AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY REPORT

PARR HYDROELECTRIC PROJECT

(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtGroup.com

June 2016

AMERICAN EEL
(*ANGUILLA ROSTRATA*)
ABUNDANCE STUDY REPORT

PARR HYDROELECTRIC PROJECT

(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtGroup.com

June 2016

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY REPORT

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY REPORT

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Shoals Development and the Fairfield Pumped Storage Development. The developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as Licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of relicensing issues in the context of a new license.

The Fisheries TWC requested that SCE&G perform American eel (*Anguilla rostrata*) collections during 2015 to document the relative abundance of this species in the Broad River directly downstream of the Parr Shoals Dam. During a review of the 2015 study results at a Rare, Threatened and Endangered Species (RTE) TWC meeting, the TWC requested that SCE&G perform one more year of backpack electrofishing during 2016 to verify the 2015 study results.

2.0 RELEVANT LIFE HISTORY INFORMATION

The American eel, *Anguilla rostrata*, is a catadromous species known to occur within river systems in South Carolina. The present distribution of American eels in South Carolina is primarily downstream of the fall line (Rhode et al. 2009). Mature American eels spawn in the ocean and the egg and pre-larval stages mature into the leptocephalus stage, where they drift with ocean currents for approximately a year before metamorphosing into the glass eel stage. Glass

eels migrate across the continental shelf, eventually entering estuaries and tidal rivers, where they mature into elvers. Elvers migrate primarily at night and are able to overcome obstacles that often times prevent passage of other aquatic species. Vertical obstacles, such as a dams, can be traversed by small eels as long as the surface of the structure is textured and remains wet. As the small eels continue to mature into yellow eels, they may gradually move upstream over many years, with the greatest movement occurring during the moderate water temperatures of spring and fall (ASMFC 2000). Upstream migrations of small eels in the southeast appear to increase as water temperatures reach 15^{o}C and continue until water temperatures reach approximately 22^{o}C (USFWS 2014 and Haro 1991).

Although the American eel currently does not have special status under state or federal regulations, it has been identified by United States Fish and Wildlife Service as an "at risk species" and the South Carolina Department of Natural Resources (SCDNR) as a priority species (SCDNR 2005).

3.0 STUDY OBJECTIVE

The objective of this study was to document the relative abundance, size, and movement patterns of the American eel in the Broad River in the immediate area downstream of Parr Shoals Dam through the use of elver traps, an elver fyke net, and backpack electrofishing. During 2016, backpack and boat electrofishing were used to verify the 2015 study findings.

4.0 METHODOLOGY

This study focused on collection of elvers in areas of the Broad River located immediately downstream of Parr Shoals Dam. Site selection for each collection method was based on attraction flows (dam leakage), safety for access and sampling, and input from the USFWS (USFWS 2014). Methodologies employed in this study were specified in the American Eel Abundance Study Plan (Appendix A).

Kleinschmidt personnel positioned two elver traps at the base of the dam in the west bank area and one trap on the east bank (directly downstream of the powerhouse). An elver fyke net was used to sample the flowing channel of water in the west channel of the Broad River.

Kleinschmidt personnel also sampled the pools and channel areas on the west side of the river and directly downstream of the dam (with a focus on areas near each of the elver traps) with a backpack electrofisher (Figure 1).

Elver traps were constructed using the design of Haro (2006) (Appendix B). Traps consisted of wooden ramps lined with landscape fabric as climbing substrate (Enkamat), an attraction flow, and a covered 44 gallon collection bucket with a flow-through water supply. Our water source for the traps on the west bank was supplied by gravity flow of leakage through the Parr Shoals Dam spillway gates (Photo 1). A reservoir height of 260.75 feet or greater was required for sufficient leakage flow to fill the collection buckets and water the traps. One of the elver traps was fitted with double ramps that sampled in different directions to increase the chances of elvers finding and using the ramps (Photo 2) and one trap was fitted with a single ramp (Photo 3). Flow for the east bank trap was provided by an electric water pump. This trap was also fitted with double ramps that sampled in opposite directions to increase the chances of elvers using the ramps.

Flow was delivered onto each of the ramps at a 45 degree angle over metal sheeting (Photo 4), so that any elvers that followed the flow up the ramp would then slide down the metal sheeting into the collection bucket. Hoses that provided attraction flow were secured at the bottom of the ramps using zip ties (Photo 5). Fine mesh screens were placed over the holes at the outlets of the collection buckets, to ensure that any elvers collected could not pass out of the traps.

Elver ramp traps were deployed and monitored from March 2, 2015 through June 12, 2015. Monitoring was also performed in the fall from October 9 to November 16, 2015. However, high flows during the month of October reduced the amount of time that the ramps effectively sampled during the fall sampling period. Traps were typically checked three times per week (Monday, Wednesday, and Friday), but only once or twice during high flow periods. Ramp flows and attraction flows were checked and repositioned as needed during each trap check event.

An elver fyke net was used to collect eels moving upstream through the west channel area (Photo 6). Kleinschmidt personnel identified an area of laminar flow and level bottom, with depths of approximately 2 to 3 feet that were ideal for use of a fyke net. The fyke net was initially placed in the main flow of the west channel. However, debris knocked the net over

multiple times when it was set in this location, therefore the fyke net was moved to an area with moderate water velocity that was downstream and on the edge of the main west channel flow.

The fyke net was deployed and monitored from March 2, 2015 through June 12, 2015. Monitoring was also performed in the fall from October 9 to November 16, 2015. However, high flows during the month of October reduced the amount of time that the net sampled during the fall sampling period. The net was optimally checked three times a week (Monday, Wednesday, and Friday) and at least once or twice a week during high flow periods.

Backpack electrofishing sampling was conducted on April 1, May 1, and May 13, 2015. One electrofishing effort was also conducted during the fall period on November 16, 2015. Each electrofishing effort was conducted for 600-800 seconds. One person operated the backpack shocker, and either one or two additional people assisted in netting fish during sampling. Backpack shocking was conducted in the pools and runs located in the west channel side of the dam, with a focus on areas close to the traps.

FIGURE 1 PARR PROJECT AMERICAN EEL - ELVER TRAP AND FYKE NET LOCATIONS

PHOTO 1 **LEAKAGE FLOW AND COLLECTION BUCKETS USED TO PROVIDE WATER TO WEST CHANNEL ELVER TRAPS**

PHOTO 2 **DOUBLE RAMP ELVER TRAP USED IN WEST CHANNEL**

PHOTO 3 SINGLE RAMP ELVER TRAP USED IN WEST CHANNEL

PHOTO 4 NOZZLE SETUP FOR PROVIDING FLOWS ONTO RAMPS

PHOTO 5 EXAMPLES OF ATTRACTION FLOW AT THE BASE OF RAMPS

PHOTO 6 EXAMPLE OF FYKE NET USED DURING STUDY

5.0 RESULTS

ELVER TRAP SAMPLING

Each of the three traps were in place for a total of 2,448 hours during the spring sampling event. The two west bank traps each sampled effectively (water flowing on ramp and attraction flow flowing at the base of the ramp) for a total of 1,499 hours. Downtime periods when the traps were not fishing were associated with low reservoir levels (< 260.75 ft.) that didn't provide enough leakage flow to supply attraction flows to the ramps. Downtime periods were also associated with instances of flooding that completely submerged and/or damaged the traps, and instances where debris clogged up nozzles, blocking flow from reaching the ramps. The east bank trap sampled effectively for a total of 1,900 hours during the spring sampling event (Table 1). Downtime was caused by flooding that completely submerged the trap, and by the electric water pump being damaged during the sampling periods. Within several days of being set in the fall, all three traps were flooded out. A single ramp trap was reset in the west channel on October 16, 2015. However this trap and the east bank trap spent the majority of October underwater due to high flows, and therefore did not spend much time sampling (Table 1). No eels were collected with the elver traps.

FYKE NET SAMPLING

The fyke net sampled effectively for a total of 2,304 hours during spring sampling (Table 1). Vandals pulled the net onto the bank on two occasions during the study. The fyke net caught approximately two hundred fish and approximately thirteen crayfish, including longnose gar, piedmont darter, redbreast sunfish, bluegill, young of year smallmouth bass, bullhead species, and shiner/minnow species. No eels were collected in the fyke net. The fyke net sampled effectively for one week during the fall sampling period, catching minnow/shiner species and a piedmont darter (Table 1). No eels were collected with the fyke net.

BACKPACK ELECTROFISHING SAMPLING

Fish collected during backpack electrofishing efforts include American eel, shorthead redhorse, gizzard shad, bluegill, redbreast sunfish, white crappie, smallmouth bass, and piedmont darter. One 250 mm American eel was collected on the May 1, 2015 electrofishing effort (Table 2). This fish was in the "yellow eel" lifestage, and was collected approximately 40 meters from the west

channel double ramp trap. A visual inspection of the eel showed no elastomer tags. No elvers were collected during this study. The combined catch per unit of effort (CPUE) for all three springtime electrofishing efforts was 1.7 eels/hour. No eels were collected during the fall electrofishing effort. The total CPUE over all four electrofishing efforts was 1.3 eels/hour.

