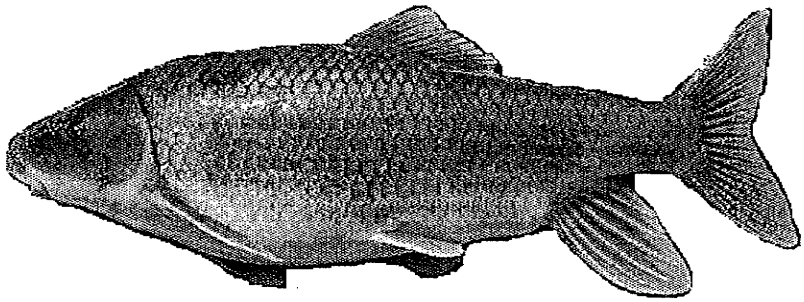
ROBUST REDHORSE

CONSERVATION COMMITTEE



ANNUAL MEETING
SOCIAL CIRCLE, GEORGIA

OCTOBER 29 - 30, 1997

Session facilitated and report written by T. DeMeo of the Institute of Community and Area Development, a service unit of the University of Georgia under contract with the Wildlife Resources Division of the Georgia Department of Natural Resources

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The members of the Robust Redhorse Conservation Committee met on October 29 and 30, 1997, to review progress on robust redhorse recovery activities and to chart a course for future action. The meeting opened with an encouraging announcement, a single adult robust redhorse was collected from the Savannah River near Plant Vogel by the Georgia Power Company on October 14, 1997.

Using a facilitated process, the committee identified a number of major impediments to the progress of robust redhorse recovery. Issues and considerations associated with the inherent subtleties and complexities of the impediments were identified. Finally, solutions to the major impediments were developed. One impediment, inadequate funding, remained undeveloped and unresolved at the end of the meeting.

The committee agreed to base both the focus of its 1998 research and recovery activities on the identified impediments and solutions. The committee established a Technical Advisory Group to oversee its 1998 work activities including: Savannah River monitoring; clarification of "experimental" status related to re-introduction; predation; habitat degradation; availability of spawning sites and life history requirements; fingerling culture requirements; genetics; Oconee River re-introduction scenarios; and the development of an e-mail based list-serve to enhance communication.

The committee reviewed a list of Phase I fingerling re-introduction sites for the fall of 1997. After a discussion of concerns and considerations the committee agreed on stocking sites according to the number of fingerlings harvested. The Piedmont National Wildlife Refuge is the primary 1997 stocking site which will be stocked regardless of harvest size. Secondary stocking sites include the Broad River and the Ogeechee River. The Little River and the Apalachee River are considered third tier stocking sites.

Recovery activities have, to date, focused on two main lines of research: (1) the effects of the Oconee River hydrologic regime on the ecology/biology of the robust redhorse population; and (2) the development of cultural techniques to produce fingerlings at hatcheries. During 1997, recovery activities made important strides and revealed informative considerations.

- Lower than optimum water temperatures of the Oconee River during the spawning season were believed to have reduced the number of fish eligible for spawning. However, there is evidence that fish are spawning naturally and an inspection of those collected show no evidence of invasive parasites.

- There was a disappointingly low harvest rate from Phase II fingerling production in 1996. Re-introduction efforts for the Fall of 1997 have been limited to Phase I fingerlings, the final outcome of production will not be known until the end of 1997; some of the harvest will be held for Phase II stocking.

- Five ponds at Piedmont National Wildlife Refuge have been removed from public fishing and will be used as adult rearing ponds to establish a refugial population. Pond rearing of this species is in its infancy; issues include water quality, impact of aquatic plants, carrying capacity, feeding regimes and predation.

- Evidence from length frequency and mark-recapture studies of a sampled Oconee River population supports the theory of a senescent population with little successful reproductive activity. Population size and survival estimates indicate a closed system of spawning fidelity. Although catch rates have declined in recent years, survival estimates do not point to a precipitous decline.

Much of the preliminary research indicates important and encouraging results which could be used to help manage the species.

- Sedimentation and substrate composition do seem to effect robust redhorse reproductive success; high levels of fine sediment limit larvae emergence. It appears, however, that swimming performance of post-emergent larvae under the existing hydrologic regimes at Sinclair Dam is adequate for survival.

- The relationship of various diets to growth and survival indicates that the robust redhorse needs natural food in its early development, especially the first 75 days; artificial food during this period seems to cause spinal deformities.

- Early results in the development of cryogenics techniques for storage of robust redhorse sperm are encouraging. These techniques could protect against loss of the wild population and allow appropriate genetic mixes.

- Assessment of reproductive and recruitment success in the Oconee River to determine the reasons for recruitment failure have found that at least some of the population are spawning, which disproves the presence of pervasive biological constraints. Furthermore, initial indicators do not point to hydropeaking at Sinclair Dam as a major detrimental environmental constraint. However, there remains no evidence of recruitment to adults.

- The early results of monitoring to determine the success of the Broad River re-introduction efforts seem to indicate that Hannah Creek is a good release site for robust redhorse fingerlings as it is a productive system with few predators. There have been no recaptures of stocked fish from the vicinity of other release sites.

- Preliminary results of genetics investigations indicate that moderate diversity exists in the Oconee River robust redhorse population with no evidence of significant inbreeding to date.

The committee selected a search committee to: (1) create a process for chairperson selection; (2) consider developing a chair and chair-elect protocol; and (3) develop charter language for the position including duties.

The American Fisheries Society meeting is scheduled for August 1999, in Charlotte, North Carolina. The committee agreed this would be a good opportunity to share background and progress on the recovery activities and to present papers on research related to the robust redhorse.

The 1998 Robust Redhorse Conservation Committee Annual meeting will be extended to two full days, Wednesday, October 28, from 9:00 a.m. to 6:00 p.m. and Thursday, October 29, from 8:00 a.m. to 5:00 p.m.

INTRODUCTION

The third annual meeting of the Robust Redhorse Conservation Committee was held on October 29th and 30th at the headquarters of the Wildlife Resources Division, the Georgia Department of Natural Resources in Social Circle, Georgia. The annual meeting is required under the Memorandum of Understanding which established the committee in 1995. The committee was created to develop and manage a prelisting recovery approach for the robust redhorse (*Moxostoma robustum*), previously a Category 2 candidate for Federal listing under the Endangered Species Act.

Within its historic range in the Atlantic Slope drainages from the Pee Dee River system in North Carolina to the Altamaha River system in Georgia, the only known population inhabits an approximate 80 km reach of the Oconee River below Sinclair Dam in central Georgia. Recovery efforts, coordinated by the Georgia Wildlife Resources Division, are focused on the formation of stakeholder partnerships to fund, implement and monitor recovery activities in Georgia, North Carolina and South Carolina. The committee's responsibilities include identifying priority conservation needs for the robust redhorse and its habitat and coordinating the implementation of programs for addressing those needs.

The purpose of the meeting was to better focus resources in support of the committee's recovery objectives. Using a facilitated process provided by the Institute of Community and Area Development, a service unit of the University of Georgia, members of the committee shared information on the status of recovery activities and the preliminary results of early research. They also received updates on the progress of work items established at last year's meeting and undertook a process to establish tasks for 1998. This report is a record of the committee's presentation summaries and group discussions and decisions regarding recovery activities. The material presents a wealth of information useful both now and in the near future.

Approximately 45 participants were invited to attend. Participants represented federal and state agencies, hydroelectric power concerns, researchers and the conservation community actively committed to the restoration of the species throughout its known range. A list of those who attended the meeting appears as Appendix T.

Jimmy Evans, a biologist with the Georgia Wildlife Resources Division and current Committee Chairperson, opened the meeting by welcoming participants and announcing that a single adult robust redhorse was collected by Georgia Power Company workers on October 14, 1997 from the Savannah River near Plant Vogel. This find represents only the second intact specimen collected from the Savannah River. Its discovery could influence the focus of the meeting through discussions on the implications of a second existing population and its potential to serve as an additional brood source. This discovery may shift the scope and direction of the recovery and monitoring efforts.

Day one of the meeting involved presentation sessions on current recovery efforts, summaries of preliminary results of early research and an overview of recovery activities planned for 1998. It included an opportunity for comments on and a facilitated review and rating of the ambitious agenda for the second day. Day two involved the identification of the major impediments to progress in the recovery efforts and the development of solutions. The committee ranked primary and secondary re-introduction sites in Georgia, formed the 1998 research and recovery activities agenda, accomplished business items related to the election of a chairperson and scheduled the fourth annual meeting.

RECOVERY ACTIVITIES

Results of 1997 Spawning Season — Greg Looney

An overview was presented of the capture and collection process conducted at the Beaverdam Wildlife Management Area on May 12 - 14 and May 19 - 22, 1997. The fish were anesthetized prior to a work up which included fin clip samples, measurement of length and weight and ovulation evaluation. PIT (Passive Intergraded Transponder) tags were placed in all fish. New procedures included netted holding tanks resulting in no loss due to fish jumping. Journalists and reporters were present during both fish collection and spawning to video record the process.

The optimum temperature of river water for spawning appears to be 23°c, with a 21 - 25°c range remaining acceptable. Spring of 1997 had uncharacteristically cool temperatures. As the river temperature May 7 - 8 was 19°c, many of the fish collected were found to be ineligible for spawning.

Thirty (30) females and 45 males were transported to the spawning facility. Eight (8) females were spawned without the use of hormones, producing 79,491 eggs. Another eight (8) were spawned through an Ovaprim injection (0.5 ml/kg) which effected a 100 percent success on eligible fish three (3) days after injection and produced 280,683 eggs, a dramatic increase in efficiency. Of the total 360,174 eggs produced, 65,810 were used for studies at the University of Georgia (UGA) and Warm Springs RFC. The remaining egg and sperm mixture was shipped to hatching facilities: 112,103 to McDuffie SFH; 72,317 to UGA (52,351 for production and 19,966 for study); and 175,758 to Warm Springs (129,914 for production and 45,844 for study). A total of 189,167 fry were stocked in 12 ponds (totalling 9.1 acres) and 3 tanks. This year's rate of survival from egg to fry was 67.4%. This represents tremendous progress; last year's rate was 30% and 1995's was 11%.

A disease specialist, Norm Heil from Warm Springs Hatchery, inspected fish for infectious disease at the river spawning holding area. Results showed no evidence of invasive parasites and no observed viral cytopathic effect but some opportunistic secondary bacterial invasion indicative of stress typical of spawning, handling, feeding, nutrition and poor water quality. The full report appears in Appendix A., *Diagnostic Report on the Robust Redhorse Sucker.*

Phase II Fingerling Production and Re-introduction Efforts in 1996; Re-introduction Efforts Planned for Fall 1997 — Jay Shelton

Summary statistics showed the November 12 - December 17, 1996 harvest of Phase II robust redhorse fingerlings at Bo Ginn, McKinney Lake, Walton and McDuffie hatcheries (Appendix B.). After stocking, the Bo Ginn Hatchery was transferred to a 'care taker' status. Although the Walton Hatchery demonstrated an 86% survival rate, the overall lack of production (7.7% total survival) was a major disappointment. Despite the amount of data collected, there is no explanation for the variation in survival and no clear link for the lack of success that makes sense across hatcheries. These production rates obviously point to problems connected with producing the larger Phase II fingerlings thought to be more suitable for introduction. Investigators have not attempted to release Phase I fingerlings but are now rethinking this option.

Summary Statistics for stocking of Phase II robust redhorse fingerlings into ponds at Piedmont National Wildlife Refuge, McDuffie Hatchery, and Whitehall Lab and into the Broad River during the period November 13 - December 17, 1996 (Appendix C.) showed

actual stocking data. Appendix D. illustrates in map format the stocking locations for Phase II robust redhorse fingerlings (1993 and 1995 classes) between March 9, 1995 and June 10, 1997.

Due to lack of success in rearing Phase II fingerlings in 1996, re-introduction efforts for the fall of 1997 will be limited to Phase I fingerlings; some of the 1997 harvest will be held back for Phase II stocking. Burton Hatchery was harvested on October 8, 1997 with a 43% survival rate; 900 of those Phase I fingerlings have been stocked in the Broad River and 650 in the Piedmont National Wildlife Refuge ponds. Six hundred sixty (660) fingerlings were restocked at Burton Hatchery for grow-out to Phase II. There was about 30% mortality in the harvest and tagging process. There remain five (5) scheduled harvests; two (2) in South Carolina and three (3) in Georgia. The final outcome of 1997 Phase I production will not be known until the end of the year when all ponds have been harvested. Although there has been some difficulty in seining, there are at least some fish at each of the hatchery locations. Approximately 20% of the Phase I fingerlings will be held for Phase II release in 1998.

Status update on Adult Rearing Ponds at Piedmont National Wildlife Refuge and McDuffie Hatchery — Mark Bowers

Five (5) ponds at the Piedmont National Wildlife Refuge were removed from the public fishing program to establish a refugial population. Four (4) ponds are presently being used; 748 Phase I fingerlings were recently received from Burton Hatchery, 648 survived (Appendix E.). A total of 1,377 Phase II fingerlings were stocked into four (4) ponds in 1997.

Investigators have found that it is difficult to raise riverine fish in static ponds which differ in water quality parameters. In general, dissolved oxygen was good in the ponds, though one pond demonstrated a problem from June to August; a major rain event occurred in September, however, to return dissolved oxygen levels to within normal parameters.

The ponds were sampled in October 1997 using electro-fishing. An aquatic vegetation problem was discovered in three ponds with some mats ranging 3 - 4 feet thick, impairing fish collection. In February 1998, when the vegetation has died back, sampling will return to a standard procedure of circling the perimeter twice. The remaining fourth pond had cleaner water and was much easier to sample.

Results of sampling have supported a high confidence that there are good numbers of fish and that they appear to be healthy, "robust" individuals. Although the lengths and weight charts show some growth, the rearing ponds may not be supporting optimum growth. Next year an intensive feeding regime will begin.

A fifth pond, totaling 11 acres, is available but has not been stocked. It is infested with *Hydrilla* and has been treated with an herbicide. A second adjacent pond is becoming infested. It will not be treated with herbicide; grass carp will be introduced to attempt to control the *Hydrilla*.

Before stocking, the ponds were drained; all bass were killed but only one pond is free of competition from bluegill which represents a future management issue. Although samples taken a few weeks ago were not entirely successful, researchers remain optimistic. Pond rearing of this species is still in its infancy meriting additional research as there remains more that is unknown than known.

