Figure 9 summarize the results of the analysis to predict the extent and location of additional wetlands to be generated by various alternative futures. In viewing Figure 9, one should be aware that all of the additional wetlands landward of the levees can be realized only if these areas are added to the SFWMD's acquisition plan and the levees are breached.

TABLE 4 – ESTIMATION OF WETLANDS TO BE RESTORED BY RAISING HIGH WATER LEVELS, KISSIMMEE HEADWATER LAKES

DESCRIPTION OF ALTERNATIVE FUTURES	ADDITIONAL WETLANDS TO BE PRODUCED (ACRES)	
	LIKELY HIGHER QUALITY WETLANDS	LIKELY MODERATE QUALITY WETLANDS
Future with project, but without breaching of levees	3827	2112
Additional increment by breaching Hatchineha levee	1001	27
Additional increment by breaching Cypress levee	146	20
Additional increment by breaching Kissimmee levee	45	58
Basic project and all 3 levees breached (sum of above acreages)	5019	2217

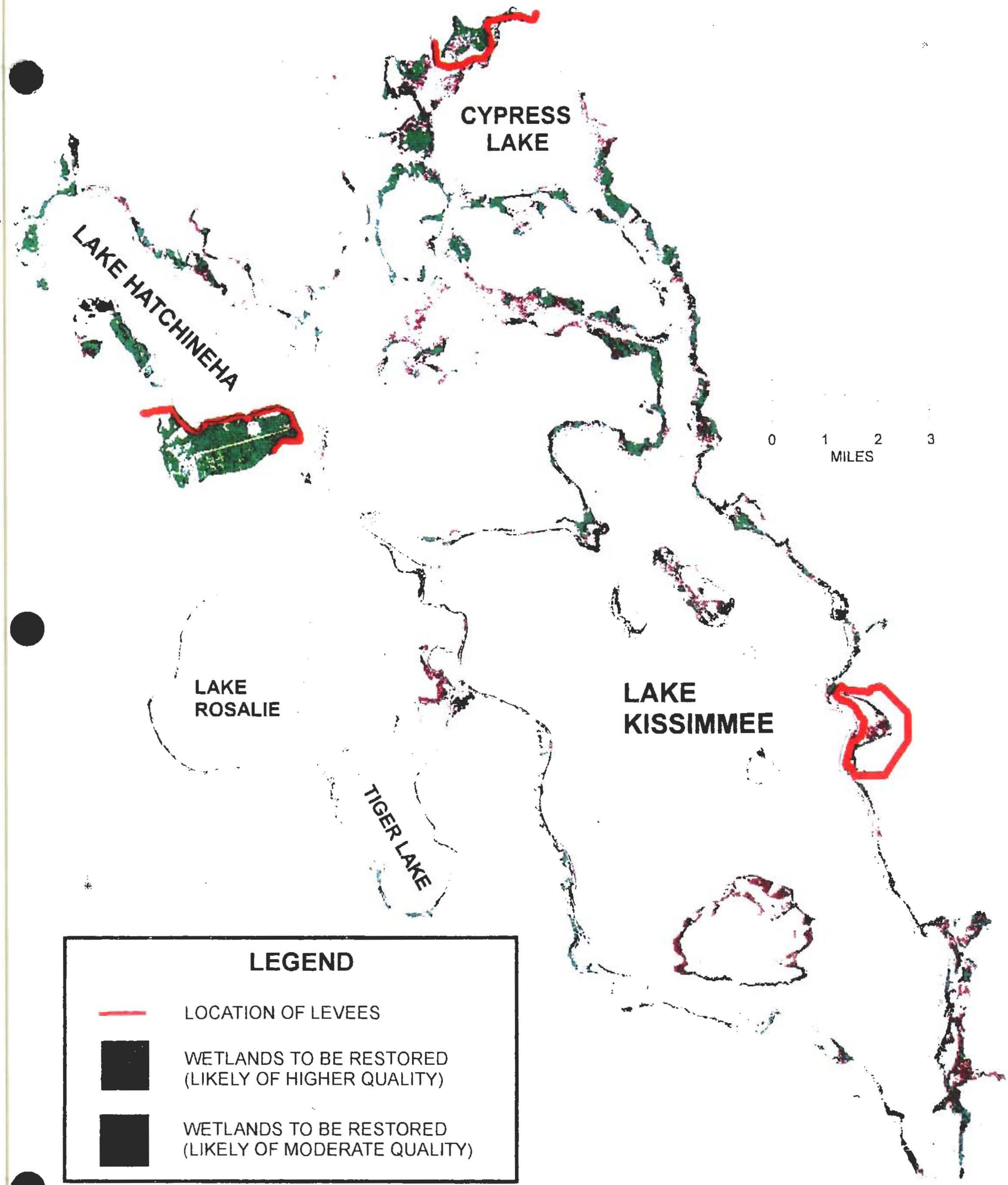

FIGURE 9 - ESTIMATION OF WETLANDS TO BE RESTORED BY HIGHER WATER LEVELS KISSIMMEE HEADWATER LAKES, IF ALL THREE LEVEES ARE BREACHED.

Of the possible total of 2217 acres of moderate quality wetlands that could be produced if all three levees are breached, 1616 acres would be generated in what is now classified as dry prairie, 369 acres in pineland, and 231 acres in barren areas. Of the possible total of 5019 acres of higher quality wetlands to be restored, 3663 acres would be converted from present-day grasslands and 1356 acres from shrub/brushland.

If all three levees are breached, the full potential of 7,236 acres of restored wetlands would be realized.

Breaching the levee south of Lake Hatchineha would produce the greatest benefits of the three additional increments, providing a 17% increase over the basic project in all possibly restorable areas, and more importantly, a 26% increase over the basic project in the acreage of the most readily restorable cover types. Breaching the levee north of Cypress Lake and the levee on the eastern shore of Lake Kissimmee (south of Overstreet Landing) would provide significant additional acres of wetland restoration, but not as great a percentage increase over the basic project as would the Hatchineha levee increment.

C. Results of Species Models

Tables 5 and 6 summarize the results of the species models; the first table expresses the values in terms of habitat units, while the second table expresses the percent change of each future scenario versus the future without the project (assumed to be equivalent to the present).

Six of the 10 species exhibit significant increases in habitat availability; these are the Florida duck, ring-necked duck, great egret, snowy egret, and wood stork. The predicted 2% increase in suitability for the largemouth bass may not be significant, particularly since we assumed that water quality parameters would remain constant with or without the project. Also, a periodic extreme drawdown has such a great beneficial effect for bass (compared to the relatively small differences between the normal operational rules), it would overwhelm any small changes in routine operation. The project is not predicted to have a significant effect on the caracara, bald eagle, and sandhill crane.

Habitat unit values should not be interpreted to reflect abundance of a species, and a given percent increase in habitat units does not imply prediction of a proportional increase in population. Increases in availability of habitat will most likely translate to increases in population, but the degree of effect on relative abundance will vary greatly from species to species. Low habitat unit totals can be the result of a species' narrow selectivity for certain habitat conditions and/or the relative abundance of its preferred habitat type(s) in the study area. For example, the relatively low habitat unit values for

TABLE 5 -- HABITAT UNITS (ACRES X HSI) FOR FUTURE WITHOUT PROJECT AND ALTERNATIVE FUTURES

SPECIES	FUTURE WITHOUT PROJECT	ALT. FUTURE 1 (PROP. SCHEDULE)	ALT. FUTURE 2 (HATCH. LEVEE)	ALT. FUTURE 3 (CYP. LEVEE)	ALT. FUTURE 4 (KISS. LEVEE)	ALT. FUTURE 5 (FULL RESTORATION)
Florida duck	6755	8792	9090	8809	8804	9119
Ring-necked duck	11516	15015	15015	15015	15015	15015
Snail kite	659	839	839	839	839	839
Great egret	17619	20810	21356	20880	20895	21509
Snowy egret	13943	15878	16387	15948	15922	16501
Wood stork	16491	18172	18273	18217	18206	18353
Largemouth bass	38174	38937	38937	38937	38937	38937
Bald eagle	31827	32031	32088	32039	32036	32102
Sandhill crane	63452	63505	63230	63472	63515	63208
Crested caracara	41486	41652	41618	41655	41649	41618
ALL SPECIES	241923	255630	256832	255811	255818	257201

Notes:
Alt. Future 1 = Adoption of proposed water regulation schedule only.
Alt. Future 2 = New water schedule, with breaching of levee south of Lake Hatchineha.
Alt Future 3 = New water schedule, with breaching of levee north of Cypress Lake.
Alt. Future 4. = New water schedule, with breaching of levee east of Lake Kissimmee.
Alt. Future 5. = New water schedule, with breaching of all three levees.

