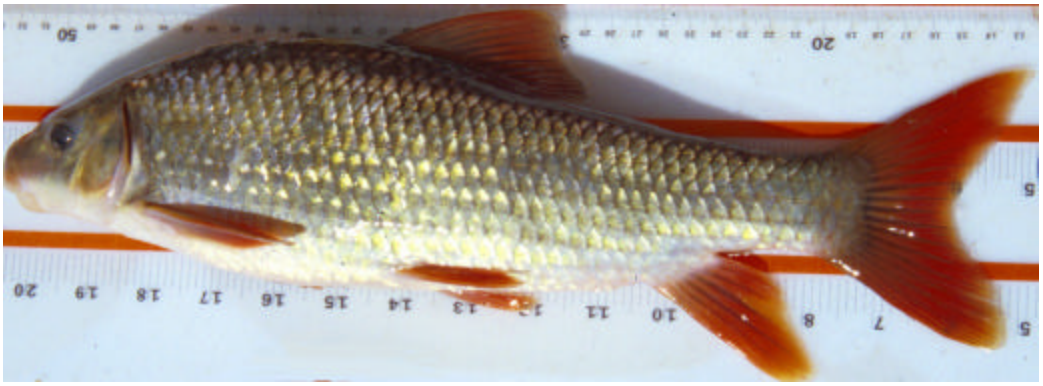
REPORT OF THE

ROBUST REDHORSE CONSERVATION COMMITTEE ANNUAL MEETING

CHARLIE ELLIOTT WILDLIFE CENTER, GEORGIA
OCTOBER 13 – 14, 1999

Unexpected "discoveries" of robust redhorse in 1999 provide evidence that pond-reared fish are able to survive in the wild.

First find of a Broad River stocking recovered in Clarks Hill Reservoir
Photo courtesy of Dr. B.J. Freeman, Institute of Ecology, University of Georgia



Piedmont National Wildlife Refuge juvenile that escaped into the Ocmulgee River
Photo courtesy of Mr. M. Bowers, U.S. Fish and Wildlife Service, Piedmont National Wildlife Refuge

Meeting facilitated and report written by T.A. DeMeo
under contract with the United States Fish and Wildlife Service

TABLE OF CONTENTS

ADMINISTRATIVE BUSINESS

TABLE

ATTACHMENTS

EXECUTIVE SUMMARY

The robust redhorse recovery effort, in its 4th year, is relatively young. The recovery activities, research, and conservation efforts undertaken by the RRCC are charting a course in an area of science that has no proven track record for a successful recovery of an imperiled aquatic species. The intense effort and expertise applied to the questions of recovery from a variety of sources have brought knowledge of the robust redhorse recovery to a comparatively advanced state considering the newness of the effort.

The 1999 artificial propagation activities were quite successful resulting in the production of 567,578 eggs from the Oconee River. In addition, spawning of Savannah River broodfish occurred for the first time in 1999 resulting in the production of 53,016 eggs. The fertilized eggs are used for fingerling production and research purposes. Some 78,859 fry (69,559 from the Oconee and 9,300 from the Savannah spawning) were distributed to 13 ponds at 7 hatcheries: Walton, Richmond Hill, and Burton State Fish Hatcheries, Georgia; Dennis Wildlife Center, South Carolina; and Campbell, Cheraw, and Shirey State Fish Hatcheries, South Carolina. Of the eggs that were shipped to the United States Fish and Wildlife Service Warm Springs Regional Fisheries Center in Georgia for incubation, 90,000 fry were lost after the aquaria suffered a severe parasite outbreak resulting in total mortality. The remainder of the 1999 fry production was distributed to research units. A total of 23,964 Phase I robust redhorse were harvested in fall 1999 (harvest results became available after the RRCC meeting). The fry through Phase I fingerling survival rate was 31%. This compares to the 1998 harvest of 13,030 Phase I fingerlings produced from 40,671 fry (31% survival) distributed to 7 hatcheries.

The spawning of Savannah River robust redhorse is an exciting development. It provides the opportunity to develop a stocking source for the Savannah River system and to establish a second genetically distinct refugial population. In addition, it broadens the DNA material available for genetic research that contributes to the understanding of the species. The dedication of a 2-acre pond at the Fort Gordon Army Base facilitated the establishment of a Savannah River stocking source and the development of a refugial population of Savannah fish. The RRCC decided to stock an estimated 3,200 Savannah River robust redhorse from the 1999 year class at the Fort Gordon pond. The remainder of the Savannah fingerlings is being held at the Burton Hatchery in Georgia. The Piedmont National Wildlife Refuge is the location of the second permanent refugial population containing only fingerlings from Oconee River broodfish. The RRCC decided to add another year class to the existing 3 by stocking about 3,000 1999 fingerlings. Establishing refugial populations is significant to ensure adequate numbers and genetic diversity if either of the wild populations was to decline suddenly and dramatically.

Surveys on the status of robust redhorse populations continue as a high priority of the RRCC. More unexpected “discoveries” of robust redhorse were made in 1999 resulting, in part, from increasing sophistication in survey techniques developed by the RRCC. Ocmulgee River surveys resulted in the capture of 2 wild adults and 2 juveniles collected between Warner Robins and Cockran. The juveniles had escaped in 1998 from the Piedmont National Wildlife Refuge when ponds overflowed from heavy winter rains. They were almost 100 mm longer and nearly double the weight of pond-held juveniles of the same year class. Ogeechee River status surveys

resulted in the capture of 1 tagged juvenile from the 1997 stocking of 1,762 Phase I robust redhorse. The Oconee River broodfish collection efforts captured 81 adults, while 23 adults were collected on the Savannah River. However, 15 individuals representing 2 year classes were recaptured in Clarks Hill Reservoir from the 4 year classes of robust redhorse that had been released into the Broad River during 1995 - 1998. Over several years of monitoring in the Broad River system well upstream from the reservoir, 1999 was the first year providing evidence that the Broad River releases had been successful (although the recaptures in Clarks Hill Reservoir were the result of sampling not associated with the robust redhorse project). All indications support the evidence that pond-reared fish are able to survive when released and may be successful at establishing and/or blending with a population in the wild. These encouraging results from recent monitoring advance the merit of additional status surveys throughout the historic range of the robust redhorse in North and South Carolina and Georgia.

However, research on the status of the Oconee River population and long-term trends in robust redhorse broodfish collection data continue to substantiate the view that the population is in decline. Recruitment may be occurring but at a low level, the exact recruitment level is unknown. Very low catch rates of juveniles, a general decline in overall catch rates, and the length frequency shift to larger fish provide additional evidence that larger year classes that compose a substantial portion of the Oconee population are nearing the end of their natural lifespan. There continues to be uncertainty about what recruitment failure means to a long-lived species. Lack of successful reproduction and recruitment in the wild may remain the largest challenge to the survival of the robust redhorse. Other management challenges involve identifying recruitment in the wild when it happens and determining what amount of recruitment is necessary to sustain the population including if it is necessary for some level of recruitment to occur on a steady basis.

Significant advances were made in numerous research efforts in 1999 that add to the existing understanding of the biology and ecology of the robust redhorse and that help determine environmental constraints that challenge restoration. Highlights of some of the research reported include:

- Research on the effects of fine sediment on larval spawning substrate in the Oconee River support the view that a zero to 8 percent emergence survival of wild larvae is likely.

- Genetic assessment of robust redhorse populations have led to the theory that the Oconee and Savannah robust redhorse populations underwent a genetic divergence about 400,000 years ago resulting from absolute reproductive isolation. The implications of the genetic findings suggest the need for conservative decision-making with respect to transfers of robust redhorse across river systems.

- New research, begun in 1999, on otolith microchemistry provided preliminary evidence of possible migration of robust redhorse to saline or brackish environments that are beyond the currently understood habitat preferences.

A key component of the 1999 RRCC annual meeting was the proposed robust redhorse conservation strategy and conservation agreement. These documents have been under development at the request of the RRCC to help assure the species' continued survival. The conservation strategy is a policy statement providing overall recovery guidance and establishing a process for reintroducing the species. A conservation agreement states specific management actions for reintroduction and recovery efforts in the Ocmulgee River Basin. The RRCC discussed 1) short and long-term recovery goals; 2) the time-line for measuring progress toward the goals; and 3) definition of a self-sustaining population. The proposed robust redhorse conservation strategy was approved based on the recommended changes.

The annual RRCC stocking decision (where and how many fingerlings to release) has become increasingly challenging as new data informs the process including the probability of a decline in the wild populations. Several considerations influenced the 1999 stocking decision such as the results of the genetic assessments and the status of the development of the proposed conservation strategy. In addition, consultations with a group of fish geneticists and the resulting recommendations were also a factor. After considerable discussion, the RRCC decided to stock the Ogeechee, Oconee, and Ocmulgee rivers as well as hatchery ponds. The Broad River was dropped as a stocking consideration for 1999 due the genetic implications inherent in the uncertainty of Oconee River fish escaping the Clarks Hill Dam and reproducing with the wild Savannah River population.

Significant progress was made on the work items assigned at the 1998 annual meeting. Protocols for collections, surveys, introductions, and hatchery management regimes were developed. Several communications mechanisms were put into place during 1999 to facilitate the flow of information among the RRCC members. A robust redhorse listserv and a project management schedule to track research activities and other major projects were established to provide an effective means of communicating.

In addition, the RRCC established research priorities and work items for 2000, approved the draft of a third MOU creating the RRCC (effective January 1, 2000 - December 31, 2005) and affirmed Terry DeMeo as vice-chair of the RRCC, effective immediately. Exciting announcements included continued interest from the South Carolina Aquarium in Charleston in displaying the robust redhorse in a permanent exhibit as an example of a big river fish. In addition, members of the RRCC conducted 10 presentations in a robust redhorse symposia titled, *The Biology, Ecology, and Restoration of Imperiled Fishes in Atlantic Slope Drainages: The Robust Redhorse Case History* at the annual meeting of the National American Fisheries Society on September 1, 1999 in Charlotte, North Carolina.

It is important to remember that recovery of the robust redhorse is challenged by many factors. Yet the RRCC has developed an adaptive management recovery process that sensitively responds to new knowledge and flexibly adjusts actions based on the best information available at the time management decisions must be made. The next annual RRCC meeting is scheduled for October 11 - 12, 2000 at the Charlie Elliott Wildlife Center near Mansfield, Georgia.

INTRODUCTION

The fifth annual meeting of the Robust Redhorse Conservation Committee (RRCC) was held October 13-14, 1999 at the Charlie Elliott Wildlife Center near Mansfield, Georgia. The RRCC was established by a memorandum of understanding (MOU) signed in 1995 to develop and manage a prelisting recovery approach for the robust redhorse (*Moxostoma robustum*), previously a Category 2 candidate for Federal listing under the Endanger Species Act (ESA).

Historically, the robust redhorse inhabited Atlantic slope drainages from the Pee Dee River system in North Carolina to the Altamaha River system in Georgia. The species is presently known to exist in a relatively short reach of the Oconee River below Sinclair Dam and in a short upper Coast Plain section of the Ocmulgee River (Altamaha Drainage) in Central Georgia. As well, individuals have been found in the Savannah River below the New Savannah River Bluff Lock and Dam (the boundary river between Georgia and South Carolina).

Impoundment of rivers primarily for hydroelectric production, predation by introduced nonnative species (principally flathead catfish and blue catfish), and general deterioration of habitat due to sedimentation and water pollution are believed to have contributed to the decline of the species and are perceived as threats to the survival of the remaining populations. The complex and diverse problems facing the robust redhorse call for an interdisciplinary approach, using a broad spectrum of experience, expertise, and management authority, to maintain and restore this imperiled species. In addition, it is essential that recovery efforts include a process that works closely with the private sector as well as government agencies potentially impacted by and interested in robust redhorse conservation.

