Interstate Fisheries Management Program Implementation for North Carolina

North Carolina Commercial Statistics System Enhancement

July 2005-June 2010

Pilot Study of Conversion Factors Used by the North Carolina Trip Ticket Program

North Carolina Department of
Environment and Natural Resource
Division of Marine Fisheries
Morehead City, NC 28557

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for the

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ABSTRACT

Funds received from the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) were used to help conduct a preliminary study to evaluate and validate the conversion factors used by the North Carolina Trip Ticket Program (NCTTP). Conversion factors are typically used to convert landings of finfish and shellfish into whole pounds or pounds of meat when the commercial harvest is landed in processed form or in differing marketing units (such as bushels). During this study 3,241 samples were obtained from 26 different species. Species sampled were mainly from the snapper-grouper complex and shellfish. For species with adequate samples sizes, preliminary analyses were conducted and comparisons were made between currently used conversion factors and the estimated conversion factors from this study. The preliminary results of this study indicate that some of the conversion factors used by the NCTTP may need to be updated and may not be reflecting the true relationship between whole pounds and landed pounds. More detailed work and an expansion in sampling will be needed to do a complete review of the conversion factors used by the NCTTP.

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INTRODUCTION

The North Carolina Division of Marine Fisheries Trip Ticket Program (NCTTP) began on 1 January 1994 (Lupton and Phalen 1996; Watterson 1999; Sabo 2001). Prior to the implementation of the NCTTP, commercial statistics and harvest data were collected under the National Marine Fisheries Service (NMFS)/North Carolina Cooperative Statistics Program (Sabo 2001; Lupton and Phalen 1996). The NCTTP was initiated due to a decrease in cooperation in reporting under the voluntary NMFS/North Carolina Cooperative Statistics Program in place prior to 1994, as well as an increase in demand for complete and accurate trip-level commercial harvest statistics by fisheries managers (Sabo 2001; Watterson 1999; Lupton and Phalen 1996). The detailed data obtained through the NCTTP allow for the calculation of effort (i.e. trips, licenses, fishermen, vessels) in a given fishery that was not available prior to 1994 and provide a more accurate record of North Carolina's commercial seafood harvest.

Funds from the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) have been awarded to the North Carolina Division of Marine Fisheries (NCDMF) since 1995 and have been used to improve, enhance, and support the NCTTP. A number of improvements have been made to the NCTTP, including an increase in the number of variables collected, and the methods to process, store and analyze the data. Significant enhancements in SAS© programs have also been developed that have led to more accurate linkages between the NCTTP data and NCDMF license data that improve efficiency in processing analyses and explore new analytical techniques. These enhancements have enabled the state of North Carolina to meet the increased demands for summarized fisheries statistics by making these data available to agencies and individuals, for the development of fisheries management plans, use in stock assessments, determining effective management strategies, and analyzing trends in landings and effort.

A large portion of the state's commercial fishery harvest is processed at sea (such as gutting or heading) or uses other units of measure (such as bushels, bags, or baskets) instead of reporting by poundage. Conversion factors are commonly applied to commercially landed units of finfish and shellfish to determine the whole weight of commercially harvested finfish or shellfish by poundage. The conversion factors the NCTTP currently employ were those historically provided by NMFS (Hesselman and Kemp 2006). However, these conversion factors have not been evaluated or validated since the early 1980s in North Carolina and only limited documentation can be found (NMFS 1990).

Commercial landings data are extremely valuable to help describe the trends in a commercial fishery and for use in state and regional stock assessments. Accurate conversion factors are needed to determine the total amount of fish and shellfish landed so that the fishery can be described and assessed as accurately as possible. Conversion factors likely vary over time as the health of fish and shellfish stock changes. Likewise, conversion factors may vary seasonally (spawning seasons, months of high food abundance, etc.) and between sexes. It is has also been noted that conversion factors also vary across different states (Hesselman and Kemp 2006). Currently, no documentation exists to help describe the changes or differences in conversion factors over time, seasonally, between sexes or regionally.

In July 2008, the NCTTP began a study to evaluate the conversion factors that are currently used by the program. The new pilot study had two primary objectives:

1) Evaluate and validate the conversion factors currently employed by the NCTTP.
2) Update current documentation on conversion factors used by the NCTTP.

METHODS

PERSONNEL

In December 2008, a technician was hired to collect samples of fish and shellfish for this project and was responsible for coordinating sampling efforts between commercial fishermen and seafood dealers. To help the technician coordinate these activities, trip ticket data were analyzed by species and area to determine when selected species were typically harvested and in what counties they were landed. Trip ticket data were also analyzed on a seafood dealer and commercial fisherman basis to assist the technician in coordinating sampling efforts. From these data, the technician contacted commercial fishermen and seafood dealers to schedule dates and times for sampling. The technician would then meet the commercial fishermen at the docks to obtain as many whole samples of fish as possible which were then measured, processed according to industry standards, and measured again by the technician. Other staff assisted in the data collection. Data were then transferred to standardized coding sheets to be entered into the NCDMF biological database for analysis.

TARGETED SPECIES AND SAMPLING

This pilot study focused on obtaining samples from two primary groups: finfish that are typically processed at sea before being landed (including species from the snapper-grouper complex, king mackerel (*Scomberomorous cavalla*), swordfish (*Xiphias gladius*), tunas and sharks, and shellfish species that are typically marketed in bags, bushels, or numbers such as hard clams (*Mercenaria mercenaria*), oysters (*Crassostrea virginica*), blue crabs (*Callinectes sapidus*) and bay scallops (*Argopecten irradians*). Finfish were weighed whole to the nearest 0.01 kg on a digital scale, gutted according to industry standards, and then weighed again. Each weight was recorded along with the sex of the specimen. The total length (measured from the tip of the snout to the tip of the tail, mm), fork length (measured from the tip of the snout to the fork of the tail, mm), and standard length (measured from the tip of the snout to the peduncle of the tail, mm) for all fish were measured and other appropriate biological parameters were recorded (i.e., market grade). For shellfish species, bushels or bags of oysters/clams were purchased from various dealers located throughout the state and brought back to NCDMF to determine pounds of meat per bushel/bag while peeler and soft blue crabs were sampled at seafood dealerships. Samples of shellfish were measured with a digital caliper and were weighed to the nearest 0.1 grams. All shellfish were measured and the carapace widths (mm) for all soft and peeler blue crabs were obtained

STATISTICAL ANALYSIS

SAS® data management and analysis software was used to access and analyze these data (SAS® 2004). Proc GLM was used to run simple linear regressions on these data to determine the relationships between gutted weight and whole weight and other biological parameters. Microsoft Excel© was used to organize and summarize these data and to generate the graphics presented in this report.

Finfish Analysis

For all species that were determined to have an adequate sample size (n>=30 across all market grades or size classes combined), a simple regression analysis was used to determine

the relationship between whole weight and gutted weight of finfish. Although samples were collected across as many market grades and size classes as possible for all species, there weren't enough samples obtained within each market grade and size class to determine if size has an effect on the relationship between whole weight to gutted weight. The gutted weight to whole weight relationship was expressed with the following equation:

$$WW = x\,(GW) + b$$

where WW is the whole weight, x is the slope of the regression, GW gutted weight, and b is the intercept.

Gutted weight to whole weight conversions were determined by using the equations that were calculated from the simple regression analyses and by forcing the regression analysis to pass through the origin. By forcing the regression analysis to go through the origin, it is assumed that when the whole weight of an animal is zero and the gutted weight of the animal is zero. The gutted weight to whole weight conversion is then simply the slope of the regression, x.

Simple linear regression analyses were also used to determine the relationship between other biological parameters as well including the following: fork length to total length ($TL = x\,(FL) + b$), standard length to total length ($TL = x\,(SL) + b$), and standard length to fork length ($FL = x\,(SL) + b$), where TL equals total length, FL equals fork length, and SL equals standard length and L equals primary length (length measurement typically used to describe the species). For these relationships, the intercepts were maintained (i.e., regressions were not forced through the origin).

