Final Report: U.S. Gulf of Mexico Commercial Snapper/Grouper/Black Drum Conversion Factors Validation 2024

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Project Synopsis

This project was a cooperative one-year study with the Gulf of Mexico state partners to improve the quality and accuracy of commercial snapper, grouper, and black drum landings data. This was done by collecting and analyzing snapper, grouper, and Black Drum samples to validate, verify, and update conversion factors used to determine whole weight of snapper, grouper, and Black Drum landings from other reported units, such as gutted weight.

Samples were collected across the Gulf of Mexico, including samples independently obtained by State Partners from their respective commercial snapper, grouper, and Black Drum fisheries in Florida, Alabama, Louisiana, and Texas. Fishery dependent samples were collected from Spring 2020 to Fall 2023, while additional fishery independent samples were acquired from a previous project from 2014 to 2017. The wide range of sample collection allowed for both spatial and temporal variability, as well as addressing variability in snapper, grouper, and black drum processing methods. The data obtained through this study are being used to compare and validate conversion factors currently in use by State Partners, and results are being discussed as to the adoption of new conversion factors for commercial snapper, grouper, and black drum species. Standardization of conversion factors will result in more accurate data for stock assessments, and development or modification to fisheries management plans.

Introduction

Background

Commercial landings data are a critical component to fishery management. Frequently, commercial landings are reported in units other than the original whole condition (ex. gutted weight reported for fish). It is important that the conversions of landings reported in these other units back the original whole condition (ex. whole weight) are accurate and validated in order to provide the most reliable description of commercial landings for finfish and shellfish.

The most commonly used conversion factors were supplied several decades ago and have been used to convert fisheries products (finfish and shellfish) from landed weights to whole weight or meat weight. The conversion factors were historically provided by NOAA's National Marine Fisheries Service (NMFS) in the early 1990's. However, there is a lack of metadata describing the sample data sets, analytical techniques, and the strength of the regression equations that provided the basis for these original conversion factors and they have not been updated and/or validated since. Additionally, there are some

variations in conversion factors used among Gulf of Mexico partners. These inconsistencies may result in uncertainty when comparing landings among partners.

The standardization and validation of currently used conversion factors are vital in depicting fishery trends and will result in more reliable data for use in stock assessments, state and regional quota monitoring, evaluation of the effectiveness of fishery management plans, and data analysis across different fishery management agencies. It is imperative that conversion factors used by fishery managers are accurate and routinely validated in order to provide the most reliable description of commercial landings of finfish and shellfish. This project fits into the FIN Development and Quality Management funding priorities. Developing more accurate commercial conversion factors will not only strengthen GulfFINs ability to provide high quality data for stock assessments, but will also collaboratively result in a standardized method that will be applied to additional species in the future as funding can be obtained.

History

No previous funding for this project in the Gulf of Mexico has been provided. A similar study was conducted in 2011-2012 by ACCSP and participating state partners along the Atlantic Coast. This proposed project will be similar in scope, with exception that the previous study focused on finfish and shellfish, while the current proposed study will focus primarily on snapper, grouper, and Black Drum.

Methodology

In order to validate and update historically used conversion factors provided by NMFS to convert landed product weights to whole fishery product weight, Gulf of Mexico State Partners individually collected and processed commercial fish species (i.e. snapper, grouper, tilefish, and Black Drum) to estimate conversion factors. Each State Partner attempted to acquire their target fish species through various means under direction of their own state's rules for sample acquisition. Due to seasonal or geographic availability, each state focused on the fish species that they might be able to acquire with reasonable certainty to achieve the proposed sample sizes in this study. For the purpose of this study, the target sample sizes for each state for each snapper, grouper, tilefish, and black drum species was 200 individual measurements. Black Drum was the target species for Louisiana, and Red Snapper was the target species for each state; however, each state had the ability to collect and process other commercially important snapper, grouper, and tilefish species if locally available.

To ensure we obtained adequate and consistent samples, landings data for target snapper, grouper, and Black Drum species were inspected for each state to identify locations and seasons when samples could be collected. Attempts to obtain unprocessed (whole) snapper, grouper, and Black Drum directly from wholesale seafood dealers or Gulf commercial fishing boats were made; however, some fishers forgot to keep some of their catch whole at times hampering the project. To supplement samples, additional Red and Vermilion Snapper samples in Texas were obtained from previous fishery independent surveys by the Harte Research Institute for Gulf of Mexico Studies (HRI). For each individual fish, at least one length

(standard, fork, or total length) was taken to the nearest mm. The whole weight was measured to the nearest 0.01 kg on a digital scale, the fish were gutted, and then a gutted weight was obtained from the same scale (to nearest 0.01 kg). Each State Partner provided their collected data for compilation, so that the combined data could be QA/QC'd together.

Once the measurement data was obtained, checks for errors and outliers were conducted. Outliers (errors due to data entry or transcription) were identified by visualizing the regression of the measured variables. Any data points that appeared to be well outside the relationship were submitted back to the State Partners to check original data sheets for confirmation. If an error was not resolved, the data point was removed. Also, the assumption was made that the ratio of whole weight/gutted weight was greater than 1 (i.e. the gutted weight must be less than the whole weight). If the ratio was equal to or less than 1, the data was checked for errors and removed if there was no resolution. The fit of the collected data for the relationship between fish whole weight and gutted weight was estimated through linear regression, with regression equations and their R^2 values obtained.

The conversion factor was estimated through analysis of the mean ratios between whole weight and gutted weight. The final conversion factors were estimated from the data by calculating the ratio of the means (mean[y]/mean[x]) of the whole and gutted weight for each fish species using the SURVEYMEANS procedure in SAS, which also provided associated estimates of standard error, variance, and confidence limits for the factor (ratio). Also, the results of the linear regression (R^2) of whole (y) and gutted (x) weight were used to assess the suitability of the conversion factor for these fish species, and were compared to current conversion factors in use for these species. Additionally, alternate linear regression equations were calculated by constraining the y-intercept to zero, which was a method that NOAA used previously for other conversion factors and we also used to compare to the ratio of means results.

Results

During the project sampling period, 3,137 samples were collected for 8 snapper species, 537 samples were collected for 6 grouper species, 301 samples were collected for Black Drum, 92 samples were collected for tilefish species and 47 samples were collected for Atlantic Sharpnose by the Gulf State Partners (Table 1). Each State Partner collected samples at various times during a period from September 2021 to September 2023; however, the fishery independent samples of Red Snapper (N=1,765) and Vermilion Snapper (N=44) obtained from HRI were originally collected from 2014 to 2018 in Texas offshore waters. Since the original dataset from HRI was not obtained by commercial fishers, the Red Snapper analyses were filtered to only include commercially legal-sized samples (13" TL), which was determined to be 305 mm FL from TL-FL regressions. So, only Red Snapper $\geq$ 305 mm FL were included in the analysis. The sample size target for each state for each species was 200 measurements; however, due to unforeseen seasonal conditions affecting availability of some species, not all targets were met. There was also opportunistic sampling of some grouper and snapper species. Samples sizes for individual species across all State Partners ranged from 1 to 2,673 (Table 2).

Results of the linear regression analysis for the whole to gutted weight relationships for each species show a good fit of the collected data, with a high R^2 (Table 2, Figures 1-17). R^2 values for the whole to gutted weight relationship of each linear regression ranged from 0.99 to 1.00, with the exception of Atlantic Sharpnose Shark (R^2=0.92). Results of the linear regressions with the intercept constrained to zero were similar to the results of calculating the conversion factor using the ratio of means (Proc SuveyMeans method). When comparing the two methods, the differences between the regression slope and the ratio of means estimate for all species ranged from 0.000 to 0.005 (Table 2).