Approximately 30 representatives of the MOU signatory agencies and university research affiliates attended the 1999 annual RRCC meeting. Signatory agencies include: Georgia Department of Natural Resources, North Carolina Wildlife Resources Commission, South Carolina Department of Natural Resources, Georgia Power Company, Carolina Power and Light Company, Duke Power Company, Georgia Wildlife Federation, U.S. Geological Survey (Biological Resources Division), U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Army Corps of Engineers and Georgia Rivers Network. University research affiliates include: University of Georgia Warnell School of Forest Resources, University of Georgia Institute of Ecology, University of Georgia Cooperative Fish and Wildlife Research Unit, State University of New York Medical Center, and Roanoke College Department of Biology. The success of the recovery effort, to a large extent, is dependent on the willingness of these members to participate in the annual meeting and to continue to support recovery throughout the year.

The RRCC identifies priority conservation needs for the robust redhorse and its habitat as well as coordinates implementation of research and recovery programs for addressing those needs. The annual RRCC meeting satisfies partial requirements for conservation of the species as designated in the MOU. It also represents a singular opportunity for all members meeting as a group to assess the progress of recovery efforts to date and to chart a course through management decisions that guide recovery efforts in the upcoming year and beyond. The annual meeting is the primary occasion to explore possible implications of new data, to argue differing

points of view, and to gather the collective expertise of fisheries professionals. The ensuing discussion and clarification informs the RRCC's recovery and policy decisions based on the best available science on the robust redhorse.

Although a consensus approach guides decision-making at the annual meeting, a consensus may not always be possible due to divergent viewpoints on the interpretation of preliminary findings, differing comfort levels with acceptable risk, or due to enduring responsibility related to the consequences of certain decisions. Therefore, some decisions may need to be made solely by designated representatives of the signatory agencies to the MOU or by a representative of the administrative agency that has legal purview for the management decision. As management and recovery decisions become increasingly complicated, the RRCC may chose to adopt a process that designates official representatives of the signatory agencies whose purpose is to make decisions when it is not possible to obtain a reasonable group consensus among the participants at the annual meeting.

The RRCC has formalized roles to increase efficiency and management of the recovery process including a robust redhorse project manager, and a RRCC chairman, vice-chair, and technical advisory group (TAG). Jimmy Evans, a biologist with the Georgia Wildlife Resources Division of the Department of Natural Resources, is the robust redhorse project manager and past chairman of the RRCC. Mr. Evans oversees day-to-day implementation of management activities with a focus on coordinating hatchery and spawning efforts. Scott Hendricks, a fisheries biologist with Georgia Power, serves as current RRCC chairman and provides overall administration of the recovery approach including coordination of the work of the TAG. The vice-chair position has remained vacant to date but the appointee is expected to assist the project manager and chairman as training to assume the responsibilities of chairman. The TAG was formed as a core work team at the direction of the RRCC during the 1997 annual meeting. The TAG provides guidance on and assists the day-to-day work of the project manager and chairman. It acts as a decision body in lieu of the full RRCC and makes recommendations for the RRCC's consideration.

The RRCC is actively committed to the recovery of this imperiled species throughout its former range. This report summarizes the recovery activities, research reports, direction of conservation efforts, and management decisions made at the 1999 RRCC annual meeting.

RECOVERY ACTIVITIES

1999 Spawning Results for the Oconee and Savannah Rivers ¾ Greg Looney, USFWS

The current spawning methodology is based on experience gained during previous robust redhorse propagation activities. The accepted spawning protocols were used to select candidates based, in part, on the gray coloring of the back and little, to no, mucus covering. Fish were captured through electrofishing and brought to temporary spawning facilities erected adjacent to the brood source rivers. All fish were anesthetized before handling and females were injected with Ovaprim to induce egg flows within 3 days. In addition, PIT tags and two Floy tags were attached to each fish collected.

Spawning activities on the Oconee River occurred May 3 through May 8, 1999 and again May 10 through May 14, 1999 during which time 23 females and 17 males were collected. Fifteen (15) females and 14 males were considered good candidates to spawn and subsequently produced 21 crosses. Total egg production was 567,578 ranging from 1699 to 62,687 eggs per female and averaging 37,838 eggs per female. The total length of females ranged 545 to 695 mm; weight ranged 2.90 to 5.45 kg.

Robust redhorse collected from the Savannah River were spawned for the first time May 24 through May 28, 1999. Five boats collected fish at several sites below the Augusta Shoals Diversion Dam, about river mile 204-206. Twenty-three (23) broodfish were collected, 19 of which (4 females and 15 males) were considered good spawning candidates. Four fish collected below the New Savannah River Bluff Lock and Dam (river mile 187) were not used in spawning efforts. Three (3) of the 4 females were spawned with 4 males producing 4 crosses. Total production included 53,016 eggs, ranging from 2,332 to 29,759 eggs per female and averaging 17,672 eggs per female. The length range of all Savannah fish was 501 to 655 mm; weight ranged 1.70 to 4.32 kg. The length range of the 4 spawned females was 607 to 651 mm with weight ranging between 3.38 to 4.32 kg. The single female not spawned was 599 mm in total length and weighed 2.44 kg.

In terms of observable differences in robust redhorse between the river basins, the Savannah fish seem to have smaller heads, slimmer bodies, and less reddish color in fins than the Oconee. In addition, the spawning indicators on the Savannah River robust redhorse did not seem as pronounced as those on the Oconee fish. However, investigators found no significant differences among the external morphometry in a preliminary study.

1999 Oconee Fry and Fingerling Distribution ¾ Jay Shelton, UGA

In 1998, 140,000 eggs produced 40,671 fry that were shipped to production ponds at 7 hatcheries. In 1999, 78,859 fry (69,559 from the Oconee and 9,300 from the Savannah spawning) were distributed to 13 ponds at 7 hatcheries. Table 1 lists the details of the 1999 robust redhorse fry stocking. For the first time in the recovery effort, an incubation pond at Warm Springs suffered a major parasite outbreak resulting in total mortality over 2 days of the 90,000 fry that were shipped there; those numbers are not included in the following table.

Table 1. 1999 Robust Redhorse Fry Stocking

Hatchery/Pond	Pond Size (acre)	Stocking Rate (fish/acre)	Number Stocked
Dennis Center 53	1.00	8,000	8,000
Dennis Center 54*	1.00	3,500	3,500
Dennis Center 55*	1.00	3,500	3,500
Walton 5	0.48	10,060	4,829
Walton 12	1.00	10,324	10,324
Richmond Hill 13	0.30	10,000	3,000
Richmond Hill 14	0.30	10,000	3,000
Campbell 4	0.48	43,750	21,000
Campbell 8	0.75	8,666	6,500
Cheraw 5	0.75	11,200	8,400
Shirey 5	0.40	11,265	4,506
Burton 5*	0.30	3,833	1,150
Burton 6*	0.30	3,833	1,150
TOTAL	8.03	-	78,859

* Source of fry: Savannah River spawning.

Update of the Refuge Ponds at Piedmont NWR ¾ Mark Bowers, USFWS

Water quality monitoring of the refugial ponds at the Piedmont National Wildlife Refuge (Piedmont NWR) was regularly conducted during the summer and fall of 1999 (see Attachment 1 for a summary of year class stockings at Piedmont NWR). The water quality results were similar to previous years since monitoring began in 1997, with low levels of dissolved oxygen in one pond.

During January and February of 1998, ponds 11A and 11B overflowed due to heavy rains and several hundred robust redhorse (stocked in 1996 and 1997) are estimated to have escaped into the Ocmulgee River. Two of the Piedmont NWR escapees were collected during subsequent sampling of the Ocmulgee River and length and weight comparisons were made to 35 Phase II juveniles collected from the refugial ponds. The escaped fish measured 440 and 448 mm compared to the average 360 mm of refugial pond fish and weighed 1500 and 1620 gm compared to refugial pond weight of 600-700 gm.

These findings support evidence that, as a riverine species, robust redhorse have trouble developing to optimal size in ponds. Yet the physiology of the pond-reared robust redhorse do not seem to be hampered by the feeding regime available in the ponds. The 2 robust redhorse that escaped were collected in the same general location as 2 wild fish were found. This is encouraging in terms of survivability of pond-reared fish that are released into the wild.

1999 Broodfish Collection Results on the Oconee River ¾ Jimmy Evans, GA DNR

In 1999, the majority of broodfish were collected upstream of where robust redhorse have been found in previous years, perhaps due to habitat alterations resulting from the 1998 floods. Attachment 2 presents several graphs of length frequency comparisons over different time periods, those sampled in 1999, samples from 1992-1999, and from 1994-1999. The length frequency of the 75 robust redhorse sampled in 1999 range from 52 to 76 cm. Length frequency comparisons of 1994 and 1999 samples showed a distribution shift to the right, indicating an aging population.

Attachment 3 presents electrofishing catch rates from 1993 to 1999 and the trend in electrofishing catch rates from 1993 to 1999. There were higher catch rates 1993 to 1995 than in 1996 or 1997 but rates leveled out in 1998 and 1999. The average number of fish caught per hour includes 19.7 in 1994, 16.5 in 1995, 7.8 in 1996, 6.1 in 1997, 3.7 in 1998 and 5.4 in 1999. Attachment 4 presents 3 graphs of 1992-1999 sampling data including 1) mean, median, and modal lengths; 2) trends related to those lengths; and 3) minimum and maximum lengths.

About 40 percent of the Oconee fish collected in 1999 are recaptures. Fish movement from habitat alterations may bias the length frequency results and catch rate data. Yet long-term trends in robust redhorse electrofishing data from the Oconee River show:

- a continuation of very low catch rates of juveniles;
- a shift in length frequency to larger fish (with a slight trend reversal in 1999); and
- a decline in electrofishing catch rates for the period of record (although there has been little change over the last three years).

Results of the 1999 Status Surveys ¾ Jimmy Evans, DNR

In 1998, 8 status surveys were conducted: 4 in the coastal plain reaches of the Savannah River, 3 in the upper reaches of the Savannah River, and 1 in the Pee Dee River system. In 1999, status surveys focused on the Ocmulgee, Oconee, Ogeechee, and Savannah rivers. Based on the results of this year's sampling, continued status surveys are necessary with more effort needed in Georgia, South Carolina, and North Carolina.

1999 surveys of the Ocmulgee River occurred at 12 stations over 3 days and involved 6 electrofishing boats, which accumulated a total of 27.2 hours of pedal time. Two wild adults and two juveniles escaped from the Piedmont NWR were captured in the area between Warner Robins and Cochran. In the Oconee River 14.1 hours of pedal time resulted in the capture of 81 adults. Six stations near the Augusta Shoals area from downstream of the City of Augusta Dam to the tailwaters of the New Savannah River Bluff Lock and Dam were sampled for 16 hours pedal time, producing a total of 23 adults. Surveys of the Ogeechee River, as of the meeting

date, involved 10.1 hours of pedal time at 6 stations and resulted in the capture of 1 tagged juvenile measuring 387 mm and weighing 820 gm. This capture indicates some success from the 1997 Ogeechee River stocking of 1,762 Phase I robust redhorse (averaging 90 mm in length and 7 gm in weight). No evidence of a wild population was discovered in the Ogeechee River, although that was the primary focus of the sampling effort.

Snags and cut away banks with nearby gravel beds seem to comprise the typical robust redhorse habitat and the highest sampling success has occurred when surveys target these areas. However, there seems to be some variety in habitats between river systems. For example, the banks of the Ocmulgee are higher and more stable than the Oconee. The Ogeechee is much smaller in size and has a higher number of snags than the Oconee or Ocmulgee, making it more difficult to sample. In addition, only one gravel patch, smaller than the normal spawning substrate, was observed in the Ogeechee, although plentiful mussels and lots of young of the year suckers were observed. On a final note, there were no visible differences and no genetic differences between the captured Oconee and the Ocmulgee adults.