The relationship between length and whole weight was also analyzed. To determine the relationship between length and whole weight, the data were log transformed. Simple linear regression was then used to determine the relationship between ln(WW) and ln(L) with the following equation:

$$\ln(WW) = (\ln(a) + (b(\ln(L))$$

where ln(WW) equals natural log of whole weight, ln(L) equals natural log of the primary length (length measurement typically used to describe the species), a is the intercept, and b is the slope of the regression, and L equals the primary length.

The resulting equation was then recalculated to determine the non-linear relationship between length and weight ($WW = a * L^b$).

Shellfish Analysis

Several methods were used for shellfish samples because of the numerous units shellfish are marketed as (e.g., bushels, numbers of individuals, etc.). Hard clams, oysters, bay scallops, and blue crabs were all sampled during this pilot study. Bags of hard clams were separated by size/market grade, individuals counted, and meat weights were recorded. Bushels of oysters and scallops were counted, and meat weights were recorded. The individual whole weight (shell weight and meat weight) was measured for all hard clams, oysters and scallops. Hard clams and oysters were then "shocked" by being placed inside a freezer for approximately ten minutes, shucked, drained and then the meat weight measured. Bay scallops were shucked and meat weight and gonad weight were measured. Conversions were then calculated for

average meat weight of hard clams by size/market grade, meat weight of oysters per bushel, and the meat weight of bay scallops per bushel and then compared to conversions currently used by the NCTTP.

Samples of soft and peeler crabs were also enumerated and weight was recorded. The total number of crabs per pound, for both soft and peeler crabs was then calculated and compared to the current conversion factor used by the NCTTP. Similar to the finfish analysis, the relationship between carapace width and weight was analyzed by log transforming the data. A simple regression analysis was used to determine the relationship between ln(CW) and ln(W) for soft and peeler crabs using the equation $\ln(W) = a + b(\ln(CW))$, where W equals weight, *b* equals the slope of the regression, CW equal carapace width, and *a* equals the intercept. The resulting equation was then recalculated to determine the non-linear relationship between carapace width and weight ($W = a * CW^b$).

RESULTS

Twenty-six different species were sampled from December 2008 through October 2009 (n=3,241). The majority sampled were oysters, bay scallops, vermilion snapper (*Rhomboplites aurorubens*), hard clams, soft blue crabs, red grouper (*Epinephelus morio*), gag grouper (*Mycteroperca microlepis*), king mackerel, peeler crabs, scamp (*M. phenax*), and rock hind (*E. adscensionis*). These species accounted for over 98% of the total number of samples collected (Table 1).

Sampling occurred in the coastal fishing counties of North Carolina which are typically grouped into three districts (Figure 1). Samples were collected from all three districts, with the majority of samples from the central and southern districts. The central and southern districts accounted for 89% of the total number of samples. Samples were collected across six counties: Beaufort, Brunswick, Carteret, Dare, Hyde, and Onslow. The majority of the samples were obtained from Carteret and Brunswick counties, which accounted for 89% of the total samples (Table 2).

Samples were collected from five primary gear types: hand harvest gears (rakes, tongs, etc.), handline gears (trolling, rod-n-reel, bandit, etc.), peeler pot, oyster dredge, and longlines. The majority of the samples came from hand harvest gears and handline gears (81% (Table 3)).

FINFISH RESULTS

Vermilion Snapper

A total of 399 vermilion snapper were collected from Carteret (n=100) and Brunswick (n=299) counties during this study. Vermilion snapper were sampled across four different market grades, with the 0.5 to 1 pound and 1 to 2 pound market categories accounting for the majority of the samples [92% (Table 4)]. Vermilion snapper sampled ranged in size from 250 mm to 500 mm (Figure 2).

The gutted to whole weight conversion factor that is currently used by the NCTTP for all snappers is 1.08. The conversion factor for vermilion snapper estimated from this study was also 1.08, supporting its use by the NCTTP (Table 5 and Figures 3 and 4). The relationship

between various length measurements and between whole weight and length are reported in Tables 6 and 7 and illustrated in Figure 5.

Table 1. Total number of fish and shellfish measured and weighed.

Species	Scientific Name	Number
Oyster	*Crassostrea virginica*	1,258
Bay scallop	*Argopecten irradians*	445
Vermilion snapper	*Rhomboplites aurorubens*	399
Hard clams	*Mercenaria mercenaria*	357
Soft crabs	*Callinectes sapidus*	308
Red grouper	*Epinephelus morio*	150
Gag grouper	*Mycteroperca microlepis*	94
King mackerel	*Scomberomorous cavalla*	61
Peeler crabs	*Callinectes sapidus*	45
Scamp	*Mycteroperca phenax*	32
Rock hind	*Epinephelus adscensionis*	31
Dolphin	*Coryphaena hippurus*	12
Black grouper	*Mycteroperca bonaci*	7
Greater amberjack	*Seriola dumerili*	7
Cobia	*Rachycentron canadum*	6
Red hind	*Epinephelus guttatus*	5
Graysby	*Epinephelus cruentatus*	4
Red snapper	*Lutjanus campechanus*	4
Almaco jack	*Seriola rivoliana*	3
Hogfish	*Lachnolaimus maximus*	3
Blackfin tuna	*Thunnus atlanticus*	2
Coney grouper	*Epinephelus fulvus*	2
Swordfish	*Xiphias gladius*	2
False albacore	*Euthynnus alletteratus*	1
Glasseye snapper	*Priacanthus cruentatus*	1
Snowy Grouper	*Epinephelus niveatus*	1
Yellowfin tuna	*Thunnus albacares*	1