TABLE 1 TIME THAT ELVER RAMPS AND FYKE NET SPENT FISHING IN THE BROAD RIVER

	TIME EFFECTIVELY SAMPLED (HOURS)	
	SPRING SAMPLING	FALL SAMPLING
Double Ramp Trap – West Bank	1,499	44
Single Ramp Trap – West Bank	1,499	271
Double Ramp Trap – East Bank	1,900	155
Fyke – Net West Channel	2,304	170

TABLE 2 DATES, SAMPLING TIME, AND NUMBER OF EELS COLLECTED DURING FOUR BACKPACK ELECTROFISHING EVENTS IN THE BROAD RIVER

DATE	SAMPLING TIME (SECONDS)	NUMBER OF EELS COLLECTED
4/1/2015	800	0
5/1/2015	608	1
5/13/2015	710	0
11/16/2015	600	0

6.0 ADDITIONAL COLLECTIONS DURING 2016

During a meeting on March 1, 2016, the RTE TWC (specifically NOAA Fisheries) requested that SCE&G perform additional American eel backpack electrofishing collections during 2016 to verify the relative abundance of eels in the study area downstream of the Parr Shoals Dam (see Appendix C). The backpack electrofishing collections in 2016 replicated methodologies from 2015 (see Section 4.0 of this report). In addition, boat electrofishing was also used to collect additional samples in the deeper portions of the tailrace along the downstream face of the powerhouse tailrace area. During collections, one person operated the boat, while one netter stood on the bow of the boat. Collection locations for each methodology are depicted in Figure 2.

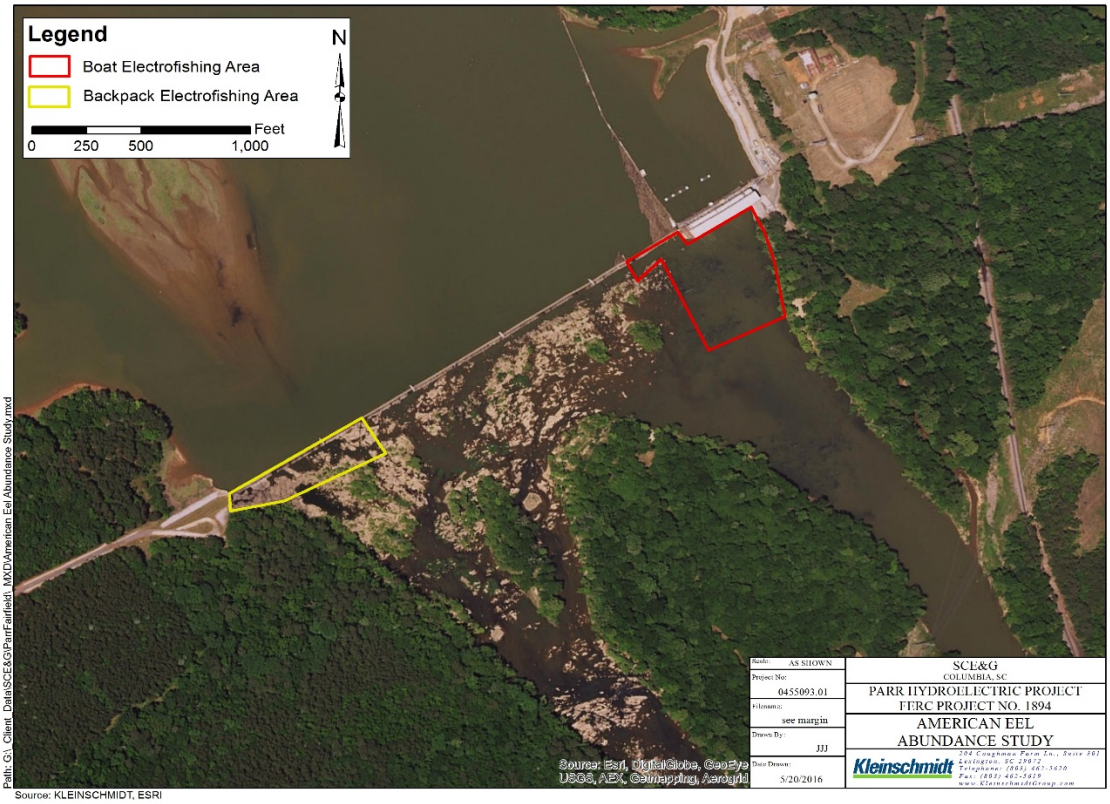


FIGURE 2 PARR PROJECT AMERICAN EEL - 2016 SAMPLING LOCATIONS

RESULTS

Fish collected during 2016 backpack electrofishing included similar species as the 2015 collections. One American eel was shocked but not netted during the April collections. Boat electrofishing detected one eel during the April collection also (Table 3). The eels observed were shocked but due to sampling conditions could not be netted. Both observed eels were yellow eels and appeared to be comparable in size to the yellow eel collected during 2015 sampling.

The combined catch per unit of effort (CPUE) for all three backpack electrofishing efforts was 1.4 eels/hour. The combined CPUE for all three boat electrofishing efforts was 0.9 eels/hour. Based on the total of 6,675 seconds of shock time, the total CPUE was 1.1 eels/hour.

TABLE 3 SUMMARY OF AMERICAN EEL COLLECTIONS DOWNSTREAM OF THE PARR SHOALS DAM DURING 2016

DATE	BACKPACK SHOCK TIME (SEC)	EELS OBSERVED	CPUE (EELS/HR)	BOAT SHOCK TIME (SEC)	EELS OBSERVED	CPUE (EELS/HR)
3/21	854	0	0.0	1,100	0	0
4/28	880	1	4.1	1,263	1	2.8
5/12	821	0	0.0	1,757	0	0
TOTALS	2,555	1	1.4	4,120	1	0.9

7.0 DISCUSSION

A one-year study was conducted in 2015 to determine the relative abundance, size and movement patterns of American eel in the Broad River immediately downstream from the Parr Shoals Dam. Despite using a variety of sampling methods , and sampling when water temperatures ranged from 7-24 ^{o}C during the spring sampling period, only one American eel was collected. The results of this study suggest that while American eels are present in the area downstream of Parr Shoals Dam, they do not appear to be abundant. The low numbers of eels collected could have resulted for several reasons, including low numbers of American eels in the vicinity of the project or inefficient sampling methods.

Low numbers of American eels collected could be related to the actual abundance of eels near the Project. There are a number of downstream blockages that hinder eels from reaching Parr Shoals Dam (i.e. multiple downstream dams). During 2010-2012, the SCDNR collected 13 eels downstream of the Columbia Hydroelectric Project dam (located on the Broad River 23.5 miles downstream of Parr Shoals Dam) by eel ramps (2), electrofishing (10), and Fukui trap (1) (SCDNR 2013). The mean annual backpack electrofishing CPUE at the Columbia Dam was 1.28 eels/hour (range of 0.61 – 2.35), which is comparable to the CPUE of 1.3 eels/hour experienced during our current study in the Parr tailrace. In separate studies during 2009-2014, the SCDNR collected a total of 21 yellow eels in the Broad River with 12 of those eels collected immediately downstream of Parr Shoals Dam via boat electrofishing. The 12 eels were collected over a total sampling time of 9600 seconds (CPUE=4.5 eels/hour), which is somewhat higher than the CPUE experienced during this study.

Three backpack and three boat electrofishing efforts were conducted in the spring of 2016 to provide an additional assessment of the abundance of American eels downstream of Parr Shoals Dam. A total of two yellow eels were observed during the collections. Combined springtime CPUE from the 2015 backpack electrofishing efforts (1.7 eels/hr) are comparable to the combined springtime CPUE for the 2016 backpack electrofishing efforts (1.4 eels/hr). The results of the 2016 study corroborate the findings of the previous 2015 eel sampling effort, that while American eels are present in the area downstream of Parr Shoals Dam, they do not appear to be abundant.

Low numbers of American eels collected could also be a result of the difficulty of catching eels with eel traps, fyke nets, and by boat or backpack electrofishing. Much of our study sampling effort targeted elvers or smaller yellow eels. Eels greater than 90 mm in length and over 14 months old are likely to have transitioned from the elver lifestage into yellow eels (Machut 2006, as cited in Pitman and Schmidt 2012). Therefore, it is possible that in the time it takes for most eels to reach the Parr project, they have matured into yellow eels. The Columbia Dam collections during 2010-2012 reinforce this theory in that all thirteen eels collected downstream of the Columbia Dam were greater than 128 mm in length (128 – 314 mm total length).

According to Rhode et al. (2009), "American eel are widespread and common in the Coastal Plain and the Piedmont up to the first migration barrier" and the SCDNR describes American eels as rare in the piedmont of the State (http://www.dnr.sc.gov/fish/species/americaneel.html). Regardless of the reasons for the low catch rates of American eel in this study, the results and conclusions of this study appear to be consistent with the current understanding of American eel distributions in South Carolina.

8.0 REFERENCES

Atlantic States Marine Fisheries Commission (ASMFC). April 2000. Fishery Management Report No. 36. Interstate Fishery Management Plan for American Eel.

Haro, A. 1991. Thermal preferenda and behavior of Atlantic eels (genus *Anguilla*) in relation to their spawning migration. Environmental Biology of Fishes 31: 171-184.

Machut, L. S. 2006. Population dynamics, *Anguillicola crassus* infection, and feeding selectivity of American eel (*Anguilla rostrata*) in tributaries of the Hudson River, New York. MS Thesis, SUNY ESF.

Pitman, L.M. and R.E. Schmidt. 2012. Diet of American eel (*Anguilla rostrata*) elvers in a Hudson River tributary. Section V: 1-18 pp. *In* D.J. Yozzo, S.H. Fernald, and H. Andreyko (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 2011. Hudson River Foundation.

Rohde, F. C., R. G. Arndt, J. W. Foltz, and J. M. Quattro. 2009. Freshwater Fishes of South Carolina. University of South Carolina Press, SC. 430 pp.

