Final Report of Fishery

Resource Grant Project 2017

Conducted by George Trice

Project Title: COMPARING THE EFFECTIVENESS OF 7.5 AND 9.0 GPPS TO CONDUCT LOW-FREQUENCY ELECTROFISHING TO REMOVE INVASIVE CATFISH FROM VIRGINIA WATERS

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Introduction

The blue catfish *Ictalurus furcatus* is a non-native species as first introduced to Virginia tidal waters in the 1974 and currently inhabit all major Virginia tributaries of the Chesapeake Bay (Jenkins and Burkhead 1994, Schloesser et al. 2011). More recently, blue catfish have spread to Maryland waters and are multiplying at an alarming rate. The James River tributary has the largest number of blue catfish (Schloesser et al. 2011) in Virginia. The amount of blue catfish inhabiting the James River in unknown but is likely to be over five million (Fabrizio et al. 2009, Greenlee 2011) and blue catfish are estimated to be over 75% of the freshwater-tidal biomass (Schloesser et al. 2011). In recent years, blue catfish have extended their range further down river than ever thought that they would. We are catching blue catfish in salinities of 22ppt as far down river as the James River Bridge. This is very alarming for the welfare of all the native species that invasive catfish feed on. If the blue catfish population is not reduced, they could spread all over the Chesapeake Bay and tributaries further impacting commercial watermen and recreational fishers through their destructive feeding behavior. While supporting a trophy hook-and-line fishery (Greenlee 2011), management and conservation groups are concerned about the high number of blue catfish in the James River and Chesapeake Bay (Fabrizio et al. 2011, Schlosser et al. 2011). There is commercial interest for blue catfish harvest, and a management plan considered by Fabrizio et al. (2011) was to create a commercial fishery targeting "small (less than 32" total length) blue catfish".

Because it is invasive and extremely high abundance, blue catfish are a prime candidate for commercial harvest and markets are developing for fish of all sizes. Virginia harvests the majority of its finfish using anchored gillnets (AGN) which have unintended interactions with protected species that inhabit Virginia waters, i.e. Atlantic sturgeon *Acipenser oxyrinchus*, blueback herring *Alosa aestivalis*, Alewife *A. pseudoharengus*, and American shad *A. sapidissima* (Jenkins and Burkhead 1994, Trice and Balazik unpublished data). Blue catfish are laborious to remove from gillnets and are destructive to gear which increases cost to replace nets and adds waste. Hoop nets are traditional used to catch blue catfish in Virginia Rivers. Studies have shown that a certain form of electrofishing (Low Frequency Electrofishing, LFE) is very effective in Ictalurid catfish species (Corcoran 1979, Justus 1994, Schlosser 2011) when chase boats are used (Daugherty and Sutton 1995, Bodine et al. 2013). Low frequency electrofishing is not lethal to Ictalurids and does not affect protected species in Virginia waters.

During 2014 through 2016 commercial-scale LFE pilot studies resulted in the catch of over 700,000 pounds of invasive catfish (Trice 2014, 2015). While most (>95%) of the catch during the pilots studies consisted of blue catfish the invasive flathead catfish (*Pylodictis olivaris)* was also harvested. Flathead populations in the James River seems to be increasing so this fishery will help reduce their spread throughout the river. No species other than catfish appeared to be affected by the equipment. Several white catfish (*Ameiurus catus*) were observed but were purposely not captured. The commercial LFE likely lowered invasive blue and flathead catfish populations that helps relieve resource pressure for native species. Removal of invasive catfish also helps reduce predation of native species. Several species of commercial concern (American eel *Anguilla rostrata*, striped bass *Morone saxatilis*, white perch *M. Americana*, blue crab *Callinectes sapidus*) have been documented in blue catfish stomachs along with several species of additional concern (American eel, blueback herring, Alewife *A. pseudoharengus*) (Matt Balazik, unpublished data).