Conversion factor estimates using the ratio of means (mean[y]/mean[x]) for whole and gutted weight of each fish species varied between State Partners and from the original factor being used across the Gulf (Table 2). For example, the original factor being used for Red Snapper (and all other snapper) is 1.11; however, while some state to state differences were found, the estimates of the new factor based on each states' own Red Snapper samples were lower in each case than the original value and varied between 1.041 and 1.061, with an overall combined value of 1.059 (N = 2,673; Figure 18). In another example, the original factor being used for Vermilion Snapper again is 1.11; however, each state's values were lower in each case than the original value and varied between 1.055 and 1.073, with an overall combined value of 1.066 (N = 413; Figure 19). There was a significant difference found in factor estimates between some states for Red Snapper. Specifically, factor estimates from Red Snapper collected in Louisiana were lower than the other states (Figure 18). There was also a seasonal (monthly) difference in conversion factors for Red Snapper, with June-July being slightly higher than winter months, likely due to a combination of gonad production for spawning and possibly gut fullness (Figure 20). However, neither gonads nor gut contents were weighed in this study.

Table 1. Comprehensive list of fish sampled by each state for Gutted to Whole Weight conversion factor analysis. Species noted in red text had a combined sample size less than 10 and indicated a species that an alternate conversion factor was used based on the morphometrically closest genus/species.

Fish Species	AL	FL	LA	MS	TX	Combined
Drum, Black	0	0	301	0	0	301
Grouper, Black	0	6	0	0	0	6
Grouper, Gag	0	144	0	0	0	144
Grouper, Red	0	140	0	0	0	140
Grouper, Scamp	0	14	0	0	0	14
Grouper, Snowy	0	190	0	0	0	190
Grouper, Yellowedge	0	1	0	0	42	43
Sharpnose, Atlantic	0	47	0	0	0	47
Snapper, Blackfin	0	3	0	0	0	3
Snapper, Gray	0	25	0	0	0	25
Snapper, Lane	0	2	0	0	0	2
Snapper, Mutton	0	1	0	0	0	1
Snapper, Red	417	156	131	0	1,969	2,673

Snapper, Silk	0	4	0	0	0	4
Snapper, Vermilion	220	32	0	0	161	413
Snapper, Yellowtail	0	16	0	0	0	16
Tilefish	0	75	0	0	0	75
Tilefish, Blueline	0	17	0	0	0	17
Total sampled	**637**	**873**	**432**	**0**	**2,172**	4,114

Table 2. Overall State Partner conversion factor results. The "Estimated Factor" was estimated using the SAS SurveyMeans ratio of Whole to Gutted Weight, which includes the Lower and Upper 95% confidence limits (LCL,UCL). Linear regression results (Regression = slope; Whole WT = slope x Gut WT + Intercept) for both unconstrained and constrained to intercept of zero are provided.

Species	N	Original Factor	Estimated Factor	Lower 95% CL	Upper 95% CL	Regression	Intercept	R^2	Regression (Int = 0)	R^2 (Int = 0)
Drum, Black	301	1.14	1.132	1.125	1.138	1.135	-0.012	0.996	1.133	0.998
Grouper, Black	6	1.18	1.053	1.049	1.058	1.054	-0.007	1.000	1.054	1.000
Grouper, Gag	144	1.18	1.071	1.063	1.079	1.067	0.026	0.987	1.070	0.998
Grouper, Red	140	1.18	1.050	1.047	1.054	1.051	-0.002	0.998	1.051	1.000
Grouper, Scamp	14	1.18	1.040	1.025	1.056	1.014	0.073	0.998	1.035	1.000
Grouper, Snowy	190	1.18	1.065	1.061	1.068	1.066	-0.003	0.999	1.065	1.000
Grouper, Yellowedge	43	1.18	1.049	1.046	1.052	1.047	0.016	1.000	1.048	1.000
Sharpnose, Atlantic	47	1.39	1.143	1.129	1.157	1.125	0.053	0.917	1.143	0.998
Snapper, Blackfin	3	1.11	1.053	1.049	1.058	1.059	-0.011	1.000	1.053	1.000
Snapper, Gray	25	1.11	1.065	1.048	1.083	1.047	0.024	0.994	1.061	0.999
Snapper, Lane	2	1.11	1.071	1.071	1.071	1.071	0.000	1.000	1.071	1.000
Snapper, Mutton	1	1.11	1.062							
Snapper, Red	2,673	1.11	1.059	1.058	1.060	1.055	0.009	0.999	1.058	1.000
Snapper, Silk	4	1.11	1.044	1.019	1.069	1.012	0.063	0.997	1.042	1.000
Snapper, Vermilion	413	1.11	1.065	1.062	1.068	1.075	-0.006	0.997	1.067	0.999
Snapper, Yellowtail	16	1.11	1.074	1.062	1.086	1.088	-0.014	0.998	1.076	1.000
Tilefish	75	1.12	1.065	1.056	1.073	1.059	0.012	0.996	1.064	0.999
Tilefish, Blueline	17	1.12	1.040	1.033	1.046	1.031	0.023	0.997	1.039	1.000

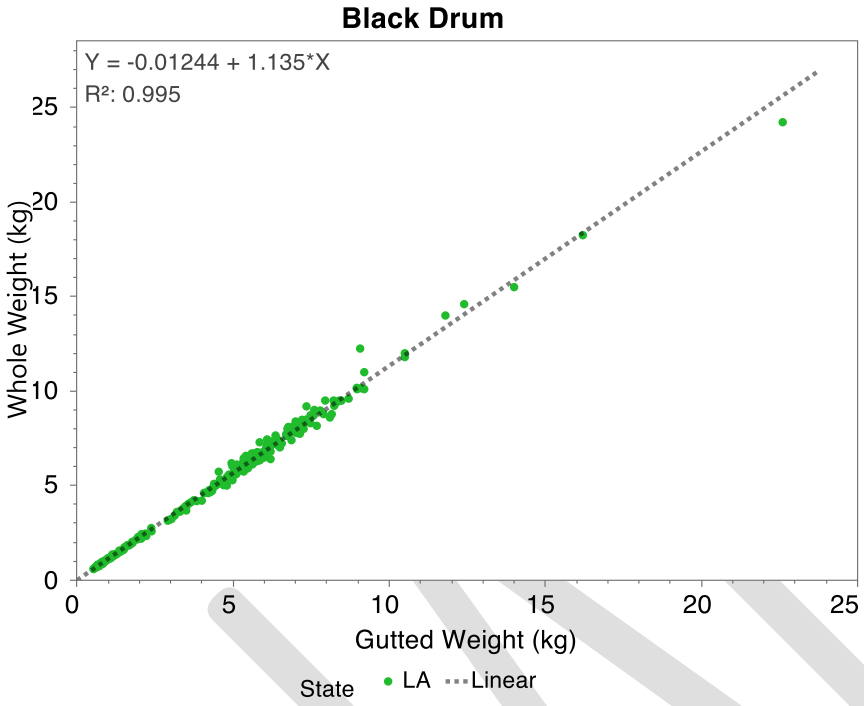

Figure 1. Linear regression analysis of Black Drum gutted to whole weight relationship for each State Partner's samples.