South Carolina Department of Natural Resources (SCDNR). 2012. Unpublished Presentation: American Eel Abundance and Distribution Along the Spillways of Lake Wateree Dam and Columbia Dam. November, 2012.

South Carolina Department of Natural Resources (SCDNR). 2013. American Eel Abundance and Distribution Along the Spillways of the Lake Wateree Dam on the Wateree River and the Columbia Dam on the Broad River.

SCDNR. 2005. Comprehensive Wildlife Conservation Strategy. South Carolina Priority Species. [Online] URL: http://www.dnr.sc.gov/cwcs/ Accessed September 5, 2013.

United States Fish and Wildlife Service (USFWS). September 5, 2014. Personal communication and site visit by Mark Cantrell.

APPENDIX A

AMERICAN EEL ABUNDANCE STUDY PLAN

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY PLAN

PARR HYDROELECTRIC PROJECT (FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

September 2014

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

September 2014

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

TABLE OF CONTENTS

LIST OF FIGURES

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. The developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. Collaboration and cooperation is essential for the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

The Fisheries TWC has requested that American eel (*Anguilla rostrata*) studies be performed in 2015 to document the relative abundance of this species in the Broad River, directly downstream of the Parr Shoals Dam.

2.0 RELEVANT LIFE HISTORY INFORMATION

The American eel, *Anguilla rostrata*, is a catadromous species known to occur within river systems in South Carolina. Mature American eels spawn in the ocean and the egg and pre-larval stages mature into the leptocephalus stage, where they drift with ocean currents for approximately a year before metamorphosing into the glass eel stage. Glass eels migrate across the continental shelf, eventually entering estuaries and tidal rivers, where they mature into elvers.

Elvers migrate primarily at night and are able to overcome obstacles that often times prevent passage of other aquatic species. Vertical obstacles, such as a dam, can be traversed by small eels as long as the surface of the structure is textured and remains wet. As the small eels continue to mature into yellow eels, they may gradually move upstream over many years, with the greatest movement occurring during the moderate water temperatures of spring and fall (ASMFC 2000). Upstream migrations of small eels in the southeast appear to increase as water temperatures reach 15^{o}C and continue until water temperatures reach approximately 22 ^{o}C (USFWS 2014 and Haro 1991).

Although the American eel currently does not have special status under state or federal regulations, it has been identified by the South Carolina Department of Natural Resources (SCDNR) as a priority species (SCDNR 2005). The federal status of this species is currently under review by the U.S. Fish and Wildlife Service(USFWS) and has been reviewed by the USFWS and National Marine Fisheries Service (NMFS) several times over the past decade.

3.0 STUDY OBJECTIVE

The objective of this study is to document the relative abundance, size, and movement patterns of the American eel in the Broad River in the immediate area downstream of Parr Dam through the use of elver traps, elver fyke net, and electrofishing methods.

4.0 GEOGRAPHIC SCOPE

The study will focus on the Broad River immediately downstream of Parr Shoals Dam. Three to five elver traps of standard design will be positioned at two sites along the base of the dam located near the west bank and one site on the east bank of the Broad River, directly downstream of the powerhouse. Site selection was based on dam leakage, current flow, and safety for access and sampling. One elver trap will be placed in each area at the start of sampling and two additional traps (for a total of 5 traps) may be added to these areas during the sampling period based on the collection or observations of elvers (in the traps or during electrofishing) in those areas. An elver fyke net will be positioned in the west channel that drains a large portion of the leakage from the Parr Dam. Backpack electrofishing efforts will be performed in the pools and channel areas on the west side of the river and directly downstream of the dam with a focus on areas near each of the elver traps (Figure 1).

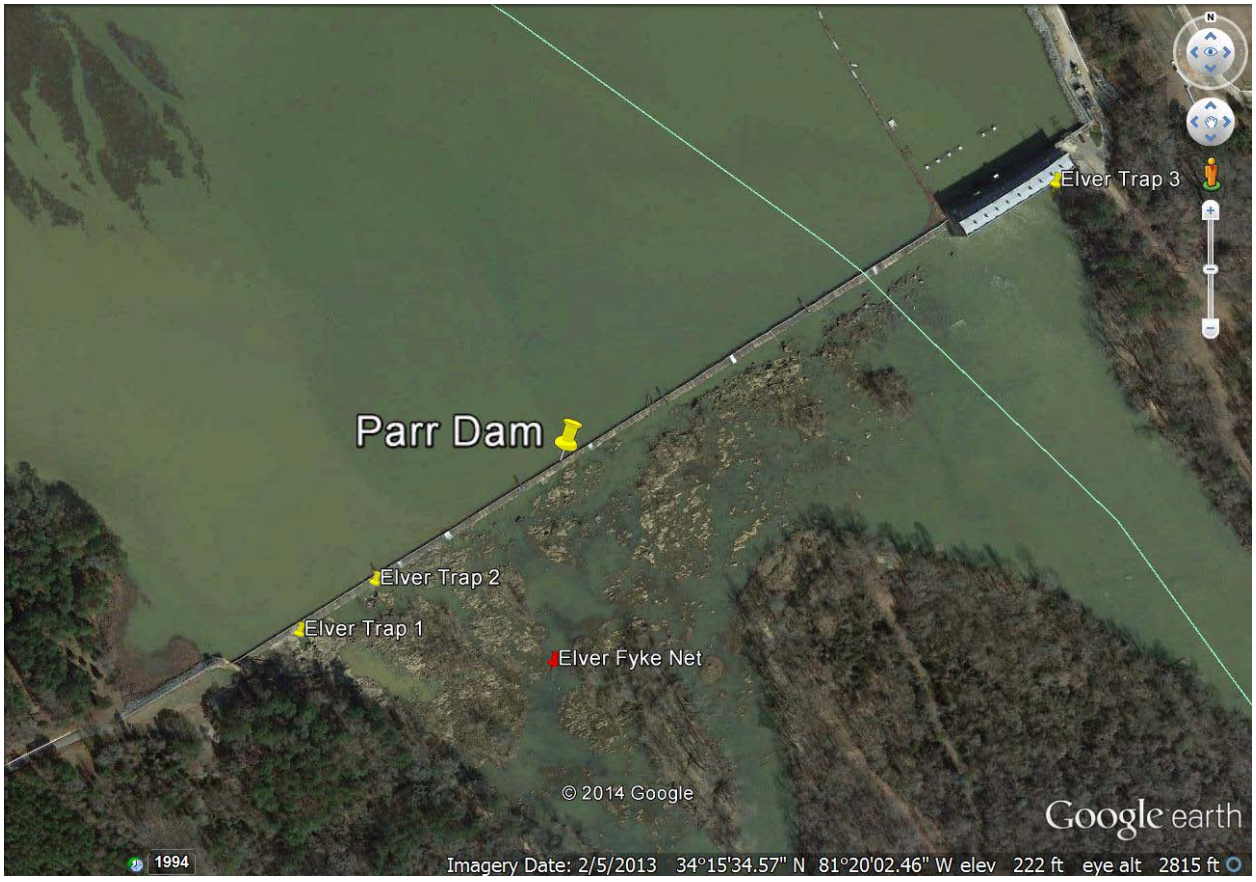


FIGURE 1. PARR PROJECT AMERICAN EEL – ELVER TRAP AND FYKE NET LOCATIONS

5.0 METHODOLOGY AND TEMPORAL SCOPE

Passive collection methods for elvers will consist of a metal ramp lined with landscape fabric climbing substrate (Enkamat or Akwadrain), an attraction flow, and a covered collection bucket with aeration or flow-through water supply. Ramp attraction flow will be provided by either gravity fed or pumped water supply (Figure 2). Elver traps in areas 2 and 3 will be fitted with double ramps that will sample in opposite directions to increase the chances of elvers using the ramp. The area 1 trap will only be fitted with a single ramp. An elver fyke net will also be used to collect eels moving upstream through the west channel area (Figure 3). We have identified an area of laminar flow, level bottom, and depths of approximately 2 to 3 feet that will be ideal for use of a fyke net. Spare equipment will be kept on hand in order to replace damaged or lost traps and nets to reduce "down time" and safely complete the study following subsidence of spill events.

American eel studies performed by the SCDNR on the Broad River, below the Columbia Diversion Dam, have indicated that the greatest frequency of catch occurs during April - June. However, a review of temperature data at the Parr Dam indicates water temperatures of 15^{o}C could occur as early as the beginning of March. Therefore elver ramp traps will be deployed at the end of February 2015 and will be monitored beginning on March 2, 2015 and ending on June 15, 2015. Monitoring will also be performed in the fall during October 5 to November 15, 2015 (Figure 4). Monitoring during the spring period will occur once a week until water temperature reaches 15^{o}C, then traps will be monitored three times a week (Monday, Wednesday, and Friday) until temperatures reach 22^{o}C, and then spring monitoring will be discontinued. The elver traps will be placed back in position on October 5th and monitoring of the traps will occur three times per week until November 15 or until the water temperature drops below 15^{o}C, and monitoring will be discontinued for the year. Trap entrances and attraction flows will be checked and repositioned as needed during each trap check event.

FIGURE 2. EXAMPLE OF A PORTABLE ELVER RAMP TRAP USED AT THE DOMINION PROJECT TAILRACE.