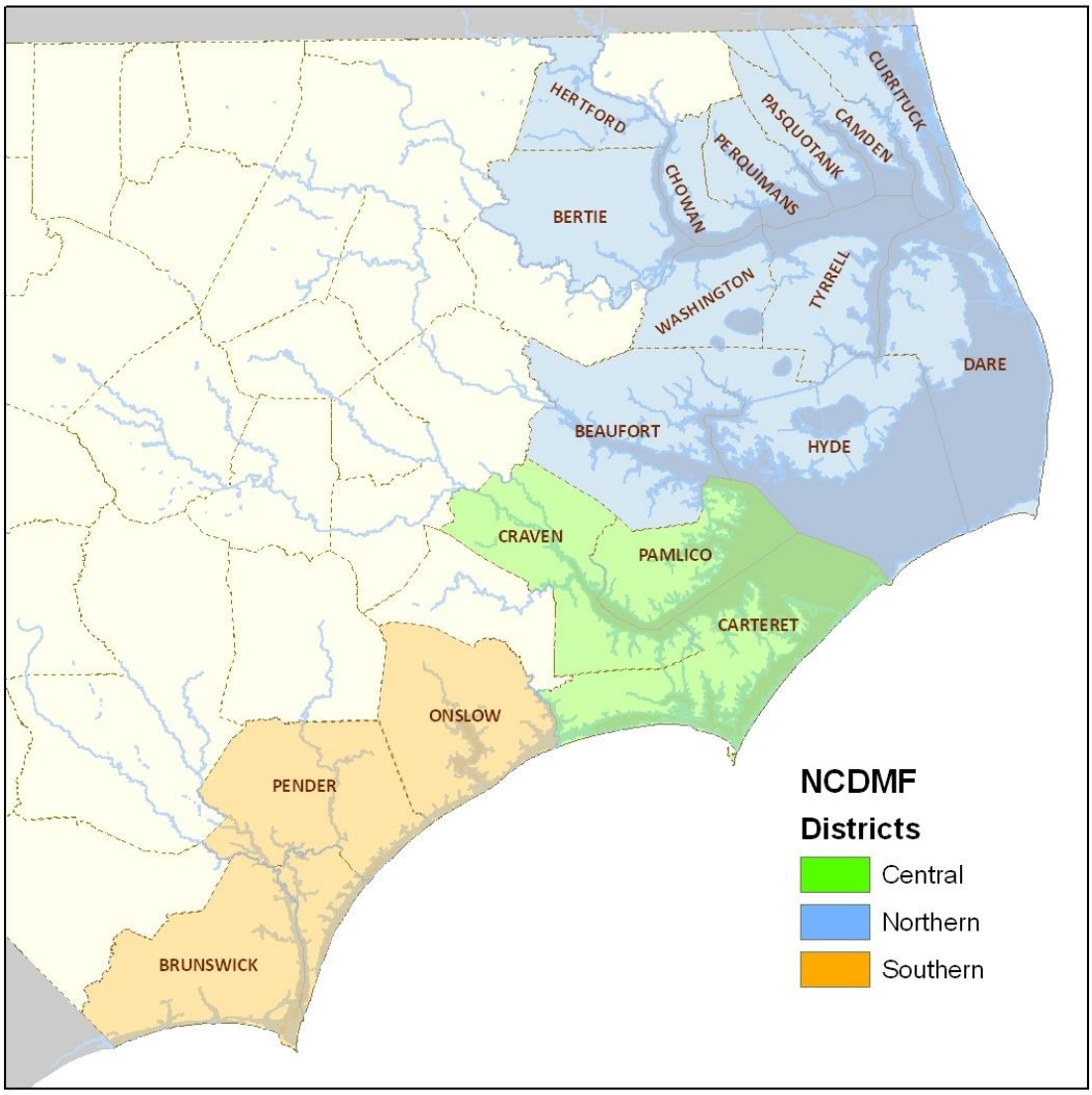

Figure 1. Map of the study area showing the North Carolina coastal fishing counties grouped into three districts.

Table 2. Total number of samples collected by district and county.

District	Beaufort	Brunswick	Carteret	Dare	Hyde	Onslow	Total
Central	0	0	1,899	0	0	0	1,899
Northern	67	0	0	1	262	0	330
Southern	0	972	0	0	0	40	1,012
Total	67	972	1,899	1	262	40	3,241

Table 3. Total number of samples collected by gear type

Gear	Samples
Hand harvest gears	1,798
Handline gears	824
Peeler pot	353
Oyster dredge	262
Longline gears	4

Table 4. Number of samples of vermilion snapper by market grade.

Market grade (lb)	Number
0.5 to 1	111
1 to 2	256
2 to 4	31
>4	1

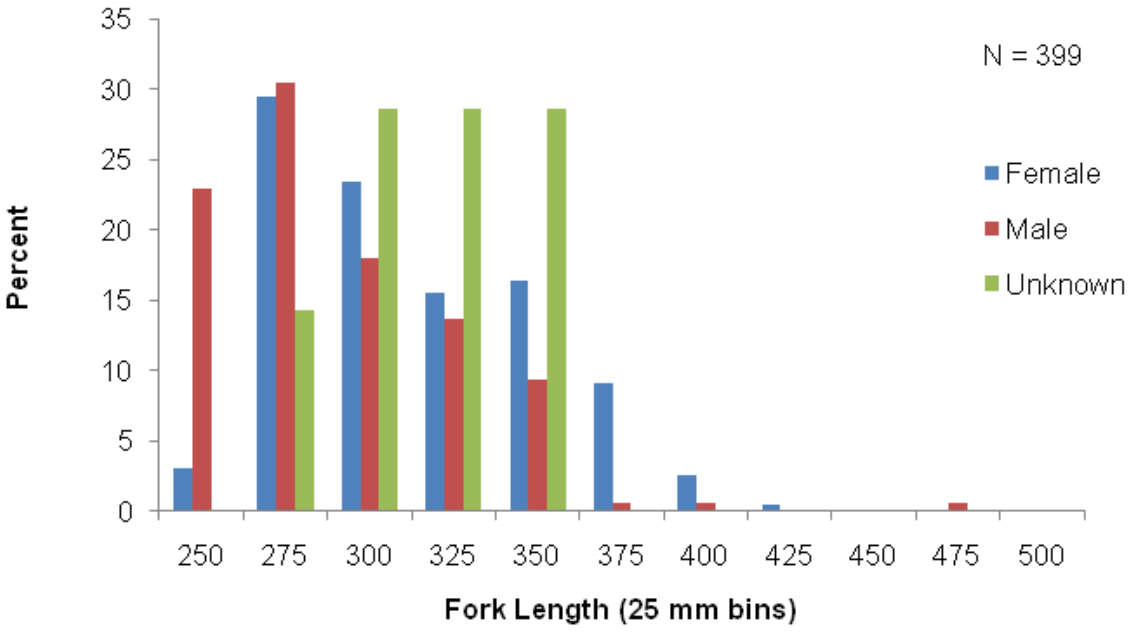

Figure 2. Length frequency (25 mm bins) for vermilion snapper.

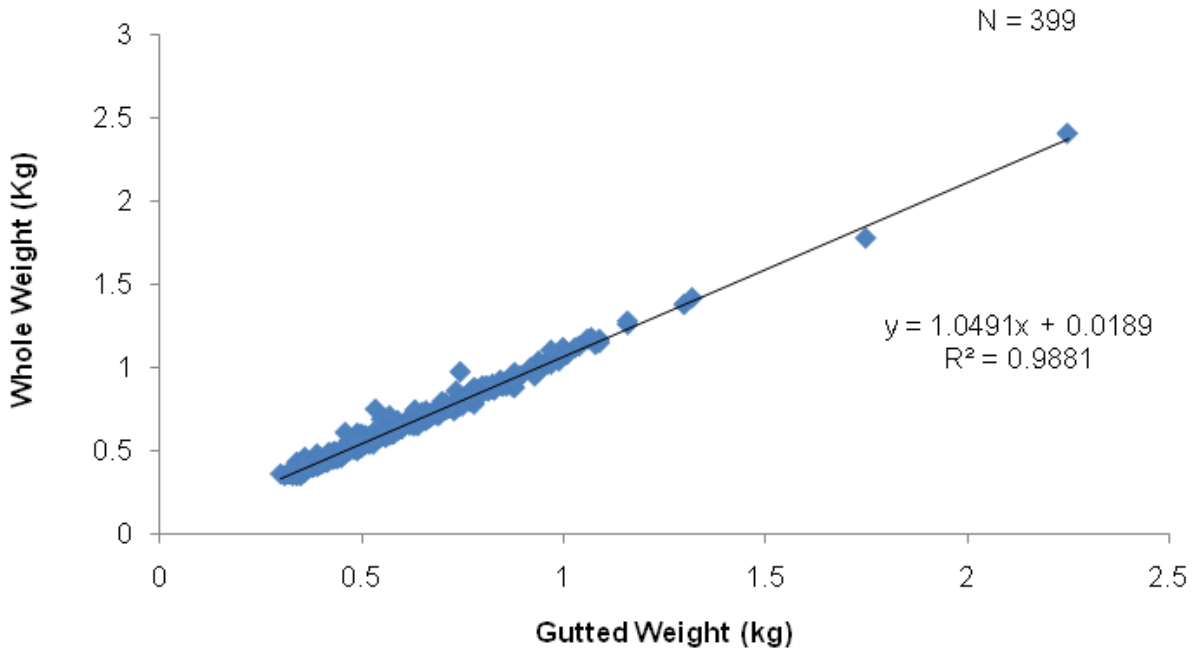

Figure 3. Gutted weight (kg) to whole weight (kg) relationship for vermilion snapper.