Recaptures from the Broad River and Clarks Hill Reservoir ¾ Bud Freeman, UGA

The Broad River was stocked annually from 1995 to 1998 with 1993, 1995, 1997, and 1998 year classes (see Attachment 5 for stocking dates, year class, release locale, tag location, and numbers stocked). Attempts to find robust redhorse in the Broad River system have been unsuccessful. In a study unrelated to robust redhorse monitoring in the Broad River, the Clarks Hill Reservoir was sampled at five stations monthly during 1999 using gillnets and electrofishing techniques (map in Attachment 6). The gillnet equipment included 250' x 8' total length nets with 3/8" to 4" mesh in 25' panels established at 2 floating and 2 bottom sets per station. The electrofishing sampling was conducted in 3, 150 meter shoreline transects per station using fixed transects in a randomized original selection. Although Clarks Hill Reservoir has been similarly sampled during previous years, 1999 was the first year that robust redhorse were collected.

The first robust redhorse recovered was a 1995 year class juvenile measuring 404 mm in total length and 878 gm in weight collected in the Russells Creek Embayment (station 4) portion of the Clarks Hill Reservoir in February 1999. In all, 15 juvenile robust redhorse from 2 year classes were recaptured from the Clarks Hill Reservoir system prior to the October 1999 RRCC meeting (Attachment 7 provides a complete list of fish and location). All the fish had tags and most were captured from 1 bottom set gillnet, but at least 1 fish was collected from stations 1, 2, 4, and 6. Station 1, immediately below Richard B. Russell Dam, has special considerations due to the potential of fish to be impacted by entrainment during operation of the dam.

The results of the recaptures from the Broad River and Clarks Hill Reservoir system contribute significant considerations:

- fish were collected at times other than in the spring;

- it appears that pond-reared fish are able to survive and may be successful at establishing a population in the wild; and

- stocked fish appear to move substantial distances downriver after the initial stocking.

Potential Robust Redhorse Display at the South Carolina Aquarium ¾ Ross Self, SC DNR

The Fisheries Division of the South Carolina Department of Natural Resources and the South Carolina Aquarium in Charleston continue to discuss the potential installation of robust redhorse at the aquarium for its opening in mid 2000. The aquarium is interested in displaying the robust redhorse in a permanent exhibit as an example of a big river fish and a meeting to discuss the details is set for November.

Hatchery Status — Discussion

An update on the status of hatcheries involved in robust redhorse rearing and a discussion of potential new hatchery sites provided the following notes:

- There are several thousand Phase I Savannah River fingerlings in hatcheries in South Carolina, which must be stocked in refugial ponds in the Savannah Drainage by fall 2000.

- Fort Gordon has agreed to make an estimated 2-acre pond available for fall 1999 stocking as a permanent robust redhorse refugial site.

- An additional 2-acre pond is available for stocking fall 1999 at the UGA Central Georgia Branch Station in Eatonton.

- Additional pond space at Burton Hatchery is also a possibility as a temporary rearing facility for Savannah River fingerlings.

- Pond space at the Savannah River Site Nuclear Weapons Facility is under negotiation and may be available for fall 1999 stocking.

- Carolina Sandhill Wildlife Refuge (Pee Dee Drainage) will also commit 2-3 ponds.

RESEARCH REPORTS

Short- and Long-Term Storage of Robust Redhorse Sperm ¾ Greg Looney, USFWS

A study of sperm cryogenic techniques has been underway since 1993 to help protect species viability in the event of sudden declines in the wild and to ensure short-term availability of sperm for annual spawning activities. Short-term storage has been successful for up to 14 days with techniques involving refrigeration, or holding on ice, at 2-4^{o} C. Long-term storage can be successful for an indefinite time using liquid nitrogen freezing at about -196^{o} C. In 1999, sperm was collected using the stripping techniques employed in the past. Several fish produced 30 mls of sperm each, 1 or 2 produced 40-50 mls, and 1 fish produced 80 mls of sperm.

Short-term storage studies included: 1) determining osmotic pressure of seminal and ovarian fluid (seminal 269∀13 and ovarian 264∀19 mmol/kg) -- low osmotic ovarian fluid can activate sperm; 2) development of an activation curve using activating solutions of various concentrations determined osmolality for initial motility (~10% of the sperm motile), osmolality for maximum motility (120-180 mmol/kg), and duration of motility (up to 15 minutes at 120-180 mmol/kg); 3) extender development involved testing a number of saline extenders in refrigeration storage; and 4) refrigeration techniques. Fertilization studies using sperm exposed to short-term storage included: 1) a control group with a 98.9 percent fertilization rate; 2) the use of Hanks= Balanced Salt Solution (HBSS), which produced a 81.0 percent fertilization rate; 3) undiluted semen stored with oxygen resulting in 76.8 percent fertilization rate; and 4) undiluted stored with air resulted in 65.6 percent fertilization.

Long-term storage studies included: 1) determining cyroprotectant toxicity; 2) cyropreservation technique development; and 3) testing for fertilization rates post-thaw. Cyroprotectants, DMSO and methanol, produce acceptable motility rates (37.5 and 11.0 respectively) but motility rates using glycerol are much lower. DMSO at 5 percent concentration produces better motility rates than a concentration of 10 percent. Cyropreservation technique testing included the impact of the speed at which sperm is frozen. The faster the freeze, the higher the motility rates upon thawing. The fertilization rates post-thaw are variable depending on treatment. Fertilization rates: Test #1: range of 16.4-32.0%, control = 61.0%; Test #2: range of 1.8-26.0%, control =18.0%; Test #3: range of 0.7-4.1%, control = 23.6%; and Test #4: range of 2.2-20.5%, control = 16.7%. Quality of the eggs and individual males influenced the variability in the results. Cyropreservation has not usually been as good as fresh sperm but fertilization rates are high enough to make it useful for improvement of genetic diversity and, in the better cases, for production.

Future plans for sperm storage experiments include additional fertilization studies, refinement of techniques, and the establishment of a repository in which sperm from every male is frozen with the best available technique for future use. While this last procedure may not produce the highest survival numbers, it can maintain genetic diversity on which to establish a population, if needed.

Temperature and Flow Study Update ¾ Jay Shelton, UGA

The affect of water temperature, flow, and turbidity on incubation success has been under investigation since 1996 to determine the optimum temperature and flow rates for use in the hatchery program. The overall survival of eggs to reach a swim-up fry stage and incidence of gross deformities were studied using an experimental temperature range of 19 to 25° C and flow rates of 200 to 1600 mls/s in hatching jars.

The reduced flow and mid temperature treatments (21 to 23 ° C) resulted in a lower incidence of gross deformities in the larvae stage than at the extremes of the experimental temperature range. However, mean gross deformities were highest at all temperatures under the sustained flow treatment. Mean survival was low across treatments but the 21 to 23 ° C range had the highest survival rates. The high flow rate of 1600 mls/s resulted in zero survival; the 800-mls/s rate had little survival with the best survival rate at the 200 and 400 mls/s flow rates.

Results indicate that a moderate temperature range of 21 to 23° C and reduced flow rates, 200 and 400 mls/s, are optimal incubation conditions. These conditions are similar to those experienced by egg and early fry stages in the wild where gravel substrate provides shelter from high flow rates but still allows oxygen exchange and the flushing of toxins. Investigators found a distinct difference in sensitivity of eggs and yolk sac larvae to flow with eggs being significantly more tolerant to changes in flow rates.

Early Results of Hatchery Pond Production Studies ¾ Alan Fitzek, UGA

This study systematically samples hatchery ponds throughout the growing season (17 weeks) to determine a possible correlation between pond management practices and fingerling survival. The first year in this 5-year monitoring study was undertaken in 1998 yielding observational data on the feeding behavior of the robust redhorse. In 1999, zooplankton and benthic macroinvertebrate samples were compared with gut contents of 5 fish samples collected from each of the hatchery ponds. Zooplankton samples were collected with tow nets, while benthic macroinvertebrates were collected with seine nets; both were preserved in 10 percent buffered formalin.

Attachment 8 lists the stocking density, fry to acre ratio, number harvested, percent return, and percent survival for 10 ponds at 7 hatcheries: Burton, Walton, McDuffie, Richmond Hill, Campbell, Dennis Wildlife Center, and Cheraw. The 1998 stocking rate averaged 6,507 fry per pond acre. Ponds were fertilized at a feed rate of 300 pounds of cottonseed meal per week. The 1999 stocking rate averaged 9,803 fry per acre and feed rate was based on the 1998 Walton Hatchery regime, 1 pound of feed per 1000 fry. Fry increased between a high rate of 0.5 pound per week and a low rate of 0.25 pound per week. Low, moderate, and high growth rates seem to correlate with survival supporting a nutritional explanation for survival rates, although high temperatures and lack of rain in late July-August seemed to promote stressful pond conditions.

Zooplankton, primarily cladocerans and copepods, are the primary food source for the first 4 weeks of culture. Commercial feed residue is evident in the gut as early as week 4 with values ranging from 25 to 100 percent by the end of the culture cycle. Chironomid larvae are incidental at first but become a primary live food component by week 12. In terms of commercial feeding regimes, which can provide abundant food supplies, investigators are uncertain whether the rates are feeding the pond or the robust redhorse. Survival becomes more predictable with commercial feed but it is some weeks (4-6) before the fish start consuming it.

Future studies could include testing the benefit derived from any one food source and whether the nutritional contribution of commercial versus natural food can be quantified. Investigators would also like to determine whether the commercial food is increasing the size of the fish or feeding the pond as there may be something other than the commercial feed that is getting the fish to a large size. The gut content of wild fish have not produced any shells but soft bodied invertebrates have been found, which continue to be consumed even when the fish become bigger. This study shows that robust redhorse can be grown on commercial food if the fish get to the critical 4-5 week period after which they can revert back to a natural diet when released.

Oconee River Reproduction and Recruitment Assessment ¾ Cecil Jennings, USGS

The goal of this study is to assess the reproductive and recruitment success of the Oconee River robust redhorse including estimates of the abundance and distribution of larval and post-larval fish in response to the flow regime mandated by the 1996 FERC license for Sinclair Dam. Sampling for larval and post larval robust redhorse and measurements of environmental conditions have been undertaken since 1995 and are expected to continue for several years. Investigators are currently analyzing the 1999 data and a complete report of the results will be available at the 2000 annual meeting.

The frequency of fish captures over the study period includes 6 in 1995, 7 in 1996, 25 in 1997, and 6 in 1998. Traces of larval and post larval fish larger than 14 mm disappear from the river until fish approximately 400 mm in length are found during electrofishing. Investigators are uncertain as to where the fish go between these sizes and believe that gear selectivity may contribute to their absence from sampling.

When comparing densities of fish collected to flow regimes from Sinclair Dam, under hydropeaking flows maximum densities included: 13 in 1995 and 7 in 1996, but under run of the river flows 33 fish were collected in 1997 and 10 in 1998. It is important to note the low level of maximum density of fish collected in 1998 may reflect the very high (flood level) flows in spring, whereas there may have been drought condition flows in 1999.

In terms of limiting factors to recruitment success, investigators have ruled out biosenescence, predation from the flathead catfish, and lack of spawning habitat. But investigations have not rule out the impact of limitations in suitable rearing habitat in terms of fine sediment and gravel conditions. There is tremendous variability in the Oconee River flows (and corresponding turbidity) with managed versus natural hydrographs. Investigators believe a stable and moderate

flow is probably best for reducing the effects of fine sedimentation on larval robust redhorse. It seems that recruitment is occurring but at a low level, the exact recruitment number is unknown.

Future studies will refine sampling protocols to better evaluate the abundance of juvenile robust redhorse. In addition, a mark-recapture experiment should be conducted to determine the population size, individual survivability, and annual recruitment. Also the level of recruitment needed to maintain a population of long-lived fish such as the robust redhorse should be determined.

