

**The**  
**Conservation and Restoration of the Robust Redhorse**  
*Moxostoma robustum*

**Volume 5**

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# 1. INTRODUCTION

This report is the fifth report in a series of bi-annual reports required by the Federal Energy Regulatory Commission (FERC) license for Georgia Power Company's (GPC) Sinclair Hydroelectric Project (FERC No. 1951). The Sinclair Project license, issued by the FERC on 19 March 1996 (effective date 1 May 1996), requires the submission of a report every two years to the FERC. The license states 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, Volume 2*, was submitted to the FERC in April 2000 and was limited to conservation activities that occurred from June 1998 through April 2000. *Conservation and Restoration of the Robust Redhorse, Volume 3*, was submitted to the FERC in May 2002 and was limited primarily to activities that occurred between June 2000 and April 2002. *Conservation and Restoration of the Robust Redhorse, Volume 4*, was limited to activities that occurred between April 2002 and May 2004.

This report begins with May 2004 activity results and continues through the most recent data available in May 2006. The format generally follows that of volume 4. There are more thorough and detailed reports of research projects available from the RRCC and at the website, [www.robustredhorse.com](http://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 (Appendix A). Some basic background information initially presented in previous reports has been included for readers that may be unfamiliar with the robust redhorse conservation efforts.

## 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 ichthyologists.



**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 (GA DNR) 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 (UGA) 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 were 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 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.

Mr. Ross Self of the South Carolina (SC) DNR succeeded Mr. Greg Looney of the U.S. Fish and Wildlife Service (USFWS) as the 5<sup>th</sup> Chair of the RRCC in October 2004. His term will expire in October 2006 when Mr. David Coughlan of Duke Energy, approved at the 2005 RRCC annual meeting, will succeed him. Other members of the Executive Committee (Excom) confirmed by the RRCC at the 2005 annual meeting represent GA DNR, SC DNR, North Carolina Wildlife Resources Commission (NC WRC), USFWS,

United States Geological Survey (USGS), two representatives from Utility Companies (GPC and Progress Energy), and a representative from Academia.

## Adopted Documents

### **Memorandum of Understanding**

The MOU's purpose is to establish and describe the RRCC. The first MOU was approved in 1995 and expired December 31, 2004. The MOU was revised, became effective Jan 1, 2005, and expires December 31, 2009. Changes include the following:

1. The signatory list reflects a name change from Carolina Power and Light to Progress Energy, removal of the Georgia River Network from a Signatory to a Cooperator, and South Carolina Electric and Gas has joined as a formal member;
2. Changing of "species" to Evolutionary Significant Units or "ESUs" in the Policies and incorporation of "...preserving genetic integrity as and where appropriate, when possible and as resources allow"; and
3. Minor editorial changes.

### **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. The Robust Redhorse Conservation Strategy (Strategy) describes the extent of 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. An initial version of the Strategy, drafted by Mike Nichols of GPC, was reviewed by RRCC member organizations and was subsequently approved in March 2000 by Scott Hendricks of GPC, then Chair of the RRCC.

The Strategy was updated by Mr. Nichols with new information on the RRCC policy and guidance. It was distributed to several RRCC members for comment, presented to the RRCC, and approved by Mr. Looney on May 6, 2003.

### **Robust Redhorse Conservation Committee: Policies**

The RRCC has developed sufficient information on the robust redhorse and activities have expanded to the point that unifying policies were needed to implement the long- and short-term goals established in the Strategy. The following policies were taken directly from *Robust Redhorse Conservation Committee: Policies*, adopted October 18, 2002, and describe the current understanding and processes for conserving the robust redhorse.

## **Goals Policies**

**Measurement of Success:** RRCC members and collaborators agree to abide by and support its short- and long-term goals and to use RRCC definitions of specific terms related to measuring the success of the restoration effort.

**Species and Population-level Management:** The RRCC will continue to manage the extant populations of the species as ESUs; newly discovered populations will be evaluated genetically and will be managed in accordance with its ESU status (i.e., new or existing ESU).

## **Conservation Policies**

**Criteria for Conducting Surveys for Robust Redhorse:** Surveys should be conducted to detect the presence of robust redhorse in suitable rivers and habitats prior to the initiation of reintroduction or augmentation efforts. Further, these surveys should be scheduled and organized as described herein.

**Propagation and Breeding:** When management actions call for the use of cultured offspring, such use should prevent the loss of genetic variability of an ESU and the species as a whole.

**Goals and Objectives of the Refugial Population Program:** The RRCC supports the continued establishment and maintenance of refugial populations of robust redhorse to safeguard the species against catastrophic losses of ESU in the wild.

**Reintroduction Programs and Monitoring:** Reintroductions of robust redhorse into a river system from which the species has been extirpated will be conducted according to a well-developed reintroduction plan that includes the assembly and synthesis of relevant information about the river to be stocked, the identification of potential factors that may limit the success of the reintroduction, and reasonable goals and monitoring schedules. The long-term goal of the reintroduction should be the establishment of a self-sustaining population.

**Habitat Restoration:** The RRCC will promote habitat restoration and protection.

## **Administrative Policies**

**Decision Making:** The RRCC will use a combination of consensus- and vote-based decision approaches to develop and document 'recommendations' and 'decisions' of the RRCC as a whole or of subsets of members to guide implementation of the robust redhorse recovery and management effort and the structure and function of the RRCC.

