Seeing Red: Does the Color of a Crab Pot Really Matter?
Virginia Fishery Resource Grant Program
Final Report by Dan Knott

Abstract

As part of the VA Fishery Resource Grant Program, I was awarded a grant to conduct a large-scale study during the 2017 crabbing season to determine if the color of a crab pot has any affect on catch. The thought behind this study was based on the previous season and seeing a significant difference and trend in the catch of certain crab pots—particularly pots with the color red. Adding to the desire to determine whether color affects catch were the conversations I had with long-time crabbers that all had differing opinions on the topic.

Once the grant was received, I purchased materials to produce 80 test pots. 40 of these pots were constructed using all black vinyl wire and 40 of the pots were constructed using black vinyl wire for the structure and red vinyl for the entrance funnels and bait well. Additionally, 40 all galvanized wire pots were used as a control sample.

These pots were then deployed on 26 May in two separate locations (deep and shallow) within Mobjack Bay—60 pots per location consisting of 20 black and red, 20 black, and 20 galvanized. The deep location was maintained at an average of 15' and the shallow location was 4'. These pots were fished regularly and data collected for each pot until 15 November. In total, there was over 96 days of collected data. Weather was the largest factor for days with incomplete data collection. The data was consolidated into a spreadsheet that averaged the catch and then the standard deviation was calculated. As a result, the overall catch showed that in both the deep and shallow locations the catch was affected by color. Although the results were not drastically increased—less than ½ crab per pot—the black and red pots did increase the overall and keeper male catch by more than the standard deviation across all variables. Additionally, the black and red pots showed a significant reduction in the overall bycatch.

As a result of the study, I will consider color as a variable in producing or deploying crab pots and will likely switch to square-mesh, galvanized pots…***with dipped red entrance funnels***. The square mesh pots are faster to fish due to the door construction and held up better during the season due to added strength in the construction design. Galvanized pots do not foul as quickly as vinyl coated pots which considerably reduced the amount of time required for cleaning.

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Background

Does the color of a crab pot matter? Can the color of a crab pot affect the catch by increasing selectivity or efficiency while also reducing by-catch? 2016 was my first year as a full-time waterman and crabber. During the season, I noticed that of the six different types, styles, or color of crab pots I acquired with my license, each seemed to *catch* at a different rate. I decided to make my own pots and sought guidance from other personnel and conducted research on the best crab pot to make…This is where the fun began. Every waterman I spoke with had a strong opinion on what style and color of pot works best and steadfast opinions on what doesn't work. For the last few days of the season, I kept a record of my pots and several observations added to my interest in conducting a large-scale test on crab pot type and color. On 11 November, my black vinyl crab pots had an average catch of seven crabs per pot, yellow/green vinyl and standard galvanized averaged six, and any pot with algae growth (dirty) averaged three. But, several black vinyl pots with red entrance funnels averaged 10. On 18 November, similar results with black vinyl at eight, standard galvanized at six, yellow vinyl at five…and, black vinyl with red funnels at 13. What wasn't recorded during these two days was the type/size of crab caught, but the red funnels contained mostly male crabs. During my research to determine what type crab pot to make, I have also found that there might be a correlation between entrance funnel color and terrapin and other by-catch—either a reduction or possibly an increase depending on color and type material.

Purpose

Primary: To determine if color can be used as an effective means of increasing the selectivity and efficiency of crab pots. Can I specifically target Jimmies with the use of certain colors while reducing the by-catch? Secondary: If color can be used to increase pot selectivity and efficiency, does this change throughout the season—cold or hot water temps, reproductive cycles, etc.

Methods Employed

Once the grant was received, I purchased materials to produce 80 test pots. 40 of these pots were constructed using all black vinyl wire and 40 of the pots were constructed using black vinyl wire for the structure and red vinyl for the entrance funnels and bait well. Additionally, 40 all galvanized wire pots were used as a control sample. All of the pots used in the study were of similar construction and funnels were formed, constructed, and installed in the same manner. There was a slight delay in purchasing material to construct pots due to the timing of the award and availability of the wire. Specifically, the red bait box wire was out of stock and

the only company that makes it stated that they only run red bait box mesh several times a year and the next time wouldn't be until the fall. I substituted the bait box mesh with dipped mesh with a paint that matched the funnel color.