Status of the Oconee River population — Jimmy Evans

The known range of the existing robust redhorse population in the Oconee River below Sinclair Dam was displayed (Appendix F.). In

previous years, sampling has occurred in Areas 3, 4, and 5. The majority of the brood fish have been collected from Area 5. This year, Areas 1 and 2 were sampled for the first time to collect brood; there were not as many as was hoped.

Eight (8) sampling days occurring over the last week of April to May 19, 1997 culminated in 126 individuals collected: 7 from area one (1), 14 from area two (2), 29 from area three (3), 23 from area four (4), and 55 from area five (5). Sixty-one (61) of those collected were females (48% of the total, the highest ratio yet); fifty-three (53) were recaptures (42% of the total), and two (2) were immature (1.6% of the total).

The length frequency of the 1997 sample from the Oconee River was presented (Appendix G.). Length range of the sample was 42 - 70 cm. Ninety-eight (98) fish were collected measuring between 42 to 70 cm. Sixty-six (66) cm is the modal length. Sampling between 1992 and 1997 has repeatedly netted 1 - 3 immature specimens (Appendix H.). Normally, one would expect a higher percentage of younger age classes. The low numbers of immature robust redhorse is very atypical. In fact, the sampling has never collected a fish smaller than 42 cm. This evidence supports the theory of a senescent population with little successful reproductive activity.

A comparison of the modal length of the 1997 sample with those collected in 1994 indicates an increase in average length (Appendix I.). This supports the idea that the age distribution may have increased; it may take 2 to 3 years for older age class robust redhorse to grow 2 cm. These factors additionally support the concern that the entire population may be aging and could conceivably be lost within three to five (3 - 5) years due to natural die-off. There remain, however, many unanswered questions about the dynamics of the Oconee River population.

Population size and survival estimates, based on mark-recapture studies, indicate a closed system of spawning fidelity; fish return to the same spawning aggregation site each year. Population estimates have been calculated for two periods based on mark-recapture studies. The May 1995 and May 1996 estimates are 2,439 and 1,746 adults, respectively. Since very few subadults have been collected, and recruitment is very low, virtually the entire Oconee River robust redhorse population seems to be composed of adults.

These numbers indicate an apparent decline in the population size from 1995 to 1996 but this conclusion cannot be made with confidence due to very high variance. The survival estimate from 1995 to 1996 is nearly one (1), indicating excellent survival with few individuals dying. Based on the population size and survival estimates, it can be concluded that the Oconee River robust redhorse population has not begun to decline drastically but length frequency analysis gives cause for concern in the next few years.

Nothing obvious has changed in the sampling conditions over the past several years with the exception of one possible difference being river temperature. A few degrees difference in temperature can influence spawning aggregations. Thus, river temperature at the time of sampling may be critical to the numbers caught. The robust redhorse is the number one species being caught during sampling but that may be a bit biased since investigators specifically sample for their collection.

RECENT RESEARCH RESULTS

Effects of sedimentation and substrate composition on robust redhorse reproductive success — Erik Dilts

The goal of this research was to determine if the lack of recruitment to adult individuals in the Oconee River is due to substrate composition. Preliminary results indicate that fish are spawning in the Oconee River. Furthermore, it appears that larvae can sustain swimming position under the present hydrologic regime at Sinclair Dam. However, low survival rates indicate that larvae emergence is being limited.

Three factors influence substrate suitability: the physical space available to eggs and larva, permeability, and transport of dissolved oxygen. Trial one of the research considered excessive fine material in the sediment; trial two looked at the quality of the gravel mixture. Eggs were placed in experimental cells, buried 6 - 15 cm in a gravel mixture. Peak emergence of hatching occurred on day 16, a little later than what usually occurs in the hatchery. In trial one, results indicated that the lower the percentage of fine material in the sediment, the higher the emergence rates. Trial two conditions disclosed the highest emergence rates.

Gravel quality, in terms of sizes and amount of fine sediment in the Oconee River, might effect emergence success. Conclusions based on this research indicate that excessive amounts of fine sediment is a problem and poor gravel quality is a lesser problem. There is not any accurate idea of how much suitable habitat is in the Oconee River but it seems likely there is not a lot.

Gravel spawning substrate movements associated with high flow events. Implications for robust redhorse spawning success — Bud Freeman

The depth-velocity substrate transect research is located adjacent to the Avant Mine on the Oconee River. At this site, during the 1997 season, there was a short spawning period of about five (5) days. Gravel deposition at the spawning site is nourished by a gravel bank with an imbedded kaolin slice.

Researchers monitored what the shiners were eating, finding quite a few robust redhorse yolk sac larva in their stomachs. A hydrophone sampling technique was used successfully to detect spawning which was occurring around the gravel deposits at the site. Substrate sampling methods included: (1) a nitrogen freeze core device, revealing that most of the gravel material is relatively large, greater than 4.5 mm and that eggs are distributed throughout the core, present to a depth of 15 cm; (2) sediment traps; (3) measurements of dimensions of gravel patches; (4) tracer values measuring shear stress; (5) pipe intrastrate gravel; and (6) visual observation of gravel substrate and spawning activity.

There was very little fine sediment present. This low amount of fine sediment might be due to the physical spawning activities of the robust redhorse and other suckers present which may sweep the gravel clean of excess sediment.

The relationship of various diets and stocking densities to growth and survival of early robust redhorse life stages — Greg Looney

These studies occurred at the Warm Springs Hatchery. The density study (Appendix J.) began with non-feeding larvae that underwent four different density treatments: 100 fish, 200 fish, 300 fish and 600 fish. Each treatment

resulted in different mean lengths and weights, percent survival and percent deformities. The 100 fish treatment netted the largest fry in mean length, (47.3 mm), and in weight (.92 gms), nearly 10 mm longer and over double the weight of the 600 fish treatment (37.8 mm in length and .44 gms in weight). However, the variance in survival is relatively low between treatments and the difference in the percentage of spinal deformities was found to vary widely depending upon the investigator collecting the data.

The diet study (Appendix K.), conducted over a duration of 120 days, also used four different treatments with 200 individuals in each diet category. The organisms reacted similarly to striped bass diet studies before they were placed on artificial diets. The first three treatments resulted in very low survival rates.

The first treatment, using BioKyowa B, produced high mortality in the first nine (9) days and no mortality after sixty (60) days. There was a 1.3% survival rate and a 87.5% deformity rate. The second treatment, incorporating a fourteen (14) day transition, produced high mortalities nineteen (19) days after transition to artificial diet. This treatment had an 0.8% survival rate and a 60.0% deformity rate. The third treatment used a 30 day transition to an artificial diet with mortality results similar to treatment two, an 0.8% survival rate and a 100.0% deformity rate. The fourth treatment incorporated a slow transition to artificial food which seemed to increase survival, 52.8%, and reduce deformities, 19.0%.

Based on this research investigators believe that the robust redhorse needs natural food in its early development, approximately the first 75 days. As well, there seems to be something about the artificial food that causes spinal deformities. There were some mitigating variables between treatments such as stress from increased light in an uncovered tank which led to increases in mortality. However, there is still much to learn about dietary requirements of robust redhorse larvae and fingerlings.

Early results in the development of cryogenics techniques for storage of robust redhorse sperm — Greg Looney

Cryogenics semen storage studies have established short-term storage, up to 14 days, at 2-4° c. Long-term, indefinite storage was accomplished using liquid nitrogen at approximately minus 196°c. This research included five components: the testing of four (4) different extenders to store and maintain motilities; a fertilization trial; motility studies; osmolalities; and activation curves with saline solution and ovarian fluid.

Results showed that if the sperm are not in immediate contact with eggs, motility declines. However, sperm can be activated with exposure to ovarian fluid and reasonable fertilities can result using stored sperm up to approximately three (3) days. Other conclusions demonstrate the requirement for oxygen on samples, that Hank's balanced salt solution (1:5: 1:10) can maintain motility for quite some time, and that freezing sperm with DMSO seems to result in fairly good motility.

Although investigators have not conducted sperm counts, they were very dense in the samples. The quality of the males sampled, however, was a subjective judgement. Sperm will be stored in 1998 to test the utility of cyropreservation. This past year, fewer males flowed than two years ago; cyropreservation, therefore, will be important to protect against low availability of sperm during some periods and allow appropriate genetic mixes.

Assessment of reproductive and recruitment success in the Oconee River — Cecil Jennings

This research has been an ongoing, three (3) year study, on the Oconee River. Its purpose

is to determine the reasons for recruitment failure, evaluating if the source of constraints are biological (associated with an older population) or environmental. Investigators have found that at least some of the fish in the population are spawning which disproves the presence or effect of biological constraints (i.e., low reproductive survival of an aging population). Furthermore, hydropeaking at Sinclair Dam has been determined to not be a detrimental environmental constraint, at least relating to displacement of post-emergent larvae by excessive current velocities.

Environmental conditions measured during the study include: dissolved oxygen, water temperature, water depth, current velocity and turbidity. The table below shows the success of various collecting methods in 1997.

In 1995, six (6) larval and post-larval robust redhorse fish were collected; in 1996, seven (7) larval and post-larval robust were caught. Low densities of larvae and post-larvae were also found in the gravel, 8.5 per month on average in 1995 and even lower in 1996 at 2.5 per month on average. Slightly higher densities were found in the water column, but the number was still very low. When comparing the two years, it is difficult to determine if the low densities are a sampling artifact or a true indication of robust redhorse larvae in the Oconee River. It should be noted that silver redhorse seemed more abundant in 1996.

Preliminary results of 1997, the first year of the new flow regimes from Sinclair Dam, indicate that robust redhorse seem to have increased by an order of magnitude in abundance. However, there remains no evidence of increased recruitment to the adult population. Investigators began sampling earlier and collected samples later in 1997 than during 1995 or 1996. Twenty-four (24) larval and post-larval robust redhorse fish have been collected. More young-of-the-year (YOY) silver redhorse have been found in 1997, but no YOY robust redhorse fingerlings have ever been collected. Further studies intend to sample the deep channels of the Oconee River by using larger seines.

Number of Samples	*Number of Fish*	*Sampling Gear Used*
5	5	Benthic pump added this year
		OLD/previous years used
73	1056	Push-net
136	4344	Light trap
175	33310	Seine

Early results of monitoring activities to determine success of the Broad River re-introduction efforts — Bud Freeman

This research included a substantial sampling effort in the upper Broad River; less activity has occurred in the lower river. Investigators collected silver redhorse but caught none of the approximately 1,400 Phase II robust redhorse fingerlings that were released into the upper Broad River in 1996. They have, however, encountered no flathead catfish in upper reaches of the river either.

An introduction of approximately 200 Phase I fingerlings was made on October 10, 1997 below the dam on Hannah Creek in the Broad River. The next morning investigators monitored a creek stretch using a global positioning system (GPS) finding the first fish 2,610 feet below the release point. The largest fingerling was found the furthest downstream; it had moved through a beaverdam and pool. There was no clear habitat type where fingerlings were found; thirty fingerlings were collected within 2,610 feet of the release location from both slow and fast current

velocities. Hannah Creek seems to be a productive system with few predators present (none were collected). Early monitoring results seem to indicate that Hannah Creek is a good release site for robust redhorse fingerlings.

Preliminary results of genetics investigation of the Oconee River robust redhorse population — Ike Wirgin

Genetic research has developed molecular tools to assess the genetic diversity of the Oconee River robust redhorse population. Microsatellites were used for the genetic analysis. Although the level of variation is high, investigators have established markers to the individual and definitely to the population level.

The investigator asked the committee for guidance on what research objectives would best promote their conservation efforts. At present, however, the molecular tools will determine: (1) if the Oconee River contains a single population or multiple stocks; (2) how the nuclear DNA of the native population compares with that of the hatchery stock; and (3) the extent, if any, of inbreeding (i.e., genetic heterogeneity of the parental stock). Results will support management considerations which could influence decisions on number of hatchery matings required to supplement the native population, to develop genetic tags to monitor the success at hatcheries, or to positively identify larval robust redhorse collected from the Oconee River.

Twelve (12) loci have been tested on fish collected in 1996. Based on preliminary results, it looks like there is quite a bit of genetic diversity in the Oconee River robust redhorse population; it is on the low end of normal when compared to other species. In addition, the studies indicate no evidence of significant inbreeding to date.

Note: The investigator stressed that tissue samples should not be placed in formalin as it increases the difficulty in conducting genetic studies.

OVERVIEW OF RECOVERY ACTIVITIES PLANNED FOR 1998 — Scott Hendricks

Recovery activities planned for 1998 are not fully developed. The recovery activities to date have maintained a focus on two main lines of research which are both incomplete: (1) the effects of the Sinclair Dam hydrologic regime on the ecology/biology of the robust redhorse population; and (2) the development of cultural techniques to produce stock at hatcheries.

Priorities for the focus of recovery activities during 1998 could include projects in the following areas.

Ecology related recovery activities
- Substrate-larvae relationships.
- Larvae collections on the Oconee River related to flow changes.
- Radiotelemetry.
- Population dynamics of a long-lived species.
- Document survival of stocked populations.
- Surveying of other drainage basins for native populations and habitat.
- Literature review.

Culture related recovery activities
- Post-larval stages, grow-out problems to Phase I and II fingerlings.
- Stocking issues—timing, water quality and nutrition requirements, predation problems, and presence of low-level contaminants.
- Development of standardized procedures for stocking ponds.

AGENDA REVIEW AND RATING

In order to ensure that time was well invested and productive, a review and facilitated rating of the ambitious agenda for October 30th identified priority topics that the committee considered to be the most critical to accomplish the following day. Two items were added to the agenda prior to ranking: identification of genetic research objectives and implications of the Savannah River find in terms of work for 1998. The agenda and rating (using sticking dots) results appear below.

1. Review progress on work items assigned at last meeting of the RRCC (no dots).
2. List major impediments in progress to recovery; list possible solutions (17 dots).
3. Evaluate necessity/protocol for restocking Oconee River below Sinclair Dam (3 dots).
4. Review prioritized list of and obtain consensus on primary and secondary sites for Phase I fingerling re-introduction in the fall of 1997 (14 dots).
5. Review information on hatchery space for Phase I and II fingerling production (2 dots).
6. Review list and obtain consensus on proposed research activities for 1998; identify genetic research objectives (14 dots).
7. Identify and discuss specific work to be accomplished before the next meeting; including efforts on the Savannah River (11 dots).
8. Committee discussions (3 dots).