**Executive Committee and Technical Working Groups:** The RRCC will elevate the original Technical Advisory Group (TAG) to the level of an Excom. The RRCC empowers the Excom with the day-to-day issues associated with the regional recovery effort and to address regional issues. In addition, the RRCC will form Technical Working Groups (TWGs) and empower them to address local or special interest issues.



Membership to the Robust Redhorse Conservation Committee: Requests to participate in the RRCC shall be made in writing and addressed to the Chair of the RRCC. The letter should include the party's willingness and ability to bring resources to the conservation effort.

Stakeholder Notification of RRCC Recovery Actions: The RRCC supports notifying potentially affected local governments, large landowners, and other major stakeholders prior to undertaking major conservation or management actions and agreements that involve the RRCC as a whole, a subset of members of the RRCC, or individual RRCC members and will provide meaningful opportunities to these groups to give input on the proposed action.

Evaluating and Communicating Threats to RRCC Recovery Efforts: The RRCC will inform all MOU signatories regarding potential actions that threaten recovery efforts so that each signatory can respond appropriately to agents posing threats or to regulatory agencies as needed during comment periods or in a timely manner.

Annual Meetings: The RRCC will dedicate ample time to research and management updates, presentations from guests who share knowledge of similar endeavors, discussions of information provided, and decisions.

Research: The RRCC will take an active role in determining research topics and prioritizing research needs in support of the robust redhorse recovery, without compromising the investigators' ability to fulfill requirements of the funding agent(s) or to pursue independent publication of research findings. In order to base decisions on sound information, the RRCC will require complete, timely, well-written research results that will serve as the scientific basis for its decisions.

Communications within the RRCC: The RRCC Excom and TWGs should communicate activities and action items of the robust redhorse recovery effort to participants, as appropriate.

**Candidate Conservation Agreement with Assurances for the Robust Redhorse:  
Ocmulgee River, Georgia**

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 CCAs was published by the USFWS in 1999 (64 Federal Register 32726-32736 and 50 C.F.R. §§ 13 and 17). Essentially, CCAs 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, 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 has a 30-year FERC license expiring January 1, 2024. 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 an undefined risk to the Lloyd Shoals facility, if the species was ever federally listed under the ESA. GPC expressed these concerns to GA DNR and the USFWS, and discussions began that ultimately led to a CCAA for the robust redhorse (Candidate Conservation Agreement with Assurances for the Robust Redhorse (*Moxostoma robustum*), Ocmulgee River, Georgia, 2001).

Under the CCAA, GPC agreed to support specific conservation actions following introduction by the Georgia DNR, including funding for telemetry studies on the reintroduced fish, surveys, and population estimates. 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 are 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 issues, 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 United States. It was also the first CCAA to involve an aquatic species and a private company.

## 2.3 Flow Advisory Team and Technical Working Groups

### 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 GA DNR, GPC, Georgia Wildlife Federation (GWF), USFWS, and USGS. 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 reviews 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 (implemented June 1996) 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 the Sinclair Hydroelectric Project.		
MONTH	FLOW	OPERATION
Dec - Feb	500 cfs minimum	normal peaking
Mar - Apr	1500 cfs minimum	modified peaking <sup>a</sup>
May	run-of-river	
Jun <sup>b</sup> - Nov	700 cfs minimum	normal peaking

<sup>a</sup> modified peaking refers to the number of units (1 or 2) utilized, depending on inflow into the reservoir  
<sup>b</sup> from June 1-10, units are operated run-of-river unless electric system demands necessitate normal peaking operation. The agreement also provides for an increase in generation (from 5 to 7 days per week) to reduce extended low-flow periods that previously resulted from little weekend generation.

### **Flow Suitability**

The Advisory Team met on July 28, 2005, in Athens, GA. In attendance were representatives from GA DNR, GPC, USFWS, and USGS. GWF was not represented, but indicated concurrence with GA DNR. The attendees reviewed the responsibilities of the Advisory Team and the following:

1. GPC maintains temperature monitors at three locations in the Oconee River and two in the Ocmulgee River during spring months and has since 2003. It is expected that this information will help to better understand environmental cues governing robust redhorse spawning in the Oconee River, which, in turn, will enhance efficiency of broodfish collection and propagation efforts. These data 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.

2. Flow data from 2004 and 2005 were reviewed. Under the licensed flow regime, high spring flows are passed during March and April with a 1500 cfs minimum, run-of-river flows are provided during May and if possible until June 10, and 700 cfs or inflow provided from June through November. In 2004 and 2005 run-of-river flows were extended until June 15<sup>th</sup> and 16<sup>th</sup>, respectively. Under high and low flow conditions during the summer, as seen in 2003 and 2002, respectively, run-of-river flows may extend to a substantial portion of the summer period;
3. GPC is performing another gravel mapping survey below Sinclair Dam for comparison to the original 1994 study;
4. Discussed changing run-of-river flows to an extended (10-14 days) period of low, stable flows (400-800cfs) during the peak spawning period (early May) in order to provide optimum spawning flows that may also lead to higher larval production. Such flows and corresponding high larval production are reported in Jennings et al (2005).

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. However, weather permitting; modifying flows during the 2006 spawning period (see point 4 above) may improve spawning conditions.