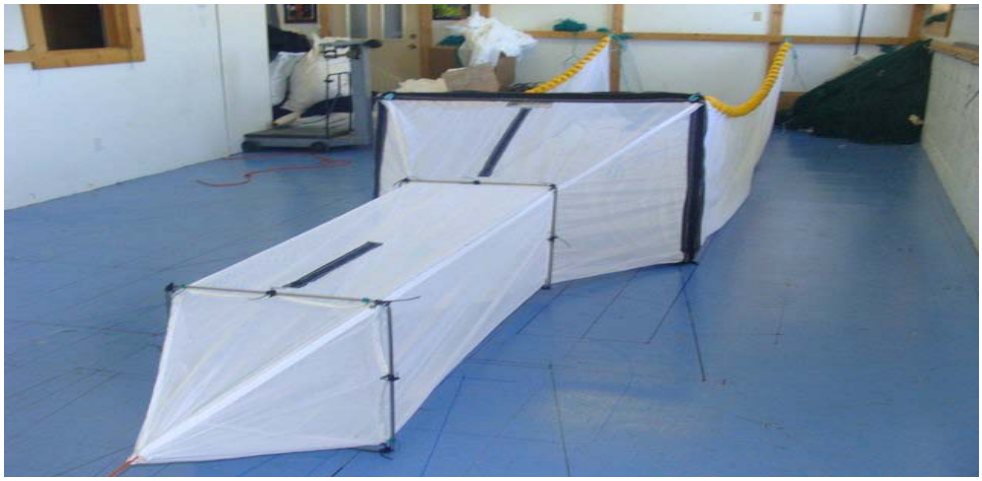


FIGURE 3. EXAMPLE OF AN ELVER FINE MESH FYKE NET PRODUCED BY FILMAR, INC.

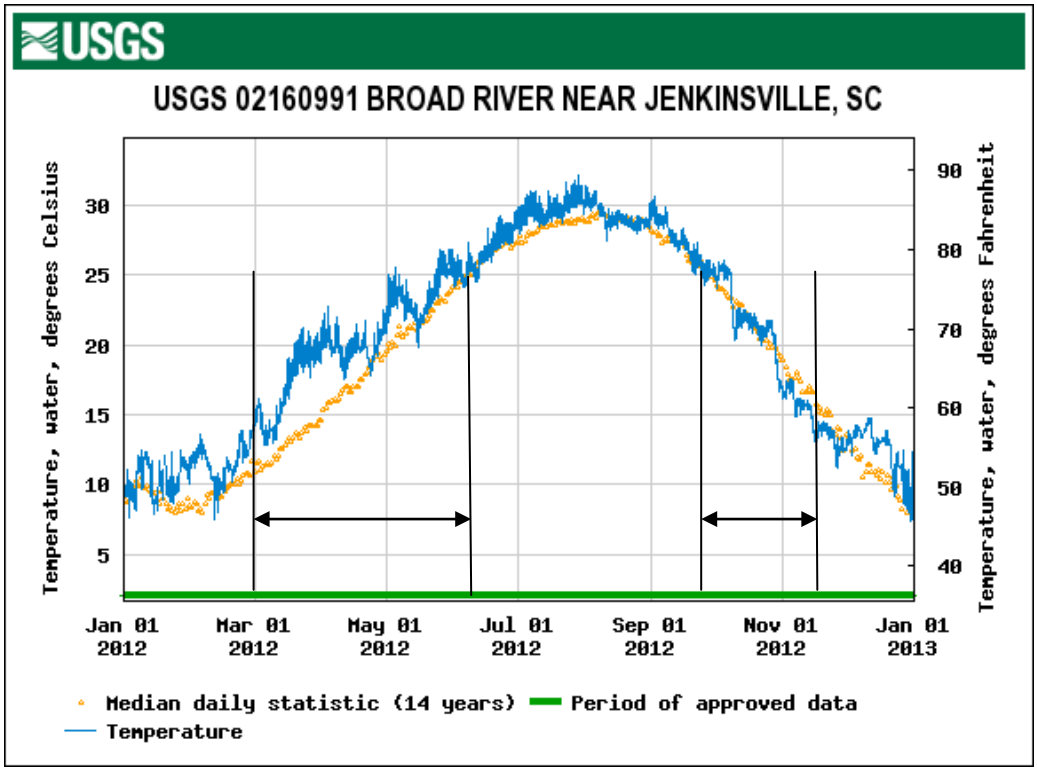


FIGURE 4. BROAD RIVER WATER TEMPERATURE AT PARR DAM – MEDIAN OVER 14 YEARS AND FOR 2012

Backpack electrofishing will be conducted once in late March, April, and May, 2015 and one sample in October during the fall period. Since American eels can be difficult to catch by electrofishing methods, one person will operate the backpack shocker and two additional people

will assist in collecting eels during the effort. Backpack shocking will be conducted in the pools and runs located in the west channel side of the dam with a focus on areas close to the traps.

All eels collected will be measured, checked for visual implant elastomer (VIE) tags, recorded, and released to the Broad River upstream of Parr Dam. If the color of the VIE tag cannot be positively determined (especially pink or orange) the eels will be kept and preserved for dissection and color determination.

6.0 PRODUCTS

A final report summarizing the study findings will be issued within 120 days of completion of field work in 2015. Study methodology, timing and duration may be adjusted based on consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, Fisheries TWC, and other relicensing stakeholders.

8.0 REFERENCES

Atlantic States Marine Fisheries Commission (ASMFC). April 2000. Fishery Management Report No. 36. Interstate Fishery Management Plan for American Eel.

Haro, A. 1991. Thermal preferenda and behavior of Atlantic eels (genus *Anguilla*) in relation to their spawning migration. Environmental Biology of Fishes 31: 171-184.

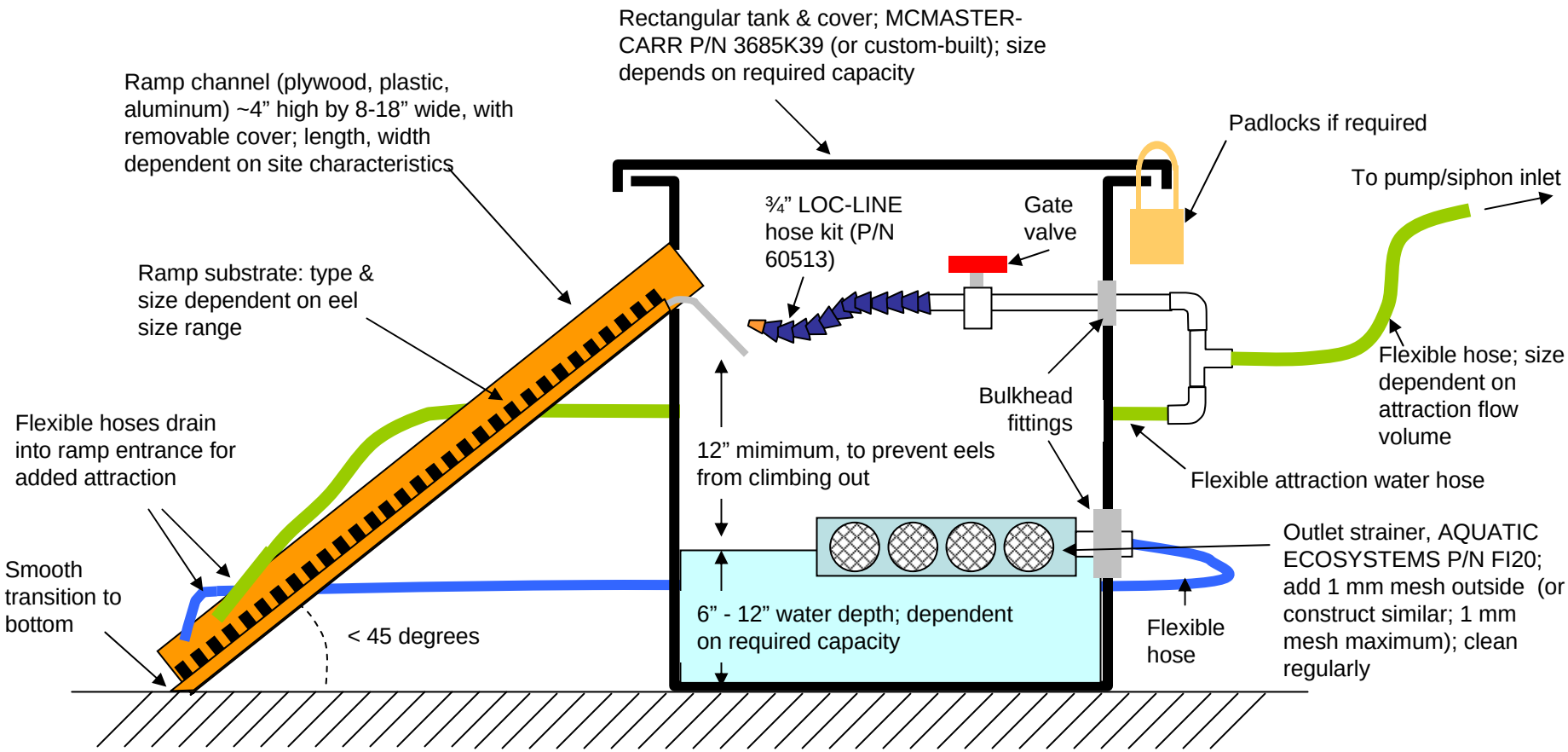
South Carolina Department of Natural Resources (SCDNR). 2012. Unpublished Presentation: American Eel Abundance and Distribution Along the Spillways of Lake Wateree Dam and Columbia Dam. November, 2012.

SCDNR. 2005. Comprehensive Wildlife Conservation Strategy. South Carolina Priority Species. [Online] URL: http://www.dnr.sc.gov/cwcs/ Accessed September 5, 2013.