Effects of Fine Sediment on Larval Robust Redhorse ¾ Cecil Jennings, USGS

The primary objective of this study, initiated in 1997, is to determine possible causes for the low larval densities observed during recruitment monitoring investigations. The current population estimate of the Oconee River robust redhorse is between 806 – 4,028 individuals with a probable population range of 2,500 – 3,000 fish. The age structure of the Oconee River population seems to be skewed toward older individuals with apparent recruitment failure over the past 10-plus years. Possible causes for apparent recruitment failure include biological constraints such as senescent population that is beyond reproductive age and excessive predation by flathead catfish, and environmental constraints such as limited spawning and limited rearing habitat.

Over time the Oconee River has shifted from a historically pristine state to degraded conditions from large-scale erosion and sedimentation. Gravel treatment trials have been undertaken in a laboratory setting to determine the impact of the filling of interstitial voids with fine silt on the emergence success of larvae robust redhorse. Studies conducted in 1997 showed larvae survival rates related to 0 to 25 percent fine sediment. Studies in 1998 looked at survival related to increasing rates of fine sediment, at 5, 10, 15, 20 and 25 percent. Results showed an inverse relationship between the amount of fine sediment and larval survival with a 60 percent survival rate at 0 percent fines and 10 percent survival at 25 percent.

There seems to be a marked threshold in survival rates at 10 to 15 percent fine sediment. Recommendations for future rearing habitat include a fine sediment threshold of between 10 to 12 percent with adequate gravel quality consisting of particle diameters between 2 to 8 mm to reduce impediments to emergence success. In addition, the higher fine sediment treatments showed a drop in dissolved oxygen post emergence that seemed to affect the total length at emergence. Apparently the larval emerged early, at 10 mm, due to reduced dissolved oxygen levels, as compared to the 14-millimeter length typical of emergence in the wild.

The spawning substrate in the Oconee River ranges from 25 to 50 percent fine sediment. At these levels, a zero to 8 percent emergence survival of wild larvae could be expected (not including natural mortality and considering an 8 percent survival as the best case scenario even if spawning substrate is clean when eggs are deposited). The high percent of fine sediments in the Oconee River could be a significant factor limiting recruitment. Restoration and remediation options for spawning substrate could include flushing flows, sediment traps, gravel cleaning devices, and artificial spawning beds.

Contaminant Impacts to Early Life Stages in the Oconee River ¾ Pete Lasier, UGA

This study, in its second year, examines the toxicity and chemistry of depositional sediment, the basic chemistry of pore water, the presence of major and trace cations and organic contaminants, and the physical characteristics at 12 sites that span the known spawning area in the Oconee River. In addition, in the fall of 1998, pore-water toxicity tests were conducted on macroinvertebrate indicator organisms that reflect toxicity response. Tests included the effect of chronic exposure on the survival and reproduction of ceriodaphnia dubia and the effect on survival and growth of hyalella azteca. Sediment toxicity trials also tested the effect of chronic exposure on the survival and growth of hyalella azteca. In spring 1998 and 1999, exposures of robust redhorse to sediment and pore-water toxicity and contaminant tolerances were undertaken.

Water chemistry assessments at the 12 sites showed pH levels in normal ranges, generally good conductivity and acceptable levels of sodium, potassium, calcium, and magnesium. Sediment quality assessments, however, showed that zinc concentrations increased significantly below Buffalo Creek (sites 7 through 12). Investigators believe there is chronic sediment toxicity due to the zinc inputs to the watershed that may cause adverse effects to the biota but that other metals (copper, mercury, and manganese) are within acceptable ranges. Pore-water metal assessments showed potential problems with high levels (above 15 mg/L) of manganese at nearly all of the 12 sites but other metals were again within acceptable ranges.

Robust redhorse exposure studies were conducted as a tiered duration approach for 4, 8, and 12 days. Eggs, yolk-sac fry, and swim-up fry were exposed to trials with sediment and surface water and to trials with pore-water from sites 1, 3, 7, 11 and a controlled exposure. These early robust redhorse stages were also exposed to metal solutions. Pore-water toxicity tests with eggs showed sensitivity to manganese at sites 3, 7, and 11. In-situ samples were less toxic than laboratory samples supporting the conclusions that manganese toxicity is an artifact of sample storage and organic matter decomposition and that manganese in the fine sediments is available under anoxic conditions. Sediments from sites 3, 7, and 11 were found to be toxic to robust redhorse exposed during the transition from egg to yolk-sac fry.

In-situ contaminant concentrations were found to be low during the spring. Fine sediments represent the worst-case scenario for robust redhorse exposure but impacts of the sediment-bound contaminants on early-life stages are considered to be insignificant. In addition, this study found no traces of organic contaminants when a large survey for PCBs was undertaken in the Oconee and Ocmulgee. However, PCB concentrations were found in an independent study of robust redhorse eggs, which merits further investigation.

Preliminary Results of Otolith Microchemistry Analysis ¾ Dave Coughlan, Duke Power

Although robust redhorse habitat seems limited, sucker species have been found in a variety of habitats such as the 3 collected from brackish waters in Chesapeake Bay. Previous robust

redhorse salinity tolerance studies have shown acute exposure survival up to 22 days in 29 parts per million and chronic exposure survival to levels of 12 parts per million. In addition, size may be related to survival, as larger robust redhorse appear to survive salinity exposure better than do young.

The otolith microchemistry analysis was begun in 1999 to examine the potential presence of salinity in the robust redhorse's environment by assessing strontium/calcium ratios (strontium concentration is greater in seawater than in fresh). It is believed that robust redhorse do not distribute beyond freshwater environments but otolith studies of 16 year-old females showed a dark nucleus surrounded by a light area indicating a high strantium/calcium ratio at earlier life stages. These findings may give clues as to the present distribution of robust redhorse indicating some migration to areas that are more or less saline even if the movement is not to brackish water.

Additional otolith microchemistry analysis of strantium/calcium ratios seems merited based on the preliminary findings including otolith analysis of pond-raised robust redhorse for comparisons. In addition, an investigation of potential strantium sources should be conducted in the Oconee River along with a general survey for strantium within the known robust redhorse range. An ultra-sonic/radio tagging and tracking study could document the movement of robust redhorse, perhaps revealing distributions beyond what is currently thought likely. The robust redhorse are definitely known to move as soon as they are released. Perhaps studies of the life-history of other long-lived species might reveal similarities in migration and movement patterns.

Genetic Assessment of Robust Redhorse Populations ¾ Ike Wirgin, NYU Medical Center

Genetic assessment has been ongoing since 1996 to investigate the population structure and genetic diversity of the robust redhorse. Study objectives include: 1) determining if there are significant genetic differences in the Oconee River robust redhorse population; 2) determining the frequency of distinguishing genetic markers between the Oconee and Savannah river fish; and 3) comparing the overall levels of genetic diversity of the broodstock. Investigation methods include amplification of the mitochondrial DNA from fin clip samples using PCA techniques.

Results of the 1999 studies show no statistical difference among the genetic markers of fish from various sites within the Oconee River. There is a higher level of genetic diversity within the Savannah River samples than there is in those from the Oconee River. In addition, there is no genetic difference between spawning aggregates in the Oconee and Ocmulgee rivers.

Significant genetic differences were found in DNA comparisons of Oconee/Ocmulgee and Savannah river fish. Investigators speculate that the Oconee and Savannah robust redhorse populations underwent a genetic divergence about 400,000 years ago resulting from absolute reproductive isolation. The fixed genetic differences between the Oconee and Savannah rivers are more pronounced that those found in comparisons of sturgeon from different river basins. Another analysis measured the number of maternal and paternal characteristics revealing high

polymorphic differences supporting evidence of 100 percent reproductive isolation between the river basins.

Evolutionarily Significant Units is a determination of a subset population that meets two criteria:

1) groups that are reproductively isolated from other conspecific population units; and

2) species where reproduction is an important component in its evolutionary legacy.

The investigator believes the robust redhorse qualifies on the first standard and may qualify on the second. The Oconee and Savannah robust redhorse may qualify for this designation based on allopathic distinction, morphological differences, life history variability, and genetic variability. As no specific level of criteria is needed in order to make a designation as a separate population or subspecies, further work will be required to evaluate the full significance of the differences and associated management implications.

The strong genetic difference between the Oconee (and apparently Ocmulgee) and Savannah robust redhorse advocate management decisions that include prohibition of hatchery-reared offspring transfers between populations. Future research should include genetic comparisons of hatchery-reared fish to natural population broodstock in the Oconee and Savannah rivers as well as genetic assessments of newly "rediscovered" robust redhorse populations. In addition, genetic analysis of a second sucker species found in the Ocmulgee, Oconee, and Savannah rivers could be compared to the diversity seen in the robust redhorse.

ROBUST REDHORSE STOCKING

CONSERVATION STRATEGY AND CONSERVATION AGREEMENT — Mike Nichols, GA Power

At the 1998 RRCC Annual Meeting, the committee gave direction to pursue the development of a proposed Robust Redhorse Conservation Strategy and Conservation Agreement to help assure the species' continued survival within its historic range. The concepts supporting these new USFWS conservation approaches were provided in an overview and the major points of a draft robust redhorse conservation strategy were presented. Through discussion, the RRCC determined several items for inclusion in the proposed robust redhorse conservation strategy including: 1) short and long-term recovery goals; 2) the time-line for measuring progress toward the goals; 3) an acceptable definition of a self-sustaining population; and 4) approval of the conservation strategy based on the recommended changes. In addition, the RRCC gave direction to purse the development of a Conservation Agreement for the Ocmulgee River.

Conservation Strategy

The conservation strategy is a policy statement of the RRCC providing overall guidance for the process of protecting the species. It addresses the five Endangered Species Act criteria and includes 1) the status and distribution of the species and present threats to its survival, 2) goals for the species' recovery, and 3) a general plan on how to accomplish recovery with the existing information. The USFWS will review the contents of the conservation strategy and the RRCC chairman will act as the RRCC signatory representative.

The conservation strategy should encompass a range of conservation actions but be flexible enough to accommodate different issues throughout the species' range and to allow the RRCC to react to new threats that may arise. It must be a living document that can be altered as new information is learned every year. Therefore, once the conservation strategy is approved it will be reviewed by the RRCC annually. Based on recovery progress and new knowledge, the TAG may make recommendations for changes at the annual meeting and the RRCC could provide its approval after which the conservation strategy would be amended.

The RRCC developed the following short-term goals for the conservation strategy 1) establish a refugial population for 2 stocks of adults, 2) locate other wild populations, 3) describe population characteristics (number, recruitment rate, etc), and 4) habitat protection and enhancement for the Oconee and Savannah Rivers; specific actions can be taken from the conservation needs/opportunities discussion. The long-term goal is to establish or maintain at least 6 self-sustaining populations distributed throughout the historic range.

The conservation strategy timeline for completion of the short-term goals was set in broad terms at 2000 – 2005. Members believe it is important to not establish dates that may be unrealistic or unreachable due to a suite of considerations outside of the control of the recovery effort. A timeline for the long-term goal was not established. Conservation actions undertaken on the Ocmulgee River will be monitored to help determine progress toward reaching the goals.

Definition of a self-sustaining robust redhorse population is an important concept to the overall determination of successful recovery of the species. The RRCC discussed the following definition, taken from the Recovery/Management Plan for the Gulf Sturgeon, as a starting point for the development of a definition for robust redhorse. "A self-sustaining population is one in which the average rate of natural recruitment is at least equal to the average mortality rate in a 12-year period. While this objective will be sought for all management units, it is recognized that it may not be achievable for all management units."

Conservation Agreement

A conservation agreement will be developed for reintroduction and recovery efforts in the Ocmulgee River Basin and state specific management actions. It requires the approval of major basin stakeholders in return for assurances if the robust redhorse were to be listed.

