Final Report of Fishery Resource Grant Project 2015-01

Conducted by George Trice

Project Title: : TESTING EXPERIMENTAL COLLECTION GEARS TO INCREASE HARVEST EFFICIENCY OF THE ELECTROFISHING FISHERY TARGETING INTRODUCED BLUE CATFISH IN VIRGINIA WATERS

Name of PI: George Earl Trice IV

Technical Advisor: Matthew Balazik, PhD. Virginia Commonwealth University

Telephone: 757-868-4058

Address: 147 Church Street, Poquoson, VA 23662

Brief Summary

The goal of the project was to design a more effective way to harvest invasive catfish (predominantly blue catfish, *Ictalurus furcatus*) in Virginia waters stunned by low-frequency electrofishing (LFE). LFE was conducted from May 18, 2015 to October 6, 2015; however, no weight was harvested on October 6 when water temperatures were 19°C . None of the data collected from the October 6 trip was used for catch statistics. Seventy-five trips were made during the LFE season; 37 in the James River and 38 in the Pamunkey River (Figure 1). The last day enough blue catfish (BCF) were susceptible to make commercial harvest worthwhile was September 29, 2015 when water temperatures were 23°C. In 2014 only large hooped (handle length about 2.5m long with a 0.4m^2 net opening) were used to collect stunned fish. During the 2014 study 155,161lbs of catfish were harvested electrofishing for 5430 minutes resulting in a catch-per-unit-effort (CPUE) of 28lbs per minute. In 2015 a total of 334,680lbs of catfish were landed electrofishing for 12850 minutes resulting in a CPUE of 26lbs per minute (Figure 2, Table 1). Three different new harvest techniques methods were attempted to increase the harvest efficacy of invasive BCF compared to regular dip netting: 1) a modified butterfly skimmer (Figure 3), 2) pulling a hoop net along the side of the boat, 3) dragging a surface trawl behind the boat (Figure 4). All three techniques were compared to a chase boat that utilized simple dip nets. The chase boat using dip nets harvested significantly more weight than the new techniques (Table 2). One modification that substantially helped harvest of small fish was using dip nets with smaller openings (0.24m^2) and handles 3.5m long. The smaller nets had a wire mesh which allowed fish to be dumped out quicker without hanging in the mesh.

The purpose of the project was to increase harvest efficiency of BCF. The three different methods had disappointing results. The positive fact is that LFE, just by using dip nets, is a very efficient and easy way of harvesting BCF compared to traditionally methods such as gill nets and hoop nets. As in 2014 there were only four species observed to be effected by the sampling gear: BCF, flathead catfish (*Pylodictis olivaris*, invasive), channel catfish (*I. punctatus*, invasive), and white catfish (*Ameiurus catus*, native).

No white catfish were intentionally harvested during the project and likely none were harvested incidentally. There was no bycatch/unintended mortality observed. This is a highly effective/efficient fishery that can be used to help control invasive catfish populations, especially over-abundant BCF populations like in the Chesapeake Bay watershed.

Methods

Between May 19, 2015 and October 6, 2015 electrofishing was conducted for 76 days. The James River was sampled 37 times and the Pamunkey River was sampled 39 times (Figure 1, Table 1). The same Smith Root 7.5KW boat mounted Generator Powered Pulsator (GPP) was that used in 2014 was used again in 2015. The GPP was modified by Smith Root so the output pulse frequency could not exceed 15Hz. LFE settings were set based on recommendations from Smith Root and the scientific literature. The typical settings were 0.3-0.7 amps with volts from 40-60. Conductivity was monitored and the volts were adjusted accordingly under guidance from Smith Root. Effort (seconds of shocking) was monitored by a timer on the GPP. Weights were determined at the fish processing center. The fish were separated at the buyers fish house into round weights of 0-1lb, 1-3lb, 3-5lb, 8-15lb, and 15lb+. CPUE was the total weight of the day divided by minutes electrofishing. It needs to be noted that markets for small BCF (as small as 3" total length) have developed creating incentive to harvest small fish compared to the previous year.

The first harvest technique was a modified butterfly skimmers (Figure 3). The skimmers were wire boxes with a 32 inch X 72 inch opening facing forward. The boxes were 48 inches deep. The boxes were attached to the sides of the boat with hinges so the boxes could be lifted in and out of the water. The boxes were lined with 2 inch X 4 inch wire mesh. The boxes were lowered into the water and pushed through large masses of stunned fish on the surface (Figure 5). The skimmers were fished in both the James and Pamunkey Rivers. In the James River a lot of fish were so small they went through the holes in the 2 inch X 4 inch mesh so the mesh was replaced by 0.5 inch X 1 inch mesh. When the box was full of fish the box was dumped into the boat using the hinges on the side of the boat. Effort was recorded and weights from the skimmer and a typical chase boat were compared.

Because of the problems with the skimmer setup (see results), a similar method using a hoop-net attached to the side of a boat was tried in the James River. A hoop-net was attached to the side of a boat and pushed through the water. As with the skimmer setup the hoop-net method was compared to the typical chase boat. A third method tried in the James River was a towed surface trawl (Figure 4). A 16' surface trawl was pulled behind a boat and catch was compared to a typical chase boat.

Results

Catch Results:

The water temperature was 25^{o}C on May 18 in the Pamunkey River when the project started and 23^{o}C on September 29 when it ended (Figure 2). Water parameter changes likely due to a large rain event was a large factor contributing to the poor catch (840lbs) on September 29 rather than temperature. It is safe to say the project could have started earlier, however; the project came to a halt in late

September. A large rain event occurred at the end of September which abruptly dropped water temperatures. By the time the water parameters normalized on October 6 temperatures were down to 19^{o}C and no fish larger than 3" total length seemed effected by the gear.

