REPORT OF THE

ROBUST REDHORSE CONSERVATION COMMITTEE ANNUAL MEETING

Hickory Knob State Park
McCormick, SC
September 19 – 21, 2017

Jamie Roberts, Georgia Southern University, holds a female robust collected in November 2016 during electrofishing surveys on the lower Savannah River. Credit: GSU

Report compiled by
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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
USACOE	U.S. Army Corps of Engineers
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

EXECUTIVE SUMMARY

The robust redhorse recovery effort, in its 23nd 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 annual meeting of the RRCC was held September 19-21, 2017 at Hickory Knob State Park in McCormick, SC. Approximately 30 representatives (see Attachment 1) of the signatory agencies to the MOU, university research affiliates and other interests attended the meeting. The 11 signatory agencies include: Georgia Department of Natural Resources, South Carolina Department of Natural Resources, North Carolina Wildlife Resources Commission, Georgia Power Company, Duke Energy Carolinas/Progress LLC, South Carolina Electric and Gas Company, U.S. Fish and Wildlife Service, U.S. Geological Survey, USDA 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, Georgia Southern University, 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 2017 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 on a 5-year basis 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

Welcome & Introductions – Tanya Darden
Tanya Darden, Chair, gave a big, warm welcome to all the participants. She informed the newcomers to the Committee that the location of the 2017 meeting isn't new and has been used as a meeting spot in the earlier years of annual meetings. Introductions were made by each participant that included their name, agency affiliation, and their answer to an ice breaker question "If money were not a consideration, how would you spend your days?."

MANAGEMENT ACTIVITIES

Yadkin-Pee Dee TWG Update – Brena Jones

In spring 2017, partners in the Yadkin-Pee Dee Technical Working Group continued annual cooperative sampling and population monitoring for Robust Redhorse in the Pee Dee River downstream of Blewett Falls dam. The total electrofishing effort (pedal time) in this reach was 68.3 hours. We captured 19 Robust Redhorse during targeted sampling. Eight were previously untagged and six were recaptures from previous years, yielding a recapture rate of 43%, the lowest rate observed since 2008 (32%). Four of these recaptures were animals previously tagged with radio transmitters and tracked as part of movement studies conducted by the NCWRC and NC State University in 2006-2008. During that time, scales were collected to determine individual ages and these adults are now at least 14-16 years old. They showed signs of active spawning in 2017, supporting observations that this species can be long-lived and one animal can contribute to the population via reproduction many times over its life span. Of the new fish, seven were juveniles and one was an adult female.

In addition, five Phase II juveniles were collected, products of the 2015 year-class raised in NCWRC and SCDNR hatcheries and released in the Pee Dee River in November of 2016. Two more juveniles were captured outside the targeting sampling window by Duke Energy biologists near Blewett Falls dam. Total length of all captures ranged from 225 to 752 mm TL.

Genetic analysis of fin clip material revealed that all juveniles collected in 2017, as well as two juveniles captured in SC in 2016, matched as products of the 2014 captively propagated year-class. The single new adult female collected in May 2017 was a wild-spawned fish.

Figure 1. Brena Jones holds an adult wild female collected from the Pee Dee River in 2017. Credit: T. Kwak, NCSU

Using annual capture-recapture data from 2006-2017, we model the estimated number of adults on the spawning areas. Annual population estimates of spawning Robust Redhorse remain very

low and previously ranged from 31 (95% CI 23-39) to 52 (95% CI 39-65). The estimate in 2017 was 16 fish (95% CI 7-25), driven by the capture of only one new adult. While this is cause for significant concern, overall 2017 capture numbers also included a substantially higher number of juveniles than any previous effort, some of which are large enough to begin recruiting as spawners within the next year or two. These data also underscore the potential significance of contributions from the captive propagation program, which made up 100% of this year's sub-adult captures.