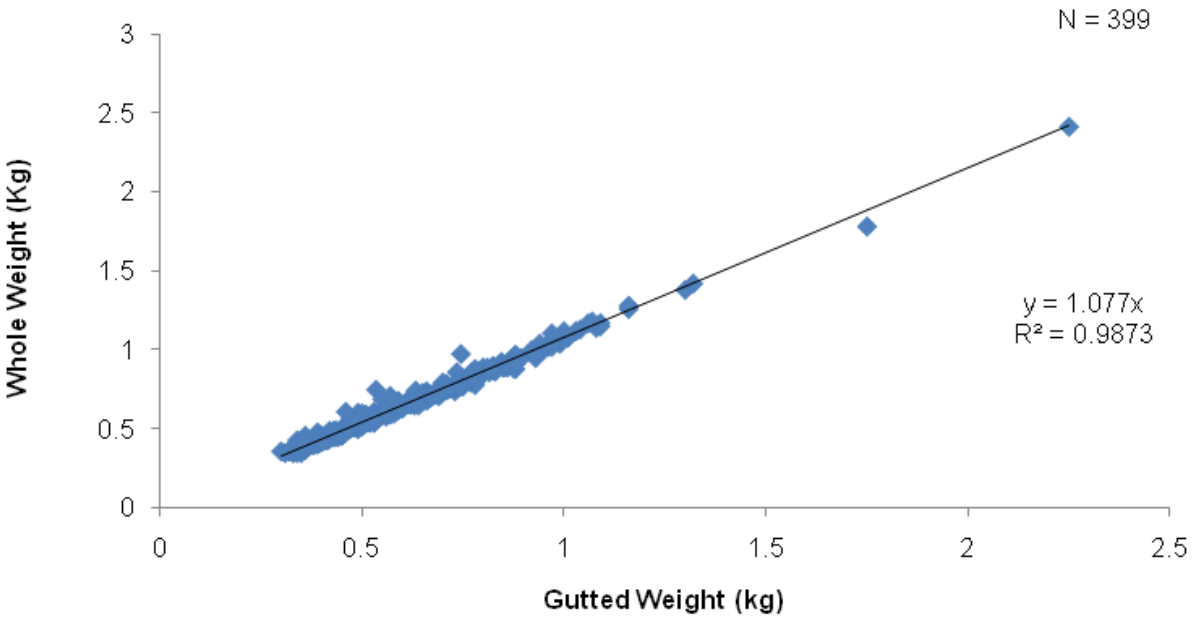

Figure 4. Gutted weight (kg) to whole weight (kg) relationship for vermilion snapper with intercept set at zero.

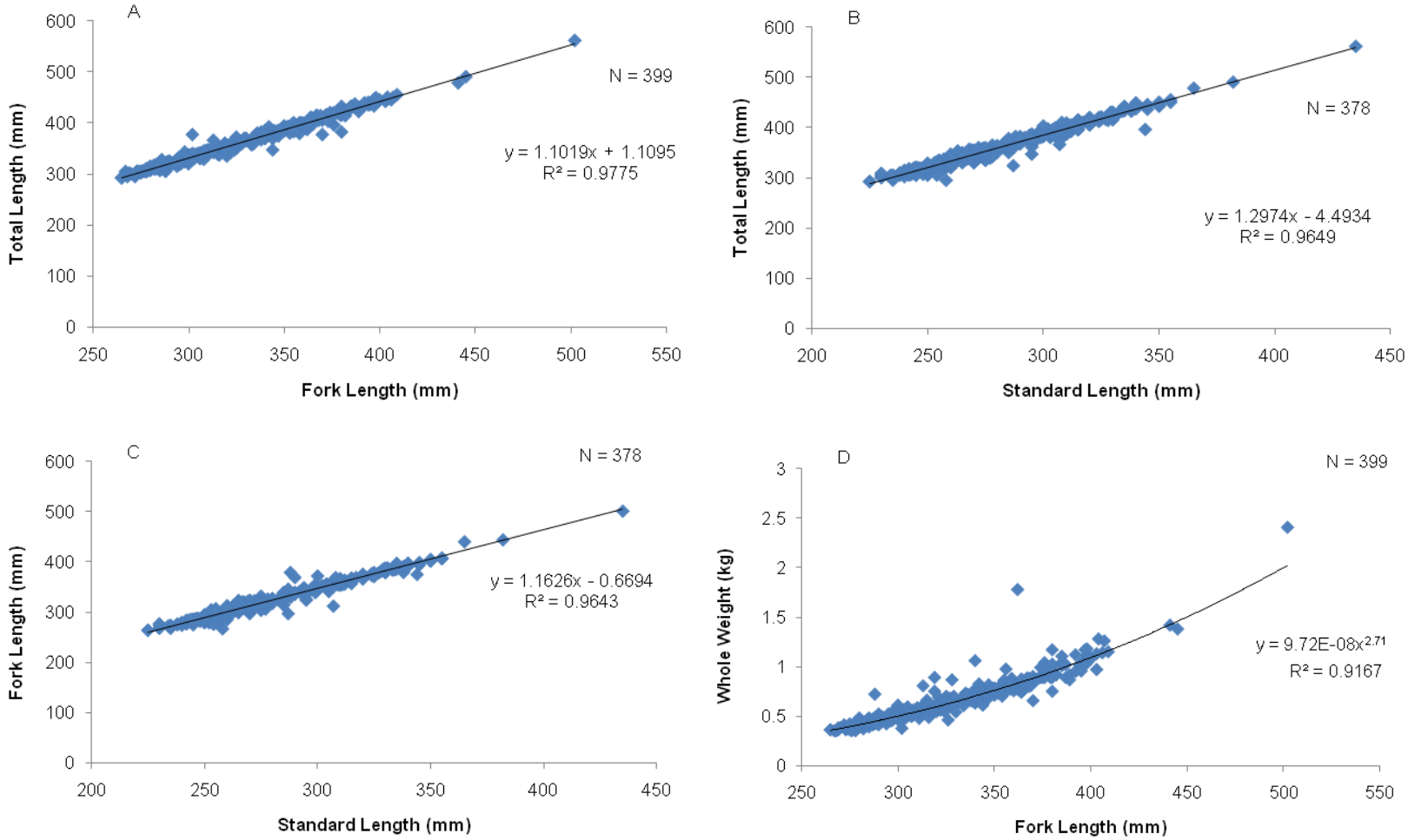

Figure 5. (A) Fork length (mm) to total length (mm), (B) standard length (mm) to total length (mm), (C) standard length (mm) to fork length (mm), and (D) fork length (mm) to whole weight (kg) relationships for vermilion snapper.

Table 5. Whole weight (kg) to gutted weight (kg) relationships for six main species of finfish, their estimated gutted to whole weight conversion, and the current conversion used by the NCTTP.

Species	WW= *x* (GW) + *b*	R^2	WW = x (GW)	Estimated conversion	NCTTP conversion
Vermilion snapper	WW = 1.0491(GW) +0.0189	0.9881	WW = 1.077(GW)	1.08	1.08
Red grouper	WW = 1.023(GW) + 0.2008	0.9936	WW = 1.053(GW)	1.05	1.25
Gag grouper	WW = 1.1267(GW) - 0.2457	0.9946	WW =1.085(GW)	1.09	1.25
King mackerel	WW = 1.0698(GW) – 0.0373	0.9988	WW = 1.065(GW)	1.07	1.04
Scamp	WW = 1.0056 (GW) + 0.1587	0.9981	WW = 1.043(GW)	1.04	1.25
Rock hind	WW = 1.0385 (GW) + 0.0185	0.9965	WW = 1.052(GW)	1.05	1.25

Table 6. Total length (mm) to fork length (mm), total length (mm) to standard length (mm), fork length (mm) to standard length, (mm) and length (mm) to weight (kg) relationships for six main species of finfish.

