REPORT OF THE

ROBUST REDHORSE CONSERVATION COMMITTEE ANNUAL MEETING

Charlie Elliott Wildlife Center
Mansfield, Georgia
October 21 – 23, 2014

Ogeechee River, Georgia.
Credit: Georgia DNR

Report compiled by
Jaclyn Zelko
U.S. Fish & Wildlife Service

TABLE OF CONTENTS

ACRONYMS & ABBREVIATIONS

CPLC	Carolina Power and Light Company
CVIOG	Carl Vinson Institute of Government
DPC	Duke Power Company
FERC	Federal Energy Regulatory Commission
GA Coop	University of Georgia Cooperative Fish & Wildlife Resource Unit
GA DNR	Georgia Department of Natural Resources
GPC	Georgia Power Company
GRN	Georgia River Network
GWF	Georgia Wildlife Federation
NC WRC	North Carolina Wildlife Resources Commission
NCS MNS	North Carolina State Museum of Natural Sciences
NYU	New York University
SC Coop	South Carolina Cooperative Fish & Wildlife Research Unit
SC DNR	South Carolina Department of Natural Resources
SCEG	South Carolina Electric and Gas
SCA	South Carolina Aquarium
UGA	University of Georgia
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey (Biological Resources Division)

FTC	Fish Technology Center
NFH	National Fish Hatchery
SFH	State Fish Hatchery
WMA	Wildlife Management Area

CCAA	Consolidated Conservation Agreement with Assurances for the Ocmulgee River
Excom	Former Technical Advisory Group to the RRCC
GIS	Geographic Information System
IT TWG	Information Technology Technical Working Group
MOU	Memorandum of Understanding
PIT	Passive Integrated Transponder Tags
RRCC	Robust Redhorse Conservation Committee
TAG	Technical Advisory Group
TWG	Technical Working Group

AGR	Artificial genetic refuge
C	Celcius
cfs	Cubic feet per second
cm	Centimeter
g	Gram
kg	Kilogram
km	Kilometer
m	Meter
mg/l	Milligrams per liter
mm	Millimeter
MWe	Megawatts of electrical output
m3/s	Cubic meter per second
N*e*	Effective population size
ppt	Parts per thousand
rkm	River kilometer
RM	River mile
TL	Total length
YC	Year class
YOY	Young of year

E X E C U T I V E S U M M A R Y

The robust redhorse recovery effort, in its 20th year, encompasses management activities and research and conservation efforts undertaken by members of the Robust Redhorse Conservation Committee (RRCC), university scientists, and other affiliates. The RRCC, established by a Memorandum of Understanding (MOU) signed in 1995, is responsible for developing and managing a recovery approach for the imperiled robust redhorse (*Moxostoma robustum*). The effort and expertise applied to the questions of recovery are brought together at the annual meeting of the RRCC.

The seventeenth annual meeting of the RRCC was held October 21 – 23, 2014 at Charlie Elliott Wildlife Center in Mansfield, Georgia. Approximately 35 representatives (see Attachment 1) of the signatory agencies to the MOU, university research affiliates and other interests attended the meeting. The 13 signatory agencies include: Georgia Department of Natural Resources, South Carolina Department of Natural Resources, North Carolina Wildlife Resources Commission, Georgia Power Company, Duke Energy Progress, South Carolina Electric and Gas Company, U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Forest Service, Georgia Wildlife Federation, and South Carolina Aquarium. University research affiliates include: University of Georgia Warnell School of Forest Resources, University of Georgia Institute of Ecology, University of Georgia Cooperative Fish and Wildlife Research Unit, Roanoke College Department of Biology, University of Georgia Carl Vinson Institute of Government, University of Georgia Department of Genetics, Cornell University Department of Molecular Biology and Genetics, Clemson University Cooperative Fish and Wildlife Research Unit, New York University School of Medicine Institute of Environmental Medicine, and State University of West Georgia. In addition, representatives of other concerns with interest in recovery of the robust redhorse include: Santee Cooper Power Company, Georgia Aquarium, Georgia River Network, and the North Carolina State Museum of Natural Sciences. The success of the recovery effort, to a large extent, depends on the willingness of RRCC members and others to participate in the annual meeting and to continue to support recovery throughout the year.

This report summarizes updates on management activities, research findings, and conservation efforts and decisions made at the 2014 RRCC Annual Meeting. The RRCC Annual Meeting Reports have become important documents of research, science, management, and recovery that are often referred to and cited. The format of this year's report closely follows the format of previous reports and it provides a more accurate record of activities. The report notes discussion points, questions, main ideas, and/or notes recorded by the participants.

I N T R O D U C T I O N

Historically, the robust redhorse (*Moxostoma robustum*) inhabited Atlantic slope drainages from the Pee Dee River system in North Carolina to the Altamaha River system in Georgia. The first scientifically confirmed sighting of robust redhorse since naturalist Edward Cope described the species in 1869 occurred when the fish was re-discovered in the Oconee River in Georgia in 1991. In the Altamaha River drainage, the species is presently known to exist in a relatively short reach of the Oconee River between Sinclair Dam and Dublin, Georgia, in a short upper Coastal Plain section of the Ocmulgee River, and an individual has been found in the Little River, a tributary to Lake Sinclair. Individuals also have been found in the Savannah River (the boundary river between Georgia and South Carolina) in the Augusta Shoals area as well as below the New Savannah River Bluff Lock and Dam. In addition, robust redhorse have been captured in the Pee Dee River below Blewett Falls Dam in North Carolina. Robust redhorse populations have also been reintroduced within their historic range into the Broad, Ocmulgee, and Ogeechee rivers, Georgia, as well as the Broad and Wateree rivers, South Carolina. The robust redhorse appears to inhabit specialized areas of large rivers, which are difficult to sample but regardless of the absence of sightings, small numbers are usually found when species-targeted surveys are conducted.

River impoundments, predation by introduced nonnative species, and significant deterioration of habitat due to sedimentation and water pollution are believed to have contributed to the decline of the species. The complex and diverse problems facing the robust redhorse require an interdisciplinary approach, using a broad spectrum of experience, expertise, and management authority to maintain and restore this imperiled species. In addition, it is essential that recovery efforts include a process that works closely with the private sector as well as government agencies potentially impacted by and interested in robust redhorse conservation.

The Robust Redhorse Conservation Committee (RRCC) was established by a Memorandum Of Understanding (MOU) signed in 1995 and renewed in 2010 to develop and manage a recovery approach for the robust redhorse (*Moxostoma robustum*), previously a Category 2 candidate for Federal listing under the Endangered Species Act. The RRCC is actively committed to the recovery of the imperiled robust redhorse throughout its former range. It identifies priority conservation needs for the robust redhorse and its habitat and coordinates implementation of research and management programs for addressing those needs.