Based on the low priority given to several of the agenda items and the fact that the subject matters were primarily informational in nature, summaries or assessments of those items were distributed for review. The committee chair's assessment of the progress on work items assigned at the last annual meeting appears as Appendix L. *A Tentative Schedule for the Harvest of Phase I Robust Redhorse Ponds at Various Hatcheries* appears as Appendix M. This schedule was developed by the Hatchery Subcommittee under work item c. of Appendix L. A summary of the Hatchery Subcommittee meeting, held on September 15, 1997, can be requested from Jimmy Evans. *The Hatchery Space for Phase I and Phase II Fingerling Production* appears as Appendix Q.

MAJOR IMPEDIMENTS IN PROGRESS TO RECOVERY

The following major impediments in making progress toward recovery of the robust redhorse were identified by the committee during a brainstorming session.

- Flathead catfish predation.
- Available spawning sites.
- Incomplete understanding of fingerling culture requirements.
- Identification and suitability of re-introduction sites.
- Limited manpower (trained) in the spring when activity peaks.
- Inadequate of funding.
- Lack of guidance for "experimental population" designation under a prelisting recovery approach.
- Little understanding of habitat requirements, especially YOY and juveniles.
- Little understanding of nutritional requirements.
- Habitat degradation.
- Genetics and considerations for restocking Oconee River.
- Dams and associated hydrologic regimes related to habitat requirement.

OPTIONS TO RESOLVE MAJOR RECOVERY IMPEDIMENTS

Issues and considerations connected with the impediments were identified during the development of the above list and in subsequent group discussions. These issues and considerations began to further develop the subtleties and complexities of impediments to recovery.

The committee broke into small groups to focus on generating options for resolving the major recovery impediments. Some small groups believed that a few of the impediments were so closely interdependent that they chose to clump them and their issues/considerations together while developing solution options. When small groups had completed one impediment area, they were instructed to select and work with another.

Work continued until solutions for all impediments had been developed at which time the small groups reported their results to the committee. The committee decided to move the funding impediment onto the 1998 Work Items list because funding solutions will be closely related to the specific focus of upcoming work activities.

This next section summarizes the small group reports. Impediments appear as headings, followed by the issues and considerations the large group generated and which were used by the small groups as a jumping off point. The remaining work under each impediment represents the specific solution options identified by the small groups.

Re-introduction Sites/Hydrologic Regimes/Unresolved "Experimental Population" Impediments

Issues and Considerations

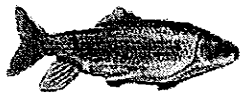
Re-introduction Sites
- Support from all stakeholders.
- Identify gaps, develop a process to identify and rank potential re-introduction sites.
- Poor understanding of the present and historic distribution and abundance and life history characteristics of the robust redhorse.

Hydrologic Regimes
- Are the hydrologic regimes of dams a benefit or adversity to habitat?
- What are the impacts of dam connected hydrologic regimes on sedimentation?
- What is the relationship between dams and available habitat sites ?

Undefined "Experimental Population"
- It is unclear if a population stocked prior to listing can be declared "experimental".

The following is a response to this issue from a US Fish and Wildlife Service (FWS) representative.

"The FWS is trying to get clarification on the possible implications of classifying a population as experimental. It seems an experimental designation cannot be made prior to the species being listed. The Robust Redhorse Conservation Committee could create a Memorandum of Understanding (MOU) regarding the management of an experimental population that was stocked prior to listing. Another option is to create a conservation agreement that details management options under a recovery plan in lieu of a listing designation. The conservation agreement approach, however, is new policy for the FWS that has not been finalized so no assurances can be given at this time. The FWS has received



some resistance from conservation groups on the west coast who believe the recovery plans implemented through conservation agreements preclude listing and provide fewer protection mechanisms. An "experimental" candidate conservation agreement is in draft form; conservation groups could be provided the opportunity to comment on drafts."

Below are additional committee comments and concerns in response to the FWS update.

- We do not have enough information to move forward with stocking under an "experimental" designation and there is opposition to re-introduction without this designation.
- The Endangered Species Act could be changed to include wording on experimental status for species under a "prelisting" recovery effort. This would increase the flexibility of the FWS authority to designate and manage efforts under this classification.
- A letter of support of the changes to the Endangered Species Act from the FWS would help this process.
- We could get a hearing to request these changes.
- If an amendment to the Endangered Species Act is proposed, it goes for public comment which would be a good place for the FWS to submit a letter of support.
- The window of opportunity to make these changes is closing. The Endangered Species Act is going to the floor for legislative consideration as we speak.
- Suggestion: Ronnie Just, with Georgia Power, and Mark Bowers, who provides FWS representation, should get together to move the experimental status definition issue to resolution.
- The wording must assure that the re-introduced population would be considered "experimental" prior to listing.
- The committee could prepare a draft and present a candidate conservation agreement in anticipation of its approval.
- It might take approximately 18 months to get the draft conservation agreement to a final format.
- In the meantime, anyone can draft a candidate conservation agreement. The FWS must sign-off on it, however, providing final approval.
- We are not sure if a conservation agreement would give enough assurance to power companies with projects on rivers where re-introductions are planned.
- It is difficult to impossible to get or guarantee absolute assurances that no alterations to existing power company operations would occur.
- This issue is a gamble of potential future listing against increasing the viability of populations of robust redhorse.
- South Carolina was expected to investigate suitable stocking sites. It is not, however, a current high priority objective in the state.
- Are other states versed in the risk versus benefits of stocking a species that has potential to be listed?
- North Carolina is versed, but not interested in stocking unless there is evidence of success in Georgia.
- Support from power companies and other groups could help sway the current view in South and North Carolina.
- We need additional stocking sites in the historic range of North and South Carolina to push the "success" of the efforts in Georgia.
- South Carolina Electric and Gas is interested in the MOU, but has been reluctant to sign it.
- The decision on the precise conservation status of the fish is up to the Department of the Interior and ultimately could be made by a federal judge if there is a petition to list.
- There are other stakeholders that must be included in re-introduction decisions under an "experimental" designation such as the US Army Corps of Engineers whose projects overlap stocking sites and local municipalities who are managing water resources that also overlap stocking sites.
- With the recent find of robust redhorse in the Savannah River, there might be support from the Savannah River stakeholders to stock fish, fortifying the chances of recovery success and preventing federal listing if the Oconee population were to begin to decline.

Solutions — Re-introduction Sites/Hydrologic Regimes/Unresolved "Experimental Population" Impediments

Issue: Lack of support from North Carolina and South Carolina to re-introduce species to its historic range.

Solution # 1
1. Clarify "experimental population" designation.
2. Offer rewording of possible amendment to the Endangered Species Act. Also a Georgia Power Company lobbyist, Ronnie Just or Mike Wilder, should arrange a meeting with the FWS that might include Laverne Smith, John Fridell, and upper management at Georgia Power.
3. Schedule a meeting with the Assistant Chiefs or Chiefs of Fisheries in Georgia, North Carolina, and South Carolina to provide a briefing on the current state of knowledge regarding prelisting approaches: (1) experimental population designation or (2) conservation agreement.
4. Consider the issue of gaining support from conservation groups. Enlist Georgia Wildlife Federation to contact others in the conservation community to solicit support.

Solution #2
1. Gain information on critical habitat requirements; specifically juveniles, through the use of telemetry, increased monitoring on the Broad River and at all future re-introduction sites.

Solution #3
1. Conduct site assessments in South and North Carolina.
   a. First, generate a written description of stocking site criteria for acceptable spawning, rearing and holding habitat.
   b. Contact and meet with appropriate state agency and power company people.

Note: The North Carolina and South Carolina American Fisheries Society (AFS) meetings are coming up and would be an opportunity to address this item.

   c. Consult the fluvial hydrology experts.
   d. Clarify the impact that the endangered mussel issue has on the robust redhorse.
   e. Develop a genetics management plan.

Predation Impediment

Issues and Considerations
- Presence and impact of flathead catfish.
- Impact of other predation such as shiners foraging on eggs and larvae.
- Need to determine the extent of flathead predation.
- Consider potential control mechanisms for predation (especially flathead catfish).
- Knowledge gaps exist regarding:
  - Predation impacts on Phase I versus Phase II stocking;
  - Cost, time and effort involved in controlling predation; and
  - Post-stocking behavior.

Solutions — Predation Impediment
1. Conduct research on the stomach contents of potential predators on sucker larvae and stocked fingerlings.
2. Investigate the stomach content of predators, pre- and post-stocking.
3. Determine if predators most impact Phase I or Phase II fingerlings.
4. Assess feasibility of flathead catfish removal on the Oconee River. Monitor both predators and prey subsequent to removal.

Fingerling Culture Impediment

Issues and Considerations
- Inadequate knowledge of nutritional requirements.
- Lack of hatchery space.
- Undefined protocols for Phase I and II fingerlings, juveniles and adults regarding:
  - Rearing;
  - Nutrition; and
  - Handling.
- Research on the benefits of supplemental

versus natural feeding regimes.
- Cannot intensively raise young because we do not know their needs and requirements.

Solutions — Fingerling Culture Impediment
- Conduct experiments to examine fry and Phase I microhabitat usage.
- Conduct a preliminary experiment to test differences in emergence success between sucker species, if any.
- Conduct experimental emergence trials on the Oconee River, Broad River and Hannah Creek.
- Evaluate results of 1997 fingerling harvest comparing food availability, water quality and diet.
- Develop a protocol for 1998 pond rearing and conduct experiments designed to address optimal management of target pond biota.
- Find some 1995 Phase II preserved fish and examine stomach contents to determine diet.

Habitat Degradation Impediment

Issues and Considerations — Small group identified first tier issues indicated with #1
- There is little understanding of habitat suitability.
- There is little knowledge of how fluvial processes impact the amount of suitable habitat (#1).
- Current and future land use changes will likely have a negative impact on habitat quality.
- The time horizon of dealing with habitat degradation is too great. However, we should attempt to prevent degradation of presently suitable sites.
- Successful habitat preservation involves community-based conservation efforts (#1).
- Does the State of Georgia have a designation for stream protection? Answer: Not now, but now is the time to put one in place. Conservation groups could perhaps influence the Georgia Environmental Protection Division to institute stream protection regulations.
- Habitat Degradation was defined to mean: The habitat and the effects of sediment on spawning and adult holding areas and on areas where fingerlings will be stocked. Water quality issues are localized; however, there are hydro-peaking and dam impact questions and water resource allocation issues.
- Sediment is the primary force influencing habitat degradation. The major cause of sediment loading is failure to use good construction practices (#1):
  - Need to determine historic sediment loads; and
  - Need to determine present loads.
- Need more understanding of the relationship between dams and sedimentation. Note: When the impact of dam releases on the fluvial structure and sedimentation loads was investigated, results indicated that sediment free releases pick up and scour the channel of sediment until equilibrium is reached.

Solutions — Habitat Degradation Impediment (#1)
- Identity adult holding and spawning habitat by location of adults through telemetry and hydroacoustics.
- Define what "suitable" means.
- Investigate modification of spawning substrate to increase spawning activity and improve survival of larvae.
- Determine the depth of spawning habitat and the extent of gravel bars.
- Research needs:
  - Refine the understanding of the effects of fine sedimentation in 1998;
  - Determine the extent of spawning areas;
  - Investigate the fate of emergent larval fish; and
  - Develop sampling methods and sample the remaining difficult-to-sample habitat to determine why there is a gap in collected specimens between 14 mm and 42 cm.

Available Spawning Sites Impediment — Group identified this as related to Habitat Degradation Impediment, solutions are same.

Issues and Considerations
- Lack of available gravel/cobble habitat.
- Sedimentation.
- Impoundments, flow regimes and barriers.
- Use of artificial spawning sites:
  - Habitat enhancements.
- Range of suitable spawning habitat:
  - Lack of knowledge of depth range suitable for spawning.

Re-introduction Impediment — Group identified this as related to Habitat Degradation and Available Spawning Sites Impediments, issues and solutions overlap.

Solutions — Re-introduction Impediment
- Build artificial spawning sites to determine:
  - Suitable habitat characteristics (enhancing existing sites may be limited by regulations);
  - The site's carrying capacity for improving reproductive success; and
  - The desired recruitment rate.

Habitat, Nutrition And Life History Requirements Impediments — Group identified this as related to Habitat Degradation, Available Spawning Sites and Re-Introduction Impediments, issues and solutions overlap.

Solutions — Habitat, Nutrition and Life History Requirements Impediments
- Determine food resources in the river by sampling:
  - Available food sources;
  - Stomach content; and
  - Macroinvertebrates.
- Conduct research on food needs by size and availability.

Genetics Impediment

Issues and Considerations
- The limited number of genetic crossings potentially possible could impact the genetic characteristics of the existing Oconee River population. However, the extent of impact can be determined and managed to negate negative effects.
- Genetic diversity of native population is currently in good shape.
- Stocking into the Oconee River needs to happen in the next few years.
- Need to characterize fry from known adults that will become a future brood stock.
- Must characterize individuals or the population in the Savannah River to determine if investigators could and should stock with the Oconee River fry.

Solutions — Genetics Impediment
- Continue genetic analysis of brood fish collected from the Oconee River.
- Sample the larvae of each mating.
- Take tissue samples of all fish captured; an optimum of 50 captures per site.
- Use a global positioning system to record the location of each capture.
- Initiate an intensive sampling effort in the Savannah River. Take tissue samples from any captures.
- Get/develop protocol for sample collections.
- Characterize and compare the genetic diversity of the established population with silver redhorse.
- Dedicate one person for tagging and recording during collection activities to increase consistency of data.

Restocking The Oconee River Impediment

Issues and Considerations
Comments from the committee chair prior to the meeting: "The major issue involves the viability of the Oconee River population. If the population is viable, stocking could reduce genetic diversity, resulting in net harm to the species' survivability. If the population is not viable and cannot be induced to successfully spawn and recruit through flow manipulation, then stocking will be required to save the population. Timing of any stocking is crucial since the stocked fingerlings will require 6 - 8

years to mature, and should be allowed enough time to mature and spawn with the wild population before the wild fish die out completely. If too much time is allowed to assess the viability of the parental population, it may die out leaving only the stocked juveniles which may not possess the desired genetic diversity.

Flathead catfish cannot be eliminated but the abundance could be reduced with available methods. This would require a massive effort, and data on potential impacts of flathead catfish predation needed to justify such an effort are lacking. It is unclear if there is enough time to acquire this data before declining abundance of the parental stock would require the stocking of fingerlings."

Below are comments from the committee.

- Genetic characterization of the native population will be completed winter 1998.
- Investigators will characterize the stocked brood fish as new individuals recruit into the population.
- We need to determine the carrying-capacity of the Oconee River. If the native population is dying, however, carrying-capacity is not an issue that will influence restocking decisions.

