The
Conservation and Restoration of the Robust Redhorse
Moxostoma robustum

Volume 3

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1. INTRODUCTION

This report is the third report in a series of bi-annual reports required by the FERC license for Georgia Power Company's (GPC) Sinclair Hydroelectric Project (FERC No. 1951). The new license for the Sinclair Project, issued by the FERC on 19 March 1996 (effective date 1 May 1996), required the submission of a report every two years to the FERC. The license stated these reports should document the status of the robust redhorse and provide a determination regarding the adequacy of flow releases in meeting the needs of the robust redhorse.

The original report, titled *Conservation and Restoration of the Robust Redhorse, Volume 1*, was submitted to the FERC in June 1998. Because conservation activities had begun prior to the issuance of the Sinclair license, *Volume 1* presented detailed information about the rediscovery of the robust redhorse in 1991, the formation of the Robust Redhorse Conservation Committee (RRCC) in 1995, and other significant activities that occurred through April 1998. The second bi-annual report, titled *Conservation and Restoration of the Robust Redhorse, Volume2,* was submitted to the FERC in April 2000 and was limited to conservation activities that occurred from June 1998 through April 2000.

This report is limited primarily to activities that occurred between June 2000 and April 2002. When appropriate, some information on currently planned activities is presented. The format generally follows that of the previous reports. However, this report does not contain as much detail and discussion of research projects and results as did Volumes 1 and 2. This is because there are several other, more thorough and detailed reports available from the RRCC and their website, www.robustredhorse.com.

The material for this report was gathered from a multitude of sources, including complete and incomplete project reports, RRCC updates, letters, personal communications, and oral presentations. Some basic background information initially presented in previous reports has been included for readers that may be unfamiliar with the robust redhorse or its conservation.

1.1 Sinclair Hydroelectric Project

Sinclair Dam, a 45 megawatt hydroelectric project owned and operated by GPC, was completed in 1952 on the Oconee River near Milledgeville, GA. The dam forms the 15,330 acre Lake Sinclair, a popular fishing and recreation destination in central Georgia (Figure 1). The Sinclair Project is primarily used to provide generation capacity during peak demand periods, and it serves as the lower reservoir for Georgia Power's Wallace Dam pumped storage project.

During the early stages of FERC relicensing in 1991, a rare fish was "rediscovered" in the Oconee River downstream of the Sinclair Project. The fish was eventually identified as the robust redhorse *Moxostoma robustum* by several icthyologists.

Figure 1. State of Georgia showing the location of GPC's Sinclair Hydroelectric Project and major rivers within the Georgia portion of the historic range for the robust redhorse.

1.2 Robust Redhorse *Moxostoma robustum*

The robust redhorse was originally described in 1870 by master naturalist Edward Cope from specimens collected in the Yadkin River, NC. Unfortunately, Cope's original specimens were lost, and labels were mistakenly applied to another species. During the next 100 years or so, the real robust redhorse was known by only two specimens, collected from the Savannah River, Georgia / South Carolina in 1980 and from the Pee Dee River, North Carolina in 1985. The two existing specimens were believed to belong to an undescribed species of redhorse. The discovery of the Oconee River population of robust redhorse helped to unravel the history of this species.

That discovery occurred in August 1991, when biologists with the Georgia Department of Natural Resources (GDNR) collected five large, unrecognized suckers from the Oconee River downstream of Sinclair Dam. Several well-known ichthyologists including Dr. Henry Bart (then curator of the Auburn University fish collection), Dr. Byron Freeman, curator of the University of Georgia fish collection, and Dr. Robert Jenkins of Roanoke College, Virginia, worked to unravel the mystery. They concluded the five specimens from the Oconee River were the same species as the two existing specimens that had been collected in 1980 and 1985. They further concluded that all specimens belonged to the species originally described by Cope in 1870. The currently accepted historic range consists of southeastern Atlantic slope rivers, extending from at least the Altamaha River system in Georgia to at least the Pee Dee River system in North and South Carolina.

Subsequent reviews of available information by many agencies and individuals suggested that conservation and restoration actions should begin immediately for this species. Part of the concern centered on the lack of other records for the species, which potentially indicated that a sole remnant population had been rediscovered in the Oconee River. Another issue was that fish collections from the Oconee River were comprised primarily of larger individuals, prompting concerns about a senescing population or some other problems that might be affecting recruitment of robust redhorse. These potential problems included, but are not limited to, artificial flows from power generation, erosion and siltation, and introduced predatory species such as flathead catfish.

2. ADMINISTRATIVE ACTIVITIES

2.1 Robust Redhorse Conservation Committee

The Robust Redhorse Conservation Committee (RRCC) was formed by the signing of a Memorandum of Understanding (MOU) in 1995. The RRCC was designed as a stakeholder partnership to restore the robust redhorse throughout its former range. The primary goals of the RRCC are to implement research and conservation measures, enhance recruitment in the existing Oconee River population, and re-establish robust redhorse populations in appropriate river systems within the species' former range.