A D M I N I S T R A T I O N

Introductions – Alice Lawrence
Alice Lawrence, Chair of the RRCC gave the opening remarks for the 2014 annual meeting. She welcomed all the participants and gave a quick overview of the 20 years of robust redhorse recovery effort. All participants were asked to introduce themselves and their agency.

Welcome – Don Imm
Don Imm, Field Supervisor at the FWS Georgia Ecological Services Field Office in Athens, Ga welcomed all the participants to the 20th annual Robust Redhorse Conservation Committee meeting. He commended all the partners and participants in the recovery efforts that have been conducted as indicated his hope that the collaboration continues well into the future.

M A N A G E M E N T A C T I V I T I E S

Georgia 2014 Update – Jimmy Evans

Recently completed research

- Movement patterns, habitat use, and home range of adult robust redhorse released into the Oconee River, GA (Patrick Ely). Final report completed.
- Abundance, size structure, movement patterns, and recruitment success of robust redhorse stocked into the Ogeechee River, GA (Patrick Ely). Final report completed.
- Use of hierarchical occupancy models in the Ocmulgee River, GA (Will Pruitt). Thesis to be completed in December.
- Population status and assessment of reproduction and recruitment of robust redhorse in the Broad River system (Carrie Straight and Bud Freeman). Final report completed.
- Reproduction, Migration, and Prospects for Persistence of a Reintroduced Population of an Imperiled Riverine Fish, Robust Redhorse (Carrie Straight). Dissertation accepted in May 2014.

Ongoing research

- Oconee River population status assessment (Oconee TWG).
- Ogeechee River population status assessment and recruitment monitoring (Joel Fleming).
- Search for wild and/or stocked populations above Sinclair Dam (Little River, Murder Creek) and above Wallace Dam (Apalachee and Oconee rivers). (Jimmy Evans).
- Monitoring of Oconee River gravel augmentation sites (Jimmy Evans).
- Recruitment monitoring in the Broad River, GA (Jimmy Evans).
- Recruitment monitoring in the Ocmulgee River, GA (Jimmy Evans).
- Sampling the lover Savannah River for juveniles (Alice Lawrence).

Environmental reviews

- Ongoing efforts to obtain fish passage at Juliette Dam on Ocmulgee River.
- Increase ROR spawning/rearing flows on Oconee River by five additional days (from May 1 – June 10 to June 15).
- Ongoing efforts to obtain fish passage at NSRB on Savannah River.
- MWA offer to provide funding support for RRH recovery project.

Public relations

- Live fish displays at Georgia Aquarium and Go-Fish-Georgia Center.
- New state park under construction at Balls Ferry on Oconee will increase awareness of recovery efforts.
- Georgia Outdoors TV program has completed video on robust redhorse recovery effort.

Following is a summary of robust redhorse recovery activities in Georgia planned for 2015.

Oconee River population status assessment (Oconee TWG)

- Intensive sampling effort to assess status of the Oconee River population from Sinclair Dam to Dublin (60 – 80 hrs. total effort); sample Sinclair tailrace and Avants.
- Continuing visual, electrofishing, and hydro-acoustic monitoring of Oconee River gravel augmentation sites and Avant Mine spawning site.

Ogeechee River population status assessment/recruitment monitoring (Joel Fleming)

- Continue electrofishing standardized sampling program, with possible addition of sites in the Louisville area and collect fin clips for genetic-based recruitment analysis.

Savannah River population status assessment/recruitment monitoring

- Continue electrofishing standardized sampling program, and add robust to target species list (J. Fleming).
- Visual and hydro-acoustic monitoring of spawning sites (C. Straight).

Ocmulgee River population status assessment/recruitment monitoring

- Visual assessment of abundance and recruitment success at Juliette spawning fish; net fish to collect fin clips (non-game, A. Lawrence).

Broad River population status assessment/recruitment monitoring

- Visual and hydro-acoustic monitoring of upper Broad spawning sites (C. Straight, A. Lawrence).
- Electrofishing in Anthony Shoals area for recruitment monitoring (length distribution and to collect fin clips for genetic analysis) (TBD).

Search for wild and/or stocked populations above Sinclair Dam (Little River, Wallace tailrace) and above Wallace Dam (Apalachee and Oconee rivers)

- Search for spawning sites on the Little and Apalachee rivers (A. Lawrence, C. Nelson).
- Electrofishing in Wallace Dam tailrace (T. Dodd).

Lower Altamaha and Savannah rivers

- Possible activity if funding and activity are available.

Savannah River at Augusta Shoals

- Possible activity if funding and activity are available.

Oconee River Spring Sampling Update – Tony Dodd

The objective of the 2014 survey for Oconee River Robust Redhorse was to document presence of robust redhorse (*Moxostoma robustum*) in historically prime areas of occurrence throughout the known range of Oconee robust redhorse within the 80-mile

segment of Oconee River between Milledgeville and Dublin, Georgia. The previous survey in 2012 resulted in no captures. The 2014 effort included 21 days of boat electrofishing distributed among documented spawning areas formerly associated with frequent captures following the initial re-discovery of the species in the early 1990's. Utilizing the same technique under similar site flow conditions and with similar intensive electrofishing effort as in surveys past, the survey yielded two adult robust redhorse and one observation of a third uncaptured adult specimen. The two captured fish, a male in ripe running condition and a gravid female, were previously untagged measuring lengths of 518 mm and 527 mm, respectively. The resultant catch rate was extremely low possibly indicating either a declining or low, stable population trend. Notably, although few in number, these previously untagged captures are a positive sign of recruitment either by natal or stocked robust redhorse.

Also notable, were the investigators associated survey observations of changes in habitat expressed especially by greatly diminished surficial gravels, increase in sediment deposition, channel aggradation and flow path alterations, bankside erosion and significant deposition by recently-live large woody debris. Results of this survey leave technical investigation team members speculating about adequacy of the most recent data to reliably indicate the population level as well as gaging the impact of other major factors on the current population status including the need for supplemental stocking, regulated spawning and early-rearing season river flows, still unquantified predator-prey effects, and instream habitat changes perhaps as they relate to prevailing flow regime and/or periodic high flow events past.