These pots were deployed on 26 May in two separate locations (deep and shallow) within Mobjack Bay—60 pots per location consisting of 20 black and red, 20 black, and 20 galvanized. The deep location was maintained at an average of 15' and the shallow location was 4'. These pots were fished regularly and data collected for each pot until 15 November. In the attached map screenshot, you will see the deployed areas. Of note, you will see two areas labeled Deep Area due to the theft of 25 pots on 18 July. Due to this theft and the theft of additional pots several weeks later, the first location was abandoned in order to place pots in an area that afforded better oversight to reduce the likelihood of theft. These losses along with other variables did require a lapse in data collection for the deep area while new materials were purchased and pots could be constructed.

Data was collected each day and consisted of water temperature, location, sechi disc reading, type and number of crabs, legal and sub-legal numbers, and any bycatch. Initial data collection was on water-resistant paper, but due to the overall mess associated with keeping the paper forms I transitioned to using dry-erase markers, the boat console, and pictures.

All pots were fished regularly and baited with the same type (menhaden) and quantity of bait. After the theft of pots, I was able to make additional pots that were able to be used as spare pots to temporarily use to replace pots that needed to be removed for repair or cleaning. Although this worked well, there were days when data lines per type were missing due to unavoidable reasons. In the overall collection, this is deemed minimal and if the numbers were off (one type pot more than the others) the data was not included in the average or discarded completely. Some of these missing data points were due to poaching, but many of the pots that required removal or missing data was due to broken bio-panels or cull rings. One of the original aspects of this test was to utilize bio-degradable panels that were provided by Mobjack Binnacle. Some panels were provided directly and some were part of a voluntary test through the Virginia Marine Resources Commission. All pots initially had the panels installed and eventually, all of the bio-panels failed and pots had to be removed for repair.



The initial concept was to work all 120 pots each day while recording data. After several weeks of initial data collection this was deemed unacceptable and data collection was adjusted to record data on alternating days. This was to ensure that sufficient number of pots could be worked per day and crabs made it to market at the appropriate time. The work plan allotted for 2 hours per day to work, record, and analyze data. When recording data for each pot the time required to work pots nearly tripled. Typically, working solo, I can work at least 50-60 pots per hour, but with data collection that dropped to approximately 20 pots per hour. To reconcile data into the spreadsheet required an additional 15-20 minutes per day.

Another aspect of data collection that needed to be adjusted from the concept was individual tagging of each pot. The numbers used were thick plastic coat tags and would only remain readable for several days before needing to be cleaned off. Ones that were placed in heavily traveled areas—which also were easily wiped clean—were broken within days. If tagging is a future requirement, stamped metal tags would likely be the only acceptable means and based on research would be cost prohibitive.

For analyzing the collected data, I chose to build a spreadsheet that would take the mean (average) across the entire duration of the study between shallow and deep locations. Additionally, the spreadsheet was adjusted to average specific periods of time utilizing the solar calendar. There was a total of 96 days of data used and due to the loss of over half deep test pots on 18 July, there was a significant break in data for the deep pots—approximately 30 days. Based on the final averages and similar deviations, I do not feel that this break negatively affected the overall study or outcome.

Overall average for study

Shallow			Deep	
Black			Black	
Total Black	7.96		Total Black	6.02
Total Jimmies	1.54		Total Jimmies	1.97
Keepers	1.31		Keepers	1.79
Total Sooks	6.41		Total Sooks	4.05
Keepers	6.07		Keepers	3.82
Black and Red			Black and Red	
Total Black/Red	8.33		Total Black/Red	6.72
Total Jimmies	1.81		Total Jimmies	2.53
Keepers	1.54		Keepers	2.34
Total Sooks	6.52		Total Sooks	4.19
Keepers	6.20		Keepers	3.98
Galvanized			Galvanized	
Total Galv	7.72		Total Galv	6.04
Total Jimmies	1.56		Total Jimmies	2.12
Keepers	1.31		Keepers	1.93
Total Sooks	6.16		Total Sooks	3.92
Keepers	5.83		Keepers	3.70