Roughly 51 km of the James River and 26 km of the Pamunkey River was sampled (Figures 1, 6, 7, Table 1). Sampling did not occur in all areas along the river stretches in Figure 1, usually just small patches along the rivers were sampled (Figures 6, 7, Table 1). The actual distance of the areas shocked was about 16 km of the James River and 12 km of the Pamunkey River (Figure 6, 7). A total of 334,680lb (Figure 2, Table 1) were harvested during the study period, with ~90% being fish that weighed less than 8lbs (Figure 8). It is estimated that 208,797 invasive catfish (mostly BCF) were removed during the study with 64% (133,152) being less than 1lb. This number of fish per weight category was determined by dividing the total weight of the category by the average of the upper and lower end of the category, i.e. 1-3lbs was 99923/2=49962 fish (Table 1). The actual number for fish 15+lbs (612 fish) was documented by the commercial fishers at the fish house. The CPUE in the James River was 25lbs/minute shocking while the Pamunkey River averaged 27lbs/minute shocking. The crew averaged 4,462lbs per day; the James River averaged 4,535lbs per day while the Pamunkey averaged 4,391lbs per day. A total of 167,805lbs were harvested from the James River while 166,875lbs were harvested from the Pamunkey River (Figure 8). There was a drastic difference between the two rivers in regards to the sizes of fish captured (Figure 8). The James River was dominated by small size fish (75% <3lbs) while the Pamunkey River was dominated by 3-8lb (66%) fish. These data really show the high abundance of small BCF in the James River. It should be noted that about 40% of fish larger than 15+lb in the James River were flathead catfish (Figure 9) and not BCF, the actual amount is unknown because the fish house did not differentiate between the two catfish species but sampling crews estimated weight of flathead catfish each day. Very few large (>32" total length) BCF were observed in the Pamunkey River compared the James River where dozens were followed almost every day. All harvest laws were observed and many BCF, mostly in the James River, were purposely not netted. The crew attempted to harvest all large flathead catfish (>32" total length) stunned by LFE.

Modified Capture Gear:

The CPUE was much lower in all three modified techniques compared to a traditional chase boat (Table 2).

Modified Butterfly Skimmer:

The James River is inundated with small BCF which the skimmer rig was designed to capture. The skimmer was first tried May 29 with a 23' Carolina Skiff with a 90HP engine. Only one of the capture devices attached to the boat. A few minutes into sampling the steering cable broke on the boat due to water drag. Very few fish were captured during the brief sampling period. A larger Carolina Skiff (27') with a 200HP engine was fitted with the two boxes (Figures 3, 5). The larger boat still had limited steering but managed to move through fish on the surface (Figure 5). Different speeds were tested and about 3km per hour seemed to be the most effective speed, it was the highest speed the boat could travel before creating a pressure wake that seemed to revive a lot of stunned fish. The configuration did its job by “skimming” the water but the limited maneuverability and speed hindered capture efficiency. The skimmer was able to capture smaller fish (<3 pound) but was greatly outcompeted by simple wire dip nets (Table 2). It is imperative to recognize “WIRE” dip nets, smaller fish snag traditional dip net mesh and nets are useless in about a minute.

The skimmer setup was used in the Pamunkey River three times and had very disappointing results (Table 2). The poor efficiency was somewhat expected due to fish size and the physical setting of the river. The Pamunkey River is much narrower and shocking occurs close to the shore line unlike the James River which targets large open areas. The skimmer boat could not get into the high density fish areas effectively. The average size of fish in the Pamunkey River is larger than the James River (Figure 8). When larger fish (3+lb) hit the back end of the skimmer cage a lot would revive and swim forward out of the cage.

Attached Hoop Net and Surface Trawl:

The two additional setups tested were very inefficient. Both were ineffective in catching fish and the amount of time required to remove the fish from the gear was slow. Both capture setups utilized traditional nylon mesh and a throat/funnel system. Once fish (very few) were in the capture devises the fish could not escape. Due to the dorsal and pectoral spines on BCF removing the small fish from the bags was laborious, dangerous, and time inefficient.

Additional Observations

This project is very controversial with a lot of speculation suggesting it does more harm than good for the river system. We attempted to address some of the concerns being brought up.

LFE stops BCF from eating:

A big concern for commercial hoop-netters, recreational hook-and-line fishers, and groups profiting from recreational fishers is that BCF stop eating for prolonged periods of time after being stunned by LFE gear. While not a goal of the study two different approaches were taken to provide data to answer the question if repeated shocking stops BCF from foraging. During the study several places on the James River were sampled multiple times (Figure 6, Table 1). Two of these places were Westover (area 5, shocked 21 times) and the Benjamin Harrison Bridge (area 7, shocked 16 times). From July to September whenever these places were shocked about 30 BCF of various sizes selected at random were gutted and absence-presence of food was noted. All prey ideas were not identified to species, however; obvious prey items noticed were American eel (*Anguilla rostrata*), BCF, blue crab (*Callinectes sapidus*), gizzard shad (*Dorosoma cepedianum*), white perch (*Morone americana*), and several unidentified fish species. On average 63% of the BCF had food items, the low was 45% and the highest was 90%. These data show that BCF captured in areas that are stunned are still foraging. It is not known whether the BCF sampled for dietary work were fish that stayed in the area and repeatedly shocked and continued to forage or if new fish moved to the area and therefore this was the first time they were shocked. Considering about 5% at most of the BCF in the two areas sampled were harvested per trip we think it is highly unlikely so many new fish enter the area.

A different approach to the feeding question was used on the Pamunkey River. The idea was to add a forage item that should not be readily available for BCF while shocking and then shock again within an hour and see if the introduced forage items were ingested. On August 5 a creek (Figure 7, 10) that had never been shocked before by the commercial fishers had about 6lbs of shrimp shells were dumped in the middle of a drift while shocking was ongoing. The creek was selected because it had a bend in the middle of the drift that would likely have a high density of BCF. The middle of the drift was selected to increase the probability the BCF sampled were fish just shocked and not new fish moving into the area. BCF were harvested during the initial drift as usual. The second drift was made again from the opposite direction at the first (Figure 10). When BCF were lying on the deck of the boat at least 14 shrimp shells were regurgitated among the three boats. The crew was planning to gut BCF but the regurgitated shells were considered a positive result of BCF feeding.

