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Testing the Efficiency of Wire Reinforced Catfish Pots and Comparing Horizontal and Vertical Configurations to Catch Invasive Catfish in the James River, VA

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Abstract

The Chesapeake Bay is currently inundated with invasive blue catfish (BCF) which are a serious threat to the ecosystem balance of the watershed. The only reasonable way to reduce BCF numbers and biomass is by utilizing new and improving traditional BCF commercial fisheries techniques with emphasis on removing small BCF. In the Mississippi region pots set in a vertically orientation are easier to fish and outperform pots set horizontally. The purpose of this project was to see how pots set in two vertical orientations would perform compared to the traditional horizontal orientation. During the project 7275lbs of nonnative catfish were harvested, 3088 in vertical pots and 4187 lbs in the horizontal pots. A permutation analysis (10,000 iterations) showed no significant difference between pots suspended from a float (mean = 4.1lbs) compared to pots in the traditional horizontal orientation (mean 4.4lbs). There was a significant difference between vertical pots attached to the bottom with an anchor (mean = 15.6lbs) when compared to partnered horizontal pots (mean = 22.6lbs). A nonparametric Wilcoxon Ranked sum test concluded there was no significant difference (p=0.327) between the suspended vertical pot and paired horizontal pots but there was a significant difference (p=2.88e-09) between the vertical pots attached to the bottom and horizontal pots. Many external factors influenced this project including gear loss (likely due to theft), extremely high water flows throughout the year due to heavy rains and using pots with mesh so large that small BCF could escape. Pots suspended from floats are the easiest and quickest to fish but theft makes the technique impractical in the upper James River. Unfortunately neither of the vertical orientations outperformed their associated horizontal configuration pots so switching techniques would not benefit commercial fishers. We feel we did make some important observations in regards to bait and share ideas on how to improve bait retention which should increase harvest weights.

Introduction

The blue catfish *Ictalurus furcatus* (BCF) was first introduced to the James and Rappahannock Rivers for recreational hook-and-line fishers in the 1974 and currently inhabit most tributaries of the Chesapeake Bay (Jenkins and Burkhead 1994, Schloesser et al. 2011). BCF were recently designated as an invasive species in Virginia and Maryland waterways. The James River tributary is hypothesized to have the largest number of BCF (Schloesser et al. 2011, Invasive Catfish Task Force Symposium 2017) in the entire Chesapeake Bay. The number of BCF inhabiting the James River is unknown but is likely to be over five million (Fabrizio et al. 2009, Greenlee 2011) and are estimated to be over 75% of the freshwater-tidal biomass (Schloesser et al. 2011). A few kilometer stretch of the tidal James River was estimated to have a staggering 544 BCF per hectare (Fabrizio et al. 2016). The 544 per hectare estimate does not account for very small BCF which are likely the most numerous in the system. Management and conservation groups are concerned about the high number of BCF throughout the Chesapeake Bay (Fabrizio et al. 2011, Schlosser et al. 2011). BCF are generalist predators that eat many species of concern and commercial interest such as shad, herring, blue crab, striped bass, white perch, American eel, menhaden, to name a few (Schmitt et al. 2017, Matt Balazik unpublished data). Even though new USDA regulations have hindered catfish processing in the region, there is an insatiable market for BCF, especially for BCF that weigh 0-3lbs. With the vast abundance of BCF throughout the Chesapeake Bay, finding new techniques and improving old techniques to harvest BCF is critical to recovering some sort of ecosystem balance in the region.

River fisheries in Virginia harvest mostly use anchored gillnets (AGN) to harvest finfish. AGN have unintended interactions with protected species that inhabit Virginia waters (Jenkins and Burkhead 1994, Matt Balazik, unpublished data) and gill-net sizes used for BCF harvest capture other commercial/ recreational fish such as striped bass that the commercial fisher may not be allowed to keep. BCF are laborious to remove from gillnets and are destructive to gear which increases fishing cost to replace nets and creates waste. A commercial fisher can set 600 feet of 3.25" stretch mesh gill net and catch 300 pounds of small fish in a few hour soak time but it takes hours to pick the fish out of the net, making the technique unprofitable due to time. A hoop-net fishery has existed in the James River for decades and the technique has pretty much gone unchanged during that time. Traditional fisheries have not been able to keep up with the increasing BCF population and need to be improved.

BCF are native to the Mississippi drainage and commercial fishers in that region have been harvesting catfish for decades using pots. About 8 years ago commercial fishers in the Mississippi region started setting pots in a vertical orientation instead of the traditional horizontal orientation along the bottom. Commercial fishers in Mississippi prefer the vertical orientation saying the pots catch more and are easier to fish. The main goal of this study was to see if the relatively new method of setting pots in a vertical orientation outperforms pots set in a traditional horizontal orientation in the James River, VA.