The RRCC is the overall vehicle directing recovery of the robust redhorse, and has determined priority avenues for necessary research and action. Through formal annual meetings and innumerable informal meetings among members and other interested parties, the RRCC has identified impediments to the recovery effort, conducted research related to those impediments, and formulated solutions and implemented conservation actions. The RRCC has also been very effective in publicizing the recovery effort. As originally intended, the RRCC has been the driving force behind the conservation and restoration of the robust redhorse.

Elections

Ms. Terry DeMeo of the University of Georgia (UGA), Institute of Government, was approved by the RRCC as the 3rd Chair of the Committee at the October 1999 meeting. Her term began in October 2000 as she succeeded Scott Hendricks of Georgia Power Company as the Chair of the RRCC. Her term will expire in October 2002.

Mr. Greg Looney of the U.S. Fish and Wildlife Service was approved by the RRCC as the 4th Chair of the Committee at the October 2001 meeting. Mr. Looney is serving as the Chair-elect until the October 2002 meeting when his term as Chair will begin. His term will expire in October 2004.

Technical Advisory Group

The Technical Advisory Group (TAG) is a small group of individuals representing several RRCC member organizations. The TAG handles the bulk of the daily activities related to the conservation of robust redhorse and attempts to gather information and make recommendations to the RRCC as necessary. As the conservation effort has expanded, the RRCC has tried to add key individuals to this group.

The RRCC recognized that changes are needed in the way decisions are made and in the overall administration of the conservation program. The TAG is currently drafting

several components of a 'policy framework,' with guidance on several difficult issues that should facilitate timely and effective decisions within the RRCC. This exercise should also help the RRCC develop meaningful recommendations for state and federal natural resources agencies as the conservation effort continues to expand across state lines and jurisdictional boundaries.

In addition, the RRCC recognizes that there may be a need to modify and formalize its organization. The author of this report envisions an organization that eventually looks and functions very much like a professional society. This organizational structure may inclue an Executive Committee, led by the Chair, as the primary authority within the RRCC. The current positions for Chair-elect and Project Manager would likely continue to be critical components of the organization. This is not substantially different from the way the RRCC currently functions, however there is a perceived need to clearly designate authority and decision making processes.

Other committees would be established to deal with specific issues or geographical areas as necessary. For example, the recent expansion into the Carolinas and the discovery of robust redhorse in the Pee Dee River, NC/SC has prompted interest in forming a 'Yadkin-Pee Dee Working Group' or similarly named sub-committee to the RRCC. An initial meeting to explore options for such a group was very well attended by natural resource agencies and private utilities in the Carolinas. A charter for this group was drafted by John Crutchfield of Carolina Power and Light and is currently under review by the TAG.

Robust Redhorse Conservation Strategy

The original MOU formed the RRCC and provided some general goals, but did not offer details for implementing the conservation effort. The RRCC saw the need to develop an overall guidance document, or roadmap for the project. An initial version of the Robust Redhorse Conservation Strategy, drafted by Mike Nichols of Georgia Power Company, was reviewed by the RRCC member organizations. The Strategy was subsequently approved in March 2000 by Scott Hendricks, then Chair of the RRCC.

The Strategy describes the extent of current knowledge of robust redhorse and its distribution, discusses problems facing the species, and lists specific goals and objectives for robust redhorse conservation throughout its historic range. The Strategy also outlines procedures and actions believed necessary to reach those conservation goals and objectives. The Strategy is intended to be a flexible document and the RRCC may revise the Strategy as new information becomes available.

The Strategy has recently been updated with new information, and will likely be expanded to include some of the RRCC policy and guidance information discussed above. A revised version of the Conservation Strategy has been distributed to several RRCC members for comment. It is expected that the Conservation Strategy would then be approved by the Chair after presentation to the RRCC.

Candidate Conservation Agreement With Assurances

One of the primary stated goals for the RRCC is to create additional populations of robust redhorse by introducing the species to rivers within its historic range. In many cases, reintroduction can be successfully accomplished without incident. However, the RRCC recognized that reintroducing an imperiled species could potentially create local problems and negative publicity. In these cases, the RRCC needed a sound approach for effectively handling one of the most critical components of the conservation effort.

One type of approach may be through the use of Candidate Conservation Agreements with Assurances (CCAA). The Final Policy for CCAAs was published by the USFWS in 1999 (64 Federal Register 32726-32736 and 50 C.F.R. §§ 13 and 17). Essentially, CCAAs are meant to promote conservation actions by encouraging partnerships between private entities and state and federal natural resources agencies. Voluntary participants in such agreements may receive assurances from the USFWS that limit risk, should the target species of that agreement become listed under the Endangered Species Act (ESA).

The Ocmulgee River (Figure 1), a candidate site for reintroduction, provided an opportunity for some members of the RRCC to apply the CCAA policy. The upper reaches of the Ocmulgee River are influenced by generation from GPC's Lloyd Shoals Hydroelectric facility, which recently completed FERC relicensing. During relicensing, minimum flow was increased to enhance aquatic habitat, and a labyrinth weir was constructed to improve dissolved oxygen concentrations in the river.