TABLE 6 -- PREDICTED CHANGES IN AVAILABILITY OF SUITABLE HABITAT FOR THE ALTERNATIVE FUTURES

(Expressed as percent increase or decrease, relative to future without project condition, throughout study area.)

SPECIES	ALT. FUTURE 1 (PROP. SCHED.)	ALT. FUTURE 2 (HATCH. LEVEE)	ALT. FUTURE 3 (CYP. LEVEE)	ALT. FUTURE 4 (KISS. LEVEE)	ALT. FUTURE 5 (FULL RESTORATION)
Florida duck	30.2	34.6	30.4	30.3	35.0
Ring-necked duck	30.4	30.4	30.4	30.4	30.4
Snail kite	27.3	27.3	27.3	27.3	27.3
Great egret	18.1	21.2	18.5	18.6	22.1
Snowy egret	13.9	17.5	14.4	14.2	18.3
Wood stork	10.2	10.8	10.5	10.4	11.3
Largemouth bass	2.0	2.0	2.0	2.0	2.0
Bald eagle	0.6	0.8	0.7	0.7	0.9
Sandhill crane	0.1	-0.4	0.0	0.1	-0.4
Crested caracara	0.4	0.3	0.4	0.4	0.3

ALL SPECIES	5.7	6.2	5.7	5.7	6.3

Notes:

Alt. Future 1 = Adoption of proposed water regulation schedule only.

Alt. Future 2 = New water schedule, with breaching of levee south of Lake Hatchineha.

Alt Future 3 = New water schedule, with breaching of levee north of Cypress Lake.

Alt. Future 4. = New water schedule, with breaching of levee east of Lake Kissimmee.

Alt. Future 5. = New water schedule, with breaching of all three levees.

the snail kite and the Florida duck reflect these species' foraging preferences in a narrow band of marsh/open water fringe around the lakes with suitable hydroperiod and water depth. However, because the effects of the project are restricted to the littoral zone, both species show a relatively high percentage increase in habitat availability in the future with project scenarios. The high habitat unit totals for the caracara are the result of large areas of grasslands and moderate amount of dry prairie in the areas above the littoral zone. However, because only the upper end (short hydroperiod) of the littoral zone was scored as moderate habitat suitability for this species, the project has a relatively minor effect on habitat availability in the entire study area. The caracara is a relatively uncommon bird, so this well illustrates that it is incorrect to interpret the habitat unit values as a measure of abundance.

Figures 10 through 14 illustrate examples of the geographic distribution of habitat suitability and predicted change in habitat suitability. We have selected the great egret and the snail kite for these illustrations because other species that exhibit change in habitat suitability as a result of the project show similar patterns.

Figure 10 shows the habitat suitability for the great egret for the basic restoration plan (adoption of the proposed regulation schedule, but without breaching the three levees around the lakes). Note that although the highest habitat values are in the littoral zone, the great egret can use a wide range of wetland habitats both in the littoral zone and in the prairie wetlands that are elevated above the normal water fluctuation in the lakes. As stated previously in the description of the methodology, this provides an estimation of the relative importance of the water regulation changes in the context of the surrounding landscape.

Figure 11 shows the changes in great egret habitat suitability for the basic restoration project, expressed as percent change relative to the future without the project. Notice that although some areas show moderate declines in suitability, larger areas show either moderate or great increases in habitat suitability. The largest percentage increases generally occur along the eastern shoreline of Lake Kissimmee, around Brahma Island, and near Sturm Island. Moderate increases occur over much larger areas in the area between the three major lakes and around Lake Hatchineha. The net gain in habitat units for the great egret with the basic restoration plan is about 18% over the future without the project.

Figure 12 shows the predicted changes in great egret habitat suitability relative to the future without the project, if all three levees around the lakes are breached. The arrows point to the areas behind the levees where additional habitat will be generated, relative to the basic restoration plan (without breaching the levees).

The output for the snowy egret and wood stork vary in their details, but the same general pattern holds for those species as for the great egret.

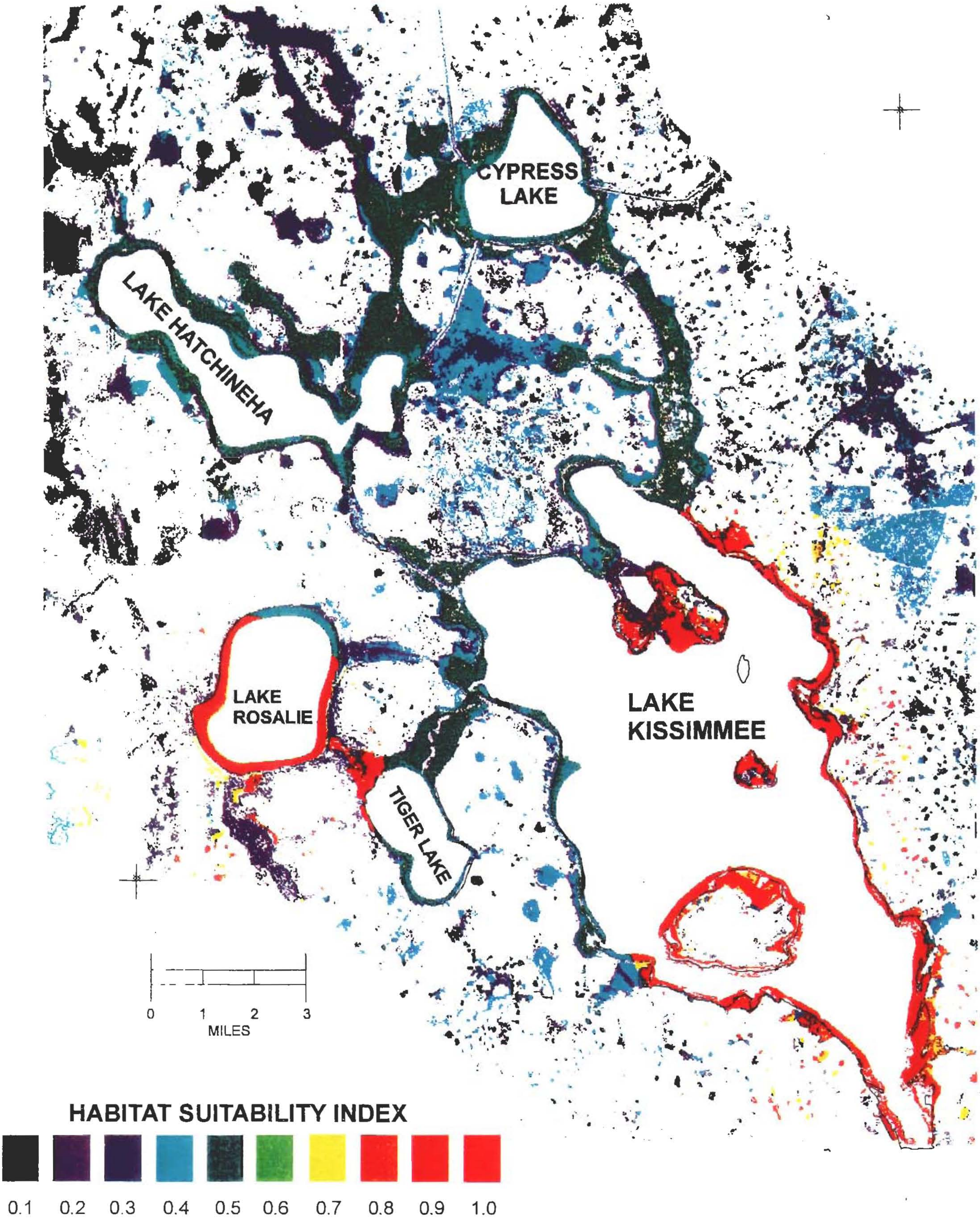

FIGURE 10 - GREAT EGRET HABITAT SUITABILITY, FUTURE WITH BASIC RESTORATION PLAN (No breaching of levees)