Methods

We used 24" X 60" wire reinforced catfish pots with 1.5" bar mesh hung square for the study. These are the same model pots that most commercial fishers use in Mississippi and are also used in the Potomac and Rappahannock River. Two different vertical methods were tested. One method was suspending a pot from an anchor surface float (SV), (Figure 1). The other vertical method was attaching the pot to an anchor on the bottom (BV) with trap opening down and a float on the cod end to keep the pot vertical in the water column (Figure 1.) Horizontal pots were attached to a cinder block or weighted down with crab pot frames (Figure 1.)

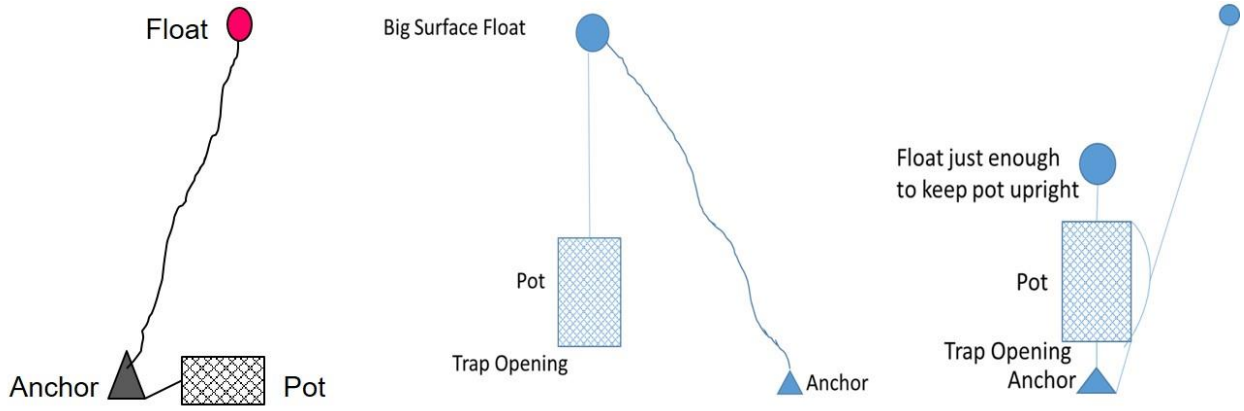

Figure 1. Reinforced wire catfish pot test configurations (not to scale). The left drawing is the traditional horizontal configuration (BVC and FVC). The middle drawing is the surface float vertical orientation (SV) and the drawing on the right is the bottom anchored (BV) vertical configuration.

A total of 14 catfish pots were purchased. Three pots were set in the BV configuration and 3 were set in the SV configuration. Each vertical pot was paired with a traditional horizontal pot for comparison, BV

comparison pot = BVC and SV comparison pot = SVC. The vertical pot was placed within 10 meters of its paired comparison horizontal pot. Replicate groups were placed at a minimum of 100 meters apart. Depending on water temperature the pots were fished every 24 to 48 hours. The project was designed to have the pots deployed at least an entire week of each month but most months we were able to exceed the one week soak time. Pots were baited with about 5lbs of Atlantic menhaden.

A few months into the project some pots were lost. Considering most of these pots were held in place by a 25lb Danforth anchor and strong line we suspect the gear did not drift nor did the ropes snap. Commercial hoop-netters have complained for years that hook-and-line fishers that target BCF steal or destroy their gear. It seems we fell victim to the same situation. After 6 pots (4 SV and 2 SVC) and associated anchors and floats were lost we attached the pots to a rope along the bottom that was anchored at both ends with no surface floats (Figure 2).

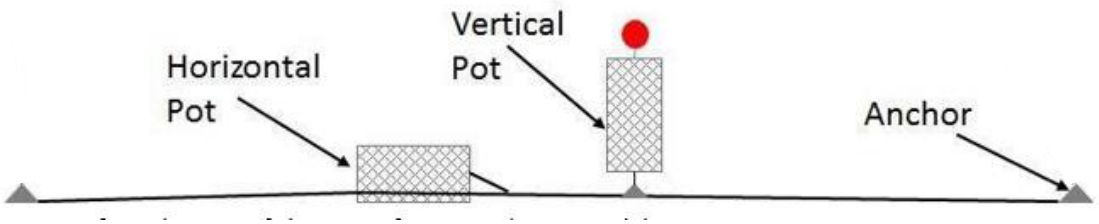

Figure 2. New pot configuration design used to prevent theft of commercial gear.

I (Matt Balazik) realize this configuration is illegal but we did not have enough anchors or rope to set each pot individually and if we marked the gear with surface floats the gear would have been compromised. This was my (Matt Balazik) idea and completely accept any punishment associated with the violation. It is what commercial BCF fishers in the upper James River are required to do in order to not have their gear stolen or destroyed and I think resource enforcement is aware of the situation.