It is blatantly obvious that invasive catfish are negatively affecting the Chesapeake Bay watershed. The LFE commercial fishery was developed to reduce the abundance of invasive catfish in Virginia waters while keeping bycatch to a minimum. While LFE is very effective in removing invasive catfish; however, more effort is needed to help reduce the overwhelming abundance of invasive catfish. Due to limited shocking area, the James and Pamunkey River can only handle one LFE crew each. We plan to compare the effectiveness of a 7.5 kW and a 9.0 kW GPP in both low various conductivity waters. Very low conductivity water <100uS/cm is not conducive to LFE. The low ion content in the water does not provide a medium for the current to flow. The current will follow the path of least resistance and will prefer to move through a fish compared to the water and therefore the chance of damaging fish even at low frequency. A 7.5 kW GPP has been used in previous years of the commercial LFE projects and is very effective for water between 100 and 700 uS/cm. According to Smith Root and other researchers, a 7.5 kW GPP does better compared to a 9.0 kW GPP for LFE in conductivities of 100-700uS/cm. However, the 7.5 GPP has inefficient power to create a field large enough to conduct commercial LFE operations in high conductivity waters. The 7.5 kW GPP works better in typically freshwater environments.   We compared a 9.0 kW GPP to our current 7.5 GPP and see if we can increase the area where commercial LFE can occur in both the James and Pamunkey Rivers, and therefore have two crews per river.

METHODS

Commercial scale Low Frequency Electrofishing (LFE) testing was performed on both the James and Pamunkey Rivers, starting where previous commercial LFE projects (2014-2016) were conducted and known fish habitat was recorded (Figure 1). We compared the new 9.0kw gpp to the 7.5kw gpp as used in previous years. Both units were used in various environmental conditions with water temperature conductivity recorded. Once we became comfortable with how fish were being brought up with the new 9.0 kw gpp unit we started to move further down river into higher salinity resulting in higher conductivities. Both units were used in as close to the same conditions as possible and all data was recorded.

Results/Discussion

There were many differences between the 7.5 kw gpp and the 9.0kw gpp that were observed over the course of this project. At the start of the season, we went to the Pamunkey River where the conductivity was 110 to 125 uS /cm, on the low end of functional commercial electrofishing. Temperatures were also lower than we had worked in previous years. We found that the 9.0kw gpp could raise blue catfish when the conductivity was only slightly over 110. The 7.5kw gpp will not begin to raise blue catfish well until the conductivity reaches ~135uS/cm . We were also able to raise blue catfish when the temperature was only 22^{0}C with the 9.0kw gpp. The 7.5kw gpp cannot raise blue catfish until the temperature reaches around 24^{0}C . This allows the 9.0 to be used at the beginning and end of the season more days than the 7.5kw gpp. Another difference between the two units was that the 9.0kw gpp had a much larger effective range away from the shock boat than the 7.5kw gpp. The 9.0kw gpp range would often reach as far as 75-100 feet away from shock boat (150-200' diameter around shock boat). The 7.5kw gpp range would only routinely reach 50-75 feet away from shock boat (100-150' diameter around shock boat). The larger affected area observed with the 9.0 unit is likely due to more power delivered into the water resulting in more volts running through fish causing them to be stunned at further distances from the boat. This is one of the 9.0kw gpp biggest downfalls that was observed while comparing both units. The 9.0kw gpp would often shock at 256 peak volts with an average of 56 volts whereas the 7.5kw gpp usually shocks at a peak of 199 volts and an average of 44 volts. The resulting amps of both units were usually around the same, 3.5 peak and .5 average. In addition, fish become de-sensitized to shocking quicker with the 9.0kw gpp than the 7.5. After fish were shocked with the 9.0kw gpp, it seemed to take much longer to raise fish between shocking events. The7.5kw gpp uses less power resulting in fish becoming de-sensitized at a slower rate upon re-shocking. When we went into higher salinity water down river, both units worked well through conductivities reaching ~1300 uS/cm to 1500 uS/cm (23-28^{0}C). At these conductivities and higher, the 7.5kw gpp would still raise fish but mostly smaller fish (<3pounds), while the 9.0kw gpp seemed to be able to raise all size fish. With increasing conductivities, more variability in catch was observed, however within specific areas, increasing volts had varied effects by both GPP unites. Changing the volts from 120 to 240 on the 7.5kw gpp unit at conductivities greater than 1200 uS/cm (24.6^{0}C) had no appreciable difference in field diameter or catch, though it caused a strain on the generator. Increasing volts to 360 at these higher conductivities caused the 7.5 unit to overload. At similar conductivities (1300 uS/cm, 25^{0}C), the 9.0 unit showed more versatility by increasing volts: at 120 V, a field diameter of 150', cpu of 0.33 pounds/sec of mixed fish small-medium size; switching to 240 V, a field of 175', cpu of 0.75 pounds/sec of mixed sizes including larger fish. However, when volts were increased to 480 under these environmental conditions, the 9.0 unit overloaded. Both units were able to raise some fish in these higher conductive waters, but once the conductivity increased above 2000 uS/cm neither unit was able to raise enough fish to sustain a commercial-scale LFE fishery. Testing results from trials at and beyond the salt-wedge in the lower James River are presented in table 1. The 9.0kw gpp would be better for surveying than the 7.5kw gpp but the 7.5kw gpp seems to be better for commercial harvesting than the 9.0kw gpp.

