"To Be or Not To Be" - The Rodman Reservoir Controversy

A Review of Available Data

Submitted by:

Daniel E. Canfield Jr., Eric J. Schulz
and
Mark V. Hoyer

Department of Fisheries and Aquaculture
Center for Aquatic Plants
University of Florida
7922 NW 71st Street
Gainesville, Florida 32606

February 1993

COMMENTS FROM THE AUTHORS

Why write "To Be or Not to Be" - The Rodman Reservoir Controversy? This is a question that we, as scientists, have pondered seriously for the last several months. Our efforts on this issue have diverted our attention from other ongoing scientific studies that we feel are also very important and slowed the publication of a number of scientific manuscripts. Since the release of the first draft of this report in September 1992, we have either been praised for writing an objective and fair report or we have been cursed for writing a biased, scientifically invalid document. Our working relationships with some of our academic and professional colleagues have been strengthened, but with others the relationships have been severely tested. Our reputations have also been attacked in the public arena. For example, David Godfrey, a spokesperson for the Florida Defenders of the Environment, was recently quoted in The Florida Times-Union (OUTDOORS SUNDAY - February 7, 1993) as calling the senior author of this report a "biostitute" or biologist/prostitute paid to do a study. So why write this report? We did it because we strongly believe "it was the right thing to do."

The Rodman Reservoir controversy is primarily a philosophical debate between a group that wishes to keep Rodman Reservoir and its associated biological community and a group that believes it would be best to remove the reservoir and reestablish the free-flowing Oklawaha River and its associated floodplain forest community. Thus, the essence of the debate is one of values! We do not believe that it is the proper role for science or scientists to advocate "value" judgments. We believe that science and scientists should inform the public and policy-makers of the facts and what the consequences of individual actions might be. It, however, is the role of society and its policy-makers to establish or affirm society's value judgments through the democratic process.

In the case of the Rodman Reservoir controversy, each side of the debate has invoked the name of science or scientists in order to add credibility to their arguments. We concur with Gray Bass, a fisheries biologist with the Florida Game and Fresh Water Fish Commission, that there probably is not now a purely professional answer to the Rodman Reservoir controversy. We, however, strongly believe that there have been deliberate campaigns of misinformation, designed to influence not only the value judgments of individual Floridians, but also Florida's policy-makers. Some individuals might argue that campaigns of misinformation are common in todays politics and should be of no great concern as each side of an issue will mount them. We do not accept this rationalization!

Campaigns of misinformation have been taking place for over 20 years in the Rodman Reservoir controversy. Because of these campaigns, misinformation such as the number of species of fish in the Oklawaha River drainage basin has been entered erroneously into the scientific record (see Issue 3 of Fish Populations and the Fisheries of Rodman Reservoir). Such intentional and often personally-motivated misrepresentations of the facts have been accepted by some "scientists" as a justifiable means to achieve the noble end of a "natural," free-flowing Oklawaha River. We, as scientists, cannot let this stand because it is a bastardization of the scientific process and shall hurt future efforts to obtain knowledge for scientific research and for management of Florida's natural resources. The bastardization of the scientific process and the resultant devaluation of scientific information jeopardizes not only the role of science in policy making, but also the integrity of policy decisions themselves. Policy-makers recognize that they must have the facts. Consequently, we attempted to the best of our abilities in this report to fairly evaluate the facts as they exist. Because our analyses tend to refute the published and verbal statements of the proponents of restoration, some individuals concluded that we are "Supporters of Rodman Reservoir." As scientists, we do not support either side of the Rodman Controversy and as citizens, we do not accept the philosophy that "The Ends Justify the Means!"

Some of our scientific colleagues (many call themselves Conservation Biologists) are strong supporters of restoration. From what we can glean from the writings and seminars of Conservation Biologists, they strongly believe that it should be the goal of Floridians to restore Florida's diverse ecosystems to the condition that existed prior to European colonization. We have no dispute with that stated goal; it is but one of many possible management objectives. It, however, is a "value judgment" to state that these systems are biologically more valuable than others. We also have strong disagreements with our colleagues when they try to connote that hypothetical concepts, that are currently being debated in the scientific community, represent theoretical advances (i.e., acceptance by the scientific community). Many of the arguments advanced in the Rodman Reservoir controversy are highly generalized. Generalized ideas, such as "it is good for the environment" or "it is important to preserve the biological integrity of natural ecosystems," may be extremely stimulating, but they do not offer a shortcut to the truth, if they are based on loosely defined premises.

The Rodman Reservoir controversy is no longer just a debate about what to do with a man-made reservoir. It has transcended that issue and become a controversy about how we will do "science" and establish public policy in Florida. It is about uncritical advocacy disguised as science, zealotry masquerading as principle, and fairness. More importantly, it is an issue about "who is telling the truth" and "due process."

We believe the Rodman Reservoir controversy has damaged both the scientific and democratic processes. So it is appropriate to ask what should be done now, given the present situation. We suggest, as one possible solution, that the Florida legislature consider an innovative conflict resolution technique developed by Susan Littell Canfield at the University of Florida. The approach known as TEAM -"Together for Environmental Assessment and Management," offers a mechanism to fairly blend scientific facts and opinion with public opinion. We present the TEAM approach below for consideration.

We recognize that many individuals will oppose implementing the TEAM approach because they believe that there has been enough debate and it is time to act! We, however, believe that most Floridians want a fair process and the best decision that can be reached based on the available scientific information. Each side of the Rodman Reservoir controversy believes that they are "right." They, therefore, should not fear the decision that would be rendered by a "jury of their peers" that would be convened under the TEAM approach.

Respectfully,

Daniel E. Canfield Jr.

Eric J. Schulz

Mark V. Hoyer

A FRESH OPPORTUNITY AND MEANS OF RESOLUTION

SUSAN LITTELL CANFIELD
DEPARTMENT OF FORESTRY
SCHOOL OF FOREST RESOURCES AND CONSERVATION
UNIVERSITY OF FLORIDA
GAINESVILLE, FLORIDA

Realizing that voting for restoration of the Oklawaha River, retention of Rodman Reservoir, or more environmental/economic studies may be politically unappealing options to varying degrees for Florida's legislators, I propose a method for soliciting a **"mandate directly from the people"** of the State of Florida. This method is the TEAM approach, "Together for Environmental Assessment and Management."

TEAM offers a mechanism to blend public opinion and scientific information. The strengths of this approach are rooted in participatory and representative democracy. It provides citizens with the opportunity to debate and reach workable compromises that reflect the needs and desires of the community-at-large, but it does not trample on the rights of the minority. While incorporating the strengths of peer-reviewed science, TEAM provides a basis for separating scientific issues from "matters of state." It is cost-effective because it resolves issues in a timely manner and it provides a recommendation (s) to policy makers that reflect societal compromise. It should also engender widespread public approval for any action taken because it permits citizens of all socioeconomic groups to participate equally in the process.

The product of the TEAM approach is a recommendation(s) to policy makers, presumably the Florida Legislature in the case of the Rodman Reservoir controversy, from a group of citizens participating in a modified American Assembly conference. These citizens, who are chosen to represent Florida's citizenry, shall carefully consider the pros and cons of the issues with the benefit of current and comprehensive scientific information, which shall be provided through a peer-reviewed scientific issues forum. The modified American Assembly Conference shall provide citizens with a forum where all the issues surrounding a controversy can be debated in a fair and open setting; majority views as well as minority views on all issues would be encouraged. Once the Assembly of citizens complete their debates and provide their final recommendations, the Florida Legislature is empowered to act on the wishes of the "majority of the people of Florida."

Implementation of the TEAM approach initially involves convening a 2 to 3 day TEAM meeting at which the representative group of citizens identifies and prioritizes the issues as they see them for any given controversy, in this case the issues that define the Rodman Reservoir controversy. Then, a scientific issues forum is convened and scientists representing both sides of an issue like the Rodman Reservoir controversy debate the available information and eventually make it available in a form that is understandable and organized according to the priorities the citizens established. The scientific experts, rather than being asked to recommend policy, are relegated to a supportive role in the policy making process, thus maintaining their scientific independence; this uncoupling of the evolution of scientific information from the political process is one of the overwhelming strengths of the TEAM approach. Finally, the same group of citizens meets again for 2 to 3 days after receiving the full range of pertinent scientific information from the scientific issues forum. They discuss the issues they identified at their first meeting, alternatives for resolution, and ultimately make a democratic recommendation(s) regarding resolution of the controversy to policy makers.

The TEAM approach, as mentioned above, involves three steps: Step 1) Identification and prioritization of the issues - modified American Assembly Conference, Step 2) Development of scientific information and consensus - Scientific Issues Forum, and Step 3) Discussion of alternatives and recommendation - modified American Assembly Conference. These steps are outlined in Figure 1 and discussed in detail below for resolving the Rodman Reservoir controversy.

A group of individuals is needed to organize and run the TEAM approach. I suggest that the Canal Authority of the Florida Department of Natural Resources be charged with the primary responsibility of organizing and running the TEAM approach. To insure fairness, the Canal Authority should be assisted by a steering committee. The steering committee should be chosen so that its members reflect the diversity of parties with a interest in the Rodman Reservoir controversy. For example, the Steering Committee might consist of 12 members including one appointee from each of the following groups: supporters of Rodman Reservoir, supporters of Oklawaha River restoration, St. Johns River Water Management District, Florida Department of Natural Resources, Florida Department of Environmental Regulation, Florida Game and Fresh Water Fish Commission, U.S. Army Corps of Engineers, Department of Community Affairs, State University System, the Florida Senate, the Florida House of Representatives and the Florida Cabinet.

STEP 1: MODIFIED AMERICAN ASSEMBLY CONFERENCE - PHASE 1

As previously stated, the purpose of Phase 1 of the modified American Assembly Conference is to identify and prioritize the issues of the Rodman Reservoir controversy as perceived by the citizens of Florida. To insure fair representation, I suggest one hundred citizens should be invited by the Steering Committee to participate in Phase 1. I suggest the following mix of individuals: 10 supporting retention of Rodman Reservoir, 10 supporting restoration of the Oklawaha River, 30 community leaders (including business, academic, and philanthropic leaders) selected by the steering committee, and 50 randomly selected citizens from the Florida Drivers License Registry. Phase 1 should be conducted over a weekend and, if necessary, compensation similar to that of a juror should be paid to insure that the citizens are truly representative and not simply those with flexibility to take time from work.

Upon convening Phase 1 of the modified American Assembly Conference (Figure 2), the participants are presented with the format, the explicit purpose of, and their role in the conference. Two or three keynote speakers introduce the main facets of the Rodman Reservoir controversy. Then, the participants break into groups called TEAM huddles, and begin to identify and define the issues they consider important. Each group is serviced by a facilitator and a recorder. Following the first TEAM huddle, the facilitators and recorders meet with conference staff and together they produce a complete list of issues as defined by all the groups. In the second TEAM huddle, working with the complete list of issues, the participants prioritize the issues. Following the second TEAM huddle, facilitators, recorders, and conference staff combine the ranked issues and produce a draft list of prioritized issues. Last, the participants meet as a whole group, have the opportunity to make final changes, and ratify the list of prioritized issues.

The final list of prioritized issues is passed on to Step 2, the Scientific Issues Forum. The scientists involved in this step develop and provide information pertinent to the issues as listed.

STEP 2: SCIENTIFIC ISSUES FORUM

The Steering Committee invites scientists having expertise applicable to or directly involved in the Rodman Reservoir controversy to a Scientific Assembly, a brief meeting at which they discuss and decide which scientific issue areas are pertinent to the larger issues identified in Step 1 (Figure 3). At the conclusion of the Scientific Assembly, the scientists are divided into two teams, a pro team and con team. In the case of Rodman Reservoir, one team will defend the retention of Rodman Reservoir and the other the restoration of the Oklawaha River.

The pro and con teams engage in a peer-review process, the length of which is to be determined by the Steering Committee. The length of time allotted by the Steering Committee should reflect the complexity of the issue; in the case of Rodman Reservoir the time period might range between six months and a year. Each team should assemble scientific evidence pertinent to their respective case and disclose this evidence to the opposing team. After the discovery and disclosure period, each team prepares a report addressing the issues identified in Step 1 and the Scientific Assembly, and then sends the report for review to the opposing scientific team. Following peer-review, the teams rewrite their respective reports. In rewriting, each team must address the specific criticisms of the opposing team. The review and rewrite stages may be repeated if necessary and time permitting. The final reports of each team should include the following: 1) points of agreement, 2) points where additional studies are needed, if any, and 3) points of disagreement, if any, accompanied by explanations of why they disagree with the opposing team.

Finally, the Steering Committee combines the final reports from each team into one document, which is provided to the participants of Phase 1 of the modified American Assembly Conference. These citizens are reconvened for two to three days for Phase 2 of the modified American Assembly Conference.

STEP 3: MODIFIED AMERICAN ASSEMBLY CONFERENCE-PHASE 2

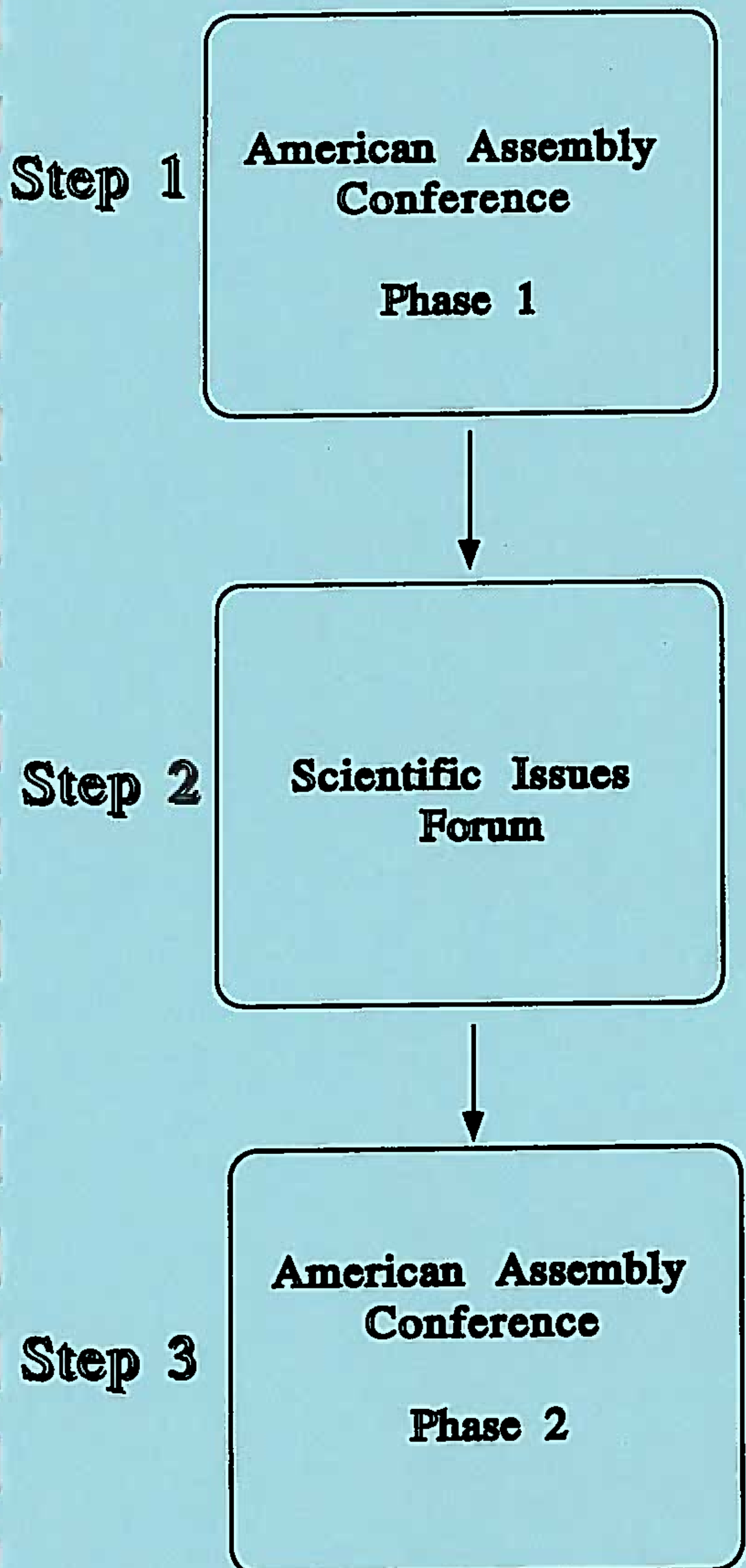
The purpose of Phase 2 of the modified American Assembly Conference is to: 1) discuss and debate the issues identified in Phase 1, given that each citizen has had an opportunity to review the scientific evidence provided to them; 2) identify alternatives for resolving the controversy; and 3) produce a final report that contains both majority and minority recommendations (Figure 4).

As in Phase 1, the participants are presented with the format, the explicit purpose of, and their tasks in Phase 2. The participants return to their TEAM huddles and discuss and debate the issues they identified in Phase 1 with the benefit of the Scientific Issues Forum final report. The participants draft proposals for resolution of the Rodman Reservoir controversy.

Facilitators, recorders, and conference staff combine the proposals from each group into a single list of proposals. In the second TEAM huddle, working with the complete list of proposals, the groups edit the proposals and each group produces majority and minority (if any) recommendation(s) for the resolution of the Rodman Reservoir controversy. Facilitators, recorders, and conference staff combine the recommendations into a draft final recommendation(s). Finally, the participants convene as a whole assembly, make modifications to the recommendation(s) (if necessary), and ratify by majority vote, the final recommendation(s).

The final recommendation(s), **"the mandate from the people of Florida"**, is provided to the appropriate policy makers, presumably the Florida Legislature, for debate and action. With this recommendation, the Florida Legislature is empowered to act on the wishes of the majority of the people of Florida. The process, however, also clearly identifies minority views and does not trample on the rights of expression of the minority. An investment by the Florida Legislature in the TEAM approach should result in widespread public approval for the ultimate action taken. If future evidence indicates the majority view was incorrect, future decision makers shall have the benefit of the minority view for different action.

Figure 1: The three steps of the TEAM Approach



Step 1

Purpose: Identification and prioritization of the issues as perceived by the citizenry

Time table: 3 days maximum

Product: Written document detailing the issues for the Scientific Issues Forum

Step 2

Purpose: Identification of the scientific issues pertinent to the issues raised in Phase 1 of the American Assembly Conference

Time table: 2 days maximum followed by a peer review period that may vary in length

Product: Written document presenting the pros and cons of each scientific issue

Step 3

Purpose: With the aid of the report produced by the Scientific Issues Forum, discuss/ debate the issues identified in Phase 1, make proposals, and formulate recommendations

Time table: 3 days

Product: Written document submitting the final recommendations from the citizenry

Figure 2: The format of Phase 1 of the American Assembly Conference

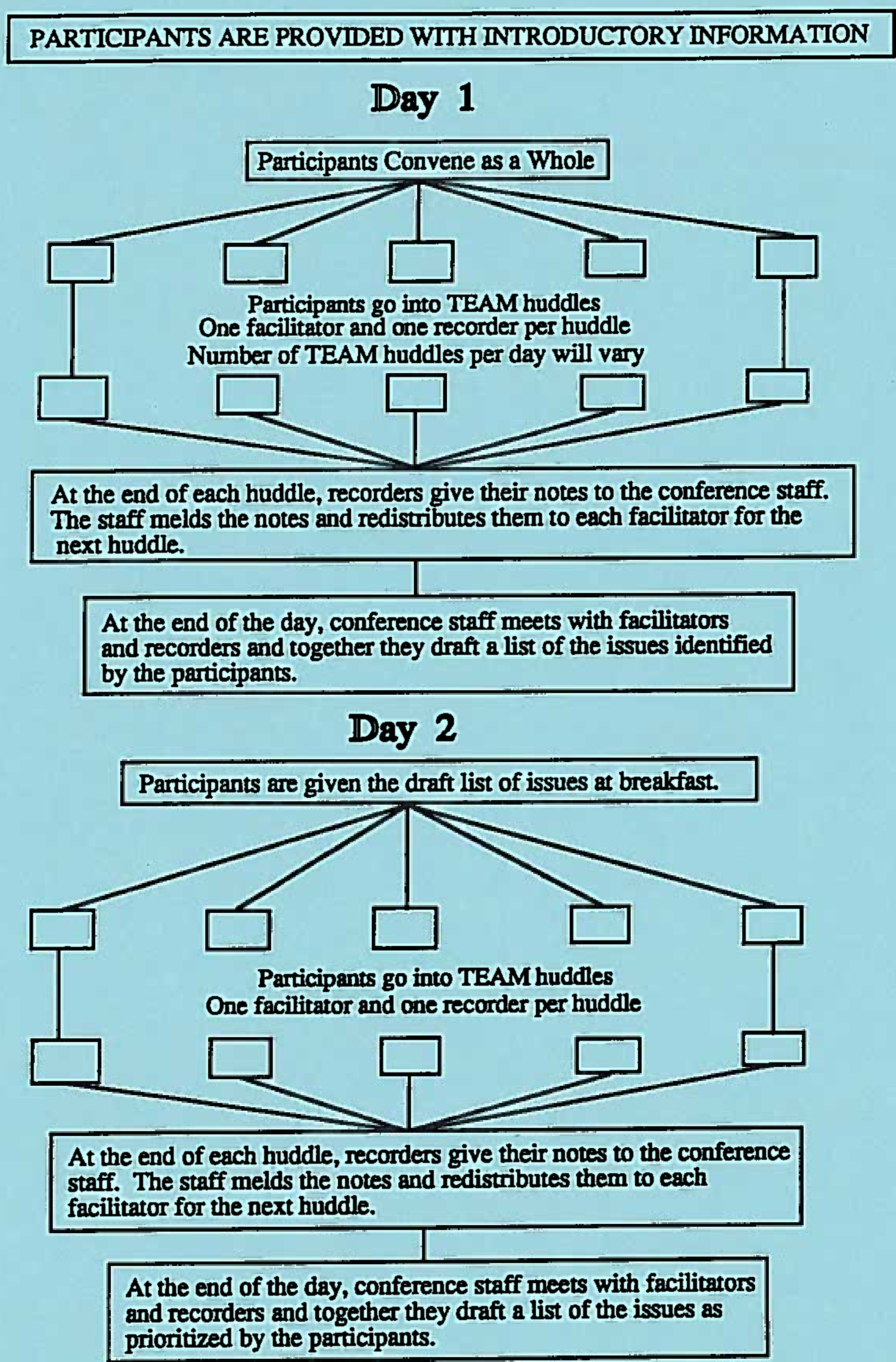


Figure 2: Continued

Day 3

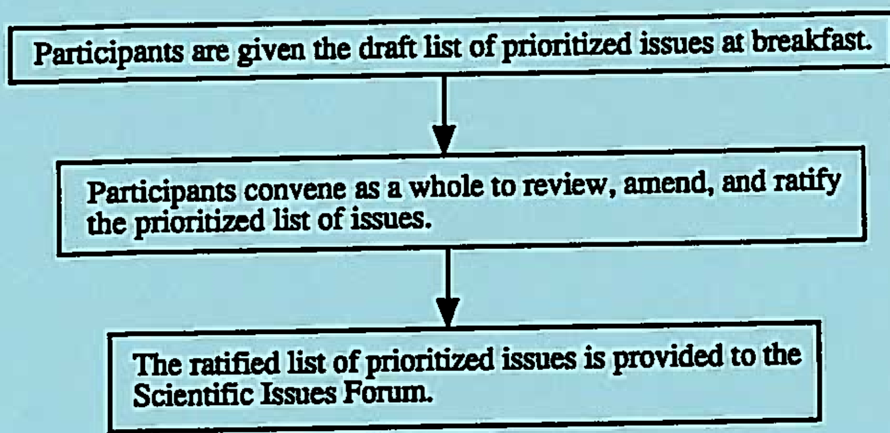


Figure 3: The format of the Scientific Issues Forum

Day 1

PARTICIPANTS OF THE SCIENTIFIC ASSEMBLY CONVENE

With the aid of a facilitator and a recorder, scientists discuss and identify scientific issues pertinent to the issues raised in Phase 1 of the American Assembly Conference.