Fish from each pot were keep separate and were weighed at Wanchese fish house. Weight from the vertical and paired horizontal configurations were compared with a nonparametric paired Wilcoxon Rank Sum test. The weights were also compared visually and also using a permutation test run at 10,000 interactions. All statistics were run in Rstudio using R version 3.5.2.

Results

The pots soaked for 90 days between April 28th 2018 and January 2nd 2019. The pots were checked 69 times during the study period. Almost every time the pots were fished the bait was usually all gone except for some heads. The bait would be gone even when no fish were caught in the pot. One possibility was the bait was being eaten by something that could escape the trap. A total of 7,275lbs were harvested during the project with the SV, SVC, BV, and BVC pots catching 771lbs, 836lbs, 2317lbs, and 3351lbs, respectively. It needs to be noted that the SV pots could not be fished in the areas of high BCF abundance without being lost, likely due to theft. Almost 85% of the catch were classified as 1-3lb fish at the fish house (Figure 3); however, some of these were 0-1lb weight class fish but were not separated due to lack of volume. There does not appear to be a difference in the size classes of the vertical pots with their paired comparison pots. The SV and SVC pots had a higher proportion of larger fish than the BV and BVC pots (Figure 3). This likely has to do with where the pots were set. The SV pots

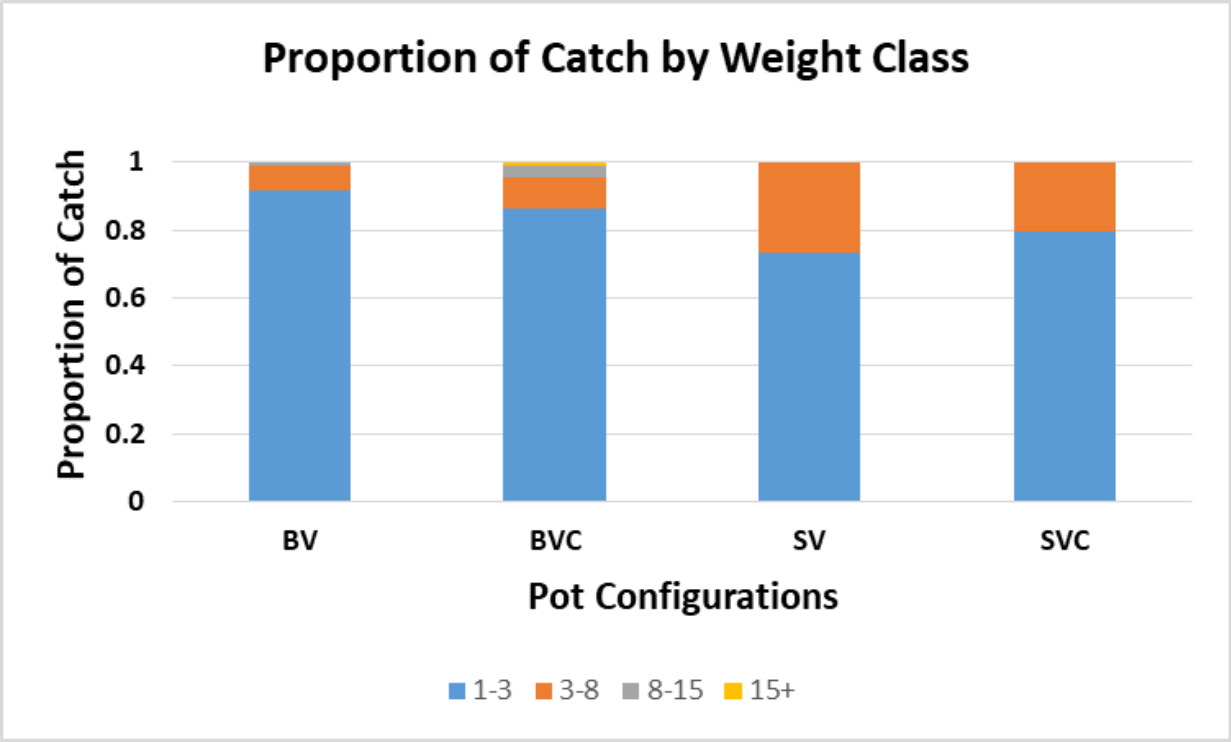

Figure 3. Stacked bar chart showing the proportions of the weight classes caught by the four groups.

were set predominantly in shallow water close to the Rice Center to help limit theft. The BV pots were set predominately in deeper water and hidden where BCF abundance is higher. Differing set locations may explain why there was a small difference in the proportion of size classes caught by the BV and SV pots. About 20lbs of flathead catfish and channel catfish were captured which were lumped in with BCF weights. A few striped bass, American eel, white catfish, white perch, and gizzard shad were caught in the horizontal pots. All non-catfish and white catfish bycatch was released alive.