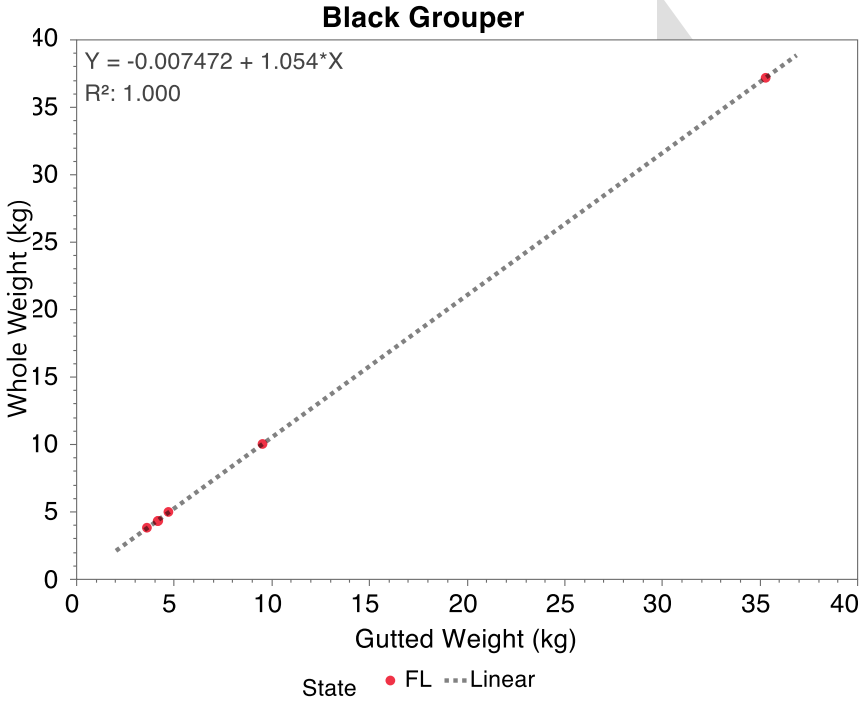

Figure 2. Linear regression analysis of Black Grouper gutted to whole weight relationship for each State Partner's samples.

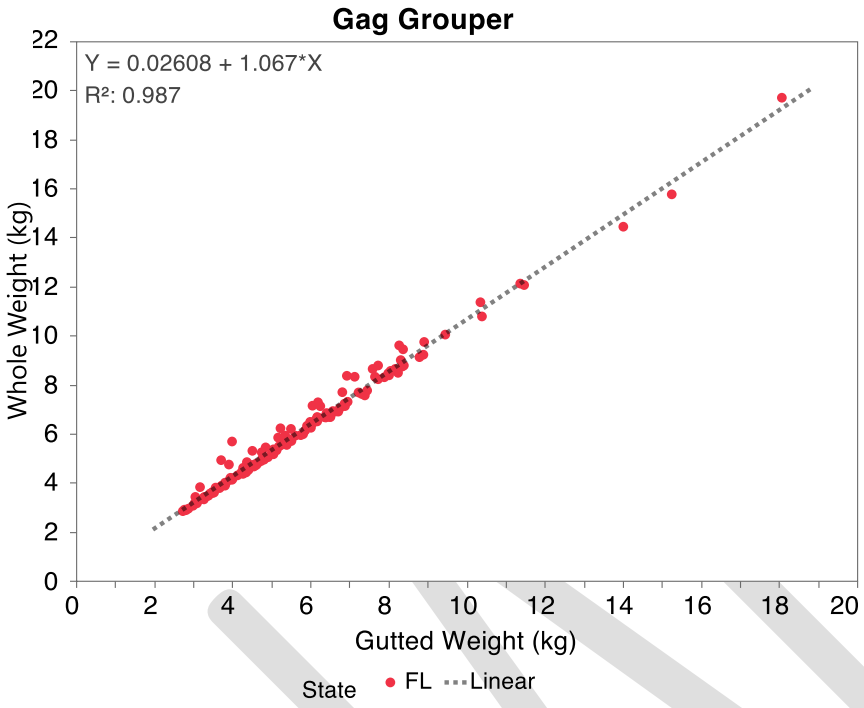

Figure 3. Linear regression analysis of Gag Grouper gutted to whole weight relationship for each State Partner's samples.

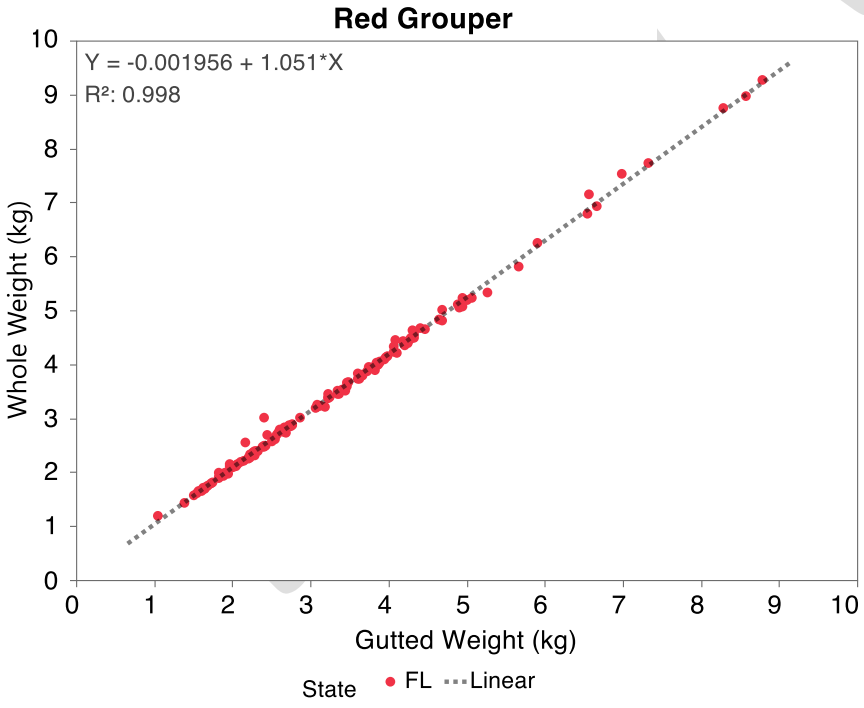

Figure 4. Linear regression analysis of Red Grouper gutted to whole weight relationship for each State Partner's samples.

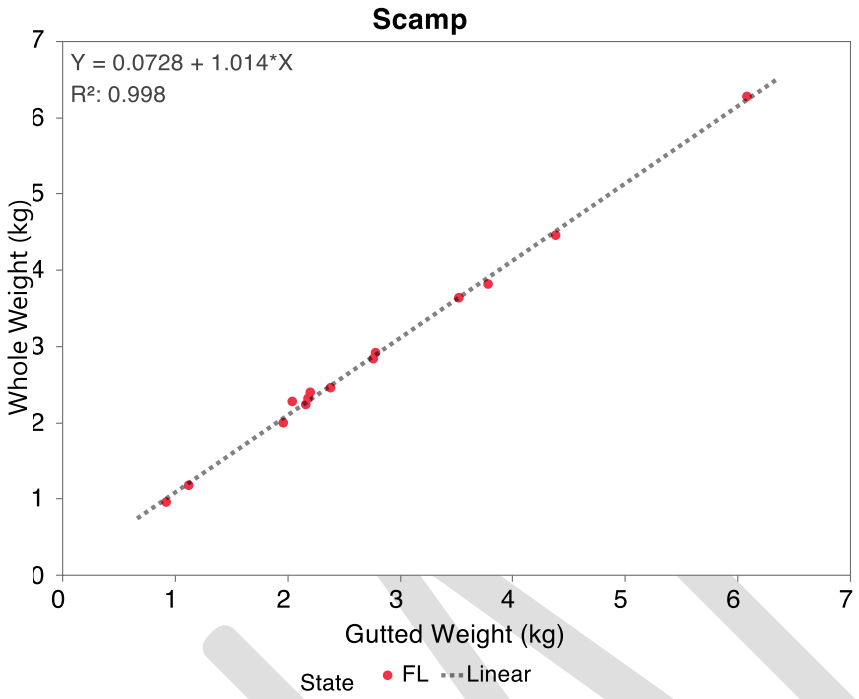

Figure 5. Linear regression analysis of Scamp Grouper gutted to whole weight relationship for each State Partner's samples.