GPC has invested considerable time and dollars on environmental enhancements to the upper Ocmulgee River and believes these enhancements should also benefit any potential robust redhorse population. However, GPC also believed that a reintroduction of robust redhorse potentially represented some unacceptable level of risk to the Lloyd Shoals facility, if the species was ever federally listed under the ESA. GPC expressed these concerns to GDNR and the USFWS, and discussions began that ultimately led to a CCAA for the robust redhorse.

Under the CCAA, GPC volunteered to participate in the reintroduction and provide funding for some critical telemetry studies on the reintroduced fish. GPC also agreed to some population monitoring and reporting. In return, GPC received assurances that if the robust redhorse is ever listed under the ESA, and the CCAA has been implemented in good faith by GPC, the USFWS will not require additional land, water, or resource restrictions beyond those that GPC voluntarily committed to under the terms of the original agreement. These assurances include the preservation of the flow regime described in the current FERC license for the Lloyd Shoals Project which expires in 2023. The assurances will be provided through an Enhancement of Survival Permit which will take effect if and when the robust redhorse is federally listed under the ESA.

This CCAA is important because it provides additional conservation actions for the robust redhorse while providing some regulatory certainty and operational flexibility to GPC. However, the CCAA might be more important to the overall conservation effort because it provides a working example of how potential reintroductions, or other problems, could be avoided and turned into a positive cooperative effort to benefit the species. It is believed that this CCAA for the robust redhorse was the second CCAA implemented in the U.S. It was also the first CCAA to involve an aquatic species and a private company.

Robust Redhorse Video

An excellent video that describes the conservation effort for the robust redhorse by the RRCC was completed in 2001. This video was produced by the GDNR and is suitable for a half-hour feature on public television. Several RRCC members contributed funding for the development of this video, which has won at least one national award.

2.2 Flow Advisory Team for the Oconee River

The Flow Advisory Team for the Oconee River (Advisory Team) functions under the overall umbrella of the RRCC with some shared memberships and administration. The current members of the Advisory Team are the GDNR, USFWS, U.S. Geological Survey, Biological Resources Division (USGS-BRD), Georgia Wildlife Federation, and GPC. The primary responsibilities of the Advisory Team are to monitor the effectiveness of the negotiated flows for the Sinclair Project for the robust redhorse in the Oconee River. The agreement provides that the Advisory Team may review flow data from the Oconee River, studies developed by the RRCC, and other pertinent information related to the robust redhorse to help determine if any changes to the negotiated flow agreement are necessary. If studies suggest that flow changes are needed for the Oconee River to improve habitat for the robust redhorse, the Advisory Team may petition the FERC, under consensus of members, with its recommendations. These recommendations would then be subject to appropriate FERC evaluation and approval.

Negotiated Flow Agreement

A negotiated flow agreement was finalized in 1995 prior to the submittal of the license application for the Sinclair Project. The negotiated flow agreement, outlined in Table 1 below, was designed primarily to enhance reproductive success of the robust redhorse. Specifically, the flow agreement provides: 1) significant increases in minimum flows throughout the year, 2) a significant increase in flow stability throughout the year, and 3) run-of-river flows during spawning and early rearing periods for robust redhorse. Although primarily directed at robust redhorse, anadromous species were also considered during the formation of the flow agreement.

Table 1. Negotiated flow agreement for Sinclair Hydroelectric Project.

MONTH	FLOW	OPERATION
Dec - Feb	500 cfs minimum	normal peaking
Mar - Apr	1500 cfs minimum	modified peaking**(A)**
May	run-of-river	
Jun**(B)** – Nov	700 cfs minimum	normal peaking

A - modified peaking refers to the number of units (1 or 2) to be utilized depending on the amount of inflow to the reservoir

B - From June 1 -10, units will be operated run-of-river unless electric system demands necessitate normal peaking operation

The agreement also provided for an increase in generation scheduling from 5 to 7 days per week. This was done to reduce the extended low flow periods that previously resulted from little weekend generation.

Flow Suitability

Although finalized early in 1995, the flow agreement for the Oconee River was not implemented until June 1996, as requested by the RRCC. This request was made to allow the RRCC to collect two years of baseline data for comparison with data collected after implementation of the new flow regime. Consequently, 1997 was the first year of data collection under the new flow agreement. However, the extreme hydrological variability, combined with the low numbers of the larval robust redhorse collected, have complicated the interpretation of these data and fair evaluation of the flow agreement. For example, the winter of 1997 through the spring of 1998 was influenced by the weather phenomena known as El Nino. Heavy rains, high discharges and river levels were common throughout the spring. This was immediately followed by severe drought (La Nina) that extended through at least 2001.

After several years of data collection under the new flow regime, the Flow Advisory Team met formally in August of 2001 to discuss the data and suitability of flows. Attending the meeting were: Mark Bowers–USFWS; Chris Skelton–GDNR; Dr. Carl Quertermus–GA Wildlife Federation; Mike Wilder–GPC; Jimmy Evans–GDNR; Mike Nichols–GPC; Dr. Cecil Jennings–USGS/UGA Coop Fish and Wildlife Research Unit; Greg Looney–USFWS; Dr. Bud Freeman–UGA Institute of Ecology; Scott Hendricks–GPC.