Species	TL = x(FL) + b	TL = x(SL) + b	FL = x(SL) + b	WW = a*L^b
Vermilion snapper	TL = 1.1019 (FL) + 1.1095	TL = 1.2974 (SL) - 4.4934	FL = 1.1626 (SL) - 0.6694	WW = $9.72^{-8}L^{2.71}$
Red grouper	TL = 1.0357 (FL) + 5.1056	TL = 1.0974(SL) + 64.655	FL = 1.0547 (SL) + 60.446	WW = $4.37^{-8}L$
Gag grouper	TL = 1.0477 (FL) - 9.8128	TL = 1.0695 (SL) + 76.446	FL = 1.0186 (SL) + 84.056	WW = $9.94^{-11}L^{3.76}$
King mackerel	TL = 1.0019 (FL) + 91.089	TL = 0.5407 (SL) + 483.99	FL = 0.8684 (SL) + 146.36	WW = $5.68^{-9}L^{3.06}$
Scamp	TL = 1.1129 (FL) - 5.9932	TL = 1.457 (SL) - 80.173	FL = 1.2566 (SL) - 40.343	WW = $4.05^{-8}L^{2.87}$
Rock hind*	N/A	TL = 1.1388 (SL) + 19.389	N/A	WW = $8.84^{-11}L^{3.89}$

*Rock hind does not have a forked tail.

Table 7. Coefficient of variation (R^2)for the total length (mm) to fork length (mm), total length (mm) to standard length (mm), fork length (mm) to standard length (mm) and length (mm) to weight (kg) relationships for six main species of finfish.

Species	TL = x(FL) + b	TL = x(SL) + b	FL = x(SL) + b	WW = a*L^b
Vermilion snapper	0.9775	0.9649	0.9643	0.9167
Red grouper	0.9850	0.9448	0.9486	0.7163
Gag grouper	0.9966	0.9651	0.9656	0.8987
King mackerel	0.9509	0.9935	0.9994	0.9656
Scamp	0.9601	0.9057	0.9515	0.6475
Rock hind	N/A	0.9429	N/A	0.8335

*Rock hind does not have a forked tail.

Red Grouper

A total of 150 red grouper were collected from Carteret (n=116) and Brunswick Counties (n=34). Sampled red grouper ranged in size from 550 mm to 850 mm (Figure 6).

The gutted to whole weight conversion factor that is currently used by the NCTTP for all groupers is 1.25. The estimated conversion factor from this study was 1.05 for red grouper and does not support using 1.25 for this species (Table 5 and Figures 7 and 8). The relationship between various length measurements and between whole weight and length are reported in Tables 6 and 7 and illustrated in Figure 9.

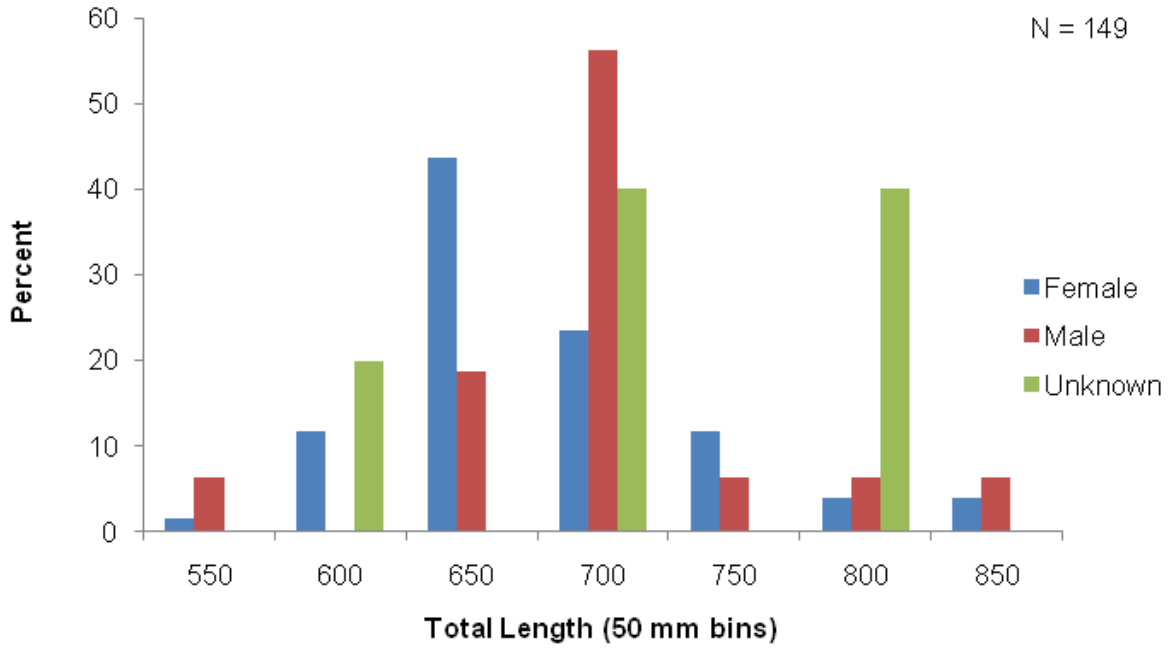

Figure 6. Total length (50 mm bins) frequency for red grouper.

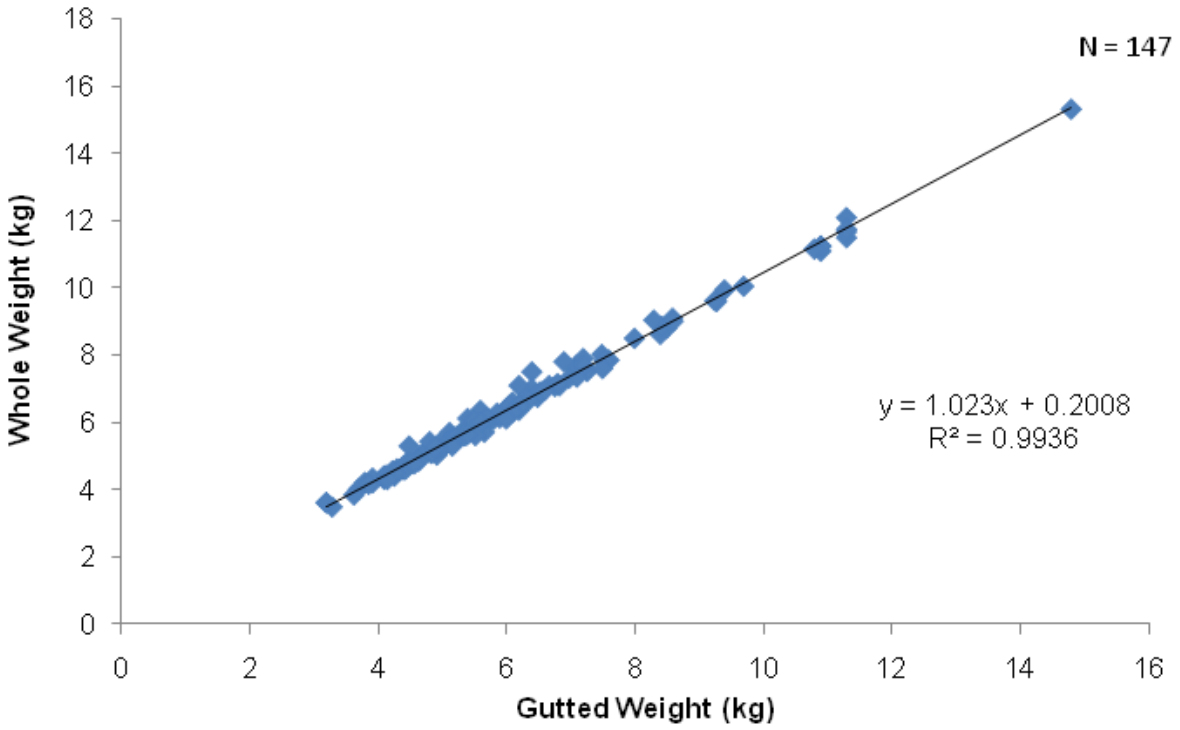

Figure 7. Gutted weight (kg) to whole weight (kg) relationship for red grouper.