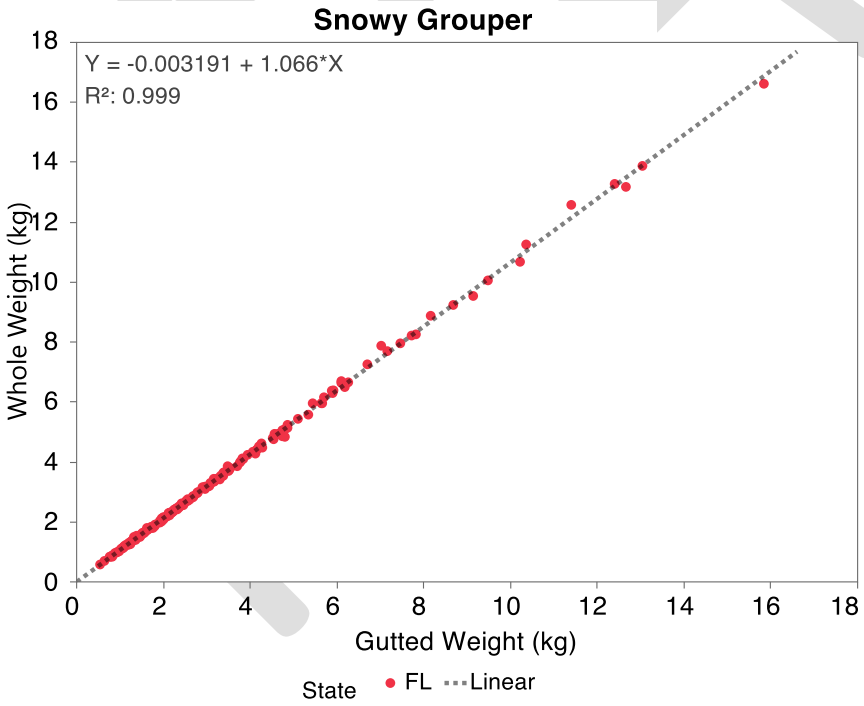

Figure 6. Linear regression analysis of Snowy Grouper gutted to whole weight relationship for each State Partner's samples.

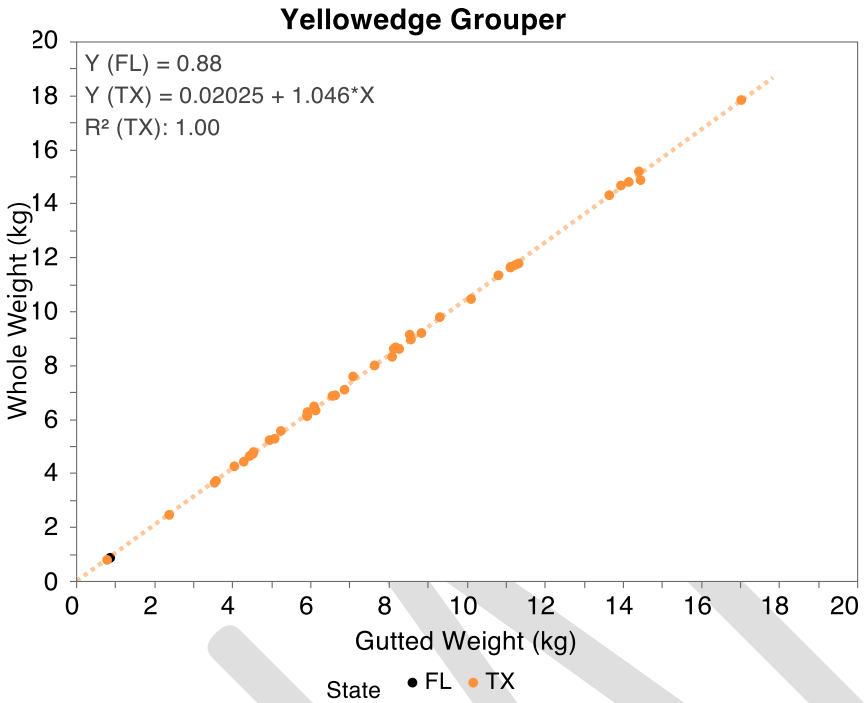

Figure 7. Linear regression analysis of Yellowedge Grouper gutted to whole weight relationship for each State Partner's samples.

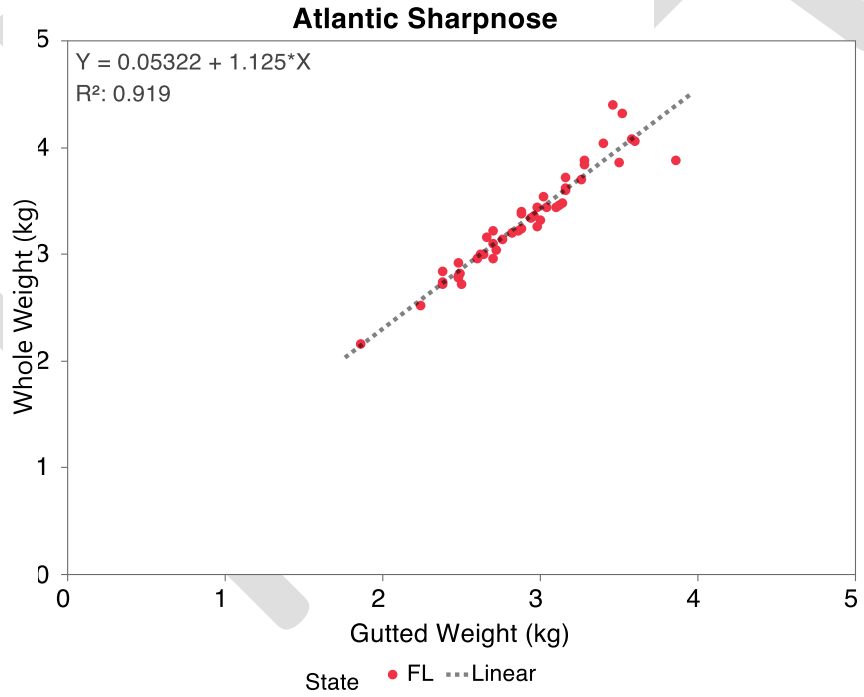

Figure 8. Linear regression analysis of Atlantic Sharpnose gutted to whole weight relationship for each State Partner's samples.