STOCKING RECOMMENDATION FOR 1999

The genetic distinction between the Oconee and Savannah robust redhorse populations and the release in past years of Oconee River fingerlings into the Broad River in the Savannah River system have greatly complicated stocking decisions. Therefore, since the last RRCC Annual Meeting, the TAG worked diligently to gather information and intelligence to inform a stocking recommendation for 1999. Members of the TAG invested considerable time in research, discussion, and consultation on genetic considerations and issues related to stocking. As well, members of the TAG met with four geneticists (John Epifanio, American Fisheries Society Genetics Section and Virginia Commonwealth University; Donald Campton, US Fish and Wildlife Service Abernathy Fish Technology Center; Erik Hallerman, Virginia Polytechnic Institute and State University; and Ike Wirgin, State University of New York Medical Center) at the annual meeting of the National American Fisheries Society on September 1, 1999. The TAG hoped to gather as much professional experience and technical expertise that could be brought to bear on their stocking recommendation. The geneticists' recommendation on a prioritized stocking scenario is summarized below followed by the TAG's stocking recommendation. The committee discussed the priorities and implications of each site, agreeing to the1999 robust redhorse stocking decision, shown at the end of this section.

Summary of Geneticists Meeting in Charlotte, North Carolina — Jay Shelton, UGA

The four geneticists and members of the TAG met for six hours to discuss past, current, and future stocking considerations. Although the level of confidence regarding escapement from Clarks Hill Dam (and possible genetic mixing of the two populations) varied among the geneticists, the following represents their agreement on stocking sites for 1999, listed in priority order.

1. Ocmulgee River: If the conservation agreement is signed by stocking time.

2. Oconee River: Do not stock huge numbers so wild population will not be genetically swamped.

3. Broad River: Stock if can the RRCC can quantify the probability of escape through Clarks Hill Dam.

4. Ogeechee River – Postpone stocking until surveys for existing robust redhorse population can be completed.

Stocking Recommendation: Technical Advisory Group — Scott Hendricks, GA Power

The TAG offered the following recommendation of stocking sites (not including ponds, which were assumed would be stocked). The sites are listed in priority order and considerations related to each site are provided followed by comments of the committee as it sought clarification on the implications of stocking scenarios. The TAG based its 1999 RRCC stocking recommendations on the defensibility of acting in the face of the threat of the species' extinction.

TAG Stocking Recommendations for the Ocmulgee River

- The TAG recommends stocking 4000 fish in the Ocmulgee River fall 1999 if the conservation agreement is finalized and in place for fall harvest.

- If the conservation agreement is not ready, TAG suggests holding the fry until March 1, 2000. This strategy would also provide larger fish and more time to develop a meaningful telemetry study.

- The Ocmulgee River ranked top priority based on the probability of the conservation agreement being approved and because there are no genetic conflicts with using Oconee River broodfish as the stocking source.

Comments from meeting participants on stocking the Ocmulgee River

- The recommended stocking release would augment the existing population.

- The project site is below the City of Macon from Lloyd Shoals to Juliette Dam, much of which is adjacent to US National Forest Service land relating to fewer potential stakeholders to sign a conservation agreement.

- A lot of work needs to be accomplished prior to the USFWS issuing a permit to release under the conservation agreement. It is not possible for all of the following steps to be by November 1999:

    > It takes 2-3 weeks to place an announcement of the proposed conservation agreement in the federal register;

- Public comment must be open for 4 weeks;
- The USFWS issues a biological opinion that takes up to 135 days to complete;
- The USFWS must also delineate a baseline population number and establish criteria for success; and
- The USFWS is responsible for analyzing the public comments.

- Due to the newness of the conservation agreement policy, it may be that agencies and groups need to come into the process before the proposal is listed in the federal register. The USFWS needs to check internal comments on this consideration.
- The RRCC should send a letter to stakeholders in the Ocmulgee River Basin prior to the conservation strategy appearing in the Federal Register.
- The conservation agreement provides assurances to whoever is issued the permit.
- Georgia Power Company is initiating the process but as many entities as possible should be involved in the conservation agreement.
- Since existing wild fish have been found, stakeholders are already at risk.
- Stakeholders would have assurances but must also engage in "active management" for the benefit of the species.
- The RRCC does not have an obligation to bring in all possible stakeholders.
- Getting Georgia Power signed on first then issuing other permits is a possible way to deal with unidentified stakeholders. Or the permit could be issued to the Georgia Department of Natural Resources and sub-agreements can be issued to others.
- The RRCC has pond space available to hold fish for at least one year if the conservation agreement process does not get worked out by March 2000.

<u>TAG Stocking Recommendations for the Broad River</u>

- The TAG recommends using the Broad River as the second site, if numbers of fry allow.
- A population of introduced and genetically distinct Oconee fish is already established in the Savannah River Basin above Clarks Hill Dam.
- The TAG believes there is little potential for these Oconee fish to survive an escape from Clarks Hill Dam and recruit to reproductively active adults.

- TAG believes the risk of genetic mixing with downstream robust redhorse is acceptable and secondary to a commitment to build diversity in the previously introduced population so as not to create another imperiled population.

Comments from meeting participants on stocking the Broad River

- Oconee fingerlings would be stocked in the Broad this year.
- Is it genetically desirable to use a diversity of stocks or better to use just one?
  - > It is best to use fingerlings from the geographically closest river because they are assumed to be suited to local conditions the next best to the native fish.
  - > Since we have already released Oconee fish into the Broad, it is best to stock with Oconee fish assuming isolation of the Broad and Savannah systems due to the 3 dams?
- There is evidence that 2 year-classes are in the reservoir now.
- If we do not stock this year and the introduced fish reproduce, a genetic bottleneck is likely.
- We are more likely to ensure genetic diversity if we stock on top of the introduced fish.
- There is evidence of survivability of escapement.
- TAG believes maintenance of the existing releases is a higher priority than the estimated risk of mixing with the Savannah population.
- Let us be clear that we are talking about irreversible decisions. We must practice good genetic stewardship.

<u>TAG Stocking Recommendations for the Ogeechee River</u>

- The priority of this stocking site may be affected by the results of the robust redhorse surveys scheduled for fall 1999.
- Although the geneticists recommended not stocking the Ogeechee River, new information revealed the presence of at least a small level of introduced fish since their recommendation was made.

Comments from meeting participants on stocking the Ogeechee River

- The Georgia Wildlife Resources Division has sampled the Ogeechee River 10 additional hours since the stocking site recommendations were developed, which brings the total number of hours the river has been sample to 25. This number is the same as the Ocmulgee and more than the Oconee has been sampled. After the next scheduled sampling is completed, involving 10 additional hours, WRD will be satisfied that enough sampling has been done to have confidence there is no wild population. In addition, it is confident the sampling results are accurate.

- Even if a few wild fish escaped sampling, they cannot be considered genetically viable, which justifiably supports a decision to stock with the nearest strain.

- Fingerlings will be held at ponds if sampling is not completed before harvest.

- The Ogeechee River was stocked in 1997 but not in 1998 because RRCC requested that additional sampling be undertaken, which has been accomplished.

- Stockings in the Broad and Ogeechee were undertaken with the best available information at the time that decisions had to be made. The information indicated that there were no wild populations in either river basin. The Savannah River has undergone 45 years of sampling; it is potentially the most sampled river in the Southeast.

<u>TAG Stocking Recommendations for the Oconee River</u>

- The TAG recommends stocking several hundred larger juveniles with Pit Tags in the Oconee River (100 fall 1999 and 100 spring 2000).

- The intent behind this recommended ratio is to stock for investigation purposes rather than for restoration.

Comments from meeting participants on stocking the Oconee River

- Although the Oconee population seems to be okay in terms of genetic diversity, the question of recruitment remains.

- The value of stocking the Oconee with larger juveniles is that it may help address recruitment issues and predation concerns. In addition larger fish allow the ability to track what happens to the juveniles through use of radio telemetry tags.

- There is the question of gamete mining the Oconee River for release to other systems that would be strong consideration if there were evidence the wild population was successfully spawning.

- The year class question is critical, which is why the RRCC is being cautious.

- We do not know if robust redhorse was ever a huge number population fish or if "viable" and "stable" should mean populations of a small number of individuals.

- The split timing release provides information on what fish do when they are released.

Stocking Decision of the RRCC for 1999 — Discussion

- The Ogeechee River was selected as the priority stocking site and was subsequently stocked with 10,800 fry from the 1999 year class.

- The Oconee River stocking decision hinged on the numbers and year class to be released to which the RRCC conferred with TAG's recommendation to stock 200 larger juveniles.

- The Ocmulgee River remained a viable and acceptable stocking site contingent on the approval and timing of the conservation strategy.

- The Broad River was dropped as a stocking consideration for 1999 but the RRCC directed continued sampling below Clarks Hill Dam to determine the probability of survivable escapement to help support future stocking decisions.

- Hatchery ponds to be stocked include:

  > Eatonton as a grow-out pond for juveniles (about 1,000 1999 year class);

  > Fort Gordon with Savannah brood to establish a Savannah River refugial population (about 3,200 1999 year class); and

  > Piedmont National Wildlife Refuge to add another year class to the existing refugial population (about 3,600 1999 year class).

DIRECTION OF CONSERVATION

Conservation Needs & Opportunities ¾ Mark Bowers, USFWS

The RRCC may need to take a lead role in coordinating watershed conservation efforts and educating landowners on available conservation options, especially as tools like the conservation strategy that involve stakeholders become used more often. Attachment 9 provides a list of federal, state, and local programs or opportunities that can be directed toward habitat conservation. The *Landowner's Guide to Conservation Options*, a brochure sponsored by the Georgia Natural Heritage Program of the Georgia Department of Natural Resources, is another source of information on landowner conservation options. The website address for the Natural Heritage Program is www.dnr.state.ga.us/us/dnr/wild/natural.html.

Some of the most important conservation opportunities may be those that improve flows in the Oconee River during the spawning season and that reduce point and nonpoint source contaminants. The RRCC may choose to focus on site-specific problems that have federal dollars available to correct such as bank erosion or cattle in streams. The hard part is identifying the problem at a specific site and reaching a landowner responsible for its correction. RRCC should identify where it can have the most effect on improving habitat, looking from a watershed level.

The following conservation options possible were offered to supplement those listed in Attachment 9.

- The RRCC should work with the Georgia Environmental Protection Division's River Basin Management Planning process as a way to connect to water quality concerns, regulations and programs.

- Fishable Rivers Legislation, if it passes, is another avenue to pursue as a conservation opportunity.

- The RRCC may need to connect with local watershed protection groups to place their efforts in the larger conservation framework.

- The kaolin industry and forestry sector could be brought in to join the RRCC's conservation approach.

- NRCS should also be considered as a potential member of RRCC.

- RRCC should get on the FERC mailing list.

- Habitat conservation, even in one basin, is a massive undertaking. The RRCC may be further ahead to seek funds to hire a conservation coordinator or form a small basin conservation team.

Progress Made in 1999 on Work Items Identified in 1998 ¾ Scott Hendricks, GA Power

The following work items were identified by the RRCC at its 1998 Annual Meeting. As in previous years, the committee charged the TAG with overseeing the accomplishment of these tasks under the guidance of the chairman. Each work item is followed by the status of its progress or completion.

- Establish protocol for any robust collection outside the Oconee River: A Protocol for Collection was developed as a very attractive fact sheet, (see Attachment 10).

- Develop protocol for surveys (when, what to collect, what to do if robust are collected): A Protocol for Surveys was also developed as a fact sheet, which was sent to universities and research centers to enhance comprehensive and consistent data surveys.

- Develop and distribute a list of rivers in each state for status surveys: TAG developed a recommended list of rivers that could benefit from status surveys (see discussion below).

- Establish an Oconee River introduction protocol: A protocol of limited introductions is recommended, based on the information provided by the group of consulting geneticists.

- Complete the development of a listserv by sending membership information to meeting participants: A robust redhorse listserv is in place. Subscription requests should be forwarded to Jay Shelton at jshelton@smokey.forestry.uga.edu. Some folks have reported problems connecting to the listserv but most are successful.