Ogeechee River Georgia DNR Update – Joel Fleming

Joel Fleming, GADNR presented an update of robust redhorse recovery activities that were conducted in 2014 on the Ogeechee River. The Ogeechee River was stocked with 7 year-classes between 1997 and 2004. A total of 43,048 fish were stocked in four locations. Georgia DNR conducts annual standardized sport-fish sampling at 18 randomized locations in the Ogeechee River. Robust redhorse have been collected yearly from 2000 to 2005 and again in 2009 during the standardized sampling events. Collection data shows that the robust redhorse population has moved upstream (Figure A) that has been verified by directed robust sampling efforts and telemetry (Ely 2013).

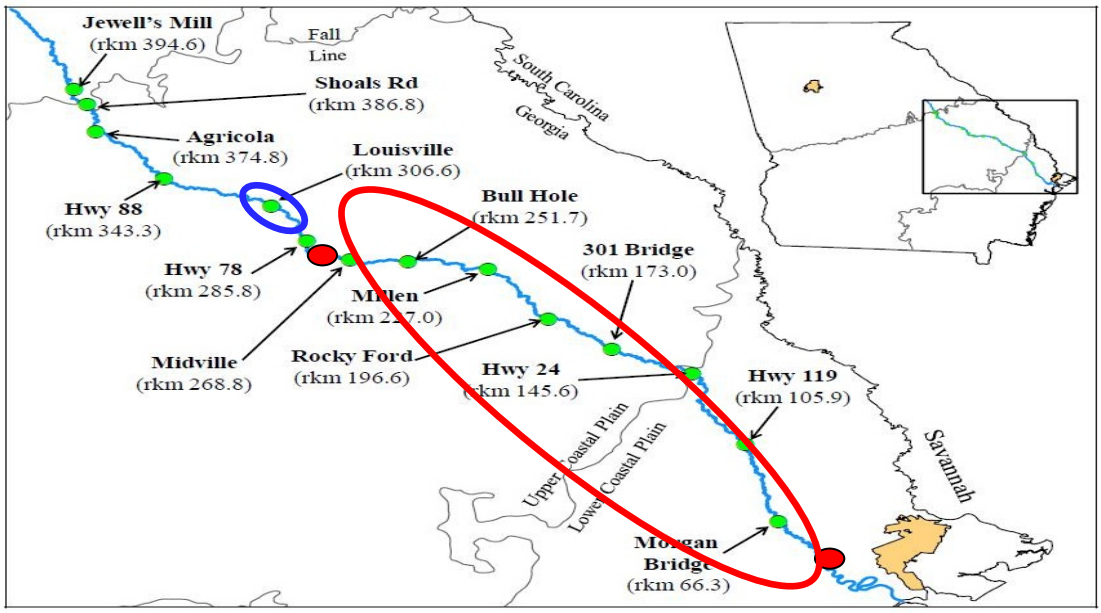


Figure A. The red circled areas show collections between 200 and 2005. The blue circle indicates collections after 2005, showing that the population has migrated upstream.

The takeaway for the Ogeechee robust redhorse population is that they are still present. From December 2010 – April 2011, 30 robust were captured upriver of Millen, GA by UGA and GA DNR for telemetry purposes (Ely 2013) and three robust were captured by GA DNR in the fall of 2014 in directed sampling efforts. There has also been a shift to older fish and length data shows this.

This presentation concluded that robust redhorse, once distributed throughout the sampled areas, has migrated to areas upstream and is concentrated around Highway 1, near Louisville, which is outside the typical standardized sampling area. Natural reproduction has not been identified through standardized or directed sampling efforts. Spawning behavior has been conclusively documented by UGA just above Highway 1 at Louisville. The population appears to be aging due to the lack of stocking and apparent lack of natural recruitment. Georgia DNR will continue to search for younger fish with hopes that the recent recovery from over a decade of drought conditions will allow for successful recruitment.

Broad and Savannah Rivers Update – Carrie Straight

Historically, Robust Redhorse likely occurred from the Yadkin-Pee Dee river system south to the Altamaha River system. Adults migrated into the Piedmont for spawning and migrated downstream to wintering habitat. Wild populations of Robust Redhorse primarily occur downstream of large dams in each of the Altamaha, Savannah, and Pee Dee Rivers. Because limited wild populations, a captive propagation and stocking program was started and over 150,000 hatchery-reared Robust Redhorse have been stocked throughout its range. Currently, there are one to three known or suspected spawning sites in the river reaches downstream of dams in each system. The main spawning sites used in the Oconee and Savannah Rivers consist of a single, large mid-

channel gravel bars in the Coastal Plain of Georgia. In the Broad River (GA) watershed, Robust Redhorse are confined to the Piedmont physiographic province. There are six known spawning sites in the Broad River system, all of which are composed of a complex of 2-6 distinct patches of gravel. The spawning sites in the Broad River occur in larger tributaries as well as the mainstem, and tagged Robust Redhorse have been documented moving between these patches within a single spawning season and between seasons.

Robust Redhorse spawn in aggregations over shoals with large gravel. Typically, spawning occurred over a couple of weeks from late-April to the end of May, when water temperatures were between 16.3-26.8 °C. However, timing varied between sites and from year-to-year. The spawning act is typically a triad with one male flanking either side of a female. The eggs and sperm are released and buried in the gravel that is disturbed during the spawning act. Most males are territorial, holding and defending territories against neighboring males in hopes of participating in spawning acts with females as they move through the aggregation. Females typically rest away from males in areas of lower velocity and over fine sediments. This behavior likely limits their energy expenditure fighting off males as they rest. As spawning activities increase, females will also rest within the spawning aggregation typically in areas of low flow behind lenses of gravel created through repeated spawning acts. As is seen in other species of redhorses, we observed dominance hierarchies in male Robust Redhorse at both the Piedmont and Coastal Plain sites. Larger males held territories in and near the center of the aggregation and smaller males were seen holding territories around the margins. I also documented an alternate reproductive tactic on one occasion in the Coastal Plain and on two occasions in the Piedmont. Smaller, red-finned males were not observed defending a territory, but followed females to and from their resting areas and participated in spawning events by sneaking in beside a female without competing for a territory. Although these males were commonly chased away before spawning began, they did appear to succeed in participating in spawning. This was likely a tactic that allowed them to fertilize more eggs than would have been gained by attempting to defend a marginal territory.