Scott Hendricks presented an overview of the Sinclair license articles regarding the robust redhorse and the responsibilities of the Advisory Team. One order of business was to elect a Chairman for the Advisory Team. The members present elected Scott Hendricks as Chairman of the Advisory Team.

The group then discussed available data from the Oconee River and its implications for robust redhorse. There was discussion of recent laboratory studies of temperature and flow effects on egg and larval survival, and that high water temperatures could limit survival. There was also discussion about how river temperatures could potentially be influenced by the Sinclair flow regime and also about the highly variable hydrologic

conditions in the Oconee basin during the last several years. Some members expressed concern that manipulating flows from Sinclair Dam in May for broodfish collection (as opposed to run-of-river flows) could also result in a temperature rise.

The relationships between temperature, flow regime, and reproductive success in the river are unclear, and there was discussion about the lack of temperature data available. GPC volunteered to install temperature monitors at four locations in the Oconee River in March 2002. GPC also plans to maintain these monitors for several years during the spring months. It is expected that this information will help us better understand the environmental cues governing the spawning time for robust redhorse in the Oconee River, which in turn will enhance efficiency of broodfish collection and propagation efforts. This information should also compliment ongoing recruitment studies and help to define any potential relationships between the flow regime at Sinclair Dam and reproductive success of robust redhorse.

Although annual variability is high, larval abundance in recent years has generally increased in sampling targeted toward the early life stages. Catch rates of larvae and juveniles of many other species have also increased over previous years and there is substantial anecdotal evidence of improved sport fish abundance. The Advisory Team agreed that we did not yet have enough solid information to determine the adequacy of the new flow regime in meeting the needs of robust redhorse in the Oconee River. However, the Advisory Team did believe that there was evidence that indicated, at least preliminarily, that the new flow regime was having positive effects on reproduction and recruitment of many other species.

Electrofishing catch rates have declined during spring broodfish sampling on the Oconee River for the 1994 – 2001 period of record. The decline was most apparent during 1994 – 1997, but has generally stabilized at lower rates since 1998. Juvenile catch rates have been low for the period of record, but it is unclear if this is a reflection of actual abundance, a sampling bias resulting from adult vs. juvenile habitat partitioning, or some other factor. By contrast, estimates of adult population size have remained relatively stable during the 1995 – 2000 period for which these estimates are available.

It is difficult to separate the effects of the extreme hydrological conditions that have been experienced during the last several years of this project from the effects of the new flow regime. At this point the direct and potentially indirect relationship between flows from Sinclair Dam and the robust redhorse is unclear. The general opinion of the Advisory Team is that the evidence provided by current research and monitoring of robust redhorse does not indicate that a modification of the current flow agreement is necessary.

3. CONSERVATION STATUS OF ROBUST REDHORSE

3.1 Oconee River Population

Much of the information on the status of the Oconee River population has been based on electrofishing catch during spring broodfish collection during 1994 - 2001. These data appear to indicate a decline in electrofishing catch rates, although catch rates were similar during the last five years. The data also show a very general shift in the length frequency of the catch toward larger individuals, which may suggest an aging population. Very few juveniles and no young-of-year have been sampled during broodfish collection or other studies on the Oconee River. The large mean length of captured individuals, and the apparent lack of juvenile fish suggests low recruitment rates of robust redhorse within the last decade or two.

During most years one or two juvenile fish, measuring around 420 – 480 mm, have been captured during broodfish collection. This indicates there is at least some recruitment occurring, but how much recruitment is necessary to maintain a viable population of this long-lived species in the Oconee River is unknown. During 2000 and 2001, catch rates of adult fish were similar to several previous years, but the abundance of juveniles and small adults (420 –560 mm) increased. There was also a slight shift in the length frequency to smaller individuals. The shift in average size is likely a cumulative effect of these younger individuals showing up in the catch. Several of the juveniles and small adults captured in 2000 and 2001 were stocked fish (see below).

The repeated appearance of wild robust redhorse near 420 mm indicates that individuals less than 420 mm do exist in the Oconee River system. The minimum size of stocked fish that have been recaptured in other systems, with electrofishing gear, has also been around 400 mm. This fact is puzzling because robust redhorse substantially less than 420 mm can be collected from ponds with electrofishing gear, indicating this size should also be vulnerable to electrofishing gear in natural habitats. Small specimens of other sucker species have also been collected from rivers containing robust redhorse, yet the smaller robust redhorse have not been collected.

Small numbers of juvenile robust redhorse (213) have been stocked into the Oconee River as part of telemetry studies and other efforts to improve understanding of habitat utilization of early life stages. A few of these individuals have been recaptured during broodfish collection efforts. There are still many unknowns about the Oconee River population, but overall, it appears stable and there are reasons to be encouraged about its future. There is evidence that some recruitment is occurring, research projects are in place to help monitor reproductive and recruitment success, and the technology and ability exists to supplement the population with juveniles if the RRCC determines that supplementation is needed to ensure the long-term survival of this population.