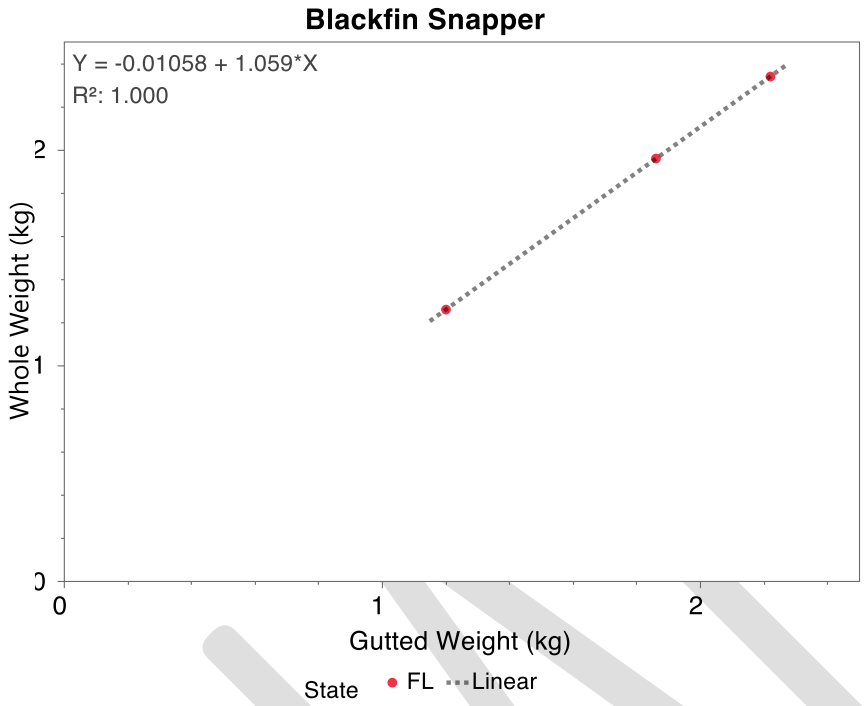

Figure 9. Linear regression analysis of Blackfin Snapper gutted to whole weight relationship for each State Partner's samples.

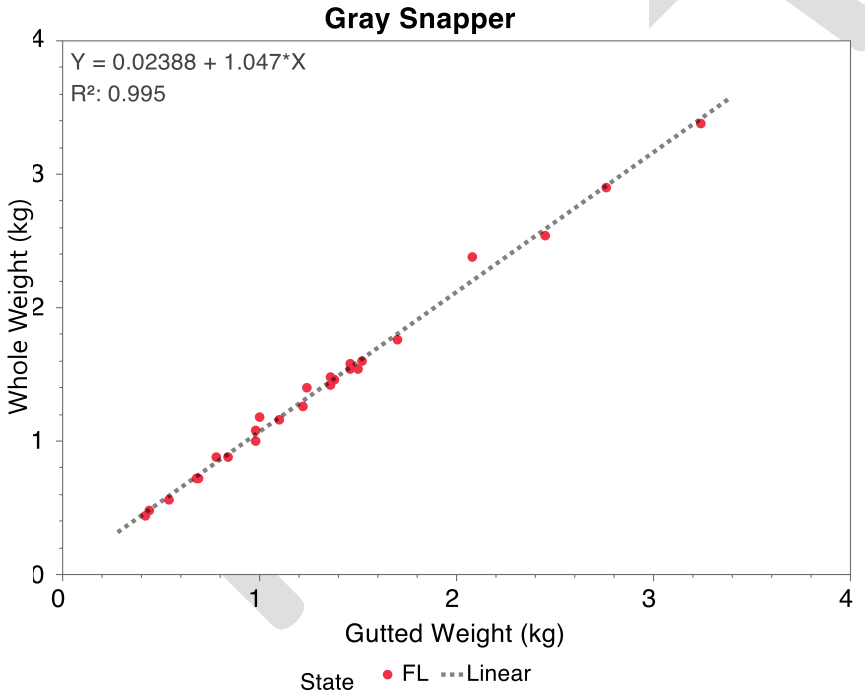

Figure 10. Linear regression analysis of Gray Snapper gutted to whole weight relationship for each State Partner's samples.

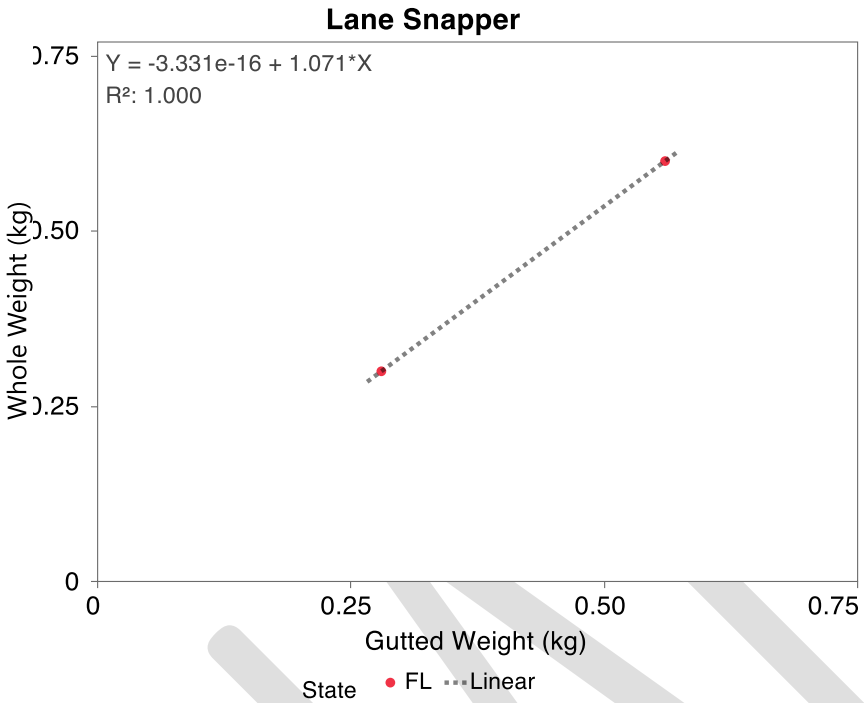

Figure 11. Linear regression analysis of Lane Snapper gutted to whole weight relationship for each State Partner's samples.

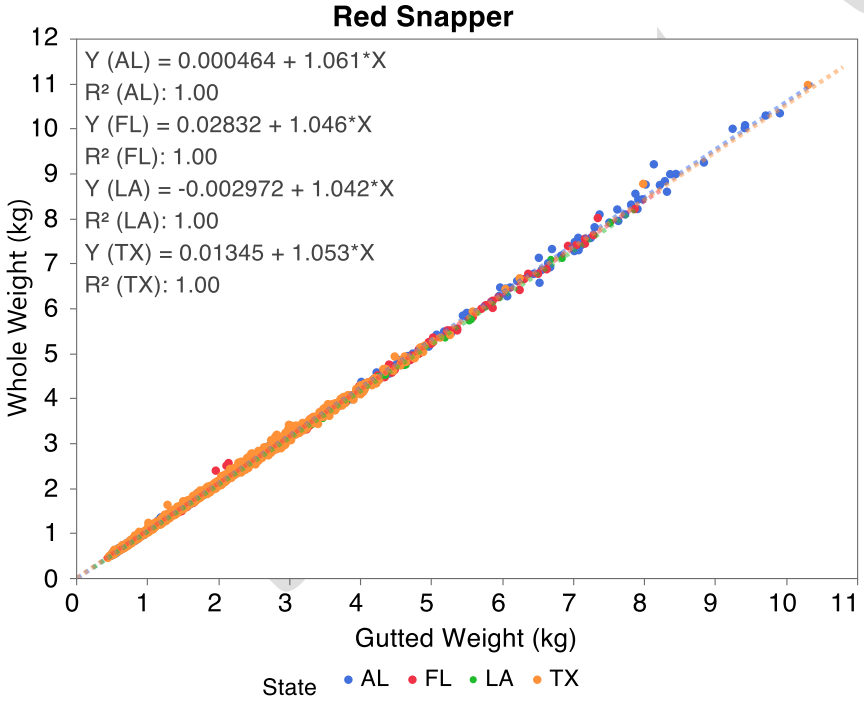

Figure 12. Linear regression analysis of Red Snapper gutted to whole weight relationship for each State Partner's samples.