Average for Spring Collection

Shallow			Deep	
Black			Black	
Total Black	8.35		Total Black	8.18
Total Jimmies	1.25		Total Jimmies	1.32
Keepers	0.97		Keepers	1.14
Total Sooks	7.05		Total Sooks	6.86
Keepers	6.59		Keepers	6.68
Black and Red			Black and Red	
Total Black/Red	9.14		Total Black/Red	8.62
Total Jimmies	1.57		Total Jimmies	1.43
Keepers	1.33		Keepers	1.26
Total Sooks	7.59		Total Sooks	7.18
Keepers	7.23		Keepers	6.93
Galvanized			Galvanized	
Total Galv	7.39		Total Galv	8.18
Total Jimmies	1.61		Total Jimmies	1.32
Keepers	1.26		Keepers	1.05
Total Sooks	5.79		Total Sooks	6.84
Keepers	5.43		Keepers	6.56

Average for Summer Collection

Shallow			Deep	
Black			Black	
Total Black	7.76		Total Black	6.08
Total Jimmies	1.68		Total Jimmies	2.25
Keepers	1.43		Keepers	2.02
Total Sooks	6.08		Total Sooks	3.84
Keepers	5.73		Keepers	3.52
Black and Red			Black and Red	
Total Black/Red	8.21		Total Black/Red	6.83
Total Jimmies	1.98		Total Jimmies	2.72
Keepers	1.62		Keepers	2.51
Total Sooks	6.22		Total Sooks	4.12
Keepers	5.80		Keepers	3.79
Galvanized			Galvanized	
Total Galv	8.18		Total Galv	5.87
Total Jimmies	1.71		Total Jimmies	2.29
Keepers	1.48		Keepers	2.06
Total Sooks	6.48		Total Sooks	3.58
Keepers	6.14		Keepers	3.30

Average for Fall Collection

Shallow			Deep	
Black			Black	
Total Black	7.09		Total Black	4.82
Total Jimmies	1.49		Total Jimmies	1.89
Keepers	1.27		Keepers	1.70
Total Sooks	5.59		Total Sooks	2.92
Keepers	5.41		Keepers	2.75
Black and Red			Black and Red	
Total Black/Red	7.34		Total Black/Red	5.54
Total Jimmies	1.69		Total Jimmies	2.46
Keepers	1.49		Keepers	2.29
Total Sooks	5.65		Total Sooks	3.08
Keepers	5.49		Keepers	2.95
Galvanized			Galvanized	
Total Galv	6.86		Total Galv	4.97
Total Jimmies	1.46		Total Jimmies	2.12
Keepers	1.09		Keepers	1.91
Total Sooks	5.41		Total Sooks	2.85
Keepers	5.09		Keepers	2.73

Results / Conclusion

The original application for the grant asked to explain how the expected results will address the problem and/or enhance fishery resources. My response to this question in the proposal was that equipment cost is currently my biggest expense for commercial crabbing. In order to ensure a profit margin, time and expense must be optimized against catch. If black vinyl pots with red entrance funnels can help target jimmies while increasing catch numbers, then the investment in vinyl pots will easily pay off. If it is strictly the color of the funnel that maximizes the catch, then I can use the less expensive galvanized metal and change the color of the funnel. If certain combinations work better at certain times of the year, pots can be alternated throughout the season to optimize catch.

I feel that the results of the study show that the color of the pot does make a difference in catch. The black and red vinyl pots slightly led the average in all categories. When looking at the significance of the increase, the other two pot types remained within the standard

deviation across the variables but the black and red pots increased the catch above the standard deviation in every variable except the shallow summer overall catch. In this variable where the black and red did not increase the catch greater than the standard deviation, it only missed it by .05 (8.05 mean with a catch of 8.21 and a standard deviation of .21). The current cost of vinyl netting is approximately $20 more per roll than galvanized mesh. This is an insignificant amount when you factor the cost of the sacrificial anodes. Even with the slight lead that the black and red pots had across all data entries, the difference should be kept in mind. The black and red pots lead each category by approximately ½ crab per pot over the entire study. If you factor that…255 pots (my license limit) that would equal 127 crabs per day over other type/color pots. If a bushel averages 75 crabs that would be 1.7 bushels per day or approximately 68lbs of crabs. The low market value of crabs was .50 cent per pound last summer which would equal $34 per day increase…over 120 days = $4080.