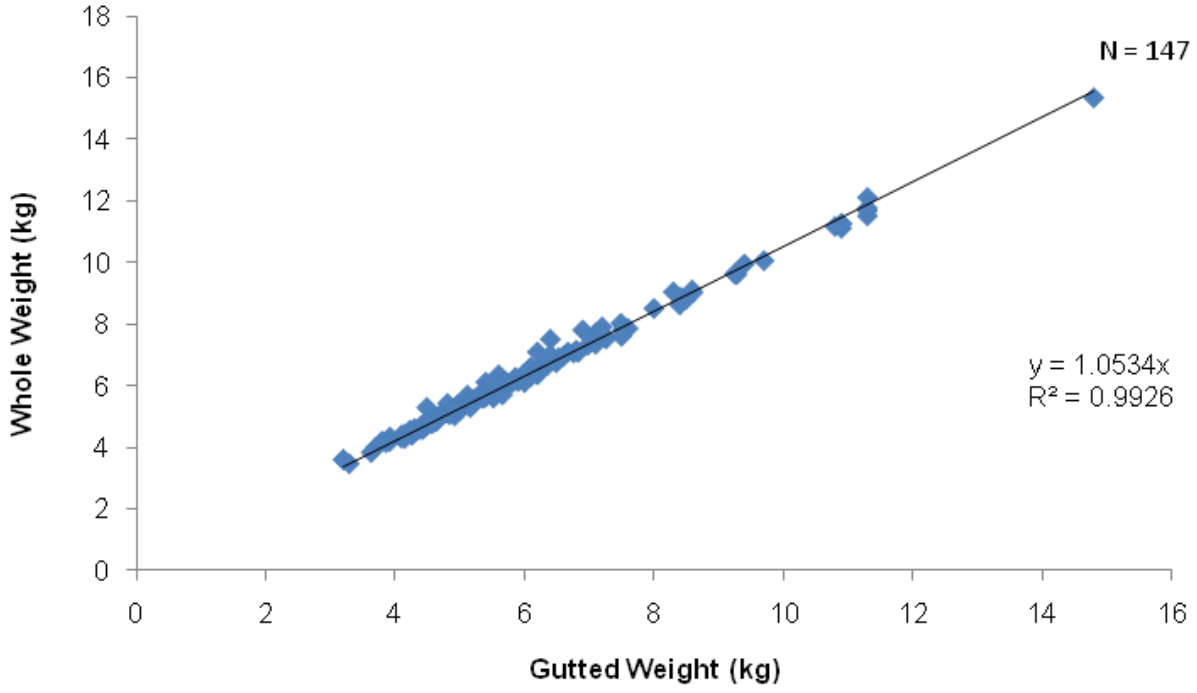

Figure 8. Gutted weight (kg) to whole weight (kg) relationship for red grouper with intercept set at zero.

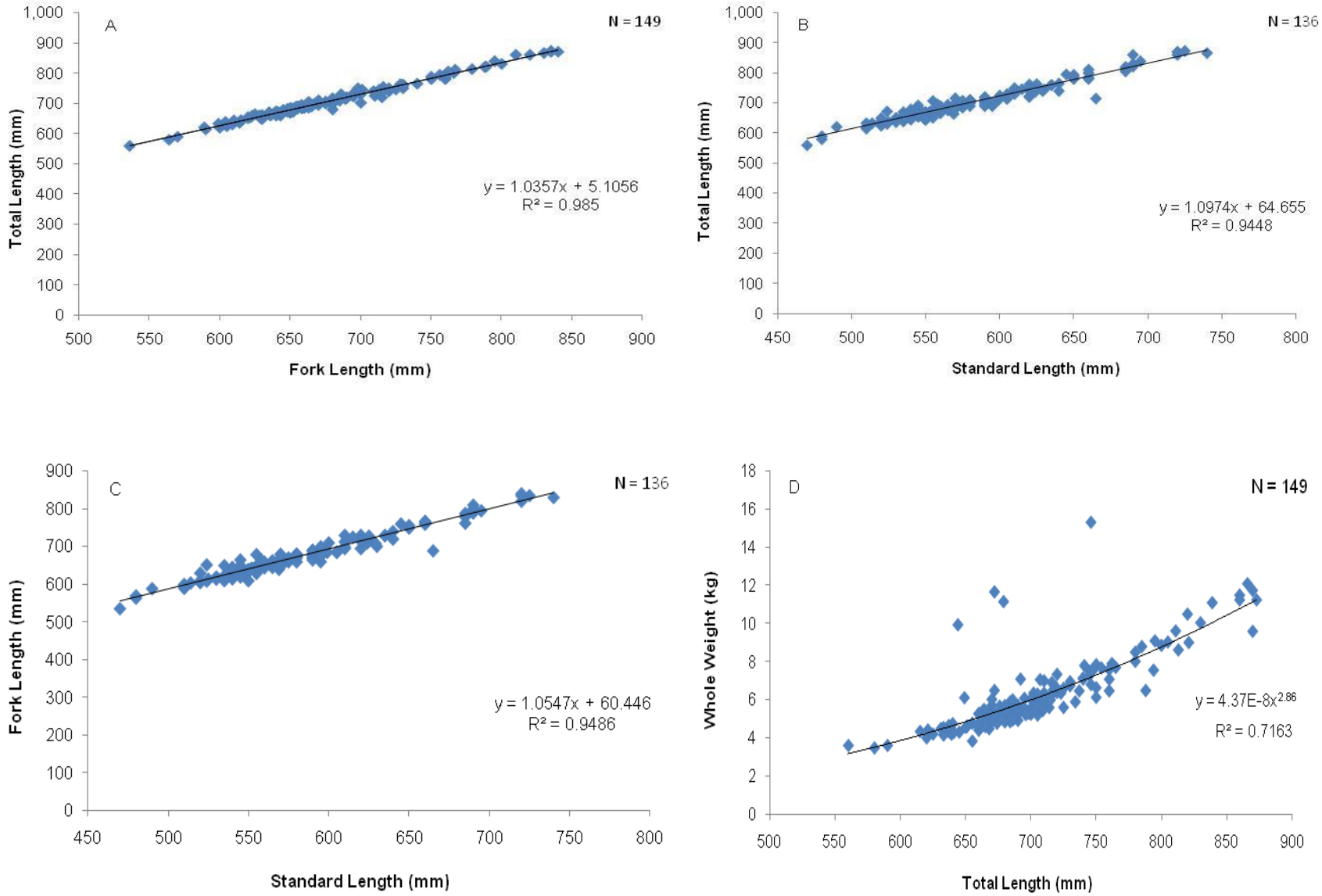

Figure 9. (A) Fork length (mm) to total length (mm), (B) standard length (mm) to total length (mm), (C) standard length (mm) to fork length (mm), and (D) total length (mm) to whole weight (kg) relationships for red grouper.

Gag Grouper

A total of 94 gag grouper were collected from Carteret (n=86) and Brunswick Counties (n=8). Sampled gag grouper ranged in size from 550 mm to 850 mm (Figure 10).

The gutted to whole weight conversion factor that is currently used by the NCTTP for all groupers is 1.25. The estimated conversion factor for gag grouper from this study was 1.09 and does not support using 1.25 as the conversion factor for this species (Table 5 and Figures 11 and 12). The relationship between various length measurements and between whole weight and length are reported in Tables 6 and 7 and illustrated in Figure 13.