Location	Tide	Conductivity (uS/cm)	Temp (^{0}C)	GPP Unit	Set Volts	Est. Field Diameter (ft)	Est. CPU (pounds/sec)
Chippokes wreck	Ebb	2425	24.6	7.5	120	120	0.75
	Ebb	2425	24.6	9.0	240	150	0.51
Dancing Point	Ebb	4486	24.5	7.5	120	75	0.10
	Ebb	4486	24.5	9.0	120	100	0.25
Bouys 61/62	Ebb	6300	24.3	7.5	120	100	0.125
	Ebb	6300	24.3	9.0	120	100	0.10
Jamestown Ferry	Ebb	7500	24	7.5	120	10	0.025
	Ebb	7500	24	9.0	120	20	0.015
	Ebb	7500	24	9.0	240	0verloaded	NA
Jamestown Island	Slack	10600	24.8	7.5	120	20 (Strain on generator)	0.02
	Slack	10600	24.8	9.0	60	20	0.05
Surry Power Plant	Slack	13000	27	7.5	120	NA	1 small fish
	Slack	13000	27	9.0	120	NA	5 small fish
Chippokes wreck	Flood	1638	25.3	7.5	120	125	0.46
	Flood	1638	25.3	9.0	120	150	0.50
Trees Point	Flood	1300	25.8	9.0	120	150	0.33

	Flood	1300	25.8	9.0	240	175	0.75
Bachelors Point	Flood	1284	25.1	7.5	120	150	0.75
	Flood	1284	25.1	7.5	240	150	0.10
	Flood	1284	25.1	7.5	360	Overloaded	NA
	Flood	1280	25.1	9.0	240	200	0.40
	Flood	1280	25.1	9.0	240	175	0.20

Table 1. Low Frequency Electrofishing Fishing trials from specific higher conductive waters in the James River comparing the 7.7kw GPP to the 9.0kw GPP (9/8/2017, starting in morning with Ebb tide and working back to locations with flood tide). Fish were marked at all locations with depth finder.

Commercial harvest of blue catfish with LFE is efficiently performed as a drift fishery, where the shock boat drifts over preferred habitat using tidal/current flow while delivering a continuous electrical current into the water. During long drifts, shocking periods can routinely reach >200 seconds. Long shocking periods in low conductive water were not a problem for both units, but at higher conductive waters, it did become a problem. The 9.0kw gpp cannot operate for continuous shocking periods (>200 seconds) without overloading the circuitry, but the 7.5kw gpp holds up better during this type of continuous shocking employed for commercial harvest of catfish . Twice this year we had to send the 9.0kw gpp back to Smith Root for repairs. Each time the circuit boards burned up. It was not determined if it was due to running the unit continuous or working in higher salinity waters. We used the 7.5kw gpp at the same higher conductivities as as the 9.0kw gpp and never had any board issues with the 7.5kw gpp. The water conductivity along the upper testing areas (Figure 1) stayed relativity the same, ranging from ~300 uS/cm to around ~700 uS/cm in the James River and ~120 uS/cm to ~750 uS/cm in the Pamunkey. Once we started to work around the salt wedge in both rivers, the conductivity would jump by the thousands within short distances, less than a half of a mile at the time.

Project Summary

The main goal of the project was to compare the low-frequency electrofishing (LFE) capabilities of Smith-Root 7.5 KW and 9.0 KW Generator Powered Pulsator (GPP) to remove invasive catfish (predominantly blue catfish (BCF), *Ictalurus furcatus*) in Virginia waters. LFE was conducted from June 7, 2017 to October 11, 2017. Sixty-five trips were made during the LFE season; 37 in the James River and 28 in the Pamunkey River. None of our fishing days occurred on the weekend and we tried to be off the river on Friday by noon. We started the first part of the season by having only one unit installed in the shock boat at a time. We would work recording conditions and catches then switch the units out and repeat with the other unit. This was not very efficient because conditions can change from day to day. Both GPPs were installed on the same shock boat so boat design would not bias the data. All fish caught were taken to Amory's fish house in Hampton or Wanchese fish house in Phoebus, with the exception of fish that were given to VIMS to help support ongoing research on blue catfish. Fish were also provided to Harrison Lake Fish Hatchery for their annual youth fishing day. We also gave fish to Virginia State University (VSU) for studies in need of specific size fish. In 2017 a total of 308,092 pounds of catfish were sold in our 65 days of fishing resulting in a CPUE of 4730 pounds per day. This effort in inclusive of days in which poor weather conditions and gear breakdowns occurred, minimizing catch.