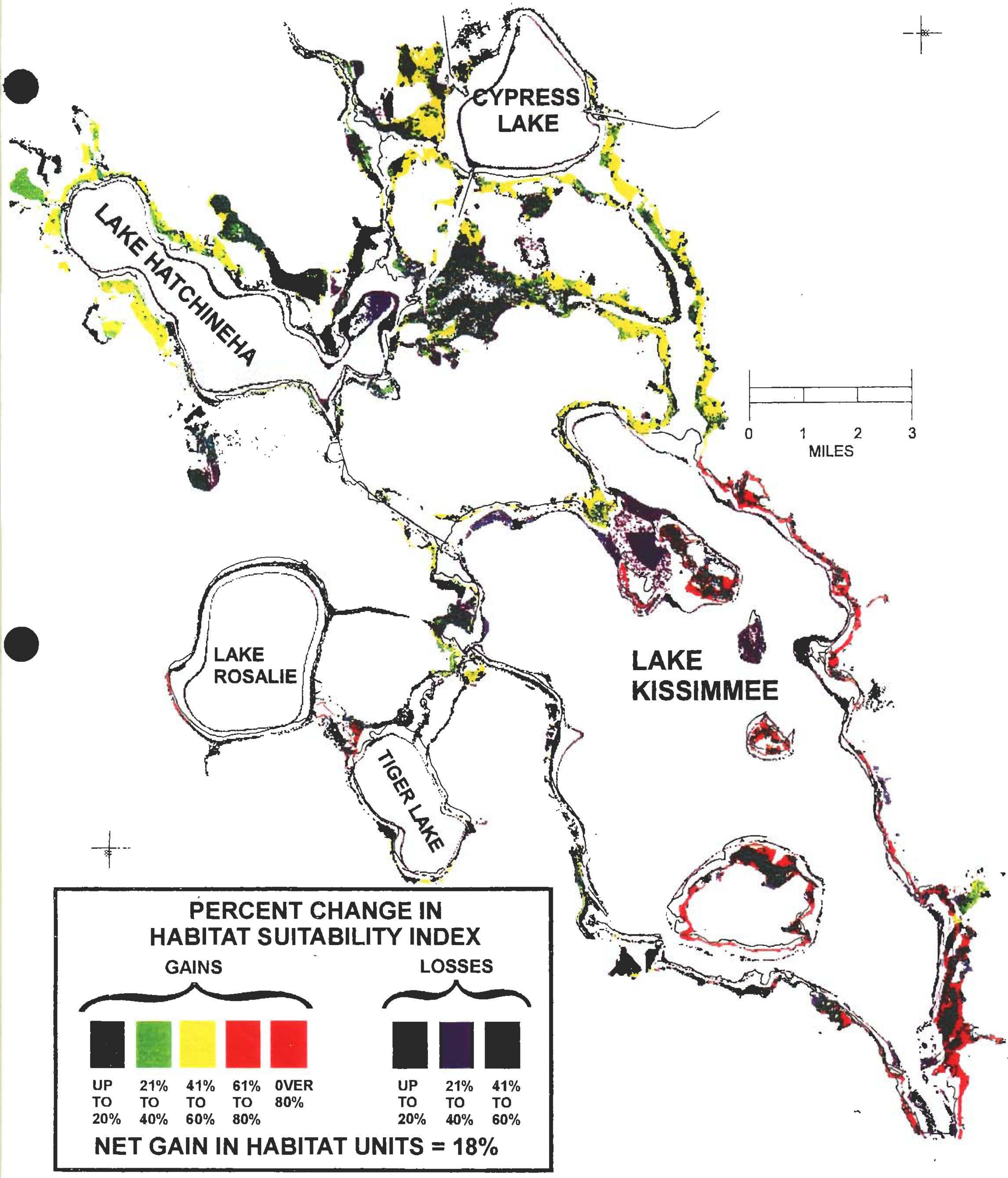

FIGURE 11 - CHANGES IN GREAT EGRET HABITAT SUITABILITY, FUTURE WITH BASIC PROJECT RELATIVE TO FUTURE WITHOUT PROJECT.

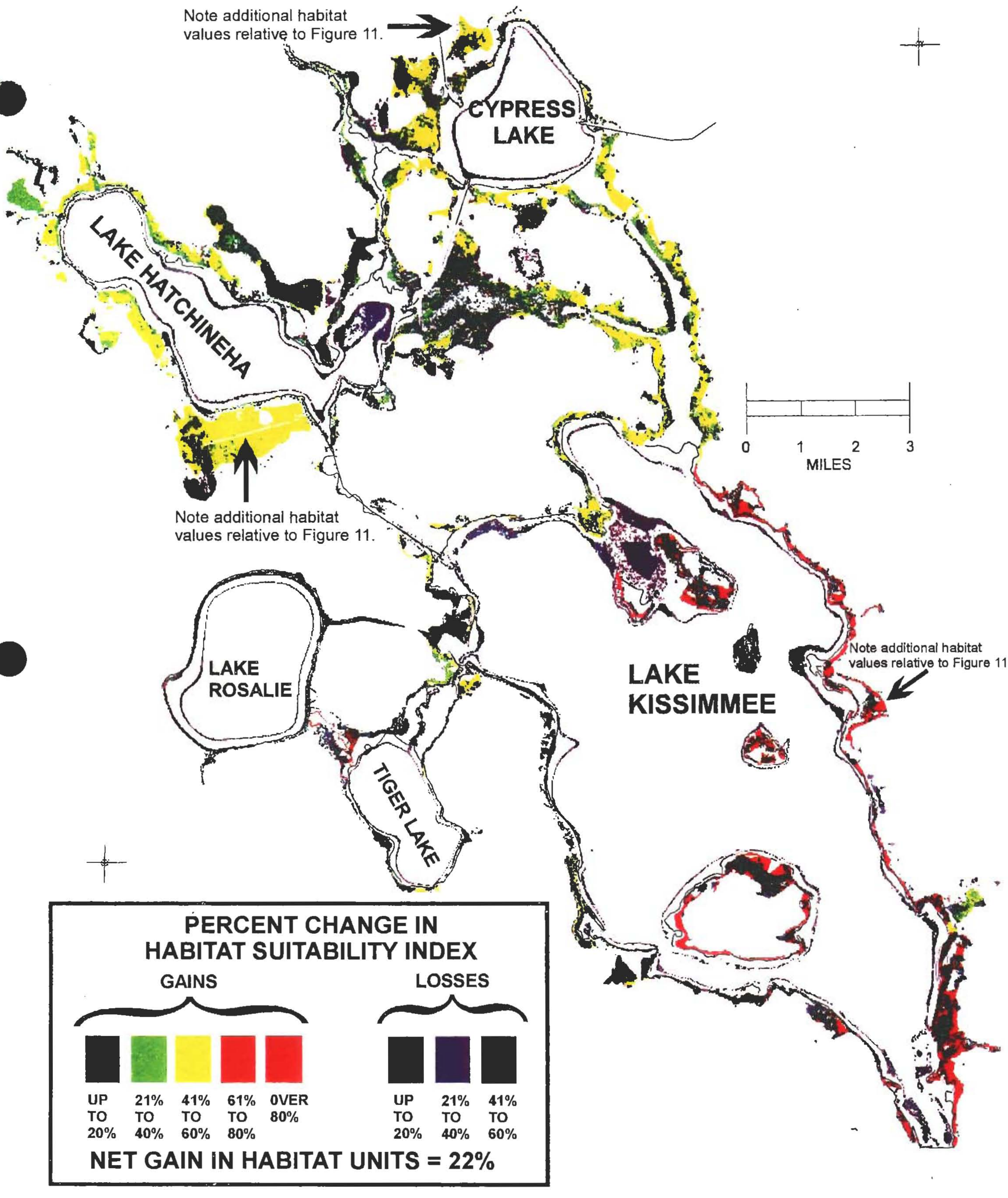

FIGURE 12 - CHANGES IN GREAT EGRET HABITAT SUITABILITY, FUTURE WITH ALL LEVEES BREACHED RELATIVE TO FUTURE WITHOUT PROJECT.