#### **Habitat TWG**

Formed at the 2002 RRCC annual meeting, the purpose of the Habitat TWG is to oversee robust redhorse habitat restoration activities. The Habitat TWG is responsible for developing guidance that both prioritizes sites for restoration and facilitates suitable habitat restoration activities that can be applied to specific individual river basins. The guidance document, or Habitat Restoration Management Plan, was presented at the 2003 RRCC annual meeting and adopted at the 2004 annual meeting. The document was updated by the Habitat TWG and re-adopted by the RRCC at the 2005 annual meeting. With the assistance of the Habitat TWG, the respective basin TWG's will be able to select sites, prepare proposals, secure funding, and conduct effective restoration activities within their basin.

#### **Information Technology TWG**

Formed at the 2003 RRCC annual meeting, the purpose of the Information Technology (IT) TWG is to create a master database of information, including GIS localities, beginning with work started by Dr. Robert Jenkins. The database is maintained at the USFWS Warm Springs National Fish Hatchery by Ms. Jaelyn Zelko, approved chair by the 2003 RRCC annual meeting. River basin data managers support the TWG. The IT TWG, assisted by Mr. Mike Nichols of GPC, is currently consolidating years of data into a Microsoft Access database.

### **Broad (SC) TWG**

Formed at the 2002 RRCC annual meeting, the Broad River (SC) TWG submitted a management plan at the 2003 RRCC annual meeting. It is currently in review.

### **Broad (GA) and Savannah TWG**

Formed at the 2002 RRCC annual meeting, the Broad and Savannah TWG will develop a management plan; no completion date scheduled.

### **Ocmulgee TWG**

Formed at the 2002 RRCC annual meeting, the Ocmulgee River TWG will develop a management plan; no completion date scheduled.

### **Oconee TWG**

Formed at the 2002 RRCC annual meeting, the Oconee River TWG is producing a management plan. A draft is currently being reviewed by TWG members and will be submitted to the RRCC upon completion.

### **Ogeechee TWG**

Formed at the 2002 RRCC annual meeting, the Ogeechee River TWG will develop a management plan; no completion date scheduled.

### **Yadkin-Pee Dee TWG**

Formed at the 2002 RRCC annual meeting, the Yadkin-Pee Dee River TWG continues to survey the population, search for spawning habitat, and monitor water quality. The TWG will begin development of a Yadkin-Pee Dee Management Plan in 2006.

## **3. ROBUST REDHORSE CONSERVATION STATUS**

### **3.1 Oconee River Population**

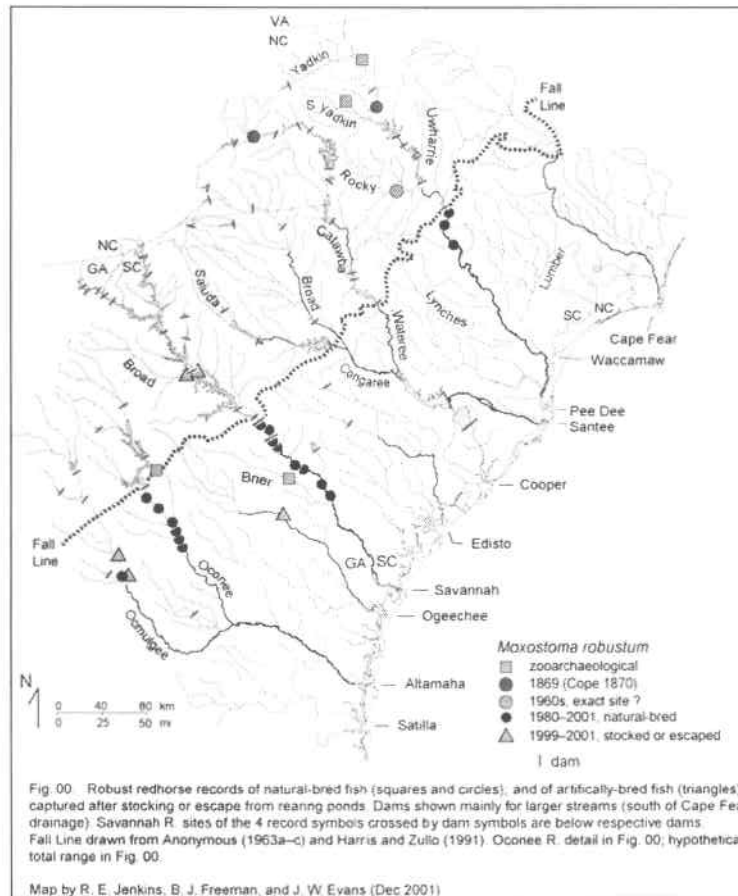
Most information on the status of the Oconee River population is based on selective electro-fishing along a 30 river mile section during spring broodfish collection from 1994 to 2006. During broodfish collection and other studies on the Oconee River between 2002 and 2006, catch rates of adult fish decreased from previous years, and no juveniles or young-of-year were collected. These data indicate a decline in electro-fishing catch rates in this area of the river. Flows provided by Georgia Power's Sinclair Dam during collection in 2004, 2005, and 2006 were optimal (low and consistent) for sampling efforts; 21, 10, and 11 adults were collected, respectively. A total of 4138 robust redhorse from eight year classes have been stocked in the Oconee River as of spring 2006.

### **3.2 Other Populations**

The RRCC organized intensive surveys within the believed historic range of the robust redhorse in large Atlantic Slope rivers from the Altamaha River drainage in Georgia to the Pee Dee River drainage in North and South Carolina, and documented known populations in 2002 (Figure 2). Currently, wild populations exist in the Ocmulgee and



Oconee rivers (Georgia), Savannah River (Georgia and South Carolina), and the Pee Dee River drainage (North and South Carolina). Successful stocking in the Broad and Ogeechee rivers in Georgia and the Broad and Wateree rivers of South Carolina has reintroduced fish but it is not known if these are self-sustaining populations.