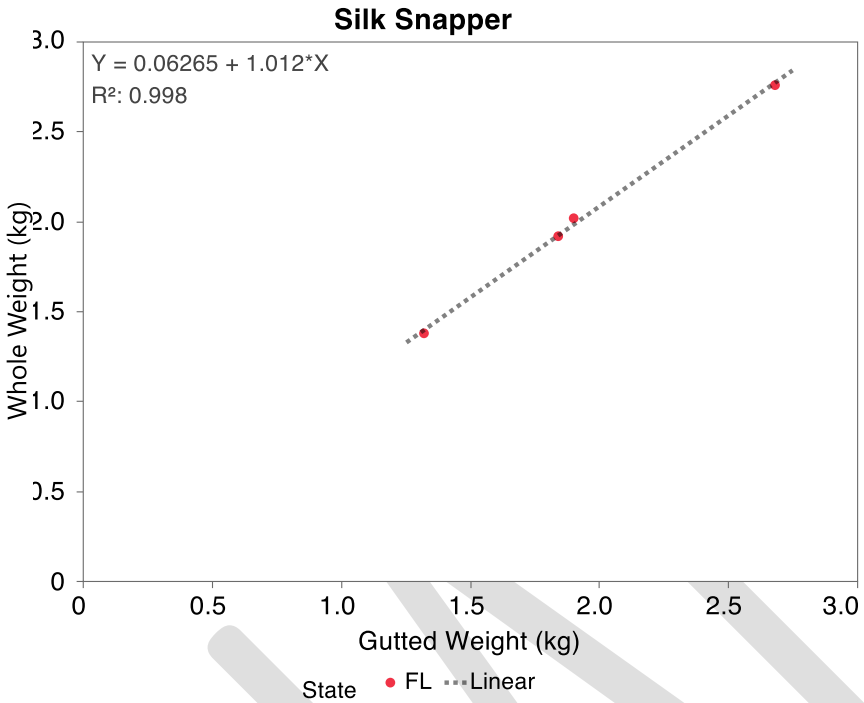

Figure 13. Linear regression analysis of Silk Snapper gutted to whole weight relationship for each State Partner's samples.

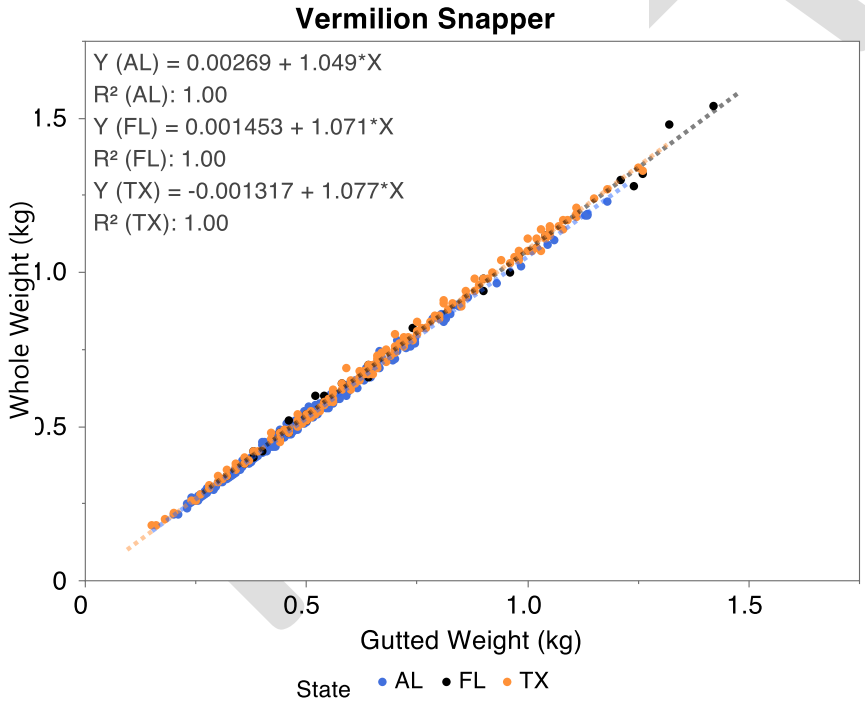

Figure 14. Linear regression analysis of Vermilion Snapper gutted to whole weight relationship for each State Partner's samples.

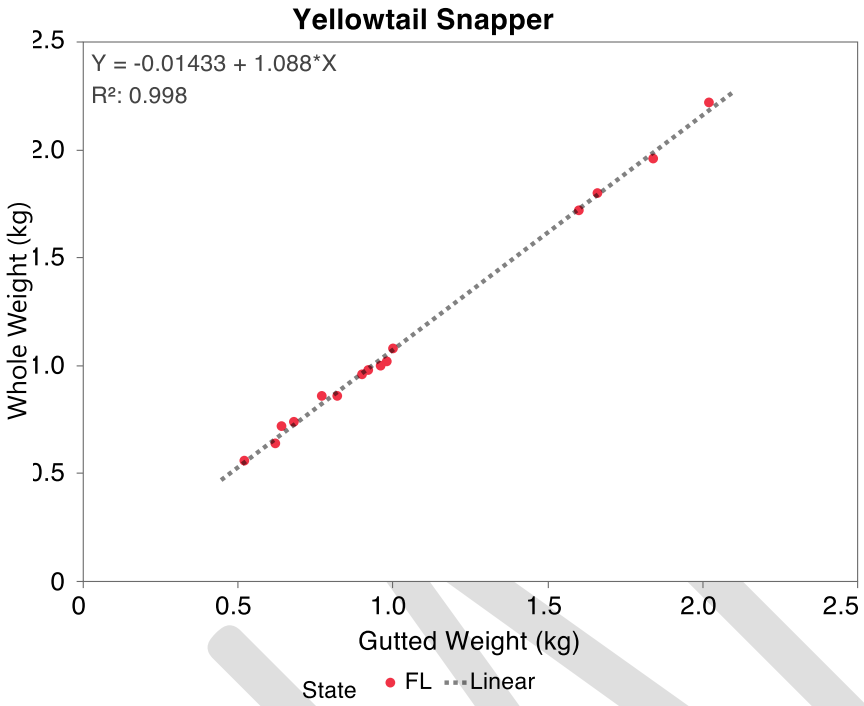

Figure 15. Linear regression analysis of Yellowtail Snapper gutted to whole weight relationship for each State Partner's samples.