At the end of the day, conference staff meets with facilitators and recorders and together they draft a list of the pertinent scientific issues identified.

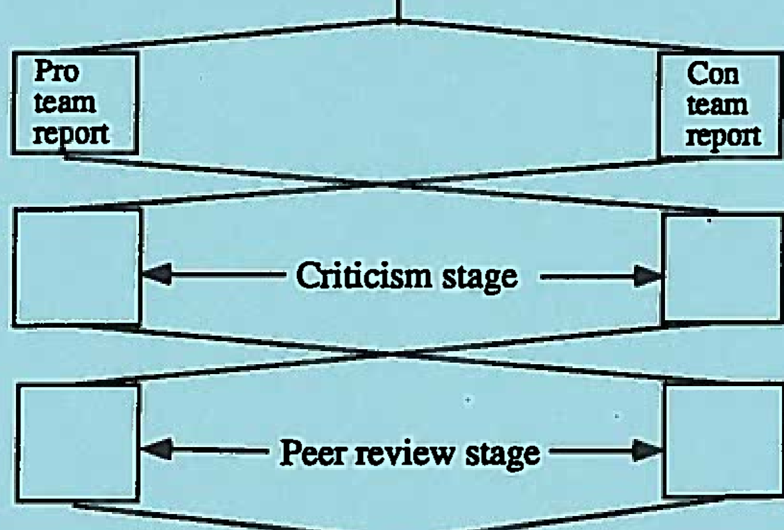
Day 2

Participants are given a draft of the scientific issues list at breakfast.

Participants convene to review, amend, and ratify the list of scientific issues. Participants are assigned to pro and con teams.
*The activities of Day 2 can be incorporated into Day 1 whenever possible.

Peer Review Period

The pro and con teams each write a report presenting their respective side.The reports are organized such that each scientific issue is specifically associated with one of the larger issues identified in Phase 1 of the American Assembly Conference.



The criticism and rewrite stages may be repeated several times.

A final rewrite is produced by each team. Where disagreements persist pertaining to specific scientific issues, each team addresses the reason(s) for disagreement.

Steering Committee staff meld the final reports from each team together and forward the final document to the conference staff of Phase 2 of the American Assembly Conference.

Figure 4: The format of Phase 2 of the American Assembly Conference

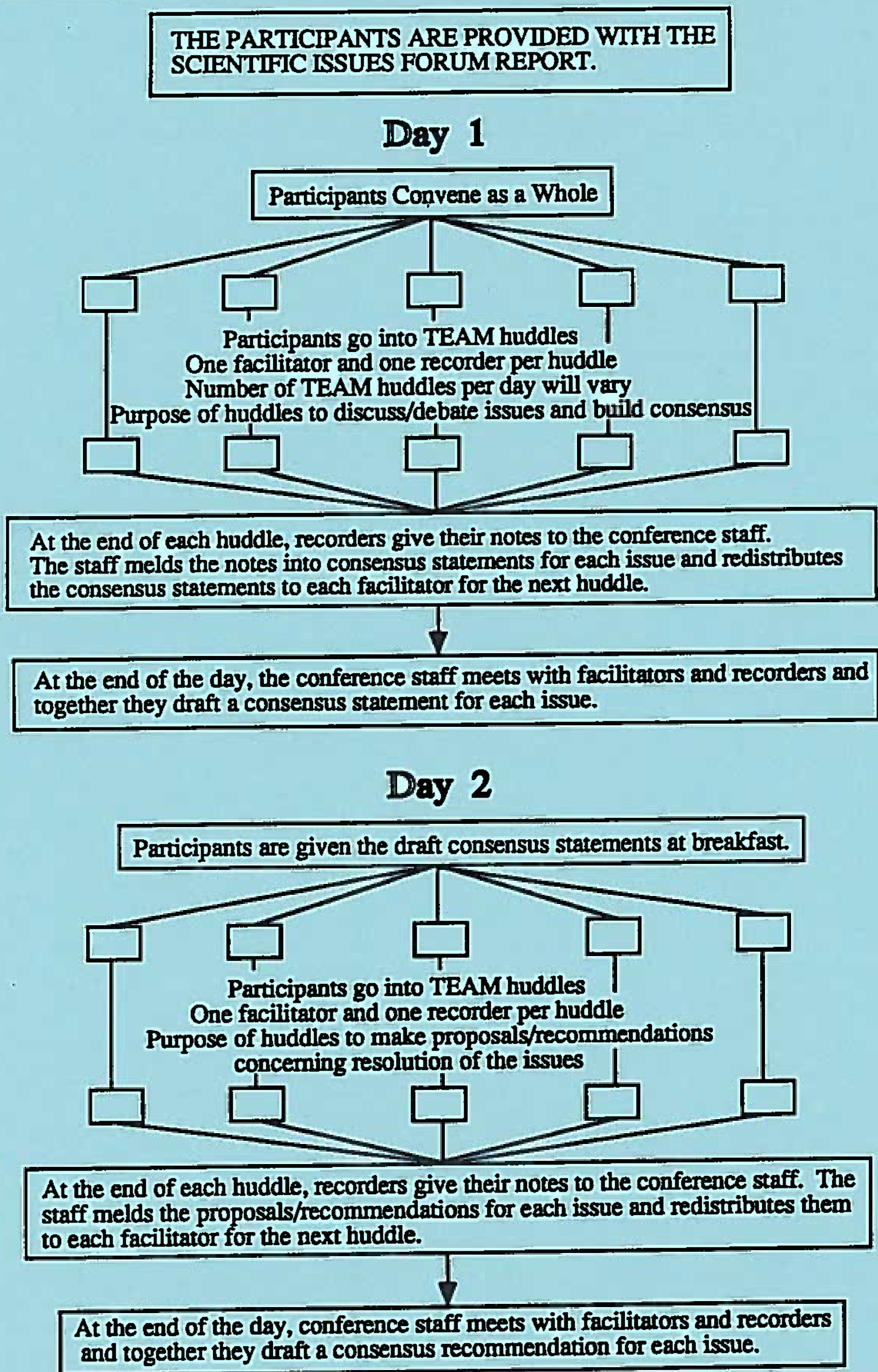


Figure 4: Continued

Day 3

Participants are given the draft recommendations at breakfast.

↓

Participants convene as a whole to review, amend, and ratify the final recommendations.

↓

The ratified final recommendations are provided to the appropriate policy makers.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

PAGE

FISH POPULATIONS AND THE FISHERIES OF RODMAN RESERVOIR

WILDLIFE POPULATIONS

TABLE OF CONTENTS (CONTINUED)

PAGE

TABLE OF CONTENTS (CONTINUED)

EXECUTIVE SUMMARY

An environmental and economic analysis of the Rodman Reservoir controversy was done between August 1992 and January 1993 to evaluate the pros and cons on some of the major points of debate. This report presents a summary of the analysis with the hope that it can assist interested parties and policy-makers with evaluating the existing claims and counter-claims.

We realize that few citizens and policy-makers will have the time or inclination to completely read this report. We also understand that many readers will rely on the Executive Summary to weigh the value of this report. We, however, urge all readers, who remain confused by an individual issue after reading the Executive Summary, to read that section in this report entirely. It is difficult, if not impossible, to summarize all of the complicated points in the Rodman Reservoir controversy in one short statement.

This report includes historical information and new data, including new fisheries and wildlife data, collected in 1992 and 1993. Because proponents of restoration have written extensively and eloquently about their concerns, issues addressed in this report are introduced with the claims made by proponents of restoration. The supporters of Rodman Reservoir, however, have produced comparatively little written material to make a case for Rodman Reservoir. Consequently, the available information for each issue was further analyzed to determine if a case could be made for Rodman Reservoir.

The Rodman Reservoir controversy is complex and there are hundreds of issues that could be relevant to the ongoing debate. This report is divided into three sections, and within each section major issues of the controversy are addressed. The first section deals primarily with philosophical issues that directly impact how different individuals interpret information relevant to the controversy. The second section addresses the major environmental issues that have been raised by both sides and the third section addresses some of the more relevant economic concerns.

The primary findings of this report are:

1) The Rodman Reservoir debate is primarily a philosophical debate between those who believe a free-flowing river and its associated floodplain forest are a more valuable ecosystem and those who believe a well-managed reservoir best meets the needs of not only fish and wildlife, but also the human community.

2) Rodman Reservoir is not a simple ecosystem. It includes floodplain forest, riverine habitat, a major transition zone, and a large area of aquatic habitat known as Rodman pool. Rodman Reservoir should, therefore, be thought of as a mosaic of interdependent terrestrial and aquatic habitats (The Rodman Reservoir Complex), not just another lake.

3) The Rodman Reservoir Complex supports an abundant and diverse flora and fauna and it has not eliminated the diverse flora and fauna of the Oklawaha River Valley. Rodman Reservoir also is not a "dying" water body that is destined for "biological senility" in our lifetime or the lifetime of our grandchildren. The Rodman Reservoir Complex will last hundreds of years with no management and longer if managed well.

4) The Rodman Reservoir Complex is unique among regional lakes because it can be a highly managed system for fish and wildlife. It is the only large aquatic system in the region where conflicting uses such as water supply, swimming, recreational boating, and aesthetics for riparian homeowners, would not limit or preclude water level fluctuations for fish and wildlife management objectives. In times of drought, the large water supply provided by upstream springs would still permit water level fluctuations. Thus, the Rodman Reservoir Complex would continue to serve as a refuge for not only fish and wildlife, but also anglers.

5) Fish population estimates based on rotenone sampling from 18 different sampling dates between 1970 and 1992 showed that Rodman Reservoir has experienced major fluctuations in the abundance of fish, primarily in response to water level changes. There, however, is no evidence of a major decline in fish abundance since 1970. There also is no evidence that sportfish abundance is declining, or that "trash fish" are replacing sportfish.

6) The fish populations in Rodman Reservoir and the Oklawaha River (above and below the reservoir) were sampled in August 1992, using rotenone sampling in the reservoir and multiple-removal electrofishing techniques in the Oklawaha River. Based on these studies, Rodman Reservoir supported over 50 times the total fish biomass that could be supported in a restored 16 mile section of the Oklawaha River. Rodman Reservoir also supported more species of fish than the Oklawaha River.

7) A restored Oklawaha River cannot support as much fishing effort as Rodman Reservoir. The river also cannot produce as many fish as Rodman Reservoir, thus fishing in the Oklawaha River will never be as good as fishing in Rodman Reservoir.

8) Largemouth bass fishing effort has declined in Rodman Reservoir since the mid-1970s, but has remained relatively constant since the 1980s. Fishing effort at Rodman Reservoir in the 1980s compared very well with other "good" fishing lakes such as Lake Okeechobee. Largemouth bass fishing could be greatly improved if the reservoir were managed with well-timed water level fluctuations.

9) There is no evidence that the construction of Rodman Reservoir has eliminated any species of fish from the Oklawaha River drainage basin. There is some evidence that the dam may have impeded migratory fish runs of some species, but no major effects on the regional abundance of migratory fish species have been documented. Rodman Reservoir does not completely block migratory fish and there are methods available for enhancing the upstream movement of migratory fish if this is ever shown to be necessary.

10) Aquatic bird populations and populations of other birds associated with water were counted on Rodman Reservoir and the Oklawaha River in August 1992 and January 1993. Based on these surveys, Rodman Reservoir supported a larger number and more than twice the number of species of birds than the Oklawaha River. Destruction of Rodman Reservoir would not be beneficial to many of these birds, including endangered species and species of special concern (e.g., the bald eagle) because there is little excess suitable habitat available for the birds on regional lakes.

11) The construction of Rodman Reservoir has not eliminated the Oklawaha River's floodplain forest community and its unique fauna. Many miles of free-flowing river still exist.

12) According to home range studies by the Florida Game and Fresh Water Fish Commission, a restored 16 mile section Oklawaha River cannot serve as a major habitat for wide ranging animals like the black bear or the Florida panther. Reestablishment of the 9000 acres of floodplain forest that were incorporated into the Rodman Reservoir Complex, if it could be done, could support approximately 1 bear and less than one panther. There is no evidence that the existing Rodman Reservoir Complex is not a suitable wildlife corridor for bear, panthers, and other wildlife.

13) There is no evidence that removal of Rodman dam will establish migrations of the West Indian Manatee to upstream springs such as Silver Springs. Manatees were in Rodman Reservoir in the 1970s and early 1980s, but none of these animals traveled to Silver Springs. Manatees that passed through Buckman lock were observed feeding on hydrilla and other aquatic plants in Rodman Reservoir. Manatees have not been in Rodman Reservoir since the mid-1980s because their entrance has been discouraged by human intervention. Manatees can be safely moved through locks and Rodman Reservoir could become a major foraging site for manatees if they were once again allowed to enter the reservoir.

14) Operating and maintenance costs of the Rodman Reservoir Complex could exceed $1 million per year if the reservoir is managed <u>as designed</u> for carrying barge traffic. If the reservoir is managed for new objectives, costs will be substantially reduced below $1 million per year. The net operating costs of Buckman Lock and the Rodman dam compared to the costs of a restored river appear to be in the range of $265,000 to $338,000 per year.

15) Sport fishing at the Rodman Reservoir Complex contributes at least $7.2 million annually to the economy of Putnam County and it supports over 100 jobs. Revenues generated from sport fishing are more than sufficient to cover the operation of the Rodman Reservoir Complex.

16) Rodman Reservoir is a resource that services the recreational needs of groups other than anglers. Based on recreational-use surveys by the U.S. Army Corps of Engineers, only 57% of the use of Rodman Reservoir was fishing. The remaining 43% of recreational use constituted a wide diversity of activities including picnicking, sightseeing, camping, and hunting.

17) The Rodman Reservoir Complex is not used by just a handful of people. Visitation to Rodman Reservoir has varied from 168,600 visitor days in 1969 when the reservoir was first filled to a high of 484,000 visitor days in 1990. In 1992, 310,700 visitor days were recorded, which is more recreational use than all but 12 of Florida's 126 state parks. This use has occurred without the development of major recreational facilities.

18) Rodman Reservoir now generates a net economic gain relative to its operational costs. The costs of managing a restored Oklawaha River and the economic gains to be realized from increased numbers of tourists and anglers remain speculative. A restored Oklawaha River will cost taxpayers money, not only for restoration but also for management. The operation and maintenance of the Cross Florida Greenbelt will require a number of government employees for administration and field operations if current management recommendations, such as the creation of a new bureau in the Florida Department of Natural Resources, are adopted.

19) The cost estimates for restoring 16 miles of the Oklawaha River range from $7.4 million to over $27 million. The actual costs may be higher depending upon what is considered acceptable restoration.

We recommend that Rodman Reservoir be retained for now, the primary management objective being the enhancement of fish and wildlife populations. We suggest that the State of Florida should manage Rodman Reservoir as a recreational reservoir for at least the next 20 years, because 20 years is adequate time to not only evaluate the effects of intensive management on fish and wildlife populations given the life cycles of animals, but also to resolve questions related to the economic-ecological costs/benefits of keeping Rodman Reservoir.

Management of the reservoir should be entrusted to a single agency with individuals committed to the management objective of enhancing fish and wildlife populations. We further suggest that an objective evaluation of Rodman Reservoir and the Oklawaha River be completed over the next 20 years. This evaluation should be a coordinated study by all the agencies that are currently working in the Oklawaha River Valley (e.g., St. Johns River Water Management District, Florida Game and Fresh Water Fish Commission, and university researchers). If the Florida legislature instructs the groups to work together, few additional resources should be needed as each agency has ongoing studies that could produce the needed information in time or could redirect resources from projects that are ending to address new issues. After these studies, if compelling reasons emerge that support the need to remove Rodman Reservoir, the Florida Legislature could then decide to restore the Oklawaha River. There currently is no compelling biological/ecological reason to rush restoration at this time.

INTRODUCTION

The Cross Florida Barge Canal (CFBC) was authorized on July 23, 1942 by Public Law 675 of the 77th Congress. Rodman Reservoir (Lake Oklawaha or Lake Ocklawaha) was created amidst much controversy in the fall of 1968 as part of the CFBC project. The construction of Rodman Reservoir was controversial because many individuals and environmental organizations, such as the Florida Defenders of the Environment Inc., were opposed to inundation of 16 miles of the Oklawaha River Valley. On November 26, 1991, the President of the United States signed legislation that deauthorized the CFBC, but this did not end the Rodman Reservoir controversy. Instead, it began an intense debate on the difficult question of whether to keep or destroy Rodman Reservoir.

Since the deauthorization of the Cross Florida Barge Canal, the debate concerning the future of Rodman Reservoir and the potential restoration of the Oklawaha River Valley has become extremely polarized. Proponents of restoration consider the reservoir to be an illegitimate offspring of the scenic Oklawaha River. They cite evidence suggesting Rodman Reservoir is harmful to the environment and that it would be cost effective to remove the dam. They further believe that the controversy cannot be satisfactorily resolved until Rodman Reservoir is removed and the free-flowing Oklawaha River with its associated floodplain forest is reestablished. Supporters of Rodman Reservoir, however, cite evidence suggesting that the dam is beneficial to the environment and that it would be more cost effective to keep Rodman Reservoir. They see the reservoir, nurtured through management, as an economically valuable and important recreational resource for north Florida.

Both sides debate vigorously and they cite information obtained from numerous studies conducted on Rodman Reservoir and the Oklawaha River to defend their positions (e.g., Duchrow 1971; Duchrow and Starling 1972; U. S. Army Corps of Engineers 1976; Haller and Shireman 1984; Estes et al. 1989). Both sides also claim that the other side is misleading the public and decision makers by spreading misinformation and making false claims to the press. Because it is difficult to determine what the "truth" is in the Rodman Reservoir debate, we conducted an independent analysis of the Rodman Reservoir controversy to determine, to the best of our ability, which pros and cons of the major points of the debate are substantiated by scientific evidence.

We present here a summary of our analysis to assist interested parties with evaluating the existing claims and counter-claims. We include historical information and new data collected by us and others in 1992 and 1993. It is important to note here that the proponents of restoration have been well organized and well funded over the last 20 years. Consequently, they have written extensively and eloquently about their concerns. The supporters of Rodman Reservoir, however, have been less well organized and they have produced comparatively little written material to make a case for Rodman Reservoir. Therefore, we introduce most issues in this report with the claims made by the proponents of restoration. Then, we examine the available information for each issue to determine if a scientifically-based case can be made for maintaining or removing Rodman Reservoir.

The Rodman Reservoir controversy is complex and there are hundreds of issues that could be relevant to the ongoing debate. This report deals only with the major issues and is not inclusive of all issues that have been raised concerning the Rodman Reservoir controversy. Because it is important to keep scientific issues separated from philosophical (e.g., individual or societal value judgments) and economic issues, this report is divided into three sections. Within each section, major issues of the controversy are addressed. The first section deals primarily with philosophical issues that directly impact how different individuals interpret information relevant to the controversy. The second section addresses the major environmental issues that have been raised by both sides and the third section addresses relevant economic concerns. We have numbered the issues within each section in this report to assist readers with finding information on issues that may concern them. The order of presentation is not intended to imply anything about the relative importance of the issues.

PHILOSOPHICAL ISSUES

ISSUE 1. MAN VERSUS NATURE.

Proponents of restoration and supporters of Rodman Reservoir interpret many of the environmental and economic issues in the Rodman Controversy differently because of opposing views on the role of humans in the environment. Many of the proponents of restoration believe that it should be the goal of society to maintain or restore the functioning of native ecosystems. They believe that this requires no intrusive or at least minimal human uses. Many supporters of Rodman Reservoir, however, believe that humans can change native ecosystems and can manage the newly created ecosystems not only for the benefit of wildlife, but also for humans. They believe humans are an integral part of the environment and that human-created ecosystems, given rapid human population growth and its associated demands on natural resources, can have as much biological value as native ecosystems.

Early in human history, humans faced immense challenges to survive. The natural environment was often hostile and meeting the basic needs of life (e.g., food, water, and shelter) was often difficult. Consequently, human populations throughout the world remained relatively small. Although it is nostalgic to believe that early humans lived in "harmony" with nature and did nothing to alter the native environment, nothing is further from the truth. Nearly every culture, including the human communities that occupied Florida before the arrival of Europeans, used human creativity to alter the native environment to increase their chance for survival.

With the industrial revolution and technical advances in fields such as medicine, humans began to populate the earth in ever increasing numbers. Humans also achieved sufficient technology to radically alter the native environment. In the United States, early societal concerns focused on the westward expansion and the "taming" of the wilderness. In Florida, the State sold large areas of land to private individuals for the purpose of "improving" the land and making "worthless swamps" productive for human uses such as agriculture. Growth and economic development were priorities for a young nation and a State that was nearly bankrupt.

In the early 1900s, there were increased concerns about the rapid exploitation of natural resources. Conservation movements developed and people such as Teddy Roosevelt helped establish national parks and forests. Organizations such as the U.S. Forest Service, Soil Conservation Service, and state fish and game agencies were established to manage natural resources. These efforts, however, did not curb the loss of native ecosystems and calls went forth from men such as Aldo Leopold for the development of a new "land ethic" (Leopold 1949).

Leopold and his disciples called for the development of an "ecological ethic" that placed limitations on methods that humans had previously used in their struggle for existence (Leopold 1949). The new ecological ethic called for changing the role of humans from conquerors of the land community to plain members and citizens of the ecological community. This new ethic called for the development of an "Ecological Conscience" that recognized the rights of all plants, animals, and natural communities to exist.

The efforts of people like Leopold (1949) led to the development of a strong conservation movement in the 1960s, 1970s, and 1980s. A fundamental debate soon began among conservationists in North America as to whether management for conservation should be directed solely towards restoring the biological community to its native condition (prior to European colonization) or towards accepting and managing the modified landscape and its associated biological community. By the 1980s, those individuals, whose conservation goal was primarily restoration of the biological community to its native condition and those individuals, who were concerned with issues like the extinction of species, began to unite under a new banner known as "Conservation Biology" (Soule and Wilcox 1980; Soule, 1986).

Leopold (1949) believed that humans were members of a larger biotic team and that conservation is a state of harmony between humans and the environment. Conservation biology has become the biology of scarcity and conservation biologists are consulted when an ecosystem, habitat, species, or population is subject to some kind of artificial limitation (Soule 1986). Today, some individuals associated with the conservation biology movement do not see humans as an integral part of the environment because humans have the ability to radically change native ecosystems. Because of their concerns for what they perceive as detrimental cultural impacts, some of these individuals believe that native ecosystems have greater biological value than ecosystems that arise from human activities (Ewel et al. 1992). Consequently, proponents of restoration have stated that it is pointless to say that a "new ecosystem" of long-term biological value has been created at Rodman Reservoir.

ISSUE 2. NATURALISM VERSUS MANAGEMENT.

The belief that "Mother Nature Knows Best" has divided members of both the lay and scientific community into two basic groups. One group believes that humans are not omnipotent and that management of natural resources by humans has contributed to the "ecological mess" that they believe the planet is now experiencing. They call for "restoration of natural ecological processes" and the "preservation of natural ecological communities" to guarantee sustainable use for future generations. They, however, also believe that human uses of the resources should be either curtailed or minimized. The other group generally believes that humans can manage the environment not only for the long-term sustainability of human populations, but also for different ecological communities. Individuals, who believe in "intensive human" management of natural resources, include humans as an integral part of the environment. They recognize that unless someone figures out how to reduce population growth or convinces people to move out of areas like Florida, it is not going to be possible to reestablish the "native ecological communities" that existed prior to human settlement.