FINAL SUMMARY

This year we used both the 7.5kw gpp and the 9.0kw gpp electrofishers under many different environmental conditions. Each unit had its pros and cons. Early and late in the season the 9.0kw gpp would be better than the 7.5kw gpp by being able to work in slightly cooler water temperatures. As far as being able to extend the range down river by going further into the salt wedge, the 9,0kw gpp was able to perform better than the 7.5kw gpp as to a better mix in fish size, with largely on the smallest of fish being raised by the 7.5kw GPP. Both GPP's were observed to raise fish on a commercial scale in conductivities <2000 uS/cm (~.45 CPUE), however, catch using both units at conductivities greater than 2000 uS/cm diminished to levels that would not support a commercial fishery (Figure 2). When we worked around the salt wedge, the conductivity will jump so quickly that the distance may only be one to three river miles with conductivity going from 700 to 2000. That result in little fishing range overlap using the 9.0kw GPP versus the 7.5kw GPP.

With more power from the 9.0kw gpp fish become de-sensitized quicker, and are not as likely to be raised up again without a longer rest period compared to the 7.5kw gpp. Both units require a rest period between shocking; two to three days was good for the 7.5kw gpp, but the 9.0kw gpp seemed to take almost a week. In addition, the 7.5 kw gpp can be used more continuous without stopping during drift fishing over extensive blue catfish habitat. The 9.0kw gpp should not be used for long durations (greater than ~200 seconds) to avoid overheating and circuit board failure. During the course of this study, we had trouble with the 9.0kw gpp twice where it required service from Smith Root. The 7.5kw gpp only needed brushings replaced after four years of running, thereby providing a more efficient unit as far as maintenance. The main problem observed in commercial LFE fishing blue catfish, is the low percentage of raised fish actually captured during shocking; where efficiency of capture by chase boat(s) dip netting fish within the short (60-90 sec) window when fish are stunned at the surface and before they revive and swim back down, is very low. We had a drone fly over (provided by Virginia Commonwealth University) and take pictured/videos (Figure 3) and record distance (diameter) of the field of raised fish along with number of fish within the field. Estimates from the resulting footage and estimated catch per shocking episode indicated that only approximately three percent of the fish raised were landed.