The committee was presented with the opportunity to complete the following table to provide needed guidance on recommendations to restock the Oconee River. If restocking is recommended, guidance on stocking rates and timing would also be provided.

Yes, stock			**No, don't stock**	**Timetable**
Stocking rate, percentage of harvest				
Small	Medium	Large		1998
				1999
				2000
				2001
				2002
				2003
				2004
				2005
				2006

While some committee members were prepared to provide stocking recommendations by completing the table, others could not complete the task without further information. Below are comments reflecting this discussion.

- We need to conduct a statistical sampling of population to verify the population estimate. We do not have enough information on how many are actually in the river.
- The Oconee River stocking could jeopardize what is currently happening.
- If the population is not crashing, do not stock the river.
- What part of the Oconee River would be stocked?
- Stocking the river is not urgent right now; the decision can wait.
- Re-introduction activities will divert stocking material from other sites.
- We need to wait for the results of the genetic research because we do not know of potential genetic diversity impacts.
- It may be that current recruitment can sustain the population, we do not know.
- An estimate of a population crash must be based on a population estimate.

- We do not have monitoring data of current stocking success.
- Can stocked fish be marked? Yes, they can be marked with coded-wire tags, PIT (Passive Intergraded Transponder) tags, and Tetracycline marking to track the genetic characteristics of stocked fish.

Based on these divergent comments, the development of an evaluation of the necessity, and an associated protocol, for restocking the Oconee River below Sinclair Dam was tabled until later in the meeting. The committee's final disposition for this issue is reflected below in the Work Items for 1998.

Manpower Impediment — Solutions to this impediment were not developed.

Issues and Considerations

- Investigators must depend on volunteer help.
- It is difficult and time consuming to match volunteer availability with weather dependent activities.
- Volunteer help involves many random aspects, too much help some days and not enough on others.
- Need funds to support ongoing help.
- There is a lack of communication regarding the need for help and the areas in which help is needed, or the help volunteers want to give and that which is really desired.
- Need fully-trained spawning help/personnel.

POTENTIAL GEORGIA RE-INTRODUCTION LOCATIONS

The committee reviewed a prioritized list of sites for Phase I fingerling re-introduction in the fall of 1997 (below). Using an assumption that approximately 63,000 fingerlings will survive rearing and harvesting to be available for stocking, the committee discussed primary and secondary stocking sites (see Appendices N., O. and P.).

Location	*# Sites*	*RVR Mile*	*#Phase I Fingerlings*
Piedmont NWR (Jones County)	4 ponds 17.4 acres	N/A	1,800
Broad River (Franklin, Madison, Ogle. and Wilkes)	7	121	32,000
Ogeechee River (Warren, Glassock and Jefferson)	5	60	15,000
Little River (Morgan, Jasper, Putnam)	4	35	8,000
Apalachee River (Green, Oconee)	3	30	7,000
TOTAL			63,000

Piedmont National Wildlife Refuge
- The Piedmont National Wildlife Refuge has one (1) more pond available bringing the total to five (5) covering approximately 28 acres. However, the fifth pond will be available for stocking in 1998. It may be that the water quality is not currently suitable due to recent herbicide treatment for *Hydrilla*.

Broad River
- The goal of the committee is to establish a reproducing population in the Broad River.
- We can expect a high mortality rate of stocked material in the Broad River.
- Mortality rates for the first year are just a guesstimate.
- However, high stocking numbers will support the research being conducted there.
- Thirty-two thousand Phase I fingerlings for stocking the Broad River in 1997 comes from mathematical modeling; we can modify the stocking rate in subsequent years.
- In the Broad River, stock the same total of fingerlings (32,000) but concentrate stocking to the upper portion and to site seven (7) on the South Fork of the Broad River. Distribute the number of fingerlings currently designated for sites five (5) and six (6) into the remaining sites (1, 2, 3, 4, and 7). Although there is no flathead catfish presence at site seven (7), move the designated stocking site upstream on the South Fork.

Ogeechee River
- There are no flathead catfish in the upper Ogeechee River. However, there has been one verified fish collected lower on the river. There may be a 10 - 15 year window before the species' presence becomes a significant predation issue.
- The Ogeechee River is the largest suitable stocking location in Georgia that has no predation issues.
- However, the spawning habitats on the river (located in the Piedmont) are too small to be good adult holding areas.
- We do not know how the robust redhorse will survive in a blackwater acidic system. The upper river is only marginally a blackwater system, however.
- There are five (5) sites above the blackwater conditions of the lower portion of the Ogeechee.
- The Ogeechee does not seem to be a good site for a reproducing population. Re-introduced stock could become a refugial population that is free of predation.
- The committee's primary goal for the Ogeechee River is to establish a brood source, and secondarily, a reproducing population.
- The Ogeechee River has good water quality, a good sucker population and a good native mussel population.
- The Ocmulgee River might be a better stocking site than the Ogeechee.
- Stocking into the Ocmulgee requires clearance; it will not be available this year.
- We need to do a mussel survey to determine locations of the best food sources, but keep all five (5) sites that are currently indicated.

Little River and Apalachee River
- There are few native mussels in either river.
- There are no flathead catfish.
- These two rivers are definitely third-tier sites, but have enough suitable habitat to possibly support a small population of stocked fish.

Concerns/Considerations related to Phase I re-introduction fall 1997
- Some fish from the 1997 harvest should be held for stocking the Oconee River in the fall of 1998.
- If we only harvest 30,000 fingerlings, stock the Piedmont National Wildlife Refuge entirely and then proportionately stock others; do not stock the Little and Apalachee rivers at all.
- Madison and Walton counties are putting in water intakes on the Apalachee River which could conflict with stocking survival. This river should be dropped first if we need to stock below the shoals.
- There are power company facilities on the Little and Apalachee rivers that raise concerns regarding stocking those sites.
- If we harvest more fingerlings than

anticipated, stock the additional pond at the Piedmont National Wildlife Refuge, sites five (5) and six (6) on the Broad River and proportionately increase the stocking rates at all of the sites.
- Stocking the Apalachee and Little rivers involves many concerns. There are downstream lakes (Sinclair and Oconee) where fingerlings may not do well. We would never find robust redhorse in these reservoirs. Potential future listing would impact the management of these reservoirs. The Georgia Power Company believes the "experimental" population status should be clarified prior to stocking sites on these two rivers.

The Piedmont National Wildlife Refuge was clearly considered the primary 1997 stocking site, to be stocked regardless of harvest size. Secondary stocking sites included the Broad River, with some rearranging of sites, and the Ogeechee River. The Little River and the Apalachee River should be considered third tier stocking sites, if at all.

RESEARCH ACTIVITIES FOR 1998

Two outlines were distributed, *Prioritized Research Needs* and *Proposed Conservation Actions* (Appendices R. and S.). After a brief discussion, the committee agreed to focus 1998 research activities on the issues and solutions identified during Options to Resolve Major Recovery Impediments.

WORK ITEMS FOR 1998

The following options and needs were identified by the committee while discussing specific work to be accomplished before the next meeting.
- Create task forces to flesh out impediment solutions, identifying an appropriate sequence for activity accomplishment, time lines, and resources.
- Another task force that could be created could work on various "what if the Oconee River population crashes" scenarios, developing current population estimates and re-introduction responses and protocols.
- Sample the Savannah River further to determine the extent, if any, of its native robust redhorse population.
- Develop site selection criteria for re-introduction protocols.
- Recreate a version of the Technical Advisory Group that has been formed in the past to accomplish the committee's work items.

The committee agreed to form a Technical Advisory Group (TAG) to oversee its 1998 work items. TAG members include: Cecil Jennings, Bud Freeman, Jay Shelton, Jimmy Evans, Scott Hendricks, Greg Looney and Mark Bowers. The following are priority activities the committee asked TAG to work on during 1998.
1. Savannah River.
2. Re-introduction and the "experimental" status.
3. Predation.
4. Habitat degradation, availability of spawning sites and life history requirements.
5. Fingerling culture.
6. Genetics.
7. Oconee River re-introduction.
8. Creation of a list serve on an e-mail system to enhance communication between members for new developments and other important news. (Jay volunteered to oversee the accomplishment of this task).

MOTIONS FOR COMMITTEE CONSIDERATION & UNFINISHED BUSINESS

The election of a new Robust Redhorse Conservation Committee Chairperson was the first item of business the committee addressed. According to the MOU, "The Committee shall establish its own working rules, including a procedure for designating the Chair. The position of the Committee Chair shall rotate every two years;..." (Item III, Article C.).

Jimmy Evans provided a brief outline of the amount of time his tenure as chair has required. He explained that for two (2) months of the year, he spends between 80-90% of his work hours on committee functions and averages about 50% per month other times.

Below are some of the ideas the committee generated regarding chairperson election.

- Jimmy Evans could be elected chair again. Note: This would require a change in the wording of the MOU.
- Change MOU wording to accommodate re-election of the current chair.
- Create a search committee to nominate candidates for the chairperson position.

The committee decided to establish a search committee. Jimmy, Dave, and Cecil volunteered to staff it. They will have their first meeting by telephone conference. The committee charged the search committee to:

1. Create a process for chairperson selection;
2. Consider developing a chair and chair-elect protocol to facilitate smooth transitions to the chairperson position; and
3. Develop charter language for the position including duties.

Closing comments of the annual Robust Redhorse Conservation Committee meeting included a suggestion that the committee organize a session at the American Fisheries Society Meeting in Charlotte, North Carolina, scheduled for August 1999. This would be a good opportunity to share background and progress on the recovery activities and for investigators to present papers on research related to the robust redhorse.

A final discussion centered on the schedule for the 1998 Annual Meeting of the Robust Redhorse Conservation Committee. After some exchange regarding moving the date to November or December to prevent conflicts with stocking activities and state meetings that required attendance by some of the North and South Carolina folks, it was agreed to leave the meeting date in October.

Furthermore, it was agreed to extend the meeting to two (2) full days. The 1998 Robust Redhorse Conservation Committee Annual Meeting is scheduled for Wednesday, October 28, from 9:00 a.m. to 6:00 p.m. and Thursday, October 29, from 8:00 a.m. to 5:00 p.m. Jimmy closed the meeting by thanking the members for their participation and hard work.

Appendix A
Diagnostic Report on the Robust Redhorse Sucker

United States Department of the Interior

U. S. Fish and Wildlife Service
Warm Springs Regional Fisheries Center
Fish Health Laboratory
5151 Spring Street
Warm Springs, GA 31830-9712

IN REPLY REFER TO:

DIAGNOSTIC REPORT

DATE: July 15, 1997

CASE NUMBER: 97-42

Facility: Beaver Dam Wildlife Management Area
Owner/Manager: Georgia Dept. Natural Resources
Address: Oconee River
Allentown, Ga

Phone: NA
Sample submitted by: Greg Looney / Norm Heil

Species submitted: Robust Redhorse Sucker, *Moxostoma robustum*
Date submitted: May 19, 1997

BACKGROUND: On site visit to river spawning-holding area to check suckers for infectious disease using non - lethal techniques. Ovarian fluids, skin and anal swab samples were taken.

RESULTS:

Parasitology: Externally, the adult suckers showed no signs of gill, skin, or fin parasites visible to the eye. Skin condition was dry mostly void of mucus.

Bacteriology: Samples no good, TSA slants over grown due to delay in processing.

Virology: Four mucus and eight ovarian samples were processed and inoculated at 1:2 and 1:100 dilutions onto EPC (Epithelioma papillosum cyprini), FHM (Fathead Minnow) cell lines to screen for possible virus infection or carrier state. Viral assays were performed in 96 well microtiter plates. No viral CPE(cytopathic effect) was observed.

REMARKS:

Norman P. Heil

Fish Health Biologist
706-655-3382

United States Department of the Interior

U. S. Fish and Wildlife Service
Warm Springs Regional Fisheries Center
Fish Health Laboratory
5151 Spring Street
Warm Springs, GA 31830-9712

IN REPLY REFER TO:

DIAGNOSTIC REPORT

DATE: July 15, 1997

CASE NUMBER: 97-46

Facility: Beaver Dam Wildlife Management Area
Owner/Manager: Georgia Dept. Natural Resources
Address: Oconee River
Allentown, Ga

Phone: NA
Sample submitted by: Greg Looney

Species submitted: Robust Redhorse Sucker, *Moxostoma robustum*
Date submitted: May 28, 1997

BACKGROUND: On site river spawning-holding area to check suckers for infectious disease using non - lethal techniques. Ovarian fluids, skin and anal swab samples were taken. This sampiing will contribute to the Wild Fish Health Survey Fish were identified via Pit tag. See sample list.

GPS coordinates : N 32° 42. 456' W 083° 57.546'

Results:

Parasitology: Negative

Bacteriology: Skin swabs were streaked onto TSA slants. 15 fish sampled. See sample list for results of isolate identification.

Virology: 15 mucus and 1 ovarian samples were processed and inoculated at 1:100 dilutions onto EPC (Epithelioma papillosum cyprini), CHSE(Chinook Salmon Embryo) cell lines to screen for possible virus infection or carrier state. Viral assays were performed in 96 well microtiter plates. No viral CPE(cytopathic effect) was observed.

Remarks: The bacteria isolated from the external lesions and mucus are typically found in water, soil, and sewage. They are opportunistic secondary invaders and will cause infection when conditions are favorable. Infection typically indicates that several stressors are involved , including spawning, handling, feeding, nutrition, and water quality.

Norman P. Heil
Fish Health Biologist
706-655-3382

ID numbers and bacterial isolates found. Case #97-46, Beaver Dam Wildlife Management Area

Sample #	Pit Tag # or ID#	Bacteria Species
1	40336412E	*Morgnella morganii, Serratia sp.*
2	100/101	*Pseudomonas sp.*
3	280/399	*Citrobacter freundii, Aeromonas hydrophila*
4	519/520	*Aeromonas hydrophila, Citrobacter freundii*
5	528/542	*Morgnella morganii, Pseudomonas sp.*
6	514/515	*Aeromonas hydrophila, Morgnella morganii*
7	518/526	*Aeromonas hydrophila, Morgnella morganii*
8	516/517	*Morgnella morganii*
9	17982/17988	*Aeromonas hydrophila*
10	544/21927	*Pseudomonas sp., Morgnella morganii*
11	497/498	*Aeromonas hydrophila*
12	351/352	*Morgnella morganii*
13	543/546	*Pseudomonas sp.*
14	309/310	*Pseudomonas sp.*
15	179821/17983	*Aeromonas hydrophila*

Figure 1. Summary statistics for harvest of Phase II robust redhorse fingerlings at Bo Ginn, McKinney Lake, Walton and McDuffie hatcheries, November 12 - December 17, 1996.