Although the philosophical debates between "Naturalists" and "Managers" can be intense and highly complicated, both groups in practice are managers. Why? Management in the larger context must be viewed as a continuum ranging from the decision to preserve to the decision to manage. In Florida, the debate often centers on what one calls "natural." There are a number of preserves in Florida, including Paynes Prairie State Preserve. The Florida Department of Natural Resources uses the writings of William Bartram, a naturalist who visited Florida in the

18th century, to guide resource management. The Florida DNR's goal is to recreate the conditions that existed in Florida before the pervasive influence of Europeans led to large scale changes in the environment. At Paynes Prairie State Preserve, the Florida DNR, however, must continually manage the preserve to keep it looking like what William Bartram may have seen. Why does the Florida DNR interrupt natural processes? Paynes Prairie, prior to Bartram's visit, was a lake. Natural processes drained the lake and a prairie formed. Paynes Prairie might have evolved into a forest, but natural processes created a second lake sometime after Bartram's visit and from that lake a second prairie evolved. Today, Florida's DNR intervenes and interrupts the natural processes that would drive today's Paynes Prairie to a forest because it is no longer possible to permit Paynes Prairie to become a lake.

It is important to note here that biological communities evolve and change over time. Change in nature is a normal process and it is good not bad. Biological communities respond to change with some species decreasing in abundance and others increasing in abundance. Only humans place value judgments on the changes that occur. Consequently, deciding that conditions that existed prior to the arrival of Europeans are the "natural" conditions is just as much a matter of opinion as deciding that present conditions should be deemed the "natural" conditions by humans in the year 2192.

ISSUE 3. THE CONSERVATION - PRESERVATION CONTROVERSY: CAN WE COMMUNICATE?

One of the biggest problems humans face is an inability to communicate effectively. In the heat of debate, we know with certainty what we think we are saying, but do we know what our opposition is hearing? Far too often, communication is ineffective because opposing groups do not use the same definitions for critical words. This is especially true in the Rodman Reservoir controversy. In establishing the Cross Florida Greenbelt, the Florida Legislature stated that it is the intent of the Legislature to conserve and protect the natural resources and scenic beauty of the Oklawaha River Valley. Proponents of restoration and supporters of Rodman Reservoir, however, define the terms "conserve", "protect", and "natural" in different ways. They also have different interpretations of the words conservation, preservation, and restoration.

Conservation was defined by Aldo Leopold (1949) as a state of harmony between humans and the environment, but what does this mean? Webster's dictionary first defines conservation as the preservation and protection of something. Proponents of restoration use this definition to suggest the Oklawaha River should be restored to protect the natural ecological functioning of the Oklawaha River valley. The dictionary, however, also defines conservation as planned management of a natural resource to prevent exploitation, destruction, and neglect. Unfortunately, it is unclear what constitutes exploitation, destruction, and neglect. Supporters of Rodman Reservoir claim that planned management of Rodman Reservoir and the surrounding lands would be the best approach to prevent the destruction and neglect of the biological community in the Oklawaha River valley.

The University Planning Team (1992), in proposing the management plan for the Cross Florida Greenbelt, defined conservation as the management of human uses of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. They suggested that management for conservation requires either restoration of the biological community to its native condition or acceptance and management of the modified biological community. Proponents of restoration believe that restoration of the biological community in the Oklawaha River valley to its condition prior to the construction of Rodman Reservoir constitutes the greatest benefit to present and future generations. Supporters of Rodman Reservoir, however, believe management of the modified community that has developed in the area of Rodman Reservoir is in the best interest of present and future generations.

ISSUE 4. THE BIOLOGICAL INTEGRITY OF FUNCTIONING ECOSYSTEMS.

Maintenance of the biological integrity of functioning ecosystems is a new concept that is being heard nationwide. The concept involves terms such as biological diversity, biodiversity and biological integrity. Although these terms are finding widespread acceptance in both the lay and scientific communities, it is not clear that the precise meaning of the terms is understood. Generalized ideas such as these may be extremely stimulating, but they do not offer a shortcut to the truth if they are based on loosely defined premises (see Peters 1991).

The Management Plan for the Cross Florida Greenbelt states that the focus should be on the maintenance of the biological integrity of the functioning regional ecosystem (University Planning Team 1992). They recommend against a reliance on a species-oriented approach to measuring biodiversity. They believe "species", in and of themselves, represent poor and unacceptable units for measuring and monitoring changes in Greenbelt biodiversity. They also suggest that the presence of endangered species should not be given any more importance than other native species. They assert that the full spectrum of biodiversity is the appropriate metric for assessing the biological integrity of ecosystems.

Unfortunately, it is unclear what is actually meant by the University Planning Team when they state that the full spectrum of biodiversity is the appropriate metric for assessing the biological integrity of ecosystems. For example, it is stated that it will often be important to resuscitate species such as wire grass, gopher tortoises, or red-cockaded woodpeckers to restore the functioning ecosystem. However, eagles and ospreys at Rodman Reservoir are not considered important because it is believed they will do well in a restored river system. The rationale for this conclusion is that there is little justification for highlighting eagles and ospreys and maintaining their populations at artificially high levels because the goal should be the restoration of balanced indigenous populations and balanced biological communities. Yet, they assert that the former barge canal on the west coast of Florida needs to be preserved because it is believed to be an important calving area for manatees. Is this not an attempt at maintaining manatee numbers at an artificially high level at the expense of a balanced indigenous population?

The National Research Council (1992) recently reviewed the United States Environmental Protection Agency's proposed Environmental Mapping and Assessment Program (EMAP). A major purpose of EMAP is to assess trends in biodiversity and the effects of various environmental disturbances on the biological integrity of the Nation's environmental resources. The National Research Council (1992) criticized the program because ways of measuring biodiversity and the biological integrity of systems were not defined. The National Research Council recognized that interpretations of what constitutes biodiversity and biological integrity are capricious and highly individualistic.

The University Planning Team (1992) stated that the U.S. Congress, Office of Technology Assessment defined the term biological diversity as the variety and variability among living organisms and the ecological complexes in which they occur. For the supporters of Rodman Reservoir, the diverse "wildlife" at Rodman Reservoir (see Wildlife Population section) would more than satisfy the definition because there are so many species. The University Planning Team, however, further refined the Office of Technology Assessment's definition by stating that the native assemblages that constitute Florida's flora and fauna should be the focus of conservation efforts instead of "wildlife." If this definition of biodiversity is accepted, Rodman Reservoir must be removed because the biological community that is there now, although it may support a greater variety of living organisms, is not the "native community" that existed before the construction of Rodman Reservoir. This definition of biological diversity and how it is interpreted is the crux of the Rodman Reservoir controversy.

ENVIRONMENTAL ISSUES

GENERAL ECOLOGY

<u>ISSUE 1.</u> RODMAN RESERVOIR IS NOT AS COMPLEX AN ECOSYSTEM AS THE NATURAL OKLAWAHA RIVER.

Proponents of restoration have stated that the natural climax community of the Oklawaha River valley is a floodplain forest (Ewel et al. 1992). They further state that the climax community is typically more complex in its structure and biological interactions and contains more species of plants and animals than earlier successional stages, such as the highly disturbed Rodman Reservoir area. They further claim that this is a basic ecological principle and one of the reasons why Rodman Reservoir should be destroyed and the inundated Oklawaha River floodplain restored. Supporters of Rodman Reservoir, however, have argued that Rodman Reservoir supports more plants and animals than the natural Oklawaha River so it should not be destroyed.

In the past, many ecologists once accepted the concept that climax communities are more diverse in terms of the number of species (species richness) than earlier disturbed successional stages. Now, however, that concept is not totally accepted as a binding ecological principle. Evidence from several field studies have shown that, in many instances, the total number of plants and animals supported in a given area declines with successional stage (Margalef 1963; Smith 1980). These declines occur because of the elimination of transition zones (ecotones) once the climax community is established.

Rodman Reservoir is not a simple ecosystem. Claims that Rodman Reservoir is a simple ecosystem seem to be based on the mistaken concept that the reservoir is entirely an open-water area. The area known as Rodman Reservoir includes 16 miles between Eureka and the Rodman dam. Near Eureka, the reservoir is still dominated by floodplain forest/riverine habitat. As one moves from the floodplain forested area towards the open-water pool area of Rodman Reservoir, there is a transition zone between the floodplain forest/riverine ecosystem and the open-water reservoir ecosystem. Along the margins of the Rodman Reservoir, there are transition zones between the aquatic ecosystem and the pond pine flatwoods, longleaf pine flatwoods, longleaf pine sandhill, sand pine scrub, slash pine flatwoods, mixed swamp, bayheads, xeric hammock, mesic hammock, hydric hammock, freshwater marsh and prairie ecosystems (U.S. Corps of Engineers 1976). Thus, Rodman Reservoir is not a simple reservoir, but a mosaic of interdependent biological communities. The waters and lands within the right-of-way corridor constitute a complex, which should be called the Rodman Reservoir complex.

Although Rodman Reservoir represents a major change in the once continuous climax floodplain forest of the Oklawaha River, floodplain forests still exist upstream and downstream of the Rodman pool. Thus, the Rodman Reservoir complex constitutes a major "ecotone." Because the "edge effect" associated with ecotones allows for an increased variety and density of plants and animals, the Rodman Reservoir complex now supports plants and animals (see issues on fisheries and wildlife) from not only the climax floodplain forest community, but also from the expanded aquatic community associated with the creation of the reservoir.

Harris and Hoctor (1992), authors of the University of Florida's Planning Team's Biological Issues Volume and proponents of restoration, have stated that it is generally accepted by conservation biologists (based on recent theoretical advances) that fragmentation and the creation of "edge effects," such as any associated with Rodman Reservoir, are the most serious threats to the conservation of biological diversity. This belief constitutes one of the major points of contention in the Rodman Reservoir controversy. It should be noted that the arguments of Harris and Hoctor (1992) are based primarily on hypothetical concepts rather than field studies from the area of Rodman Reservoir. Theoretical advances are great, but not if they are not supported by actual field data (Simberloff et al. 1992). Before it is assumed that the Rodman Reservoir complex constitutes a threat to biodiversity, additional studies should be done. It should then be determined which side of the Rodman Reservoir debate the evidence supports.

ISSUE 2. A BUILD-UP OF ORGANIC MATTER AND DEBRIS ON THE BOTTOM WILL CONVERT RODMAN RESERVOIR INTO A SWAMP WITHIN 50 YEARS.

Proponents of restoration have correctly noted that shallow, nutrient-rich aquatic ecosystems like Rodman Reservoir gradually fill in with silt and decayed plants, becoming first marshes and finally evolving to climax forests (Ewel et al. 1992). Some proponents of restoration have implied that this process could take as little as 50 years (Florida Defenders of the Environment Inc. 1970). The amount of time it takes to transform a water body to a terrestrial ecosystem, however, is generally extremely long. Reservoirs, because of their large watershed, typically fill in faster than natural lakes, but reservoirs have life expectancies measured in hundreds of years.

There have been no definitive studies of how fast Rodman Reservoir is filling in with sediments. We, therefore, estimated the sedimentation rate in Rodman Reservoir by calculating the difference in mean depth (standardized to a water level of 5.49 m or 18 feet Mean Sea Level) estimated from depth profiles made in August, 1979 (Haller and Shireman 1984) and September 1992 (University of Florida, Mark Hoyer, unpublished data). The September transects were identical to those established by Haller and Shireman (1984) 13 years earlier. The mean depth of Rodman Reservoir in August 1979 was 2.36 m. In September 1992, the mean depth of Rodman Reservoir was 2.11 m. Therefore, the estimated sedimentation rate is 0.19 cm/year. Although this is a rough calculation of the long-term sedimentation rate at Rodman Reservoir, it is reasonable for Florida lakes. For example, Reddy and Graetz (1991) calculated that Lake Apopka, one of Florida's most eutrophic lakes, had a sedimentation rate of 1.15 cm/year.

Using the estimated sedimentation rate calculated for Rodman Reservoir, it would hypothetically take over 250 years to fill in half of the existing Rodman pool, assuming a water level of 5.49 m Mean Sea Level. If the Lake Apopka sedimentation rate were used, it would take over 90 years to fill in half of the existing Rodman pool. Because management activities such as water level fluctuation and natural factors such as sediment compaction will decrease sediment build-up, Rodman Reservoir should remain a "lake-like" aquatic ecosystem for well over 250 years. From a comparative standpoint, it is clear that Rodman Reservoir will not become a "swamp" within 50 years because Lake Rousseau, a similar type reservoir on the Withlacoochee River, has been in existence for over 90 years and has not even come close to transforming into a "swamp."

ISSUE 3. RODMAN RESERVOIR IS A HIGHLY EUTROPHIC, DYING WATER BODY

Proponents of restoration have stated that the reservoir is eutrophic and that the "aging" process destines Rodman Reservoir for "biological senility" (Florida Defenders of the Environment Inc. 1970). They have also stated that all that remains today is a shallow, weed-choked lake with a declining sport fishery (Florida Defenders of the Environment Inc. 1992). Some individuals have also suggested that the lake will soon "die" because Rodman Reservoir experienced two major fish kills in the 1980s.

The terms "oligotrophic", "mesotrophic", and "eutrophic" were introduced into the aquatic sciences at the beginning of the 20th century to describe the general nutrient conditions and biological productivity of lakes (i.e., trophic status). Oligotrophic aquatic ecosystems were recognized as nutrient-poor, biologically unproductive systems whereas eutrophic systems were described as nutrient-rich, biologically productive aquatic ecosystems. Mesotrophic aquatic ecosystems were described as moderately rich in nutrients and moderately productive.

Since the 1960s, the term "eutrophic" has often been used by the press and other nonscientific groups to imply that an eutrophic lake is polluted and undesirable. This negative use of the word "eutrophic" is generally accepted by many people because eutrophic lakes are biologically productive and support extensive growths of either algae or large aquatic plants. Many people find these conditions undesirable compared to the clear-water, plant-free conditions of oligotrophic systems. It is important to note, however, that eutrophic lakes are not always polluted lakes and that eutrophic lakes occur naturally in many parts of the world including Florida (Canfield and Hoyer 1988a). Although the word "eutrophic" continues to be used by some individuals to connote a "dead lake", it is important to remember that eutrophic lakes are not always undesirable lakes because many eutrophic lakes support extensive fish and wildlife populations (Hoyer and Canfield 1990, 1992; Canfield and Hoyer 1992).

Rodman Reservoir is an eutrophic water body. It is naturally eutrophic because the waters of the Oklawaha River are naturally rich in nutrients. Why? A major source of water and nutrient inputs to Rodman Reservoir originates from Silver River, which is fed by Silver Springs. Water quality sampling of the Silver River indicates the river is rich in total phosphorus and total nitrogen, the two primary nutrients used to classify the trophic status of an aquatic ecosystem. Total phosphorus and total nitrogen concentrations in the Silver River averaged 42 and 1300 µg/L, respectively, during August 1992.

Although Rodman Reservoir is eutrophic, the term "eutrophic" encompasses a broad range of conditions and it is important to recognize that Rodman Reservoir is not as eutrophic as many other natural Florida lakes. It is also not as eutrophic as some of Florida's best fishing lakes (e.g., Lake Okeechobee). Rodman Reservoir will ultimately make the transition from an open-water type of reservoir to a wetland ecosystem, but "biological senility" will not occur. Studies of eutrophic Florida lakes and marsh-like lakes have shown that these waters can be excellent habitat for fish and wildlife (Canfield and Hoyer 1992). Also, it is now recognized by ecologists that wetlands are some of the most productive biological systems for fish and wildlife, not "dead" systems as implied by the theory of "lake aging."

ISSUE 4. RODMAN RESERVOIR IS NOT A REGIONALLY IMPORTANT LAKE BECAUSE THERE ARE MANY LAKES IN THE AREA.

Proponents of restoration have argued that a free-flowing Oklawaha River is an unique ecosystem and that anglers wishing to fish lakes have over 200,000 acres of lakes within 30 miles of Rodman Reservoir (Florida Defenders of the Environment Inc. 1992; Florida Game and Fresh Water Fish Commission 1992). Supporters of Rodman Reservoir, however, argue that many of these lakes cannot provide the fishing, hunting, wildlife habitat, and public recreational access that Rodman Reservoir provides.

It is true that there are many lakes near Rodman Reservoir. A large number of these lakes, however, are extremely small (< 250 acres). Small lakes typically have limited public access because public boat ramps are few and shorelines are in private ownership. Access has also been limited in recent years because the long-term drought that has been affecting north Florida has reduced water levels. Also, nearly all these lakes lack the recreational facilities that are available at Rodman Reservoir.

Many of the small lakes in the Rodman Reservoir area are oligotrophic whereas Rodman Reservoir is eutrophic (Canfield and Hoyer 1988a). It is therefore not reasonable to compare these lakes to Rodman Reservoir when discussing the ability of these lakes to support fish and wildlife. Oligotrophic Florida lakes cannot support as much fish and wildlife as eutrophic Florida lakes (Hoyer and Canfield 1990; Canfield and Hoyer 1992). It is also important to note here that as the drought continues in north Florida and lakes levels decline, Rodman Reservoir becomes increasingly important as a refugia for aquatic birds (both local and migratory) and as a fishery resource for the region.

Milon et al. (1986) found that many anglers prefer Rodman Reservoir to other large lakes in the region because Rodman Reservoir has the ability to produce large numbers of sportfish (see also issues on fish populations and the fisheries of Rodman Reservoir). Thus, Rodman Reservoir takes pressure off the few regional lakes that are considered good substitute lakes by anglers by spreading out angling efforts. For example, Orange and Lochloosa lakes in Alachua County constitute two of north Florida's major fishing lakes that are considered by anglers to be good substitutes for Rodman Reservoir. These lakes, however, are heavily fished when water levels are high enough to allow access and there are concerns that fishing mortality due to angling is reaching the point where Orange and Lochloosa may not be able to support more fishing pressure without damaging the fisheries (Estes and Myers 1991). Fishing at these lakes in recent years has also been substantially curtailed because lower water levels have precluded access for many anglers.

Supporters of Rodman Reservoir have also noted that the reservoir is unique among regional lakes in that it can be an intensively managed ecosystem. Water levels in the reservoir can be maintained during periods of drought because of the sustained flow of water from Silver Springs. The water control structures also permit a lowering of water levels when required. Manipulation of water levels could enhance the fishery of Rodman Reservoir (Note: Rodman Reservoir has not been managed as managers would like with regard to water level manipulation because of the threat of litigation). This type of management, including an extreme drawdown of water levels, could be accomplished at Rodman Reservoir because there are few riparian land owners that would be inconvenienced by low water levels and facilities are available to provide fishing access during such periods of low water. It is also possible with the deauthorization of the Cross Florida Barge Canal to establish fish and wildlife management objectives as the primary management goals for Rodman Reservoir. Making fish and wildlife management the priority management goal is not something that can be done effectively on most Florida lakes because of intense development. It is also not possible on most large reservoirs in Florida or elsewhere in the United States because of competing uses (e.g., hydropower, commercial navigation, or flood control requirements). With intensive management, Rodman Reservoir can support an even more productive and diverse range of recreational opportunities than it now does.

FISH POPULATIONS AND THE FISHERIES OF RODMAN RESERVOIR

<u>ISSUE 1.</u> THE FISH POPULATION OF RODMAN RESERVOIR IS DECLINING AND SPORTFISH HAVE BEEN REPLACED BY ROUGH FISH.

One of the primary uses of Rodman Reservoir is sportfishing. Proponents of restoration speculated in the 1970s that Rodman Reservoir would have a "good" sportfish population for a few years, but that the fish population would ultimately decline and sportfish would be replaced by nondesirable fish called "rough fish" or "trash fish" (e.g., Florida Defenders of the Environment Inc. 1970). The Florida Game and Fresh Water Fish Commission reported fish population and angler utilization data from Rodman Reservoir that indicated a declining fishery since 1971, but they also reported that it is possible to create an excellent largemouth bass fishery in Rodman Reservoir, if the reservoir were managed for sportfish (Estes et al. 1989).

We evaluated the status of the fish population in Rodman Reservoir by compiling all available fish population data, estimated by use of rotenone sampling, from seventeen dates between fall of 1970 and fall of 1987 (Duchrow 1971; Duchrow and Starling 1972; Florida Game and Freshwater Fish Commission, unpublished data 1973, 1987; Haller and Shireman 1984). We also used rotenone sampling to assess the fish population of Rodman Reservoir in August of 1992 because the reservoir had not been sampled since fall of 1987.

The fish population of Rodman Reservoir has undergone major fluctuations since the 1970s, but there has been no major decline in the total fish population (Figure 1). There is no evidence of a decrease in the percent composition (by weight) of sportfish (Figure 2). As noted by Duchrow (1971), the total fish population (biomass) increased steadily during the first three years after the dam was closed because the fish population was expanding into its new unexploited habitat (Figure 1). For the next 20 years, the total fish population, however, fluctuated above and below an average of 117 kg/ha, with peak biomass values recorded in 1975 and 1981. Haller and Shireman (1984) also noted these years of peak biomass and they realized that these peaks occurred after periods of lake level fluctuation (Figure 1). This strongly suggests that the fish population in Rodman Reservoir can be managed at higher levels with water level fluctuations. The manipulation of water levels to enhance fish populations is accepted by fisheries managers. It has been used on other Florida lakes and reservoirs (Wegener and Williams 1974) and has been recommended for Rodman Reservoir (Estes et al. 1989).

The total fish biomass in Rodman Reservoir fluctuated from a low of 41 kg/ha in the fall of 1982 to a high of 255 kg/ha in the fall of 1975 (Figure 1). This large amount of variation in the fish population has been used to suggest that there is something wrong with Rodman Reservoir and that the fish population is unstable. All estimates of the total fish biomass for Rodman Reservoir, however, fall within the natural range expected for eutrophic Florida lakes (Figure 3; Canfield and Hoyer 1992). Rodman Reservoir, therefore, supports the total fish biomass that would be predicted by its trophic status. The large amount of variability is natural and therefore, is not a sign that the fish population will collapse.

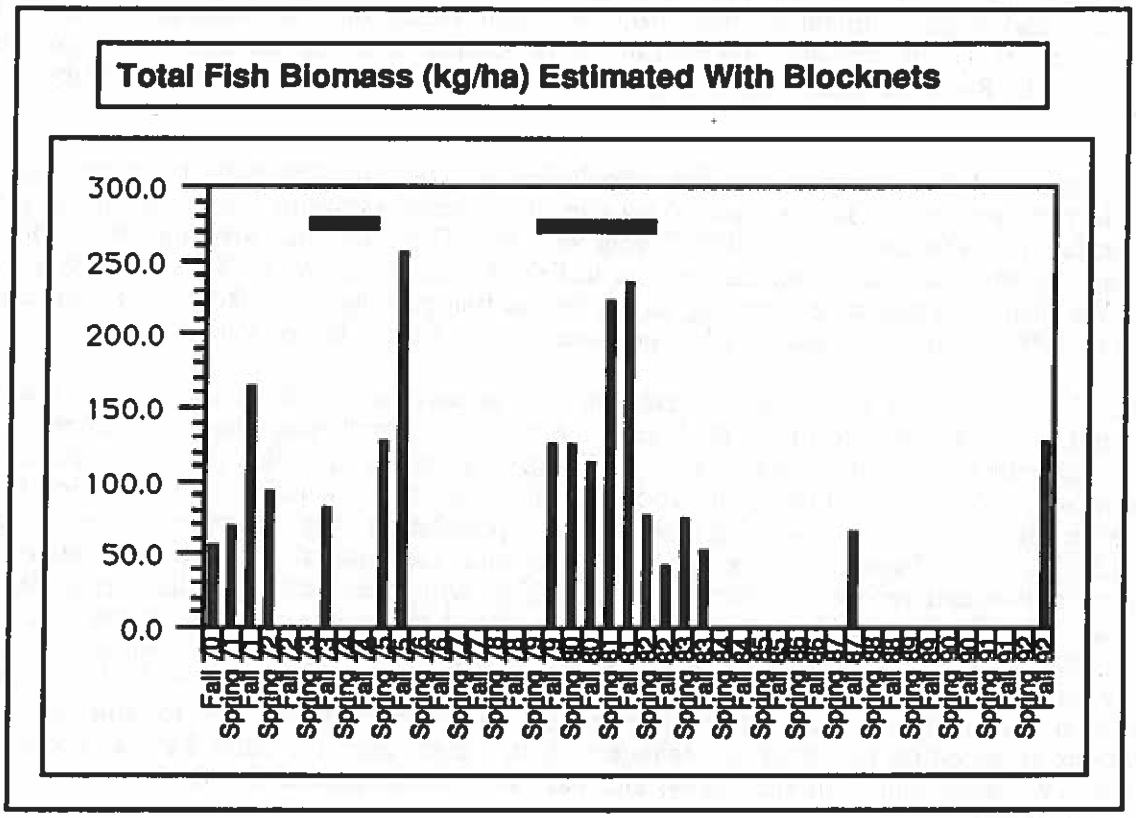


Figure 1. Average total fish biomass (kg/ha) for Rodman Reservoir from 1970 to 1992 as estimated with rotenone sampling. Horizontal lines represent periods of water level fluctuation.