There was no successful captive propagation in 2017 due to lack of sufficient broodstock captures. In early November 2016, over 1,700 Phase II fish held from spring 2015 propagation were PIT tagged at the McKinney Lake Fish Hatchery (NC) and the Dennis Center (SC). A subset of 15 individuals from each facility had a Vemco sonic tag surgically implanted to study juvenile Robust Redhorse life history. On November 4, all fish were released into the Pee Dee River at Cheraw, SC and Jones Creek Shoal, NC.

Figure 2. A Phase II fish that was implanted with a Vemco sonic tag. Credit: B. Jones, NCWRC

Santee Basin Update – Scott Lamprecht

From our collective surveys in the Santee Basin, a total of 26 fish were collected. Five fish were from the Wateree/Congaree zone, 19 from the Lower Broad River, and 2 from the upper Broad River. Twenty-five genetic samples from these fish were analyzed and 18 were positively identified as cultured individuals with year-class assignments, 3 additional samples were identified as cultured but not assigned a year-class, and 4 were identified as non-cultured. The largest individual collected was 650 mm and the smallest was 383 mm.

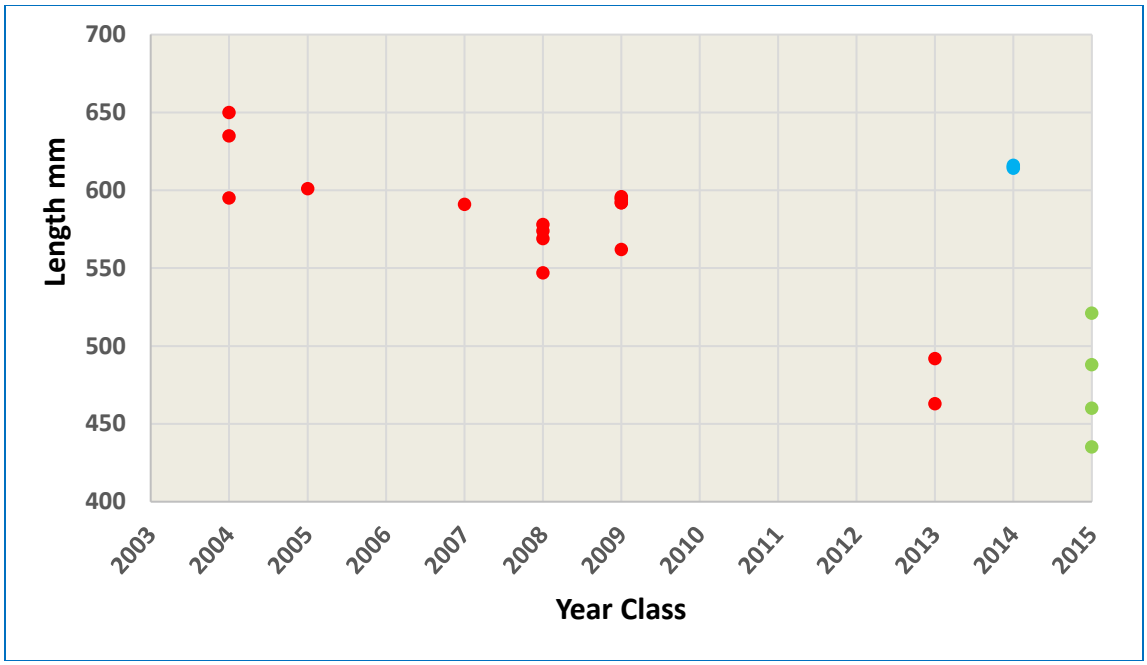

Figure 3. Length of individuals and Year-class designation for fish collected in 2017. Credit: SCDNR