United States Fish and Wildlife Service (USFWS). September 5, 2014. Personal communication and site visit by Mark Cantrell.

APPENDIX B

ELVER TRAP DESIGNS

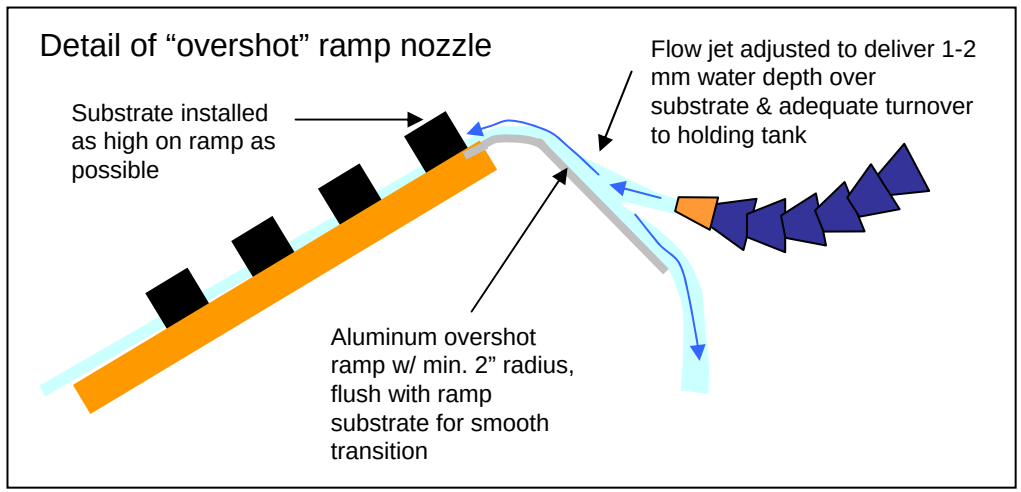


"Generic" Temporary Eel Ramp Pass Trap

Design by Alex Haro
S.O. Conte Anadromous Fish Research Center,
U.S. Geological Survey, Biological Resources
Turners Falls, MA USA

March 2006

USGS science for a changing world



APPENDIX C

RTE TWC MEETING NOTES
MARCH 1, 2016

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Rare, Threatened and Endangered Species TWC Meeting

March 1, 2016

Final KMK 03-28-16

ATTENDEES:

Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Brandon Stutts (SCE&G)
Caleb Gaston (SCE&G)
Tom McCoy (USFWS)
Fritz Rohde (NOAA)
Bill Marshall (SCDNR)
Rusty Wenerick (SCDHEC)
David Eargle (SCDHEC)
Bill Stangler (Congaree Riverkeeper)
Henry Mealing (Kleinschmidt)
Shane Boring (Kleinschmidt)
Kelly Kirven (Kleinschmidt)
Jared Porter (Kleinschmidt)

These notes serve as a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

The objective of the meeting was to review several reports that were issued to the TWC summarizing five studies that were completed during 2015, including the Rare, Threatened and Endangered Desktop Assessment, the American Eel Abundance Study, the Rocky Shoals Spider Lily Study, the Broad River Spiny Crayfish Study, and the Monticello Reservoir Mussel Survey. A brief PowerPoint presentation was prepared summarizing the methods and results of each study. This presentation is attached to the end of these notes. A second meeting objective was to identify any Protection, Mitigation, and Enhancement (PM&E) measures associated with the study issues for possible inclusion in the Settlement Agreement.

RTE Desktop Assessment

Henry said this report was originally issued in 2014, but after additional input from the USFWS, the report was revised and reissued in the late fall of 2015. The bald eagle is known to occur within the Project boundary, and SCE&G will continue to work with SCDNR on monitoring this species. There are also several fish that are known to occur within the Project boundary that will be further addressed through the IFIM study.

Bill Stangler said that the report has wording that suggests SCE&G is "likely to consult" with agencies on blueback herring and asked if there was a reason why they would not consult. This wording will be changed to remove "likely." He also asked if striped bass and sturgeon spawning would be addressed during any additional studies. Henry said yes, striped bass will be looked at during the IFIM study, and both species will be studied further as part of the ongoing Downstream Flow Fluctuation investigation.

Bill Marshall said that SCDNR has noted that robust redhorse are known to occur in the Monticello Reservoir. He said that the SCDNR may have some concerns about entrainment impacts if it passed into that reservoir through the pumpback operations. Henry said that it probably did get there through pumpback operations at Fairfield, and that there may be mortality, but there is also survival. This may be something that will need to be addressed further as fish passage becomes an issue in the future.

Bill M. also said that a new State Wildlife Action Plan was completed last year, so the report may need to be updated to reflect those changes. Tom McCoy said that the official status of several of the species had also changed since the report was issued. These should be updated for the Draft and Final License Application. An addendum to the report will be prepared to address these changes. Bill M. and Tom M. were asked to send their recommended updates/edits to Kleinschmidt.

American Eel Abundance Report

Jared gave the group a summary of the American eel study that was completed in the spring and fall of 2015. Henry stated that Mark Cantrell with the USFWS accompanied Kleinschmidt and SCE&G on a site visit to help pick sites for installing the eel ramps. Jared noted that the ramps did not catch any eels or any other species and the fyke net didn't catch any eels either, although it did catch a wide variety of other species, including fish, crayfish and turtles. One backpack electrofishing effort did result in the collection of one American eel. The eel was a yellow eel; no elvers were found. These results are similar to the results of additional studies conducted by Ron Ahle with SCDNR.

Fritz asked what type of substrate was used on the eel ramps and Jared said Enkamat. Fritz pointed out that if the yellow eel life stage is what is located below the Project, Enkamat may not have been the best substrate. Henry agreed and said that during study plan development, everyone expected that elvers would be the dominant life stage of eel in the area, instead of the larger yellow eels. Henry said that based on the information collected during this study and the SCDNR study, future studies and fish passage should focus on the collection of larger eels. Fritz agreed and said he would send the group some additional information regarding eel passage.

Tom said that periodic monitoring as a PM&E measure in the new license might be a good idea. The group agreed that doing surveys on a 5-10 year basis, or when initiated by a pre-determined trigger, could be part of the Settlement Agreement. Henry said this could be tied into the fish passage requirements as described in the Accord Agreement. Tom said he would send the group some information on the triggers used for eel passage at the Wateree Project. Bill A. said that additional American eel studies could be initiated when a percentage of a trigger number is hit, similar to how fish passage study and design for American shad and blueback herring is set up in the Accord Agreement.

Fritz said that of the three methodologies used in the study, the only effective one was backpack electrofishing. He asked that the backpack electrofishing be replicated in the spring of 2016 to verify that yellow eels are the life stage of eel that are dominant below the Parr Shoals dam. This way, when additional studies are warranted, methodology can be targeted toward the collection of yellow eels. SCE&G agreed to do an additional year of backpack electrofishing downstream of the dam. Three sampling events will be scheduled during late March, mid-April and mid-May and the results will be issued as an addendum to the American Eel Abundance Report.

Rocky Shoals Spider Lily (RSSL) Report

Shane gave the group a summary of the RSSL study, and said that populations of the plant were concentrated around the top of Bookman Shoals and the top of Frost Shoals. Bill Stangler asked for clarification on the green polygons shown in the report. Shane said that the polygons were drawn around large population clusters of the plants. Henry said that transect elevation data is also being collected in some of the RSSL areas as part of the IFIM study.

Henry asked Bill S. if there was something specific that he wanted to see coming out of relicensing. Bill said that he would like to see something similar to what was done during the Columbia relicensing, such as long term monitoring and possible restoration efforts. If restoration isn't feasible in the Broad River downstream of the Project, it could be done elsewhere in the basin. Bill said that currently there is less usage in this stretch of the river, so the plant is less visible here than it is below Columbia. There is less human predation, but this could change if additional access is created downstream of Parr. Bill A stated that as part of the Saluda Project, SCE&G is a supporting member of the team that currently monitors the RSSL population below Columbia dam. SCE&G could carry this forward for consideration for the Parr Settlement Agreement – but more specific information will need to be added to the PM&E measure.

Broad River Spiny Crayfish Report

Jared gave an overview of the Broad River Spiny Crayfish study and said that Byron Hamstead (USFWS) accompanied Kleinschmidt staff to identify specific study areas for deploying crayfish traps. Jared said that ultimately, the traps did not collect any crayfish, but they did collect several fish species. He noted that the fyke net used during the American Eel Abundance Study collected many crayfish, but none of these were identified as the Broad River spiny crayfish. He noted that the traps were out during the months of September and October, and while flows were unusually high during October, which may have created unfavorable conditions for crayfish, the month of September was a typical month and provided prime conditions for crayfish.

Bill S. noted that the fyke net was deployed during spring and fall of 2015, and since crayfish were caught in the fyke net, asked if the timing was off during the crayfish study. Maybe the crayfish study should have occurred during the spring. Jared said that the study was planned for fall based on recommendations from Arnie Eversole and to make identification easier. He also noted that crayfish were also caught during the fall months in the fyke net.

Henry mentioned that during study plan development, Byron Hamstead noted that he did not believe any Broad River spiny crayfish were present in the study area, but he wanted the study to help verify this assumption.