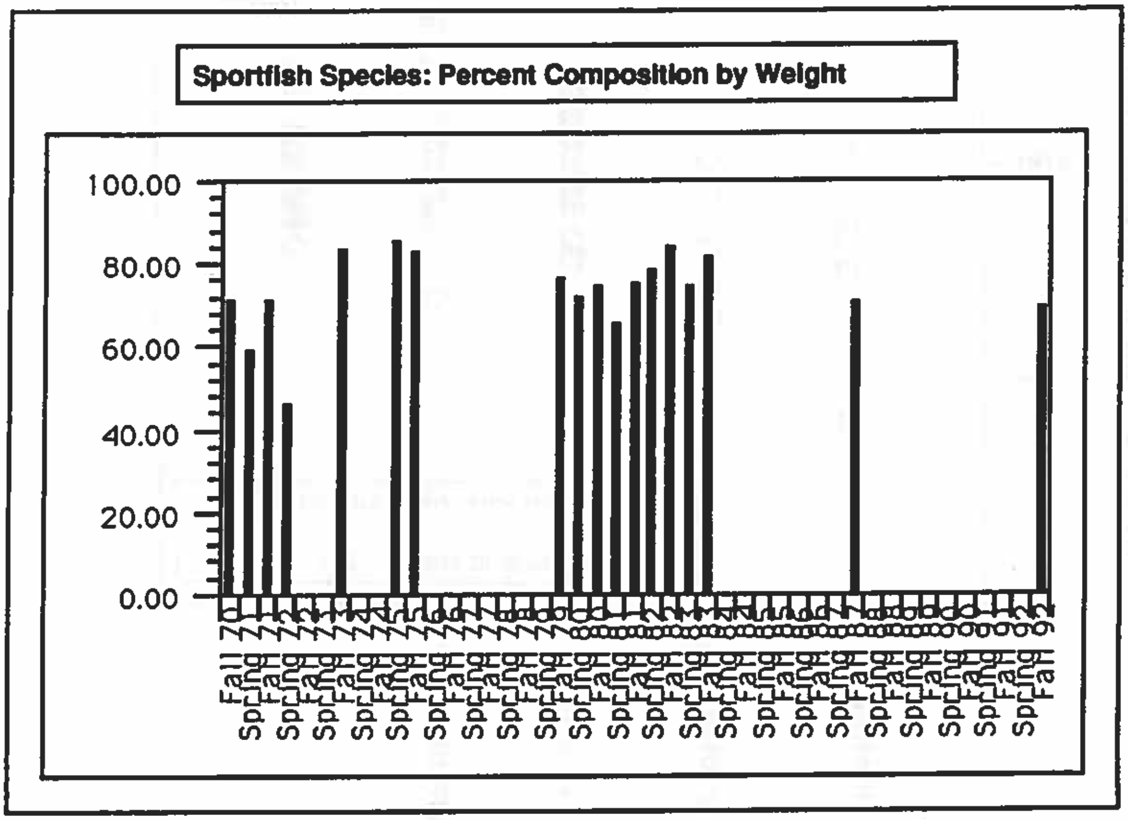


Figure 2. Percent composition of sportfish for Rodman Reservoir from 1970 to 1992.

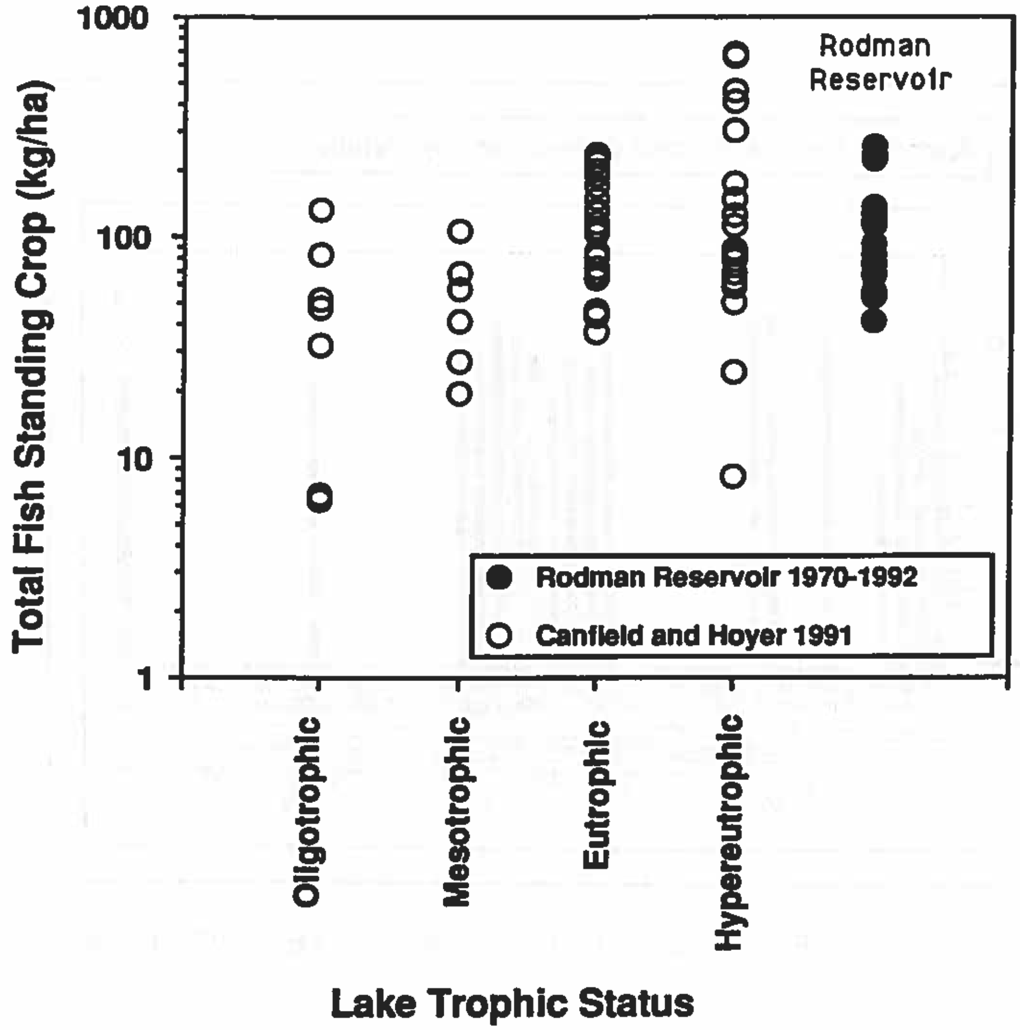


Figure 3. Relation between lake trophic status and total biomass (kg/ha), as estimated with rotenone sampling for 60 Florida lakes (Data from Canfield and Hoyer 1992). Data for Rodman Reservoir from 1970 to 1992 are also plotted.

ISSUE 2. A RESTORED OKLAWAHA RIVER CAN SUPPORT AS MANY FISH AS RODMAN RESERVOIR.

There have been very few fisheries studies of the Oklawaha River. Thus, the debate regarding which system (the restored river or the reservoir) can support more fish is contentious. Some individuals focus the debate on the total size of the fish populations whereas others focus the debate on how many species are present in each system. Other individuals, however, discuss the fisheries in terms of fishing success, catch, and effort.

We sampled the fish populations in the Oklawaha River at two sites between Eureka and Gores Landing (Above Pool) and two sites between the Rodman dam and the St. Johns River (Below Pool) in August 1992. The fish in the river sections were sampled with electrofishing and standing crop estimates were calculated according to the methods of Hoyer and Canfield (1991). The total fish standing crop in the river above Eureka averaged 82.4 kg/ha and the total fish standing crop in the river below Rodman Reservoir averaged 65.8 kg/ha, which were less than the average total fish standing crop (126.8 kg/ha) for the Rodman Reservoir in August 1992 (Table 1). Our estimates of total fish standing crop merely provide estimates of density. When our August 1992 total fish biomass estimates were expanded to the total area of available fishing habitat, Rodman Reservoir had over 50 times the total fish biomass that could be supported in a restored 16 mile section of the Oklawaha River (Table 1).

These findings suggest that Rodman Reservoir can support a higher biomass of fish than the natural river channel. We, however, only have a one-time estimate of fish biomass for the river. We, therefore, compared our estimates of total fish standing crop in the Oklawaha River to fish standing crops in other rivers to determine if our estimates were reasonable. Average total phosphorus concentrations at the Above Pool and Below Pool sites averaged 42 µg/L and 31 µg/L, respectively. Hoyer and Canfield (1991) reported a direct relation between total phosphorus concentrations and fish standing crops in North American rivers. When the values for the Oklawaha River are plotted with data from 79 other North American rivers, it is apparent that the fish standing crops in the Oklawaha River at the Above Pool and Below Pool sites are in the range that would be predicted from their phosphorus concentrations (Figure 4). Thus, the Oklawaha River, like most rivers in North America, will generally support a lower fish standing crop (given an equal trophic status) than either lakes or reservoirs.

Table 1. Average standing crop (kg/ha) by species in the Oklawaha River between Eureka and Gores Landing (Above Pool), between Rodman dam and St Johns river (Below Pool), and in the Rodman pool (Pool). All samples were collected in August, 1992.

Fish Species	Above Pool	Pool	Below Pool
American eel	3.500	•	1.300
Atlantic needlefish	•	0.030	•
Black crappie	•	1.130	•
Bluefin killifish	•	3.980	•
Bluegill	5.000	34.840	9.300
Bluespotted sunfish	•	6.620	•
Bowfin	14.900	•	1.500
Brook silverside	•	0.120	0.001
Brown bullhead	•	0.800	•
Chain pickerel	5.700	10.940	•
Coastal shiner	0.300	•	0.001
Dollar sunfish	0.100	1.660	0.001
Everglades pygmy sunfish	•	0.000	•
Flagfish	•	0.130	•
Florida gar	17.200	•	7.000
Gizzard shad	•	0.090	•
Golden shiner	3.400	20.040	0.500
Golden topminnow	•	0.020	•
Hogchoker	•	•	0.001
Lake chubsucker	15.600	6.090	1.900
Largemouth bass	4.700	5.550	4.100
Least killifish	•	0.000	•
Longnose gar	1.000	•	0.300
Mosquitofish	•	0.140	•
Pirate perch	•	0.010	•
Redbreast sunfish	2.700	•	16.600
Redear sunfish	3.700	15.500	1.700
Redfin pickerel	•	0.060	•
Sailfin molly	•	0.120	•
Seminole killifish	0.000	0.010	•
Spotted sunfish	1.600	1.130	2.400
Swamp darter	•	0.460	•
Tadpole madtom	•	0.020	•
Threadfin shad	•	0.010	•
Warmouth	2.200	17.290	0.200
White catfish	0.200	•	18.400
Yellow bullhead	0.600	•	0.600
Total Fish Species	18	28	18
Total Standing Crop	82.4	126.8	65.8
Total fish biomass (kg-expanded to total area)	1470	272800	1510

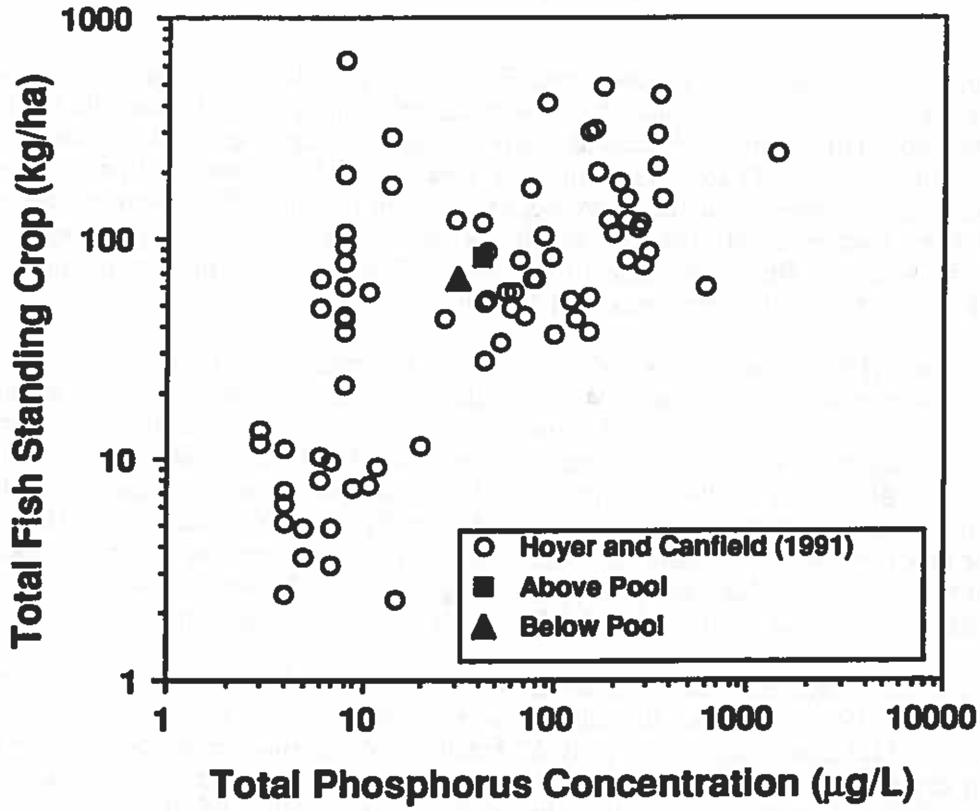


Figure 4. Relation between total fish standing crop (kg/ha) and total phosphorus (µg/L) for 79 North American streams and the Oklawaha River in Florida between Eureka and Gores Landing (Above Pool) and between Rodman dam and St. Johns River (Below Pool) .

ISSUE 3. THE OKLAWAHA RIVER SUPPORTS MORE SPECIES OF FISH THAN RODMAN RESERVOIR.

Florida Defenders of the Environment Inc. (1989) has written that the Oklawaha River sustains approximately 110 species of fish, which is more than similar rivers in the Southeast. This great array of species has been attributed to the antiquity of the river and to the wide variety of bottom sediment types, aquatic plants, and invertebrates. Proponents of restoration have used this information to imply that Rodman Reservoir has seriously degraded the fish fauna of the Oklawaha River. Supporters of Rodman Reservoir, however, point out that the reservoir also has diverse sediment types, aquatic plants, and all types of fish are in the reservoir.

Routine sampling by the Florida Game and Fresh Water Fish Commission has generally found more species of fish in the Rodman Reservoir complex than in the Oklawaha River. Our sampling of fish populations in the Oklawaha River and Rodman Reservoir yielded 37 fish species during August 1992 (Table 1). Only 20 species of fish were collected from the Oklawaha River while 28 species of fish were collected from Rodman Reservoir. Based on this sampling and other available information, routine sampling will most likely produce more species of fish in Rodman Reservoir than in the river. Thus, there is no strong quantitative evidence that the river supports more species of fish than the reservoir.

Hubbs and Allen (1943) studied the fishes of Silver Springs in the early 1940s. Based on fish collections made between 1929 and 1943, they documented the presence of 36 freshwater and marine species of fish. Nearly all of the species collected by Hubbs and Allen were also collected by us in August 1992. The only three species that Hubbs and Allen (1943) collected that we did not collect were the channel catfish, the southeastern starhead and the rainwaterfish. If we assume that the fish fauna in Silver Springs and the Silver River are a useful index for assessing the fish fauna that would occur in the Oklawaha River, it seems that the fish community of the Oklawaha River, including Rodman Reservoir, is not that much different than that documented by Hubbs and Allen prior to the construction of Rodman dam.

To provide a better assessment of the fish community in the Oklawaha River, we examined the work of McLane (1955) who conducted a detailed 10-year study of the fishes of the St. Johns River system. McLane documented only 62 freshwater and marine species of fish in the Oklawaha River drainage basin. Four of the species were limited to the headwater lakes of the Oklawaha River. Some documentations were based on the collection of only one individual (i.e., American shad and the Southern flounder). McLane also noted that many species were not abundant (i.e., striped bass and threadfin shad). Based on McLane's 10-year study, the total number of fish species in the Oklawaha River drainage basin is similar to that found in other Florida rivers.

Florida Defenders of the Environment Inc. (1989) has written that the Oklawaha River sustains approximately 110 species of fish and the Cross-Florida Barge Canal Restudy Report stated that over 100 species of fish have been recorded from Rodman Reservoir or the Oklawaha River and its tributaries above the dam (U.S. Army Corps of Engineers 1976). These estimates of fish species richness conflict with McClane's estimates of 62 fish species in the Oklawaha River prior to the construction of Rodman Reservoir. The scientific basis for the fish species richness numbers provided by the Florida Defenders of the Environment Inc. and the Cross-Florida Barge Canal Restudy Report are unclear. The Florida Department of Natural Resources (1989) in its Florida Rivers Assessment book and Livingston (1991) in his Rivers of Florida book cite the presence of over 100 fish species, which could be taken as scientific support, but both of these documents cite the nonscientific publication put out by the Florida Defenders of the Environment Inc. (1989) as their primary reference.

A review of the ichthyological records kept at the Florida Museum of Natural History on the University of Florida campus indicate that only 77 fish species have been collected from the Oklawaha River system (Carter Gilbert, Professor and Curator, University of Florida; personal communication). Of the 77 species recorded from the system, 4 species have restricted distributions and are unlikely to be of concern in the area of Rodman Reservoir. Eleven of the species recorded have been captured only in the lowermost section of the Oklawaha River near its confluence with the St. Johns River. Thus, the number of fish species actually recorded from the Oklawaha River system in the vicinity of Rodman Reservoir according to the records kept at the Florida Museum of Natural History is 62, which agrees with the number of species recorded by McLane (1955) prior to the construction of Rodman Reservoir. If this number of species is correct, there is no strong evidence that the construction of Rodman Reservoir has eliminated any species of fish from the Oklawaha River drainage basin.

Construction of Rodman Reservoir caused a shift from riverine habitat to a mixture of riverine and lake habitats in the area of the Rodman Reservoir complex. Proponents of restoration (e.g., Harris and Hoctor 1992) have suggested that the greater fish species richness found in the Rodman Reservoir complex versus the Oklawaha River is not a sign that "damage" has not been done. For example, proponents of restoration assume that Rodman Reservoir has displaced a number of listed fish species and that the overall increase in species richness in the reservoir has come in the form of very common lake-dwelling fish species at the expense of rare species, such as the dusky shiner (*Notropis cummingsae*), the snail bullhead (*Ameiurus brunneus*), and the tessellated darter (*Etheostoma olmstedi*), that depend on the flowing waters of the Oklawaha River. The dusky shiner, the snail bullhead, and the tessellated darter, however, have recently been captured both below and above Rodman dam (Carter Gilbert, Professor and Curator, University of Florida; personal communication) suggesting that the construction of Rodman dam has not eliminated these species from the system. It should also be remembered that many of the species, like the tessellated darter, are known primarily from small creeks such as Orange Creek and would not necessarily have been captured with the methods incorporated in this study. Until there have been detailed studies of these rare and threatened species of fish in Rodman Reservoir and the Oklawaha River basin, it should not be concluded that these fish species have been displaced or reduced in numbers.

<u>ISSUE 4.</u> THE CREATION OF RODMAN RESERVOIR HAS BLOCKED THE MOVEMENTS OF MIGRATORY FISH.

Proponents of restoration have claimed that fish such as shad, striped bass, mullet, and eels once migrated up and down the free-flowing river to breed, but that the presence of Rodman Reservoir has severely impacted such migrations (e.g., Florida Defenders of the Environment Inc. 1989; Florida Game and Fresh Water Fish Commission 1992). Supporters of Rodman Reservoir, however, have noted that quantitative documentations regarding reductions in migrations are nonexistent, thus any loss in migration remains largely speculative.

Extensive spawning by American shad in the Oklawaha River has never been documented. Prior to 1975, there had been only one documented collection of American shad (a single specimen) in the Oklawaha River (i.e., McLane 1955). In 1975, it was reported that American shad had spawned in the tailrace (the area directly below the dam) of Rodman Reservoir (Dave Bowman, U.S. Army Corps of Engineers, Palatka, Florida; personal communication). Based on the available evidence, an alternative hypothesis would be that the construction of Rodman Reservoir and its associated tailrace may have encouraged rather than discouraged the spawning of American shad in the river.

Hubbs and Allen (1943) documented the presence of large numbers of threadfin shad in Silver Springs. They noted that the occurrence of this species was sporadic and they speculated that this species probably came from the St. Johns River. Threadfin shad, however, are still abundant in the Oklawaha River upstream of Silver Springs and in many of the headwater lakes. Thus, it cannot be concluded that the presence of Rodman dam has adversely affected this species. It is interesting to note here that Hubbs and Allen (1943) recorded that this species first appeared in 1933 and soon disappeared. Threadfin shad reappeared in 1941 when Hubbs and Allen recorded a massive die-off of threadfin shad that created a smelly nuisance.

Striped bass are found upstream of Rodman Reservoir, but extensive spawning by the striped bass in the Oklawaha River either before or after the construction of Rodman dam has not been documented. However, it has been speculated that striped bass travelled the Oklawaha to use springs like Silver Springs for thermal refuge in the summer (Florida Game and Fresh Water Fish Commission 1992). It is interesting to note that Hubbs and Allen (1943) never documented the presence of striped bass in Silver Springs prior to 1943. If we assume that Silver Springs is an important thermal refuge and we assume that extensive migrations of striped bass occurred in the Oklawaha River prior to the construction of Rodman dam, why was the presence of this fish species not documented by Hubbs and Allen (1943)?

Fish like the mullet and eel do not breed in the Oklawaha River. There has been no documentation that mullet migrations have been blocked as mullet are found upstream of Rodman dam in both the Oklawaha River and Silver Springs. Eels are also found upstream of Rodman dam, but collections of eels in upstream lakes have declined since the mid-1970s (Estes et al. 1990). This could be evidence that Rodman dam is adversely affecting the migration of eels, but there is a major elver (young eels) fishery between the mouth of the Oklawaha River and Rodman dam (Dugan Whiteside, commercial eel wholesaler, Hastings, Florida; personal communication). The commercial fishery for elvers could be reducing adult eel numbers in upstream lakes, but other natural factors such as drought could be more important for determining the abundance of eels. Because detailed studies of eels in the Oklawaha drainage have not been conducted, any statement that attributes a reduction in this fish solely to the construction of Rodman Reservoir remains speculative.

