Fishery Resource Grant Program Final Report 2010

Project title: Improving Gill net Selectivity by Altering Mesh Characteristics 2010
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Give a brief summary of the project/Abstract.

This project was designed to further examine the effect of twine size (mesh diameter) and hanging ratio on catch-per-unit-effort (CPUE) of striped bass, American shad and Atlantic sturgeon. It follows a 2009 study in which four 200' net strings, each consisting of four identically varied 50' net sections that mimicked nets fished in 2010 in every way except .62mm twine sized nets were replaced with .90mm webbing. 2009 nets strings were constructed as described in table 1.

		1st 50ft section	2nd 50ft section	3rd 50ft section	4th 50ft section
net 1	hanging ratio	0.5	0.625	0.5	0.625
	webbing size	0.4	0.4	0.62	0.62
	color code	green red	green blue	yellow red	yellow blue
net 2	hanging ratio	0.625	0.5	0.625	0.5
	webbing size	0.62	0.62	0.4	0.4
	color code	yellow blue	yellow red	green blue	green red
net 3	hanging ratio	0.625	0.625	0.5	0.5
	webbing size	0.4	0.62	0.4	0.62
	color code	green blue	yellow blue	green red	yellow red
net 4	hanging ratio	0.5	0.5	0.625	0.625
	webbing size	0.62	0.4	0.62	0.4
	color code	yellow red	green red	yellow blue	green blue

In 2009, no sturgeon were attained and thus no gear comparisons could be made. Total shad and striped bass catches and distributions of count data varied greatly with excessive zeros occurring for shad. A zero-inflated poison (ZIP) assumes that zero and nonzero counts might come from two different sources. It thus reduces the effect of zeros on analysis and this is why this analysis was used to examine differences in shad catches between net panels. Catches of American and Hickory shad were combined to increase catch numbers. Though fewer days with no catch occurred per panel type for striped bass, too many occurred for an assumption of equi-dispersion of the likelihood of catch to be applied which ruled out many analysis approaches that assume a normal poison distribution of data. ZIP analysis of shad catch distribution in 2009 suggested that twine size alterations from .4 to .62 mm were not enough to alter shad retention rates ($p=.2911$). Increasing the hanging ratio from .5 to .62 was found to significantly decrease shad catch

or CPUE. Panel location was barley significant for shad in the poisson model (p=.0463) and more significant in the Logit (p=.0212). This finding could have lead to bias due to location of experimental panels since shad numbers were reduced.

A negative binomial regression was applied because its model addresses the issues of over-dispersion (too many zeros) by including a dispersion parameter to accommodate the unobserved heterogeneity in the count data. Panel location did not effect striped bass distributions between panels (p=.2276) nor did twine size (p=.0807) or hanging ratio (p=.2966) at a ninety-five percent confidence interval. A general linear model was also run on the striped bass lengths resulting under the four treatments. It revealed that hanging ratio had no significant effect on fish size but that mean fish size varied significantly (p<.0001) between twine sizes with the .62 twine size retaining significantly larger fish on average.

2009 research suggested that hanging ratio augmentation can help reduce bycatch of shad and does not negatively affect striped bass CPUE. Twine size augmentations from .4mm to.62mm did not reduce shad bycatch but it did increase the average sized striped bass retained and had no significant impact on the striped bass catch rates.

In 2010 the heavier of the two twine sizes tested was enlarged from .6mm to .9mm to determine if the .9mm webbing would be large enough to deter shad retention. A secondary objective was to expand the data set so that improved analysis of variables could be conducted.

NEED TO THINK ON THIS

NEED TO CREATE ABSRACT OF 2010 WORK

What work did you intend to do, and how did you plan to accomplish it?

In 2010, we proposed that four 200' net strings, each consisting of four 50' net sections which mimicked nets hung in 2009 in every way except that .9mm webbing was used instead of .62. Nets were to again to be deployed in the Croaker area of the York River three times a week for 12 weeks (36 total days) from February 12- May 4th. Five and one half inch stretched mesh webbing was to be used with the mesh depth standardized to 20 meshes. Twine sizes were to be alternated between .4 and .9 mm and hanging ratios varied, as they were in 2009, from .5 (5 meshes in 13.75 inches) to .625 (4 meshes in 13.75). Look to Table 2 for proposed design.