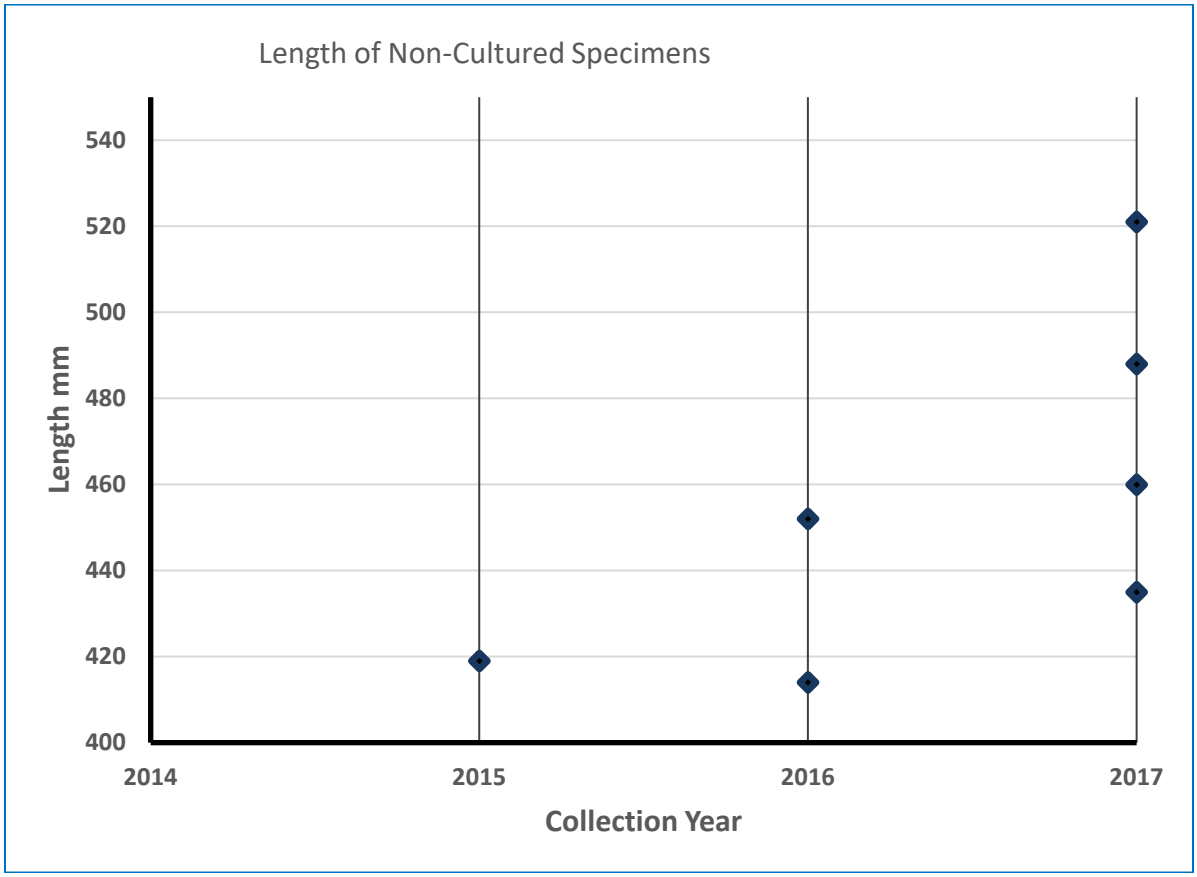

Figure 4. Length of individuals of non-cultured specimens collected 2015-2017. Credit: SCDNR

Pee Dee and Wateree Rivers Update – Ryan Heise
Each spring, Duke Energy monitors the population of American Shad in the Pee Dee River from Blewett Falls dam downstream to Hwy 74. During the 2017 sampling effort two Robust Redhorse were collected. The total length of these individuals was 267 and 466 mm TL.

The Pee Dee River juvenile RRH telemetry study continues and data from November 2016 through July 2017 was summarized in the presentation. Twenty-nine of the 30 tagged fish were recorded on the receivers. The total number of detections so far was about 76,300 and 87% of these were from the 6 upstream most receivers (Figure 1). Five individuals moved long distances downstream and one juvenile was detected in the Waccamaw River (Figure 2; December 2016 data). Less than 1% of all of the detections were from downstream of I-95. Sampling on the Wateree River at the Wateree Dam was canceled this year due to concerns about encountering sturgeon without a permit. In 2018, sampling will resume and any Robust Redhorse captures will be summarized at the RRCC meeting