Rodman Reservoir does not block all migratory fish. We have collected migratory species both in and above Rodman Reservoir during August 1992 (e.g., American eel). Striped mullet were not collected but were observed jumping in all areas including the upper Oklawaha, lower Oklawaha and Rodman Reservoir. These data and data provided by others (i.e. U.S. Army Corps of Engineers 1976) suggest that migratory species are managing to circumnavigate Rodman Reservoir dam and reach upstream areas. Additional studies are needed before it can be stated unequivocally that the removal of Rodman Reservoir will restore major migratory runs of fish like the striped bass and shad. It is also important to note that there are alternatives available for helping fish around dams if it is ever documented that Rodman Reservoir is a major impediment to fish migration. These alternatives should be explored before the destruction of Rodman Reservoir is undertaken strictly in the name of restoring fish migrations (i.e., Florida Game and Fresh Water Fish Commission 1992).

ISSUE 5. FISHING WILL BE AS GOOD IN THE RESTORED RIVER AS IT IS IN RODMAN RESERVOIR.

Proponents of restoration often state that the Oklawaha River has long been famous for its lunker (large) largemouth bass and other species of gamefish such as crappie, shell crackers, and warmouth (e.g., Florida Defenders of the Environment Inc. 1989). They imply that the destruction of Rodman Reservoir will not adversely affect fishing in the region because the river provides better fishing. Supporters of Rodman Reservoir, however, argue just as vehemently that the reservoir is a better place to fish and that more fishing takes place in the reservoir than in the river.

The Florida Game and Fresh Water Fish Commission attempted to determine the relative value of the fisheries in the river and reservoir as part of the Cross Florida Barge Canal Restudy Report (U.S. Army Corps of Engineers 1976). In the fisheries study, the lower and upper Oklawaha River supported 930 angler-fishing hours/ha and 1,100 angler-fishing hours/ha, respectively. Rodman Reservoir supported only 95 angler-fishing hours/ha. This finding taken at face value suggests that the Oklawaha River is a better place to fish, but these types of numbers fail to account for the total area of fishable waters in the river and reservoir.

When the fishing effort is expanded to account for the area of fishable waters, Rodman Reservoir supported over 330,000 angler-fishing hours compared to a total effort in the river of approximately 124,000 angler-fishing hours. The actual fishing effort at Rodman Reservoir, however, must also include the fishing effort that takes place at the tailrace. The Florida Game and Fresh Water Fish Commission estimated that the tailrace supported over 100,000 angler-fishing hours alone (U. S. Army Corps of Engineers 1976). When the fishing effort at the tailrace is included with the effort at the reservoir, the total fishing effort at Rodman Reservoir exceeds 430,000 angler-fishing hours compared to the 124,000 angler-fishing hours expended on the river. It is important to note here that Rodman Reservoir is being compared against the entire Oklawaha River. If we assume the restoration of the Oklawaha River is eventually completed and fishing effort becomes similar to that measured in existing sections of the river, the restored 16 miles of Oklawaha River would support an estimated 60,000 angler-fishing hours. This would represent a net loss of 370,000 angler-fishing hours. This information supports the contention of supporters of Rodman Reservoir that more fishing takes place in the reservoir.

The Florida Game and Fresh Water Fish Commission estimated that the yields of largemouth bass from the lower and upper Oklawaha River were 60 fish/ha/yr and 74 fish/ha/yr, respectively (U.S. Army Corps of Engineers 1976). The yields of bream (bluegills, shell crackers, redbellies, etc.) were approximately 500 fish/ha/yr and 700 fish/ha/yr in the lower and upper Oklawaha River, respectively. The yields of largemouth bass and bream in Rodman Reservoir during the same time period, however, were estimated at 15 fish/ha/yr and 29 fish/ha/yr, respectively. This type of information would again suggest that fishing is substantially better in the Oklawaha River, but this type of analysis fails to account for the total area of fishable waters.

During the Florida Game and Fresh Water Fish Commission's study, Rodman Reservoir alone yielded over 50,000 largemouth bass and 100,000 bream to anglers. The estimated yield of fish from the Oklawaha River was 8,400 largemouth bass and 76,000 bream. Our sampling of the upper and lower Oklawaha River in August 1992 estimated the largemouth bass standing crops at 4.7 kg/ha and 4.1 kg/ha, respectively (Table 1). The standing crops of bream for the upper and lower Oklawaha River were 15 kg/ha and 28 kg/ha, respectively. The largemouth bass and bream standing crops in Rodman Reservoir were estimated to be 5.6 kg/ha and 72 kg/ha, respectively. When the total largemouth bass and bream standing crops in the river and reservoir were expanded to the total area of fishable waters, Rodman Reservoir's largemouth bass standing crop was approximately 33 times greater than that found in the Oklawaha River and the standing crop of bream in Rodman Reservoir was over 131 times greater than the standing crop of bream in the Oklawaha River (Table 1). Because large amounts of fish are needed to support large numbers of anglers, the study in the mid-1970s by the Florida Game and Fresh Water Fish Commission and our 1992 study support the contention that Rodman Reservoir provides more sportfish to a larger number of anglers than the restored Oklawaha River could provide for the long term (U.S. Army Corps of Engineers 1976).

ISSUE 6. THE LARGEMOUTH BASS POPULATION IN RODMAN RESERVOIR IS DECLINING WITH A RESULTING DECLINE IN ANGLER USE.

Proponents of restoration have stated that largemouth bass fishing has declined in the reservoir and fewer anglers are using the reservoir (Florida Defenders of the Environment Inc. 1992). The Florida Game and Fresh Water Fish Commission reported that the largemouth bass fishing effort in Rodman Reservoir between January 1975 and January 1976 was approximately 230,000 angler-fishing hours (U.S. Army Corps of Engineers 1976). The Commission reported that the largemouth bass fishing efforts in Rodman Reservoir in 1987 and 1988 were 186,000 and 198,000 angler-fishing hours, respectively (Estes et al. 1989). These data provide strong support that fishing has declined, but supporters of Rodman Reservoir note that the largemouth bass fishing effort is still extremely high. It is also important to note here that different methods were used to conduct the creel census of the mid-1970s and the creels of 1987 and 1988. Thus, it can be argued that the numbers obtained may not be comparable and that fishing may not have declined as dramatically as indicated by the creels in 1987 and 1988.

Haller and Shireman (1984) reported largemouth bass fishing data for the period 1 October to 30 April between 1979 and 1983. They reported that largemouth bass fishing effort ranged from 58,000 angler-fishing hours (1981-82) to 114,000 angler-fishing hours (1980-81). Five years later, for the same time period in 1987 and 1988 and using the same methods, the largemouth bass fishing effort was estimated at 99,400 angler-fishing hours (Estes et al. 1989). Thus, there is no strong evidence that the angling effort for largemouth bass at Rodman Reservoir has declined since 1979.

The Florida Game and Fresh Water Fish Commission reported a total catch of largemouth bass in Rodman Reservoir of 52,000 in 1975 and a catch rate of 0.16 fish per angler-fishing hour (U.S. Army Corps of Engineers 1976). Haller and Shireman (1984) reported largemouth bass catches ranging from 12,000 to 32,000 fish/year. Catch rates during their study ranged from 0.21 to 0.29 fish/angler-fishing hour. Estes et al. (1989) reported a catch 11,600 largemouth bass and a catch rate of 0.11 fish/angler-fishing hour. This information again suggests largemouth bass fishing is declining in Rodman Reservoir.

We suggest after reviewing all the available data on angler-fishing effort, catch, and catch rates that there is evidence that fewer anglers are using Rodman Reservoir since the mid-1970s. It is important to note here, however, that the fishing effort at Rodman Reservoir in the 1980s compares very well with other Florida lakes (Table 2) and on an area basis is higher than some of Florida's best bass fishing lakes (e.g., Tohopekaliga, Jackson, Lochloosa and Orange Lake). It is also important to note here that the period of high largemouth bass catch and catch rates during the early 1980s coincided with the largest estimates of largemouth bass standing crop (Figure 5). This was also a time of large water level fluctuations (Figure 5). This strongly suggests that the manipulation of water levels in Rodman Reservoir is an important management tool for enhancing not only the fish population (see Figures 1 and 5), but also the fishery of Rodman Reservoir. Thus, the superior largemouth bass fishing of the mid-1970s could be returned if the reservoir was managed for largemouth bass and other sportfish (Estes et al. 1989).

Table 2. Largemouth bass angler-fishing effort at Rodman Reservoir and other Florida lakes. Data for other Florida lakes were compiled by Williams et al. (1985) from Florida Game and Fresh Water Fish Commission annual reports.

LAKE - RESERVOIR	EFFORT (Angler-fishing hrs/ha/yr)
Rodman Reservoir 1975-76	62.5
Rodman Reservoir 1987	50.5
Rodman Reservoir 1988	53.8
Jackson 1975-76	79.0
Jackson 1978-79	10.9
Okeechobee 1979-80	4.5
Okeechobee 1980-81	4.0
Conway 1976-77	69.2
Orange 1979	42.0
Lochloosa 1979	20.8
Tohopekaliga 1974-75	25.9
Harris 1978-79	10.9
Griffin 1978-79	5.2
Kissimmee 1975-76	5.4
Carlton 1979	1.4

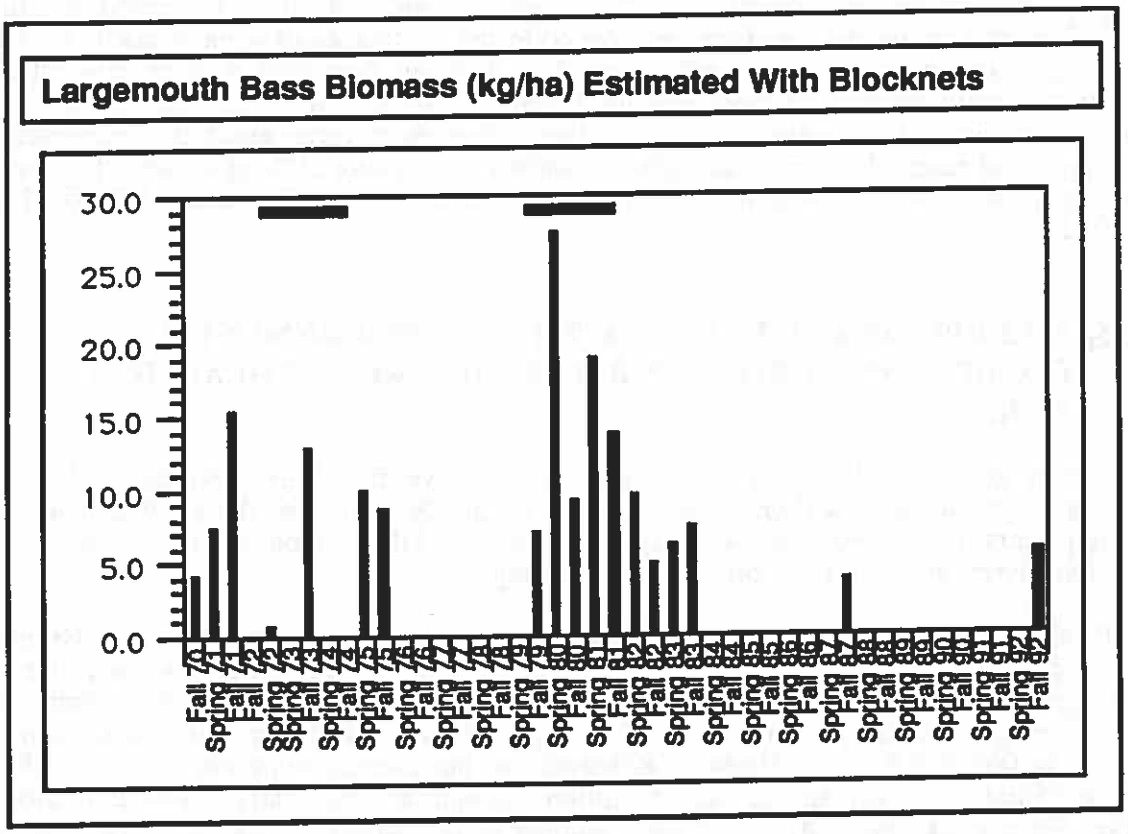


Figure 5. Average largemouth bass standing crop (kg/ha) for Rodman Reservoir 1970 to 1992 estimated with blocknets. Horizontal lines represent periods of water level fluctuation.

ISSUE 7. RODMAN RESERVOIR IS A WEED-CHOKED WATER BODY THAT THREATENS THE FISH POPULATION

Proponents of restoration such as Marjory Carr have often stated that Rodman Reservoir is a weed-choked reservoir that threatens fish life because the weeds deplete the water's oxygen (e.g., Palatka Daily News, July 1991). Supporters of Rodman Reservoir, however, have contended that the "weeds" are not weeds, but vital wetland habitat for fish.

We sampled the aquatic vegetation in Rodman pool during September 1992 according to the methods of Canfield and Hoyer (1992). The aquatic plants of Rodman Reservoir constitute a diverse flora and are not all weed species. We collected 32 species of aquatic plants from the reservoir including many desirable native species. Rodman pool had a large percent area covered with aquatic vegetation (approaching 100%), but only 50% of the pool's total water volume was occupied by aquatic vegetation. Thus, there were large areas of open-water in Rodman pool and research on Florida lakes has shown that having 50% of a lake's total water volume occupied by aquatic vegetation is not detrimental to fish populations (Canfield and Hoyer 1992).

ISSUE 8. MASSIVE FISH KILLS INDICATE THAT ENVIRONMENTAL CONDITIONS AT RODMAN RESERVOIR ARE NOT HEALTHY FOR FISH.

Proponents of restoration have stated that the massive fish kills reported in Rodman Reservoir are symptoms of a dying water body (Florida Defenders of the Environment Inc. 1989). Supporters of Rodman Reservoir argue that the fish kills, although undesirable, do not have any long-term effect on fish populations or fishing.

The Florida Game and Fresh Water Fish Commission reported major fish kills at Rodman Reservoir during 1985 and 1988 (Estes et al. 1989). The size of these kills, however, must be placed in perspective relative to the size of the fish population at Rodman Reservoir. The long-term average abundance (numbers) of fish in Rodman Reservoir based on rotenone sampling is 18,000 fish/ha, thus Rodman Reservoir on the average supports over 64 million fish. The 1985 fish kill was estimated at 8.5 million fish and the 1988 fish kill was estimated at 2.5 million (Estes et al. 1989). Although these number seem "massive", Rodman Reservoir lost only 13% of the total fish population in 1985 and 4% of the population in 1988. These losses seem large to individuals looking at dead fish in the reservoir, but they do not have any long-term effect on Rodman Reservoir's fishery (Estes et al. 1989).

It is important to recognize that the fish kills at Rodman Reservoir are typically associated with heavy rainfall after long periods of dry weather (Estes et al. 1989). The kills occur because large amounts of water containing low levels of oxygen are delivered to the reservoir by the Oklawaha River. The river water is low in oxygen because heavy rainfall floods extensive tracts of forested floodplain where organic matter has accumulated. The biological decomposition of the accumulated organic matter removes oxygen from the water. This process is not unique to Rodman Reservoir because fish kills also occur on many Florida lakes when similar conditions exist.

Proponents of restoration have asked if there is any evidence for assuming that there would be any threat of fish kills in a restored Oklawaha River (Kaufmann 1991). It has also been asked if there were any fish kills before the dam was built or in the river above the reservoir. By asking these questions, proponents of restoration seem to be implying that "massive" fish kills would never occur in a free-flowing Oklawaha River. Hubbs and Allen (1943), however, have documented a "massive" fish kill of threadfin shad in Silver Springs and the Silver River in 1941. The Florida Game and Fresh Water Fish Commission has also documented fish kills in the Oklawaha River upstream of Rodman Reservoir. It is important to remember that the Oklawaha River does not support as many fish as Rodman Reservoir. Thus, if each ecosystem lost a similar proportion of their total fish population, it would be more difficult to detect a kill in the Oklawaha River because fewer fish would be killed.

WILDLIFE POPULATIONS

<u>ISSUE 1.</u> RESTORATION OF THE FREE-FLOWING OKLAWAHA RIVER AND FLOODPLAIN FOREST WILL BENEFIT AQUATIC BIRD POPULATIONS.

Bird populations on Rodman Reservoir provide recreation to individuals who hunt for waterfowl and to individuals who enjoy bird watching. Rodman Reservoir is also beneficial habitat for both resident and migratory aquatic bird populations. Why? Many wetland habitats in Florida are decreasing due to development and long-term drought conditions. Proponents of restoration, however, have stated that restoration of the Oklawaha River will benefit wildlife, especially species like the limpkin and the wood duck. (Florida Defenders of the Environment Inc. 1989). Supporters of Rodman Reservoir argue that this is not true because Rodman Reservoir supports large numbers of aquatic birds and fewer birds are seen on the river.

There have been no detailed studies comparing the present-day use of Rodman Reservoir and the Oklawaha River by aquatic bird populations; thus, it was difficult to assess the relative merit of the arguments advanced by the opposing sides in the ongoing Rodman Reservoir controversy. We, therefore, decided to count aquatic bird populations in four sections of the Oklawaha River basin during August, 1992 and January 1993. The sections were: (1) river between Eureka and Gores Landing (Above Pool), (2) Eureka to Orange Springs (Transitional Zone), (3) Orange Springs to Rodman dam (Pool), and (4) river between Rodman dam and the St. Johns River (Below Pool). Aquatic birds were defined as birds utilizing aquatic habitats. Counts were conducted according to the methods of Hoyer and Canfield (1990; 1992), which permits an initial scientific analysis of the various wildlife issues related to aquatic birds in lieu of expensive detailed studies. Although many factors (e.g., weather, time of day, season, and observer variability) can influence bird counts, our surveys should at least represent what an average citizen might see during a daytime excursion on the Oklawaha River and Rodman Reservoir, and represent conservative estimates of the actual bird utilization.

Aquatic bird densities were greater in river sections (Above Pool - 112 birds/km^2; Below Pool - 100 birds/km^2) than in the Transitional Zone (72 birds/km^2) or the pool (69 birds/km^2) of Rodman Reservoir during August 1992 (Table 3). This type of information would seem to support the contention that a restored river would benefit aquatic bird populations, but the area of available habitat is substantially larger in the Transition Zone and the Pool. Consequently, the total number of aquatic birds counted in the Transitional Zone or Pool during August 1992 was nearly 50 times greater than either river section (Table 3). We also found fewer aquatic bird species along the Oklawaha River in August. Six species of aquatic birds were found on the Oklawaha River above Rodman Reservoir and 11 species of aquatic birds were observed below Rodman Reservoir (Table 3). The Transitional Zone (22 species) and the Pool (29 species) taken as a complex and compared to the two river sections supported over two times the number of species of aquatic birds in August, including endangered species like the bald eagle (Table 3). Thus, there is evidence that the destruction of Rodman Reservoir would not be beneficial to summer aquatic bird life in terms of overall numbers and species richness.

Table 3. Total number of aquatic birds counted by species in the Oklawaha River between Eureka and Gores Landing (River Above Pool), between Eureka and Springs Landing (Transitional Zone), Rodman Pool (Pool), and between Rodman Dam and St Johns River (River Below Pool). All counts were conducted in August, 1992.

Bird Species	River Above Pool	Transitional Zone	Pool	River Below Pool
American Coot	.	9	47	.
Anhinga	.	66	116	1
Bald Eagle	.	.	1	.
Bank Swallow	.	.	1	.
Belted Kingfisher	.	8	8	2
Black Vulture	.	3	3	.
Black-crowned Night-heron	.	1	1	.
Boat-tailed Grackle	.	249	132	.
Cattle Egret	.	.	1	.
Common Moorhen	.	150	380	.
Crows	.	13	16	.
Double-crested Cormorant	.	25	66	1
Glossy Ibis	.	1	.	.
Great Blue Heron	3	25	58	4
Great Egret	.	78	105	.
Green-backed Heron	.	9	26	1
Gulls	.	.	3	.
Killdeer	.	.	1	.
Least Bittern	.	2	16	.
Limpkin	5	9	2	5
Little Blue Heron	.	138	157	.
Osprey	.	26	54	4
Pied-billed Grebe	.	.	6	.
Pileated Woodpecker	2	.	.	2
Purple Gallinule	.	.	2	.
Red-shouldered Hawk	2	.	1	1
Red-winged Blackbird	.	15	41	.
Sanderling	.	1	.	.
Snowy Egret	.	150	170	.
Swallowtail Kite	6	.	.	.
Tricolored Heron	.	47	43	.
White Ibis	2	3	2	1
Wood Duck	.	.	14	1
Total number of species	6	22	29	11
Bird density (birds/km2)	112	72	69	100
Total birds counted	20	1028	1473	23

Aquatic bird densities at the Rodman Reservoir complex (Transition Zone and Pool) and on the Oklawaha River were substantially greater in January 1993 (Table 4). Species richness in January was also either equal or greater at all sampling sites (Table 4). The total number of aquatic birds counted in the Transitional Zone and Pool during January 1993 was over 100 times greater than the number of aquatic birds counted on the Oklawaha River. We also again found fewer aquatic bird species along the Oklawaha River in January. Eight species of aquatic birds were found on the Oklawaha River above Rodman Reservoir and 11 species of aquatic birds were observed below Rodman Reservoir (Table 4). The Transitional Zone (28 species) and the Pool (32 species) taken as a complex again supported over twice the number of species of aquatic birds in January (Table 4). The reservoir complex counts also included 17 bald eagles whereas none were counted on the river during the January survey (Table 4). Thus, there is evidence that the destruction of Rodman Reservoir would not be beneficial to winter aquatic bird life in terms of overall numbers and species richness.

Harris and Hoctor (1992) stated that all of the wading bird species and most of the duck species counted during our bird surveys would also be found in a restored Oklawaha River. It is highly possible that the birds mentioned by Harris and Hoctor could be found on the river with more intensive surveys, but our synoptic survey suggests that the Oklawaha River does not support the same number of species of wading birds and ducks. In August, 12 species of wading birds and 5 species of ducks were encountered (Table 3). Eight of the wading bird species and four of the duck species were found only on Rodman Reservoir. In January, 10 species of wading birds and 6 species of ducks were encountered (Table 4). Five of the wading bird species and five of the duck species were found only on Rodman Reservoir.

Harris and Hoctor (1992) stated that the results of our bird counts are invalid because we did not take into account a variety of factors that could influence bird abundance and detectability. They also state that they believe that no refereed journal of vertebrate biology would publish a paper based on the methods of Hoyer and Canfield. Although the methods of Hoyer and Canfield do not follow those that would be accepted by Harris and Hoctor, we believe that the methods were the most appropriate given the limited time and money available to conduct the surveys. It should also be noted that Hoyer and Canfield's 1990 and 1992 papers were peer reviewed and published in Lake and Reservoir Management and a special issue of Hydrobiologia, two internationally recognized scientific journals. The 1992 paper was presented at a 1991 international symposium on aquatic birds in the trophic web of lakes. This conference was attended by many aquatic bird specialists and was well received, which led to the paper being published in the special issue of Hydrobiologia.

Harris and Hoctor (1992) and anyone else, including us, can criticize a published study. What is important here is that we made an effort to obtain up-to-date information on the system rather than solely using data (Cross Florida Barge Canal Restudy report) that was over 15 years old (U.S. Army Corps of Engineers 1976). Even if some of the criticisms voiced by Harris and Hoctor (1992) about our methods are valid, it is important to remember that our reanalysis of the wildlife data presented in the Cross Florida Barge Canal Restudy report initially raised questions regarding the validity of previous statements made by proponents of restoration (see Issue 3). Our aquatic bird survey data, even if it is just viewed as observational data, raises similar questions. Harris and Hoctor (1992) have presented no recent field data on aquatic birds along the Oklawaha River and Rodman Reservoir. In the absence of new detailed studies, we believe that it is premature for Harris and Hoctor (1992) or any other proponents of restoration

Table 4. Total number of aquatic birds counted by species in the Oklawaha River between Eureka and Gores Landing (River Above Pool), between Eureka and Springs Landing (Transitional Zone), Rodman Pool (Pool), and between Rodman Dam and St Johns River (River Below Pool). All counts were conducted in January 1993.