There are many conditions that prevent observations of spawning activities like turbid and turbulent water, bad weather, high flows and time of day. Using a hydrophone and a recorder placed near the spawning aggregation, we recorded underwater sounds and used these recordings to assess spawning rates. By simultaneously observing spawning and recording activities, we assessed the accuracy of an automated software program used to identify spawning events in long term recordings. The software correctly identified spawning events with accuracy of 80%. However, for the following work all acoustic events were manually reviewed and verified. We used this method to document spawning at two populations of Robust Redhorse, one in the Broad River in 2012 and one in the Savannah River in 2013. We recorded spawning over 19 days among the two sites, and documented over 9,400 spawning events (Figure B). The Robust Redhorse at the Broad River site had a lower mean spawning rate than those at the Savannah River site (mean = 16.9 spawns / h; SD = 10.6; range 0-48); Savannah (mean = 41.22 spawns / h; SD = 19.26; range 4-84). Both sites showed trends in spawning rates during the period of recordings and fit into a general pattern of spawning frequency increasing during the

initial period of spawning, reaching a peak period and then declining. I have documented this same pattern in change of fish density at a number of sites in the Broad River. The number of fish at an aggregation increasing in number, reaching a peak then decline in numbers after the peak. The series decomposition showed a daily periodicity for both the Savannah River and Broad River. This periodicity was more evident in the Savannah River. At both sites, the lowest rates occurred just after mid-day and increased to the highest rates after midnight and into the early hours of the morning (Figure C).

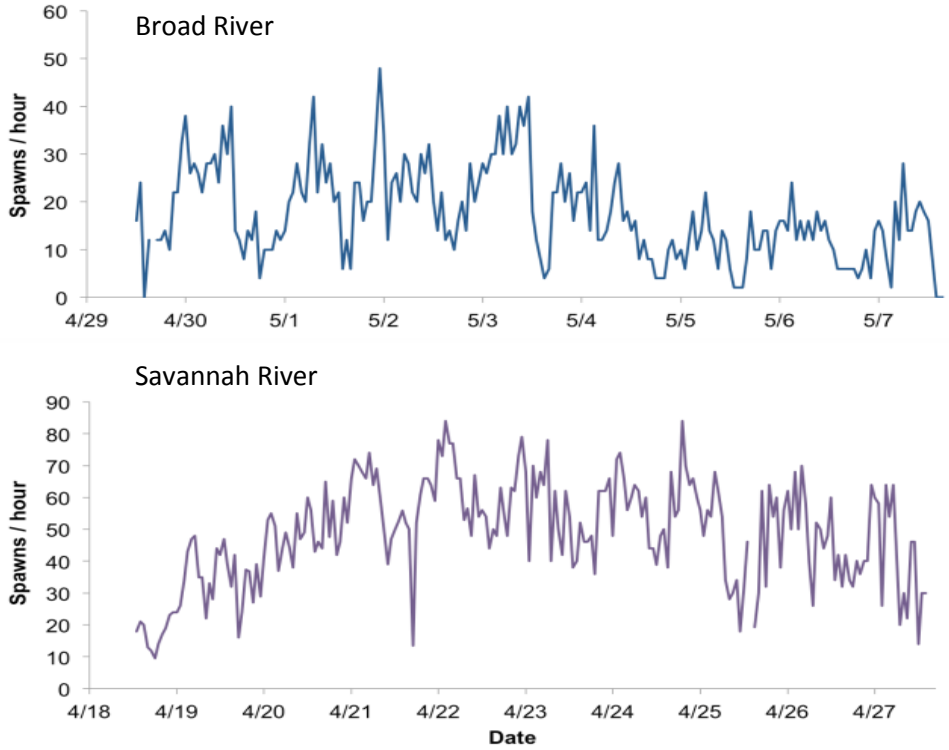


Figure B. Hourly spawning rate at the Broad River spawning site (upper panel), and Savannah River (lower panel).

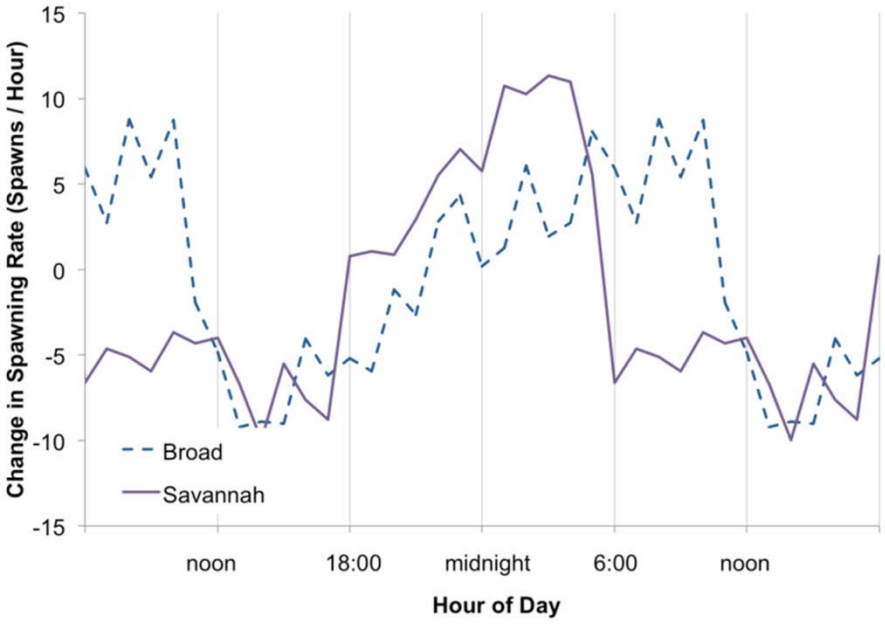


Figure C. Periodicity in spawning rates at the Broad and Savannah River spawning sites.

South Carolina 2014 Update – Scott Lamprecht
Report not submitted at this time.

Lower Savannah River Update – Alice Lawrence
In September 2012 South Carolina Department of Natural Resources (SCDNR) collected a juvenile robust redhorse (*Moxostoma robustum*) in the mainstem Savannah River near Hardeeville, South Carolina while sampling for American shad. Subsequently, while conducting a fish community assessment in and near Savannah National Wildlife Refuge (NWR), U.S. Fish and Wildlife Service (FWS) personnel collected a second juvenile robust redhorse in November 2013 in the mainstem Savannah River. The two collection locations were approximately four river miles apart, and the uppermost capture is approximately 131 miles below the lowermost gravel bar known for robust redhorse spawning.

Because of these two incidental captures of juveniles that were closely collected in proximity and time of year, SCDNR, FWS, Georgia Department of Natural Resources (GDNR), and Georgia Power will sample the Lower Savannah River encompassing these capture locations during the week of November 17-21st, 2014 via boat electrofishing. An initial interagency sampling plan outlines a sampling reach of approximately 20 miles of the mainstem Savannah River.