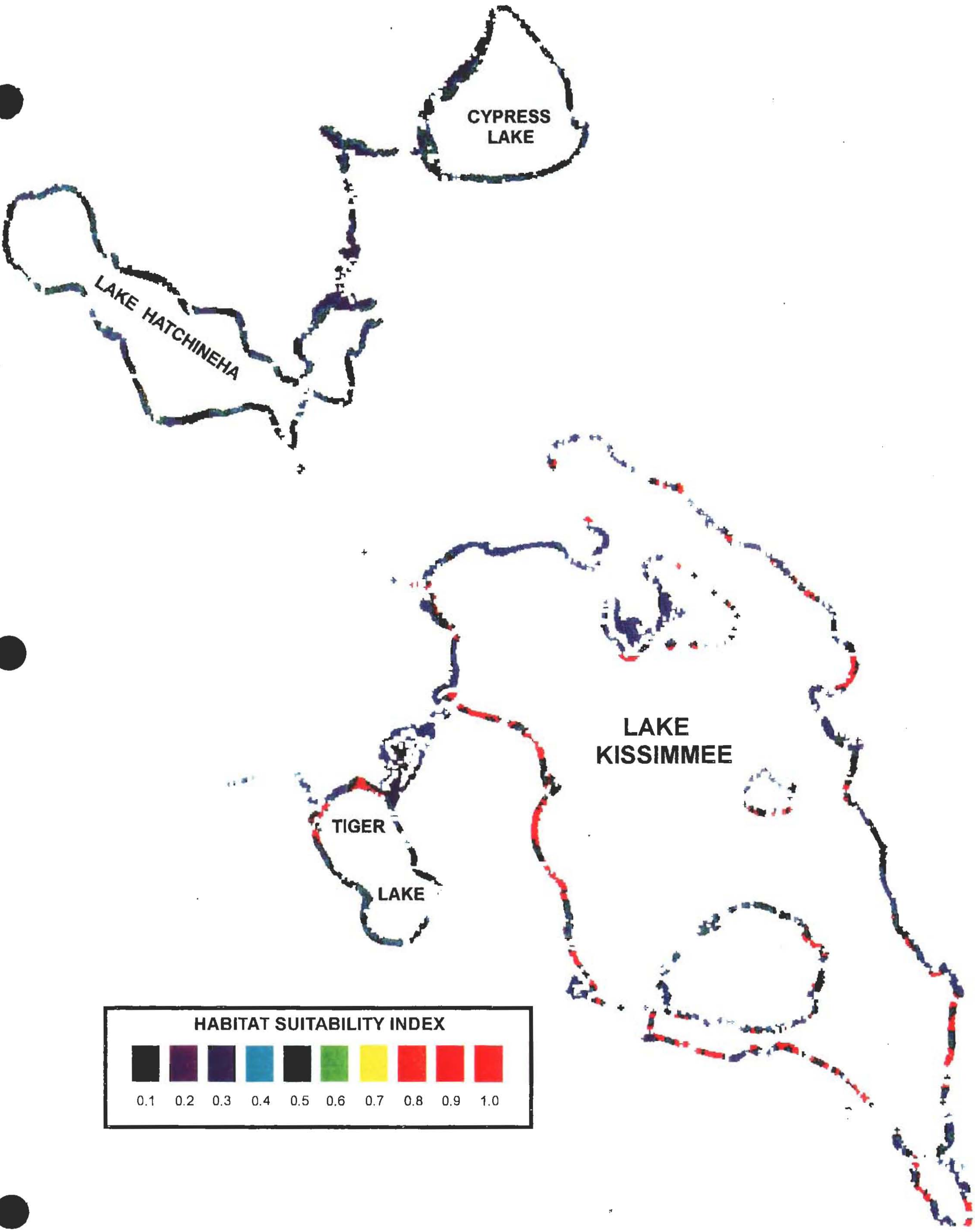

FIGURE 13 - SNAIL KITE HABITAT SUITABILTY, ANY OF THE ALTERNATIVE FUTURES

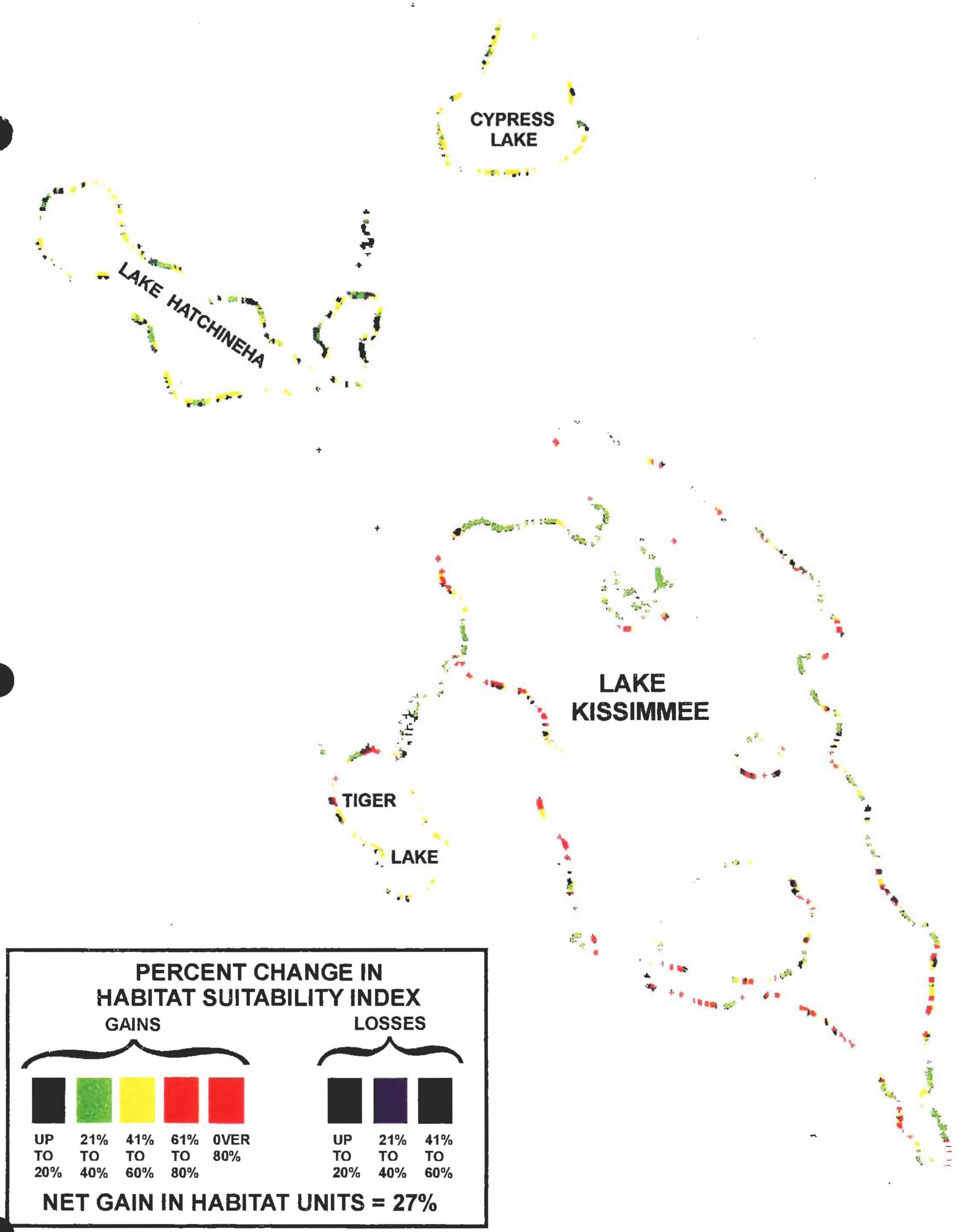

FIGURE 14 - CHANGES IN SNAIL KITE HABITAT SUITABILITY, ANY OF THE ALTERNATIVE FUTURES, RELATIVE TO FUTURE WITHOUT PROJECT.

Figure 13 shows habitat suitability for the snail kite for any of the alternative futures. Notice that the snail kite is not as likely to feed in the prairie wetlands as are the wading birds; the snail kite preferentially selects areas of suitable vegetation and hydrology in narrow portions of the littoral zone. Also notice that the highest habitat values are assigned to portions of the shorelines of Lake Kissimmee and Tiger Lake, where feeding areas are located close to documented nesting areas.

Figure 14 shows the change in habitat suitability for the snail kite for any of the alternative futures, relative to the future without the project. The greatest increase in habitat suitability are predicted to occur along a narrow band around Lake Kissimmee and the northern shore of Tiger Lake. Moderate increases in suitability are predicted for the shorelines of Cypress Lake and Lake Hatchineha. The absolute area of habitat changes for the snail kite is smaller than for the great egret. However, the kite's selectivity of habitat along the shorelines of the lake is precisely in areas to be affected by the project. This translates to a greater percentage change for the species due to the effects of the project, with a predicted net gain in habitat units of about 27%. As stated in Section VII.E.5. of this report, nesting conditions for snail kites are not expect to change significantly; the predicted gains in habitat suitability are strictly the result of improved foraging conditions in response to changes in hydrology.