Monticello Freshwater Mussel Survey Report

Shane gave an overview of the Monticello Freshwater Mussel survey and said that the study was conducted by Three Oaks during September and November in Monticello Reservoir and the Recreation Lake. No live mussels were found in the Recreation Lake and six species were found in Monticello Reservoir. David Eargle said that one of the species found in the reservoir, the Carolina creekshell, was unexpected, since it had never been identified in that area before. David stated that

the genetic testing would be less than $1,000 based on discussions with Tim Savage (Three Oaks). He asked if genetics could be run on the samples collected, just to verify if that was the correct species, or if it was actually a similar species known to occur in the area. SCE&G agreed to contact Tim and have the additional testing completed on the samples. David said that knowing the correct identification wouldn't have any effect on Project operations, but it would be good information to know.

David said that he was curious as to why no mussels were found in the Recreation Lake. Ray said that there are racks on the intakes and fish cannot pass back and forth from the Recreation Lake and Monticello Reservoir. Upon initial filling, the Recreation Lake was treated with rotenone and stocked with fish. It is likely that mussels never had the opportunity to get established in that body of water.

David identified a few typos in the Three Oaks report and said he would send these over to Kleinschmidt to address.

Protection, Mitigation and Enhancement Measures

Several general PM&E measures were identified during the meeting, and are listed below. These should be developed with more detail through input from TWC members and will be considered as the relicensing process moves forward and a Settlement Agreement is developed.

- Periodic monitoring/studies for American eels throughout the term of the new license – possibly every 5-10 years, or based on a trigger system, similar to the triggers established in the Accord Agreement
- Establish long term monitoring of the Rocky Shoals Spider Lily populations located downstream of Parr Dam and upstream of Columbia Dam (similar to the monitoring already taking place downstream of Columbia Dam) – Possible restoration efforts for the species – Possible public outreach and education efforts (could tie into the education and outreach already established for the Columbia Project)

Action items identified during the meeting are listed below.

ACTION ITEMS:

- SCDNR and USFWS will send updates/edits for RT&E Desktop Assessment.
- Fritz will send Fish Passage Primer, which includes information on eel passage, to group.
- SCE&G and Kleinschmidt will perform 3 additional backpack electrofishing sessions during the spring of 2016 for American eels downstream of Parr Dam.
- David will send comments/edits for the Monticello Freshwater Mussel Survey Report to Kleinschmidt.
- Kleinschmidt will work with Three Oaks to get genetic testing done on mussel samples that are thought to be Carolina creekshell.

Rare Threatened and Endangered Species Desktop Assessment

Methods and Materials

- Objective- Identify RTE species potentially occurring in the Project vicinity
- Project Vicinity- Project Boundary and downstream reach of Broad River influenced by the Project
- USFWS and SCDNR county-level listings for Newberry, Fairfield, and Richland counties reviewed to find listed or at-risk species that may occur in study area
- Species on 2008 Birds of Conservation Concern list included for review
- Ten species considered priority species in the SCDNR Comprehensive Wildlife Conservation Strategy included for review

Results

- Some of the species reviewed may occur in the Project boundary
- Impacts are unlikely
- Species present in Project boundary not protected by state or federal law
- Of the 13 state and federally listed/protected species, only the bald eagle likely occurs in the study area regularly
- Fish species classified as SCDNR priority conservation species documented in study area
- Fish habitat requirements assessed further in IFIM Study

American Eel Abundance Report

Materials and Methods

- Objective- Characterize the abundance and distribution of American eels downstream of Parr Shoals Dam
- Two traps (3 ramps) set at base of dam near the west bank
- One trap (two ramps) set near powerhouse on east bank
- Fished from March 2-June 12 and October 9-November 16
- Fyke net set in west channel from March 2-June 12, and October 9-November 16
- Four backpack electrofishing efforts

Results

- One yellow eel collected over four total electrofishing efforts
- No elvers collected in traps or fyke net
- Ramp traps fished for a total of 3,428 hours
- Downtime associated with low leakage flows and flooding

Rocky Shoals Spider Lily Study Report

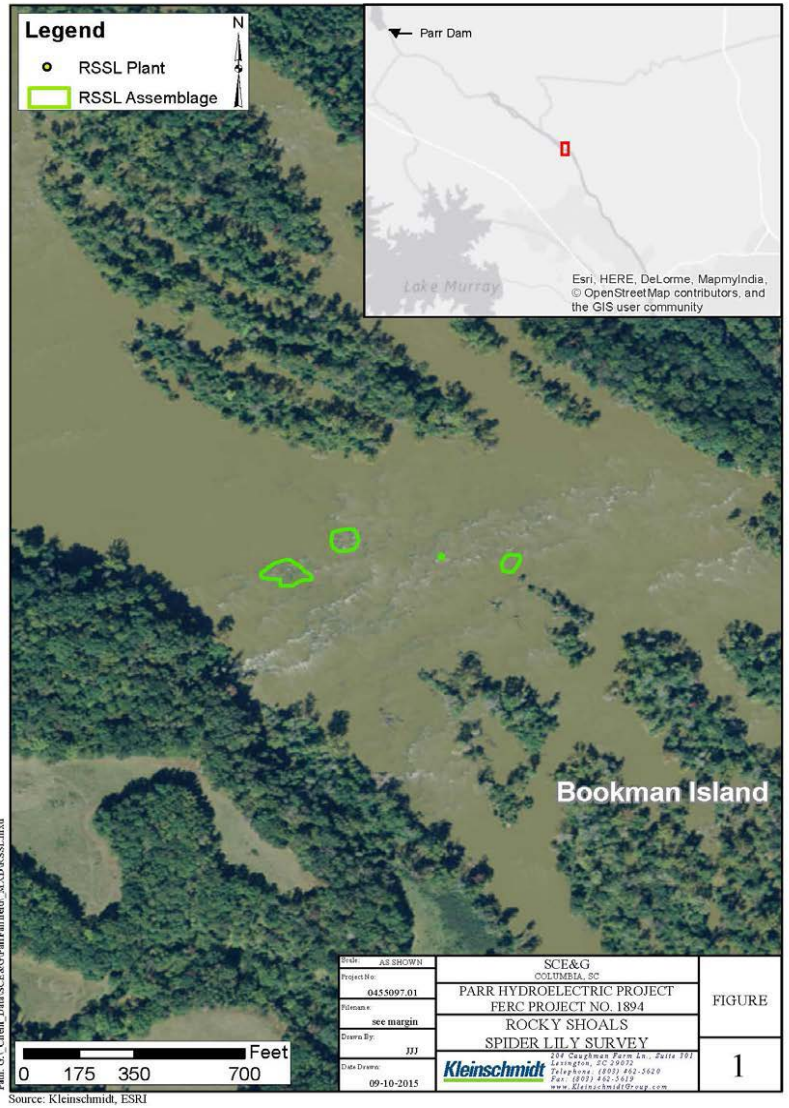
Materials and Methods

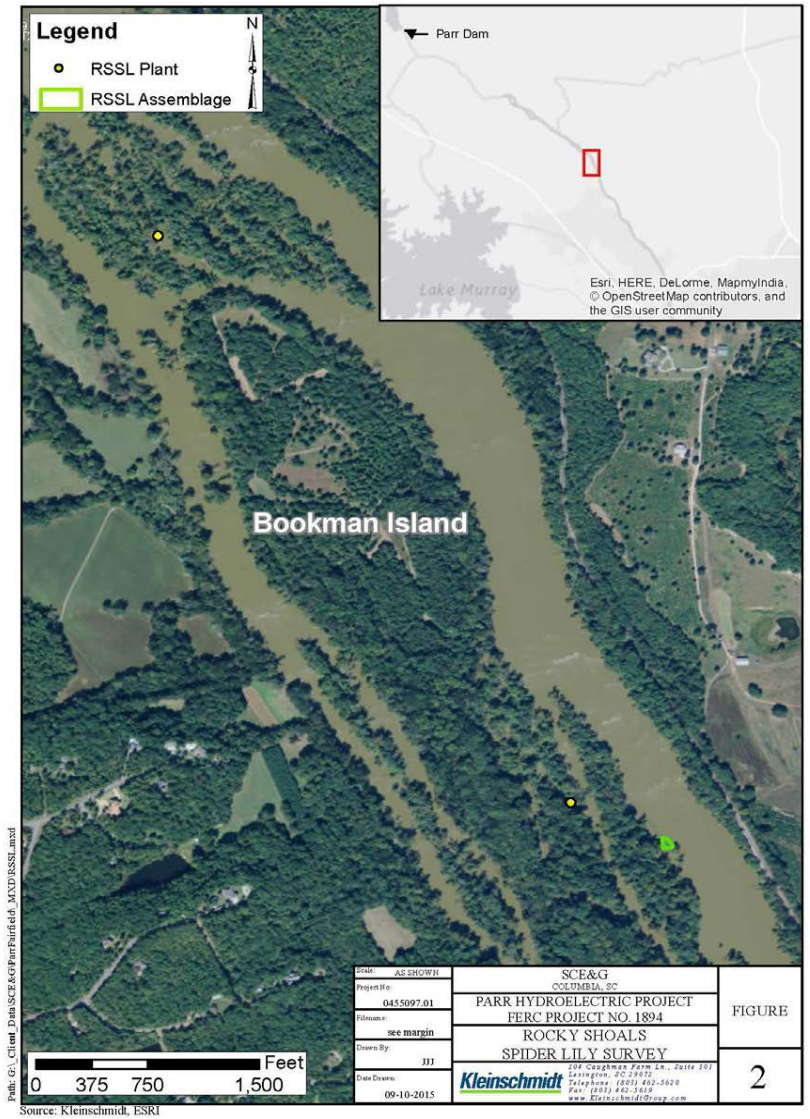
- Objective: Assess abundance and spatial distribution of RSSL between Parr Shoals Dam and Frost Shoals
- Crews floated Broad River between Parr Shoals Dam and Boatwright Island
- Study conducted during May 26-27(height of flowering season)
- Plants or clusters documented using handheld GPS
- Clusters of plants measured for length and width