Hatchery	Pond No.	Pond Size (ac)	Stocking Rate (#/ac) (Dec. 1995)	No. Stocked (Dec. 1995)	No. Harvested (Nov. 1996)	Percent Survival	Lbs. Stocked (Dec. 1995)	Lbs. Harv. (Nov. 1996)	Ave. Len. (mm) (Dec.1995) (Range)	Ave. Len. (mm) (Nov.1996) (Range)	Ave.Wt. (g) (Dec 1995) (Range)	Ave. Wt. (g) (Nov. 1996) (Range)	No./lb (Dec. 1995)	No./lb (Nov. 1996)
Walton	5	0.45	5,000	2,250	1,944	86.4	61.6	370.8	106 (50-153)	192 (145-224)	13 (3-38)	87 (31-140)	36.5	5.2
McDuffie	11A	0.5	10,000	5,000	22	0.4	112.3	14.8	104 (67-150)	292 (270-314)	12 (1-39)	307 (236-372)	44.5	1.5
Bo Ginn	3	0.3	10,017	3,005	182	6.1	77.9	68.5	109 (50-153)	246 (193-280)	14 (1-39)	171 (76-248)	38.6	2.7
	4	0.6	2,545	1,527	20	1.3	39.6	2.8	109 (50-153)	177 (155-196)	14 (1-39)	64 (46-86)	38.6	7.1
	10	0.7	4,993	3,495	12	0.3	91	5	109 (50-153)	253 (183-276)	14 (1-39)	189 (68-242)	38.4	2.4
	16	1.3	2,495	3,244	31	1	84.5	17.7	109 (50-153)	273 (125-285)	14 (1-39)	259 (21-285)	38.4	1.7
	17	1.1	4,995	5,492	51	0.9	143	26.1	109 (50-153)	271 (243-288)	14 (1-39)	232 (165-284)	38.4	1.9
	22	1.7	5,972	10,152	6	0.06	263.9	3.3	109 (50-153)	259 (239-287)	14 (1-39)	231 (200-286)	38.5	1.8
McKinney Lake	2	0.8	2,562	2,050	694	33.9	96.7	196.1	119 (70-154)	219 (179-250)	18 (3-37)	129 (65-194)	21.2	3.5
	5	0.8	5,317	4,254	142	3.3	137.2	69.5	119 (70-154)	268 (234-286)	18 (3-37)	222 (141-270)	31	2
TOTALS	-	8.2	-	40,469	3,104	7.7	1,107.7	774.6	-	-	-	-	-	-
MEAN	-	0.8	-	-	-	-	-	-	110	218	14	113	36.4	4.0

Appendix B
Summary Statistics for Harvest of Phase II Robust Redhorse Fingerlings

Appendix C
Summary Statistics for Stocking of Phase II Robust Redhorse Fingerlings

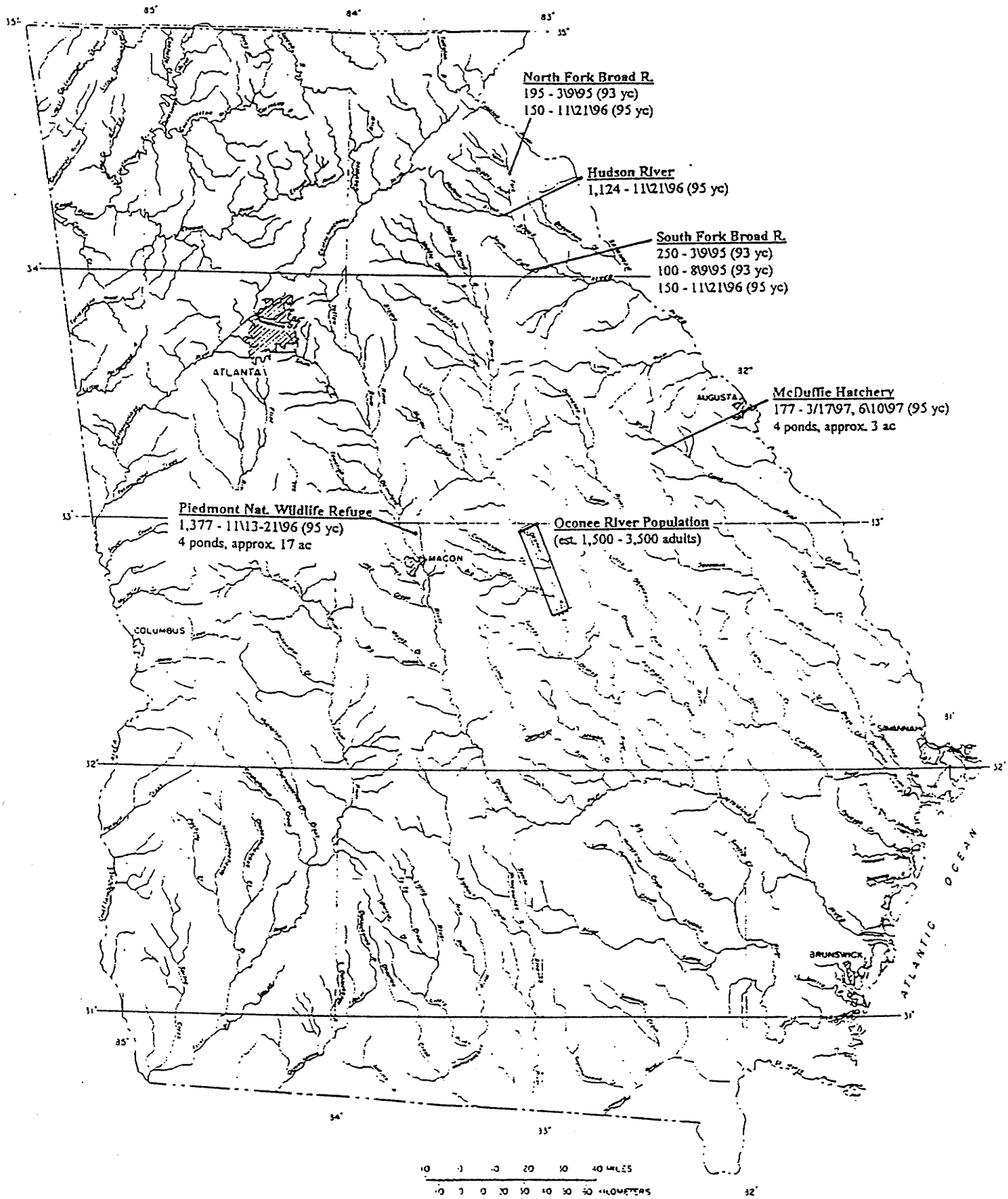
Figure 2. Summary statistics for stocking of Phase II robust redhorse fingerlings into ponds at Piedmont National Wildlife Refuge, McDuffie Hatchery, and Whitehall Lab and into the Broad River, Georgia during the period November 13 - December 17, 1996.

Date (1996)	Area Stocked	Stocking Site	Pond Size (ac)	Fingerling Source	Number Stocked (lbs. stocked)	No./ac (lb./ac) (Cumulative)	Ave. Len. (mm) (Range)	Ave. Weight (g) (Range)
Nov. 13	Piedmont	9A	7.3	BoGinn, McDuffie	109 (46.4)	15 (6.4)	249 (125-314)	193 (21-372)
		11A	4.5	Bo Ginn, McDuffie	73 (31.1)	16 (6.9)	249 (125-314)	193 (21-372)
		Pippin	3.5	Bo Ginn, McDuffie	57 (24.3)	16 (6.9)	249 (125-314)	193 (21-372)
		7A	2.1	Bo Ginn, McDuffie	33 (14.0)	16 (6.7)	249 (125-314)	193 (21-372)
Subtotal					272 (115.8)			
Nov. 14	Piedmont	9A	7.3	Bo Ginn, McKinney	252 (103.3)	49 (20.1)	249 (179-288)	187 (65-286)
		11A	4.5	Bo Ginn, McKinney	156 (63.9)	51 (20.9)	249 (179-288)	187 (65-286)
		Pippin	3.5	Bo Ginn, McKinney	121 (49.6)	51 (20.9)	249 (179-288)	187 (65-286)
		7A	2.1	Bo Ginn, McKinney	71 (29.1)	50 (20.5)	249 (179-288)	187 (65-286)
Subtotal					600 (245.9)			
Nov. 21	Piedmont	9A	7.3	-	-	49 (21.0)	-	-
		11A	4.5	Walton	225 (42.9)	101 (31.2)	192 (145-224)	87 (31-140)
		Pippin	3.5	Walton	175 (33.4)	101 (31.2)	192 (145-224)	87 (31-140)
		7A	2.1	Walton	105 (20.0)	100 (31.9)	192 (145-224)	87 (31-140)
Subtotal					505 (96.3)			
Total (Piedmont)					1,377 (458.0)			
Nov. 21	Broad R.	N. Fork	NA	Walton	150 (28.6)	NA	192 (145-224)	87 (31-140)
		S. Fork	NA	Walton	150 (28.6)	NA	192 (145-224)	87 (31-140)
		Hudson	NA	Walton	1,124 (214.3)	NA	192 (145-224)	87 (31-140)
Total (Broad R.)					1,424 (271.5)			
Dec. 17	McDuffie	13W	0.34	McKinney	94 (26.5)	276 (77)	218 (182-250)	128 (76-194)
		10W	0.29	McKinney	94 (26.5)	324 (91)	218 (182-250)	128 (76-194)
Total (McDuffie)					188 (53.0)			
Dec. 17	Whitehall	Otter Pond	0.25	McKinney	50 (14.1)	200 (56)	218 (182-250)	128 (76-194)
Total (Whitehall)					50 (14.1)			
Grand Total					3,039 (796.6)			

Appendix D

Stocking Locations for Phase II Robust Redhorse Fingerlings (1993 and 1995 year classes)

March 9, 1995 - June 10, 1997



STATUS OF ADULT ROBUST REDHORSE REARING PONDS

PIEDMONT NATIONAL WILDLIFE REFUGE

Five ponds at Piedmont National Wildlife Refuge were removed from the public fishing program to a establish refugial population for the nearly extinct robust redhorse. Robust redhorse stocking was initiated in four of these ponds in November of 1996 with individuals from the 1996 year class. The main goals of our efforts are to establish a healthy population of robust redhorse in the rearing ponds and provide a possible source of brood fish for future propagation and biological studies. Management considerations for the success of rearing a riverine species in a static pond environment include water quality, available habitat vs various stocking rates, artificial feeding to provide optimum growth, and predator control.

STOCKING STATUS

November 1997

Pond	Size	No. Stocked
7A	2.1 Acres	209
9A	7.3 Acres	361
11A	4.5 Acres	454
Pippins Lake	3.5 Acres	353
	Total	1,377

September 9, 1997

Approximately 748 tagged individuals from the 1997 year class were received from Burton Hatchery.

399 were stocked in Pippins Lake

249 were stocked in pond 9A

An estimated 100 individuals expired during transport to the ponds.

A higher mortality estimate will be used for these fish due to the variation in size and condition of the fish.

As of today **2,025** robust redhorse have been stocked at Piedmont National Wildlife Refuge.

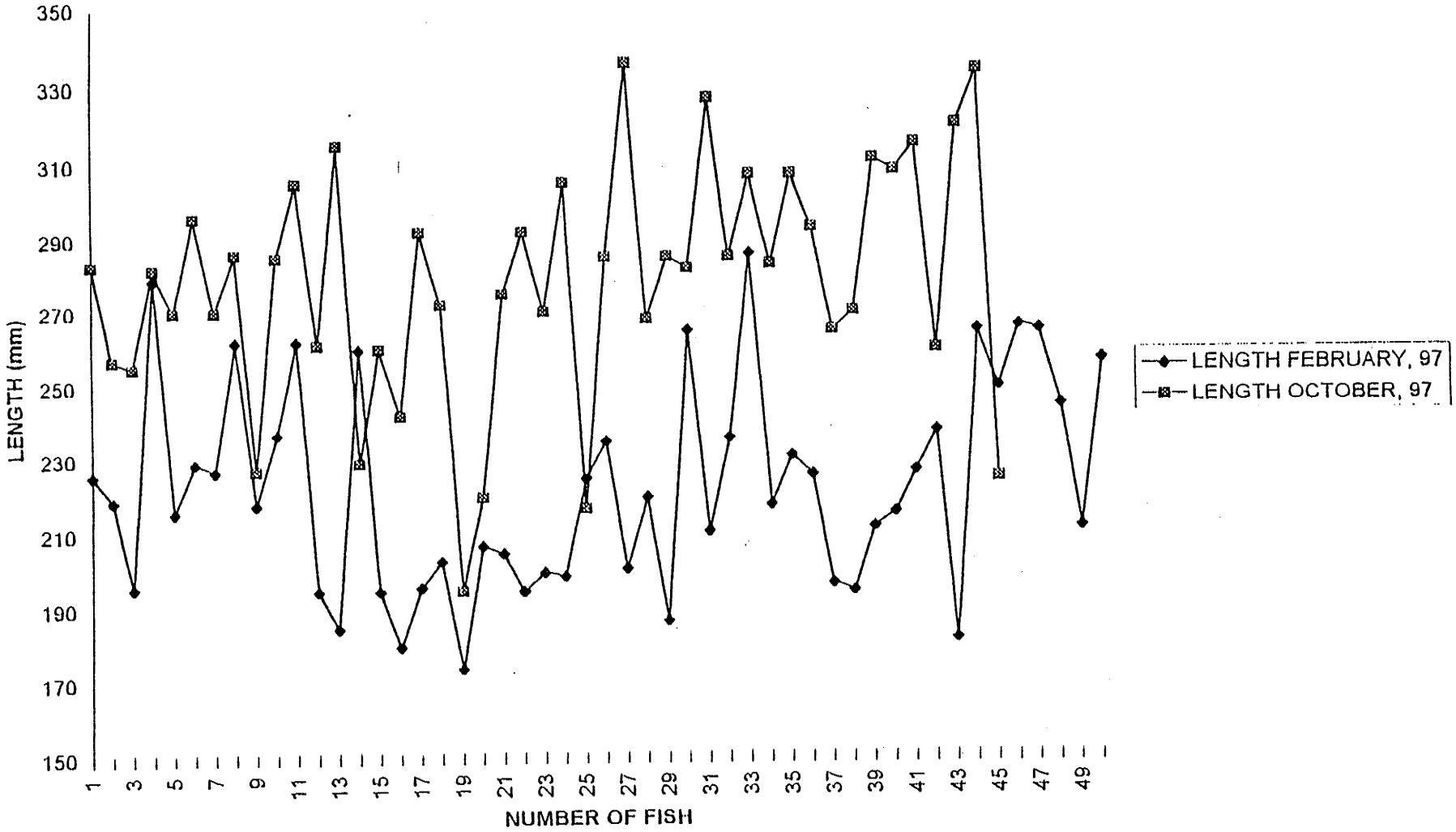
SAMPLING

October 14 and 15 all four ponds were sampled to determine the numbers and growth of robust redhorse. However, sampling conditions were not ideal. Few fish were collected from three of the ponds due to the seasons growth of aquatic vegetation. Many fish were seen but could not be collected before they disappeared into the vegetation. Additionally, the majority of robust redhorse were suspended in three to five feet of water, further complicating sampling.