		1st 50ft section	2nd 50ft section	3rd 50ft section	4th 50ft section
net 1	hanging ratio	0.5	0.625	0.5	0.625
	webbing size	0.4	0.4	0.9	0.9
	color code	green red	green blue	yellow red	yellow blue
net 2	hanging ratio	0.625	0.5	0.625	0.5
	webbing size	0.9	0.9	0.4	0.4
	color code	yellow blue	yellow red	green blue	green red
net 3	hanging ratio	0.625	0.625	0.5	0.5
	webbing size	0.4	0.9	0.4	0.9
	color code	green blue	yellow blue	green red	yellow red
net 4	hanging ratio	0.5	0.5	0.625	0.625
	webbing size	0.9	0.4	0.9	0.4
	color code	yellow red	green red	yellow blue	green blue

Table 2: Table two illustrates the net sections of each net fished in 2010.

(Hanging ratio explanation: In other words if the net were six inch mesh and it was a 600' stretched bundle hung on .5 it would turn out to be a 300' net and four meshes would be hung between knots 12" apart. If you hang on .62 you are hanging a tighter net than one hung on .5, a net that has fewer meshes per linear foot and thus has meshes that are more opened or wider horizontally. You also end up with a net that is longer than one hung on .5, ~ 340' versus 300'.)

Net fishing depth was standardized by attaching three floats at an equal distance (25') along each 50' net section. Floats standardized fishing depth of each net in reference to the water's surface at approximately three feet. Net sections were also to be consistent between years in nylon color. As in 2009, conduit poles were used as anchors in 2010 to provide standard marks for net locations. The location of each net string at each of the four sites was to be randomly selected at the start of the study and net strings reversed or swapped between locations randomly during the study period.

Retained fishes were to be enumerated by species and panel and total length measured to the nearest millimeter. Physical characteristics of environment such as water clarity, temperature, and salinity were to be recorded prior to fishing each day. Duration of set was also to be recorded in case set time varies from proposed twenty four hour duration due to weather or other events.

Applicable statistical analysis was to follow conducted by Dr. Hager of Va. Sea Grant to determine the effect of twine size (mesh diameter), hanging ratio augmentations and net section location on catch of American shad, striped bass and possibly Atlantic sturgeon.

What was accomplished?

Nets sections were fished for 36 days and every net string was run on every day from March 13 to April 15. All net strings were fished every day and each was fished for a standard 24 hour period. As in 2009 net panels in each string were not tied together. Nets were, however, not flipped or moved from one site to another. Fishes were enumerated by species and panel and total length measured to the nearest millimeter. Physical characteristics of environment such as water clarity, temperature, and salinity were recorded for potential analysis later. Data sheets were entered by Sea Grant employees. Dr. Hager volunteered to proof data entry and shad and striped bass catches and to conduct all analysis.

Since all net sections and net strings were fished simultaneously the number of fish caught during each set by each of the four experimental nets sections is equivalent to the panel's catch-per-unit-efforts (CPUE). Raw catch numbers are presented in table 3.

Hanging Ratio	Twine Size (mm)	Striped bass	Shad
0.5	0.4	300	48
0.62	0.4	194	31
0.5	0.9	347	28
0.62	0.9	244	25

TABLE 2. Table two contains raw data collected in each net panel for 2010. Hickory shad and America shad are combined into a single shad category based on an assumed equal likelihood of retention based on the fisher's and scientist's opinion that gear would select equally for either species due to similar morphology and behavior. This approach was also chosen to increase shad numbers and power of analysis.

Statistical Analysis

No sturgeon were taken in 2010. Catch distributions of raw count data (catch numbers) for shad and striped bass again contained excessive zeros. However, zeros were less prevalent than in 2009 so negative binomial regressions were used to examine the gear and location factors affecting both shad and striped bass catches. The null hypothesis in both examinations was that catch was evenly distributed between factors.