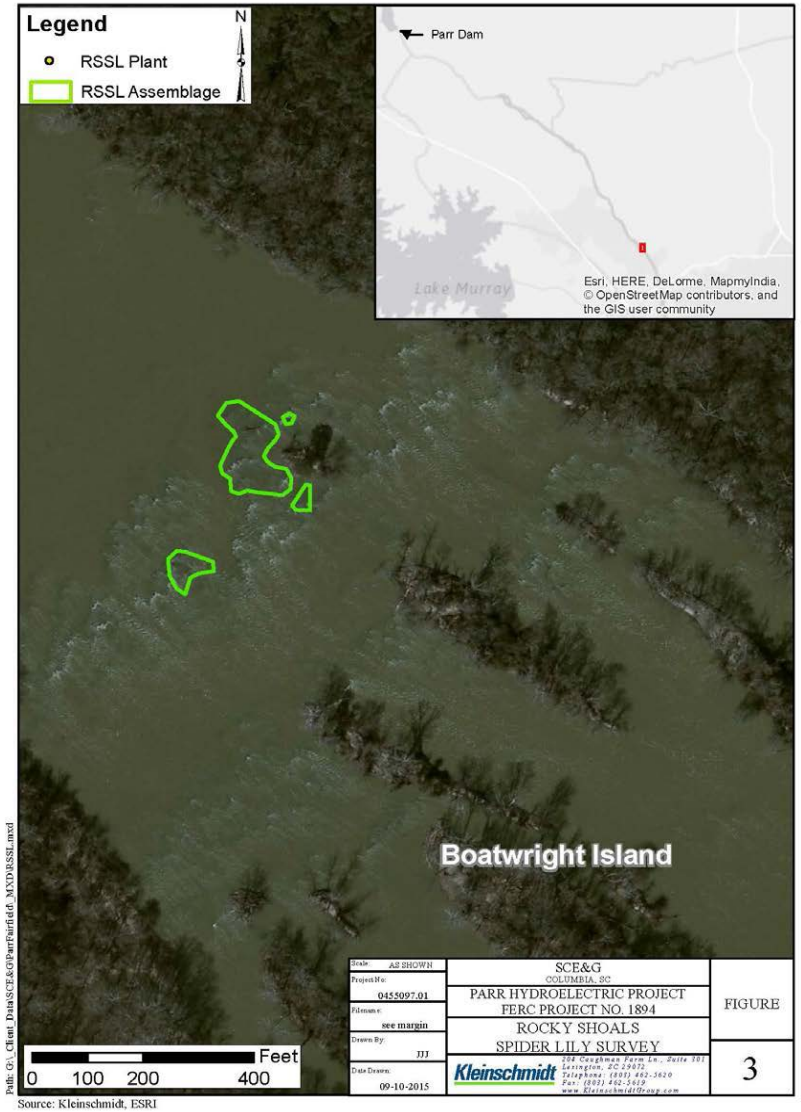
Results

- 81 plants or clumps of plants documented
- Occurrences were limited to Bookman Shoals and Frost Shoals
- Majority of plants located on bedrock ledges, in water depths of 0-30 inches
- Basal areas ranged from 0.05 m^2- 20,000 m^2