North Carolina 2014 Update – Ryan Heise
The Yadkin Pee Dee Technical Working Group continued spring boat electrofishing on the Pee Dee River. The goals of this effort are to monitor the population abundance and to collect brood fish for the hatchery program. In addition, we are assessing the population size structure to see if additional recruitment has occurred since the change in minimum flows from Blewett Falls Dam (see annual report from 2013 for more details).

In 2014, we collected 19 individuals between May 2 and May 15. Nine individuals were untagged and 10 were among year recaptures. There were 10 individuals captured from Jones Creek shoal and 9 from Hitchcock Creek shoal, the two main spawning shoals. Eight fish were male and 11 were female. We continued to collect a few younger individuals this spring and the total length ranged from 505 to 774 mm. Four of the 6 smaller individuals (under 580 mm) were untagged, which suggests that limited recruitment is occurring.

Using the software program MARK, the Cormak-Jolly-Seber open population model was used to estimate the population size. We used annual capture-recapture data from 2006-2014 and the population estimate applies to the number of adults on the spawning areas. Population estimates of Robust Redhorse were very low and range from 34 (95% CI 21-47) individuals in 2013 to 58 (95% CI 36-80) individuals in 2008.

Yadkin-Pee Dee FERC License Update – Jason Brown
Duke Energy is in the process of relicensing the Blewett Falls Hydroelectric plant on the Pee Dee River. As part of the relicensing efforts Duke Energy has received a North Carolina Division of Water Resources 401 Water Quality Certificate (WQC). This WQC outlines new water quality standards related to river flow and dissolved oxygen. During 2014 Duke Energy made a voluntary effort to comply with the new standards outlined in the WQC.

One of the main reasons Duke Energy has not received a new operational license for Blewett relates to the relicensing effort at upstream facilities (APGI) and the ongoing section 7.0 consultations for Shortnose and Atlantic Sturgeon. Duke Energy is expecting a new license for the Yadkin Pee Dee projects in the first quarter of 2015.

Wateree River Collections 2014 Update – Mike Abney
A total of 9 robust redhorse were collected in 2014 below the Wateree Hydroelectric station during American shad boat electrofishing surveys. The fish collected ranged in size from 475 mm to 644 mm. Seven new specimens (non-tagged) fish were collected.

R E S E A R C H U P D A T E S

Yadkin-Pee Dee Propagation Study – Rick Bradford

Due to the low adult population size in the Pee Dee River population a long-term augmentation program was initiated. We were able to spawn 3 females this year and the fertilized eggs were brought to both the NC WRC and SC DNR hatcheries for rearing. Both hatcheries had good hatching rates and the fish were stocked into ponds for grow out. In October 2014, a total of 13,000 fingerling Robust Redhorse were released at Hitchcock and Jones Creek shoals. Opportunities for reintroduction upstream are being considered and an option to move forward may include a Candidate Conservation Agreement with Assurances (CCAA).

Water Quality, Intersex Fish, and Robust Redhorse in the Pee Dee River, NC: NC State University Update – Tom Kwak, Greg Cope, Ryan Heise, Casey Grieshaber, Tiffany Penland

Robust redhorse (RRH) populations in the Yadkin-Pee Dee River (Y-PD) currently include approximately 38-55 adult individuals with little evidence of significant recruitment. These low population numbers have prompted the investigation of issues that could be impacting the reproductive success and overall survival of the species. We pursued a series of related objectives to examine water and sediment contaminants, occurrence and severity of the intersex condition in fish, and survival of young fish in the river. Point and non-point sources of pollution in the river were identified. Organic and inorganic compounds were measured longitudinally along the river in water and sediment samples, as well as passive sampling devices that integrate contaminant occurrence over time. Most samples are being analyzed in the laboratory, and results will be forthcoming. Estrogenecity was measured at 13 river sites using grab samples of water, and levels were all below the predicted-no-effect concentration of 2.0-ng/L. In the 2012-2013 sampling period, passive sampling devices were used to measure naturally occurring and synthetic estrogens in the water column. Naturally occurring estradiol levels were all below the predicted-no-effect level. Ethinylestradiol (synthetic estrogen) levels, however, were all measured above the 2.0-ng/L level. These high levels of synthetic estrogen hormones are important because of the impact they may have on intersex. Past research by Hinck et al. (2009; Aquatic Toxicology 95:60-70) examined nation-wide intersex occurrence and discovered that the highest rates of largemouth bass (LMB) intersex occurred in the Y-PD. A related NC State University project in 2012-2013 examined intersex across North Carolina, including one site on the Y-PD. Results showed 66% intersex for LMB from this site, which closely matches the Hinck et al. (2009) findings. In the summer of 2014, we sampled 11 of the 13 sites longitudinally located along the Y-PD for black bass, sunfish, and catfish. Intersex occurrence and severity will be determined for these individuals. In-situ bioassays were conducted at 8 of the 13 sites along the Y-PD. Each bioassay was conducted for a maximum of 28 days and consisted of placing 20 juvenile RRH, LMB, or adult fathead minnows (FHM) into a plexiglass cage that allowed water and food to flow through. The goal of this research component was to determine if young fish could survive in the Y-PD. Fish were checked approximately every 3 days and mortality was recorded. The same assay was also conducted in hatchery ponds,

where fish were originally reared, to test for cage and transport effects. LMB had a mean survival of 9.7 days, and RRH had a mean survival of 12.1 days in river assays. FHM survived for an average of 22.2 days in the river. Survival in hatchery ponds was much higher. These low in-situ survival rates of young fish, occurrence of intersex, and contaminant levels are a concern for the already imperiled RRH populations, and future results will further enhance our understanding of this fish's biology and ecology to inform conservation and management.

Environmental DNA as a Recovery Tool – Greg Moyer

Little consideration has been given to the accuracy and precision of environmental DNA (eDNA) detection data. The certainty of species detection relies on understanding false positive and false negative error rates. We used artificial ponds in conjunction with logistic regression models to assess the detection of A eDNA at varying fish densities (0, 0.32, 1.75, and 5.25 fish/m^3), to determine the most effective water stratum for eDNA detection, to estimate true and false positive eDNA detection rates, and to assess the number of water samples necessary to minimize the risk of false negatives. There were 28 eDNA detections in 324, 1-L, water samples collected from four experimental ponds. The best-approximating model indicated that the per-sample probability of eDNA detection was 4.86 times more likely for every 2.53 fish/m^3 (1 SD) increase in fish density and 1.67 times less likely for every 1.02 C (1 SD) increase in water temperature. The best section of the water column to sample and detect eDNA was the surface and to a lesser extent the middle and bottom. Although no false positives were detected, the estimated likely number of false positives averaged 3.62. At high densities of fish, 3-5 L of water provided a > 95% probability for the presence/absence of its eDNA. Conversely, at moderate and low densities, the number of water samples necessary to achieve a >95% probability of eDNA detection approximated 42-73 and >100 L, respectively. Potential biases associated with incomplete detection of eDNA could be alleviated via formal estimation of eDNA detection probabilities under an occupancy modeling framework; alternatively, the filtration of hundreds of liters of water may be required to achieve a high (e.g., 95%) level of certainty that eDNA will be detected at low densities (i.e., < 0.32 fish/m^3 or 1.75 g/ m^3).