BV Pots

The mean catch per trip for the BV and BVC pots was 15.6lbs and 22.6lbs, respectively, a mean difference of 6.9 lbs. A boxplot displaying the weights caught per sampling trip also suggests that the BVC pots performed better than the BV pots (Figure 4). A scatterplot of the paired pots with a 1:1 abline shows that BVC pots outperformed BV pots 72% of the time (Figure 5). The permutation test with 10,000 iterations produced a normal bell curve around a mean difference of zero (Figure 6). The vertical abline at the true mean difference of the project (6.9lbs) was highly shifted towards the right side of the distribution (Figure 6). Over 99% of the means generated by the permutation test were below the true mean of the project suggesting that the treatment pots (BV) caught less than the comparison traditional (BVC) pots. The nonparametric Wilcoxon Ranked Sums test had a p-value = 2.88e-09 suggesting there was a significant difference between the BV and BVC pots.

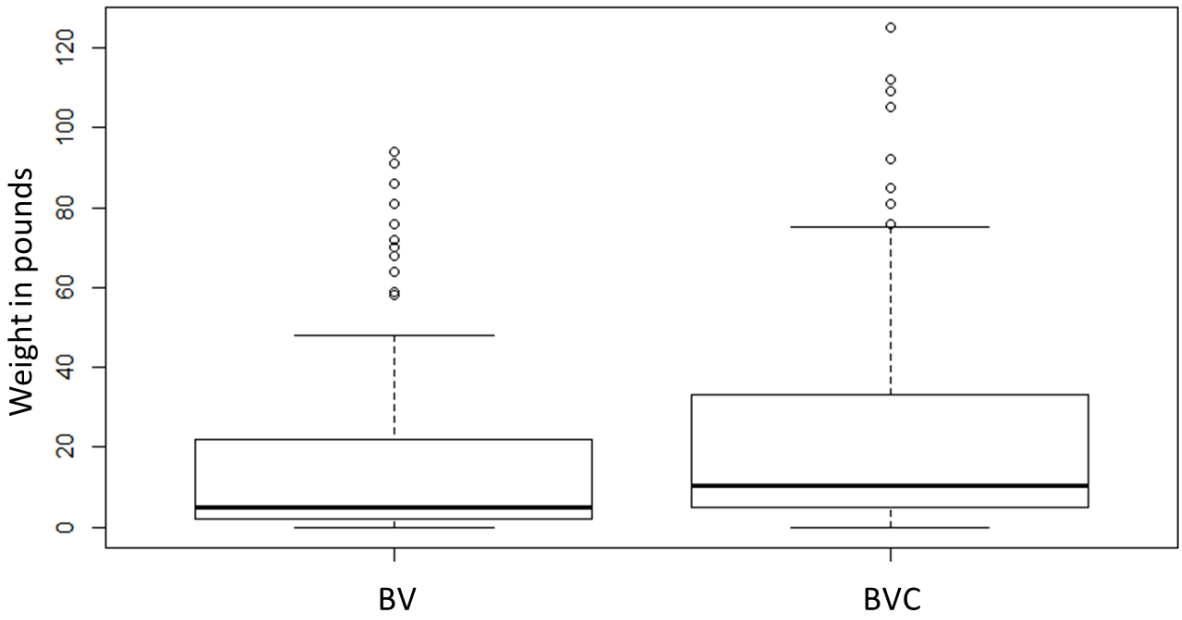

Figure 4. Two boxplots showing the weights caught per sampling trip by the BV and BVC pots.