Negatively effects other fish:

There is concern on how LFE may affect non-ictalurid species. While LFE has been conducted for years and a recurring observation is that it has no noticeable effects on non-ictalurid species, it is unknown why the situation would be any different in this instance. Certain managers have noted two species of concern, the federally endangered Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*, AS) and longnose gar (*Lepisosteus osseus*, LNG). It is thought LFE works on catfish is because catfish lack scales making them susceptible to a lower amount of electricity compared to scaled species. It seems unlikely LFE would affect two species that have considerably more protection due to heavy external protection compared to a typical scaled fish. We were not able to acquire much data for LNG on this topic. LNG were frequently observed coming to the surface during shocking to gulp air and did not seem stressed. The hydrilla flats (Figure 7, area 4) on the Pamunkey River are shallow and have relatively good visibility. While shocking the hydrilla flats LNG were seen actually swimming with BCF in their mouth within a few meters of the boat. One LNG was followed for about 30 meters before the fish swam out of view.

More data are available for AS behavior compared to LNG. On the Pamunkey River researchers caught adult AS on proposed spawning grounds upstream of the area targeted by commercial LFE. From October 12 to 21 eight AS females were captured in the lower James River and all had ovaries suggesting the fish had spawned during the fall spawning period. The LFE did not stop the females caught from releasing eggs. An area frequently targeted by LFE was Westover Plantation (Figure 6, area 5). Telemetry data show that adult male AS stage in this area during the fall spawning run. Twice a Vemco VR100 mobile receiver was drifted during LFE operations. Both times AS were in the area during LFE and the fish were still in the area after shocking. It can not be determined if the AS were stressed during the shocking periods but the fish did not leave the area. AS are strong swimmers and could easily leave the area if stressed. It seems if LFE caused stress to the adult AS the fish would leave the area. Telemetry data from real-time remote receivers show adult male AS moved upstream to hypothesized spawning areas during the 2015 spawning season. There are no data available on how LFE may affect juvenile AS in the James River because even with extensive sampling no juveniles can be found. It is not known why there seems to be recruitment failure in the James River but the high abundance of small BCF that could potential eat AS eggs and larvae is a concern for AS recovery.

Conclusions

Unfortunately none of the harvest techniques increased CPUE but the project shows a lot of invasive BCF can be removed from Virginia waters with little effort and with no unintended mortality. A big positive is how markets for small (3” long total length) BCF have developed which provides more incentive for harvesting small BCF. This project continues to show that LFE is a very effective and profitable fishery that helps reduce invasive flathead and BCF from Virginia waters. In regards to non-ictalurid species being effected by LFE this project provided more data suggesting other species are no noticeably effected by LFE. This project also provided preliminary results that BCF do continue to feed with LFE commercial operation occurring in the area.

Final Summary

LFE is an effective method for reducing invasive catfish from Virginia waters. The reduction of invasive catfish (mostly BCF) should relieve some pressure for native and other commercial species. There is enough BCF biomass and reproduction in Virginia waters to sustain commercial LFE for years without eradicating the targeted species. Hopefully the increased harvest of small catfish (<3lbs) will increase the population’s growth rate and provide larger fish on average in the future. A reduction in BCF biomass would be a big step forward to restoring a natural balance in Virginia waters.