- Establish a robust redhorse web page: Development of a web page was not a high priority for the TAG in 1999, but the committee directed that the task be added to the 2000 Work Item list.

- Support search committee efforts to select a chair-elect candidate: The Chair-Elect candidate was reported under Administrative Matters (below) for the approval of the RRCC.

- Create a task force to determine the extent of a Savannah River population including broodfish collection and spawning procedures, sampling, etc: While not a formal task force, robust redhorse activities on the Savannah River have been a cooperative effort involving the South Carolina Department of Natural Resources, the Georgia Department of Natural Resources, the Georgia Power Company, the Duke Power Company, the US Fish and Wildlife Service, the US Army Corps of Engineers, Augusta Water Works, the UGA Institute of Ecology and Warnell School of Forest Resources and Roanoke College.

- Determine if there are significant morphometric differences in Oconee and Savannah river populations of robust redhorse: There appears to be some minor visual differences between

the populations but Bob Jenkins, a professor with Roanoke College in Salem, Virginia reports no significant morphometric differences in the characteristics analyzed.

- Establish a proposed stocking rate range for the Ocmulgee River: TAG recommends the stocking rate at 4000 fish for the Ocmulgee River in 1999.

- Develop a letter from the RRCC to the USFWS that requests a change to the Endangered Species Act allowing "experimental" status designation for non-listed species: The development of the conservation agreement and conservation strategy replaced the need to conduct this work item.

- Define "viable population" (consider numbers, ages, sexes, genetics, etc): The RRCC decided to use the term "self-sustaining population" in lieu of "viable population". The basis for a definition of a self-sustaining population was agreed to during the conservation strategy discussion and can be found in that section.

- Other accomplishments: Members of the RRCC conducted 10 presentations in a robust redhorse symposia titled, *The Biology, Ecology, and Restoration of Imperiled Fishes in Atlantic Slope Drainages: The Robust Redhorse Case History* at the annual meeting of the National American Fisheries Society Meeting held August 30-September 2, 1999 in Charlotte, North Carolina.

South Carolina Status Survey Activities ¾ Ross Self, SC DNR

Robust redhorse status surveys are planned for 2 river basins in South Carolina. A comprehensive fisheries survey that will target robust redhorse is planned for the South Carolina Broad River drainage above the fall line. Survey information from this basin should be gathered over the next 2 years. In addition, status surveys in the Pee Dee will be undertaken in cooperation with Carolina Power and Light.

Comments of the RRCC

- Surveys on the Broad should include the river below the fall line as those river segments correspond to the known robust redhorse habitat in Georgia.

- The Columbia Gas and Light Dam is undergoing FERC re-licensing. Perhaps surveys for robust redhorse could be targeted on the Broad River as part of this process.

- North Carolina has been sampling the Pee Dee for 2 years with fixed sites but it could target robust redhorse spawning habitat in spring 2000.

- Fixed site surveys do not work for the robust redhorse. Efforts must target robust redhorse-specific habitat.

- The USGS Species at Risk Program funds might be available for status surveys for robust redhorse in South and North Carolina. Also a USFWS Section 6 (90/10 matching funds) grant may be available if a request is made by the RRCC cooperating members.

Georgia Status Survey Activities for 2000 ¾ Jimmy Evans, GA DNR

The following river segments are priority status survey sites in Georgia.

- Lower Oconee
- Lower Ocmulgee
- Upper Altamaha
- Savannah below New Savannah River Bluff Lock and Dam
- Oconee between Barnett Shoals and Lake Oconee

Surveys of portions of the lower and upper reaches of the Oconee River are already scheduled for fall 1999, additional surveys in the upper segment are anticipated during 2000.

Priority Research Activities for 2000 — Discussion

The RRCC reviewed research priorities that were established at the 1998 Annual Meeting and discussed alterations. The following represents the committee's ranking of research activities for 2000.

1) Continue genetics research.

2) Conduct status surveys in North Carolina and South Carolina above and below the Fall line.

3) Monitor reintroductions.

4) Investigate movement and habitat utilization of robust redhorse in the Oconee, Broad, and possibly Ocmulgee rivers through telemetry methods.

5) Develop mortality, survival, and population estimates for the Oconee River population and modeling of population dynamics.

6) Conduct remediation of spawning sites in the Oconee River through management actions.

7) Review the literature on the probability of rare species detection through fisheries surveys to provide an idea of the reasonable amount of time to invest in sampling for robust redhorse.

8) Evaluate possible correlation between historical flow regimes and year class strength in the Oconee River.

9) Investigate interactions between endangered mussels and robust redhorse.

10) Write a genetics management plan.

11) Conduct a literature review of the entrainment issue.

12) Develop husbandry techniques in an aquarium environment (South Carolina Aquarium).

Work Items for 2000 — Discussion

- Create a subcommittee to seek funds to hire a permanent robust redhorse coordinator position to organize recovery efforts.
- Establish a robust redhorse web page.
- Continue robust redhorse investigations on the Savannah River including sampling and spawning activities of broodfish, habitat surveys, and investigations of potential Broad River stocked fish.
- Facilitate concentrated status surveys for robust redhorse in North Carolina and South Carolina.
- Pursue installation of robust redhorse at the South Carolina Aquarium in Charleston.
- Finalize development and approval of the robust redhorse conservation strategy.

ADMINISTRATIVE BUSINESS

MOU Expiration and Renewal ¾ Scott Hendricks, GA Power

The second memorandum of understanding creating the RRCC to oversee restoration of the robust redhorse throughout its known range expired December 31, 1999 (the first expired December 1996). The RRCC chairman drafted a third RRCC MOU and will distribute it to signatories for approval. The only changes to the MOU are the new expiration date (December 31, 2005) and the addition of a signatory entity.

The Georgia River Network, a statewide environmental organization dedicated to the conservation of Georgia's waters, will become a signatory member of the RRCC with the approval of the MOU. The Georgia River Network submitted a $400,000 grant proposal to the National Fish and Wildlife Foundation in support of the Ocmulgee River reintroduction and habitat improvement as might be directed by the conservation strategy. Specific project objectives include: 1) improvements to water quality targeting the area of reintroduction; 2) rehabilitation and stabilization of stream habitats also along the reintroduction site; 3) monitoring of the reintroduced population to document migration, survival rates, and threats; and 4) documentation and dissemination of the results of the reintroduction process to serve as a demonstration of partnership efforts.

Communication Needs and Expectations ¾ Scott Hendricks, GA Power

In a general discussion of the committee's need and expectation for internal communications, it was decided that communication via the listserv, emails, and project management tracking of research activities and other major projects are all important and should be continued. The Microsoft Project Management schedule of research will be updated and distributed semi-annually. It was noted that many members of the RRCC develop various documents related to the robust redhorse in fulfilling individual needs, therefore a list should be developed and updated of the various reports, research documents, etc. In that manner, descriptive information can be requested from the originating source and distributed as needed. Brief information and announcements can be posted to the listserv at any time (again, to subscribe email requests to jshelton@smokey.forestry.uga.edu). Finally, the Georgia Rivers Network is willing to develop and maintain a robust redhorse website, if the funds to cover the fairly low cost of buying the site address were made available.

Vice-Chair Affirmation ¾ Scott Hendricks, GA Power

The TAG went through a lengthy and thoughtful process in selecting a vice-chair candidate for the committee's approval. The process involved conversations with and review of written material from several highly qualified prospects. The TAG recommended and the committee affirmed Terry DeMeo as vice-chair of the RRCC, effective immediately. The vice-chair will assist the chairman and project manager in the details of administering the recovery effort for one year and then step into the chairman position October 2000.

RRCC Annual Meeting Arrangements for 2000 ¾ Scott Hendricks, GA Power

The next RRCC Annual Meeting is scheduled for October 11 and 12, 2000 at the same location, the Charlie Elliott Wildlife Center near Mansfield, Georgia. The 2000 annual meeting will begin at 9:00 a.m. and run until 6:00 p.m. on October 11 with a catered working lunch. The meeting will end at noon on October 12 so folks can travel home.

ATTACHMENT 1

ROBUST REDHORSE
STOCKING SUMMARY

PIEDMONT NATIONAL WILDLIFE REFUGE
30 DECEMBER, 1998

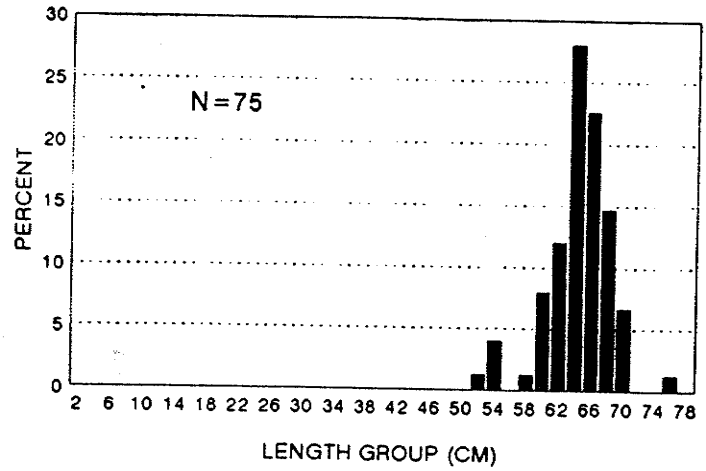
POND	SIZE	STOCKING RATE	NO.STOCKED	NO. TO BE STOCKED
7A	2.1 ac.	150/acre	Nov. 96 209/P2 Nov. 98 100/P1	TOTAL 315
			Total: 309	Less 6
9A	7.3	250/acre	Nov. 96 361/P2 Oct. 97 250/P1 Nov. 97 500/P1 Nov. 98 700/P1	TOTAL 1,825
			Total: 1,811	Less 14
11A	4.5	250/acre	Nov. 96 454/P2 Nov. 97 600/P1 Dec. 98 233/P1	TOTAL 1,125
			Total: 1,287	Over 162
11B	11.4	150/acre	Nov. 98 1000/P1 Nov. 98 1000/P2 Dec. 98 300/P1	TOTAL 2,100
			Total: 2,300	Over 200
PIPPINS	3.5	250/acre	Nov. 96 353/P2 Oct. 97 400/P1 Nov. 98 100/P1	TOTAL 875
			Total: 853	Less 22

TOTAL STOCKED ON PIEDMONT 6,460

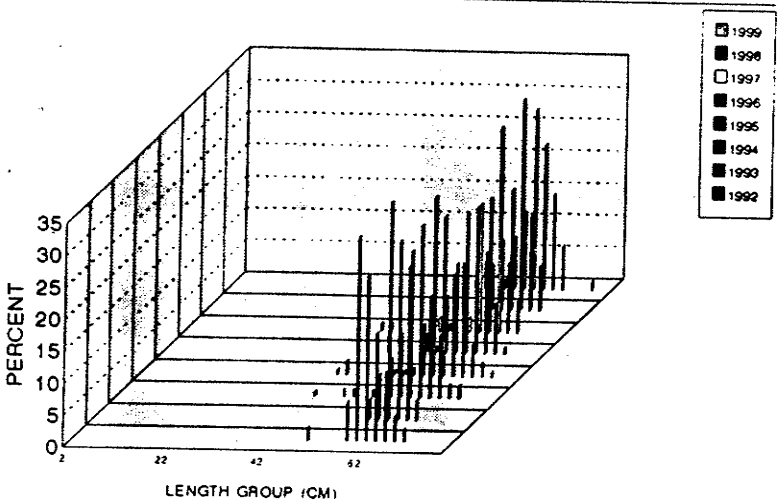
****TOTALS DO NOT INCLUDE 30% MORTALITY ESTIMATE

P1=Phase one fingerlings (>1yr)
P2=Phase two fingerlings (1yr+)