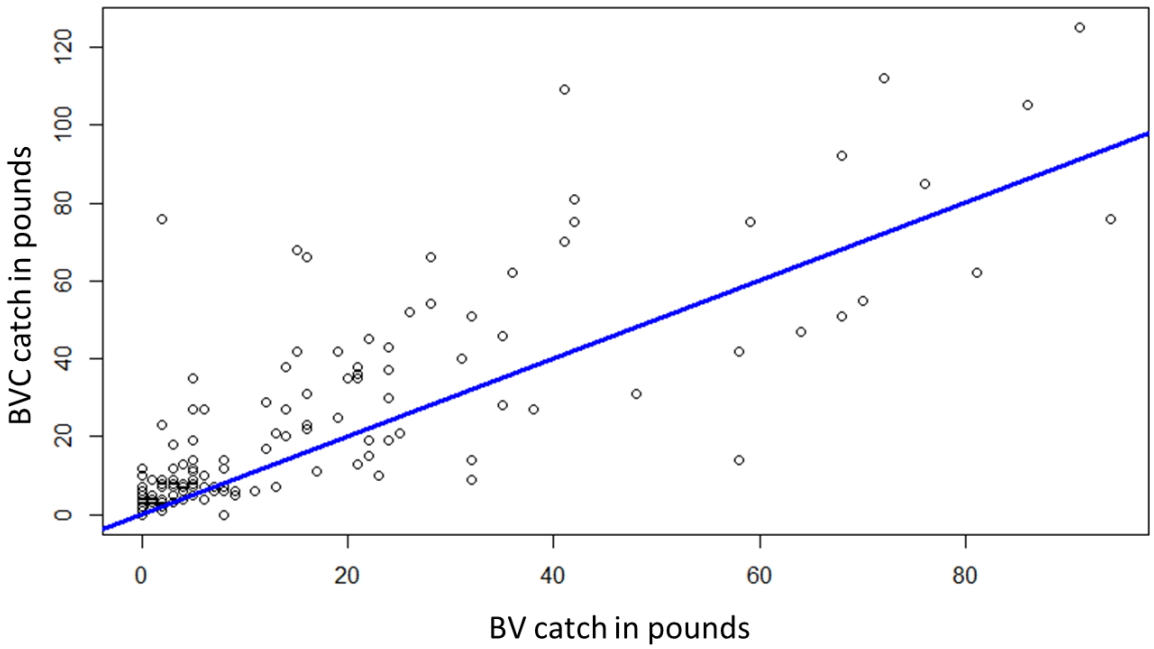

Figure 5. Scatterplot showing the weight caught by the paired pots, BV on the X axis and BVC on the Y axis. The high proportion of points above the 1:1 abline suggests that the BVC pots outperformed the BV pots.

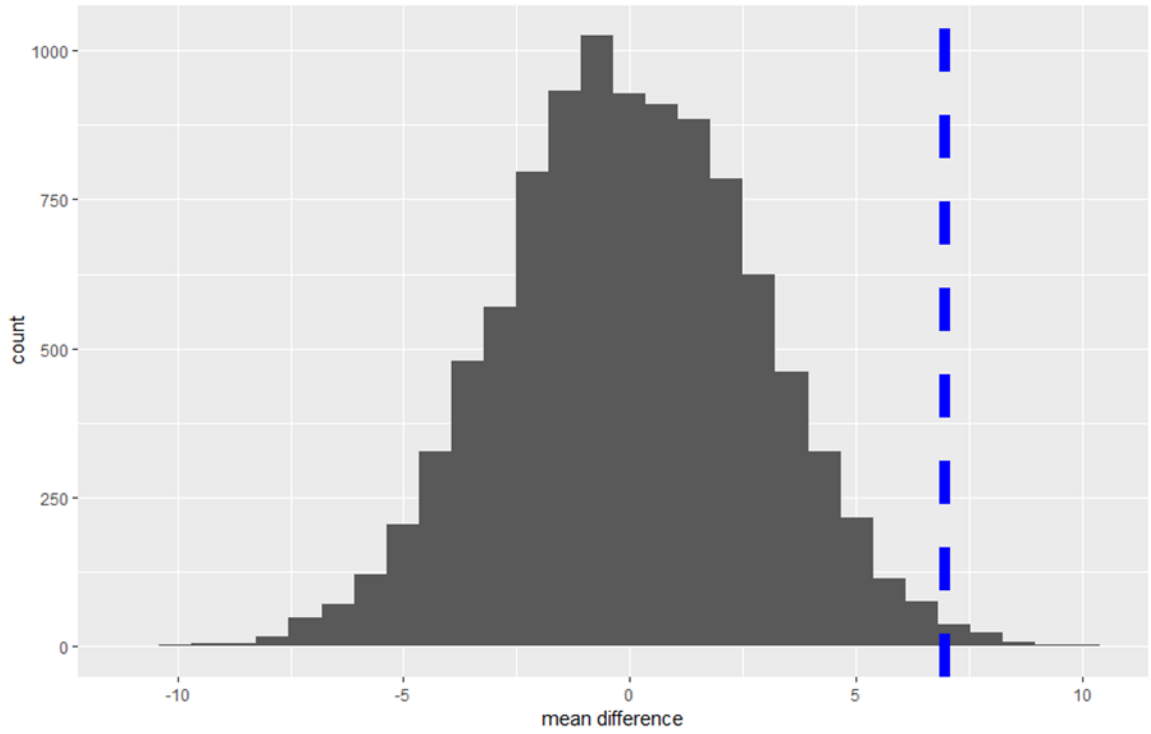

Figure 6. Bar chart displaying the mean differences generated by permutation test run with 10,000 iterations. The blue abline at 6.9lbs marks where the true mean difference of the project data.