Robust Redhorse Cryopreservation as a Recovery Tool – Jaci Zelko

The Warm Springs Fish Technology Center has developed cryopreservation protocols for several species, which can be used for spawning populations, transport of semen over long distances, long-term storage in the event of catastrophes, and preservation of genetic materials. A cryopreservation protocol was developed for robust redhorse in 1997 and refined thru spawning efforts in 2005. The FTC currently maintains a cryopreserved sperm repository of 55 males from the Savannah River and 51 males from the Oconee River. Efforts are currently underway to include males from the Pee Dee River in North Carolina. The development of a successful protocol for robust redhorse sperm cryopreservation will allow the establishment of a sperm repository for future restoration efforts.

Observation of Bacterial Infections in Suckers – Carrie Straight

In 2012, there were an unusual number of mortalities in Spotted Suckers (*Minytrema melanops*) and Notchlip Redhorse (*Moxostoma collapsum*). This unusual number of dead / dying fish was also noted by locals that commonly paddle the system throughout the year. The dead and dying individuals all had a red flush to the fins and body, and presumably dying individuals being lethargic. This lethargic state created the additional vulnerability to predation, as was seen by a number of half-consumed fish. A die-off of suckers with reddened areas of fins and body was also noted in the South Branch of the Potomac (pers. comm. Vicki Blazer).

Figure D. Notchlip Redhorse found along the bank of the Broad River, Georgia.

Both of these systems along with others in the southeast experienced an early spring, with spawning in the Broad River occurring from 5-30 days ahead of normal. Water temperatures also increased with increased air temperatures with water temperatures being 5-6 °C above what we have seen during the typical spawning season for Spotted Suckers. Vicki Blazer suggested that in the Potomac this possible opportunistic bacterial infection might be related to some water quality issues and a possible immunosuppression. If these issues were related to water temperature, the loss of mucus coat, spawning stresses, and injury could make spring-spawning catostomids vulnerable to opportunistic pathogens as climate fluctuates in the future.

O U T R E A C H

Effective Communication Strategies & Media Outlets for the RRCC – Jeff Fleming
Jeff Fleming, Assistant Regional Director for External Affairs in the FWS Southeast Region, presented on communication strategies that can be used by the RRCC. The recommendations included focusing on the power of our story and following one cardinal rule of communication "Just because you can, doesn't mean you should!" (Scott Bedbury, *A Brand New World*. He also indicated that we need to ask questions about the story in order to have success in sharing the story with the public.

The Mystery Fish Video – Jimmy Evans
Jimmy Evans discussed the video "The Mystery Fish" that was produced by Georgia Outdoors, a Georgia Public Radio station. Georgia Outdoors is a GPB original series that delivers an amazing view of all that Georgia has to offer through spectacular photography and narrative storytelling that showcases wildlife, plants, and other aspects of the state's natural beauty. Everyone watched the 12 minute video and was highly impressed and entertained.

The video can be found at the following web address:
http://www.robustredhorse.com/h/photos.html

BUSINESS & TECHNICAL WORKING GROUP REPORTS

ITTWG & Annual Report Update – Jaci Zelko
The ITTWG is charged with two responsibilities: data management and website management. Ryan Heise has taken the lead in the past few to years to maintain and update the robust redhorse website. He sends all changes and new information to be uploaded to Morgan Nolan. She has done an excellent job of keeping the website looking great. The website has also been reorganized on some of the pages and a new YouTube video has been added as well as many other pictures and documents.

Jaci asked all participants to check on their latest dataset and send updated copies to be included in the master spreadsheet.

Jaci relayed that the new protocol of each presenter submitting an abstract has greatly streamlined the annual report process. As of this meeting she has completed the 2003 – 2007 and 2009 – 2013 reports. These documents have been uploaded to the RRCC website. The missing reports from 2002 and 2008 are currently being written.

RRCC as a Co-sponsor at Southern Division AFS Meeting – Discussion
Brett Albanese reported to the Committee members that he has submitted a symposium proposal for the Southern Division AFS meeting that will be held January 28 – February 1, 2015. The special symposium will be called Ecology and Conservation of Southeastern Cypriniform Fishes. He indicated that he would like to list the RRCC as a potential co-sponsor of the symposium. It was discussed and agreed upon by all participants to be a co-sponsor for this symposium.

Robust Redhorse Status Assessment to SEAFWA – Brett Albanese
At the request of Mike Harris (Nongame Conservation, GADNR) and the SEAFWA Wildlife Diversity Committee, members of the RRCC agreed to compile information to facilitate a status assessment of Robust Redhorse. The assessment is necessary because the Robust Redhorse has been petitioned for listing under the U.S. Endangered Species Act. The assessment included information on the species life history, threats, and current conservation efforts and will be used by FWS to determine if listing is necessary. Jimmy Evans, Ryan Heise, Scott Lamprecht, and Forrest Sessions authored individual sections of the document. Brett Albanese edited , compiled, and submitted the document.

RRCC ExCom Member Update – Alice Lawrence
Within the RRCC Policies, adopted in 2002, is a policy that deals specifically with the Executive Committee (Excom) and Technical Working Groups. The Excom is empowered by the RRCC to deal with the day-to-day issues associated with the regional recovery effort. The members of the Excom should be confirmed or reconfirmed by the

RRCC at each annual meeting. Each group represented on the Excom should provide to the RRCC their designee to be that agency's or group's representative.

The RRCC needs to update the Excom list for the Fall 2014 - Fall 2015 upcoming year. If groups need to confer internally before confirming their designee, please let Alice know who has been selected as soon as possible.

Future Management of the Savannah Population, a Savannah TWG? – Discussion
With SCDNR's broodstock collection coming to an end and the recent discoveries of two juveniles in the lower Savannah River, is it time to form a Technical Working Group (TWG) for the Savannah population? We have an Oconee TWG and a Pee Dee TWG at this point. There is a great deal of robust redhorse monitoring work that needs to take place in the Savannah (Augusta Shoals, gravel bars below NSBLD, lower Savannah for juvenile monitoring, etc.) and many anthropogenic modifications to the waterway.