### Broad (GA) and Savannah Rivers

Four year classes (n = 32,189) were stocked in the Broad River, GA, between 1995 and 1998 from the Oconee River stock. Although populations are not expected to mix, due to Clark Hill Reservoir, stocking halted after the incidental collection of a single robust redhorse from the native Savannah River population in October 1998. Fourteen robust redhorse were collected in spring 2006 and ten were used for the Ocmulgee River telemetry study.

Two gravel bed spawning aggregations, separated by 15 river miles, of robust redhorse have been observed below Augusta. Not including recaptures, a total of 43 (2004) and 64 (2005) robust redhorse were collected in the Savannah River.

### Ocmulgee River

The CCAA describes goals of the project, agreement responsibilities of the parties, provides a timeline, and suggested measures of progress toward the goals of the recovery effort. Under Conservation Action 1, eight year classes (n = 13,095) have

been stocked into the Ocmulgee River as of spring 2006, including 2,898 in 2004 and 3,505 in 2005.

Under Conservation Action 3, the second of six electro-fishing surveys was conducted by Georgia Power biologists May 17, 2005, on the Ocmulgee River from the Lloyd Shoals Dam boat landing down to the upper shoals at the Highway 16 bridge. Three robust redhorse were collected during 21 minutes of peddle time (active electro-fishing time). A ripe male from the 1999 year class, as indicated by a coded wire tag, was captured. Additionally, a previously captured wild female and a new wild female were captured. Although more time was allotted towards Ocmulgee River sampling, that time was devoted towards assisting in the collection of brood fish from the Oconee River, by request of the Robust Redhorse Executive Committee. The third of six status surveys, performed in alternating years, under Conservation Action 3 is scheduled for spring 2007.

In addition to electro-fishing a visual survey was conducted May 18-19, 2005, on the Ocmulgee River in the Juliette Dam tailrace. Observations were made of spawning robust redhorse (n=7) for the first time on the Ocmulgee River. Two groups spawned multiple times (separate groups of three and four individuals) at the same location on May 18. Although spawning was not witnessed on May 19 two individuals were captured and the presence of coded wire tags identified fish as the 2000 year class. Additional visual surveys were conducted in the Juliette Dam tailrace during late May 2006, but no robust redhorse were seen. However, recently telemetered fish were documented in the area and also not seen.

### Ogeechee

Since 1998, a total of 43,048 robust redhorse from seven year classes have been stocked into the Ogeechee River. Surveys in 2003, 2004, and 2005 collected 22, 13, and 16 individuals, respectively. Twenty-two robust redhorse were collected in spring 2006 and used for the Ocmulgee River telemetry study.

## **3.3 Research Summary**

### Telemetry Studies

#### Ocmulgee River

As agreed upon under Conservation Action 2, two telemetry studies provided information on dispersal following stocking, movement patterns and habitat preferences. These completed studies were summarized in the May 2004, volume 4, report to the FERC. A third telemetry study began in late April 2006 with thirty adult robust redhorse in the Ocmulgee River and will continue for one year (estimated life of implanted monitors).

#### Savannah River

Updated telemetry results (initial findings in 2004 report) by Dr. Tim Grabowski and Dr. Jeff Isely, Clemson University, were presented at the 2005 RRCC annual conference. Findings included the following:

1. Spring migrations of robust redhorse in the Savannah River initiate in April when

- water temperatures reach 12-14°C;
2. Adult robust redhorse show a high degree of site fidelity to over-wintering habitat and most return to within 100-200 m of locations where they spent the previous winter;
  3. Adult robust redhorse appear to have a high degree of site fidelity to spawning habitat; however, there appears to be some evaluation of this habitat that occurs regardless of past use; and
  4. The availability of suitable adult habitat is not limiting the Savannah River population.

#### **Other studies**

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. Agendas from the 2004 and 2005 annual meetings of the RRCC are attached to provide the reader with a better idea of the full range of topics under consideration by the RRCC (Appendices B and C).

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 and telemetry studies to address movement patterns in the Ocmulgee River. GPC continues to collect temperature data from several locations in the Oconee River (and Ocmulgee 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 is still an important topic as the RRCC supports the use of propagation and stocking as 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, good growth, and spawning 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 United States 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 intends to handle 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. This includes a study by Mr. Diarra Mosley and Dr. Cecil Jennings (UGA) on habitat selection by juvenile robust redhorse in an experimental mesocosm presented at the 2005 RRCC annual conference. The laboratory study suggested that juveniles:

1. avoid flows over 15 m/s in the winter and early spring;
2. prefer eddies and backwaters, respectively, in the winter; and
3. prefer eddies in early spring.

A study by Dr. Cecil Jennings to determine fry and juvenile abundance on the Oconee River between Milledgeville and Dublin collected 54 redhorse fry (included both robust and notch-lip) between May and July 2005. No juvenile robust redhorse were collected between September and November, although one notch-lip redhorse was collected in an October gillnet.

Mr. Forrest Sessions (SC-DNR) presented initial results at the 2005 RRCC annual conference by Dr. Tom Kwak (North Carolina State University) on electrofishing injury and short-term mortality of juvenile robust redhorse. There was excellent survival for test fish and PIT tags were retained, although injuries do occur at 60Hz Pulsed DC.