SV Pots

The mean catch per trip for the SV and SVC pots was 4.1lbs and 4.4lbs, respectively. Boxplots (Figure 6) and a scatterplot comparing the catch using SV and paired SVC pots (Figure 7) show a similar distribution. The SV pots did better than paired SVC pots 35% of the time and had equal weight 25% of the time (Figure 7). The permutation test run at 10,000 iterations produced a normal shaped bell curve around zero (Figure 9). The abline at 0.4 is the actual mean difference from the project. The project mean was only 17% away from a mean difference of 0 run by the 10,000 iterations (Figure 9). These data suggest there is no significant difference between the weight caught in the SV and SVC pots. The nonparametric Wilcoxon Ranked Sum test between the catch of SV and SVC had a p-value = 0.327 suggesting there was no significant difference between the catch of the two configurations.

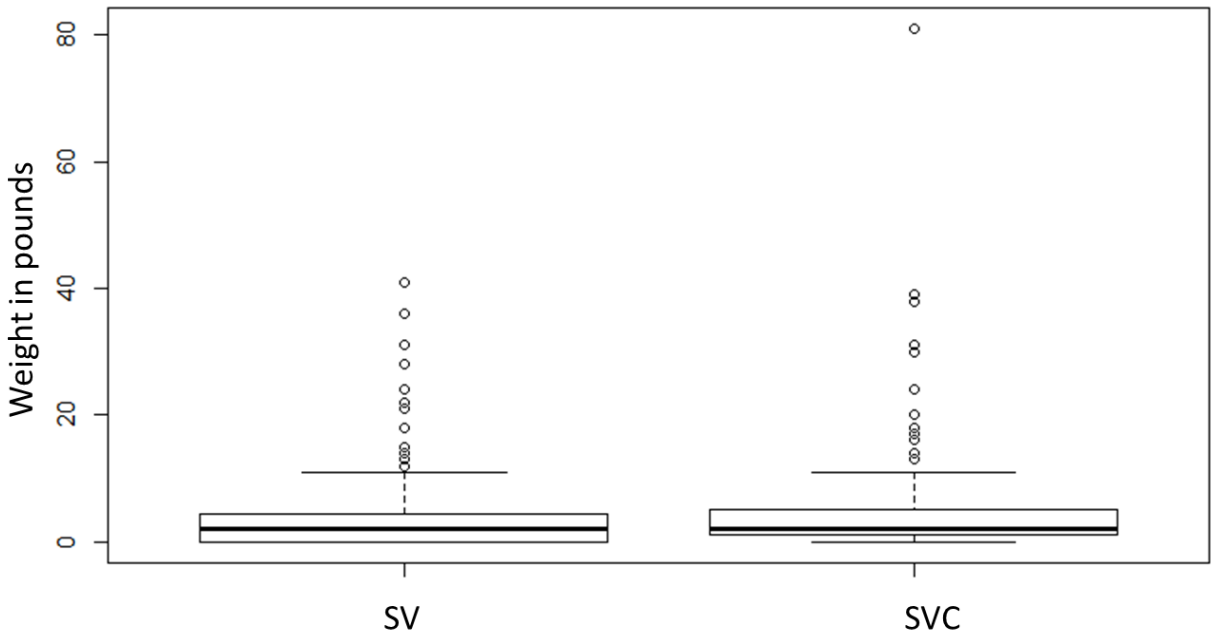

Figure 7. Boxplots showing the catch of SV and SVC pots.