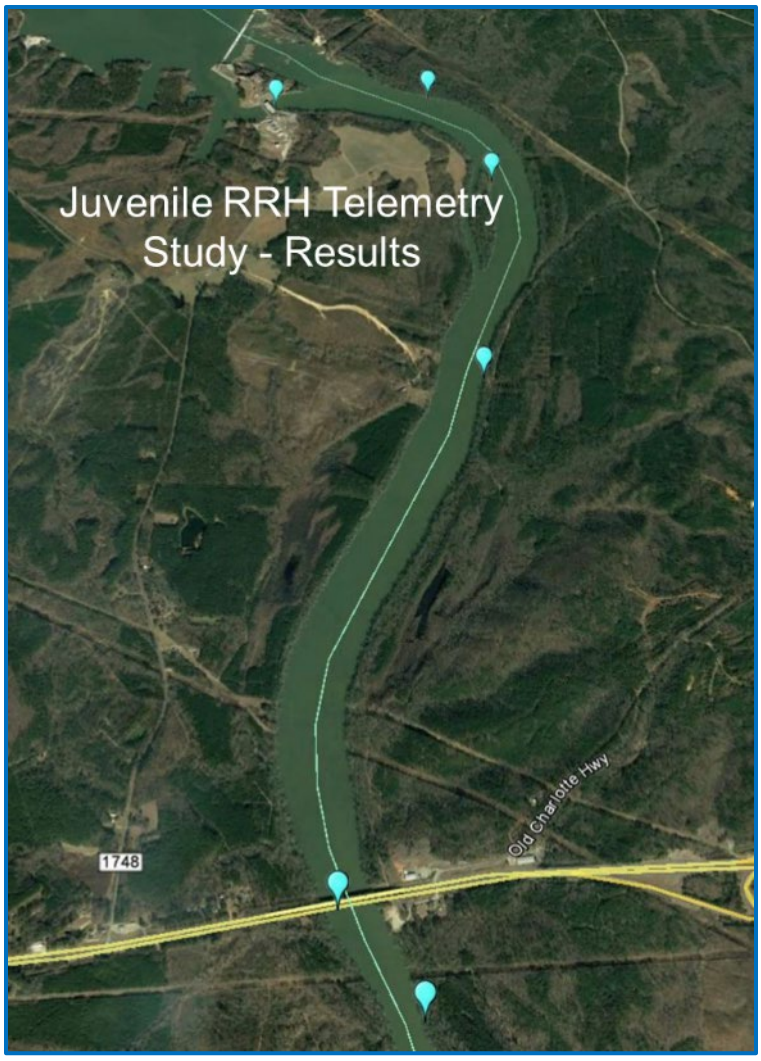

Figure 5. Receiver locations that detected juvenile Robust Redhorse. Credit: Duke Energy