Signature______________________________________Date_____________________________

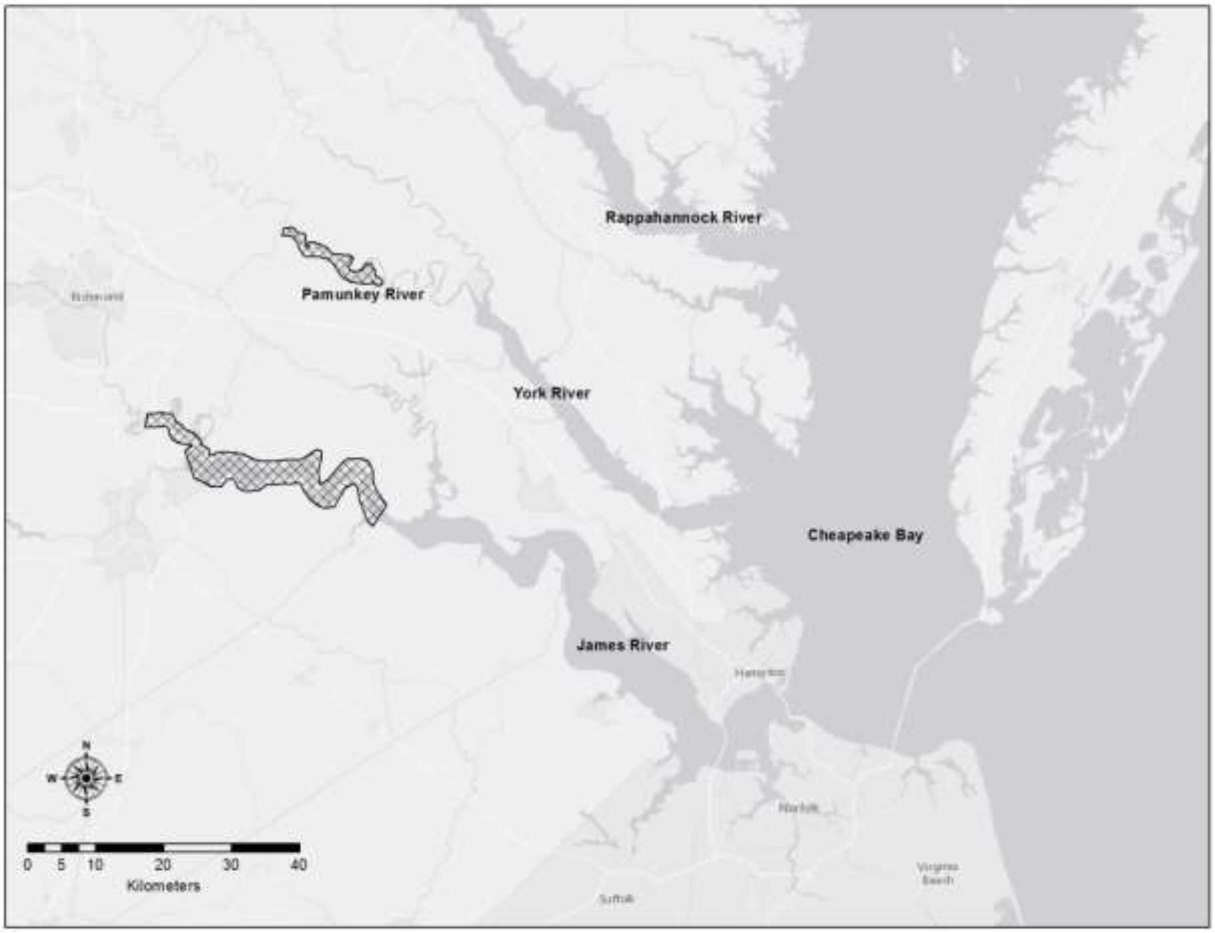

Figure 1. Map showing the general area where commercial low-frequency electrofishing was conducted in 2015.

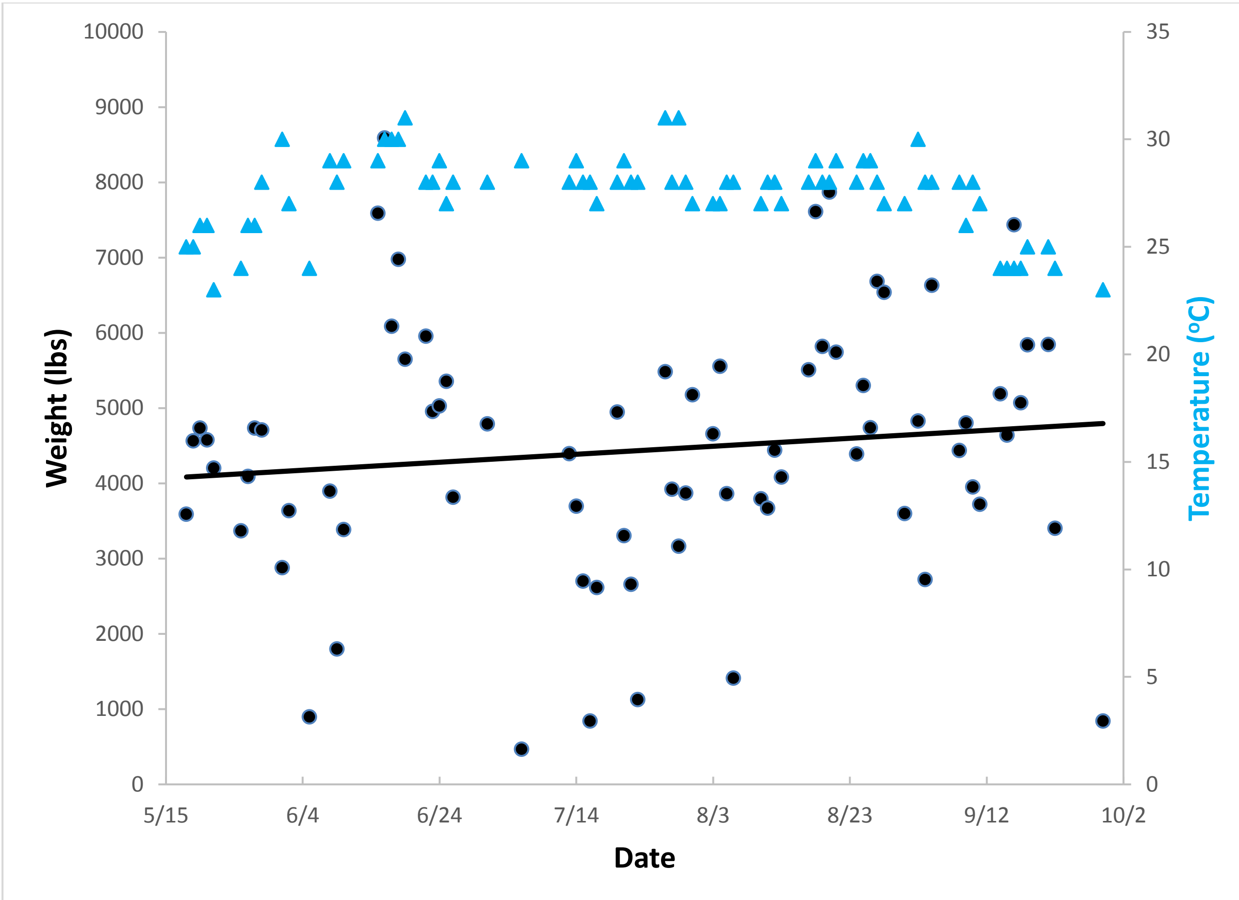

Figure 2. Total weight (black dots) harvested each day with corresponding water temperatures (blue triangles) for the 2015 commercial low-frequency electrofishing season.

Figure 3. Picture of the butterfly skimmer setup on the 27’ Carolina skiff. The boat is actively operating during low-frequency electrofishing operations.


Figure 4. Picture of surface trawl being pulled during low-frequency electrofishing operations.

Figure 5. This is an example of stunned fish on the surface. Skimmer rig can be seen in the background.