Bird Species	River Above Pool	Transitional Zone	Pool	River Below Pool
American Coot	.	1700	3063	.
Anhinga	.	71	156	3
Bald Eagle	.	4	13	.
Belted Kingfisher	4	12	16	3
Black Vulture	.	13	22	1
Black-crowned Night-heron	.	6	.	.
Blue-winged Teal	.	.	10	.
Boat-tailed Grackle	.	193	592	5
Common Grackle	11	.	.	.
Common Moorhen	.	228	728	.
Crows	.	3	23	.
Double-crested Cormorant	.	13	43	6
European Starling	.	.	4	.
Glossy Ibis	.	22	13	.
Great Blue Heron	3	25	46	1
Great Egret	.	40	47	2
Green-backed Heron	.	1	2	.
Gulls	.	14	68	.
Limpkin	1	6	5	1
Little Blue Heron	.	118	65	1
Northern Harrier	.	.	1	.
Osprey	1	37	44	.
Pied-billed Grebe	.	3	43	.
Red-shouldered Hawk	1	12	6	1
Red-tailed Hawk	.	.	2	.
Red-winged Blackbird	.	1339	236	.
Ring-necked Duck	.	.	33	.
Snowy Egret	.	87	92	.
Terns	.	6	28	.
Tree Swallow	.	50	342	.
Tricolored Heron	.	36	38	.
Turkey Vulture	1	21	9	.
White Ibis	.	268	71	49
Wood Duck	2	2	2	.
Total number of species	8	28	32	11
Bird density (bird/km2)	135	303	273	317
Total birds counted	24	4330	5863	73

to claim based on recent "theoretical" advances in conservation biology, that a restored Oklawaha River will support all or most of the aquatic bird species currently found on Rodman Reservoir. We also do not believe that it can be stated with any high degree of certainty that a restored Oklawaha River will provide equal or better habitat for aquatic birds. Thus, we suggest that the State of Florida should err on the side of caution and conduct additional aquatic bird studies to insure that restoration of the Oklawaha River will not adversely affect regional aquatic bird populations (see next issue).

ISSUE 2. WHEN RODMAN RESERVOIR IS DRAINED, AQUATIC BIRD SPECIES USING THE RESERVOIR WILL FIND AN EXCESS OF SUITABLE HABITAT NEARBY.

Proponents of restoration suggest that restoring the Oklawaha River will benefit many types of wildlife including many aquatic bird species (Florida Defenders of the Environment Inc. 1992). In other Florida aquatic systems, Hoyer and Canfield (1990; 1992) have shown that aquatic bird densities are positively related to the trophic status of the system. Plotting bird densities from Table 3 or Table 4 with the data from Hoyer and Canfield (1992) shows that aquatic bird densities in the eutrophic Rodman Reservoir complex during August 1992 (summer) and January 1993 (winter) are at the level that would be predicted from its trophic state (Figure 6 and 7). The river sections (Above Pool, Below Pool and the Transitional Zone) also support bird densities representative of nutrient rich systems (Figure 6 and 7). This information strongly suggests that the densities of birds on Rodman Reservoir and the Oklawaha River are nearly as great as any measured on eutrophic Florida lakes (Figure 6 and 7).

Loss of the reservoir complex will undoubtedly cause birds to move as habitat is destroyed, but it cannot be stated with certainty that the birds will find excess suitable habitat available nearby. For example, the number of nesting pairs of eagles is approaching the saturation level in Florida (pg. 12; The Florida Naturalist 1991, volume 64). Evidence from bird counts on area lakes also suggests that the bird populations that currently exist on nearby eutrophic lakes may be at or near carrying capacity already. Adding new birds to these systems could very well stress the populations that already exist and cause birds to die from disease or starvation. Also, as noted earlier in this report, many of the small aquatic ecosystems located in the area of Rodman Reservoir are oligotrophic. Oligotrophic lakes cannot provide sufficient food for large numbers of aquatic birds. Furthermore, many lakes and ponds in the area are dry or nearly dry due to the drought. Most of the aquatic birds currently inhabiting the Rodman Reservoir area, therefore, would have very little excess suitable habitat to move to if the reservoir were drained.

Restoration of the Oklawaha River will most likely benefit the numerical abundance of many terrestrial species of birds, but it shall be detrimental to the abundance of many aquatic bird species. Undoubtedly, some aquatic bird species will not be lost if the Oklawaha River is restored as was true of the terrestrial species that inhabited the floodplain forest prior to the construction of Rodman Reservoir (see below). Florida's policy-makers, therefore, must decide whether they wish to favor aquatic bird species like eagles, ospreys, ducks and wading birds or whether they wish to favor terrestrial birds like the prothonotary warbler, the hooded warbler,

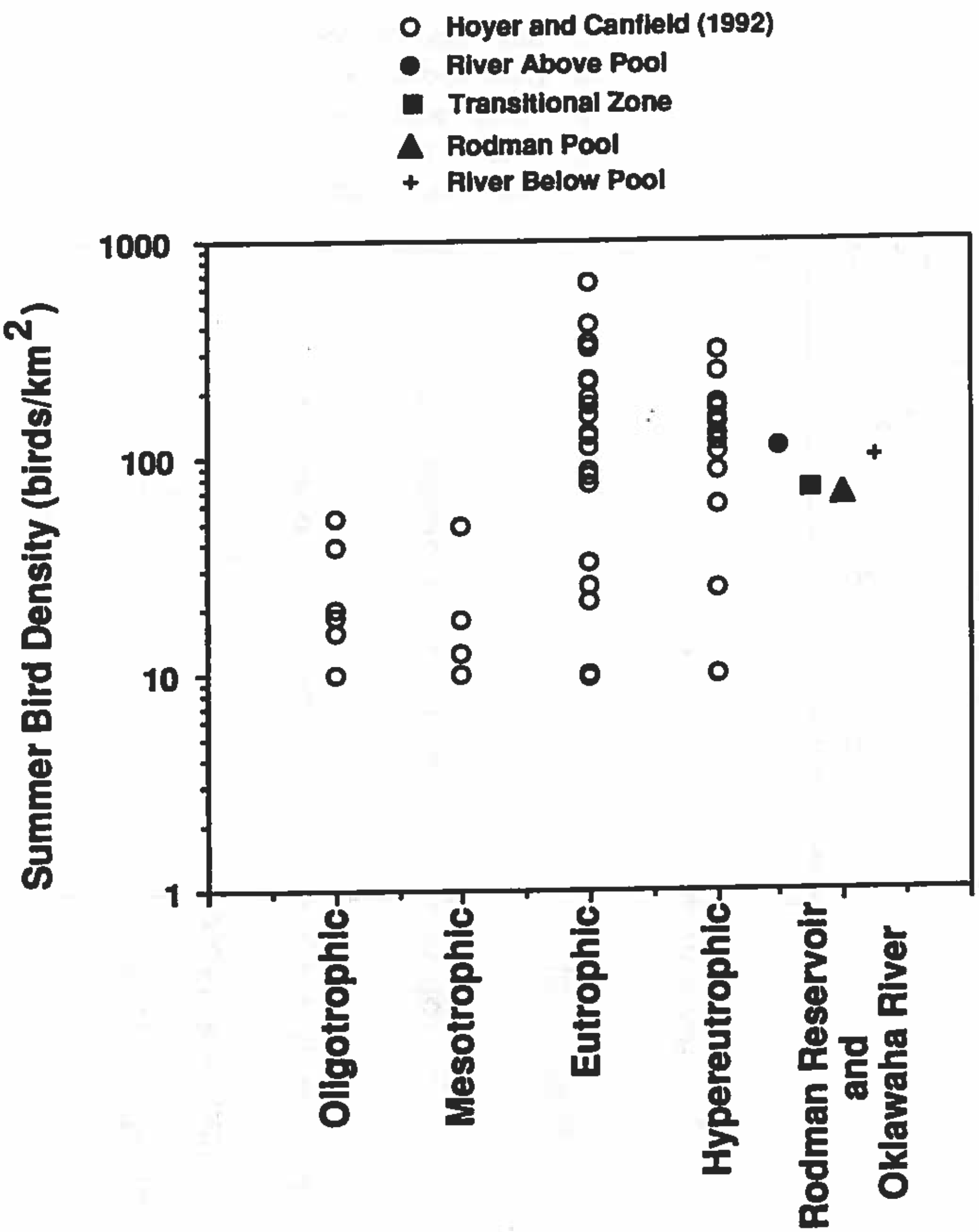


Figure 6. Relation between summer aquatic bird densities (birds/km^2) and lake trophic status for 48 Florida lakes, from Hoyer and Canfield (1992) and aquatic bird densities in the Oklawaha River basin between Eureka and Gores Landing (River Above Pool), Eureka to Orange Springs (Transitional Zone), Rodman pool (Pool), and Rodman dam to St Johns River (River Below Pool).

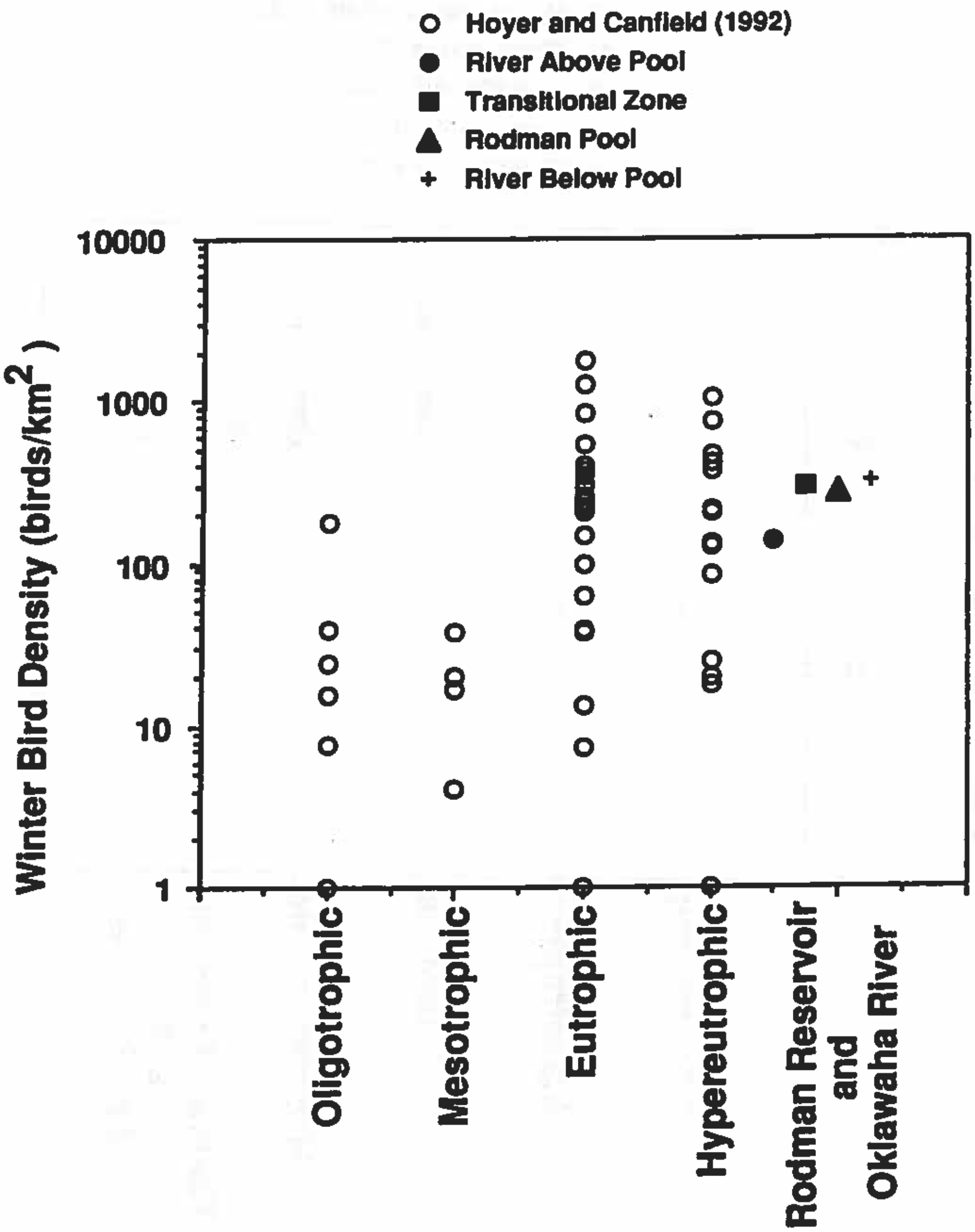


Figure 7. Relation between winter aquatic bird densities (birds/km^2) and lake trophic status for 48 Florida lakes, from Hoyer and Canfield (1992) and aquatic bird densities in the Oklawaha River basin between Eureka and Gores Landing (River Above Pool), Eureka to Orange Springs (Transitional Zone), Rodman pool (Pool), and Rodman dam to St. Johns River (River Below Pool).

the pileated woodpecker, and the Acadian flycatcher. Policy-makers will also have to determine if they wish to create habitat for rare aquatic bird species or rare terrestrial bird species.

ISSUE 3. THE CONSTRUCTION OF RODMAN RESERVOIR HAS ELIMINATED THE FLOODPLAIN FOREST COMMUNITY AND ITS UNIQUE FAUNA.

Opponents of the Cross Florida Barge Canal hypothesized that the construction of Rodman Reservoir would have a seriously deleterious effect on the terrestrial fauna of the Oklawaha River valley (Florida Defenders of the Environment Inc. 1970). In the mid-1970s, this hypothesis was evaluated in the Cross Florida Barge Canal Restudy report. Results from this study seem to support the contentions of those opposed to Rodman Reservoir, but supporters of Rodman Reservoir have argued that the design of the study was biased and that many of the conclusions are not supported by the data collected.

The Cross Florida Barge Canal Restudy report concluded that the floodplain forest supported more species of animals than Rodman Reservoir. This conclusion, however, may overstate the case for the floodplain forest. The Restudy report listed 154 species for the floodplain forest ecosystem and 148 species for the reservoir ecosystem, a difference of only six total species. The number of species of amphibians, reptiles, and birds listed for the floodplain forest and the reservoir compared favorably, but more mammal species (20) were listed for the floodplain forest ecosystem than the reservoir (8). A major criticism of the Restudy report concerns the design of the sampling program. When counts were made of the number of species of amphibians, reptiles, mammals, and birds inhabiting the floodplain forest compared to those that would inhabit the reservoir, both terrestrial and aquatic habitats were included for the floodplain forest counts. Terrestrial habitats located along the margins of Rodman Reservoir or in the transition zone were not included when enumerating the number of wildlife species associated with Rodman Reservoir. Thus, the total count of species associated with Rodman Reservoir, based on the data presented in the Cross Florida Barge Canal Restudy report, could exceed 200 species if the existing terrestrial habitat were considered part of Rodman Reservoir.

We conducted a survey during August 1992 to compare the number of species and where possible, the density of individual species occurring in terrestrial habitats adjacent to Rodman Reservoir and the upper and lower Oklawaha River. In an attempt to make sure that our counts of species numbers and abundance were comparable between sites, terrestrial and aquatic habitats located along our transects were surveyed as well as the transition zones between the major plant community types. We made counts of amphibians, reptiles, birds and mammals present at a total of nine sites. Three sites were adjacent to the upper Oklawaha River (Above Pool) and three sites were adjacent to the lower Oklawaha River (Below Pool). At each site, surveys were made along the edge of the river and surveys were made along transects between the river's edge and upland habitat. Three sampling sites were also established adjacent to Rodman Pool. At each site, surveys were made along the edge of the pool and surveys were made along transects between the pool's edge and upland habitat.

A total of 70 animal species were identified when counts from all transects were combined.

We identified 6 amphibian species, 11 reptile species, 45 bird species and 8 mammal species (Table 5). The average animal density for transects at the Above Pool, Rodman Pool, and Below Pool sites were 869, 619, and 579 (animals/km^2), respectively. Our survey, like earlier surveys done during the Cross Florida Barge Canal Restudy, suggests that the construction of Rodman Reservoir has favored some species and reduced the abundance of other species.

The area of available habitat for terrestrial organisms was reduced when Rodman Reservoir was created. Thus, the total number of terrestrial organisms must have decreased as terrestrial habitat was replaced by aquatic habitat. Destruction of Rodman Reservoir would increase the available habitat for terrestrial species, but it would decrease the available habitat for aquatic species. Thus, decision makers must once again determine if they wish to favor terrestrial animals or aquatic animals. It is clear, however, that the construction of Rodman Reservoir, while impacting the abundance of animals, has not eliminated the floodplain forest community and its "unique fauna" from the region of Rodman Reservoir.

<u>ISSUE 4.</u> THE RESTORED RIVER AND FOREST WILL AGAIN BE A VITAL PATHWAY FOR WILDLIFE.

Proponents of restoration have stated that the Oklawaha River was a major wildlife corridor and that construction of Rodman Reservoir has fragmented a once continuous forest habitat that is vital for wide ranging species such as the black bear and the Florida panther (Florida Defenders of the Environment Inc. 1992; Harris and Hoctor 1992). It is true that the construction of Rodman Reservoir has reduced the amount of floodplain forest in the area of Rodman Reservoir, but it cannot be stated with certainty that the area known as Rodman Reservoir can no longer function as a major wildlife corridor.

The wildlife corridor concept (Harris 1991) is now generally accepted by some ecologists and conservation biologists (Harris and Hoctor 1992). Corridor size, however, is often debated among those who support the concept. There have been no definitive studies for individual species; thus it is generally assumed that larger species require larger corridors. Harris (1991) suggested that corridors could range in size from as little as 30 feet to over 3000 feet depending upon how the organism is using the corridor. Based on the general principles outlined by Harris (1991), it would seem reasonable to conclude that Rodman Reservoir and its surrounding undeveloped lands potentially represent an excellent corridor for many species. The question, however, remains if the area could serve as a corridor for wide ranging species like the black bear and the Florida panther.

To determine if the area is a suitable corridor for bear and panther, it is important to determine if the area is to be used for living habitat or just as a dispersal corridor. If we wish to create more living habitat for the black bear and Florida panther, then it would be reasonable to conclude that the removal of Rodman Reservoir might ultimately be beneficial to these species because the floodplain forest will be reestablished. How many bears and panthers the reestablished floodplain forest could support, however, has not been determined. If we assume a female bear has a mean home range size of 28 km^2 and a male bear has a mean home range size of 99 km^2 (Florida Game and Fresh Water Fish Commission 1987), reestablishing the

Table 5. Average density (no/km^2) by animal species observed in three terrestrial transects adjacent to the Oklawaha River between Eureka and Gores Landing (Above Pool), the Oklawaha River between Rodman dam and St. Johns River (Below Pool), and the Rodman pool (Pool). All counts were conducted in August, 1992.

Animal Species	Above Pool (no/km^2)	Pool (no/km^2)	Below Pool (no/km^2)
Amphibians:			
Bronze Frog	68.4	.	10.5
Green Treefrog	.	4.8	5.3
Southern Cricket Frog	.	heard many	.
Southern Leopard Frog	10.5	23.8	10.5
Southern Toad	31.6	4.8	5.3
Squirrel Treefrog	.	.	5.3
Reptiles:			
American Alligator	.	.	10.5
Brown Water Snake	5.3	.	.
Cottonmouth Mocassin	10.5	.	5.3
Eumeces spp.	5.3	.	5.3
Five-lined Skink	5.3	.	.
Florida Soft-shelled Turtle	.	4.8	.
Green Anole	21.1	9.5	21.1
Ground Skink	.	19.0	.
Six-lined Racerunner	10.5	9.5	.
Southeastern Five-lined Skink	.	4.8	.
Southern Ringneck Snake	5.3	.	.
Birds:			
Acadian Flycatcher	10.5	.	26.3
American Crow	.	.	21.1
Anhinga	.	14.3	.
Barred Owl	5.3	.	.
Belted Kingfisher	.	4.8	.
Black-crowned Night-Heron	.	.	5.3
Blue Jay	.	4.8	.
Blue-gray Gnatcatcher	21.1	14.3	.
Boat-tailed Grackle	.	9.5	.
Carolina Wren	126.3	28.6	47.4
Common Grackle	10.5	.	.
Common Moorhen	.	61.9	.
Common Yellowthroat	.	4.8	.
Downy Woodpecker	36.8	4.8	10.5
Great Blue Heron	.	.	15.8
Great Crested Flycatcher	.	4.8	5.3
Great Egret	.	.	5.3

Table 5 (Continued).

Animal Species	Above Pool (no/km^2)	Pool (no/km^2)	Below Pool (no/km^2)
Great Horned Owl	.	4.8	.
Green-backed Heron	.	14.3	.
Hooded Warbler	5.3	.	.
Limpkin	.	.	10.5
Little Blue Heron	.	9.5	.
Mourning Dove	.	9.5	.
Northern Bobwhite	.	42.9	tracks
Northern Cardinal	63.2	85.7	52.6
Northern Mockingbird	.	9.5	.
Northern Parula	42.1	14.3	26.3
Osprey	.	19.0	10.5
Pileated Woodpecker	42.1	.	21.1
Prothonotary Warbler	10.5	.	36.8
Red-bellied Woodpecker	84.2	23.8	47.4
Red-eyed Vireo	21.1	4.8	57.9
Red-shouldered Hawk	31.6	4.8	.
Red-tailed Hawk	.	4.8	.
Red-winged Blackbird	.	9.5	.
Ruby-throated Hummingbird	5.3	.	.
Rufous-sided Towhee	.	28.6	.
Summer Tanager	.	33.3	.
Tufted Titmouse	73.7	23.8	63.2
Turkey Vulture	.	4.8	.
White-eyed Vireo	21.1	23.8	5.3
Wild Turkey	21.1	.	tracks
Wood Duck	5.3	.	.
Yellow-bellied Sapsucker	holes	holes	.
Yellow-billed Cuckoo	5.3	9.5	15.8
Mammals:			
Bobcat	.	tracks	.
Eastern Gray Squirrel	36.8	tracks	15.8
Feral Hog	rooting	.	tracks
Nine-banded Armadillo	tracks	tracks	skull,tracks
Northern Raccoon	10.5	tracks	tracks
Opossum	tracks	.	skull
River Otter	.	.	tracks
White-tailed Deer	5.3	4.8	tracks
Total animal species	37	45	37
Total animals (no/km^2)	869	619	579

9000 acres (36 km^2) of floodplain forest would support 1.3 female bears and 0.37 male bears. If we assume a female panther has a mean home range size of 184 km^2 and a male panther has a mean home range size of 507 km^2 (Florida Game and Fresh Water Fish Commission 1987), reestablishing the 9000 acres (36 km^2) of floodplain forest would support 0.20 female panthers and 0.07 male panthers. Increasing bear and panther living habitat, therefore, does not seem to be a reasonable justification for destroying Rodman Reservoir and its associated aquatic fauna. Thus, decision makers will have to determine whether bears and panthers are more valuable than other species and weigh the potential increase in bears and panthers against the massive losses of aquatic species that will occur with the draining of Rodman Reservoir.