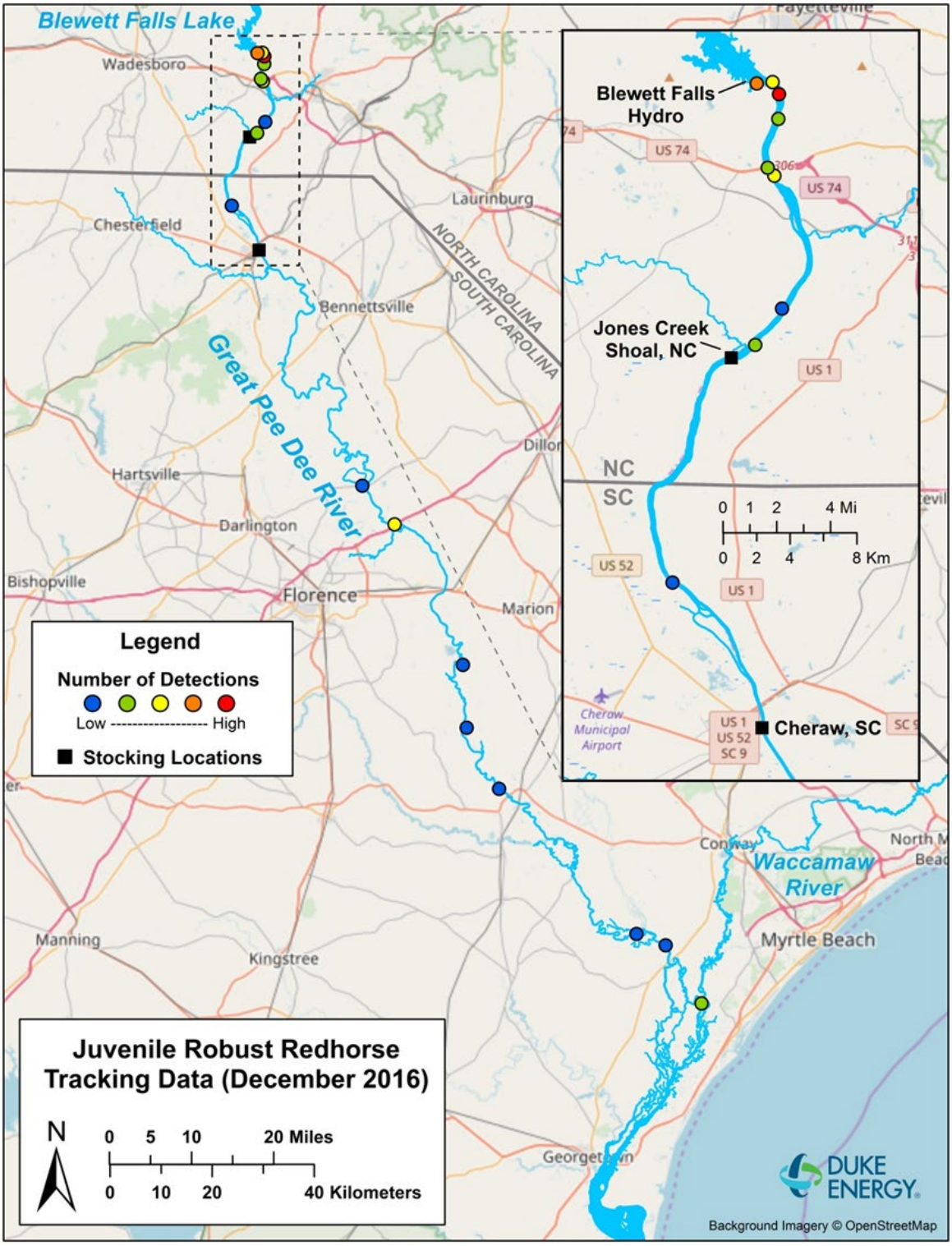

Figure 6. Receiver locations that detected juvenile Robust Redhorse. Credit: Duke Energy

Altamaha ESU Update – Paula Marcinek
A multi-state Competitive State Wildlife Grant awarded in 2016 enabled the Georgia Department of Natural Resources to expand monitoring and conservation efforts by allowing for an increase in dedicated staff time. Efforts focus on the Altamaha, Ocmulgee, Oconee, and Ogeechee Rivers during spawning season.

In 2017, Ogeechee effort included both a visual and an electrofishing survey at the Louisville spawning site. Clean gravel was present, but no Robust Redhorse were seen. No spawning has been observed since 2011, there have been no encounters since three individuals were captured in the fall 2014. No surveys are planned for 2018, but GADNR Fisheries Management and Georgia Southern University will continue their standardized sampling programs and report any Robust Redhorse encounters.

Figure 7. Electrofishing on the Ogeechee River in August 2017. Credit: Georgia DNR

On the Oconee River, staff visited three known spawning locations across three visits. Gravel, but no fish, was observed at the Avant site. The prior gravel augmentation site was degraded, however, a new gravel patch was located upstream of Avant. In 2018, staff plan to conduct reconnaissance for new spawning habitat as well as visual surveys during spawning season.