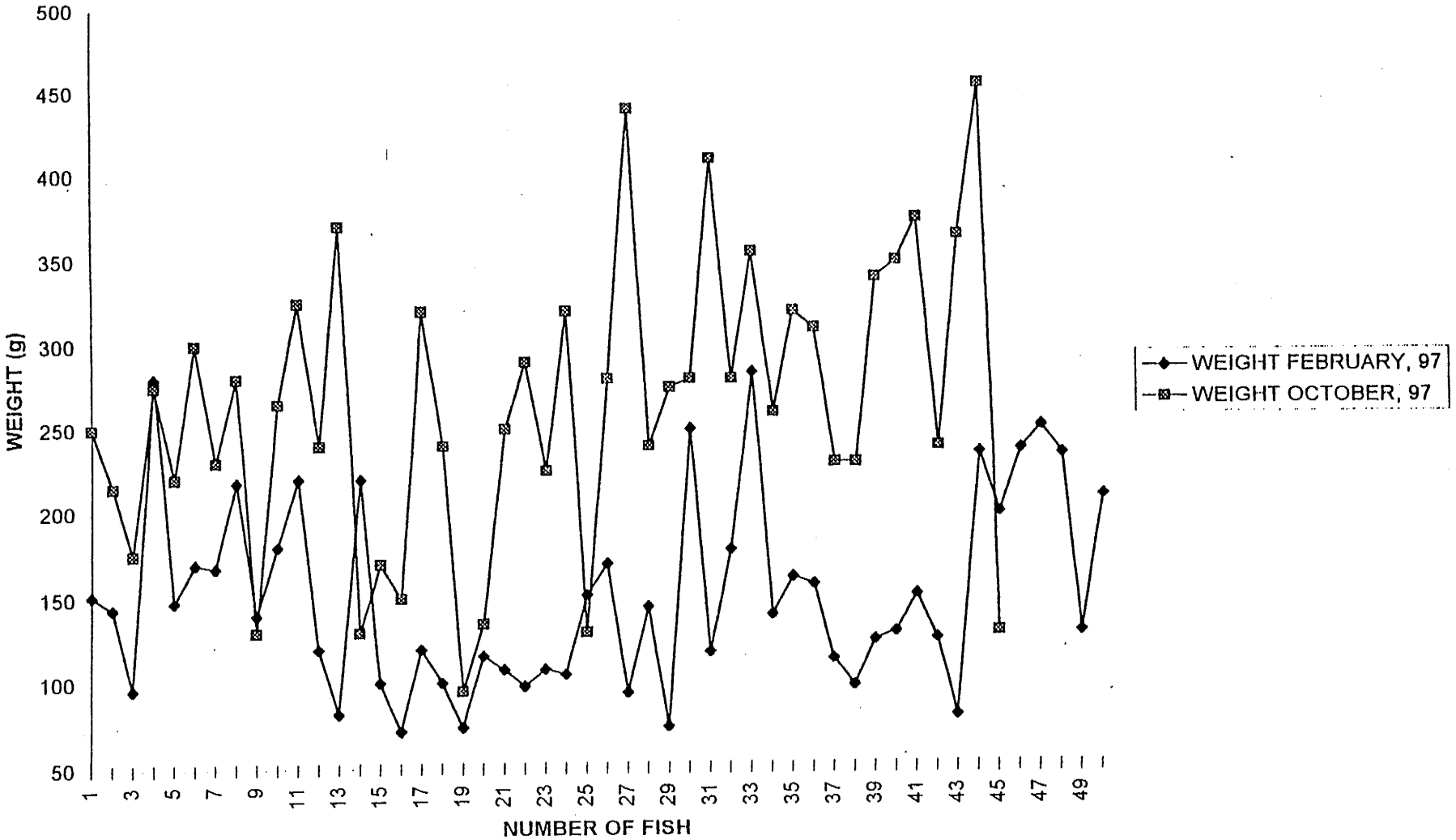
In pond 11A, however, 45 individuals were collected in the clearer water. All fish, although varying in size, appeared in good condition and have put on some growth. The standardized sampling in the ponds will be scheduled for late February each year to allow more fish to be collected before the aquatic vegetation blooms. We will sample again in February, 1998, and will determine how much growth has occurred.

In the 1998 season two ponds will be selected for intensive artificial feeding to determine if we can promote acceptable growth of pond reared robust redhorse. The limited data collected this year cannot reliably indicate growth rates or survival in the ponds. However, preliminary indications are good in that some growth has occurred. The February sampling will reveal a lot more information.