The restored river will certainly act as a wildlife dispersal corridor for bears and panthers if they are present, but supporters of Rodman Reservoir claim the existing mosaic of habitats surrounding the reservoir can also serve as a dispersal corridor. At the present time, it has not been conclusively determined that bears and panthers are or are not using the existing lands around Rodman Reservoir or the Oklawaha River as a dispersal corridor. There, however, seems to be no reason why these animals should not use the lands of the Rodman Reservoir complex for dispersal. There are substantial amounts of undeveloped land within the Cross Florida Barge Canal right-of-way and the Ocala National Forest borders the south side of the reservoir. Although some individuals have stated that bears and panthers need wide areas of undisturbed land for dispersal, studies of bear and panther movements by the Florida Game and Fresh Water Fish Commission have shown bears and panthers will move through very narrow corridors. It has also been shown that the corridors do not need to be a continuous single habitat type like a floodplain forest (e.g., Maehr et al. 1988).

It is important to note here that the wildlife corridor concept and the overall value of wildlife corridors is not universally accepted by all ecologists and conservation biologists. Simberloff et al. (1992) in a recent essay in Conservation Biology noted that there has been a remarkable publicity campaign, much of it outside the bounds of mainstream science, to promote corridors for conservation. Simberloff and his coauthors from Florida State University and the Florida Game and Fresh Water Fish Commission also wrote that "this hype is occurring in spite of a dearth of evidence of whether corridors will be useful in specific situations." They further noted that Florida provides numerous examples of the uncritical advocacy of extremely expensive corridors. Based on the available information, we conclude that there is no strong evidence that the Rodman Reservoir complex is not a valuable wildlife corridor. Additional studies are needed to insure that restoration of the Oklawaha River is not once again an uncritical advocacy for a wildlife corridor in Florida (see Simberloff et al. 1992).

ISSUE 5. RESTORATION OF THE OKLAWAHA RIVER'S FLOODPLAIN FOREST WILL BENEFIT MANY SPECIES OF SPECIAL INTEREST.

Proponents of restoration have claimed that the removal of Rodman Reservoir will benefit many wildlife species that are either endangered, threatened, rare, or of special concern (Kaufmann 1991). Based on the Florida Game and Fresh Water Fish Commission's 1976 Barge Canal Restudy Report - Wildlife, Kaufmann (1991) has concluded that the number of species that would benefit from restoration of the river would outnumber those that would lose by about 2 to 1.

The Florida Game and Fresh Water Fish Commission's 1976 Barge Canal Restudy Report - Wildlife stated that the forested floodplain of the Oklawaha River has a high wildlife value, especially when its relationship to the uplands of the Ocala National Forest is considered. A careful reading of the report, however, suggests that some of the conclusions advanced by the authors are biased and inconsistent with the field data collected. For example, the Wildlife Restudy Report did not consider the terrestrial habitat associated with Rodman Reservoir, including the Ocala National Forest, when evaluating the wildlife value for the reservoir. Four eastern indigo snakes were observed during the study. Two of the snakes were seen on Highway 310 immediately to the north of Rodman Reservoir. Although this is reservoir habitat, the snakes were not included with the list of species associated with Rodman Reservoir. Nor was the only specimen of rainbow snake that was found at this site. However, species such as the Ivory-billed woodpecker and Bachman's warbler were included in the floodplain forest list because it was assumed that these species were potentially restorable. It is important to note that the presence of these species was never documented and that potentially restorable species that would use aquatic habitat were not added to Rodman Reservoir's list of species of special interest. Despite these inconsistencies, the Wildlife Restudy Report listed 17 species of special interest for the floodplain forest and 21 species of special interest for Rodman Reservoir.

The Florida Game and Fresh Water Fish Commission's 1976 Barge Canal Restudy Report - Wildlife did state that the creation of Rodman Reservoir would be beneficial for "biologically sensitive" species such as the alligator, osprey, bald eagle, and the limpkin. They, however, concluded that benefits to most of these species could decrease because of hazards associated with barge traffic. The authors of the Wildlife Restudy Report, therefore, concluded the restored river would be better for wildlife. With the deauthorization of the Cross Florida Barge Canal, Rodman Reservoir will not conduct barge traffic. Thus, it seems reasonable that the benefits of Rodman Reservoir to those "biologically sensitive" species should not be discarded as done in the Wildlife Restudy Report. If the benefits of Rodman Reservoir are considered, it must be concluded based on the Wildlife Restudy Report that Rodman Reservoir represents, if not a better habitat for species of special interest, a habitat that is very comparable to that which may be present with restoration of the Oklawaha River.

ISSUE 6. RESTORATION OF THE OKLAWAHA RIVER WILL ALLOW MANATEES TO USE THE RIVER AND ITS ASSOCIATED SPRINGS SAFELY.

There have been some deaths of endangered manatees at Buckman Lock. Proponents of restoration have suggested that restoration of the Oklawaha River would permit the reestablishment of historical riverine access and safe habitat utilization by manatees (Florida Defenders of the Environment Inc. 1989; Florida Game and Fresh Water Fish Commission 1992). Supporters of Rodman Reservoir, however, contend that manatees never used the upper Oklawaha River for either habitat or winter refuge and that proper management of Buckman Lock could eliminate manatee deaths and allow upstream access.

There is little hard documentation that manatees used the upper Oklawaha River or the springs of the upper Oklawaha River in the recent past. Fossil evidence (a single bone?) has been used to suggest that manatees did use the upper Oklawaha River area in the distant past. Environmental conditions, such as the distance the springs (i.e., Silver Springs) may have been from the ocean, could have been very different from the environmental conditions that now exist. Consequently, it is not certain that the upper Oklawaha River could provide habitat for manatees or that the springs of the upper Oklawaha River could serve as a major thermal refuge for manatees in the winter at this time (Lynn Lefebvre, Assistant Professor, University of Florida; personal communication). It is also unclear how many manatees, if any, could be supported in the springs during the winter.

Manatees were upstream of Rodman dam in the 1970s and early 1980s, but they were not reported in the upper Oklawaha River or in upstream springs like Silver Springs. Manatees were allowed to pass through Buckman lock into Rodman Reservoir where they fed on aquatic plants like hydrilla (Dave Bowman, U.S. Army Corps of Engineers, Palatka, Florida; personal communication). Rodman Reservoir and its vast supply of aquatic plants could therefore be an important foraging habitat for manatees if the animals were allowed to pass through Buckman Lock. Closed-canopy rivers in Florida such as a restored Oklawaha River support very little aquatic vegetation due to light limitation (Canfield and Hoyer 1988b). Manatees would have to migrate up many miles of a restored river that would support few food resources until they reached Silver Springs. Manatees, however, did not migrate upstream when they had the chance in the 1970s and mid-1980s. Thus, we believe that it cannot be stated with certainty that manatees would migrate up a restored Oklawaha River to feed on aquatic plants or seek thermal refuge in Silver Springs.

When the manatees wanted to enter or leave the reservoir, they were allowed to pass upstream and downstream through Buckman lock. The death of some manatees, however, resulted in the placement of an air bubbling device downstream of Buckman Lock. This device was designed to discourage the upstream movement of manatees through Buckman Lock and has successfully kept manatees out of Rodman Reservoir since the mid-1980s. Alternatives for ending the manatee deaths at Buckman Lock have not been explored in detail, especially structural or operational alterations that could be made to the lock to allow manatees and other fish and wildlife to pass safely. If Rodman Reservoir is retained and managed for fish and wildlife, such alternatives should be explored because the system will no longer be used for barge traffic and Rodman Reservoir could provide valuable habitat to manatees. It is also important to recognize that large numbers of manatees are routinely and safely locked through structures at Cape Canaveral (Dave Bowman, U.S. Army Corps of Engineers, Palatka, Florida; personal communication). Thus, the possibility of having a few manatees in the upper Oklawaha River with restoration should be balanced against the known use of Rodman Reservoir by manatees and losses in fish and wildlife that would occur with the loss of Rodman Reservoir.

ECONOMIC ISSUES

THE RODMAN RESERVOIR COMPLEX

ISSUE 1. MAINTAINING RODMAN RESERVOIR WILL COST MILLIONS.

The cost of operating the Rodman Reservoir complex has been one of the most contentious issues debated in the ongoing Rodman Reservoir controversy. Proponents of restoration have maintained that it will cost Florida's taxpayers millions each year to keep Rodman Reservoir, whereas a restored river will cost virtually nothing once restoration is complete (Boyles-Sprenkel 1991; Florida Defenders of the Environment Inc. 1989). Supporters of Rodman Reservoir contend that the management of the Rodman Reservoir complex costs less than a million dollars per year (Boyles-Sprenkel 1991).

Early in the debate, proponents of restoration were quoting operation and maintenance costs for the reservoir in the range of $1.8 million to $2.1 million per year (e.g., Boyles-Sprenkel 1991). These figures, however, were erroneous because they were based on the total amount of dollars budgeted by the U.S. Army Corps of Engineers for the entire Cross Florida Barge Canal project. The average cost for operating and maintaining the eastern half of the Cross Florida Barge Canal, which includes Rodman dam, Buckman Lock, Rodman Reservoir, canals, recreation areas, and resource management, was estimated at $800,000 to $900,000 per year by staff of the U.S. Army Corps of Engineers (e.g., Boyles-Sprenkel 1991).

Since late 1991, opponents of Rodman Reservoir have estimated that it will cost Florida about $1 million every year to maintain Rodman Reservoir (Florida Defenders of the Environment Inc. 1992). A recent report prepared by Greiner Inc. for the Canal Authority of the State of Florida estimated that the total annual costs, including repairs and replacements, for Buckman Lock, Rodman dam and spillway, Eureka lock, and Eureka dam and spillway would range from $807,000 to $2.7 million between 1992 and 2002 (Greiner Inc. 1992). The average cost per year would be $1.1 million, which agrees well with the estimate provided by the Florida Defenders of the Environment. Proponents of restoration often compare the $1 million figure to the cost of operating and maintaining a restored Oklawaha River, which is assumed to be virtually free once restoration is complete (e.g., Florida Defenders of the Environment Inc. 1989, 1992). This assumption, however, must be examined closely before a true comparison of the operation costs of Rodman Reservoir and the restored river can be made.

Greiner Inc. (1992) estimated that the cost of operation for the Rodman Reservoir complex, exclusive of repairs and replacements, would be $838,000 in 1992. Project management costs and supervision and administration costs were estimated to be $270,000. Land management costs were estimated at $239,000. Because the restored river will be operated as a recreational resource, project management, supervision and administration, and land management costs will also be incurred by a restored river. It is highly likely that as many personnel will be hired to take care of the lands associated with the restored river as are hired to take care of the Rodman Reservoir complex. It is also likely that land management costs for the area will be nearly as high for the restored river for the next ten years; thus approximately $500,000 should be subtracted from Rodman Reservoir's 1992 operational costs of $838,000.

A net operating cost of approximately $338,000 per year would seem reasonable for Rodman Reservoir (based on the Greiner Inc. estimates) when comparisons are made between the cost of operating and managing the Rodman Reservoir complex and the restored Oklawaha River. A recent report by Thomas D. Bowman, the U.S. Army Corps of Engineers' park manager at Rodman Reservoir suggests that the net operating and maintenance cost of keeping Rodman Reservoir is approximately $265,000 ($37,000 for Rodman Dam and $228,000 for Buckman Lock). These figures, however, do not include the costs of repairs that would need to be done at Rodman Reservoir periodically to keep the structures functional over the long-term (Kiker 1991; Greiner Inc. 1992).

Greiner Inc. (1992) estimated that repair and replacement costs for the Rodman Reservoir complex between 1992 and 2002 would total $5,143,000. Greiner Inc., however, apparently based their cost estimates on what it would take to operate the Rodman Reservoir complex as designed. This means that all operating systems are fully functional and all structures and equipment are fully maintained at their original condition and capable of handling barge traffic. For example, the repair and replacement costs advanced by Greiner Inc. include the restoration of the fire system at Buckman Lock (approximately $50,000). The fire system is designed to handle fires on barges carrying hazardous materials. Because barges will not be using Buckman Lock and pleasure boats do not require extensive fire protection, it seems unreasonable to restore the fire control system to its original condition, when a less expensive alternative could meet present and future needs equally well. Similarly, it seems unreasonable to repair Buckman Lock to the condition that would be required to handle barges, when the lock will not be used to move barges as designed for the Cross-Florida Barge Canal. What the actual repair and replacement costs would be to have a functional complex is not known precisely at this time.

It is also important to note here that throughout the many debates regarding the cost of operating the Rodman Reservoir complex, it has generally been assumed that Buckman Lock must be maintained as designed. This assumption has probably never been challenged because the Oklawaha River is a navigable water and access to the upper Oklawaha River must be maintained (U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, Florida). There are, however, alternatives to Buckman Lock that should be explored because some of the alternatives would be more environmentally "friendly" and less costly to operate. For example, it has been proposed that the lock at Lake Rousseau on the west end of the former Cross Florida Barge Canal be eliminated and replaced by boat ramps above and below the dam. Elimination of the lock would result in substantial cost savings. If Buckman Lock, the most expensive part of managing the Rodman Reservoir complex, could be eliminated, the gross and net annual operating costs of Rodman Rodman reservoir could be reduced by more than 50% (Bowman 1992; Greiner Inc. 1992).

ISSUE 2. FISHING AT RODMAN RESERVOIR DOES NOT CONTRIBUTE SIGNIFICANTLY TO THE ECONOMY OF PUTNAM COUNTY.

Proponents of restoration have advanced the argument that given the high cost of maintaining Rodman Reservoir ($1 million per year, but see Economic Issue 1) the river should be restored because the dam serves no functional purpose except to keep a few fishermen happy (Gainesville Sun Editorial; April 26, 1992). Supporters of Rodman Reservoir, however, contend that maintaining Rodman Reservoir is less than $700,000 annually (also see Economic Issue 1) and that the reservoir is worth more than $13 million annually to the local economy (Palatka Daily News, May 1, 1992).

The Florida Game and Fresh Water Fish Commission estimated that the fishery at Rodman Reservoir was worth $1.6 million per year and that the tailrace fishery below Rodman dam was worth an additional $340,000 per year (Estes et al. 1989). It was further estimated that the sport fishery in a restored 16 mile section of the Oklawaha River would be worth $241,000 per year, assuming fishing in the restored section of the river became equal to that found in the upper and lower Oklawaha River. The Commission's economic estimates were based on trip expenditures and included no multiplier effects for the direct, indirect, and induced economic impacts associated with fishing. Despite the exclusion of multiplier effects, the analysis still suggested that the current economic value of the reservoir and tailrace fisheries was 8 times that of the Oklawaha River fishery.

Bell (1992), using a different set of assumptions than previous studies and more recent data, estimated both the absolute and relative economic impact of sport fishing at Rodman Reservoir on Putnam County. He estimated that the direct spending of tourists, the indirect local spending and direct local spending attributable to freshwater recreational fishing on Rodman Reservoir was $7.2 million in 1991. Fishing at Rodman Reservoir was believed to be responsible for the generation 111 jobs in Putnam County. Bell (1992), however, noted that while fishing at Rodman Reservoir generated a lot of money in absolute terms, fishing generated only 0.15% of Putnam County's total 1989 economic base and only 0.47% of Putnam County's employment.

Bell (1992) suggested that if the Oklawaha River is restored, the loss of Rodman Reservoir and its impact on Putnam County's economy is likely to be mitigated by substitute lakes of comparable quality (e.g., Lake George). Bell (1992) further concluded that it is doubtful that North Central Florida would lose recreational fishing dollars because there are many good substitute lakes near Rodman Reservoir. Certainly some of the economic wealth generated by fishing would be redistributed because some anglers will continue to fish, no matter what! Bell's assertion concerning the presence of good substitute water bodies, however, is a questionable assumption.

Bell (1992) based his conclusion on a report by Milon et al. (1986) that suggested many anglers would fish lakes where there was a good chance of catching "eating-size fish", lakes such as Lake George, Orange/Lochloosa, and Lake Kerr. Bell also assumes that substitute lakes can withstand the additional fishing pressure that must be distributed if Rodman Reservoir is lost. Lakes like Lake Kerr, however, are oligotrophic and cannot support intense fishing pressure. Fishing mortality by anglers at Orange and Lochloosa lakes is already substantial and there are concerns that the lakes cannot handle much more fishing pressure (Estes and Meyers 1991). Orange and Lochloosa lakes are also currently experiencing severe drought and angling access is greatly limited. Low water levels have caused a major reduction in fishing effort and a severe economic hardship for many fish camp operators. Newnans Lake, another major fishing lake, has lost its black crappie fishery and disease has affected its largemouth bass population. It is also important to address here that Milon et al. (1986) noted that anglers considered Crescent Lake, the Oklawaha River, and the St. Johns River poor substitutes for Rodman Reservoir. Thus, it should only be stated speculatively that the loss of Rodman Reservoir will not result in the loss of recreational fishing dollars in North Central Florida.

Bell's (1992) study considered the economic value of the fishery at Rodman Reservoir based on the existing condition of the fishery. Rodman Reservoir, however, has not been managed for fisheries. If it were, the total amount of revenue generated could be substantially greater. Bell also did not include the value of the tailrace fishery. The tailrace fishery generates a substantial amount of recreational fishing revenue. Because Bell was charged with estimating the effects of recreational fishing, his study also does not include other recreational uses at Rodman Reservoir such as hunting and camping. Hunting and camping are two major recreational pursuits now and could become even more valuable if Rodman Reservoir was managed properly and if recreational sites around the reservoir were developed.

Bell's (1992) study concludes that the 111 jobs associated with Rodman Reservoir's recreational fishery are less than 0.5% of Putnam County's total employment. Consequently, it is implied that the loss of these jobs will have little effect on Putnam County's overall economy. Before this conclusion is accepted, it is important to determine where these jobs are and how many will be actually lost. Although there has been no definitive study, it appears based on our conversations that many of the jobs generated by Rodman Reservoir are in the private sector in small communities like Interlachen (Note: jobs would also be lost in rural Marion County in towns like Orange Springs). For rural communities, the economic impact associated with the loss of Rodman Reservoir would be significantly greater than the impact on Putnam County as a whole.

If there is a significant loss of jobs in rural communities, there is a strong probability that many individuals would need government assistance until new jobs could be created. This need would occur because, as noted by Bell (1992), Putnam County does not have a large economic base that could readily absorb displaced workers. The loss of jobs in the rural areas of Putnam County and surrounding counties would then represent a hidden cost to removing Rodman Reservoir, not only in terms of dollars but in terms of human resources.

It is also important to recognize that the tailrace fishery at Rodman dam provides food fish for low income families. If Rodman Reservoir is removed, the tailrace fishery will be lost. This will cause not only a loss in revenue to the counties near Rodman Reservoir, but also a loss of food to economically disadvantaged families. It therefore should be determined if this loss of food fish would increase the demand for government assistance, for this would be another hidden cost of restoration.

ISSUE 3. AQUATIC WEED CONTROL AT RODMAN RESERVOIR COSTS MILLIONS OF DOLLARS OF TAXPAYERS' MONEY PER YEAR

Proponents of restoration have rightfully noted that aquatic plant management will be needed if Rodman Reservoir is to be managed as a recreational resource. In 1978, Dr. John R. Kaufmann, Chairman of the Florida Defenders of the Environment's Science Advisory Committee, estimated that aquatic weed control costs for Rodman Reservoir would exceed $1 million per year (Kaufmann 1978). Because it was assumed that a restored Oklawaha River would require little if any control of aquatic weeds, Kaufmann wrote that draining Rodman Reservoir would save $1 million or more per year.

Based on 24 years (1969 to 1992) of operational data (U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, Florida), the cost of aquatic vegetation control for Rodman Reservoir has averaged $33,300 per year. Annual costs have ranged from $0 to $235,700, but have never come close to $1 million per year. The highest annual aquatic plant management costs occurred in 1970 ($235,700) and 1971 ($217,600) when water hyacinths were a major problem. In these years, the U.S. Army Corps of Engineers paid for the control of over 4000 acres of hyacinths. Once maintenance control programs were in place, fewer than 100 acres of water hyacinths needed spraying in the 1980s and early 1990s. Aquatic weed control costs at Rodman Reservoir between 1972 and 1992 averaged approximately $16,000 per year.

Aquatic plant control costs at Rodman Reservoir will depend upon the management objectives established for the reservoir. In the 1980s and 1990s, the highest aquatic weed control costs occurred when hydrilla was controlled. In 1988, aquatic vegetation control costs were $93,600 and in 1990 costs were $70,100. If 1,840 acres of hydrilla were controlled to maintain a 50% open-water area in the pool (see Kaufmann 1978), control costs would be approximately $128,800 per year (Joseph Joyce, Director - Center for Aquatic Plants, University of Florida; Letter to John H. Kaufmann regarding 1978 cost estimates). Regardless, of the management scenario, 24 years of operational experience have shown that aquatic plant management control costs at Rodman Reservoir have never approached $1 million per year and that average annual costs could most likely be kept under $50,000 per year if maintenance control of weed species is initiated.

ISSUE 4. RECREATIONAL USE OF RODMAN RESERVOIR IS LOW AND IT IS USED BY ONLY A "HANDFUL OF BASS FISHERMEN"

Proponents of restoration have stated that restoration versus keeping the dam is really a debate over what is best for the future of Florida versus what is best for a small group of bass fishermen (David Godfrey, Florida Defenders of the Environment's Ocklawaha restoration project coordinator; Gainesville Sun, July 29, 1991). Supporters of Rodman Reservoir, however, have contended that Rodman Reservoir is a major recreational resource that services the needs of more than a few bass fishermen.

Rodman Reservoir is known for largemouth bass fishing, but many anglers fish for more than just largemouth bass as detailed in the fisheries section of this report. Recreational- use surveys by the U.S. Army Corps of Engineers (David Bowman, U.S. Army Corps of Engineers, Palatka, Florida) indicated that only 57% of the use of Rodman Reservoir was fishing. The remaining 43% of recreational use constituted a wide diversity of activities including picnicking, sightseeing, camping, and hunting. The most popular activity other than fishing was sightseeing (17%), which involved a large amount of bird watching (David Bowman, personal communication).

In December 1992, Mr. Charles Lee of the Florida Audubon Society testified before the Florida Cabinet that only 73,000 people visited Rodman Reservoir in 1988 and that the money spent on Rodman Reservoir could be better used to support the Florida Park system, which is used by far more people. Mr. Lee's estimate of 73,000 visitors was apparently based on an estimate made by the Florida Game and Fresh Water Fish Commission of angler trips (McKinney et al. 1988) and does not accurately reflect the actual usage of Rodman Reservoir. The U.S. Army Corps of Engineers has monitored visitation to Rodman Reservoir since 1969. Visitation to Rodman Reservoir has varied from 168,600 visitor days in 1969 when the reservoir was first filled to a high of 484,000 visitor days in 1990 (U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, Florida). In 1992, 310,700 visitor days were recorded, which is more recreational use than all but 12 of Florida's 126 state parks (Recreation and Parks Management Information System, Florida Department of Natural Resources, Tallahassee, Florida). The Florida Department of Natural Resources in 1991/1992 recorded a total visitation of 218,560 and 331,877 visitors at the state parks located at Lake Rousseau and Lake Talquin, respectively. Both of these parks are located on reservoirs. Ten of the state parks that attracted more visitors than Rodman Reservoir are all coastal parks with well developed recreational facilities.

RESTORING THE OKLAWAHA RIVER

<u>ISSUE 1.</u> THE LONG-TERM COSTS OF RESTORING THE OKLAWAHA RIVER WILL BE LESS THAN THE LONG-TERM COSTS OF MAINTAINING THE RODMAN RESERVOIR COMPLEX.

Proponents of restoration have argued strongly that the cost of restoration will be no more than the cost of maintaining the reservoir for 4 to 10 years (Florida Defenders of the Environment Inc 1992; Gainesville Sun Editorial, April 26, 1992). Supporters of Rodman Reservoir have suggested that the costs of restoration will be on the order of tens of millions of dollars (Palatka Daily News; Rodman: Should it stay, go?; July 19 1991).