Mr. Carlos Echevarria (USFWS) presented results at the 2005 RRCC annual conference showing robust redhorse fingerlings can be intensively raised with higher percent survival, at a relatively low cost, and with acceptable low rates of deformities with artificial feed. The pellets improve nutrient balance and health.

Dr. Peter Lasier et al. (UGA) published an article in *Southeastern Naturalist* in 2004, entitled "Sediment-Quality Assessment of the Lower Oconee River". Using amphipods in laboratory studies they identified contaminants present in the Oconee River from municipal and industrial effluents that may potentially affect survival of robust redhorse.

Dr. Isaac Wirgin et al. (NYU School of Medicine) published an article in *North American Journal of Fisheries Management* in 2004, entitled "Development and use of a Simple DNA Test to Distinguish Larval Redhorse Species in the Oconee River, Georgia". They describe a mitochondrial DNA assay that distinguishes between notchlip and robust redhorses.

Mr. Greg Looney (USFWS) and Dr. Cecil Jennings published an article entitled "Description of Larval and Juvenile Robust Redhorse, *Moxostoma robustum*" in *Bulletin of the Alabama Museum of Natural History* in 2004. Funded by GPC, they describe the morphological development of larval and early juvenile robust redhorse.

Dr. Campbell Nairn (UGA) and Dr. Travis Glenn (Savannah River Ecology Laboratory) were awarded a grant from GPC in spring 2006 to confirm the identity of larval sucker species through mitochondrial DNA analysis following Wirgin et al. (2004); and evaluate genetic variability of populations found within the historic range of the robust redhorse and provide a means for evaluating stockings and parental crosses through nuclear microsatellite analysis.

In 2006 GPC is conducting another spawning (gravel) habitat survey with the assistance of Geosyntec Consultants on the Oconee River as a follow-up to the original 1994 study. Hydroacoustic substrate mapping is being used in addition to low flow visual surveys.

#### **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 and, for the first time, documented spawning.

Now that the RRCC is confident that robust redhorse can be introduced into the wild, survive, and spawn, there are many continuing 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 and with greater initial survival rate than Phase II. The RRCC continues to monitor populations to see if these introduced fish will spawn successfully.

Other questions relate to reintroduction strategies, and identifying rivers or river reaches that should have high priority. The implementation of the CCAA has been 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. 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's Habitat TWG will work to address habitat issues.

Overall, the RRCC monitors eight populations of robust redhorse either as wild (Pee Dee River, Savannah River), supported through stocking (Ocmulgee, Oconee), or re-established through stocking (Broad-GA, Ogeechee, Broad-SC, Wateree).

## APPENDIX A

### **ROBUST REDHORSE LITERATURE OF INTEREST (Partial Listing)**

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APPENDIX B

2004 RRCC Annual Meeting Agenda

2004

RRCC  
AGENDA

10<sup>TH</sup> Annual Meeting  
October 13 and 14, 2004

October 13

Welcoming and Initial Business – Greg

8 a.m. MOU

2003 Collections, Surveys, and Status

Oconee Captures – Jimmy Evans

Oconee Spawning - Jaci Zelko

Oconee River and Ocmulgee River Temperatures: 2004 – Michael Abney

Savannah River Spawning – Forrest Sessions

Break ~10 a.m. (20 min.)

Pee Dee Collections – Ryan Heise

Wateree & Catawba rivers - Dave Coughlin

Broad River, SC – Ross Self/Scott Lamprecht

Research Up-dates

Oconee Recruitment – Cecil Jennings

Oconee River Flows: 1998 – 2003 – Mike Nichols

Savannah River research – Tim Grabowski

Final version of the ID key – Stuart Carlton

Lunch ~1 ½ hours

Technical Working Group (TWG) Reports

Habitat TWG – Bill Bailey

IT TWG – Jaci Zelko

Oconee TWG – Jimmy Evans

Yadkin-Pee Dee TWG – Ryan Heise

Supper at 6 p.m.



October 14

8:00 a.m.

Panel Discussion – Oconee River Status and Management Implications

(Leader – Bill Bailey; Panel Members: Jimmy Evans, Cecil Jennings, Bud Freeman; Mike Nichols, Jeff Isley)

Break ~10 a.m.

Discussion of Robust Research Needs

Oconee

Savannah

Broad (GA)

Broad (SC)

Pee Dee

Other

APPENDIX C

2005 RRCC Annual Meeting Agenda

2005

**Robust Redhorse Conservation Committee**

AGENDA  
11<sup>TH</sup> Annual Meeting  
October 19 and 20, 2005

**October 19**

8:45 **Welcome/House Keeping** (Ross)

1. Ground rules, bathrooms, etc
2. MOU Status
3. Annual Report Status

**FY05 Accomplishments:**

9:00 **A. Outreach & Education**

1. USFWS brochures (Alice)
2. DOD Conference (Ross)
3. Peterson Guide Revision (Bob Jenkins)
4. GA Aquarium update (Jimmy)
5. SC Aquarium update (David)
6. SC Wildlife Magazine TV segment (Ross)

**B. Basin Management Updates: FY05 stocking results, status survey, fry production, etc**

10:00 1. Yadkin-Pee Dee (Ryan)

**10:20 Break**

10:35 2. Savannah and Santee (Ross/Forrest/Scott)