3.2 Other Populations

For the first several years during the RRCC's existence, it was commonly thought that the Oconee River might contain the only remaining population of robust redhorse. This seemed reasonable, considering the extensive survey work on southeastern rivers. It also seemed unlikely that a fish as large as adult robust redhorse could be missed during sampling. However, habitats associated with adult robust redhorse in the Oconee River (swift, moderately deep waters with accumulations of woody debris) are difficult to sample effectively. The robust redhorse has also proven somewhat cryptic and difficult to collect even in pond environments.

The RRCC has organized intensive surveys on several rivers within the believed historic range of the robust redhorse and more are planned. Many of these surveys have documented other existing populations that are shown in Figure 2. This map, created by Dr. Robert Jenkins (Roanoke College, VA), Dr. Byron Freeman (UGA Institute of Ecology), and James Evans (GDNR), partially documents the large effort of the RRCC to increase knowledge and conservation actions for the robust redhorse throughout the historic range of the species.

Savannah River, GA/SC

Volume 2, submitted in April 2000, indicated that the Savannah River near and downstream of Augusta, GA was a high priority site because of the incidental collection of a single robust redhorse in October 1998. Subsequent surveys detected a population of unknown size near Augusta, GA. Other surveys and GDNR sampling have located robust redhorse at numerous locations between Augusta and U.S. Hwy 301. Spawning locations and spawning robust redhorse have been observed near Augusta.

Plans are being developed for a possible attempt at broodfish collection and propagation in early May 2002. It is expected that SCDNR may use these fish for introduction into the Broad River system, SC.

Ocmulgee River, GA

About 4,000 robust redhorse were stocked into the Ocmulgee River in February 2002 as the first step to establishing another wild population. These fish were from several year classes and were stocked at three locations between GPC's Lloyd Shoals Hydroelectric Project and a small, low-head dam at Juliette, GA. As discussed earlier, the implementation of the CCAA for the robust redhorse paved the way for this reintroduction.

The CCAA describes goals of the project, responsibilities of the parties to the agreement, provides a timeline and suggested measures of progress toward the goals of the

reintroduction. Currently, two separate telemetry studies are underway to learn more about the species' dispersal following stocking, movement patterns and habitat preferences. A press release about this project is provided as Appendix A.