The relatively high percent increase in habitat units for the Florida duck and the ring-necked duck are also the result of these species using areas to be affected by changes in regulation of the lake. The Florida duck's use of prairie wetlands for feeding was taken into account for the model, but its strongest preference for a mixture of open water and marsh along the shallow edges of the lakes is quite similar to areas preferred for feeding by the snail kite. (Although the species use very different resources and feeding strategies, they can often be seen in the same wetlands.) The ring-necked duck would nearly always be seen in the lakes rather than in the prairie wetlands, but preferring deeper water than the Florida duck. We have predicted a substantial increase of about 35% in habitat units for the Florida duck if all 3 levees are breached, while ring-necked duck habitat is predicted to increase by about 30%, whether or not the levees are breached.

The bottom row of Table 5 sums the habitat units for all 10 evaluation species for each of the alternative futures. The bottom row of Table 6 expresses the percent change anticipate for each alternative future, based on the sum of habitat units for all evaluation species. We have predicted approximately a 5.7% increase in habitat availability for the basic lake re-regulation, and about a 6.3% increase if all 3 levees are breached, taking into account habitat values in the prairie portions of the study area that are not likely to change in response to the project.

Among the evaluation species, the Florida duck, great egret, snowy egret, and wood stork are likely to benefit from the additional wetlands that would be restored by breaching the levees. A variety of other wetland-dependent wildlife would also most likely benefit from breaching the levees.

D. Relative Frequency of Extreme Drawdowns

In a spreadsheet, we calculated the number of extreme drawdown events (natural droughts in the pre-project period) in the 18-year period of record. An extreme drawdown was defined as water levels below 46 ft. for at least 90 consecutive days. In the same period we used to compare the evaluated alternatives with historic conditions (1939-1942 and 1945-1958), we discovered only one extreme drawdown of this magnitude. Water levels remained below 46 feet for 187 consecutive days, from mid-April to mid-October 1956. Under regulated conditions (1970-1988) the single extreme drawdown of 1977 also met this criterion, lasting 175 consecutive days, from mid-March to the end of August.

We also examined the 15-year period between 1929 and 1943. Although no droughts in this period met the criterion we set, extended low water periods occurred in 1932 and 1933. Water levels below 46 feet occurred a total of 70 days in the 15-year period, without consideration of consecutiveness. In April-August 1932, water levels stayed below 46.5 feet for more than 90 consecutive days, with 13 consecutive days below 46 feet. The longest consecutive period with water below 46 feet lasted 32 days, from early June to early July 1933.

It appears that extreme drawdowns of the magnitude we have defined did not occur more frequently than roughly every 10-20 years. However, the unregulated system fluctuated much more each year than is feasible under today's system of gates and canals. After long periods without fluctuation, a more pronounced and/or more frequent extreme drawdown is necessary to partially compensate for the lack of year-to-year variability in the location of the low water line.

The frequency and timing of extreme drawdowns need to be negotiated among the concerned agencies. The fisheries program of the FGFWFC currently recommends a frequency of once every 7 to 10 years. Due to the degree of coordination and expense of performing an extreme drawdown, once the process has been started, all attempts should be made to complete the drawdown satisfactorily. Barring any unseasonable heavy rains, the 46-foot/90-day duration guideline should be met to provide the desired benefits for the funds expended.

XII. FEDERALLY-LISTED THREATENED AND ENDANGERED SPECIES

A. Determination of Effect and General Findings

By letter, dated December 3, 1993, the Corps' Planning Division provided the Service with a determination of effect in accordance with Section 7(a)(1) of the Endangered Species Act (ESA). They determined that the proposed project is not likely to adversely affect any Federally-listed threatened or endangered species. On March 28, 1994, the Service concurred with this determination.

Section VII.E. of this report provides general biological information and the basis of our models for the bald eagle, snail kite, wood stork, and Audubon's crested caracara, which in addition to being Federally-listed as endangered, are also evaluation species for this report. On the basis of our familiarity with the species' biology in the area and the results of our species models, the Service predicts that the project will likely be beneficial to the snail kite and wood stork, while it is not likely to have a significant effect on the bald eagle or the caracara.

The Corps' evaluation included the Eastern indigo snake (*Drymarchon corais couperi*), which is listed as threatened. The indigo snake is likely to occur in higher elevations unaffected by the changes in water regulation schedules. We concur with the Corps' determination, and provide Conservation Recommendations to assist them to protect any indigo snakes that may be found during earth work in widening the flood control canals.

The Corps also mentioned the whooping crane (*Grus americana*) in its determination. The FGFWFC and the Service are cooperating in an attempt to re-introduce the whooping crane in and adjacent to the study area. Most of the introduced flock presently uses habitat west of the study area, near Lake Marian and Lake Jackson. Although the whooping crane is listed as endangered in the remainder of its range in the United States, this flock is considered an experimental population, and is not currently covered under Section 7 of the Endangered Species Act. However, we encourage the agencies to consider effects on this population in project planning. The whooping crane has a greater affinity for wetlands than the sandhill crane (Nesbitt, pers. comm.), and we expect that establishment of a breeding population in Central Florida will be enhanced by the greater water fluctuation and expanded littoral zone as a result of the Kissimmee Headwater Lakes Revitalization Project.

B. Conservation Recommendations

1. Snail kite

The Service has recommended that each of the principal nesting areas and drought refugia be managed to benefit reproduction of the species during most years, while recognizing that droughts and management of other fish and wildlife species will require periodic deviations from what is considered an ideal management plan for snail kite reproduction. Coordination of management actions throughout the species' range would be required to ensure that the majority of the essential kite habitats were managed for kite nesting in any given year. For example, an extreme drawdown of a waterbody for water supply, construction activity, aquatic weed control or fishery habitat management could be permitted if other essential habitats in the species' range were managed for kites in that same year. Ongoing telemetry studies indicate that kites will migrate long distances within their overall range to find favorable conditions and that they exhibit a high level of resilience to environmental conditions (Bennetts et al., 1994 and Bennetts, pers. comm.). However, if a number of activities adverse to the kite coincide during a prolonged drought, the impact could overwhelm the species' inherent capacity to respond with opportunistic behavior.

The responsible agencies must insure that potentially conflicting goals (such as habitat enhancement for fisheries and water management for snail kite nesting) are reconciled. This may be more a matter of timing and coordination than an inherent conflict. The long-term management of the lakes should include extreme drawdowns which could be beneficial for all species, including the snail kite. However the frequency of these events and the compatibility of lake management with kite nesting in the intervening years can be worked out through cooperation. Bennetts et al. (1994) stated the following with regard to the Everglades, but it could apply throughout the range of the snail kite:

> Undoubtedly, compromise solutions will need to be identified in order to accommodate increasing demands for water, habitat for snail kites, and flow systems that will maintain the unique Everglades environment. Almost any proposed solution to the problems of the Everglades and the kite will meet with opposition from individuals or groups with differing objectives or viewpoints.

2. <u>Eastern indigo snake</u>

The indigo snake (*Drymarchon corais couperi*) is a large black to glossy blue-black snake. Indigo snakes prefer sandy upland habitats, but can be found in many kinds of habitats, including canal banks and spoil mounds. In much of Florida it uses gopher tortoise burrows for shelter. In addition to habitat destruction, illegal collection of indigo snakes for the pet trade is a significant threat.

All construction personnel involved in this project should be informed of the possible presence of the indigo snake in the area, its recognition, and the possible civil and criminal penalties resulting from the unauthorized take (harming, harassing, killing, collection) of a listed species. The Service can furnish, under separate correspondence, an outline for an education/protection program for the indigo snake.

C. Conclusion

The Service concurs with the Corps' determination that the project is not likely to adversely affect the Audubon's crested caracara, bald eagle, wood stork, and Eastern indigo snake.

Although this does not constitute a Biological Opinion described under Section 7 of the Endangered Species Act, it does fulfill the requirements of the Act, and no further action is required. If modifications are made in the project or if additional information involving potential impacts on listed species becomes available, please notify our office (407-562-3909).

XIII. STATE-LISTED SPECIES AND SPECIES OF SPECIAL CONCERN

The sandhill crane is one of our evaluation species, and is listed by the State of Florida as Threatened. The snowy egret, another evaluation species, is listed as a Species of Special Concern. We have predicted a likely benefit for the snowy egret, and no significant effect on the sandhill crane.