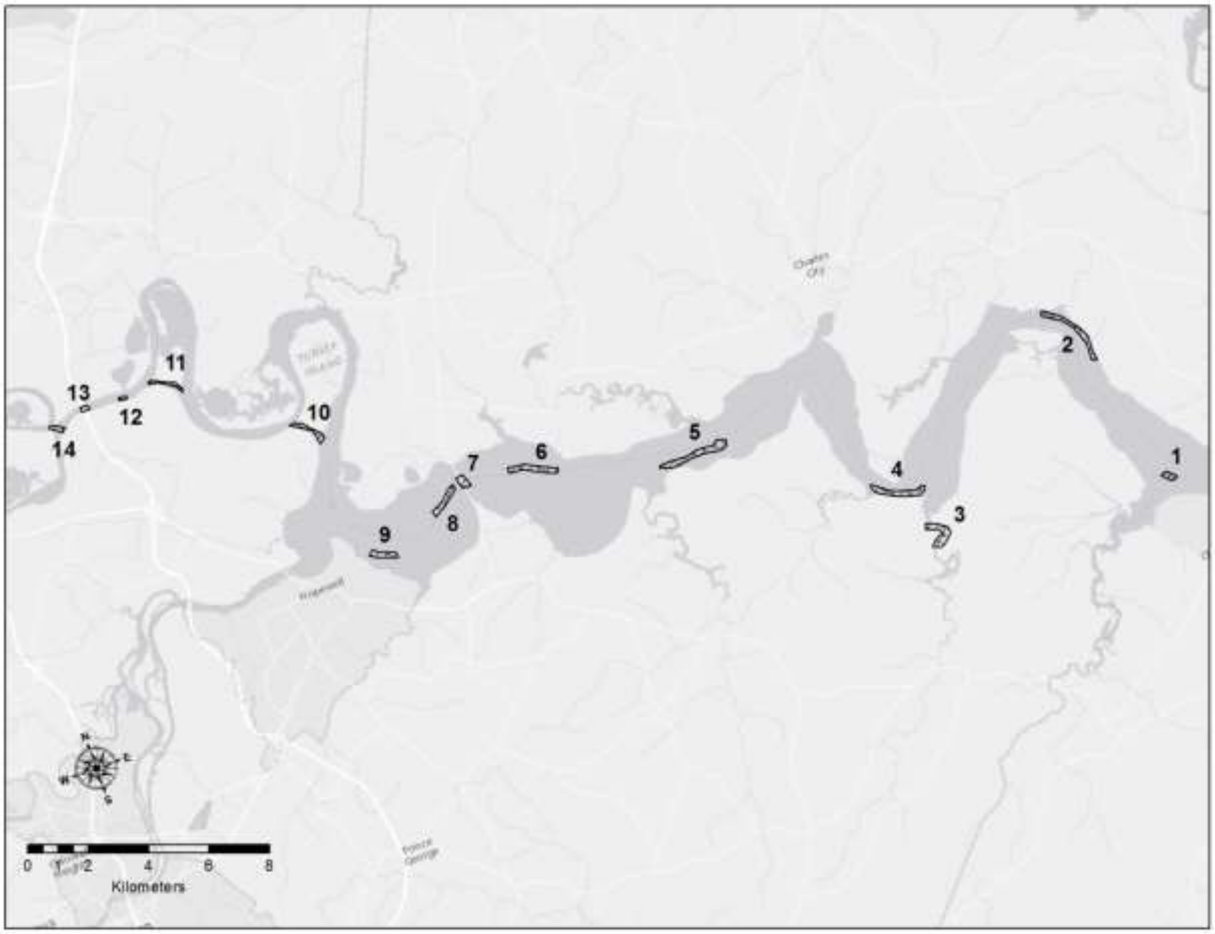

Figure 6. Map showing areas in the James River that supported low-frequency electrofishing during the 2015 commercial season.