Overall Catch

Type Pot	Shallow	Deep
Black	7.96	6.02
Black and Red	8.33 (above standard dev)	6.72 (above standard dev)
Galvanized	7.72	6.02
Mean	8	6.25
Standard Deviation	.25	.33

Overall Keeper Male Catch

Type Pot	Shallow	Deep
Black	1.31	1.79
Black and Red	1.54 (above standard dev)	2.34 (above standard dev)
Galvanized	1.31	1.93
Mean	1.39	2.02
Standard Deviation	.11	.23

Seasonal Overall Catch

Type Pot	Shallow (Spring / Summer / Fall)	Deep (Spring / Summer / Fall)
Black	8.35 / 7.76 / 7.09	8.18 / 6.08 / 4.82
Black and Red	**9.14** / 8.21 / **7.34 (above dev)**	**8.62 / 6.83 / 5.54 (above dev)**
Galvanized	7.39 / 8.18 / 6.86	8.18 / 5.87 / 4.97
Mean	8.29 / 8.05 / 7.09	8.32 / 6.26 / 5.11
Standard Deviation	.72 / .21 / .20	.21 / .41 / .31

Seasonal Keeper Male Catch

Type Pot	Shallow (Spring / Summer / Fall)	Deep (Spring / Summer / Fall)
Black	.97 / 1.43 / 1.27	1.14 / 2.02 / 1.70
Black and Red	**1.33 / 1.62 / 1.49 (above dev)**	**1.26 / 2.51 / 2.29 (above dev)**
Galvanized	1.26 / 1.48 / 1.09	1.05 / 2.06 / 1.91
Mean	1.19 / 1.51 / 1.28	1.15 / 2.20 / 1.97
Standard Deviation	.16 / .08 / .16	.09 / .22 / .24

The study also showed that by-catch was affected by the color of the pot. I only analyzed the overall number of bycatch per pot type and location. The results showed that the black and galvanized pots had nearly identical bycatch numbers across both locations whereas the black and red pots showed a significant reduction in bycatch numbers. The actual type of bycatch was recorded and is in the data spreadsheet.

Overall Bycatch

Type Pot	Shallow	Deep
Black	183	244
Black and Red	140 (significant reduction)	229 (significant reduction)
Galvanized	178	247
Mean	167	240
Standard Deviation	19	8

The study showed me that the vinyl pots will become fouled at a rate nearly two to three times faster than galvanized pots and once fouled the pot will have to be removed and pressure washed or scrubbed. I did not keep specific data that can quantify this statement, but throughout the summer I found that I had to struggle to pull pots evenly for cleaning. Typically, I would remove 10-20 pots each week to clean and would easily find the black or black and red vinyl pots that required cleaning but would have to remove galvanized pots that were still clear in order to keep the rotation numbers even.

As a result of the study, I will consider color as a variable in producing or deploying crab pots and will likely switch to square-mesh, galvanized pots…***with dipped red entrance funnels***! The square mesh pots are faster to fish due to the door construction and held up better during the season due to added strength in the construction design. Additionally, galvanized pots do not foul as quickly as vinyl coated pots which considerably reduced the amount of time required for cleaning.

Recommendations

With future FRG grant awards, I would ensure that rotational supplies be factored into the study. For instance, I should have asked for at least a 10-20% increase in materials be added. This would have given the ability to have spare crab pots to rotate for repair or cleaning instead of having to make these out of pocket to account for this inevitable fact.

I would like to see more VMRC understanding and support for these studies and truly help with incentivizing Watermen for participating or conducting these efforts. Currently, these pots and the timeframe to work them came out of my pot limit and normal daily harvest times. A separate VIMS request for subtracting study pots and daily time-limits was denied by VMRC (technically, it was modified to the point that it was completely ineffective). Though that additional voluntary effort was to support a VIMS study, it was still part of an overall effort to help advance the fishery and educate myself and others. If a daily time-limit extension could

have been granted, this would have allowed me to work normal crab pots and take crabs to market at the appropriate time while returning to work the study pots without being constrained by time and or financial responsibilities. They might consider automatic granting of VMRC study tags or placards when watermen participate in studies like this or adding emphasis areas to the Marine Police patrols. It may have helped prevent or recover the pots that were stolen during this study.

Anti-fouling and cleaning of pots is something that should be studied and might be a great idea for a future FRG award. There are quite a few innovative fixes being used that either prevent fouling or clear them up while on the water—some of these might not be great for the environment. The research and education are really lacking in the impact of these fixes and any alternative possibilities. For most watermen, time is the most precious resource and cleaning pots is a huge investment in time.