Analysis of shad catch distribution again suggests that twine size does not effect shad catch rates even when .4 is compared with .9mm (p=.2911). Increasing a net's hanging ratio from .5 to .62 was found consistently to significantly (p=.   ) decrease shad CPUE . Because panel location was not altered it was not independent of gear alteration variables and thus it could not be examined further. Panel location did not effect striped bass distributions between panels (p=.2276) nor did twine size (p=.0807) or hanging ratio (p=.2966) at a ninety-five percent confidence interval.

Analysis of striped bass catches suggests that increasing twine size from .4 to .9mm significantly (p=) decreases striped bass catch rates as does increasing twine size (p=). Interestingly panel location was highly significant (p=   ) in 2010, but again, the true meaning of this finding is obscured by the fact that panel locations were not altered.

NEED to look at net position alone since all four nets contain one of each panel alteration.

Discussion

In 2007, twine size alterations between .4 and .52 mm did not seem large enough to affect shad retention rates while hanging ratio alterations between .5 and .62 suggested that this variable showed promise as a means of reducing unwanted shad bycatch. In 2009, differences in twine size diameters were increased and diameters of .4 and .62 mm were compared. Identical hanging ratios were also reexamined. Statistics were used to examine if increases in twine size or hanging ratio affected shad or striped bass CPUE or mean striped bass length. Despite the increase in diameter differences between nets tested in 2007 (.4 and .52mm), 2009 (.4 and .62mm) and 2010 (.4 and .9mm) twine size increases did not significantly reduce shad retention. Data in 2007, 2009 and 2010 consistently suggested that augmenting hanging ratio (.5 to .62) does significantly decrease the CPUE of shad. In 2009 and 2010, all treatments were run simultaneously and four replicates of each occurred per soak period. Results in 2009 suggested that panel location was not independent of shad but was independent of striped bass CPUE. In 2010 panel location was not an independent variable because nets were not flipped at their location or moved between stands. Therefore, fish distributed could not be spatially examined.

Striped bass catches do not affirm last year's hypothesis that increasing hanging ratios and twine size does not significantly alter striped bass CPUE, however, one cannot be sure that gear location was not a factor. Exact location of the stand was not duplicated due to a waterman's drowning in the area and spatially related restrictions. Another equally plausible explanation is that increasing twine size positively influences striped bass CPUE up to a given diameter and at some point it becomes a hindrance. The point at which this positive correlation between twine size and striped bass retention is reversed is likely related to fish's size and thus dependent upon mesh size. Our study likely suggests that .9mm is too heavy/stiff for the smaller striped bass taken in 5.5" mesh and that .4 is too light.

Gill net alteration research across years is consistent in that it suggests that gill nets are not equal with respect to their selectivity. And that selectivity is not independent of twine size, hanging ratio or mesh size. This fact gives fishery's managers alternatives to closures for controlling bycatch in gill net gear, however, selectivity of given twine sizes cannot be examined as a factor independent of mesh size or species.

Stopped here . In our study twine sizes augmentation (.4 to .62 mm) increased striped bass CPUE by number and poundage. Under an ITQ or catch limit management approach increasing CPUE congruently decreases gear soak time and thus risk of interaction with protected species due to the fact that interactions with protected species are most often characterized by a as a rare event. Our findings suggest that increasing hanging ratios will reduce shad bycatch which will further conserve this protected finfish resource. In addition to these conservation benefits fishermen will increase profit margin by incorporating these gear alterations into their approaches. A higher target CPUE lowers harvest costs. Larger twine sizes increase longevity of the gear and hanging nets on a larger hanging ratio result in longer nets given the same quantity of webbing. In addition to these economic benefits, fishers that chose to be responsible stewards and take the steps necessary to improve their fisheries with respect to gear selectivity are increasing the sustainability of their industry with respect to the nature system that controls production and ecological balance and the political system that all to readily punishes the fisheries for protected species population declines.

What was planned and not accomplished?

Gear comparisons were conducted as planned for all treatments. Analysis of shad catches suggest that panel location may be a significantly important factor effecting total catch by treatment which can also be expressed as CPUE, since effort was equal between treatments. Therefore, CPUE/gear performance may be biased by this factor with respect to shad. More study will be needed to dismiss the effect of location on shad CPUE and potential bias effect on shad results.

Applicant Signature: __________________________Date: ________________

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