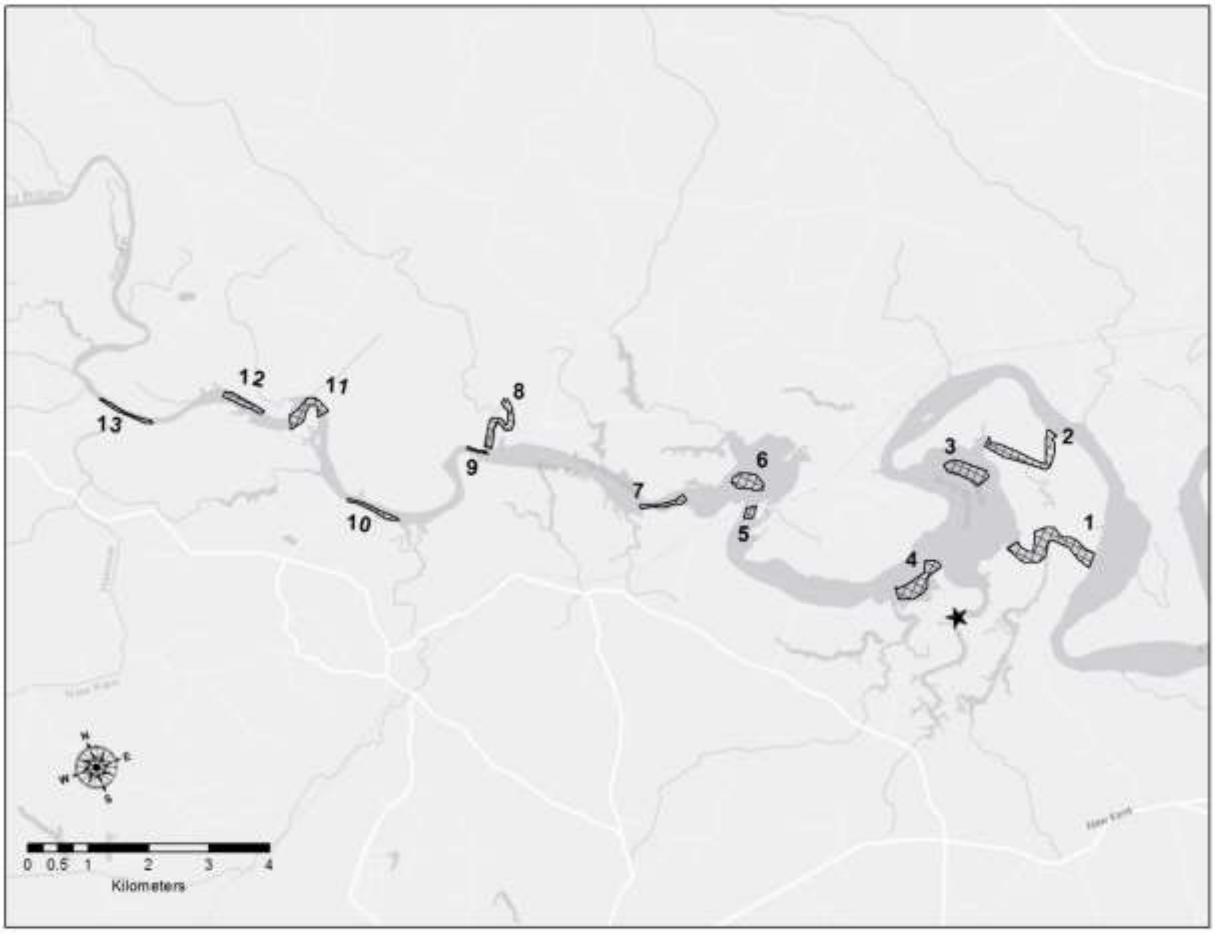

Figure 7. Map showing areas in the Pamunkey River that supported low-frequency electrofishing during the 2015 commercial season. The black star shows where the shrimp study was conducted on August 5.

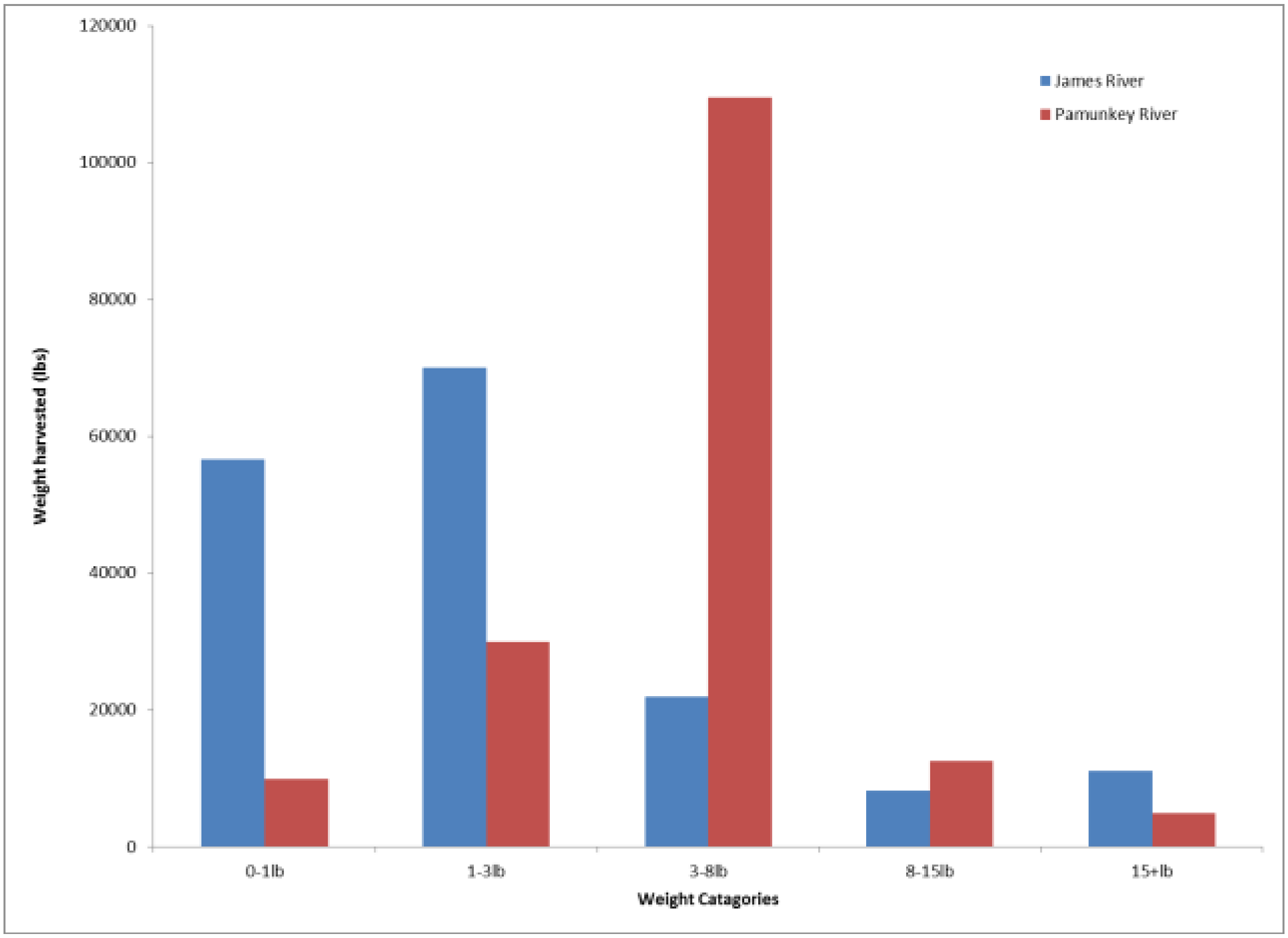

Figure 8. Weight breakdown of fish harvested during the 2015 commercial low-frequency electrofishing season.

Figure 9. Example of blue catfish and flathead catfish captured during the 2015 commercial low-frequency electrofishing season.