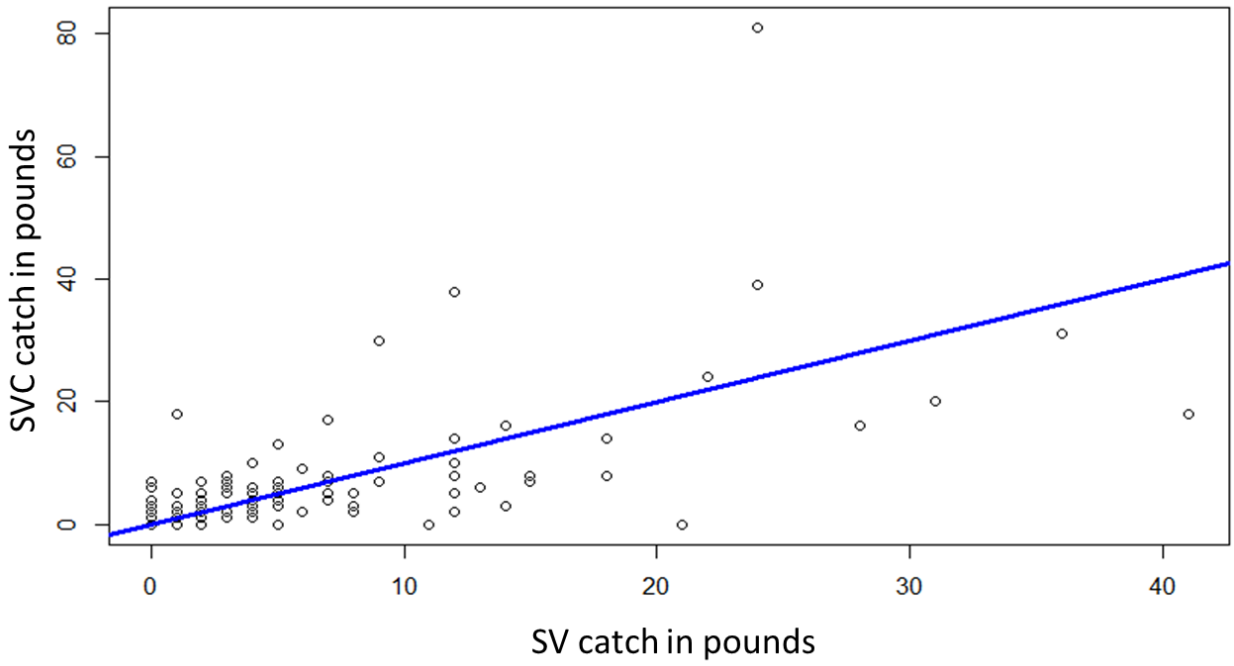

Figure 8. Scatterplot showing the weight caught by SV on the X axis and paired SVC pots on the Y axis. The SV pots caught more weight than the SVC pots 35% of the time, had equal weights 25% of the time and caught less than BVC pots 40% of the time. The points appear to be evenly distributed on both sides of the 1:1 abline suggesting the configurations performed the same.

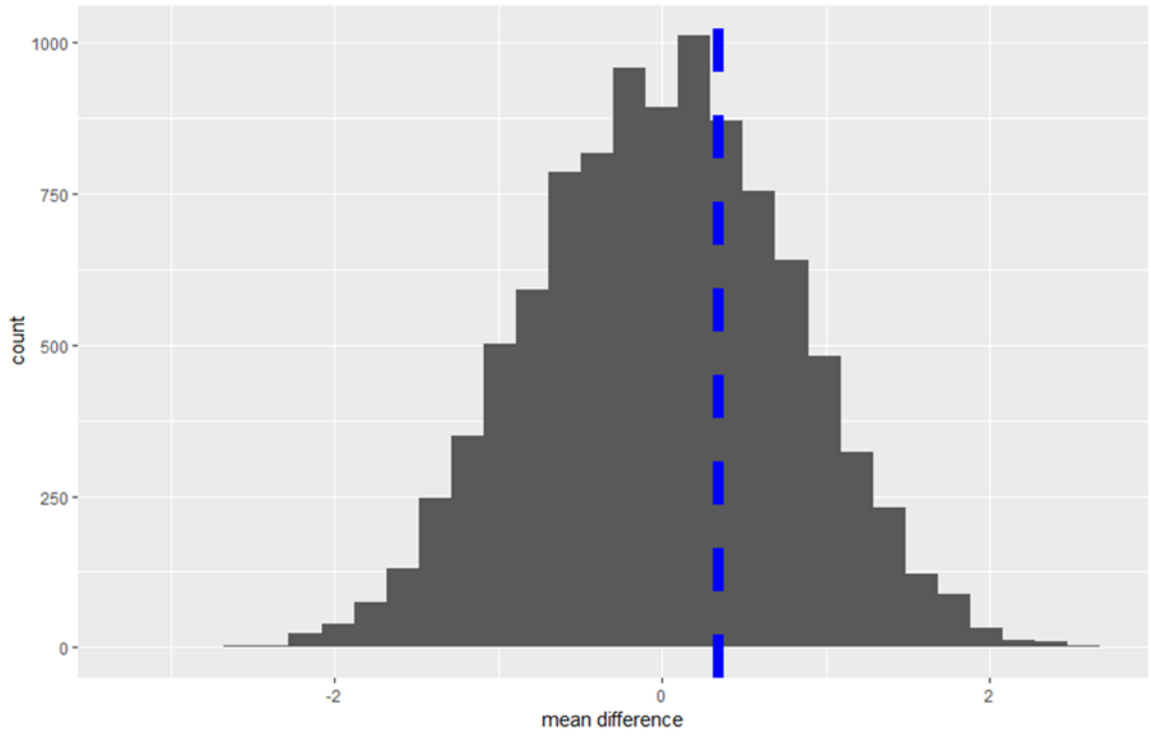

Figure 9. Bar chart displaying the means generated by permutation test run with 10,000 iterations. The blue abline at 0.3 lbs marks where the true mean difference of the project data.