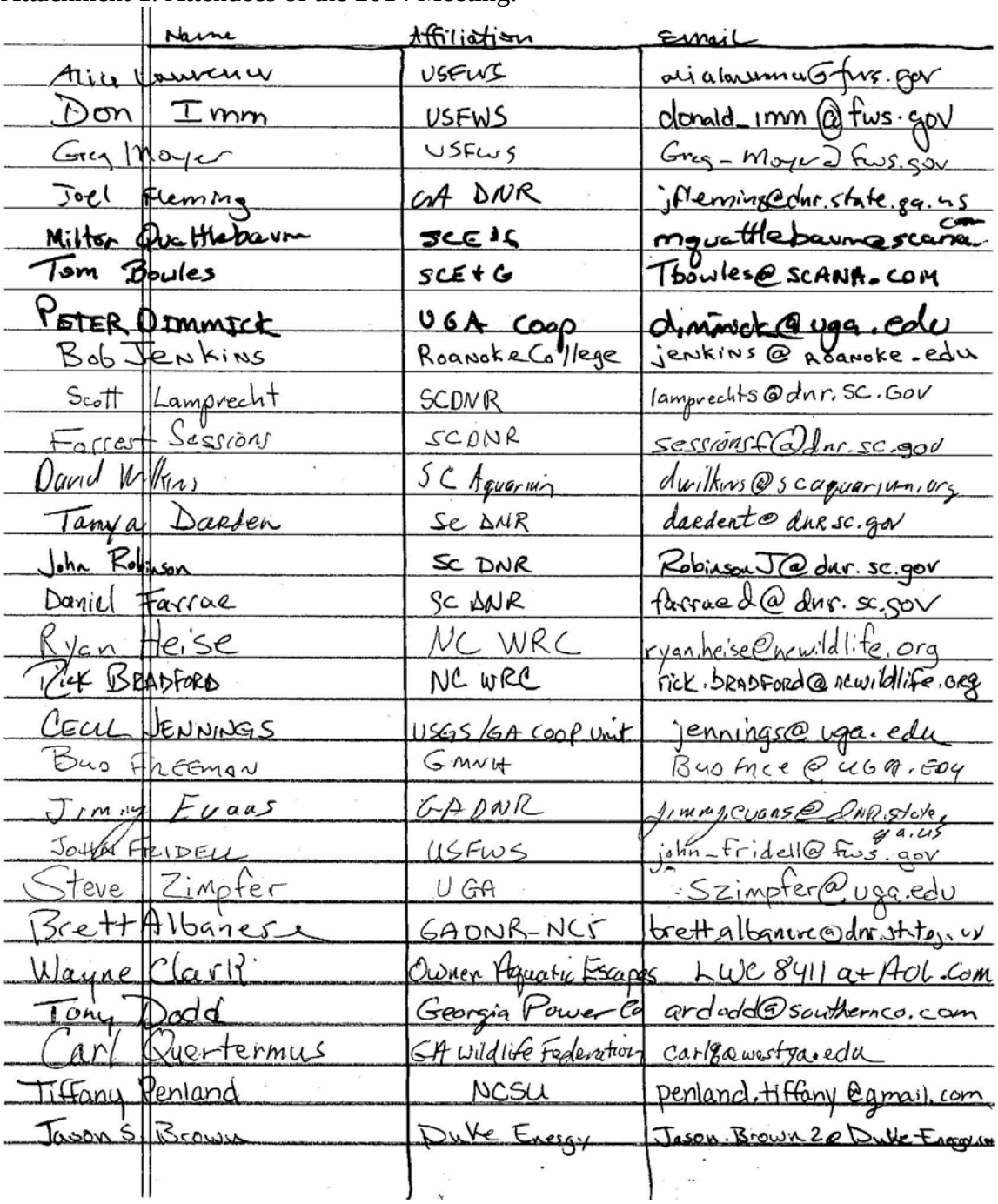
The group was open to the idea and decided it was worth further consideration. Alice said she would follow up by sending out additional emails about the idea to the parties within the RRCC that work in the Savannah basin after the fall sampling in the lower Savannah.

Robust Redhorse Datasheet – Carrie Straight
With the collections of Robust Redhorse in the lower Savannah River, we decided that formalizing a datasheet that could be distributed to groups collecting fish or doing aquatic work throughout the historic range of Robust Redhorse. Hopefully this datasheet might help us gather more information from those people targeting other species but also potentially capturing Robust Redhorse. Please see the attached flyer (Attachment 2) and distribute it to anyone working in rivers from the Yadkin-Pee Dee to the Altamaha River basin.

New RRCC Chair – Alice Lawrence
Jaci Zelko was installed as the new RRCC Chairperson by outgoing Chair Alice Lawrence. She is very excited to be the new chair and was thankful for all of our dedication over the years to the robust redhorse recovery effort.

A T T A C H M E N T S

Attachment 1. Attendees of the 2014 Meeting:



Name	Affiliation	Email
Alice Lawrence	USFWS	alice_lawrence@fws.gov
Don Imm	USFWS	donald_imm@fws.gov
Greg Mayer	USFWS	Greg_Mayer@fws.gov
Joel Fleming	GA DNR	jfleming@dnr.state.ga.us
Milton Quattlebaum	SCE&G	mquattlebaum@scana.com
Tom Boules	SCE&G	Tboules@SCANA.COM
PETER DIMMICK	UGA Coop	dimmick@uga.edu
Bob Jenkins	Roanoke College	jenkins@roanoke.edu
Scott Lamprecht	SCDNR	lamprechts@dnr.sc.gov
Forrest Sessions	SCDNR	sessionsf@dnr.sc.gov
David Wilkins	SC Aquarium	dwilkins@scaquarium.org
Tanya Darden	SC DNR	dardent@dnr.sc.gov
John Robinson	SC DNR	RobinsonJ@dnr.sc.gov
Daniel Farrae	SC DNR	farraed@dnr.sc.gov
Ryan Heise	NC WRC	ryan.heise@ncwildlife.org
Rick BRADFORD	NC WRC	rick.bradford@ncwildlife.org
CECIL JENNINGS	USGS/GA Coop Unit	jennings@uga.edu
Bud Freeman	GMNH	Budfmce@UGA.EDU
Jimmy Evans	GA DNR	jimmy.evans@dnr.state.ga.us
JOHN FRIDELL	USFWS	john_fridell@fws.gov
Steve Zimpfer	UGA	Szimpfer@uga.edu
Brett Albanese	GADNR-NCS	brett.albanese@dnr.state.ga.us
Wayne Clark	Owner Aquatic Escapes	LWC8411 at AOL.com
Tony Dodd	Georgia Power Co	ardodd@southernco.com
Carl Quertermus	GA Wildlife Federation	carl@westga.edu
Tiffany Penland	NCSU	penland.tiffany@gmail.com
Jason S. Brown	Duke Energy	Jason.Brown2@Duke-Energy.com