Among the more prominent Species of Special Concern that occur in the study area are: gopher tortoise, osprey, burrowing owl, limpkin, little blue heron, and tricolored heron. Based on our modelling of effects on wading birds, the Service anticipates that the last three species are likely to benefit from the proposed project, because they are wetland-also wetland-dependent wading birds.

XIV. CONCLUSIONS AND RECOMMENDATIONS

Restoration of the Kissimmee River and the associated proposal to improve water regulation in the Kissimmee Chain of Lakes are environmental restoration projects on an unprecedented scale; they serve as nationally significant cornerstones in efforts to restore ecosystems.

The Service recommends the following:

1. Lands up to 54 feet in elevation located behind the three levees at Lakes Hatchineha, Kissimmee, and Cypress should be added to the ongoing fee title acquisition of lands around the lakes. The levees should then be breached to hydrologically connect existing wetlands with the lakes and allow additional restoration of wetlands. These actions will realize the full potential of habitat restoration available in the upper basin and provide additional areas to buffer flood risks during storm events. Among the evaluation species, the Florida duck, great egret, snowy egret, and wood stork are likely to benefit from the additional wetlands that would be restored by breaching the levees. A variety of other wetland-dependent wildlife would also most likely benefit from this action. Direct hydrological connection of the wetlands with the lakes would increase the flow of nutrients and promote movement of aquatic animals; the wetlands behind the levees are now generally isolated from the lakes. Acquisition of the area behind the levees would also ensure that existing wetlands behind the levees are not pumped dry by more intensive agricultural practices on private lands.

2. Periodic extreme drawdowns should be superimposed on the normal regulation schedule and should be referenced in the operational notes for the schedule. This action is an essential habitat management tool for the entire lake ecosystem, particularly with respect to the sport fishery. Field research has demonstrated substantial increases in the yield of the sport fishery for several years after an extreme drawdown. The periodic reduction in density of vegetation in the littoral zone is also beneficial to the ecosystem as a whole. The frequency and timing of these drawdowns should be fully coordinated to minimize adverse effects on nesting of snail kites.

3. Spoil material excavated during widening of C-36 and C-37 should be confined to the existing spoil banks within the right-of-way. If filling of wetlands beyond the toe of the existing spoil mounds is unavoidable, the Corps should develop, during detailed project design, a plan to compensate for losses of wetlands. The Corps should investigate redirecting flow to the remnant river run adjacent to C-37. After widening the canals, the banks should be replanted

with cypress trees, and a littoral shelf should constructed and planted with desirable aquatic plants such as bulrush.

4. The Corps should develop an aquatic plant management plan, including funding projections, to address control of *Hydrilla*, floating plants, and tussocks in the lakes.

5. The Interagency Review Team used to prepare this evaluation should continue to meet after implementation of the new water regulation schedule. This will allow evaluation of its effectiveness in reaching restoration goals for the upper basin and the Kissimmee River. Environmental monitoring studies should be planned and funded. Iterative testing of modified water regulation schedules should be conducted if it appears that the project is not fully realizing potential benefits. In particular, the review agencies should revisit the issue of attempting to provide flooding of longer duration between elevations of 52.5 and 54 feet in the upper basin, if this can be achieved without increasing flood risks upstream.

6. The Service recommends that the Corps evaluate the feasibility and benefits of adding a water control structure/lock at the northern end of C-36 to enable separate water regulation of Lake Cypress at levels closer to the historic condition. Lake Cypress appears to be more adversely affected by water levels held below historic conditions, as exhibited by reduction of the littoral fringe and dense growth of aquatic weeds. Although separate regulation of this lake was not proposed in our Scope of Work, the Service is confident that separate regulation at levels higher than Lakes Hatchineha and Kissimmee would greatly enhance the environmental benefits of the currently proposed plan. We would be willing to prepare a Scope of Work to quantify these additional environmental benefits.

7. The Service continues to support the proposed Level II Backfilling Plan for the Kissimmee River restoration, a restoration project adjacent to, and hydrologically connected with, the Kissimmee Headwater Lakes Revitalization Project.

XV. LITERATURE CITED

Baca, B.J, R. Spieler, W.R. Courtenay, D. Gilliam, D. Stout, B. Touchette, and R. Reiners, 1992. An evaluation of eleven Dade County quarry lakes as habitat for largemouth bass (unpublished report). Draft Final Report prepared for: Rinker Materials Corporation, West Palm Beach, Florida.

Bancroft, G.T., A.M. Strong, R.J. Sawicki, W. Hoffman, and S.D. Jewell, 1994. Relationships among wading bird foraging patterns, colony locations, and hydrology in the Everglades. in Everglades: The ecosystem and its restoration. S.M. Davis and J.C. Ogden, eds. St. Lucie Press, Delray Beach, FL.

Bellrose, F.C. 1980. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pa. 540pp.

Bennetts, R.E., M. W. Collopy, and S. R. Beissinger. 1988. Nesting ecology of snail kites in Water Conservation WCA3A. Florida Coop. Fish and Wildlife Research Unit, Work Order No. 40, Univ. Of Florida, Gainesville.

Bennetts, R.E., M.W. Collopy, and J.A. Rodgers, Jr., 1994. The snail kite in the Florida Everglades: A food specialist in a changing environment. in Everglades: The ecosystem and its restoration. S.M. Davis and J.C. Ogden, eds. St. Lucie Press, Delray Beach, FL.

Bureau of Land Management, U.S. Department of the Interior, 1973. Habitat management series for endangered species. Report No. 5. Southern bald eagle (*Haliaeetus leucocephalus leucocephalis*) and Northern bald eagle (*Haliaeetus leucocephalis alascanus*). Technical Note T-N-171.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye, 1992. Birds in jeopardy. Stanford University Press, Stanford, California.

Kale, H.W., and D.S. Maehr, 1990. Florida's birds. Pineapple Press, Sarasota, Florida.

Kautz, R.S., D.T. Gilbert, and G.D. Mauldin, 1993. Vegetative cover in Florida based on 1985-1989 LANDSAT Thematic Mapper imagery. Florida Scient. 56(3):135-154.

Layher, W.G., and O. Eugene Maughan, 1987. Modeling habitat requirements of a euryhabitat species. Trans. Kansas Academy of Science 90(1-2):60-70.

Layne, J., 1985. Audubon's caracara. Fla. Wildlife 39:40-42

Moyer, E.J., M.W. Hulon, and G.L. Zuhl, 1986. Kissimmee Chain of Lakes studies annual progress report (unpublished report). Florida Game and Fresh Water Fish Commission.

Moyer, E.J., M.W. Hulon, J. Buntz, R.W. Hujik, J.J. Sweatman and C.S. Michael, 1992. Kissimmee Chain of Lakes studies annual progress report (unpublished report). Florida Game and Fresh Water Fish Commission.

Ogden, J.C., J.A. Kushlan, and J.T. Tilmant, 1978. The food habits and nesting success of wood storks in Everglades National Park, 1974. U.S. Department of the Interior, National Park Service. Natural Resources Report Number 16. 25 pp.

Ogden, J.C., 1989. Habitat management guidelines for the wood stork in the southeast region. U.S. Department of the Interior, Fish and Wildlife Service.

Ogden, J.C., 1994. A comparison of wading bird nesting colony dynamics (1931-1946 and 1974-1989) as an indication of ecosystem conditions in the southern Everglades. in Everglades: The ecosystem and its restoration. S.M. Davis and J.C. Ogden, eds. St. Lucie Press, Delray Beach, FL.

Ramsey, J.S., 1975. Taxonomic history and systematic relationships among species of *Micropterus*. Pages 67-75 in H. Clepper, ed. Black bass biology and management. Sport Fish. Inst., Washington, D.C.

Rodgers, J.A., 1992. Annual snail kite survey and habitat assessment, 1 July 1986 - 30 June 1992 (unpublished report, in prep. for publication). Final Report. Statewide Wildlife Research, Study No. 7520. Federal No. E-1 II-M-1. 23 pp.

Schroeder, R.L. and S.L.Haire, 1993. Guidelines for the development of community-level habitat evaluation models. U.S. Dept. Int., Fish and Wildlife Service. Biological Report 8. February 1993.

Stuber, R.J., G. Gebhart, and O.E. Maughan, 1982. Habitat suitability index models: Largemouth bass. U.S. Dept. Int. Fish and Wildl. Serv. FWS/OBS-82/10.16. 32pp.

Sykes, P.W.,Jr. 1979. Status of the Everglade kite in Florida - 1968-1978. Wilson Bull., 91:495-511.