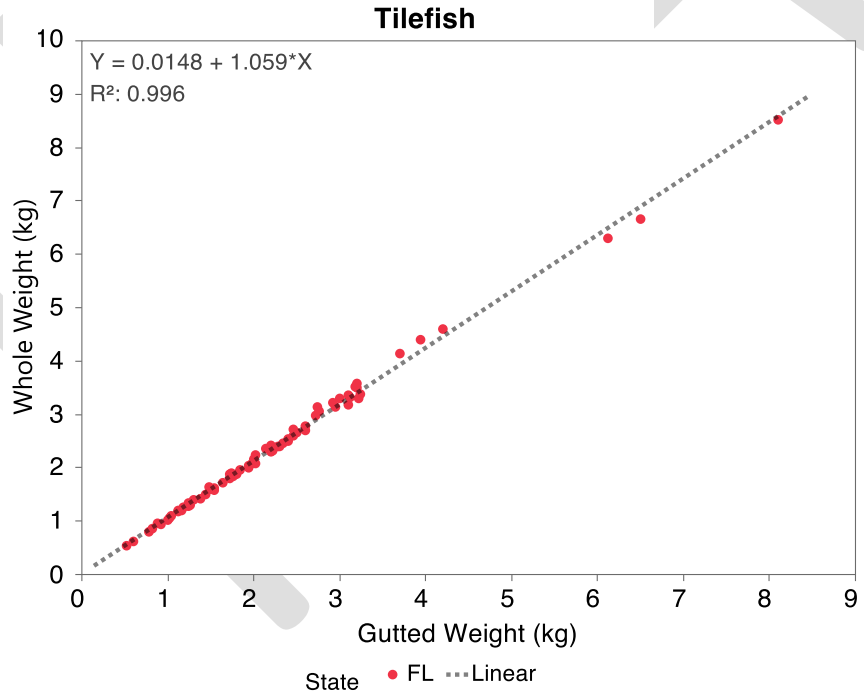

Figure 16. Linear regression analysis of Tilefish gutted to whole weight relationship for each State Partner's samples.

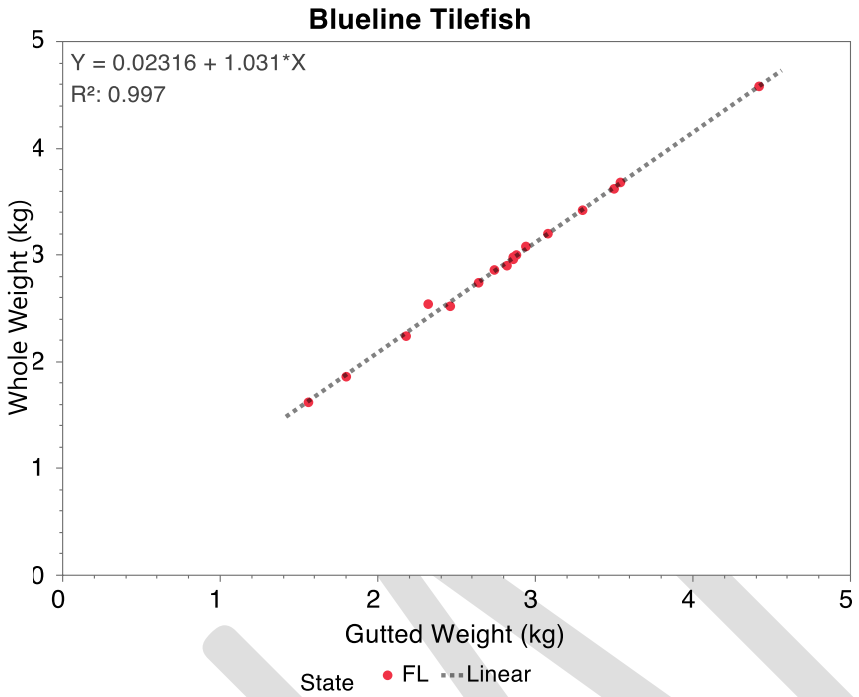

Figure 17. Linear regression analysis of Blueline Tilefish gutted to whole weight relationship for each State Partner's samples.

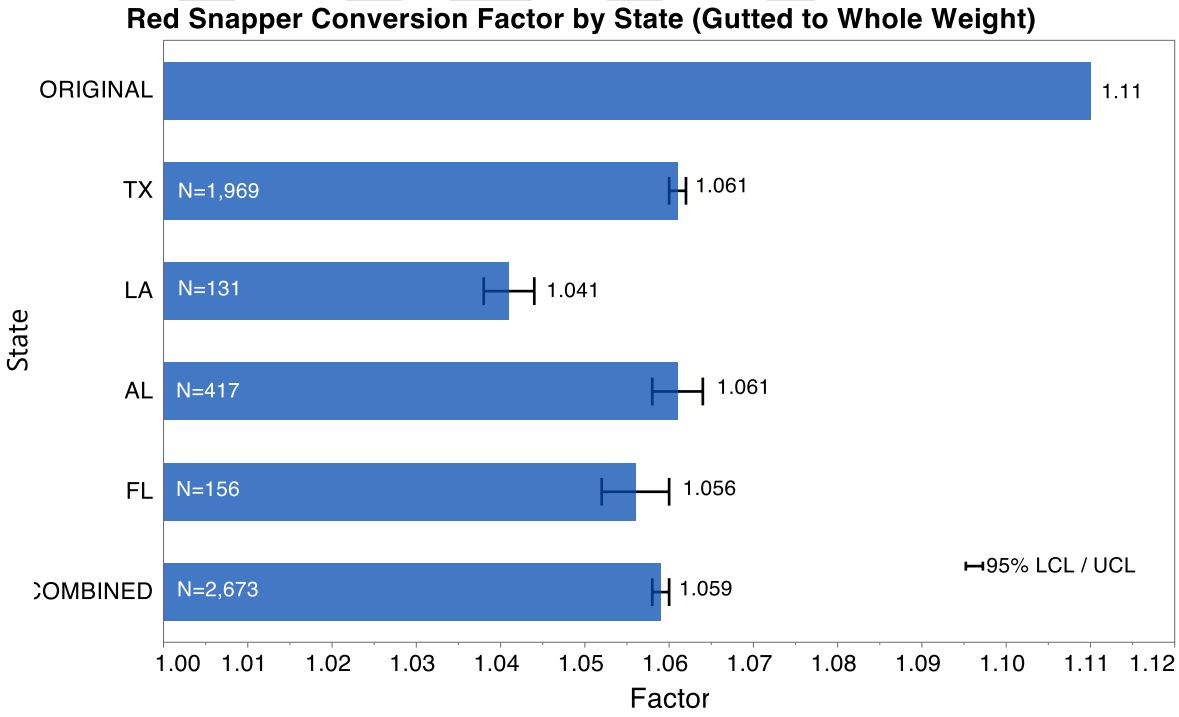

Figure 18. Comparison of each state's Red Snapper gutted to whole weight conversion factor, including the original and overall new combined factor.