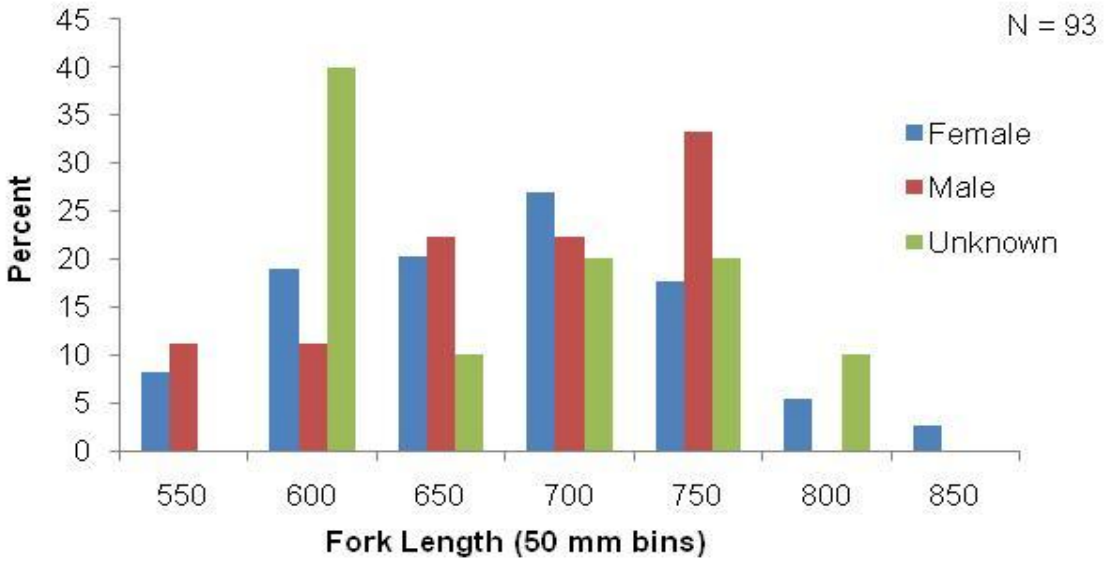

Figure 10. Fork length (50 mm) frequency for gag grouper.

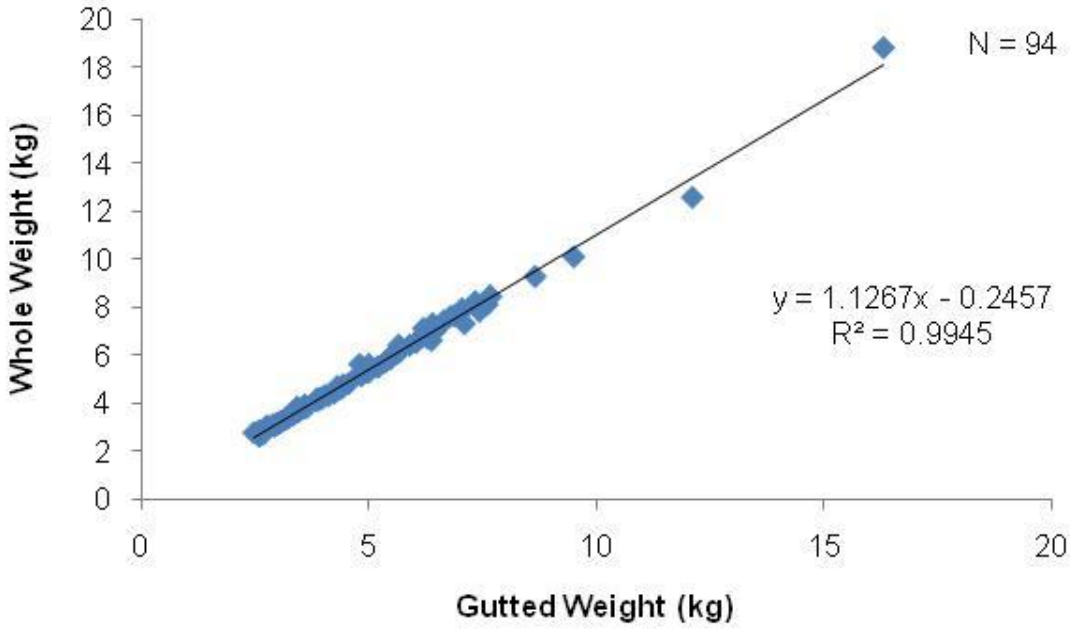

Figure 11. Gutted weight (kg) to whole weight (kg) relationship for gag grouper.

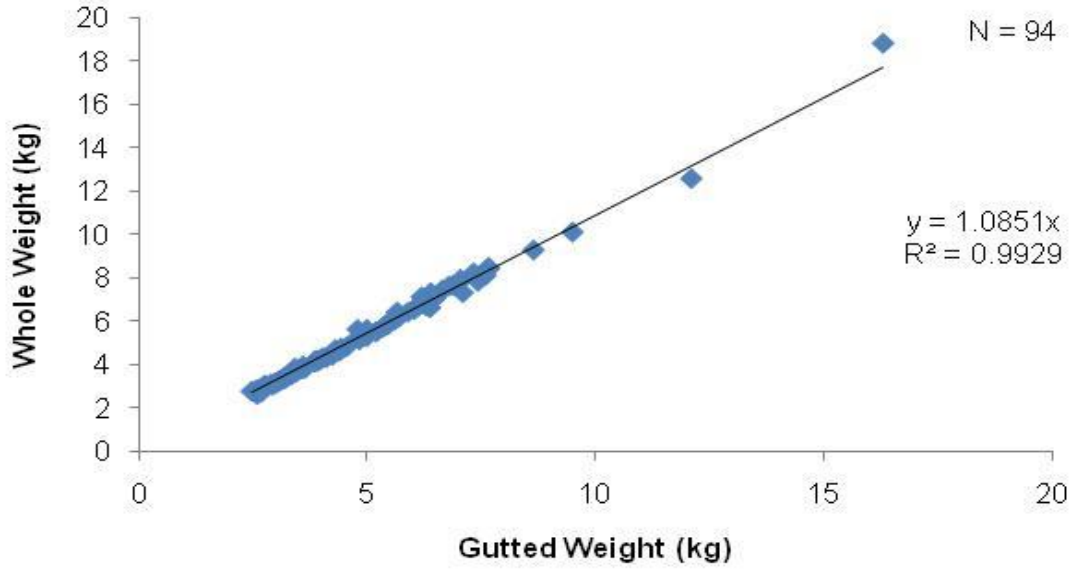

Figure 12. Gutted weight (kg) to whole weight (kg) relationship for gag grouper with intercept set at zero.