10:55 3. Altamaha

- a. Broodfish Collection (spring 05) (Jimmy)
- b. Pond harvest (fall 04) (Jimmy)
- c. Stocking (fall 04) (Jimmy)

11:25

- d. Spawning results (spring 05) (Jaci)
- e. Egg/fry production (spring 05) (Jaci)
- f. Fry stocking (spring 05) (Jaci)

**11:45 Lunch Break**

1:00

g. Recruitment monitoring (Cecil)

1:30

- 1:45
- h. Observations of the spawning aggregation on the Oconee River at Avant's (Bud Freeman)
  - i. Observations of spawning aggregation in the Ocmulgee (Mike Abney/Mike Nichols)
  - j. Oconee River Flow Advisory Team report (Mike Abney/Mike Nichols)
  - k. Oconee River temperatures and slows in 05 (Mike Abney/Mike Nichols)

**C. Research Updates**

- 2:30 1. Feeding Study (Jaci)
- 2:45 2. Broodfish rearing/spawning at Warm Springs (Carlos of Jaci)

**3:00 Break**

- 3:15 3. Mesocosm study (Cecil)
- 3:30 4. Electrofishing (Tom Kwak)
- 3:45 5. Savannah River studies (Tim)

**D. TWG Reports**

- 4:00 1. Yadkin Pee Dee (Ryan Heise)
- 4:15 2. Oconee (Jimmy)

**5:00 End for the day**

**6:30(ish) Dinner**

**October 20**

**D. TWG Reports cont.**

- 8:15 3. Information/Technology (Jaci)
- 8:30 4. Habitat (Rebecca/Bill/Alice)

**FY06 Goals/activities:**

**A. Basin Management**

- 8:45 1. Stocking Recommendations (Jimmy)  
a. Georgia (Jimmy)
- 9:30 b. South Carolina (Forrest/Scott)
2. Brood stock collections

9:45 a. Georgia (Jimmy)

10:00 b. South Carolina (Forrest/Scott)

**10:15 Break**

10:30 3. Research topics and needs (Group)

11:00 4. TWG activities, assignments and authorizations (Group)

11:15 5. Outreach/Education Opportunities (Group)

11:30 6. New RRCC Chair-elect nomination/voting (Ross, Group)

**11:45 Adjourn**

APPENDIX D

May 23, 2005 Avid Angler Article

# The Avid Angler

[Home Page](#) · [Bassin' Page](#) · [Photo Gallery](#) · [The Oconee River](#) · [Ponds](#) · [Catfish](#) · [Panfish](#) · [Contact](#)

Monday, May 23, 2005

## **Biologists Work to Save the Rare and Endangered Robust Redhorse Fish on the Oconee River**



### Surprise Discovery at Commissioner's Creek

On August 8, 1991, Jimmy Evans, a fisheries specialist with the Georgia DNR, was hard at work electroshocking the waters of the Oconee River. He was preparing a survey of fish populations for a Georgia Power federal relicensing application. That afternoon he worked his way downriver without incident -- until he reached the mouth of Commissioner's Creek in Wilkinson County. Near the creek mouth, something unexpected happened. As he pulsed the electric current through the rods hanging from the front of the boat, several extremely large red-scaled sucker

fish floated to the top. He netted the fish and took a closer look. The fish had thick robust bodies and rosy-colored fins. With an average weight over nine pounds, these red monsters were much larger than any sucker fish he knew of. Little did Evans know that he had just rediscovered a colony of fish lost to science since 1869



Once back on land, and curious for a precise identification, Evans shipped several specimens to Bud Freeman and Robert Jenkins, noted ichthyologists at the University of Georgia and Virginia's Salem College. The scientists knew they was seeing something strange; at first, even they were unable to identify the fish. Over the next two years, these and other scientists collaborated with the Georgia DNR to finally unravel the mystery of the

red-scaled catostomids.

These large sucker fish were actually robust redhorse fish -- and they had last been identified in 1869 -- over 120 years ago. Their range once spread from the Pee Dee River in North Carolina to the Altamaha River in south Georgia, but now their population seemed confined to a small creek mouth on the Oconee River between Dublin and Milledgeville, Georgia.

Out of this surprise discovery in 1991 has sprung an extensive and expensive effort to learn more about the rare and endangered robust redhorse and to save the species from extinction. This spring, biologists from the Georgia DNR, the US Fish and Wildlife Service, and the University of Georgia set up a base camp at the scenic Beaverdam Wildlife Management Area on the banks of the Oconee River in Laurens County as part of their annual effort to capture elusive redhorse



specimens for breeding.

### Breeding Redhorse at the Beaverdam WMA Base Camp



I met up with the scientists near the end of their three weeks effort to find out how they had done and what lay ahead for their efforts. Reaching the camp required bumping down a seven mile single-track road through the Wildlife area. Once I finally emerged into the boat ramp clearing, two graduate students from UGA jumped up to greet me. Jackie Zelco, the project manager from US Fish & Wildlife, was out on the river with Jimmy Evans -- the species re-discoverer -- trying to find some more redbhorse. While waiting for their return, the students displayed the eight large blue holding tanks they had set up on the river bank. The tanks circulated with water pumped up from the river. Earlier in the week, the team had trailered a large propane tank out to the landing area to power the project and set up a card table with the various instruments of the scientists, including a microscope, scale, measuring board, clamps, and scissor.