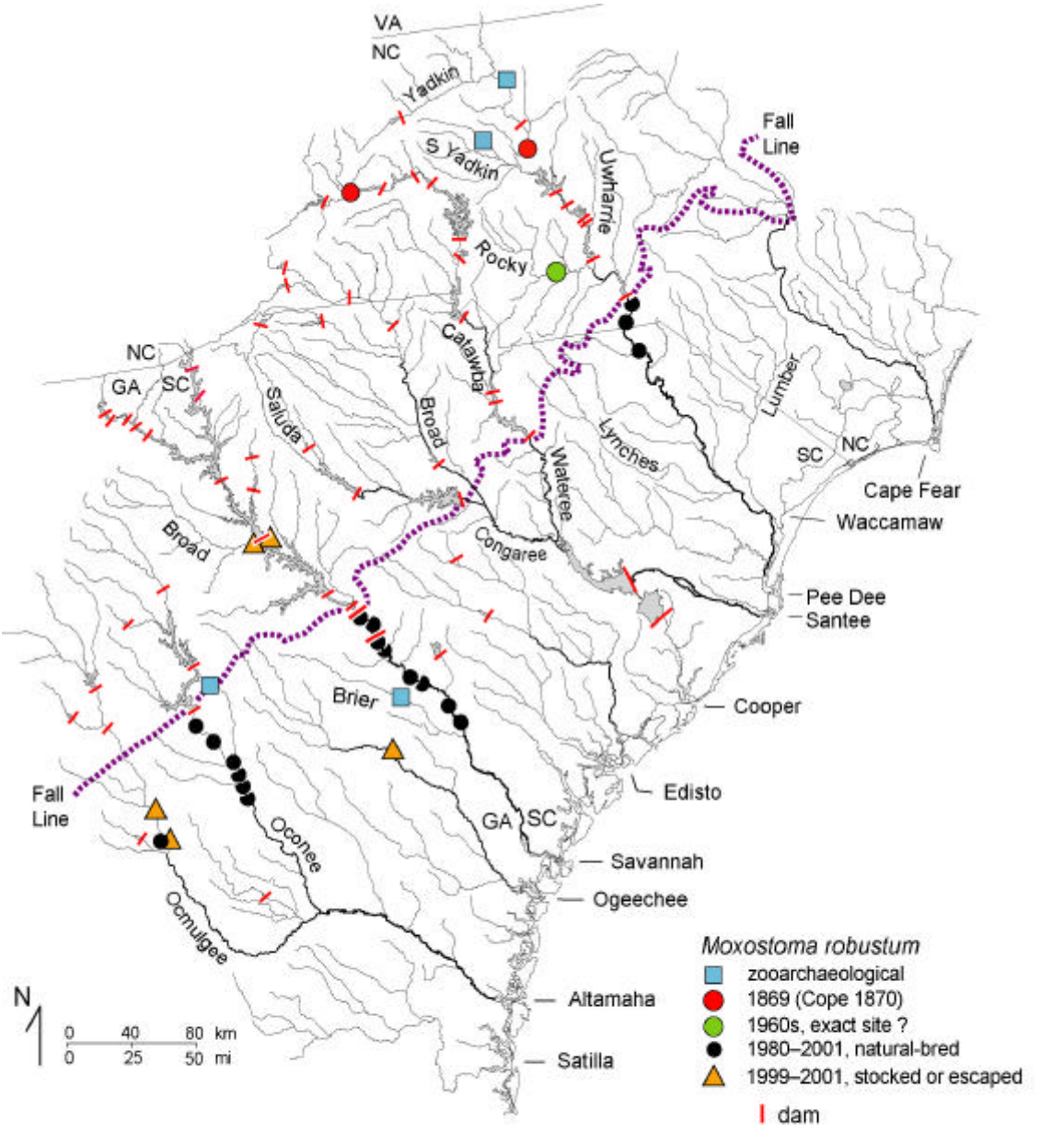

Fig. 00. Robust redhorse records of natural-bred fish (squares and circles); and of artifically-bred fish (triangles) captured after stocking or escape from rearing ponds. Dams shown mainly for larger streams (south of Cape Fear drainage). Savannah R. sites of the 4 record symbols crossed by dam symbols are below respective dams. Fall Line drawn from Anonymous (1963a–c) and Harris and Zullo (1991). Oconee R. detail in Fig. 00; hypothetical total range in Fig. 00.

Map by R. E. Jenkins, B. J. Freeman, and J. W. Evans (Dec 2001)

Figure 2. Robust redhorse records as of December 2001.

Pee Dee River, NC/SC

Volume 2, submitted in April 2000, indicated that a single, adult female robust redhorse had been captured from the Pee Dee River, near the site that produced the 1985 specimen. Surveys were also conducted during spring 2001 and two robust redhorse were captured. Additional surveys are scheduled for May 6-10, 2002. These surveys are large, multi-agency efforts that are specifically intended to detect robust redhorse if they exist in a river reach. As discussed above, a working group is currently being formed to address robust redhorse issues and conservation in the Yadkin/Pee Dee River basin. This group would continue to function under the umbrella of the RRCC.

3.3 Research Summary

Volumes 1 and 2 provided detailed summaries of most of the research that had been conducted during the previous years. Because detailed research summaries are contained in several other reports available from the RRCC, this report will only provide a short description of the research topics. The agenda from the 2001 annual meeting of the RRCC is attached as Appendix C to provide the reader a better idea of the full range of topics under consideration by the RRCC.

One of GPC's primary concerns is the relationship between flows at Sinclair Dam and the robust redhorse population in the Oconee River. For this reason, GPC continued to provide funding for reproduction and recruitment studies in the Oconee River to detect changes in reproductive success, telemetry studies to address movement patterns, and population modeling to address population size and long-term stability. GPC is also collecting temperature data from several locations in the Oconee River to help understand any potential relationships between river flow, temperature, and spawning and reproductive success.

In general, research has followed in a similar direction as previous years, building on information gained in initial projects. During the early years of robust redhorse conservation, the capture of broodfish and propagation techniques for fingerling production were primary research interests. As these techniques were developed, some of the focus shifted to enhancing growth, survival, and production in hatchery ponds. Management of genetics in hatchery produced fish also became an important topic as the RRCC realized that propagation and stocking was indeed a viable conservation option.

The conservation effort has advanced in both complexity and geographic scope, and the RRCC has observed long-term (several years) survival and good growth of introduced fish. This success, and a few incidental captures of native adult robust redhorse in previously sampled systems, highlighted the need to address potential concerns about mixing hatchery fish with wild populations. In response, the RRCC focused on intensive status surveys in several rivers in Georgia and the Carolinas to hopefully detect additional

populations. Genetics research and characterization of these populations is an important topic because there are some genetic distinctions in robust redhorse populations from different river systems.

Balancing reintroduction and establishment of additional populations with genetic concerns is a primary issue for the RRCC. The RRCC has responded by inviting several genetics experts from around the U.S. to speak and participate in annual meetings, and to provide advice on this subject. Researchers have also examined genetics management in other conservation programs and provided reports and advice to the RRCC. The question of whether to manage for species or individual populations is highly controversial and is one that the RRCC has every intent of handling properly.

There is also much interest in habitat preferences and habitat conservation. The RRCC has directed research to identify important habitats and is exploring potential measures to maintain or enhance these habitats.

4. WHERE DO WE GO FROM HERE?

Much progress has been made toward the original goals of maintaining and enhancing the Oconee River population and identifying other existing populations. Robust redhorse fingerlings, produced with techniques developed by the RRCC, have been stocked in rivers to establish additional populations. In most cases, monitoring has indicated successful survival to at least several years of age.

Now that the RRCC is confident that robust redhorse can be introduced into the wild and survive, there are many new questions relating to these reintroduction efforts. One question is whether it is more efficient to stock young Phase I fingerlings or more advanced Phase II fish. Some believe that Phase II fish may be better able to survive the predation pressures of natural rivers and may offer a better chance of establishing populations. However, larger numbers of Phase I fish can be produced in a more timely fashion with less expense than Phase II. The RRCC is watching closely to see if these introduced fish will make spawning attempts, and if that spawning will be successful.