Bell and Bendle (1992) have provided, for several proposed restoration alternatives, the most comprehensive recent assessment of the relative costs of restoration versus the maintenance of the Rodman Reservoir complex. They estimated the present value cost for a total and complete restoration of the Oklawaha River would be approximately $23 million if terrestrial vegetation was not replanted or approximately $27 million if plants were replanted. Because it was assumed restoration would take place over a period of 10 years, Bell and Bendle estimated that inflation could increase these numbers to approximately $26 million and $30 million, respectively. If the partial restoration program advocated by the University of Florida (University Planning Team 1992) is implemented, Bell and Bendle (1992) estimated that the costs of restoration could be reduced to approximately $7.4 million if vegetation is not replanted and $11 million if vegetation is replanted.

Bell and Bendle (1992) noted that individuals advocating the highest cost restoration alternative would have to wait more than 38 years (estimated at 70 years) before the present value of operating and maintaining the Rodman Reservoir complex would equal the present value of restoration. If the partial restoration program recommended by the University Planning Team were adopted, Bell and Bendle (1992) estimated that the relative costs between restoration and operating the Rodman Reservoir complex would equalize in about 12 years with replanting and in about 6 years without replanting.

Acceptance of Bell and Bendle's relative cost estimates is predicated on a number of assumptions. First, the cost estimates provided by Greiner Inc. (1992) must be accepted. If the net cost of operating the Rodman Reservoir complex is less than the costs advanced by Greiner Inc. (see Economic Issue 1), the relative costs provided by Bell and Bendle become even more favorable for retaining the reservoir complex. Second, it must be assumed that <u>no additional studies</u> will be needed before implementation of the restoration program or management of the Rodman Reservoir complex begins. This assumption will be violated because areas needing more study have already been proposed with cost estimates exceeding $10 million (University Planning Team 1992) and an environmental impact study will have to be done before Rodman Reservoir can be drained. Finally, it must be assumed that the partial restoration program proposed by the University Planning Team (1992) will successfully restore the natural ecological functioning of the Oklawaha River.

Projecting future costs for projects is extremely difficult, but experience has shown that the costs of engineering works such as dams and the costs of environmental restoration programs such as restoring rivers are generally greatly underestimated when first advanced. For example, the cost of restoration for the Kissimmee River was once estimated at less than $80 million, but some estimates now put the cost of restoration at over $400 million. The costs of maintaining Rodman dam could greatly increase if the dam were to develop leakage that threatened the structural integrity of the dam. Because it is not exactly clear what proponents of restoration mean by restoring the "natural ecological functioning" of the Oklawaha River, costs could increase dramatically if the proposed partial restoration program was deemed insufficient. This is a real concern because there are numerous earthen dikes underwater in Rodman Reservoir that, if not sufficiently breached or removed, would significantly interfere with the "natural functioning" of the Oklawaha River's floodplain. At the present time, it is assumed that partial plugging of the canals and partial breaching of the dikes will restore flow patterns sufficiently. If it does not, costs incurred to completely remove the dikes could greatly inflate the estimates provided by Bell and Bendle.

ISSUE 2. THE MONEY AND EFFORT SAVED BY RESTORING THE OKLAWAHA RIVER COULD BE BETTER USED IN SOLVING OTHER ENVIRONMENTAL PROBLEMS IN FLORIDA.

Proponents of restoration have written that a restored Oklawaha River would be more valuable because it requires no large inputs of manpower and money for maintenance, money that could be better spent upon the preservation and management of Florida's other threatened resources (Florida Defenders of the Environment Inc. 1989; Ewel et al. 1992). Supporters of Rodman Reservoir, however, contend that Rodman Reservoir, while requiring taxpayer dollars to operate and maintain, represents a net economic benefit to the taxpayers of Florida.

The economic study by Bell and Bendle (1992) clearly demonstrates that fishing alone generates more than enough economic benefits to pay for the cost of operating and maintaining the Rodman Reservoir complex. If the recreational potential of Rodman Reservoir were fully developed by initiating optimal management of the reservoir, it is also clear that additional revenue would be generated. Thus, Rodman Reservoir does not represent a loss of taxpayers' dollars.

Restoration of the Oklawaha River will cost money by everyone's estimates. Proponents of restoration, however, have suggested that the river will cost taxpayers virtually nothing once restoration is complete and there will be a tremendous economic gain because tourists and anglers will come in greater numbers to enjoy the restored river (Florida Defenders of the Environment Inc. 1992). The costs of managing a restored Oklawaha River and the economic gains to be realized from increased numbers of tourists and anglers remain speculative. It, however, is certain that Rodman Reservoir now generates a net economic gain for taxpayers. It is also certain that the restored Oklawaha River will cost taxpayers money because the river will be part of the Cross Florida Greenbelt. The operation and maintenance of the Greenbelt will require a number of government employees for administration and field operations, especially if current management recommendations such as the creation of a new bureau in the Florida Department of Natural Resources are adopted (University Planning Team 1992).

ISSUE 3. TOURISTS AND FISHERMEN WILL COME IN GREATER NUMBERS TO ENJOY THE RESTORED OKLAWAHA RIVER.

The Florida Defenders of the Environment Inc. (1992) have stated that a restored Oklawaha River will provide high quality recreation of a kind that is fast disappearing nationwide. They further stated that tourists and fishermen will come in greater numbers to enjoy a restored river and that a restored river and its wildlife will attract many pleasure boaters and canoeists to the area. Supporters of Rodman Reservoir, however, have suggested that the reservoir is a greater recreational resource.

We conducted a recreational-use survey between August 29 and September 25, 1992 to determine recreational use at the Rodman Reservoir Complex (Rodman Reservoir and its tailrace) and recreational use on the Oklawaha River, both above (Eureka to Gore's Landing) and below the Rodman Reservoir Complex (Rodman tailrace to the St. Johns River). Our survey methods were based on the roving creel survey technique of the Florida Game and Fresh Water Fish Commission.

Recreational fishing effort at Rodman Reservoir during the survey averaged 11,113 person-hours and 2,200 person-hours at the tailrace. Fishing effort averaged 1,673 person-hours on the upper Oklawaha River and 3,160 person-hours on the lower Oklawaha River. Recreational canoeing averaged 320 person-hours at Rodman Reservoir, 1600 person-hours on the upper Oklawaha River and 300 person-hours on the lower Oklawaha River. Recreational pleasure boating averaged 960 person-hours at Rodman Reservoir, 1227 person-hours on the upper Oklawaha River and 1040 person-hours on the lower Oklawaha River.

Although recreational canoeing and pleasure boating efforts on the upper and lower Oklawaha River exceeded the recreational effort for these activities at Rodman Reservoir during our survey, the magnitude of the differences is small. Thus, there is only marginal evidence to support the contention that more pleasure boaters and canoeists will use the area if the river is restored. Total recreational fishing effort at the Rodman Reservoir complex (Rodman Reservoir and the tailrace) during our survey, however, averaged 13,313 person-hours whereas total recreational fishing effort on both the upper and lower Oklawaha River only averaged 4,833 person-hours. We, therefore, do not believe that it is reasonable to state that anglers will come in greater numbers to enjoy a restored river. Our survey and other angler surveys clearly show that anglers prefer the reservoir. We further believe that it is highly speculative to imply that the recreational value of a restored Oklawaha River will be greater that of the existing Rodman Reservoir complex.

CONCLUSIONS

Natural resource management decisions should be based on an adequate data base that has been analyzed in a unbiased manner. Because every individual and every group of individuals have inherent biases regarding what constitutes a quality environment, it is important that the pros and cons of each issue be thoroughly addressed. This is especially important for policy-makers. Policy-makers not only need, but deserve to have the pros and cons of each issue thoroughly evaluated. It is they alone, who must formulate a "solution" to a given problem, when differing and conflicting views of groups collide.

The first step in evaluating any natural resource problem is to define the "problem." In the case of the Rodman Reservoir controversy, it is easy to make this determination. Proponents of restoration want a free-flowing Oklawaha River and supporters of Rodman Reservoir want a reservoir. These different and conflicting views are philosophically based and it is unlikely that either group's point of view can be changed given the past history of conflict. Consequently, we believe Florida's policy-makers have a difficult decision: either vote for a free-flowing Oklawaha River and please the proponents of restoration or vote to retain Rodman Reservoir and please the supporters of Rodman Reservoir.

Both sides of the Rodman Reservoir controversy have brought forth compelling arguments for their positions. Proponents of restoration have basically formulated their defense around the environment and the biological integrity of Florida's native ecosystems. Many of the arguments advanced by the proponents of restoration are based on hypothetical ecological concepts concerning the functioning of "natural" ecosystems. These hypotheses, such as biodiversity or the biological integrity of ecosystems, are not clearly defined and are still evolving in the scientific literature. Thus, these hypothetical ecological concepts, although very stimulating, do not offer a shortcut to the truth because they are still based on loosely defined premises.

A large amount of ecological information has been collected on Rodman Reservoir and the Oklawaha River over the past 20 years. We have reevaluated most of the existing information in preparing this report. What becomes obvious is that most of the studies conducted had problems in design and data interpretation that are directly attributable to the philosophy of the individuals conducting the studies. A number of reports had conclusions that were not supported by the author(s) own data and many of the studies did not attempt to determine if there were alternative explanations. Most of the studies also did not have well-defined, testable hypotheses.

Despite these problems, we found sufficient information to evaluate most of the environmental issues that have been raised during the Rodman Reservoir controversy. We find that most of the claims made by proponents of restoration are not supported by the available data. Some of the claims made by proponents of restoration, however, cannot be evaluated directly because they constitute articles of faith rather than testable hypotheses. After an extensive evaluation of available data and consideration of the pros and cons of all the major issues that have been raised, we find no compelling reasons at this time to recommend the removal of Rodman Reservoir.

The construction of Rodman Reservoir has not destroyed the unique and diverse fauna of the Oklawaha River. Large sections of free-flowing river still remain. Rodman Reservoir, however, has created a unique environment that supports an abundance of fish and wildlife. The reservoir supports endangered species and species of special concern. It also supports large numbers of sport fish that provide many Floridians with exciting fishing recreation. Rodman Reservoir, however, also provides large numbers of Floridians with other recreational opportunities such as bird watching and camping. To date, Rodman Reservoir has not been managed for fish and wildlife, but it is a healthy ecosystem. With management, it will last for hundreds of years. If the State of Florida institutes a well-designed management program, fish and wildlife values could be greatly enhanced not only in the reservoir, but also in adjoining sections of the Oklawaha River.

There has been a great deal of concern about how much it will cost to maintain and operate the Rodman Reservoir complex over the next 20 years. It, however, is clear based on the available data that even the most costly proposed operation and management alternative is less expensive than the money generated by fishing at Rodman Reservoir ($1.1 million for operation and management versus $7.2 million from fishing). The taxpayers of Florida will expend money on Rodman Reservoir, but they will reap a good return on each dollar invested in the future of Rodman Reservoir. Rodman Reservoir is currently a money maker for the State of Florida and management can further increase its economic value. If additional recreational facilities are developed, as called for in the original design for the Rodman Reservoir complex, Floridians could have a major multi-use recreational site with a high economic and ecological value.

We recommend that Rodman Reservoir be retained for now, the primary management objective being the enhancement of fish and wildlife populations. We suggest that the State of Florida should manage Rodman Reservoir as a recreational reservoir for at least the next 20 years, because 20 years is adequate time to not only evaluate the effects of intensive management on fish and wildlife populations given the life cycles of animals, but also to resolve questions related to the economic-ecological costs/benefits of keeping Rodman Reservoir.

Management of the reservoir should be entrusted to a single agency with individuals committed to the management objective of enhancing fish and wildlife populations. We further suggest that an objective evaluation of Rodman Reservoir and the Oklawaha River be completed over the next 20 years. This evaluation should be a coordinated study by all the agencies that are currently working in the Oklawaha River Valley (e.g., St. Johns River Water Management District, Florida Game and Fresh Water Fish Commission, and university researchers). If the Florida legislature instructs the groups to work together, few additional resources should be needed as each agency has ongoing studies that could produce the needed information in time or could redirect resources from projects that are ending to address new issues. If compelling reasons emerge after these studies that support the need to remove Rodman Reservoir, the Florida Legislature could then decide to restore the Oklawaha River. There is no compelling biological/ecological reason to rush restoration at this time.

LITERATURE CITED

Bell, F. W. 1992. An estimation of the absolute and relative economic importance of Rodman Reservoir to Putnam County, Florida. Final Report. Department of Economics. Florida State University. Tallahassee, Florida.

Bell, F. W., and B. Bendle. 1992. An overall analysis of the estimated cost of reversal of the conditions created by the Cross Florida Barge Canal compared to the cost of maintenance of the canal works with emphasis on Rodman Reservoir. Final Report. Department of Economics. Florida State University. Tallahassee, Florida.

Bowman, T. D., 1992. Some Facts about The Cross Florida Barge Canal Project. Palatka, Florida.

Boyles-Sprenkel, C. 1991. Rodman or the River? Florida Sportsman. April 1991.

Canfield, D. E. Jr., and M. V. Hoyer. 1988a. Regional geology and the chemical and trophic state characteristics of Florida lakes. Lake and Reservoir Management 4: 21-31.

Canfield, D. E. Jr., and M. V. Hoyer. 1988b. Influence of nutrient enrichment and light availability on the abundance of aquatic macrophytes in Florida streams. Canadian Journal of Fisheries and Aquatic Sciences 45: 1467-1472.

Canfield, D. E. Jr., and M. V. Hoyer. 1992. Aquatic macrophytes and their relation to the limnology of Florida lakes. Final Report for the Bureau of Aquatic Plant Management. Florida Department of Natural Resources. Library. University of Florida. Gainesville, Florida.

Duchrow, R. M. 1971. Annual progress report for investigation projects : water quality investigations. Florida Game and Fresh Water Fish Commission, Federal Aid in Fish Restoration Dingell-Johnson Project F-21-5, Tallahassee, Florida.

Duchrow, R. M. and C. C. Starling. 1972. Annual progress report for investigations project : water quality investigations. Florida Game and Fresh Water Fish Commission, Federal Aid in Fish Restoration Dingell-Johnson Project F-21-6, Tallahassee, Florida.

Estes, J. R., W. A. Sheaffer and E. P. Hall. 1989. Lower Oklawaha Basin Fisheries Investigations. Florida Game and Fresh Water Fish Commission, Wallop-Breaux Project F-55-R, Tallahassee, Florida.

Estes, J. R., W. A. Sheaffer and E. P. Hall. 1990. Fisheries studies of the Orange Lake chain of lakes. W-B Project F-55-R Final Report. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Estes, J. R. and R. Myers. 1991. Lower Oklawaha Basin Fisheries Investigations. July 1, 1990 to June 30, 1991. Annual Performance Report. Florida Game and Fresh Water Fish Commission, Project No. F-55-5, Tallahassee, Florida.

Ewel, J.J., P. Feinsinger, C. Gilbert, J.H. Kaufmann, C. Lanciani, R.W. Simons, F.G. Nordlie, and F.E. Putz. 1992. Ecological Succession and the Fate of the Oklawaha River Valley. Bulletin 36. Florida Defenders of the Environment Inc. Gainesville, Florida.

Florida Defenders of the Environment, Inc. 1970. Environmental Impact of the Cross Florida Barge Canal with Special Emphasis on the Oklawaha Regional Ecosystem. Gainesville, Florida.

Florida Defenders of the Environment, Inc. 1989. Restoring the Oklawaha River Ecosystem. Florida Defenders of the Environment, Inc. Gainesville, Florida, 32601.

Florida Defenders of the Environment, Inc. 1992. Restoring the Oklawaha River Ecosystem - The Facts About Restoration. Florida Defenders of the Environment, Inc. Gainesville, Florida, 32601.

Florida Game and Fresh Water Fish Commission. 1987. Wildlife Research Abstracts 1986-1987. Volume 3. Bureau of Wildlife Research. Division of Wildlife. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Florida Game and Fresh Water Fish Commission. 1992. Restoration of Rodman or Ocklawaha Restoration? The Views of the Game & Fresh Water Fish Commission. Draft Letter of September 16, 1992. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Gainesville Sun 1992. Let the River Flow. Editorial. April 26, 1992. Gainesville, Florida.

Margalef, R. 1963. On certain unifying principles in ecology. American Naturalist 47: 357-374.

Greiner, Inc. 1992. Final Economic Analysis Report for the Former Cross Florida Barge Canal Works. Greiner Inc. Tampa, Florida.

Haller, W. T. and J. V. Shireman 1984. Monitoring Study for Lake Ocklawaha - Lake Management Plan. Report to U. S. Army Corps of Engineers, Jacksonville, Florida.

Harris, L. D. 1991. The need, rationale and implementation of wildlife dispersal corridors. Issue IV. SWIM Ordinance Model Project. Southwest Florida Water Management District. Brooksville, Florida.

Harris, L. D. and T. S. Hoctor. 1992. Commentary on "To Be or Not to Be" - The Rodman Reservoir Controversy. Draft Report submitted to the Canal Lands Advisory Committee in September 1992. December 8, 1992. Letter to Richard Coleman of the Florida Lake Management Society. University of Florida. Gainesville, Florida.

Hoyer, M. V. and J. D. E. Canfield. 1990. Limnological factors influencing bird abundance and species richness on Florida lakes. Lake Reservoir Management. 6: 133-141.

Hoyer, M. V. and D. E. J. Canfield. 1991. A phosphorus-fish standing crop relationship for streams. Lake and Reservoir Management 7: 25-32.

Hoyer, M. V. and D. E. J. Canfield. 1992. Bird abundance and species richness on Florida lakes: Influence of trophic status, lake morphology, and aquatic macrophytes. Hydrobiologia (in press).

Hubbs, C. L., and E. R. Allen. 1943. Fishes of Silver Springs, Florida. Proceedings of the Florida Academy of Sciences 6:110-130.

Kaufmann, J.H. 1991. Letter to the Florida Game and Fresh Water Fish Commission concerning staff recommendations on restoring the Oklawaha River versus maintaining Rodman. Professor of Zoology, University of Florida and Co-chairman, Florida Defenders of the Environment's Oklawaha Project. Gainesville, Florida.

Kiker, C. 1991. A brief comment on the Economic Analysis of Fates for Rodman Reservoir. Florida Defenders of the Environment, Inc. Gainesville, Florida, 32601.

Leopold, A. 1949. A Sand County Almanac. Oxford University Press. New York.

Maehr, D. S., J. N. Layne, E.D. Land, J.W. McCown, and J. Roof. 1988. Long distance movement of a Florida black bear. Florida Field Naturalist 16: 1-6.

McKinney, S. P., W. B. Kittrell Jr., and G. A. Owen. 1988. 1987-88 Fish Management Annual Progress Report - Central Region. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

McLane, W. M. 1955. The Fishes of the St. Johns River System. Doctoral Dissertation. Library University of Florida. Gainesville, Florida.

Milon, J. W., J. Yingling, and J. E. Reynolds. 1986. An economic analysis of the benefits of aquatic weed control in north-central Florida, with special reference to Orange and Lochloosa Lakes. Economics Report 113. Institute of Food and Agricultural Sciences, University of Florida. Gainesville, Florida.

Palatka Daily News. 1991. Rodman: Should it stay, go? July 19, 1991. Palatka, Florida.

Palatka Daily News. 1992. Large crowd debates fate of Rodman. May 1, 1992. Palatka, Florida.

Peters, R. H. 1991. A Critique for Ecology. Cambridge University Press. Cambridge, England.

Reddy, K. R. and D. A. Graetz. 1991. Internal nutrient budget for Lake Apopka. Final Report. St. Johns River Water Management District. Palatka, Florida.

Ryding, S. O. and W. Rast. 1989 . The control of eutrophication of lakes and reservoirs. The Parthenon Publishing Group Limited. Casterton Hall, Carnforth, UK.

Simberloff, D., J. A. Farr, J. Cox, and D. W. Mehlman. 1992. Movement corridors: Conservation bargains or poor investments? Conservation Biology 6: 493-504.

Smith, R. L. 1980. Ecology and Field Biology. Third Edition. Harper and Row Publishers. New York.

Soule, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Inc. Sunderland, Massachusetts.

Soule, M. E. and B. A. Wilcox. 1980. Conservation Biology: An Evolutionary-Ecological Perspective. Sinauer Associates, Inc. Sunderland, Massachusetts.

University Planning Team. 1992. Management Plan Cross Florida Greenbelt State Recreation and Conservation Area. Volume 1- 6. Prepared for the Florida Department of Natural Resources and the Canal Authority of the State of Florida. Department of Landscape Architecture. University of Florida. Gainesville, Florida.

U.S. Corps of Engineers. 1976. Cross Florida Barge Canal Restudy Report. Department of the Army. Jacksonville District, Corps of Engineers. Jacksonville, Florida.

Wegener, W. and V. Williams. 1974. Completion report, Lake Tohopekaliga drawdown study, July 1, 1970-June 30, 1974. Florida Game and Fresh Water Fish Commission, Water Manipulation Project F-29, Tallahassee,Florida.

Williams, V. P., D. E. Canfield Jr., M. M. Hale, W. E. Johnson, R. S. Kautz, J. T. Krummrich, F. H. Langford, K. Langland, S. P. McKinney, D. M. Powell, and P. L. Shafland. 1985. Lake habitat and fishery resources of Florida. *In* Florida Aquatic Habitat and Fishery Resources. W. Seaman Jr., Editor. Florida Chapter of the American Fisheries Society. Kissimmee, Florida.

RODMAN RESERVOIR
FACT AND FICTION

FICTION	FACT
1. Rodman Reservoir is a dying water body.	* Rodman is NOT dying and will remain a lake for over 200 years.
2. The Oklawaha River can support as many fish as Rodman Reservoir.	* Rodman in 1992 has 50 times the total fish biomass that could be supported by the restored section of the Oklawaha.
3. Fishing will be as good in a restored Oklawaha River as it is in Rodman Reservoir.	* The 1992 crops of largemouth bass and bream in Rodman are 33 and 131 times greater than those in the Oklawaha, respectively.
4. A restored Oklawaha River will reestablish historic runs of striped bass and mullet.	* Striped bass and mullet are already moving through Rodman to the Upper Oklawaha.
5. Restoration of the Oklawaha River will benefit aquatic birds.	* Aquatic birds numbers are 50 times greater on Rodman than on the Oklawaha. Rodman supports more than 2 times the number of species of aquatic birds.
6. The construction of Rodman Reservoir has eliminated the floodplain forest community and its unique fauna.	* Construction of the Rodman Complex has reduced but not eliminated the floodplain forest community and its fauna. The Rodman Complex now supports more species of animals than the original floodplain forest.
7. Rodman Reservoir has blocked the "historic" migratory path of manatees to upstream springs.	* The only evidence of manatee use of upstream springs is 1 fossil bone. Manatees were in Rodman in the 1970s and 1980s, but did not migrate to upstream springs.
8. Maintaining Rodman Reservoir will cost millions, while restoring the Oklawaha will cost as little as $7.3 million and once completed, maintenance will be "free."	* The net operating costs of Rodman could be minimized to under $300,000, compared to Rodman's recreational value of over $7.2 million. A restored Oklawaha will incur at least the same administrative and management/personnel costs as Rodman.
9. The only people who use Rodman Reservoir are a handful of bass fishermen.	* Over 43% of the use of Rodman is by recreationists other than bass fishermen.
10. The Rodman complex is used less than most of Florida's state parks.	* With 310,700 visitor days in 1992, Rodman had more visits than all but 12 of 129 state parks.

HAVE YOU BEEN TOLD FACT OR FICTION?

***For more information regarding specific issues, please see the Table of Contents.**