Several redbhorse swam lazily in the tanks, and student Drew Taylor graciously netted one for us so that Leah Stanley, a reporter with the Courier Herald, could snap some quick pictures. After a short wait, we heard Zelco and Evans' boats powering up the river. We ran down to meet them and bring any fish up to the tanks, but they had come empty-handed. But I was not out of luck, as Zelco agreed to let me observe her work with the fish already in the tank.

She started by mixing MS222, a harmless but effective anesthetic, into a smaller holding tank. The anesthetic is necessary because the fish are, as their name

implies, quite strong and difficult to handle. Once the fish were sedated, Zelco snipped off a small piece of the fin of each fish and stuffed it into a vial. The fin samples -- valuable for their unique DNA pattern -- were sent to to the Georgia Museum of Natural History in Athens for permanent storage.

Each fish was fitted with three tags: a PIT tag, which is a small cylinder with a unique ten digit number that identifies that particular fish; a Floy tag, which is printed with a phone number to call in case the fish is captured by an unsuspecting angler; and a magnetic coded wire tag, which the biologist run inside the fish's body -- the placement of the wire in the fish's body indicates the year the fish was caught.



After tagging and clipping the fish, Zelco brought out a large towel and lifted a female fish up by the tail. She wrapped the towel around the fish's body and then began to vigorously squeeze its underbelly. As she squeezed, Taylor held out his hand to cup the small yellow eggs that flowed out of the fish's body.

Zelco explained that redborse mating in nature requires at least two males to each female. The males line up on either side of their mate and squeeze the female between them, causing the release of the eggs. Michael Abney, Georgia Power's point man for the redborse resoration project, later told me that for the first time this year he observed four males mating with one female, and then a veritable fish orgy, with five males squeezing two females. Triad mating is not unknown in the family of redborse fishes, but the multiple mating he observed this year is certainly unusual.

In nature, the spawning occurs over shallow gravel bars, so that the released roe

fall into the protected interstitial space of the gravel, where the current flows over them, turning and oxygenating the eggs until hatching. Evans hypothesizes that the widescale soil erosion precipitated by the first hundred years of cotton farming in the South covered these gravel spawning beds with sand, pushing the robust redhorse to the verge of extinction.

Learning to mimic the squeezing action of redhorse mating had taken trial and error, but Zelco is now a professional at the fish ritual, and she quickly induced the female to release a thimbleful of tiny yellow eggs. Normally, these eggs would be mixed quickly in a bucket with sperm harvested from the males, but Zelco had already collected over 15,000 fertilized eggs this year, so these eggs were merely examined for quality and then swished back into the holding tank.

Fertilized eggs are boxed and shipped off to several hatcheries across the state, where they are hatched and reared until fingerlings are ready to be released into new rivers across the south. The DNR has even established "armageddon" ponds at the Piedmont National Wildlife Refuge near Macon, Georgia. These refugial areas are dedicated to raising a permanent colony of redhorse fish, so that if some natural disaster befalls the Oconee River population, the redhorse will survive as a species.



Once Zelco had finished with the fish, a grad student carted them down to the river and released the redhorse back to their home. In a few days, they will make their way back to their old stomping grounds upstream of the landing.

### The Redhorse's Uncertain Future

The three fish we watched swim away that afternoon were some of the twelve collected this year -- an extremely low number by past standards. At least the crew was able to achieve substantial egg production from two captured females, producing a total fry production of 11,000. Hopefully, the low numbers of sample redhorse do not indicate more problems for the Oconee population, which probably numbers no more than a few hundred specimens and is dominated by aging adult male fish.

The DNR's breeding project is aimed at creating enough fish to stock other rivers historically part of the redhorse's range, including the Ocmulgee River. Sampling on that river immediately below Juliette Dam indicated for the first time this year that stocked redhorse are breeding in nature. As further counterbalance to the bleak Oconee numbers, scientists on the Ogeechee River reported large juveniles, spawned out of the Oconee population, are thriving throughout the rivercourse.

With significant efforts by the Georgia DNR, Georgia Power, and numerous public and private partners, many Southern rivers now boast small but active populations of the elusive robust redhorse fish.

posted by Joshua Kight @ 10:07 PM [0 comments](#)

## 0 Comments:

[Post a Comment](#)

APPENDIX E

November 22, 2005

Macon Telegraph News Release

robust redhorse prefer: fast, straight courses, eddies or other areas. It turns out that scientists may have been sampling in places the fish avoid, he said.

Many factors probably contribute to the rarity of the fish, Evans said. Soil erosion, both from current development and early farming in Georgia, washed into rivers and covered the gravelly bottom needed for the fish eggs.

Plus, the flathead catfish, introduced from the Mississippi River basin to Georgia, eats robust redhorse. And bottom-feeders such as mussels and the robust redhorse are very susceptible to pollution.

"The fish are an indicator species of environmental degradation," Evans said. "If you can preserve and protect and enhance your most endangered fish, then your other fish will do well."

There are no rules against catching robust redhorse, and sport fishermen have caught a few, Evans said.

The DNR increased its stocking efforts on the river this year. DNR officials find wild brood fish in the Oconee River in the spring, inject them with hormones and strip out the resulting eggs. The eggs are incubated at a hatchery during the summer, and the small fish are released in the fall.

Two female brood fish this year produced about 30,000 eggs, although many don't survive, Evans said. Each fish released is injected with a 1-millimeter wire tag with a microscopic identification number.

The history of the robust redhorse is full of contradictions. Evans said the fish, which once fed on native freshwater mussels that coated Piedmont river bottoms, now survive mostly by eating Asiatic mussels that have been destructive to other rivers and lakes across America.