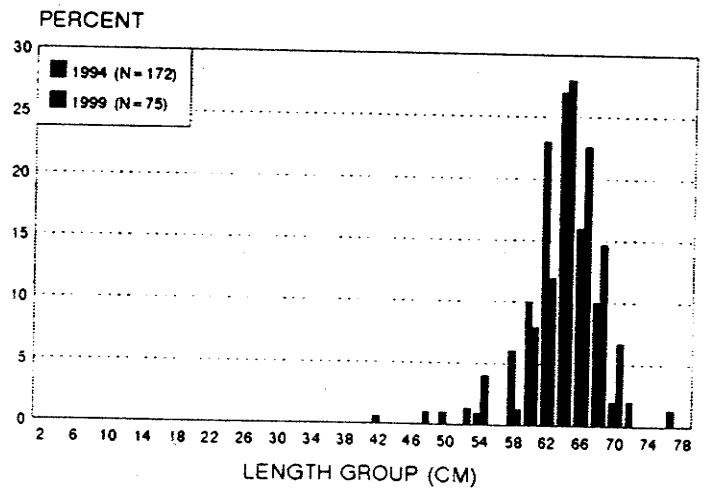
ROBUST REDHORSE LENGTH FREQUENCY
ELECTROFISHING SAMPLES
OCONEE RIVER - 1999



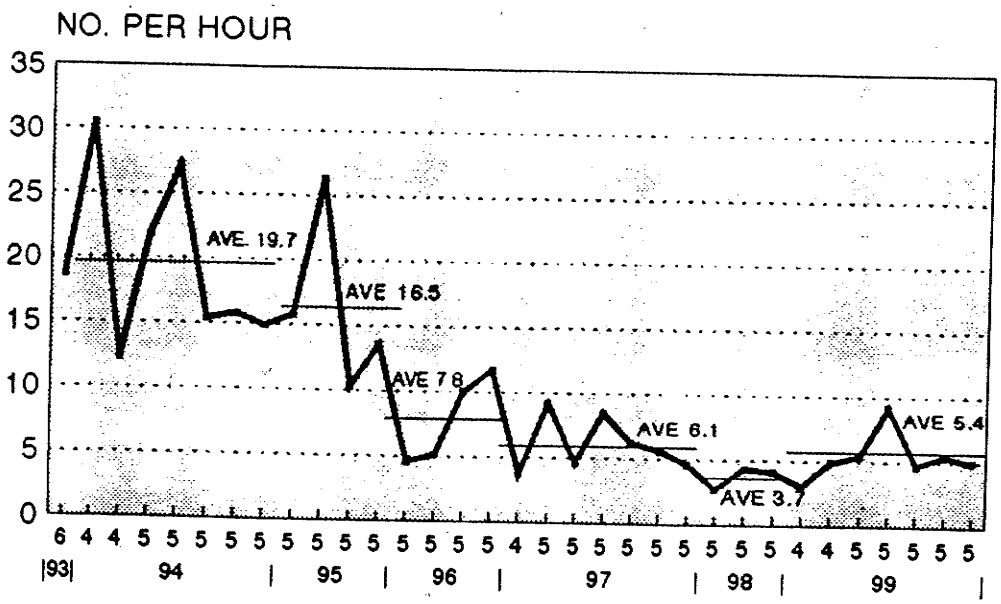
ROBUST REDHORSE LENGTH FREQUENCY
ELECTROFISHING SAMPLES 1992-1999



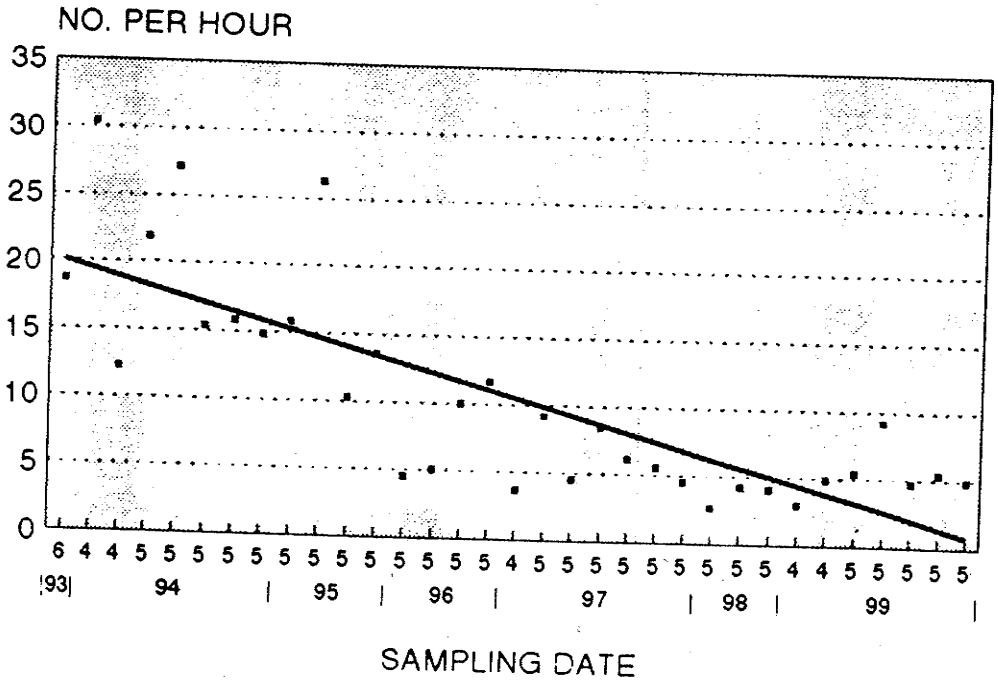
ROBUST REDHORSE LENGTH FREQUENCY COMPARISONS
ELECTROFISHING SAMPLES
OCONEE RIVER (1994 VS 1999)



ROBUST REDHORSE ELECTROFISHING CATCH RATES
OCONEE RIVER 1993 - 1999
RIVER MILE 85 - 109

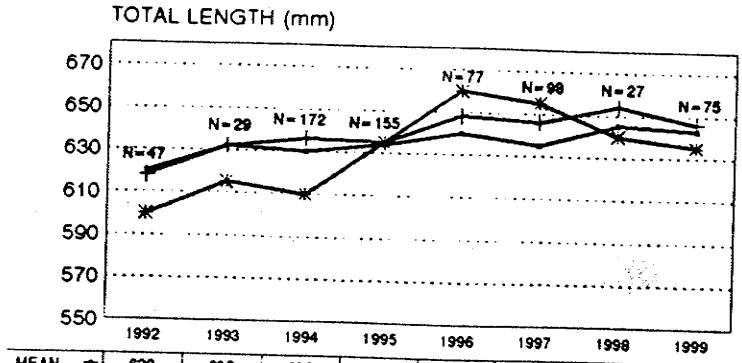


ROBUST REDHORSE ELECTROFISHING CATCH RATES (TRENDS)
OCONEE RIVER 1993 - 1999
RIVER MILE 85 - 109



ATTACHMENT 4

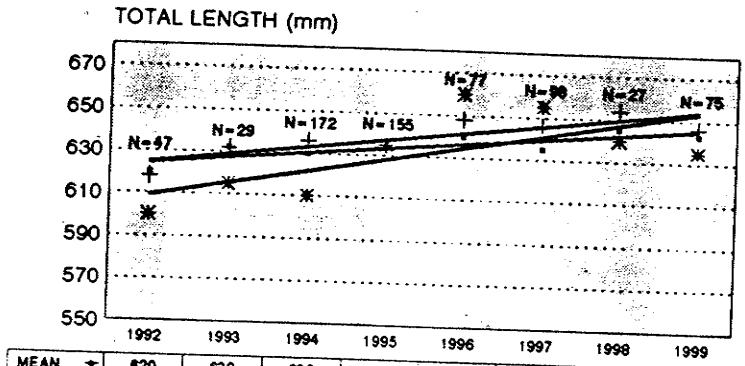
MEAN, MEDIAN, AND MODAL LENGTHS OF ROBUST REDHORSE
ELECTROFISHING SAMPLES
OCONEE RIVER 1992 - 1999



	1992	1993	1994	1995	1996	1997	1998	1999
MEAN	620	632	630	634	640	635	645	643
MEDIAN	618	632	636	635	648	646	654	646
MODE	600	615	610	635	660	655	640	635

YEAR

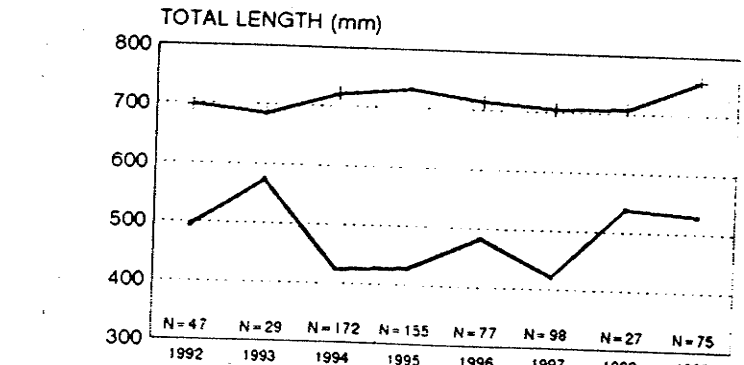
MEAN, MEDIAN, AND MODAL LENGTHS OF ROBUST REDHORSE
ELECTROFISHING SAMPLES
OCONEE RIVER 1992 - 1999



	1992	1993	1994	1995	1996	1997	1998	1999
MEAN	620	632	630	634	640	635	645	643
MEDIAN	618	632	636	635	648	646	654	646
MODE	600	615	610	635	660	655	640	635

YEAR

MINIMUM AND MAXIMUM LENGTHS OF ROBUST REDHORSE
ELECTROFISHING SAMPLES
OCONEE RIVER 1992 - 1999



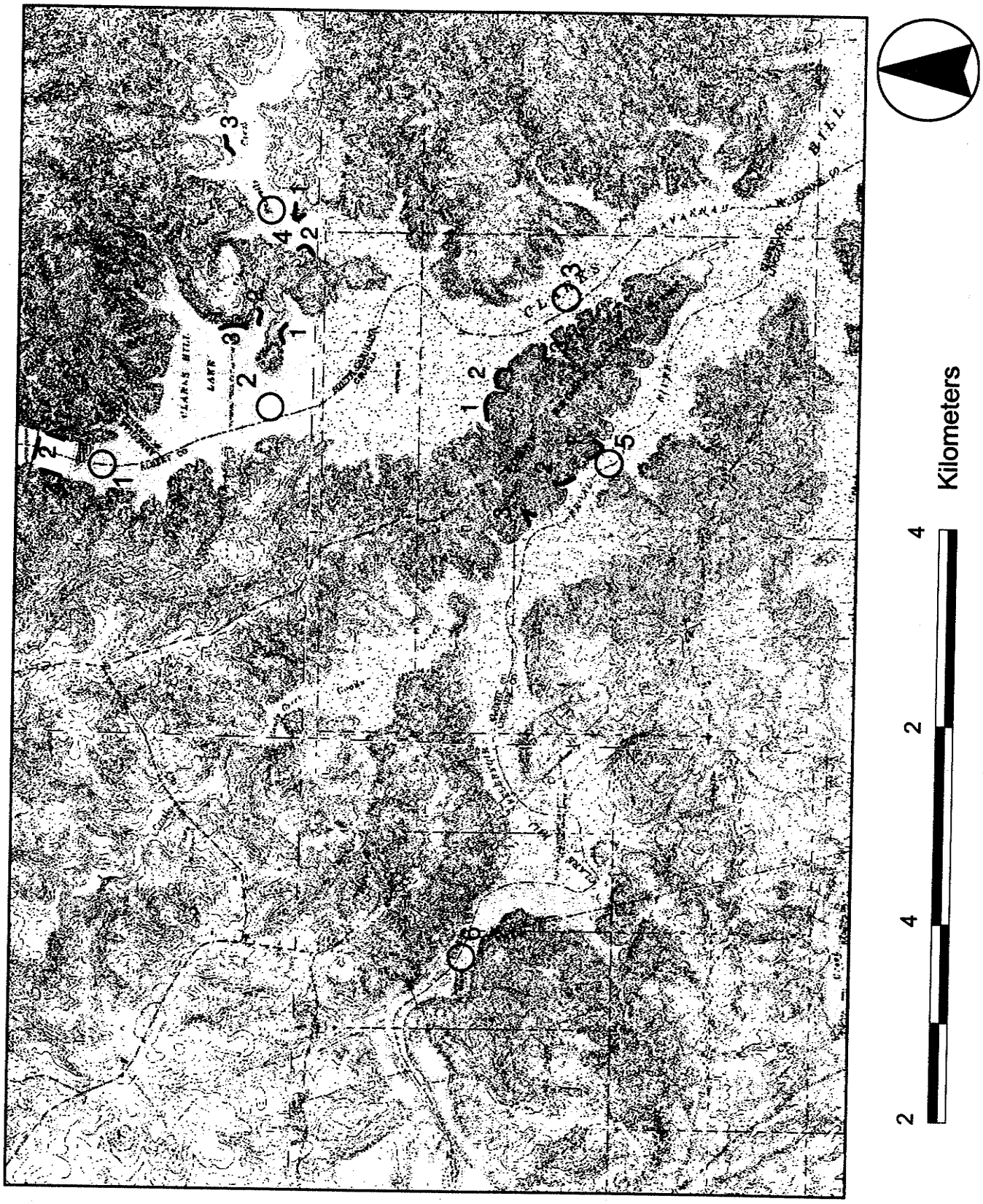
	1992	1993	1994	1995	1996	1997	1998	1999
MIN LENGTH	495	573	424	428	482	421	538	528
MAX LENGTH	698	685	722	732	715	705	708	757