Other questions relate to reintroduction strategies, and identifying rivers or river reaches that should have high priority. The implementation of the CCAA should be a boost to conservation efforts as one example of how to successfully and positively deal with problematic issues and conservation actions that cross state and jurisdictional boundaries. Still other questions center around the overall function of the RRCC and how it should be structured to effectively manage the large and complex conservation effort that now exists. The appropriate management of genetics issues will also continue to be a priority for the RRCC.

Another difficult issue will be habitat management and possibly restoration. As we learn more about the population dynamics of robust redhorse and what types of habitat may be required for various life stages, it is anticipated that the RRCC will work to address habitat issues.

Overall, the Oconee River population appears stable, and still serves as a source of broodfish for fingerling production. Investigations into population dynamics, monitoring of reproduction and recruitment success, and assessments of habitat in relation to the new flow regime at Sinclair Dam continue. Additional populations have been located and created, which adds to the long-term stability of this species.

APPENDIX A

FOR IMMEDIATE RELEASE

LANDMARK AGREEMENT HEARLDS PROACTIVE CONSERVATION OF RARE FISH TO KEEP IT FROM BECOMING LISTED AS AN ENDANGERED SPECIES

Social Circle, Ga. (January 11, 2002) – A landmark conservation agreement has been signed that will improve the status of the robust redhorse by restoring this rare fish to the Ocmulgee River between Lloyd Shoals and Juliette dams in central Georgia. The Candidate Conservation Agreement with Assurances (CCAA) was developed as a collaborative effort among the U.S. Fish and Wildlife Service(Service), the Georgia Department of Natural Resources (DNR), and Georgia Power Company (Georgia Power) and is a new and innovative approach to restoring imperiled species.

"The completion of the CCAA and the stocking of robust redhorse in the Ocmulgee River marks a major milestone in the conservation efforts by restoring the fish to a section of the Ocmulgee River where it likely occurred historically," said David Waller, Director for the Georgia Department of Natural Resources, Wildlife Resources Division. "This historic event also signals significant progress in the voluntary, proactive conservation of an imperiled species."

This is the first CCAA to be implemented in the Southeast and only the second in the nation. It is also the first CCAA involving a private company and the first CCAA to be developed for an aquatic species. In return for taking specific conservation actions to recover the robust redhorse, Georgia Power Company will receive assurances regarding their obligations under the Endangered Species Act in the event that this species is listed in the future.

The robust redhorse, a large sucker only known from large rivers along the south Atlantic Coast, was initially described from the Yadkin River, North Carolina in 1869, but the species was believed to be extinct until it was rediscovered in the Oconee River in 1991. A small population was also discovered in the Ocmulgee River in the Houston/Twiggs County area in 1999.

The Robust Redhorse Conservation Committee including the Service, DNR, Georgia Power and other stakeholders has been working since 1995 to recover the fish. These efforts have included life history research, hatchery propagation using wild fish broodfish, and establishing new populations of the species in the Broad and Ogeechee Rivers. The CCAA continues these efforts by restoring the fish to a section of the Ocmulgee River.

According to Sam D. Hamilton, Southeast Regional Director, USFWS, these conservation actions should help prevent the need to list the robust redhorse under the Federal Endangered Species Act.

"This agreement highlights the cooperation of private industry, the state of Georgia and the Service to achieve conservation of a rare species so that the Endangered Species Act may never need come into play," said Hamilton. "We applaud the cooperative efforts of Georgia Power and the Georgia Department of Natural Resources, and their leadership in pursuing conservation for this unique part of Georgia's natural heritage."

In addition to the proposed reintroduction, this latest restoration effort will include surveys and monitoring to track the introduced fish and to evaluate the results of stocking.

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APPENDIX B

ROBUST REDHORSE LITERATURE
Partial Listing of Literature of Interest**

Many of these publications were used as references for this report.

Barrett, T.A. 1997 Hormone induced ovulation of robust redhorse (*Moxostoma robustum*). M.S. Thesis. University of Georgia, Athens, Georgia.

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Jennings, C.A., J.L. Shelton, B.J. Freeman, and G.L. Looney. 1996. Culture techniques and ecological studies of the robust redhorse *Moxostoma robustum* Georgia Coop Fish and Wildlife Research Unit, University of Georgia, Athens, GA. Final report to Georgia Power Company.

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Lasier, P.J., P.V. Winger, J.L. Shelton, Jr., and K.J. Bogenrieder. 2001. Contaminant impacts to early life stages of the robust redhorse (*Moxostoma robustum*) in the lower Oconee River. Final report to Species at Risk Program, Biological Resources Division, U.S. Geological Survey.

Nichols, M.C. 1999. Conservation strategy for robust redhorse (*Moxostoma robustum*). Robust Redhorse Conservation Committee.

Ruetz, C. R. III. 1997. Swimming performance of larval and juvenile robust redhorse: implications for recruitment in the Oconee River, Georgia. MS Thesis, University of Georgia, Athens, Georgia. 63 pp.