Although Sinclair Dam causes fluctuations in water levels that can harm some fish, the robust redhorse would not have been rediscovered at all without research on the dam license, Evans said. The license includes rules that the dam can't interfere with normal river flows during the spawning season. The dam also catches eroded dirt.

Evans sees hopeful signs in the reappearance of long-lost species such as the robust redhorse and the ivory-billed woodpecker, which was found earlier this year in Arkansas.

"Despite what we've learned about our river systems, we've still got things to learn," Evans said.

The Telegraph (Macon, GA) - Copyright (c) 2005 The Macon Telegraph

APPENDIX F

May 9, 2006

The Atlanta Journal-Constitution News Release

## Redhorse, Tallapoosa shiner downstream on protected list

Elliott Minor - Associated Press  
Tuesday, May 9, 2006

Albany --- The robust redhorse, a mystery fish that dropped off the scientific radar screen for 121 years until it was discovered in the Oconee River near Dublin, would become a rare, rather than endangered, species according to a proposed new list of Georgia's protected species. In the first comprehensive revision of the state's protected species lineup since 1992, there are proposals to change the status of some species, such as the redhorse, a sucker fish that can grow to 17 inches and weigh 30 pounds. The redhorse is considered a recovering species, along with the peregrine falcon and bald eagle, both of which would be down-listed from endangered to rare. Some other species, such as the Tallapoosa shiner, a minnow that lives almost exclusively in the Tallapoosa River system in North Georgia and Alabama, would be taken off the protected list. Still others, such as the star-nosed mole, which lives in various locations from the North Georgia mountains to the Okefenokee Swamp, would get protection as rare species.

The nearly 200 species under consideration include a handful of rare crawfish, a bevy of imperiled mussels, small flowers found at only a few locations in the state, and rare songbirds, snakes and fish. The Georgia Department of Natural Resources, which is responsible for plants and critters under Georgia's Wildflower Preservation Act and the Endangered Wildlife Act, took nominations for the new list from the public and the scientific community earlier this year.

Under these proposals, 148 species would be added to the list, 13 species would be removed, and the status of 42 protected species would move up or down among the four classifications --- unusual, rare, threatened or endangered. John Ambrose, assistant chief of DNR's nongame wildlife and natural heritage section, said the proposed revision reflected changes in Georgia's landscape over the past 14 years --- the influx of new residents, forest changes, and declining open space and farmland. In some cases, biologists discovered that some protected species simply were not as rare as people thought. "We've got tremendous diversity in the state, in part because we have a lot of soil types and rock types," he said. "We have portions of five different physiological regions, the Blue Ridge, the Cumberland Plateau, the Ridge and Valley, the Piedmont and the Coastal Plain." "At the same time, we're seeing a lot of changes in the state," he said. "The challenge is to maintain that diversity in the midst of all these changes."

A naturalist identified the robust redhorse in 1870, based on a fish taken from North Carolina's Yadkin River. Then it disappeared from scientific literature until 1991, when a DNR biologist caught five unknown sucker fish near Dublin during an environmental assessment for Sinclair Dam, about 50 miles upstream of the city. That led to the rediscovery of the redhorse. Biologists have searched for them unsuccessfully in other Southern rivers, but the redhorse may have survived only in the Oconee, where they use the shoals below the dam as a spawning area. The DNR has been increasing the population by breeding them in fish hatcheries and restocking the Oconee.

The Endangered Wildlife Act and the Wildflower Preservation Act are intended to deter the illegal harvest of rare plants and animals. The DNR's proposed changes will be submitted for public comment. They will have to be approved by the state Board of Natural Resources, possibly in August, before they take effect.

ON THE WEB: For more information about this topic: Georgia Department of Natural Resources: [www.georgiawildlife.com](http://www.georgiawildlife.com); click on "Nongame Animals & Plants"; then click on "Protected Species Update."

The Atlanta Journal-Constitution (Atlanta, GA) - Copyright (c) 2006



APPENDIX G

Updated Robust Redhorse Fact Sheet

## Threats to the Species

Much has been learned about the fish since its discovery, but many questions about its habitat, life history, and survival threats remain. The robust redhorse is difficult to sample and may be easily overlooked or misidentified as a closely-related or more common fish. Non-spawning adults prefer deep, moderately swift areas of the river, often near woody debris. Spawning occurs over clean, shallow gravel deposits in swift current. Adults crush shells with molariform pharyngeal teeth and feed on bivalves including the invasive, exotic Asiatic clam (*Corbicula*).

Threats to the species may include:

- Limited population ranges;
- Low rate of recruitment to populations;
- Predation from the non-native flathead and blue catfish;
- Reduced habitat quality due to erosion and sedimentation from land disturbances; and
- Habitat loss and disruption of spawning migrations resulting from impoundments and dams.

## Partnership Accomplishments

The RRCC is currently facilitating recovery efforts and conservation measures by conducting research to answer scientific questions and address management needs including:

- Habitat use and movement;
- Early life history, population dynamics and genetics research;
- Discovery of additional populations, supplemental stocking of existing populations, and re-establishment of historical populations; and
- Public education.

In addition, the RRCC adopted a Conservation Strategy to establish short- and long-term conservation goals and management actions, and has developed Policies to describe the current understanding of the robust redhorse and the processes under which the partnership operates.

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If you believe you have seen or captured a robust redhorse or want more information, contact:

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