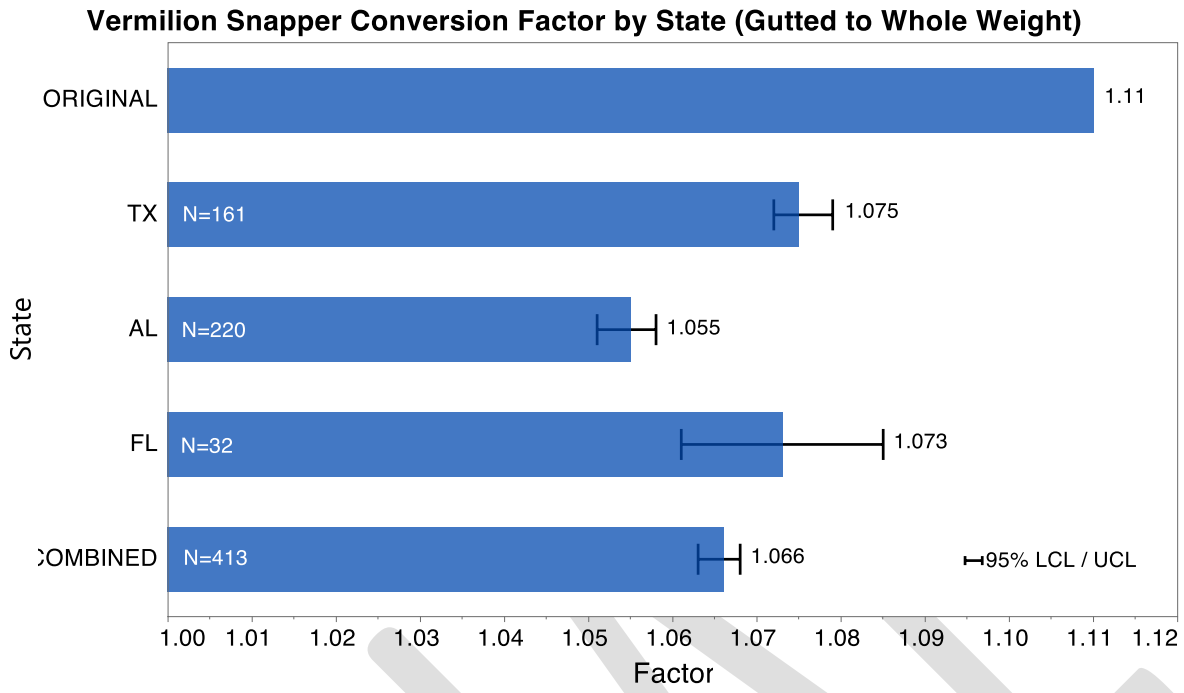

Figure 19. Comparison of each state's Vermilion Snapper gutted to whole weight conversion factor, including the original and overall new combined factor.

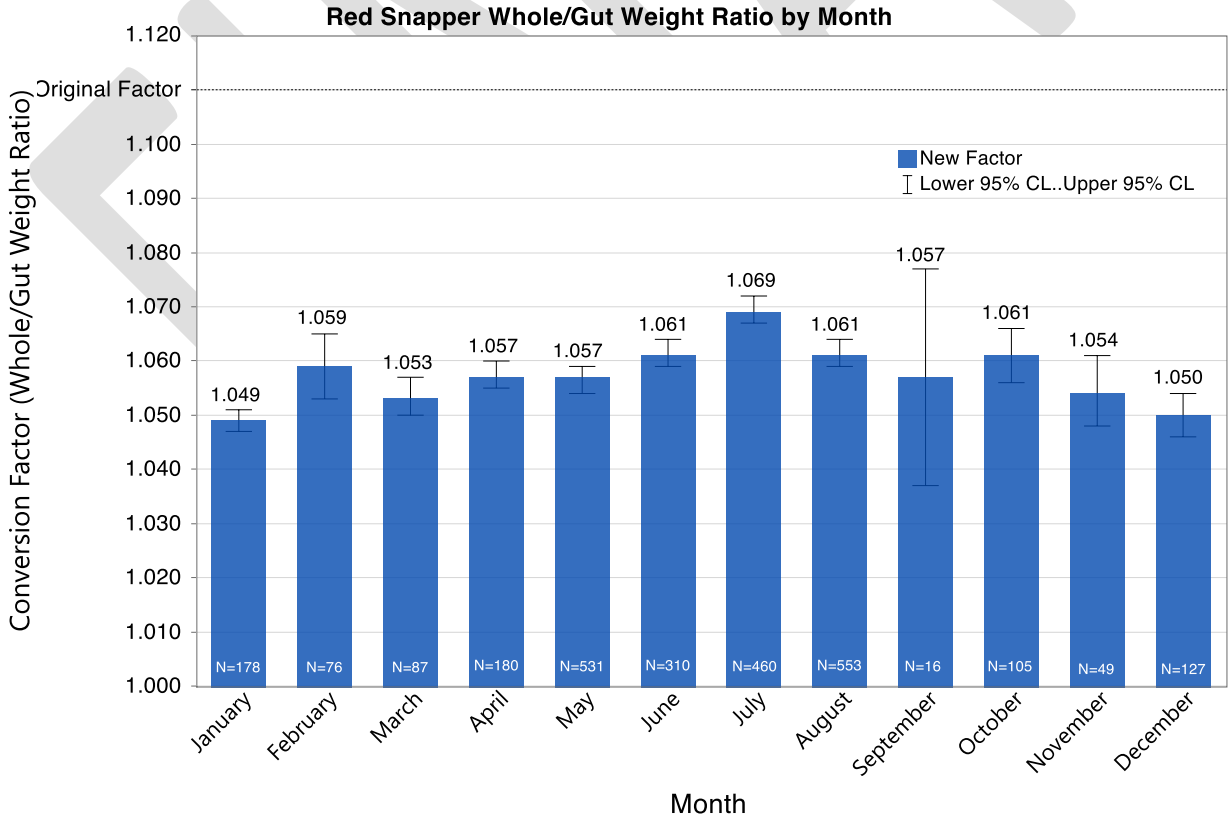

Figure 20. Comparison of estimated monthly Red Snapper gutted to whole weight conversion factors.

Recommendations for implementing calculated conversion factors:

The decision of which conversion factors to be used going forward is ultimately up to the individual states. They can choose to continue using their current conversion factors, the conversion factors calculated by their individual state or the conversion factor calculated by combining data across states (ex. Vermillion Snapper samples from TX, FL and AL). However, unless there is a biological or stock reason for using separate conversions, states should consider using the same conversions.

There were differences in Blackfin Snapper, Lane Snapper, Mutton Snapper, and Silk Snapper with Louisiana deciding to use the new factors while the rest of the Gulf state partners decided to use the Red Snapper factor on the above-mentioned species due to similar morphology. There were also differences in the start ("begin year") of use for these conversion factors, with Louisiana deciding to start using the new accepted factors beginning in 1999, while the other Gulf states partners decided to begin use in 2020. There may be some further discussions on begin year and these are subject to change.

Species	Old Factor	Accepted Factor	Factor Approval for Gulf	Begin Year	Comments
Drum, Black	1.14	1.132	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Grouper, Black	1.18	1.053	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Grouper, Gag	1.18	1.071	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Grouper, Red	1.18	1.050	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Grouper, Scamp	1.18	1.040	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Grouper, Snowy	1.18	1.065	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Grouper, Yellowedge	1.18	1.049	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Sharpnose, Atlantic	1.39	1.143	MS, AL, FL LA	Jan 1 2020 Jan 1 1999	TX does not have a gutted condition for Atlantic Sharpnose.
Snapper, Blackfin	1.11	Using Red Snapper 1.059 Using Combined 1.053	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	Similar morphology to Red Snapper - use Red Snapper factor until more data is collected Use combined factor until more data is collected
Snapper, Gray	1.11	1.065	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Snapper, Lane	1.11	Using Red Snapper 1.059 Using Combined 1.071	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	Similar morphology to Red Snapper - use Red Snapper factor until more data is collected Use combined factor until more data is collected

Species	Old Factor	Accepted Factor	Factor Approval for Gulf	Begin Year	Comments
Snapper, Mutton	1.11	Using Red Snapper 1.059	TX, MS, AL, FL	Jan 1 2020	Similar morphology to Red Snapper - use Red Snapper factor until more data is collected
		Using Combined 1.062	LA	Jan 1 1999	Use combined factor until more data is collected
Snapper, Red	1.11	1.059	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Snapper, Silk	1.11	Using Red Snapper 1.059	TX, MS, AL, FL	Jan 1 2020	Similar morphology to Red Snapper - use Red Snapper factor until more data is collected
		Using Combined 1.044	LA	Jan 1 1999	Use combined factor until more data is collected
Snapper, Vermilion	1.11	1.065	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Snapper, Yellowtail	1.11	1.074	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Tilefish	1.12	1.065	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	
Tilefish, Blueline	1.12	1.040	TX, MS, AL, FL LA	Jan 1 2020 Jan 1 1999	