On the Ocmulgee River, staff electrofished six sites upstream of Juliette Dam across five days. Downstream of Juliette Dam, staff conducted four visual surveys at the one known spawning location, Juliette Shoals. They also searched for new spawning locations in a 10 mile reach below Juliette Shoals. Decent spawning habitat was observed both below Lloyd Shoals Dam and in the reach below Juliette Shoals. Continued efforts will focus on finding new potential spawning habitat and searching for juveniles via electrofishing in the lower Ocmulgee and lower Altamaha rivers. Spawning was last documented from the Ocmulgee in 2015.

In the Broad River and Clarks Hill Reservoir, staff conducted visual spawning assessments during 15 visits across four sites. A maximum of 14 individuals were observed at one historic spawning location, and habitat searches revealed degraded gravel habitat at other historic

locations. Efforts in 2018 will continue to focus on visually documenting spawning and a habitat survey of the historic spawning locations in the Hudson River. Despite increased efforts in 2017, there is still significant uncertainty about the status of the Broad River population and little evidence that the Altamaha and Ogeechee populations are persisting, let alone self-sustaining.

In addition to increased field efforts in Georgia, a major objective of the multi-state grant is to develop a range-wide, relational database. The Access database is in design-phase and will link collection, genetic, and production data across all three states. Along with the database, an electronic data collection form will be designed and implemented through Survey 123.

Lastly, in response to a couple poaching incidences in the Savannah River, GADNR also began designing educational signage and options for bowfishing regulatory change. One of the poached fish was obtained from the angler, and accessioned into the Georgia Museum of Natural History Ichthyology collection after the otolith, opercle, subopercle, scales, fin clips, and white muscle tissue was removed for further analysis of age, genetics, and contaminants.

Savannah River Monitoring Update – Jamie Roberts

Visual surveys have been conducted at the upper and lower gravel bars downstream of New Savannah Bluff Lock and Dam multiple times annually during the 2015-2017 spawning seasons. The three objectives are to 1) develop estimates, with uncertainty, of peak spawner abundance, using non-invasive techniques, 2) better understand the duration and timing of the spawning window and what drives it, and 3) better understand detection probability and what influences it. We used a multiple-surveyor streamside visual count, which has varied somewhat over the years. In its present iteration it involves two surveyors simultaneously surveying circular plots during multiple replicate temporal intervals, to estimate surveyor and temporal error in counts. Based on counts, maximum instantaneous spawner counts on the lower gravel bar were 112, 6, and 204 individuals in 2015, 2016, and 2017, respectively, though annual variation in temperature, turbidity, and flow conditions makes these estimates difficult to compare. In 2018, we will work with SCDNR biologists to evaluate drone-based aerial counts as an alternative index of spawner abundance. On 15 and 17 November 2016, biologists from GSU, UGA, GADNR, SCDNR, and GA Power boat-electrofished 7 river km of the lower Savannah River in search of juvenile Robust redhorse, in order to better understand habitat use during this life-stage. We put in a total of 9 hours of pedal time and captured one adult and one juvenile. Juveniles have now been observed along a 24-km reach of the lower Savannah, upstream of the I-95 bridge.