YEAR

BROAD RIVER STOCKING

Stocking Date	Year Class	Stocking Locale	Tag Location	# Released
3/9/95	1993	North Fork Broad River at Highway 51	left cheek	195
3/9/95	1993	South Fork Broad River at Highway 22	left cheek	250
8/9/95	1993	South Fork Broad River at Watson Mill State Park (above dam)	left cheek	100
11/21/96	1995	Hudson River at Highway 29	right cheek	1124
11/21/96	1995	South Fork Broad River at Watson Mill State Park (above dam)	right cheek	150
10/10/97	1997	Hannah Creek at Hannah Creek Church Rd.	dorsal fin base	300
11/10/97	1997	North Fork Broad River at Highway 145 (below dam)	dorsal fin base	1800
11/19/97	1997	North Fork Broad River at Highway 145 (below dam)	dorsal fin base	2200
11/20/97	1997	Hannah Creek at Hannah Creek Church Rd.	dorsal fin base	300
11/20/97	1997	Hudson River at Highway 106	dorsal fin base	1300
11/20/97	1997	North Fork Broad River at Highway 51	dorsal fin base	926
11/21/97	1997	Hudson River at Highway 29	dorsal fin base	1930
11/21/97	1997	Hudson River at Highway 29	dorsal fin base	801
11/21/97	1997	North Fork Broad River at Highway 145 (below dam)	dorsal fin base	1900
11/21/97	1997	North Fork Broad River at Highway 145 (below dam)	dorsal fin base	1000
11/21/97	1997	North Fork Broad River at Highway 145 (below dam)	dorsal fin base	1000
11/21/97	1997	North Fork Broad River at Highway 145 (below dam)	dorsal fin base	2000
11/24/97	1997	Middle Fork at Atkinson Bridge Rd.	dorsal fin base	3000
11/25/97	1997	Hannah Creek at Hannah Creek Church Rd.	dorsal fin base	750
11/25/97	1997	Hudson River at Highway 106	dorsal fin base	3000
11/25/97	1997	Hudson River at Highway 29	dorsal fin base	3000
11/4/98	1998	Hudson River at Highway 106	anal fin base	
11/10/98	1998	Hudson River at Highway 106	anal fin base	741
11/18/98	1998	North Fork Broad River at Highway 51	anal fin base	621
11/18/98	1998	Hudson River at Highway 106	anal fin base	2479
12/4/98	1998	North Fork Broad River at Highway 145 (below dam)	anal fin base	246
12/4/98	1998	Hannah Creek at Hannah Creek Church Rd.	anal fin base	361

ATTACHMENT 6



CLARKS HILL RECAPS

Collection Date	Collection Point	Method	TL	Wt	YearClass	Hatchery
4.5.1999	Clarks Hill Station 4-2	GN	312	318	1997	Walton
4.5.1999	Clarks Hill Station 4-2	GN	422	1044	1995	Walton
4.5.1999	Clarks Hill Station 4-2	GN	220	117	1997	Walton
2.1.1999	Clarks Hill Station 4-2	GN	404	878	1995	Walton
2.18.1999	Clarks Hill Station 3-1	EF	407	869	1995	Walton
2.18.1999	Clarks Hill Station 3-1	EF	420	908	1995	Walton
5.10.1999	Clarks Hill Station 1-2	GN	450	1450	1995	Walton
3.12.1999	Broad River Anthony Shoals	EF			1995	Walton
6.24.1999	Clarks Hill Station 2-1	GN	352	540	1997	
6.15.1999	Clarks Hill Station 4-2	GN	233	139	1997	Walton 12
6.15.1999	Clarks Hill Station 4-2	GN	324	391	1997	
8.7.1999	Clarks Hill Station 4-3	GN			1997	Walton 12
8.7.1999	Clarks Hill Station 4-3	GN			1997	
8.7.1999	Clarks Hill Station 4-3	GN			1997	
8.7.1999	Clarks Hill Station 4-3	GN			1997	

ATTACHMENT 8

Table 1. Site, Stocking Density, Number Harvested and Percent Return, of Robust Redhorse (*Moxostoma robustum*) Reared in Earthen Ponds in Georgia and South Carolina From June 9 to October 8, 1998.

Site	Num. stocked	Fry/ac.	Num. harvest	% return
Burton	2,753	9,176	965	35.1
Walton 6	2,900	6,444	0	0
Walton 12	6,000	6,000	3,084	51
McDuffie	2,904	6,600	0	0
McDuffie	5,148	6,600	0	0
Richmond H.	2,666	13,330	1,131	42
Campbell 3	3,750	7,500	310	8
Campbell 4	3,750	5,000	310	8
DWC	5,900	5,900	4,669	80
Cheraw	4,900	9,800	2,561	52
TOTALS	40,671		13,030	31

Pond Grouping by Percent Survival

Pond	%Survival	Group
DWC	80	High
Cheraw	52	
Walton 12	51.4	
Richmond H.	42	Moderate
Burton	35	
Campbell 3 & 4	8,8	Low
McDuffie	0	
Walton 6	0	

HABITAT CONSERVATION OPPORTUNITIES

With more than 90% of Georgia's land in private ownership, the importance of landowners in protecting the future of our land, water, and wildlife cannot be over emphasized. There are many opportunities available to help landowners protect and improve natural resources on their property. The RRCC will need to take a lead role in helping landowners to become aware of these opportunities.

Programs Include:

1. Programs providing annual rent payments, incentive payments, or cost-share payments.
   Conservation Reserve Program (CRP), NRCS
   Environmental Quality Incentives Program (EQUIP) NRCS
   Partners for Fish and Wildlife (PFW) USFWS
   Wetland Reserve Program (WRP) NRCS
   Wildlife Habitat Incentives Program (WHIP) NRCS
   Stewardship Incentive Program (SIP) GFC

   The U.S. EPA has several programs and grant opportunities to address water quality and restoration issues. Clean Water Act Section 319 funds may be used for restoration of streams and watersheds. Additional funding may be available from the National Fish and Wildlife Foundation for larger projects.

2. General Tax Incentives.
   Conservation Easements, Government Agency
   Current Use Valuation of Conservation Use Properties
   Easements with a Wetland Mitigation Bank

3. Tax Incentives and Property Transfers.
   Bargain Sale of Property
   General Property Exchanges
   Property Donation

4. Programs Providing Technical Assistance.
   Habitat Conservation Plans, (HCP), USFWS
   Candidate Conservation Agreements, (CCA), USFWS
   Safe Harbor Program, USFWS
   Forest Stewardship Program, (SIP), GFC
   Best Management Practices (BMP's) for Agriculture
   Best Management Practices (BMP's) for Forestry

5. Recognition Programs
   Georgia DNR's Natural Areas Registry
   The Nature Conservancy of Georgia's Natural Areas Registry

Robust Redhorse

Moxostoma robustum

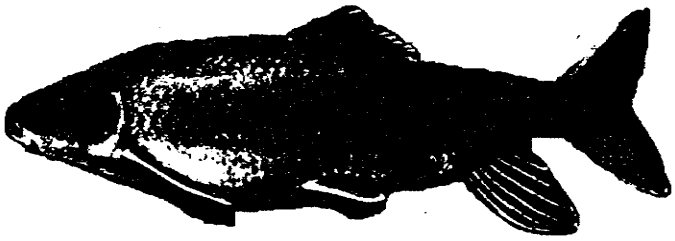


photo courtesy of Dr B J Freeman, Institute of Ecology, University of Georgia

Fact Sheet

Large, long-lived member of the redhorse sucker group. The former range is believed to be larger Atlantic slope rivers in Georgia and the Carolinas. Remnant populations are known to exist in the Oconee River, Georgia; Ocmulgee River, Georgia; and Savannah River, Georgia and South Carolina. This species is difficult to sample and may be easy to overlook.

Average length in sampled populations is 25 inches with average weight about 9 pounds. The robust redhorse is the largest member of the sucker family on the Atlantic slope and lives to at least 26 years of age.

Non-spawning adults prefer deeper, moderately swift areas in or near outside bends, often in association with accumulations of woody debris. Spawning behavior is similar to that of river redhorse, occurring over shallow to moderately deep gravel deposits from late April to early June at water temperatures from 18-24 C. Adult robust redhorse feed almost exclusively on bivalves, including the asiatic clam, *Corbicula.*

Characteristics of robust redhorse:

- adults are large, up to or exceeding 29 inches and 17 pounds; thick, robust body form
- molariform pharyngeal teeth (used for crushing bivalves)

- ❑ rose-colored caudal fin, particularly in males and juveniles
- ❑ Fleshy lower lip; margin nearly straight to slightly concave

Criteria for identification:

- ❑ any sucker collected larger than 5-6 lbs. is probably a robust redhorse
- ❑ if smaller than 5-6 lbs. and margin of lower lip is nearly straight (not distinctly V-shaped), probably either an immature robust redhorse or adult brassy jumprock (formerly known as smallfin redhorse)
- ❑ if smaller than 5 lbs. and margin of lower lip nearly straight, distinct rose-colored caudal and paired fins, is probably an immature robust redhorse;
- ❑ if 2-3 lbs., lower lip nearly straight, fins dusky colored, is probably a brassy jumprock
- ❑ if cannot distinguish between immature robust redhorse and adult brassy jumprock, assume that it may be an immature robust redhorse.

What to do if you catch a robust redhorse:

- ❑ Photograph specimen (whole body photo and lips)
- ❑ Measure length and weight
- ❑ Carefully obtain a scale sample from specimen
- ❑ Clip a small amount of fin tissue and place on ice; Put fin tissue sample in 90% ethanol as soon as possible
- ❑ Take good notes of capture location and conditions (GPS if possible)

If you believe you may have captured a robust redhorse, please contact one of the following:

James Evans
Georgia Dept Nat. Resources
jimmyevans@cstel.net
(912) 825-6151

Dr. Byron J. Freeman
University of Georgia
bud@ttrout.ecology.uga.edu
(706) 542-2962

Dr. Bob Jenkins
Roanoke College
jenkins@roanoke.edu
(540) 375-2463

Greg Looney
U.S. Fish and Wildlife Service
greg_looney@fws.gov
(706) 655-3382