1997 ROBUST REDHORSE LENGTH DATA POND 11A

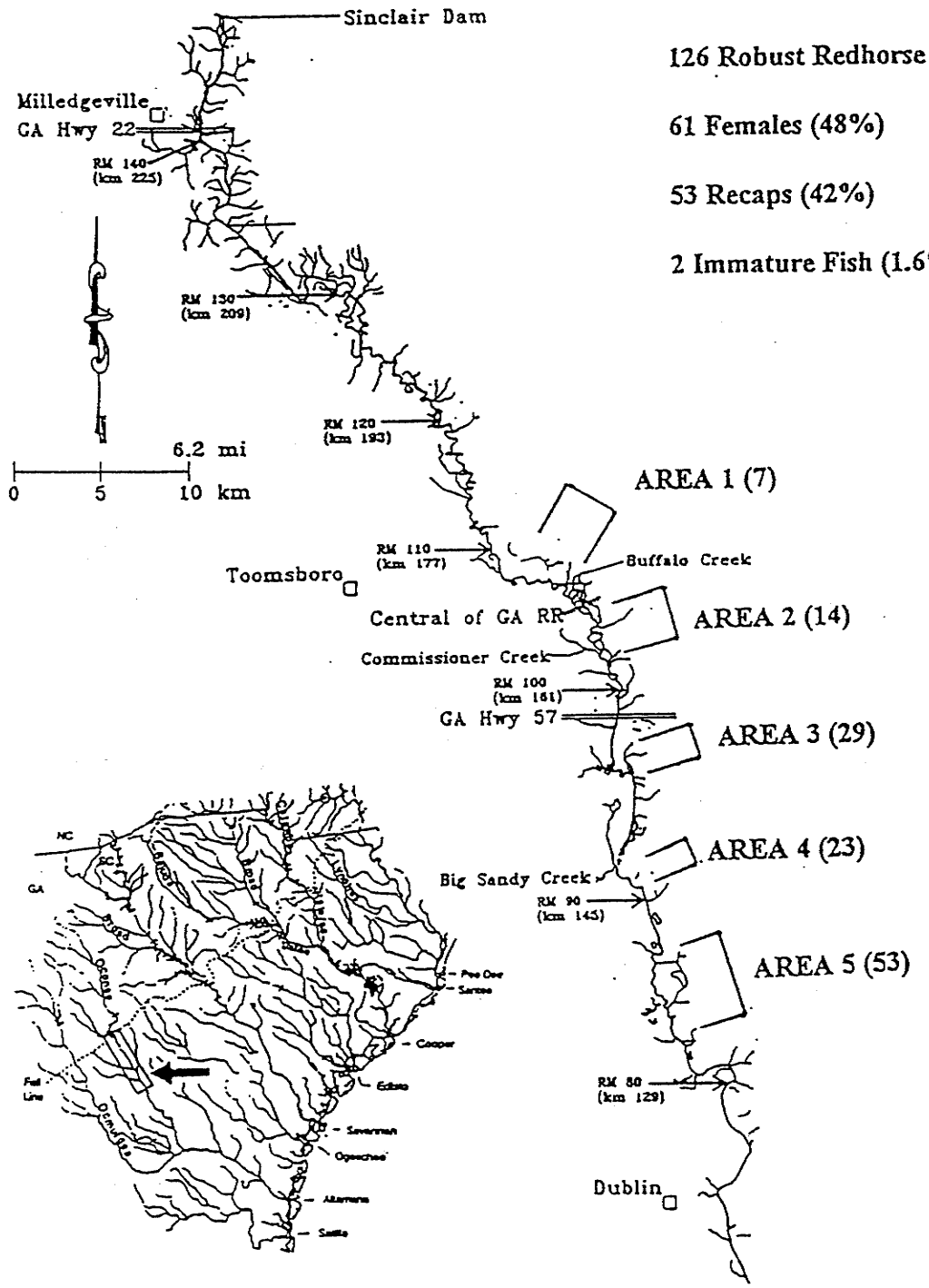


1997 ROBUST REDHORSE WEIGHT DATA POND 11A

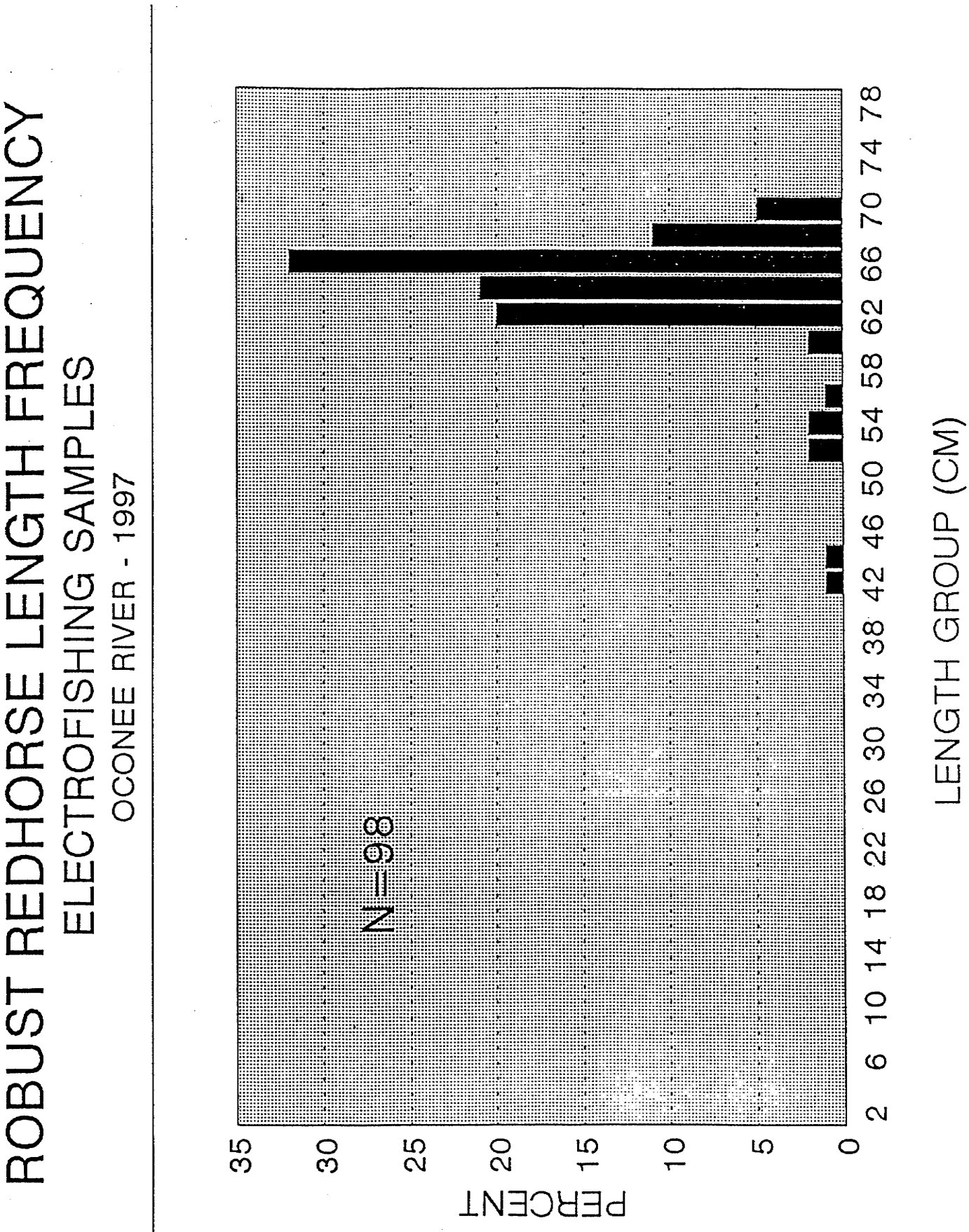


Appendix F

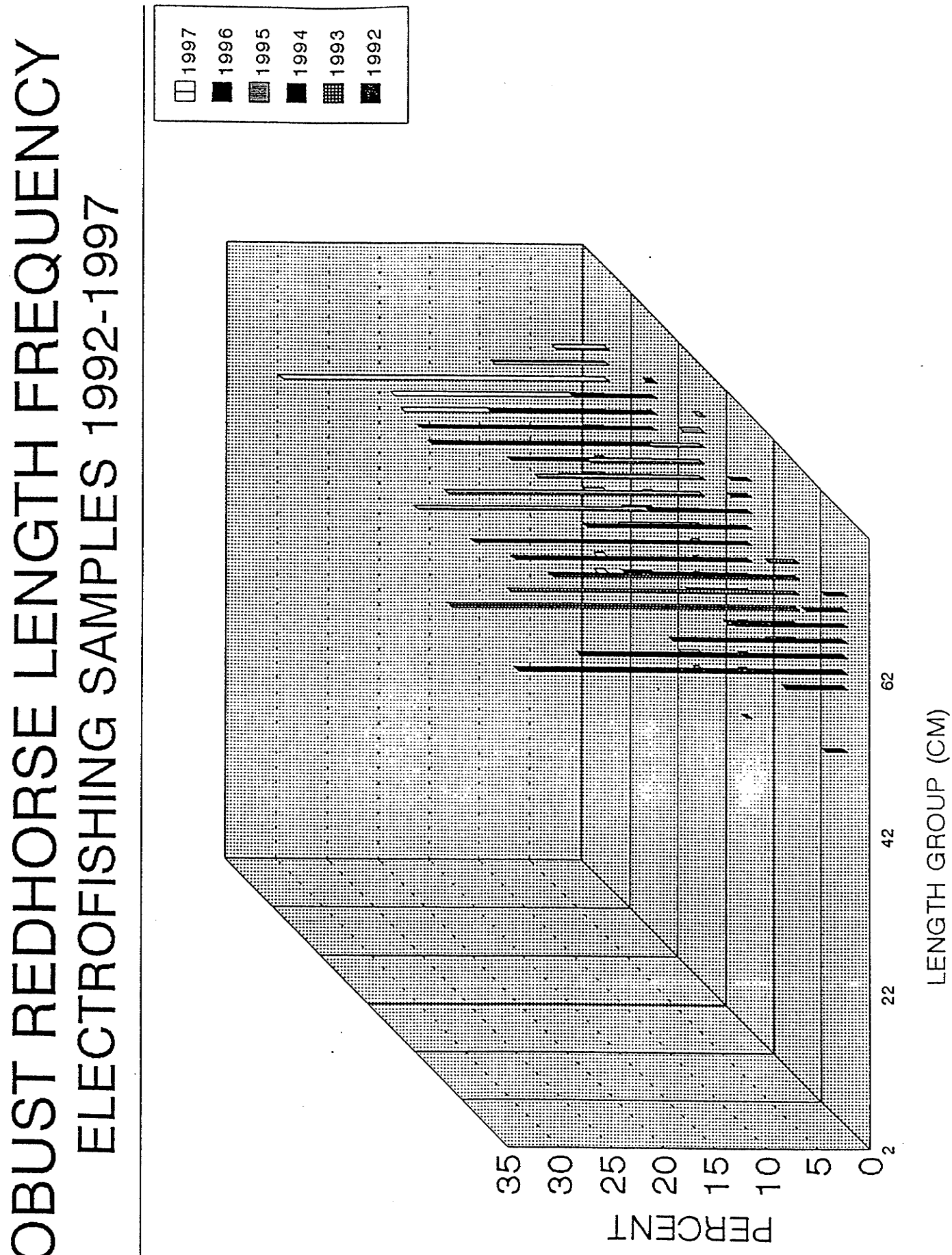
SUMMARY OF ROBUST REDHORSE COLLECTION EFFORTS IN 1997

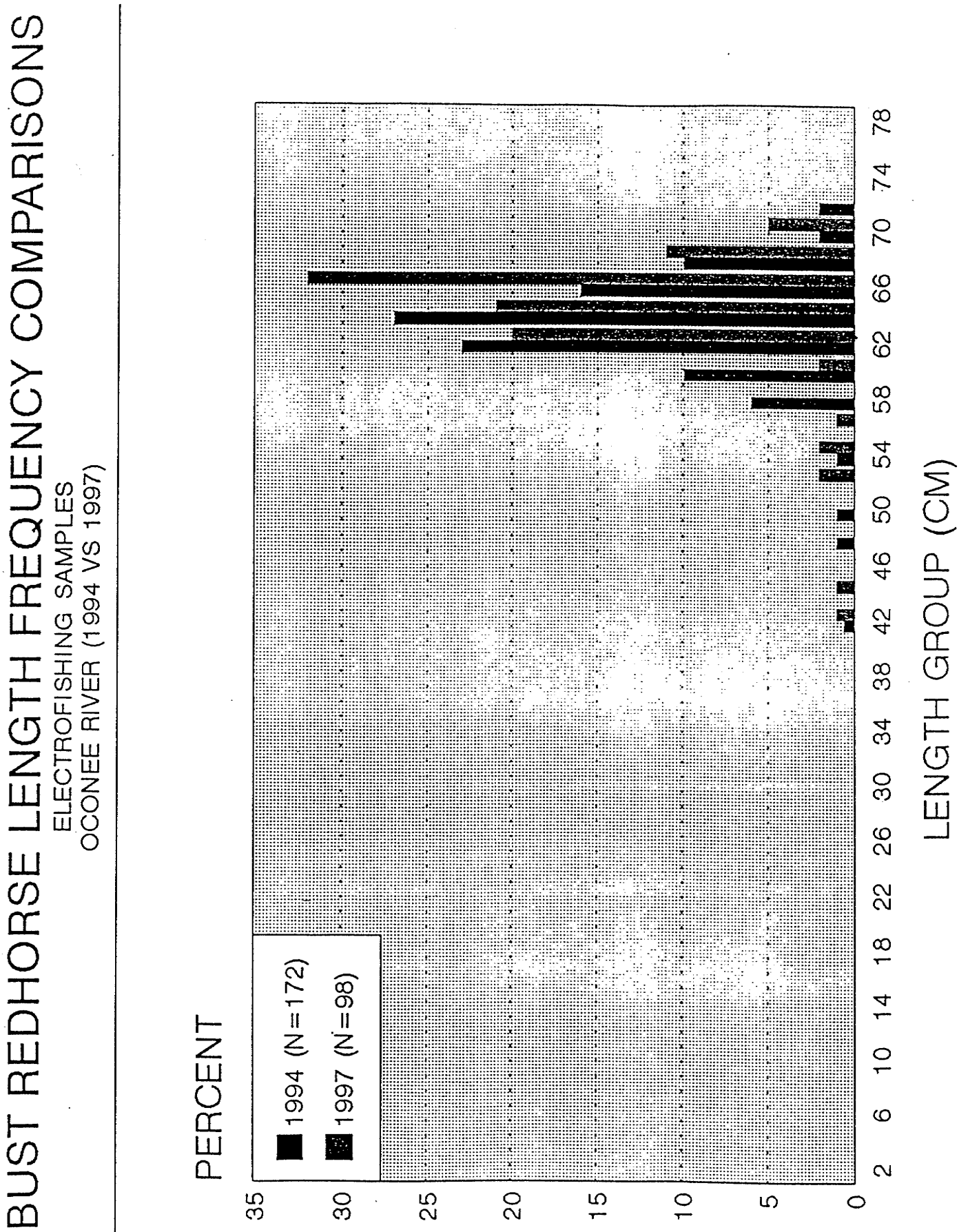


Appendix G
Robust Redhorse Length Frequency, 1997



Appendix H
Robust Redhorse Length Frequency, 1992 - 1997




ROBUST REDHORSE LENGTH FREQUENCY COMPARISONS
ELECTROFISHING SAMPLES
OCONEE RIVER (1994 VS 1997)
PERCENT
1994 (N=172)
1997 (N=98)
35
30
25
20
15
10
5
0
2
6
10
14
18
22
26
30
34
38
42
46
50
54
58
62
66
70
74
78
LENGTH GROUP (CM)

1997
ROBUST REDHORSE
DENSITY STUDY
SUMMARY

100 fish treatment	mean lgth. (mm)	47.3
	mean wt. (gms)	0.92
	% survival	72
	% deformities	0
200 fish treatment	mean lgth. (mm)	45.0
	mean wt. (gms)	0.77
	% survival	72.8
	% deformities	6.7
300 fish treatment	mean lgth. (mm)	41.5
	mean wt. (gms)	0.62
	% survival	71.9
	% deformities	27.8
600 fish treatment	mean lgth. (mm)	37.8
	mean wt. (gms)	0.44
	% survival	78.6
	% deformities	20.6

Appendix K
Robust Redhorse Diet Study Summary

1997
ROBUST REDHORSE
DIET STUDY
SUMMARY

BioKyowa B	mean lgth. (mm)	50.9
	mean wt. (gms)	1.1
	% survival	1.3
	% deformities	87.5
14 day Transition	mean lgth. (mm)	65.6
	mean wt. (gms)	3.26
	% survival	0.8
	% deformities	60.0
30 day Transition	mean lgth. (mm)	65.2
	mean wt. (gms)	2.9
	% survival	0.8
	% deformities	100.0
Slow Transition	mean lgth. (mm)	52.3
	mean wt. (gms)	1.58
	% survival	52.8
	% deformities	19.0

Appendix L
Review of Progress on 1997 Work Items

1. Review progress on work items assigned at last meeting of the Robust Redhorse Conservation Committee (October 16-17, 1996). (30 min).

a. Contact the Georgia Environmental Protection Division about the possibility of analyzing contaminant levels in the Oconee River robust redhorse population.

-EPD has been contacted, agreed to conduct standard contaminants analysis on any robust redhorse that died, also on eggs, and a sample of Corbicula from the Oconee River near spawning aggregations. EPD has been notified of the availability of the samples but work load has not allowed them time to pick up samples and conduct analysis. They are still committed to completing this work.

b. In order to address hatchery pond requirements in the short-term, the following actions were recommended:

1.) Attempt to obtain funds to operate the Bo Ginn Hatchery, at least to pay electrical bills to allow operation of the raceways.
- A total of $13,000 of FWS funds were obtained through the efforts of John Fridell for hatchery related activities. Preliminary results from tank rearing studies indicate that dietary related deformities are a major problem and studies will have to be conducted to determine appropriate dietary formulations before raceways can be used for production. These studies would best be conducted on a small scale at Warm Springs in Athens. Appropriate diets, if they can be found, could then be used for production in the raceways, but requires funding. The available funds would probably best be utilized to conduct the diet studies and focus on obtaining and testing diets that have successfully been used with other sucker species, or related species.

2.) Contact Val Nash, Chief of Fisheries at South Carolina Division of Wildlife and Freshwater Fisheries, about space on SC state hatcheries.
-Val was contacted and discussions between Val, Ross Self, Mack Watson, Forrest Sessions, and Jay Shelton resulted in the commitment of a substantial amount of hatchery space in SC. The amount of hatchery space available from various sources will be discussed under Item 5, after the break.

3.) Attempt to obtain space at the federal hatchery at Orangeburg, S.C.,
-Most of the space at Orangeburg is being used to fulfill priority needs of the SCDNR, primarily striped bass production. The striped bass will have to be produced by either state hatcheries or at Orangeburg, and it was decided to let Orangeburg produce the striped bass, freeing up some space at state hatcheries for robust redhorse production.

4.) Assess the ability of state hatcheries in Georgia to supply additional space.
-This topic was discussed at the Fisheries Section warm water hatchery

meeting in February, and at a recent meeting of the hatchery subcommittee. Sufficient space was committed, together with that provided by SCDNR, to meet production goals for 1998. The commitment was made to continue to supply the space needed to meet recovery goals. Hatchery space commitments for the coming year are will be discussed under Item 5 below.

c. It was decided that a hatchery working group should be established to arrange for hatchery space long- and short-term, and determine how the space would be most effectively used. This would include an evaluation of stocking rates and further assessments of the need to use Phase II fingerlings in the reintroduction program. The members of the hatchery subcommittee are: Jay, Jimmy, Bubba, Greg, and Chris. The hatchery working group should meet as soon as convenient and make initial recommendations to the RRCC.
-A meeting of the Hatchery Subcommittee was held on September 15 attended by Forrest and Ross hatchery managers from Georgia, as well as Jay, Bubba, Greg and Jimmy Evans. The full range of hatchery-related issues were discussed. These included 1) schedule for harvesting 1997 yc, 2) review/prioritization of stocking sites, 3) development of a harvest/stocking work plan for fall 1997, 4) finalization of pond space availability for Phase I (1998 yc) and phase II (1997 yc) production, 5) strategies for integration of robust redhorse production with other hatchery activities.
-A summary of this meeting is available for those that are interested.

d.) Obtain a legal opinion from the FWS to define the potential implications of reintroductions of an imperiled fish species conducted under a "prelisting" recovery approach, as authorized by an MOU. Initial steps should be accomplished in January or February 1997, if possible.
-Jimmy Evans had a number of discussions with John Fridell on this subject and John had additional discussions with authorities at the FWS. A meeting was held at the WRD office in Fort Valley on September 12, attended by Scott Hendricks and Mike Nichols of GPC, Mark Bowers of the FWS and Jimmy Evans, John Fridell participated in the meeting by telephone. John explained what he had discovered regarding the implications of reintroductions of an imperiled species which are conducted under a "prelisting" recovery approach. A primary issue involved is the definition of the term "experimental population". It was decided at this meeting that the following actions should be taken as soon as possible: 1) Scott Hendricks and Mike Nichols will draft an outline of a general Conservation Strategy, similar to the Recovery Plans drawn up after a species is listed under the ESA. It was felt that a Conservation Strategy was needed for power company management to grasp the full scope and implications of this "prelisting" recovery approach, including the need for reintroductions into suitable habitat outside the Oconee River. This Conservation Strategy would also serve as a reference and educational tool for anyone not closely involved with the recovery effort, 2) Mark Bowers agreed to summarize Section 10j of the ESA which specifically covers the subject of experimental populations and the criteria for designating reintroduced populations

as experimental. After summarizing Section 10j, Mark will send the summary to John for review. The summary could then be sent to power companies representatives to serve as a reference when making decisions regarding the need for future stockings in rivers where hydropower projects exist, 3) Lastly, Jimmy Evans will supply a list of factors which would result in the geographic isolation of the Oconee River population and a population which might be reintroduced into the upper Ocmulgee River (between Juliette Dam and Jackson Dam) in the future. Geographic isolation between parental and reintroduced population is a requirement for the designation of "Experimental Population".
-Note: Do we comment on the progress of these efforts here, wait until the open discussion session, or assign someone the job of sending out an update on this subject at a later date.

e. Consult a geneticist to determine if the 200 fingerlings which escaped into the Little River drainage should be augmented by additional stockings, in order to increase the available gene pool. The Little River is a relatively low priority stocking site and it was decided that a major stocking program for that river should be avoided, if possible.
-Two geneticists were consulted and the consensus seemed to be that if there was a reasonably good chance that the escaped fingerlings would survive, then the gene pool should be augmented through additional stockings. Of course, there is no consensus on the likelihood that any of these fingerlings will survive to maturity. Therefore the decision of whether or not to stock the Little River remains to be decided.

Appendix M
Tentative Schedule for Harvest of Phase I Robust Redhorse Ponds

Tentative schedule for harvest of Phase I robust redhorse ponds at various hatcheries.

Hatchery	Time Period
Burton SFH, GA	October 8 - 10
Campbell SFH, SC	October 27 - 31
Dennis Wildlife Center, SC	November 3 - 14
Walton/ McDuffie SFH, GA	November 17 - 21
Richmond Hill SFH, GA	November 24 - December 5

Summary of information to collect during fall 1997 robust redhorse fingerling harvest.