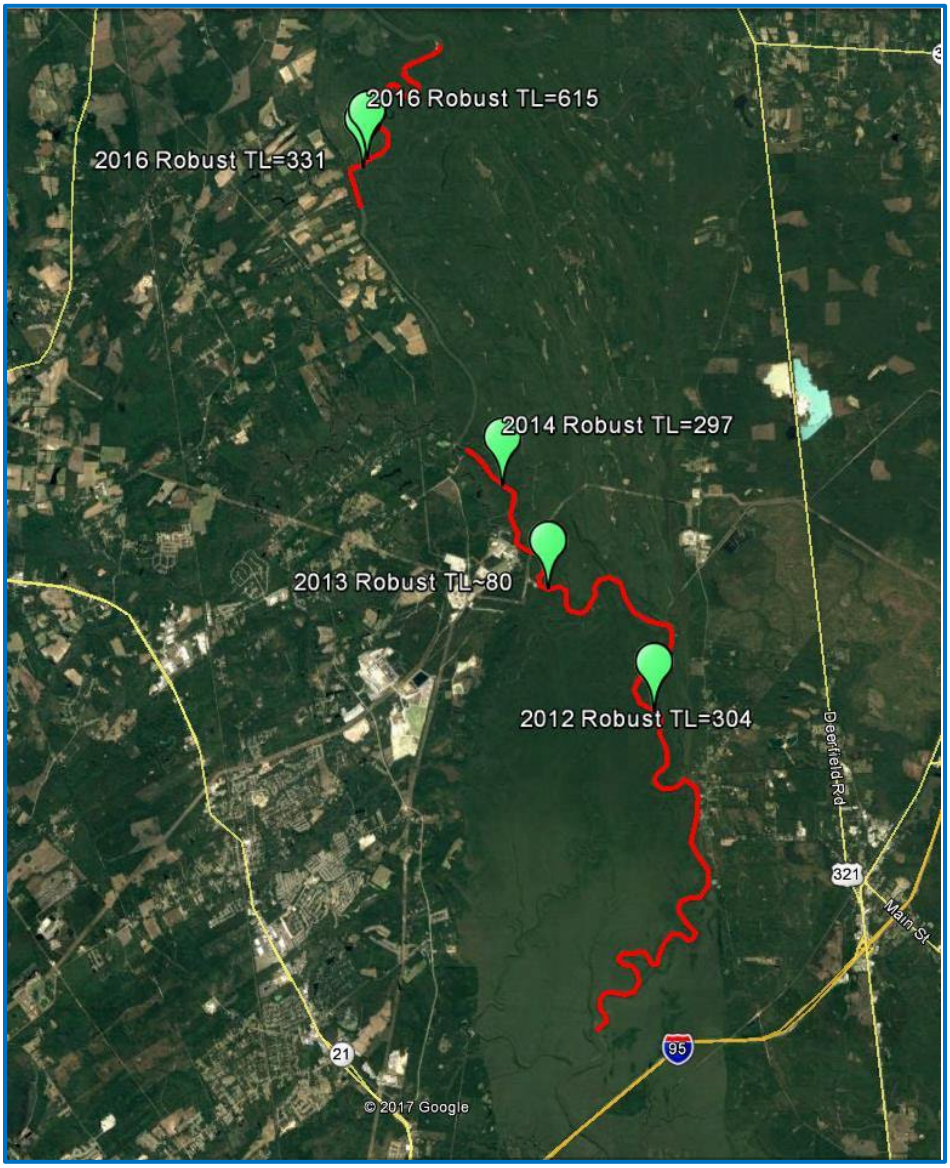

Figure 8. Locations of juveniles observed in the 24-km reach of the lower Savannah. Credit: J. Roberts, Georgia Southern University

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

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. In 2017, sperm from one male from Hitchcock Creek was collected, extended with HBSS-S and shipped to the Fish Technology Center. The sample arrived in good condition with an initial motility of 95%. The sample was frozen using the standard robust redhorse cryopreservation protocol and the 90 0.5-ml straws were placed in the repository.

Oconee River:	Savannah River:	Pee Dee River:
51 males	55 males	1 male
2122 straws	2139 straws	90 straws
1997 - 2006	1999 - 2013	2017

Robust Redhorse Adaptive Management Modeling – Angela Hsiung
The 2017 presentation included an overview of project goals and adaptive management (AM). The project team is working with RRCC members to collaboratively develop an adaptive management framework to help clarify management objectives and evaluate potential management actions for conserving and managing Robust Redhorse populations.

The AM framework is intended to support achieving management objectives and solving environmental issues. The first step of the process is to define the problem that needs to be solved, followed by eliciting management objectives that stakeholders want to achieve. Next steps include developing a list of management actions that can be implemented to achieve objectives. The management actions are then evaluated based on their expected potential to achieve management objectives. During the 2017 presentation, examples of preliminary simulations of population trajectories were included to demonstrate how changes in population parameters could affect the projected population size in the future.