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Ruetz, C.R. III, and C.A. Jennings. 2000. Swimming performance of larval and juvenile robust redhorse Moxostoma robustum and low-velocity habitat modeling in the Oconee River, Georgia. Transactions of the American Fisheries Society 129:398-407.

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"Mystery Fish" by Richard T. Bryant, James W. Evans, Robert E. Jenkins and Byron J. Freeman. Southern Wildlife. Volume 1, Number 2. 1996.

"A Splashy Comeback" by Stephen Sawicki. Animals. Winter 2002

APPENDIX C

AGENDA – 2001 ANNUAL MEETING**
ROBUST REDHORSE CONSERVATION COMMITTEE
South Carolina Aquarium - Charleston

OCTOBER 3, 2001

6:30 pm - Reception Tour of the South Carolina Aquarium and Robust Redhorse Exhibit

OCTOBER 4, 2001

8:00 am – Welcome and Introductions – Chris Andrews and Terry DeMeo
8:15 am – South Carolina Aquarium Robust Redhorse Exhibit and Educational Efforts – Chris Andrews, David Wilkins and Whit McMillan

Supplemental Breeding Program – 2001

8:30 am – Broodfish Collection on the Oconee River – Jimmy Evans
8:40 am – Spawning Results and Cryopreservation Update – Greg Looney
8:50 am – Fingerling Distribution and Fry Production – Jay Shelton

Habitat, Capture Rates and Population Dynamics

9:00 am – Evaluation of Spawning Aggregates, Oconee (Avants) and Savannah rivers – Bud Freeman
9:15 am – Database of Captures of Robust Redhorse, 1980-2001 – Bob Jenkins
9:35 am – Population Estimate of the Oconee River – Jimmy Evans
9:50 am – Reproduction and Recruitment Success in the Oconee River – Cecil Jennings
10:05 am – Flow Advisory Team Update – Scott Hendricks
10:15 am – **BREAK**

Continue Habitat, Capture Rates and Population Dynamics

10:30 am – Restoration Efforts for Razorback Sucker in the Upper Colorado River Basin – Tim Modde
10:50 am – Telemetry Evaluations – Cecil Jennings
11:05 am – Otolith Analysis and Habitat Use – Dave Coughlan
11:25 am – Discussion
12:00 pm – **LUNCH**

Hatchery Management

12:20 pm – Piedmont NWR Refugial Population – Greg Walmsley
12:35 pm – Central Georgia Branch Station Refugial Population – Jay Shelton
12:45 pm – Update on Hatchery Pond Culture Studies – Jay Shelton
1:00 pm – Discussion

Status Surveys

1:30 pm – Pee Dee River, NC Effort and Future Direction – John Crutchfield
1:40 pm – Broad River, SC – Ross Self
1:50 pm – Ocmulgee River, GA – Jimmy Evans
2:00 pm – Discussion

2:30 pm – **BREAK**

Genetics

2:45 pm – Razorback Sucker Genetics, Lessons Learned – Holt Williamson
3:05 pm – Molecular Approach to Identify Robust Redhorse Larvae – Isaac Wirgin
3:20 pm – Comparison of Mitochondrial DNA and Nuclear DNA Divergence Between Robust Redhorse and Silver Redhorse from Three Populations – Isaac Wirgin
3:40 pm – Genetic Sensitivity Analysis of Robust Redhorse Supplemental Breeding Program – Anthony Fiumera
4:00 pm – Discussion
5:00 pm – **ADJOURN**

6:30 pm – **Low Country Boil and Video Presentation:** *Chronology, Habitat and Behavior of Spawning of Redhorse Suckers, Genus Moxostoma*

October 5, 2001

8:00 am **– Commence**

Management of Robust Redhorse Through Re-introduction

8:15 am – Summary of Broad River Re-introduction – Bud Freeman
8:30 am – Update on the Ocmulgee River Conservation Agreement – Mike Nichols
8:45 am – Plans to Rear Broodfish and Stock the Broad River, SC – Ross Self
9:00 am – Stocking Scenario for Fall 2001 – Spring 2002 – Discussion

12:00 pm – **LUNCH**

Announcements

1:00 pm – Culture, Broodfish Collection, and Disease Protocols – Greg Looney
1:05 pm – Status of Grant for Robust Redhorse Genetics Workshop – Greg Looney
1:10 pm – Plans for Fish Passage Structures on the Savannah River – Mark Bowers
1:25 pm – Status of Video Distribution – Jimmy Evans
1:35 pm – Oconee River Bank Stabilization Project Update – Terry DeMeo
1:45 pm – Update on Greg's Replacement and Coordinator's Position – Terry DeMeo
1:50 pm – Presentation on the RRCC at the AZA National Meeting – Terry DeMeo
2:00 pm – Status of Remaining Work Items from the 2000 Meeting – Terry DeMeo

2:05 pm – **BREAK**

Business

2:20 pm – Establishment of a Carolina's Technical Advisory Group (TAG)
2:30 pm – Prioritize Research and Work Items for 2002
3:30 pm – Approval of Vice-Chairman Elect
3:40 pm – Location and Dates for 2002 Annual Meeting
4:00 pm – Wrap-Up
4:20 pm – **ADJOURN**

** Agenda provided by Terry DeMeo