Sykes, P.W.,Jr. 1983a. Recent population trend of the snail kite in Florida and its relationship to water levels. J. Field Ornithol., 54(3):237-246.

Sykes, P.W.,Jr. 1987a. Some aspects of the breeding biology of the snail kite in Florida. J. Field Ornithol., 58(2):171-189.

Sykes, P.W.,Jr. 1987b. The feeding habits of the snail kite in Florida, USA. Colon. Waterbirds, 10(1):84-92.

Sykes, P.W., Jr. 1987c. Snail Kite nesting ecology in Florida. Florida Field Nat., 15(3):57-84.

Toland, B.R., 1991. Effects of the Kissimmee River Pool B restoration demonstration project on wading birds and waterfowl, 1987-1989 (unpublished report). Florida Game and Fresh Water Fish Commission, Office of Environmental Services, Vero Beach, Florida.

Wegener, W. and V. Williams, 1974. Fish population responses to improved lake habitat utilizing an extreme drawdown. Proceedings of the 28th Annual Conference of the Southeastern Association of Game and Fish Commissioners, 1974.

321

FLORIDA GAME AND FRESH WATER FISH COMMISSION

June 6, 1994

Mr. David L. Ferrell
Field Supervisor
U.S. Fish and Wildlife Service
P.O. Box 2676
Vero Beach, FL 32961-2676

Re: Kissimmee Headwater Lakes Revitalization Project, Draft Fish and Wildlife Coordination Act Report

Dear Mr. Ferrell:

The Division of Fisheries, Division of Wildlife, and Office of Environmental Services of the Florida Game and Fresh Water Fish Commission have reviewed the referenced document, and offer the following comments.

The Kissimmee Headwater Lakes Revitalization Project is an important component of the Kissimmee River restoration, which we believe is the premier natural resource oriented public works project in the history of Florida. For the restoration to work, river flow from the headwater lakes must be reestablished in a regime similar to the historic condition. This will require new lake regulation schedules, the centerpiece of the revitalization project, and for these to maximize potential natural resource benefits within the Kissimmee basin, the historic condition should also be the goal.

We concur with the six conclusions and recommendations, as stated on pp. 68 and 69 of the Draft Coordination Act Report. However, we believe that the fish and wildlife habitat benefits of this project could be greatly enhanced if the water level schedule for lakes Cypress, Hatchineha, and Kissimmee provided high water levels closer to the historic condition. The modest wetland habitat benefits of the Corps of Engineers' proposed schedule (400C150RR) could be dramatically improved with longer durations of water level between the 52.5- and 54-foot contours. Table 3 of your report illustrates that the proposed schedule closely approximates historic low water stages, but provides only 36% of the historic high water levels. Your specific recommendation for the Interagency Review Team to "revisit" this

Mr. David L. Ferrell
June 6, 1994
Page 2

issue in the future acknowledges the environmental desirability of higher lake stages, but our experience has been that any modification in lake regulation schedules is an arduous, protracted process. The current Kissimmee Headwater Lakes Revitalization Project is our window of opportunity to establish an optimum schedule; should we not "go for it"? If additional flood plain acquisition is required to restore historic water levels, that requirement should be defined now. The Kissimmee River restoration is a visionary project, and we believe the headwater lakes (as well as Lake Okeechobee and the Everglades) require and deserve a similar vision. Thus our principal recommendation to the Corps of Engineers is to modify their proposed schedule to allow longer duration of water levels between the 52.5- and 54-foot contours.

Specific comments pertaining to your recommendations are as follows:

Recommendation 1. Analysis of the benefits derived by breaching the levees on lakes Cypress, Hatchineha, and Kissimmee should include the enhancement and protection of the wetlands presently existing behind these levees, which were excluded from your wetland restoration estimates. An addition to Table 4 could include this acreage, which we calculate to be 721 acres for Lake Cypress, 1,500 acres for Lake Hatchineha, and 429 acres for Lake Kissimmee. Potential project benefits would include: protection of wetlands currently in private ownership which are jeopardized by existing drainage systems; enhancement of wetland function, especially fisheries, via reconnection with the lakes; and additional flood storage acreage.

Recommendation 2. Extreme drawdowns should be referenced in the operational notes for the lake regulation schedules.

Recommendation 3. As part of the Corps of Engineers' plan to widen canals C-35, C-36, and C-37, they should investigate adding flowways through the levees adjacent to these canals. A remnant river run parallels C-37, and should be restored. After dredging, the canal banks should be replanted with cypress trees, and a littoral shelf should be constructed and planted with desirable aquatic plants such as bulrush.

We would also add a recommendation that the Corps of Engineers develop an aquatic plant management plan, including funding projections, to address hydrilla control in flowing lake water, and control of floating plants and tussocks.

We have given additional minor recommendations and corrections for this Draft Coordination Act Report to Robert Pace of your staff via telephone. Attached to this letter are two memoranda from waterfowl biologists in our

Division of Wildlife, offering specific language changes for sections of the report dealing with ring-necked ducks and mottled ducks.

Sincerely,

Bradley J. Hartman

Bradley J. Hartman, Director
Office of Environmental Services

BJH/BSB/tgw
ENV 2-6
kissimmee.bsb
Attachments
cc: Col. Terrence C. Salt, USACOE
Mr. Dennis Holcomb, GFC
Mr. Ed Moyer, GFC
Mr. Dennis Hammond, GFC
Ms. Diane Eggeman, GFC
Mr. Paul Gray, GFC

FLORIDA GAME AND FRESH WATER FISH COMMISSION

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M E M O R A N D U M May 24, 1994

TO: Duke Hammond
SWIM Coordinator

FROM: Paul N. Gray, Ph.D. Paul
Bio. Sci. III

SUBJECT: Comments on USFWS Kissimmee Headwater Lakes Revitalization Project

---

Thank you for sending parts of the Kissimmee Project report to me. I applaud the USFWS for working on plans of this sort--they will help. Here are suggestions/comments:

-He misspelled my name--Gray.

-The Fish and Wildlife Concerns (p. 8) has a good discussion about the pejorative effects of stabilized water levels in the lakes. The one point I would emphasize more is that high water levels impede decomposition--which helps create the excess muck--and serves to bind up nutrients. In continuously flooded sites, the vegetation gets thick (forms batteries or tussocks) and chokes that area out--but actually has low primary productivity, which makes the system less productive overall. During drawdowns, decomposition frees the nutrients, which allows increased productivity (such as improved fish growth).

-The Florida subspecies of mottled duck (p. 33) is denoted *Anas fulvigula fulvigula*, if he wants to include that.

-I would rewrite the first sentence of the second paragraph of the mottled duck account (p. 33) to say, "Florida's mottled duck nests primarily between mid-March and mid-May, but will attempt renesting through July."

-I would add that mottled ducks can nest as much as a mile from water, which helps reduce the chance that nesting habitat is limiting.

-Change to, "Paul Gray concurs that suitable nesting habitat probably is abundant in the study area." (changes in bold)

Mr. Duke Hammond
May 24, 1994
Page 2

-Paragraph 3 mentions "non-limiting nature of the breeding habitat" and while that might be true, it may not--and we don't know for sure. A fudge word could be added, "**presumed** non-limiting..."

Further, BROOD REARING areas have not been discussed and are a critical part of the breeding habitat. However, I think brood rearing habitat will take care of itself if the "feeding habitat" part of the model is done correctly. I think the author could explicitly state that good brood habitat resembles good feeding areas, but with a mandatory component of nearby cover (which should be no problem on lakes with cattails, bullrush, maidencane, or a similar robust cover). Adult birds do not need cover to have suitable feeding habitat.

-I am not sure I understand how the model will work, so I hope the following comments make sense.

-Mottled ducks "prefer" feeding in water less than 6 inches deep. They can use water as much as 12 inches deep, but water more than 12 inches deep should be considered unsuitable (unless it is a bed of hydrilla or some plant that grows close to the surface). Mottled ducks LOVE recently flooded, short hydroperiod wetlands because these wetlands frequently are dominated by seed-bearing plants (good food), and when newly flooded, the seeds and bugs float, making them easy to feed on. Hence, I think the authors should give very high suitability scores to shallow water areas and temporarily flooded wetland areas. Of course, short hydroperiod wetlands are suitable only when flooded.

-I'm not sure areas within 90 m of marsh/open water edges are better for mottled ducks than other areas; I think it could be deleted.