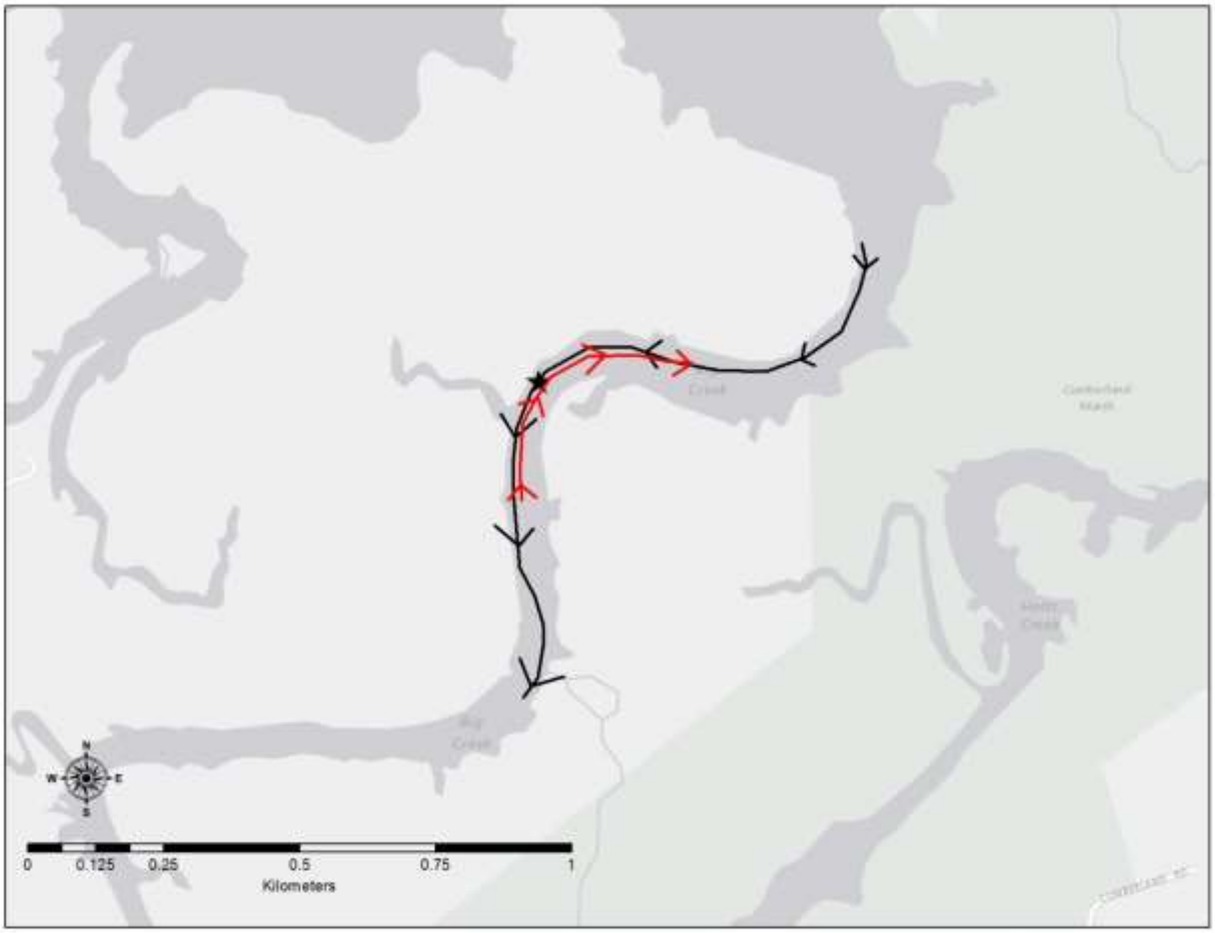

Figure 10. Map showing the forage experiment with shrimp shells. The black line is the initial drift and the red line is the return drift. The star indicates where the shrimp shells were dumped during the initial drift.

Table 1. Harvest for the 2015 sampling season. For the river sampled column the “P” stands for Pamunkey and the “J” stands for the James. The area fished numbers correspond to the areas listed on figure 6 and 7.

Date	0-1lb	1-3lb	3-8lb	8-15lb	15+lb	Total Weight (lb)	Effort Shocking (minutes)	CPUE (lbs/minute)	Temperature (^oC)	River Sampled (area shocked)
5/18/2015	63	122	2912	367	123	3587	131	27	25	P (9-10)
5/19/2015	306	594	3050	378	235	4563	146	31	25	P (5,7)
5/20/2015	272	528	3572	128	235	4735	146	32	26	P (11-13)
5/21/2015	180	350	3793	254	0	4577	82	56	26	P (1,5,7)
5/22/2015	256	496	3038	412	0	4202	129	33	23	P (1,4)
5/26/2015	284	552	2530	0	0	3366	189	18	24	P (5,7,9,10)
5/27/2015	170	330	3040	550	0	4090	101	41	26	P (1,5,6)
5/28/2015	444	861	2992	296	142	4735	201	24	26	P (1,5-7)
5/29/2015	649	1261	2190	481	129	4710	151	31	28	J (6-9)
6/1/2015	291	565	1100	410	512	2878	143	20	30	J (10-14)
6/2/2015	276	536	2405	316	104	3637	135	27	27	J (1,5,6)
6/5/2015	37	73	558	130	100	898	57	16	24	P (1,2)
6/8/2015	308	597	2681	185	125	3896	151	26	29	P (7-11)
6/9/2015	127	246	1018	247	158	1796	114	16	28	P (11-13)
6/10/2015	241	469	2050	480	144	3384	151	22	29	P (7-10)
6/15/2015	281	545	4950	1532	283	7590	259	29	29	P (1,4-6)
6/16/2015	568	1102	4950	1574	393	8587	167	51	30	P (11-13))
6/17/2015	374	726	4050	732	204	6086	142	43	30	P (7-10)
6/18/2015	461	894	4660	753	209	6977	79	89	30	P (1,3,4)
6/19/2015	374	726	3750	688	110	5648	84	67	31	P (1,4,5,7)
6/22/2015	592	1148	3350	663	201	5954	160	37	28	P (1-4)
6/23/2015	391	759	3419	268	119	4956	200	25	28	P (11-13)
6/24/2015	440	855	3600	108	25	5028	207	24	29	P (5-7)
6/25/2015	663	1287	2750	437	217	5354	209	26	27	P (1,4)
6/26/2015	340	660	2450	240	125	3815	172	22	28	P (5-10)
7/1/2015	821	1594	1805	308	263	4791	117	41	28	J (5,6)
7/6/2015	75	145	100	33	115	468	54	9	29	J (5-7)
7/13/2015	1020	1980	400	726	267	4393	206	21	28	J (10-14)
7/14/2015	903	1752	415	416	208	3694	193	19	29	J (1,3,5)
7/15/2015	666	1294	315	113	310	2698	167	16	28	J (5)
7/16/2015	133	257	158	75	217	840	93	9	28	J (5,6)
7/17/2015	719	1396	117	74	307	2613	184	14	27	J (1-7)
7/20/2015	419	814	3100	417	197	4947	193	26	28	P (1-4)
7/21/2015	452	876	1660	204	113	3305	193	17	29	P (11-13)
7/22/2015	205	1458	2115	118	218	4114	219	19	28	P (1,3,4)
7/23/2015	78	415	960	86	0	1539	193	8	28	P (8-10)
7/27/2015	1638	2528	450	106	762	5484	158	35	31	J (10-14)
7/28/2015	475	2280	550	162	452	3919	160	25	28	J (5)
7/29/2015	450	1300	475	712	226	3163	207	15	31	J (7-9)
7/30/2015	2083	900	200	412	276	3871	182	21	28	J (5,6)
7/31/2015	2412	1650	522	370	220	5174	200	26	27	J (3-6)
8/3/2015	2400	1600	336	55	268	4659	167	28	27	J (5-7)
8/4/2015	2218	1800	665	343	527	5553	219	25	27	J (3-6)
8/5/2015	140	1067	2097	277	280	3861	159	24	28	P (1,4)*
8/6/2015	40	425	692	106	147	1410	84	17	28	P (1,2)