Locations of RSSL



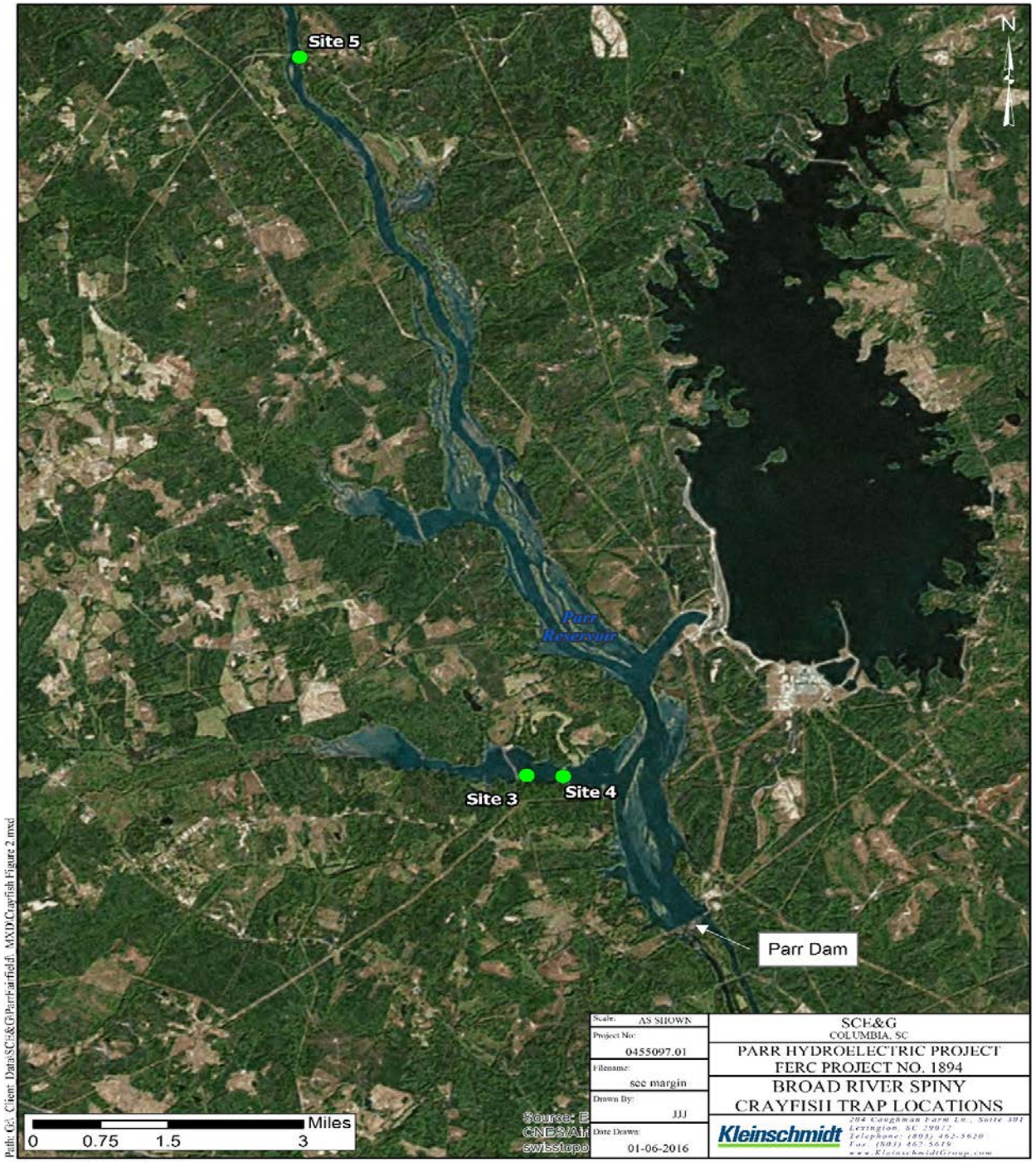




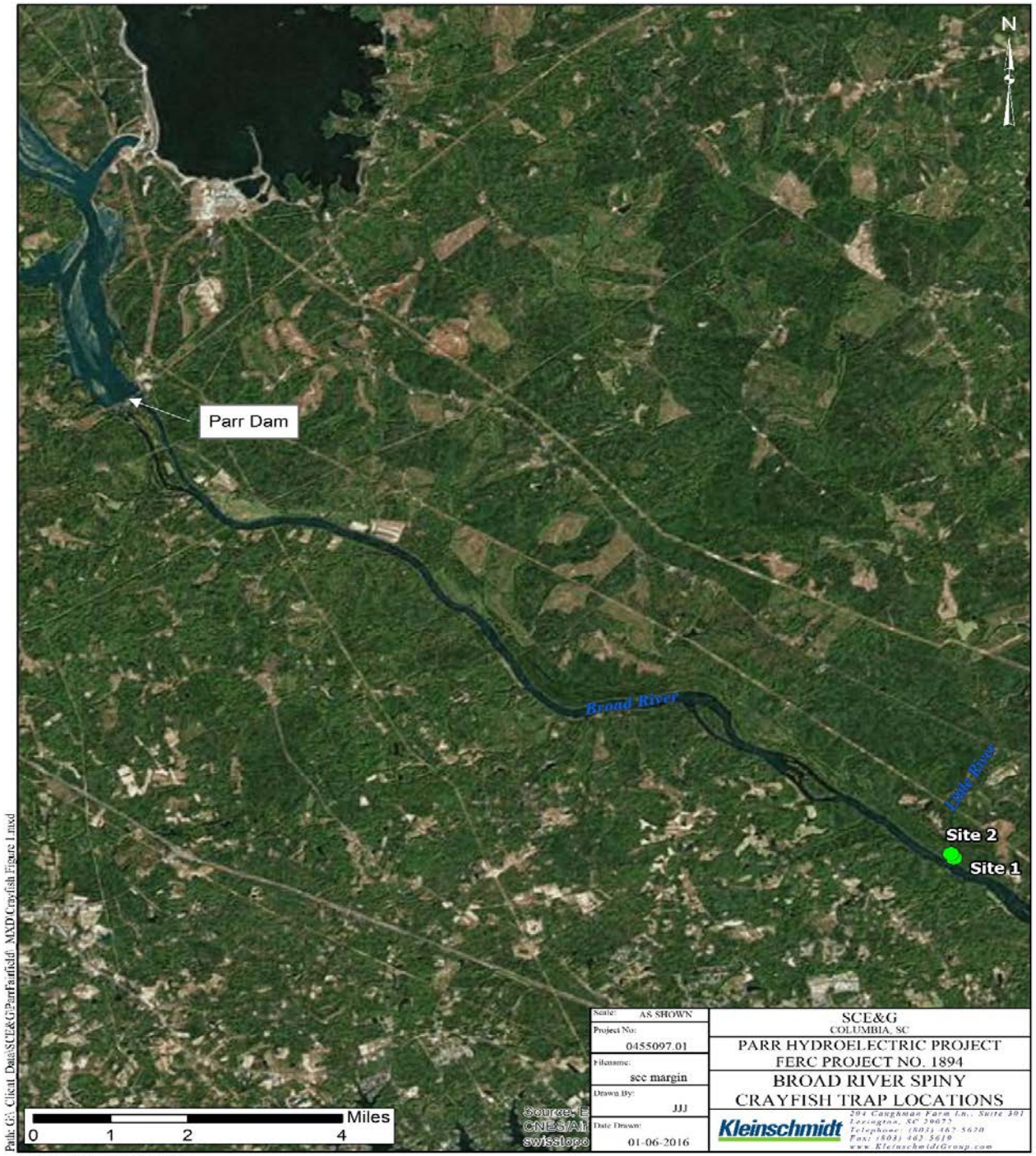
Broad River Spiny Crayfish Study Report

Objectives, Methods, and Materials

- Study Objective- Assess the presence of the Broad River Spiny Crayfish in Parr Shoals Reservoir and in the Broad River Downstream of Parr Shoals Dam
- Study site determinations w/ USFWS
- Double entry traps wire mesh crayfish traps baited, set, and regularly checked at 3 sites (September-October 2015)
    1. Broad river at the Hwy 34 bridge
    2. Cannon's Creek arm of Parr Shoals Reservoir
    3. Confluence of Little River and Broad River, downstream of Parr Shoals Dam



Source: Kleinschmidt, ESRI



Source: Kleinschmidt, ESRI

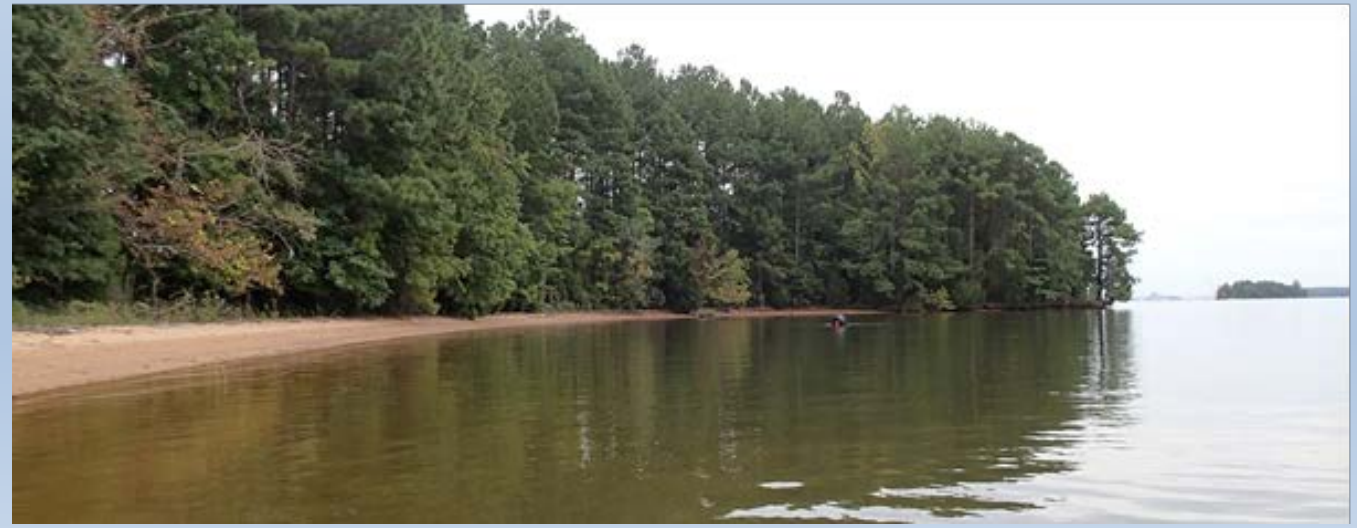
Results

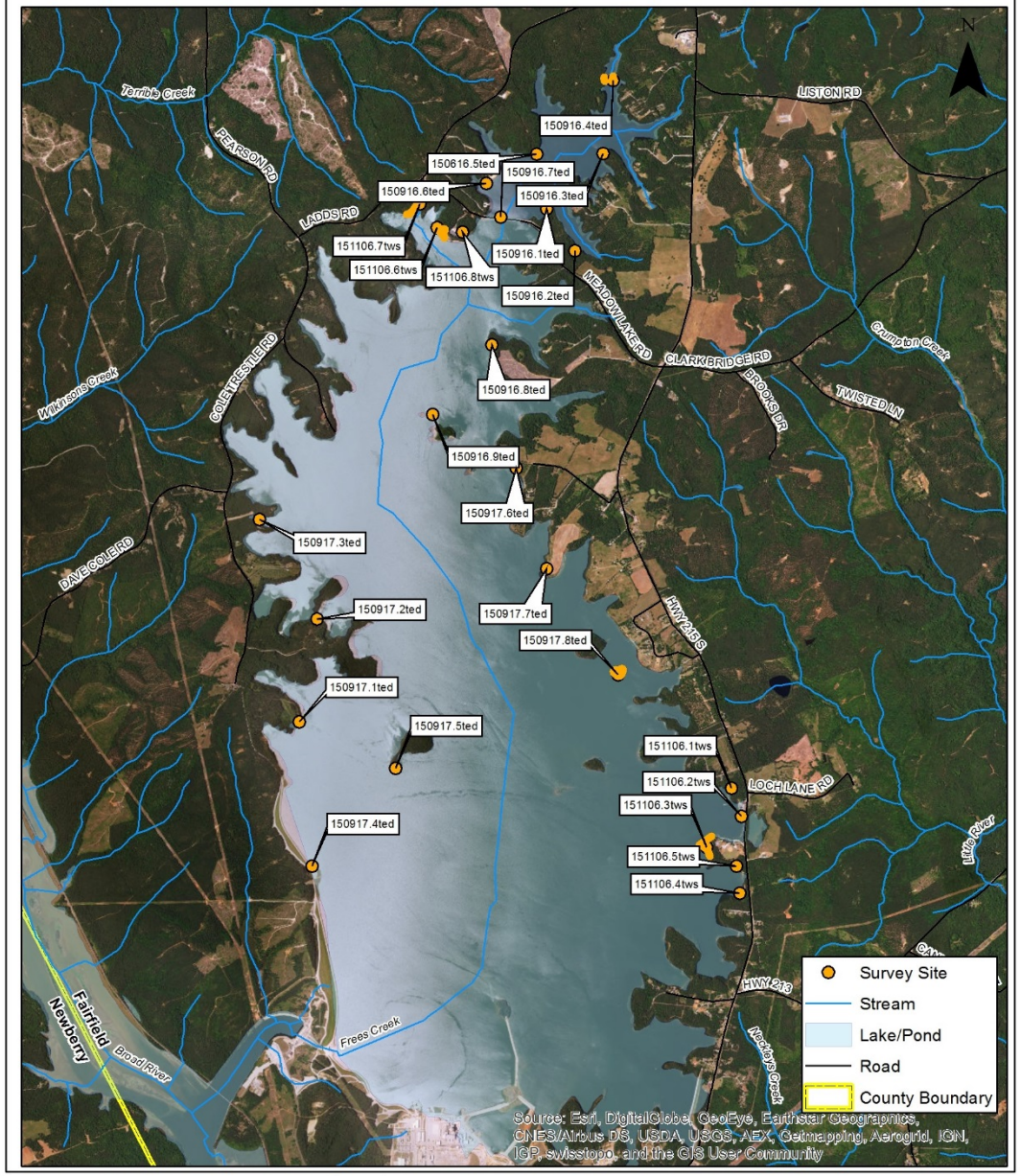
- Water temperatures ranged from 12-28°C for duration of study
- Traps fished for a total of 9,996 hours
- No crayfish collected
- Traps collected small sunfish throughout study

Monticello Freshwater Mussel Survey Report

Methods and Materials

- Surveys conducted by Tim Savidge (Three Oaks/Catena) on September 16-17 and November 6, 2015
- 25 sites surveyed via SCUBA and snorkeling
- Surveyors worked from shoreline habitats towards deeper water
- All mussels identified, enumerated, and returned to substrate





THREE OAKS ENGINEERING

Prepared For:

Kleinschmidt

Freshwater Mussel Survey
Monticello Reservoir

Fairfield County, South Carolina

Date:	December 2015
Scale	0 1,000 2,000 Feet
Job No.:	3396
Drawn By:	KMS
Checked By:	TS

Figure

1

Results

- Six species documented: Carolina Lance (moderate priority), Eastern Floater, Florida Pondhorn, Paper Pondshell, Eastern Creekshell (moderate priority), Carolina Creekshell (highest priority)
- Relic shell material (Paper Pondshell) found in rec lake
- Reproduction appears to occur for at least 5 species
- Federally protected species (Carolina Heelsplitter and Savannah Liliput) unlikely to occur in Monticello Reservoir and are not known from the Broad River Basin.