-The last sentence confuses me a little. Mottled ducks appear to "prefer" small wetlands that are found out on the prairies--and have no clear preference for large lakes. Hence, semipermanent wetlands (and some open water areas) above the littoral zone should be assigned high habitat values. Ducks do "prefer" littoral zones of large lakes when natural marsh cycles make temporally suitable habitat (such as the productive period following a drawdown or fire). However, when there is a drought, the ducks have nowhere else to go--and the lakes can become important (preferred?) habitat, even when the lakes have low quality habitat.

-I think the conclusions/recommendations (p. 68) are good, especially #2.

If you have any questions, please call.

W892/PG/pg
FN: C:\P\DUKE2
WLD 8-7
cc: Lt. Col. Daniel Dunford
Mr. David Brakhage

FLORIDA GAME AND FRESH WATER FISH COMMISSION

Waterfowl Management Section
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8932 Apalachee Parkway
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May 25, 1994

M E M O R A N D U M

TO: Brian Barnett, Biological Administrator
Office of Environmental Services

FROM: Diane Roth Eggeman, Waterfowl Biologist
Division of Wildlife

SUBJECT: Comment on Draft Report on Kissimmee Lakes Revitalization Project

Duke Hammond provided me with pages from the draft Fish and Wildlife Coordination Act Report for the Kissimmee Headwater Lakes Revitalization Project and asked that I review them and provide comments to you. My comments concern the section on ring-necked ducks on pages 35-36. I am listed as one of the "experts consulted". I did not, to my knowledge, provide any written input for this report, but I vaguely remember discussing this issue over the telephone in the distant past. I am not comfortable with the section as it is written. The first paragraph is a fairly accurate description of the ring-necked duck and its habitat. However, the application of that information to the model appears to be based almost solely on water depth. As I indicated below, the distribution of ring-necked ducks in the upper Kissimmee Lakes and elsewhere in central and southern Florida in recent years has been most strongly influenced by the presence and abundance of "topped-out" hydrilla (hydrilla growing up to the water surface). In the absence of hydrilla, ring-necked duck habitat is characterized by deep-marsh type of vegetation, typically white water lily (Nymphaea odorata) and watershield (Brasenia schreberi). Although these communitites and their value to ring-necks are more directly determined by water depth, I would not expect the extent of these communities to be dramatically influenced by the types of water regulation changes being considered. The most important point is this: I would not expect use of the upper Kissimmee lakes by ring-necks to change appreciably as a direct result of changes in the water regulation schedule. I definitely do not want my name associated with the model for ring-necked ducks as it currently described on page 36 because the model is based solely on water depth, which is relatively unimportant given the current availability of hydrilla as habitat in the region. I suggest the following re-write of the first paragraph of this section:

"The ring-necked duck (Aythya collaris) is the most abundant species of wintering waterfowl in both the upper and lower Kissimmee basins and is an important game species. During fall migration, ring-necked ducks begin arriving in central Florida in October and remain in the Kissimmee lakes region into March. This species does not breed in Florida. Ring-necks are classified as diving ducks and typically feed in waters less than 6 feet deep (Bellrose 1980). Traditionally in Florida, ring-necks use deep-marsh habitats characterized by floating-leaved and aquatic-bed type of wetland vegetation.

Seeds of white water lily (Nymphaea odorata) and watershield (Brasenia schreberi) are considered preferred foods. In recent years, the distribution of ring-necked ducks appears to be determined primarily by the presence and abundance of "topped-out" hydrilla beds. This conclusion is based on aerial surveys and other field observations of wintering waterfowl in central and southern Florida. Johnson and Montalbano (1984) studied the selection of plant communities by wintering waterfowl in the littoral zone of Lake Okeechobee. Ring-necked ducks were the most abundant spec s observed. Of all vegetative communities available, hydrilla received the highest preference ranking, and wildcelery (Vallisineria americana) the second highest. This study examined preference based on habitat use and abundance but did not examine food habits. However, hydrilla is a predominant duck food in areas where it occurs (Montalbano et al. 1978, 1979). Johnson and Montalbano's research suggested that water depth was of relatively minor importance in habitat selection. Ring-necked ducks feed on all parts of hydrilla, including vegetation, tubers and turions. Water depth is relatively unimportant to ring-necks using hydrilla beds, because hydrilla leaves, stems, and turions are available at or near the surface even in water deeper than the birds would dive if they were feeding on foods on the bottom. Therefore, given the current availability of hydrilla in the region, changes in the hydrology of the Kissimmee lakes likely will substantially influence habitat for ring-necked ducks only to the extent that the changes directly or indirectly determine the availability of "topped-out" hydrilla."

I would also suggest the author(s) consider deleting the ring-necked duck from the report because the species is not a sensitive barometer of changes in habitat caused by changes in water regulation schedules.

Thank you for this opportunity to comment. If you have questions, please give me a call.

CITATIONS:

Bellrose, F. C. 1980. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pa. 540pp.

Johnson, F. A. and F. Montalbano III. 1984. Selection of plant communities by wintering waterfowl on Lake Okeechobee, Florida. J. Wildl. Manage. 48:174-178.

Montalbano, F., III, S. Hardin, and W. M. Hetrick. 1979. Utilization of hydrilla by ducks and coots in central Florida. Proc. Southeast. Assoc. Fish and Wildl. Agencies 33:36-42.

Montalbano, F., III, W. M. Hetrick, and T. C. Hines. 1978. Duck foods in central Florida phosphate settling ponds. Pages 247-255 in Proc. Symp. Surface Mining and Fish/Wildl. Needs in the East. U.S. U.S. Fish Wildl. Serv. Biol. Serv. Program FWS/OBS-78/81.

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cc: Mr. Duke Hammond

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May 10, 1994

Robert T. Pace, Senior Biologist
Joseph D. Carroll, Senior Biologist
U.S. Fish & Wildlife Service
P.O. Box 2676
Vero Beach, FL 32961-2676

Dear Gentleman:

I was provided a copy of your draft report entitled "Kissimmee Headwater Lakes Revitalization Project, Fish and Wildlife Coordination Act Report" for review. The following are comments as they relate to aquatic plant management in the upper Kissimmee Chain of Lakes.

The Department of Environmental Protection recognizes the significance of the Kissimmee River restoration project, and supports this effort. However, we have concerns regarding the effect the Revitalization Project may have on aquatic plant management in the upper basin lakes. Hydrilla is extremely difficult to manage in flowing water conditions. Because the Project greatly restricts periods of zero discharge, costs to manage the invasive hydrilla could escalate far above recent annual expenditures which have averaged one million dollars.

Hydrilla is expanding in the upper Kissimmee Chain of Lakes, and has the potential to adversely affect implementation of the Revitalization Project. A concerted interagency effort is now underway to develop a hydrilla management plan for the South Florida Water Management District. District staff has assured us that this management plan will be incorporated into the draft plan, and final plan, of the Revitalization Project. We, therefore, request that the USFWS Coordination Act Report also acknowledge the importance of hydrilla management in the upper basin lakes.

Please contact me at 904-488-5631 if you have any questions or comments pertaining to this issue.

Sincerely,

Judy Ludlow

Judy Ludlow, Biologist
Bureau of Aquatic Plant Management

/jl

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June 1, 1994

Mr. Robert Pace
U. S. Fish and Wildlife Service
P.O. Box 2676
Vero Beach, FL 32961-2676

Dear Mr. Pace:

After review of the supporting documentation and consultation with Tony Morrell, park manager at Lake Wales Ridge GEOpark, I have the following comments with respect to the Fish and Wildlife Coordination Act Report on the Kissimmee Headwater Lakes Revitalization Project. The proposed project will result in more frequent seasonal flooding and higher water levels within the hydric communities of Lake Kissimmee State Park; this action will contribute to the hydrological restoration of these communities within the park and is consistent with the Department of Environmental Protection's emphasis on ecosystem management. The increased water levels and periodic extreme drydown events associated with the project will assist in the eradication of exotic plants such as *Sesbania vesicaria*, and the control of pest plants, such as *Ludwigia* spp. In addition, numerous vertebrate species will benefit as a result of the restoration of these communities.

If you have any questions regarding my comments, please contact me at 407-884-2102.

Sincerely,

Alice M. Bard

Alice M. Bard, District Biologist
Bureau of Parks, District 3 Administration

AMB/amb
cc: Mark Glisson, Natural and Cultural Resources
Rosi Mulholland, District 3 Administration
Tony Morrell, Lake Wales Ridge GEOpark
Judy Ludlow, Aquatic Plant Management
Patricia Sculley, South Florida Water Management District