Additional Observations

A big problem with this study was the mesh size of the pots. When we saw the catch from the hoop-netters on the James River we noticed their proportion of 0-1lb fish was a lot higher than what was in our catfish pots. The hoop-netters' pots have 0.75" and 1" bar, much smaller than ours. When doing some work on the Rappahannock River we met a commercial fisher using similar pots to our study pots. The commercial fisher had about 2,000 pounds of BCF with most of the fish in the 2-5lb range and very few in the 0-2lb range. We thought that the 1.5" bar hung square allowed BCF in the 0-1lb size class, which represents a large proportion of the population in the James River, were able to eat the bait and escape the net. We tested our hypothesis by catching 0-1lb BCF in the area using a gill net and placed 10 in 1 SV pot and 10 in 1 SVC pot. The spines on the BCF we completely intact when they were put into the pots. No bait was placed in the pots so new BCF would be tempted to enter the trap. The next day all the BCF had escaped from the SV pot and 8 had escaped from the SVC pot. This confirmed our thought that small BCF were entering the pots, eating the bait and escaping. Small BCF would consistently fall through the mesh when the pots were being lifted into the boat.

In an attempt to address the issue we placed 0.5" hardware cloth over 1 BV and 1 BVC paired pot (Figure 10). This was done towards the end of the study and the pots were only fished three times. The pots with wire mesh had the highest catch each day they were fished and did have relatively more 0-1lb BCF relative to 1-3lb fish. Small BCF could still escape from the ends of the traps but the smaller mesh covering most of the pot likely helped reduce the amount of fish that escaped.

Figure 10. Picture showing 0.5" hardware cloth installed over the pot frame and mesh.

Bait Retention

We think that some form of bait retention would be very beneficial for the BCF pot commercial fishery. When pots were pulled up the BCF were always engorged. The smaller 0-2lb BCF would regurgitate meat torn off the bait while the larger 3+lb BCF would have an entire adult menhaden in their mouth. Throughout most of the project we used previously frozen bait that was still oily but soft and easily torn apart. A few days straight in November we used fresh, never frozen bait which resulted in the best daily catches during the study period. Never-frozen fresh bait is more firm and should last longer in the pots. We can not conclude the high catch was due to the fresh, more firm bait, but it is a logical explanation. One day we fished and baited the pots in the morning and just 6 hours later we decided to pull one up out of curiosity. The pot had a decent amount of BCF but the bait was completely gone so the pot likely would not attract any new fish until the next time it was fished. One option would be to just add more bait. When we had two extra pots we did some work to see if more bait resulted in greater catch weights. Increasing the amount of bait above 5lbs did not increase catch weights. Another problem with adding more bait is it requires the pot to catch more BCF to offset additional bait costs.

If the bait lasts longer the pots would be attracting BCF for a longer time period which should improve catch. We think bait retention devices would be more useful and cost effective then just adding additional bait. A possible FRG grant in 2019 would be to test some form of bait cups (Figure 11) to protect bait so the pot will be attracting BCF for a longer time period. Most commercial fishers in Mississippi, Potomac and James use about 5lbs of bait per pot. About 2.5lbs of menhaden can fit into the trap in Figure 11. A possible study design would be to use 5lbs of bait but put half into the bait cup and the other half into the pot. Then the following fishing trip just dump the bait from the bait cup into the pot and then put about 2.5lbs of new bait into the bait cup. Having bait in the bait cup and pot

allows BCF to still feed which might be some form of attractant while still protecting some of the bait so the pot is fishing.

Figure 11. Example of a potential bait retention device to put in catfish pots. The wire top would be cut small so it fits inside the circle on the open end and held in place by a bungee cord.

Conclusions and Recommendations

Unfortunately the pots set in vertical orientations caught the same or worse than paired horizontal pots. We really do not see the benefits of switching to a vertical orientation from the traditional horizontal orientation. The SV pots may not have been accurately represented in this study. The SV pot configuration could not be set in areas of high BCF densities without being lost due to actions by other individuals which may have influenced the results. The SV pots were the easiest to fish but require a relatively large surface marker and can not be placed in good fishing spots without being lost. The pots had no problem catching large BCF (Figure 12) but the main goal of this project was trying to improve ways to reduce small BCF biomass. It was very disappointing to learn that small BCF could escape the pots used for this project. Protecting bait so the pot will attract BCF for longer time periods will likely increase catch and possibly reduce overall bait requirements. It seems that research looking into some sort of bait retention devise would be very beneficial to the fishery by increasing time the pots are attracting BCF and reducing the amount of bait needed. It may also be worthwhile to test similar size pots with smaller mesh to see if we can increase the harvest of small BCF.

Figure 12. Example of large BCF caught in the pots. The large BCF in the picture weighed 38lbs and was the biggest fish captured during the study. Also note the lack of small BCF in the picture which are in much greater numbers and total biomass.

Acknowledgements

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