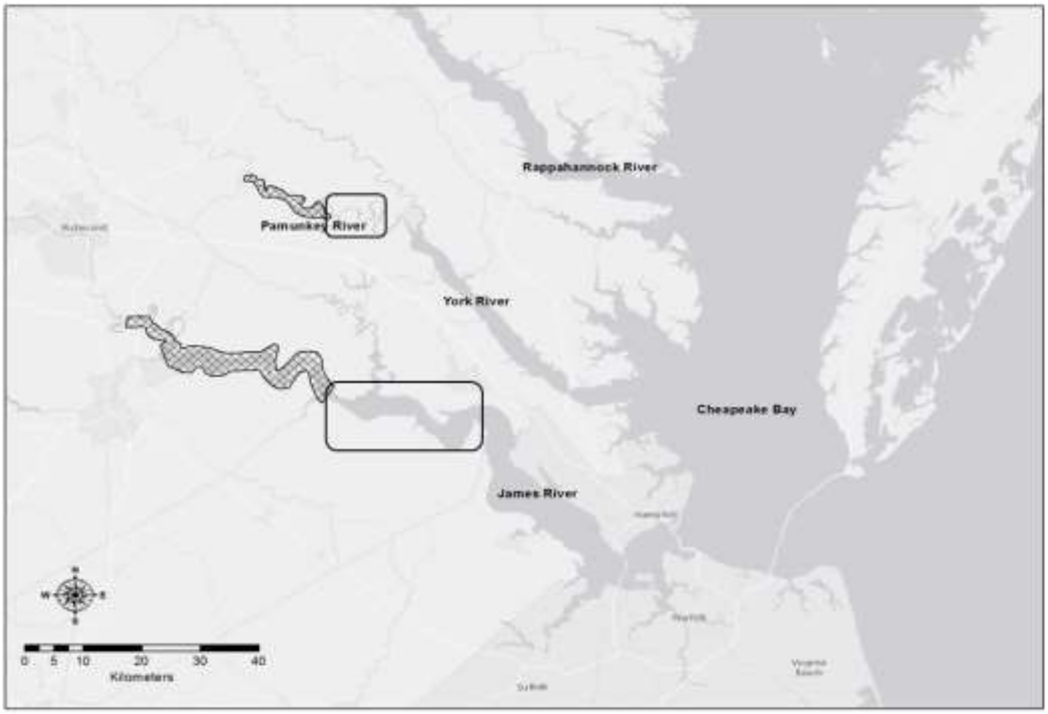

Figure 1. Map showing the general area where commercial low-frequency electrofishing was conducted in previous FRG projects (2014-2016) representing low to medium water conductivity (checkered areas of James and Pamunkey Rivers). Areas outlined on these rivers represent higher conductivity waters where both LFE units (7.5kw GPP and 9.0kw GPP) where compared.

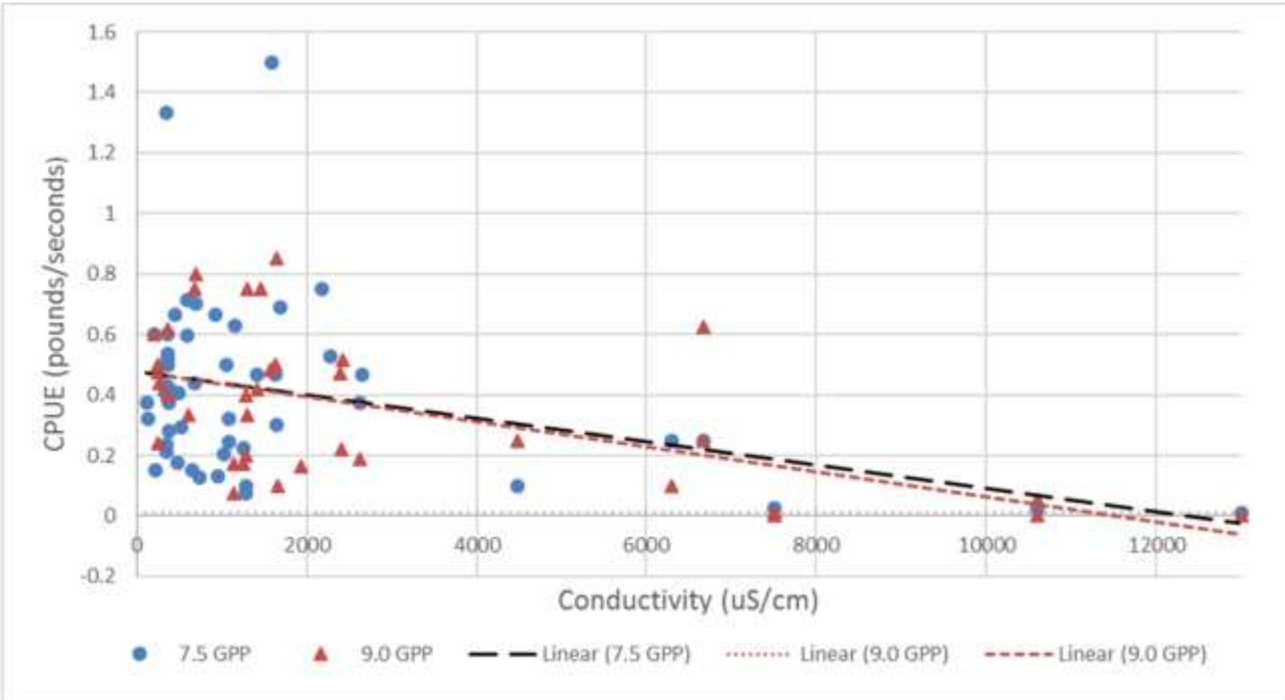

Figure 2. Catch Per Unit Effort (CPUE) by Low Frequency Electrofishing (LFE) with increasing water conductivities using the 7.5kw GPP (N=53) and 9.0 kw GPP (N=38) at temperatures 24-28⁰C.

Figure 3. Aerial photos (provided by Virginia Commonwealth University drone flyover) of commercial LFE blue catfish on the James River illustrating the effective field diameter and number of stunned fish during a single electrofishing episode.

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