Table 1. Continued

8/10/2015	500	1400	1562	100	232	3794	207	18	27	P (1-4)
8/11/2015	1885	966	360	122	335	3668	181	20	28	J (3,4)
8/12/2015	1668	2300	350	124	0	4442	168	27	28	J (5-7)
8/13/2015	1815	1650	225	167	226	4083	160	26	27	J (1,2)
8/17/2015	1000	3167	800	121	421	5509	193	29	28	J (7-10)
8/18/2015	2780	3060	783	331	655	7609	231	33	29	J (4-7)
8/19/2015	2145	2600	400	244	429	5818	177	33	28	J (1,3,4)
8/20/2015	2780	3500	720	272	597	7869	222	35	28	J (2-4)
8/21/2015	1760	2686	830	220	246	5742	160	36	29	J (5-9)
8/24/2015	1865	1800	485	103	138	4391	235	19	28	J (5,6)
8/25/2015	1877	2130	650	280	364	5301	222	24	29	J (4-6)
8/26/2015	1622	2174	420	193	330	4739	203	23	29	J (1,2)
8/27/2015	3400	2900	150	43	188	6681	153	44	28	J (6-8)
8/28/2015	3368	2685	300	55	131	6539	185	35	27	J (5-7)
8/31/2015	1212	1850	250	55	230	3597	213	17	27	J (1,2)
9/2/2015	970	2677	684	173	324	4828	218	22	30	J (7-14)
9/3/2015	460	1468	372	125	297	2722	189	14	28	J (1, DS**)
9/4/2015	2982	2700	500	216	234	6632	194	34	28	J (6-9)
9/8/2015	200	860	3250	0	124	4434	178	25	28	P (5-9)
9/9/2015	200	1120	3280	38	165	4803	158	30	26	P (1,3,4)
9/10/2015	175	970	2715	0	90	3950	175	23	28	P (1,4,8)
9/11/2015	160	618	2800	95	46	3719	186	20	27	P (1-4)
9/14/2015	68	1621	3430	45	25	5189	221	23	24	P (1,5,6)
9/15/2015	15	980	3283	363	0	4641	105	44	24	P (3,4)
9/16/2015	59	1685	5320	270	103	7437	225	33	24	P (1,4)
9/17/2015	57	1342	3544	55	70	5068	237	21	24	P (1,5-7)
9/18/2015	2300	2617	550	0	373	5840	239	24	25	J (5-9)
9/21/2015	2507	2694	357	70	218	5846	254	23	25	J (5-8)
9/22/2015	1012	1600	433	119	240	3404	208	16	24	J (5-7)
9/29/2015	0	290	550	0	0	840	107	8	23	P (7,9,10)
Total	66576	99923	131343	20741	16097	334680	12855			
Estimated # of Fish Harvested	133152	49962	23881	1804	612***	208797				

* Day the forage study was conducted. Area was not very productive and was only shocked once.
**DS stands for downstream. The crew sampled downstream of area 1 to see is shocking in higher conductivity could be effective. Shocking downstream was not very productive.
*** This is the exact number. Daily totals were noted by the commercial fishers at the fish house. It is estimated about 40% of these 15+lb fish were flathead catfish.

Table 2. Table showing the weight caught by various capture methods.

Date	River Sampled	Butterfly Skimmer (lbs)	Hoop Net (lbs)	Surface Trawl (lbs)	Dip Nets (lbs)	Sampling Time (minutes)
6/1/2015	James	80			750	70
6/2/2015	James	225			1650	95
7/1/2015	James	150			1300	78
7/6/2015	James	125			1700	109
7/13/2015	James	225			1850	150
7/14/2015	James	175			1450	138
7/15/2015	James	125			950	110
7/17/2015	James	100			1150	95
7/20/2015	Pamunkey	50			950	65
7/21/2015	Pamunkey	30			700	45
7/22/2015	Pamunkey	50			900	60
7/28/2015	James		60		850	55
7/29/2015	James		50		650	45
9/3/2015	James			10	475	30
9/4/2015	James			15	600	50