The presentation/workshop ended with a discussion about management objectives for Robust Redhorse. An identified goal of the RRCC is to have six self-sustaining populations distributed within the species' historic range that only requires periodic monitoring with continuous detection of individuals. Specific management objectives could then be related to brood stock

size, occurrence of spawning and recruitment, enough unique pairs of brood fish in each population, and that natural recruitment counters mortality rates.

TECHNICAL WORKING GROUP REPORTS

Genetics TWG – Daniel Farrae
The Genetics TWG will provide an update on all tissue collections that have passed through or are being stored at SCDNR Population Genetics lab and the efforts to track down other samples. The Genetics TWG will provide a brief update on genetic analysis of robust redhorse collected in the Santee Basin and the Pee Dee River, though a more thorough discussion of these results will be provided by the respective TWGs.

IT TWG Database and Website – Jaci Zelko
The ITTWG is charged with two responsibilities: data management and website management. The website has been reorganized on some of the pages and recent updates include the addition of the 2015 Annual Report, the current 2017 signed MOU, and updated contact list. The Committee renewed the website domain name for 9 years for $315.00, which expires September 21, 2025. The domain name was migrated from the UGA servers to register.com in February 2017 by UGA employee Morgan Nolan.

Jaci gave an update on the status of the master capture database. She asked all participants to check on their latest dataset and send updated copies to be included in the master spreadsheet.

B U S I N E S S R E P O R T S

Annual Report Update – Jaci Zelko
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 – 2014 reports. These documents have been uploaded to the RRCC website. The missing report from 2002 and 2016 are currently being written.

MOU Renewal
We reported that the new MOU document was completed this past year with all signatures and was filed with USFWS and posted on the website. The renewal period set forth in the MOU is five years. The new MOU expires in December 2020.

Guidance Document
The ExCom has decided to go forward with completing the Status Document that was started several years ago to assist USFWS in review process for listing candidacy for Robust Redhorse, even those the USFWS process has changed. Once completed, the document will be sent to the membership for review.

Data Sharing Plan
As access to RRCC data is increasing, the ExCom has begun discussions to prepare a Data Sharing Agreement as there are currently no agreements/policies in place. The goal is to be proactive in allowing access to end users, but also providing appropriate protection to both data and contributors. The ExCom will draft a document and send to membership for review/comment do that we can vote on a document at next year's meeting.

Financial Supporters & Status
We would like to recognize both our current and historic supporters of the RRCC: Duke Energy/Progress Energy, Georgia Aquarium, Georgia Power Company, Georgia Dept. Natural Resources, North Carolina Wildlife Resources Commission, South Carolina Aquarium, South Carolina Dept. Natural Resources, South Carolina Electric & Gas Company, PBS&J, State Wildlife Grants Program, Georgia, and South Carolina & North Carolina State Parks

Financial update:

- July 2016 Balance: $6,795.95
- 2016 Support: $6,005.12
- 2016 Expenses: $4,391.29
  - Website Hosting: $315.24
  - 2016 Meeting: $4,076.05
- September 2017 Balance: $8,409.78
- 2017 Support (estimated): $6,500.00
- 2106 Meeting (estimated): $4,000.00

- Projected December 2017 Balance: $10,909.78

RRCC Executive Committee Member Update

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.

The updated list of ExCom members for 2017-2018:

- RRCC Chair: Tanya Darden
- RRCC Past Chair: Jaci Zelko
- GADNR: Paula Marcinek
- SCDNR: Ross Self
- NCWRC: Brena Jones
- USFWS: Fisheries: TBD/ES Carrie Straight
- USGS: Cecil Jennings
- Utility Representative: Tony Dodd
- Utility Representative: Ryan Heise
- Academia: Bud Freeman

A T T A C H M E N T S

Attachment 1. Attendees of the 2017 Meeting:

Name	Affiliation	Email
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Ryan Heise	Duke Energy	Ryan.Heise@duke-energy.com
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Brandon Stutts	SCANA	bstutts@scana.com

2017 Group Photo!!