Name	Affiliation	Email
Tom Kwak	USGS - NC State U	tkwak@ncsu.edu
Casey Grieshaber	NC State U	cogriesh@ncsu.edu
Jesse Fischer	"	jessefischer@gmail.com
Jaci Zelko	USFWS - WSFTC	Jaclyn_Zelko@fws.gov
Carrie Straight	USFWS - GAES	carrie_straight@fws.gov
Jessica Wilson	DNR	jswilson350@gmail.com
Deb Weiler	DNR-nongame	Deb.Weiler@dnr.state.ga.us
Mike Joyce	USFS - GA	mjoyce@fs.fed.us
Jeff Fleming	VS FWS	jeffrey_m_fleming@fws.gov
Dennis Schmidt	GA DNR	dennis.schmidt@dnr.state.ga.us
Erin Rivenbark	USFWS	erin_rivenbark@fws.gov

Group Photo!!

Attachment 2. Wanted Dead Or Alive Poster

Wanted (~~Dead or~~ Alive)

If a Robust Redhorse is accidentally killed during surveys, please collect all of the above data (including fin clip), pack the individual in ice and contact Alice Lawrence or Carrie Straight at 706-613-9493 for delivery options to an appropriate museum or research group. If contact cannot be made within 24-48 hours of death, please wrap the individual in a plastic bag, include a copy of the datasheet and freeze the individual until arrangement can be made for collection.

Data on Robust Redhorse (*Moxostoma robustum*)

Straight or elongated edge to plicate lower lip
Circumpeduncle scale count for Redhorses = 12
(16 for jumprocks / *Minytrema*)

Adult
(> 5 years old or > approx.480 mm TL)
Body: overall coloration golden brown to coppery or brassy, some individuals can be very pale
Fins: fins with margins untinged or tinged with red to orange
Tubercles: well-formed and abundant on head/snout and fin rays (anal and caudal) of males, less abundant on females

Immature
(< 5 years old or < approx. 480 mm TL)
Body: overall coloration golden brown, to coppery or brassy
Fins: typically bright red fins

Lips: In both adults and immature individuals, lip is plicate with posterior edge of lower lip straight or with center plicae elongated.

Data to Collect: Date: _____

Collectors: _____

Location: _____

River Basin (circle one): Oconee Ocmulgee Altamaha Ogeechee Savannah Broad(GA) Broad(SC) Wateree Pee Dee

Latitude: _____ Longitude: _____

Capture equipment (choose one): BPEF boat EF seine trawl (mesh size: _____)

Size: Length: _____ (TL) _____ (SL) Weight: _____ Sex: _____

Expressed gametes: Y / N

Tubercles (circle one): present not present scars visible

Coded-Wire Tag Location _____ PIT Tag(s) # _____ Floy Tag(s) #_____

Fin Clip taken and clip submitted to: _____

Please take a photo and attach it with this datasheet.

Additional Data to Collect:

Capture Location (choose one on each line):

mid-channel river edge

flow minimal flow no flow eddy

tidal no tidal influence

Water chemistry:

Temperature: _____

pH: _____ Cond: _____ DO: _____ Salinity: _____

Habitat of Capture location:

Depth: _____ Velocity: _____ Bottom Substrate: _____

Vegetation: _____

Large woody material or cover (describe):

Describe individual: (scars, injuries, deformities, mucus coat): _____

_____

_____

Fin coloration (describe): _____

Additional notes:

Please scan and email or mail copies of the datasheet to your state DNR representative and to Alice Lawrence alice_lawrence@fws.gov or Alice Lawrence; USFWS; Georgia Ecological Services; 105 Westpark Dr, Suite D; Athens, GA 30606.

Commonly Confused Species

Circumpeduncle (CP) Scale Count: the number of scales around the narrowest part of the caudal peduncle.
Plicate: having tightly folded plicae with parallel ridges and grooves
Papillose: having small projections of tissue, with a dotted or pebbled appearance

16 or greater CP Scales

Catostomus commersonii (White Sucker) – lower lip with many small papillae, deeply notched; scales smaller and crowed on the front half of the body (anteriorly) and larger posteriorly; lateral line complete with more than 55 scales, CP: 17 or more

Minytrema melanops (Spotted Sucker) – lips thin and plicate; rows of black or dark spots one per scale; males develop pink or purple mid-lateral stripe during spawning season CP: 16

Moxostoma sp. (Brassy Jumprock) – (also has a straight edge to papillose lower lip) CP: 16

Moxostoma rupiscartes (Striped Jumprock) – (native in the Blue Ridge and Piedmont region of drainages from the Santee south to the Chattahoochee). CP: 16

Typically 12 CP Scales

Moxostoma robustum (Robust Redhorse) – lower lip plicate, not noticeably thinner at corners, with straight edge in youngest individuals or with prolonged edge in the central few plicae.

Moxostoma collapsum (Notchlip Redhorse) – lower lip semi-papillose (unequal-sized papillae), deeply notched, and thinner at corners; dorsal fin margin straight or slightly concave

Moxostoma pappillosum (V-lip Redhorse) – lower lip papillose (looks dotted or pebbled in appearance) and notched medially; dorsal fin margin moderately concave to falcate. (Records indicate this species only occurs upstream of the Fall Line).

Moxostoma macrolepidotum (Shorthead Redhorse) – lower lip divided into oval shaped papillae with a straight edge; dorsal fin margin concave

Moxostoma sp. (Carolina Redhorse) – lower lip plicate notched centrally and thinner at the corners

Likely Distributions of Similar Species:

Species	Altamaha	Ogeechee	Savannah	Broad / Wateree	Yadkin / Pee Dee
Minytrema melanops	X	X	X	X	X
Moxostoma sp. (Brassy Jumprock)	X	X	X	X	X
Moxostoma rupiscartes	X	-	X	X	I
Moxostoma robustum	X	X	X	X	X
Moxostoma collapsum	X	X	X	X	X
Moxostoma pappillosum	-	-	-	X*	X
Moxostoma macrolepidotum	-	-	-	X	X
Moxostoma sp. (Carolina Redhorse)	-	-	-	-	X
Catostomus commersonii	I	-	-	X	X

X = present, I = likely introduced or introduced;* only found in Piedmont reaches