1. Lengths and weights from 100 "normal" (i.e., non-deformed) fish from each pond.

2. Total number and total weight from each pond.

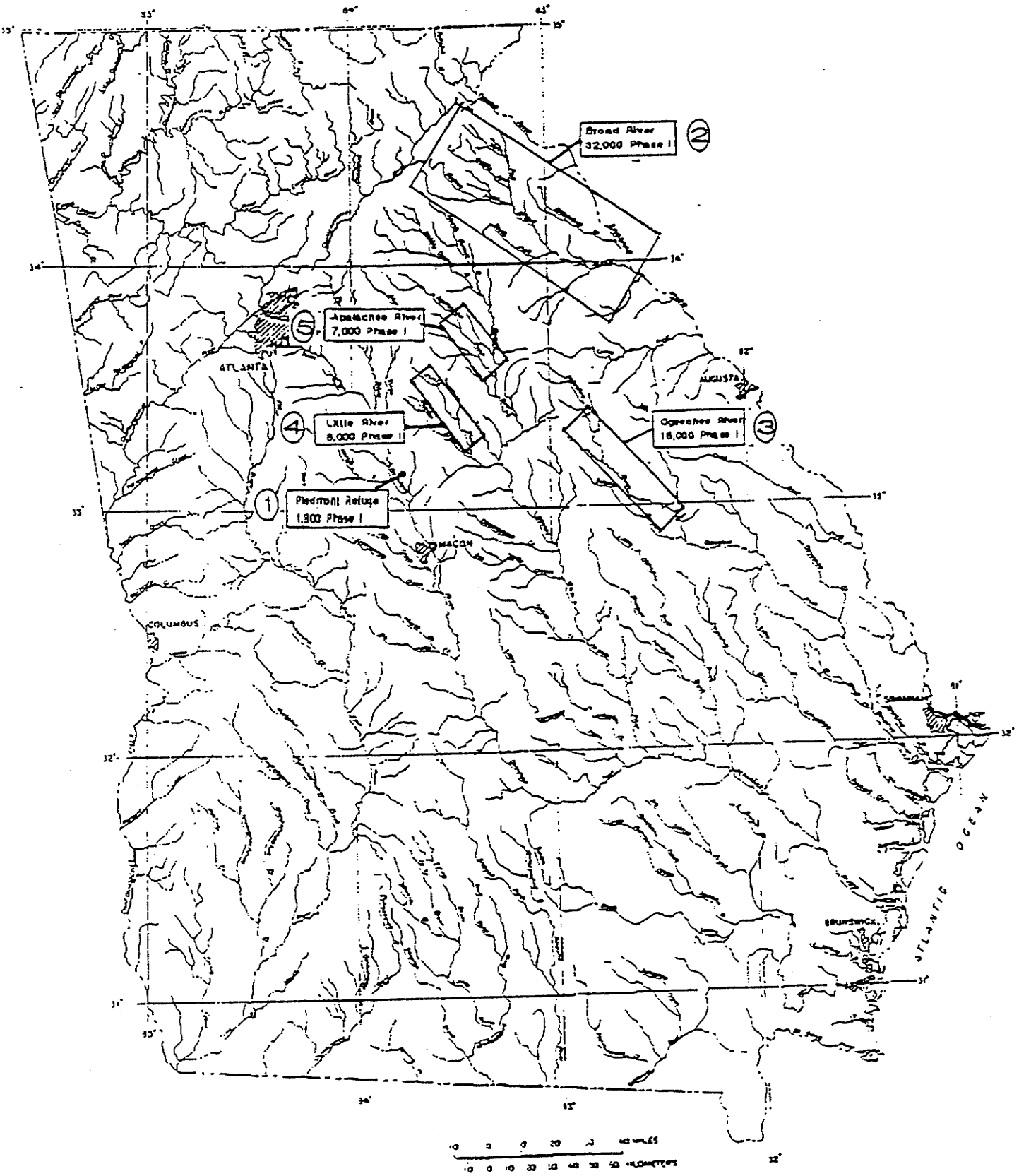
3. Pectoral fin clips from 10 "normal" fish from each pond (or a total of 30 from each hatchery) for genetic material. Preserve fin clips in 90% ethanol. Jimmy Evans will provide vials and ethanol.

4. Provide estimate of percent and type of deformities (based on an examination of fingerlings made during tagging process).

5. All fingerlings will be tagged with coded-wire tags. Start and ending tags for batches of fingerlings stocked at individual sites will be stored in vials. Individual stocking sites will therefore be coded by specific tag sequences. Tag insertion location for 1997 year class will be the dorsal fin area and the first batch tagged (Burton Hatchery) will be kept in vats for 24 - 48 hrs. after tagging to determine tag retention rate.

Appendix N

Proposed Sites for Phase I Robust Redhorse Fingerling Reintroductions in Georgia During 1997. Suggested Number of Fingerlings for Each Site are Shown. Circled Numbers Indicate Prioritization.

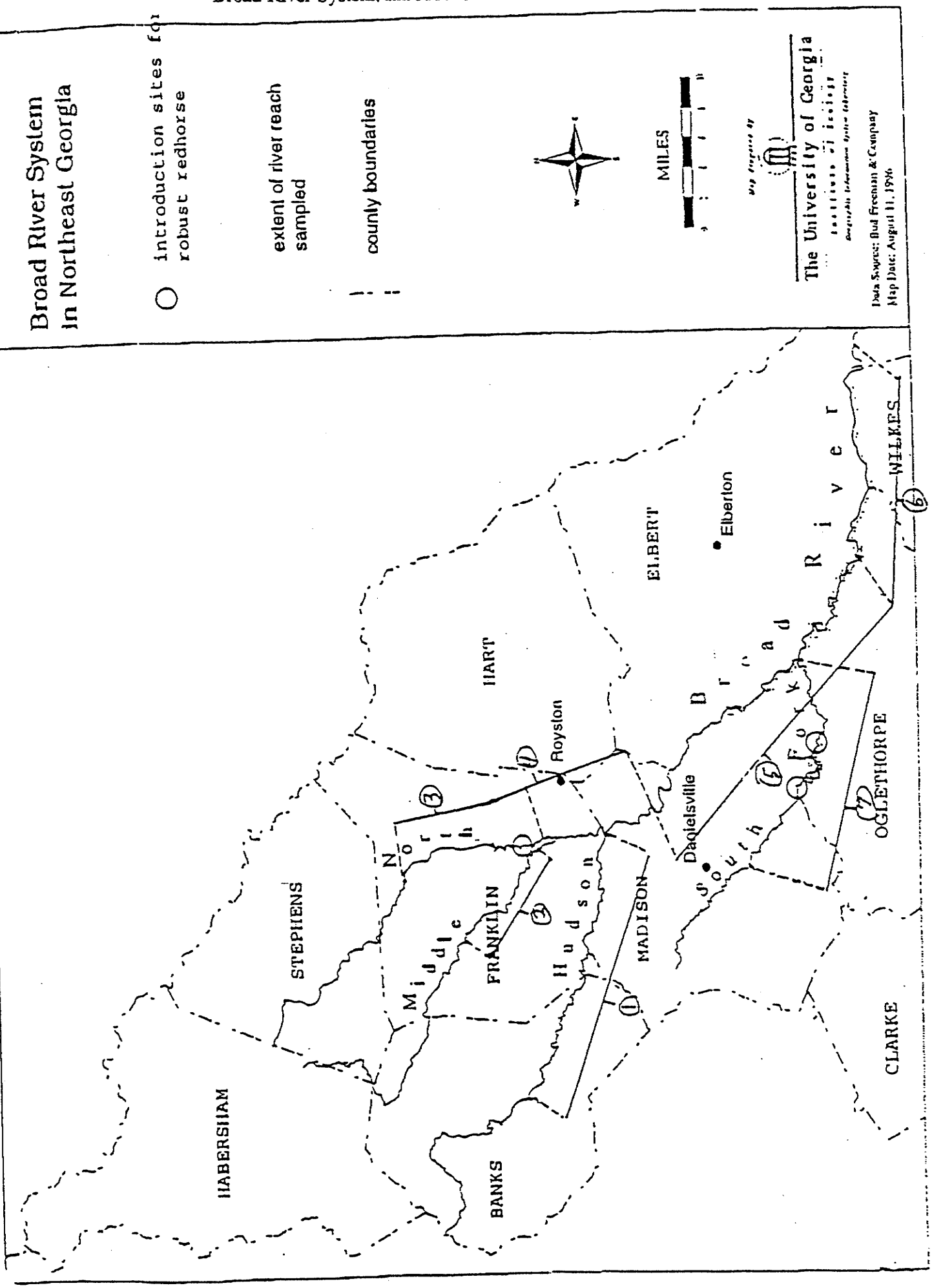


Stocking scenario for robust redhorse reintroduction efforts in the Broad River, Georgia.

Stocking Site	Length (RM)	Carrying Capacity[1] (no. per RM)	Target no. Per Site[2]	No. Fing. Required per year[3,4]
1	18	40	720	4,500
2	12	20	240	1,500
3	13	20	260	1,500
4	13	60	780	4,500
5	27	60	1,020	6,000
6	25	80	2,000	12,500
7	13	20	260	1,500
Totals	121	-	5,282	32,000

[1] Carrying capacity expressed as number of adults per river mile.
[2] Target number expressed as number of adults per stocking site.
[3] Refers to number of Phase I fingerlings which must be stocked each year to reach target number of adults in eight years.
[4] No. fingerlings required assumes 80% mortality the 1st year, 50% the 2nd year, and 20% in subsequent years.

Appendix P
Broad River System, Introduction Sites for Robust Redhorse



Appendix Q
Hatchery Pond Space Available for Rearing Phase II and Phase I Fingerlings

Hatchery pond space available for rearing Phase II (fall 1997) and Phase I (spring 1998) robust redhorse fingerlings. Pond space commitments made at meeting of Robust Redhorse Hatchery Subcommittee, September 15, 1997.

Hatchery	Phase I (ac)	Phase II (ac)	Either Phase I or II (ac)
McDuffie, GA			2.18 (3 ponds)***
Walton, GA	1.45 (2 ponds)		0.45 (1 pond)
Burton, GA	0.60 (2 ponds)**		0.30 (1 pond)
Richmond Hill*, GA	1.25 (1 pond)		
Dennis Center, SC	3.00 (3 ponds)	1.00 (1 pond)	
Campbell, SC	0.50 (1 pond)		
Totals	6.80 (9 ponds)	1.00 (1 pond)	2.90 (5 ponds)
Grand Total	10.70 (15 ponds)		

*Current acreage\usage. Commitment for Phase II in fall 1997 and fry in spring 1998 has not been determined.

**Availability of these ponds dependent on requirements for KFE ponds.

***May exchange one of these ponds for a smaller pond, resulting in a total of 1.68 ac.

Prioritized Research Needs
Robust Redhorse Recovery

I. Culture Techniques
  A. Propagation
    - Use of hormones to induce ovulation.
    - Incubation techniques.
    - Water quality requirements, temperature sensitivity.
    - Egg and fry handling techniques.
    - Fry dietary requirements, growth trials.
    - Maximizing genetic diversity.
  B. Rearing
    - Dietary requirements of Age-0 and Age-1 fingerlings.
    - Growth trials on various diets in ponds.
    - Growth and survival at various stocking rates in ponds.
    - Food habits\preference of fingerlings in ponds.
    - Intensive culture in raceways, tanks, and cages.
    - Pond preparation.
    - Rearing techniques for larger juveniles and adults.

II. Early Life History Habitat Requirements
  A. Egg viability in redds, substrate characteristics necessary for viability. Impacts of turbulence and rapid changes in current velocities.
  B. Depth, current velocity, substrate, and cover preferences (larval to advanced fingerling stage). Impacts of turbulence and rapid changes in current velocities.
  C. Swim-up survival and fry disposition.
  D. Juvenile habitat requirements.

III. Monitoring the Oconee River Population
  A. Annual electrofishing catch rate comparisons.
  B. Age and growth studies.
  C. Population estimation.
  D. Adult spawning and non-spawning habitat requirements.
  E. Spawning site delineation and characterization.
  F. Long-term migration patterns.
  G. Daily, monthly, and seasonal movement patterns.
  H. Larval and YOY sampling.

IV. Monitoring Stocked Populations
  Evaluation of sampling methods. Determination of growth, survival, reproductive success; relationships between predator types\densities and survival.

V. Post-Stocking Behavior
  Telemetry investigations of Age-1 and, if possible, Age-0 fingerling behavior for a several week or month period immediately after stocking. Important in identifying suitable stocking sites and potential for migration out of stocking sites.

VI. Tagging Studies

Coded-wire tag retention for Age-0 and Age-1 fingerlings at various tag insertion locations. Suitable tag length, diameter, etc. Effectiveness of various field detection techniques. Evaluation of tagging methods for identification of individual fish.

VII. Predator Control

Techniques for reducing flathead catfish densities. Focus on the Oconee River, but applicable to stocked rivers.

VIII. Population Genetics

Genetic heterogeneity (MDNA and electrophoretic techniques); Oconee River population as well as populations or individuals which might be collected from other drainages in the future.

IX. Distributional History

A. Additional surveys to determine if other populations or isolated individuals exist in Georgia, South Carolina, or North Carolina.
B. Investigations into historical occurrence and distribution.
C. Correlation between changing land and water use patterns and species decline.

X. Behavioral Studies of Adults.

Focus on spawning and feeding behavior, behavioral responses to rapidly changing flows.

XI. Evolutionary Biology

Establish phylogenetic relationships.

XII. Physiology

Thermal biology, endocrinology, reproductive biology, etc.

PROPOSED CONSERVATION ACTIONS
(Bold indicates short term (6-8 yr.) needs)

a. Propagation and culture studies
   i. **Culture techniques**
   ii. **Development**
   iii. **Growth**
   iv. **Nutrition Tagging**
   v. **Water quality**
   vi. **Disease**

b. **Reintroduction assessment for experimental populations**
   i. **Habitat suitability**
   ii. **Accessibility**
   iii. **Watershed development**
   iv. **Predator densities**
   v. **Water quality**

c. Habitat Restoration

d. Life History Research (early life history research is a short term goal)
   i. **Egg viability**
   ii. **Swim-up survival and fry disposition**
   iii. **Behavior**
   iv. **Food habits**

e. Riparian Zone Management

f. Environmental Requirements
   i. Habitat assessments (early life history stages)
   ii. Instream flow requirements (early life history stages)

g. Applied Research
   i. **Population genetics**
   ii. **Distributional history**
   iii. **Physiology**
   iv. **Evolutionary biology and zoogeography**

h. Predator Control Measures

i. **Monitoring Populations**

Cost estimates for all short term research needs range from $400-600 thousand.