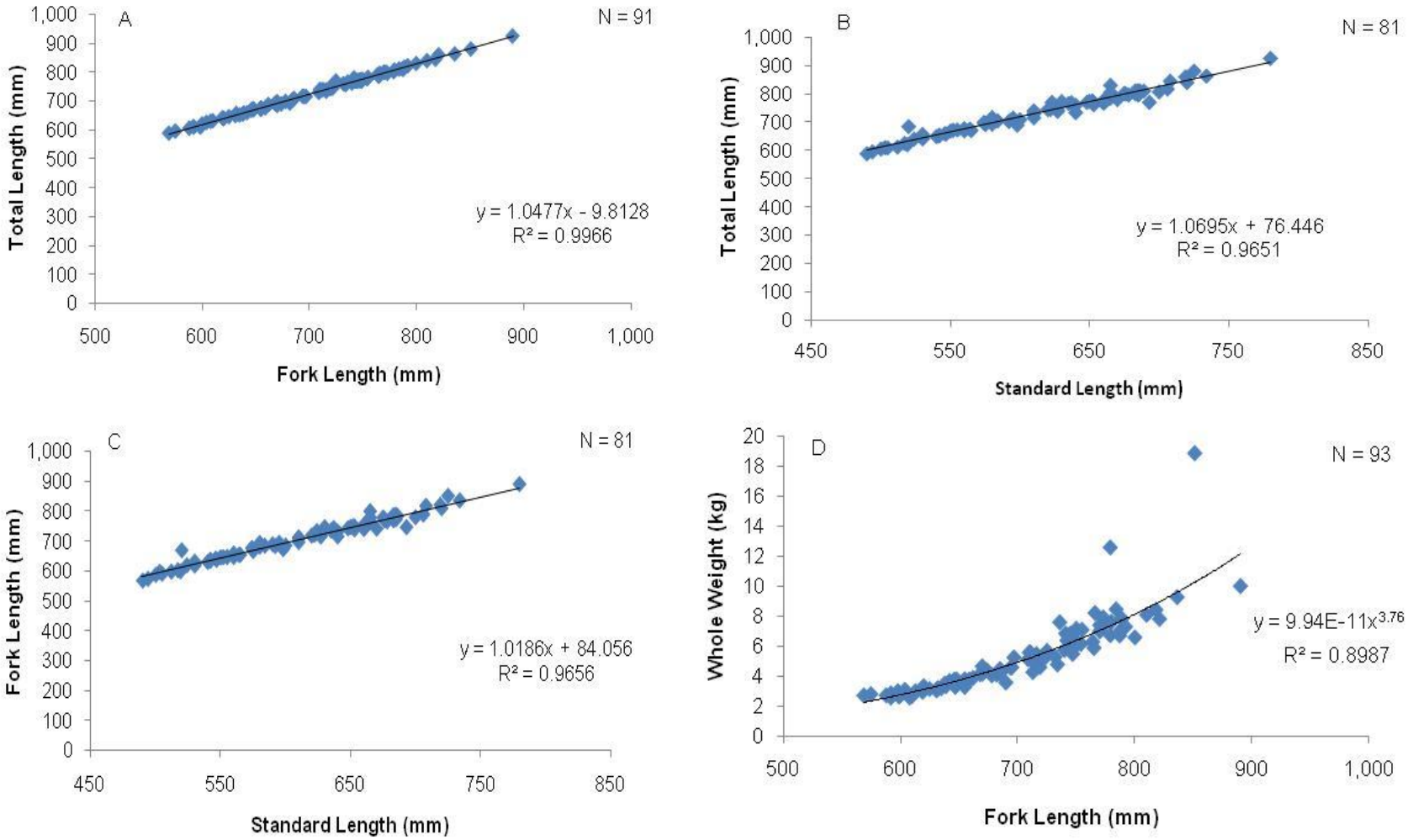

Figure 13. (A) Fork length (mm) to total length (mm), (B) standard length (mm) to total length (mm), (C) standard length (mm) to fork length (mm), and (D) fork length (mm) to whole weight (kg) relationships for gag group.

King Mackerel

A total of 61 king mackerel were collected from Onslow County (n=36) and Carteret County (n=25). King mackerel sampled in this study ranged in size from 700 mm to 1,400 mm (Figure 14).

The gutted to whole weight conversion factor that is currently used by the NCTTP for king mackerel is 1.04. The estimated conversion factor for king mackerel from this study was 1.07 which is very close to the currently used conversion factor (Table 5 and Figures 15 and 16). The relationship between various length measurements and between whole weight and length are reported in Tables 6 and 7 and illustrated in Figure 17. The relationships shown between the various length to length measurements should be used with caution because of small sample size.

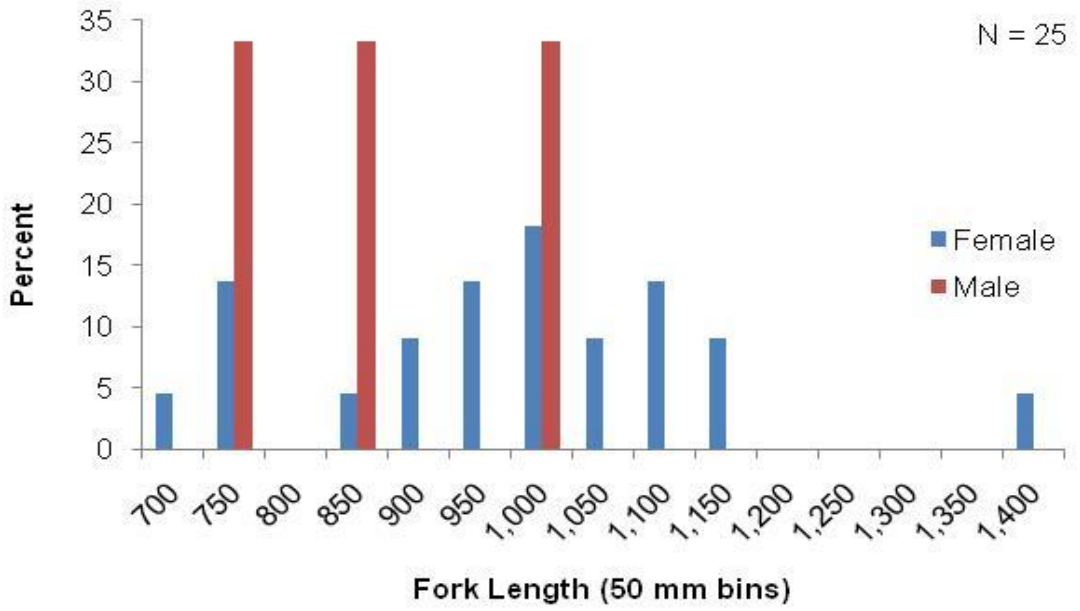

Figure 14. Fork length frequency (50 mm bins) for king mackerel.

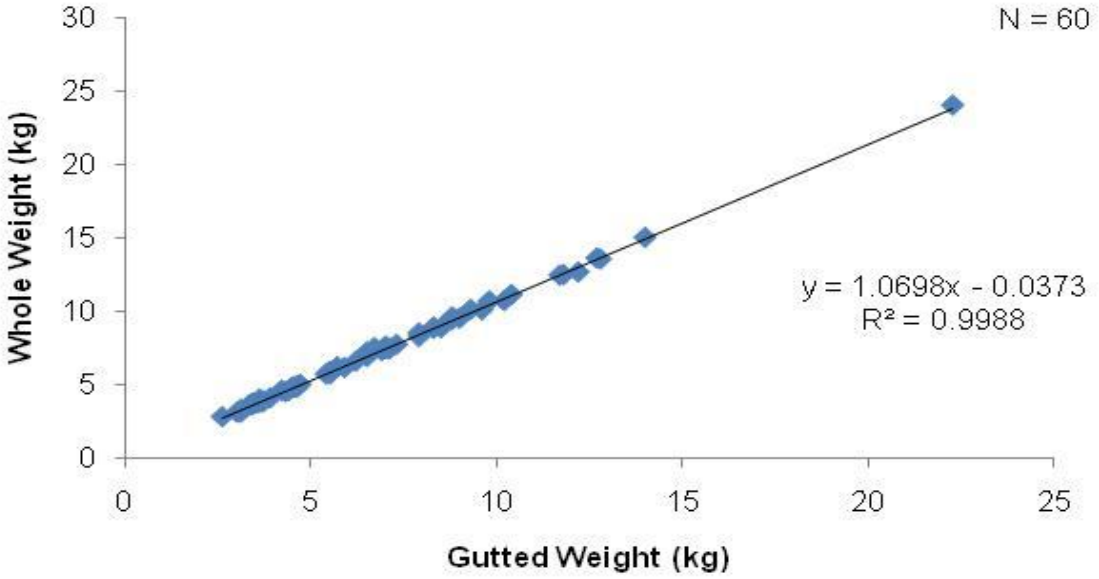

Figure 15. Gutted weight (kg) to whole weight (kg) relationship for king mackerel.

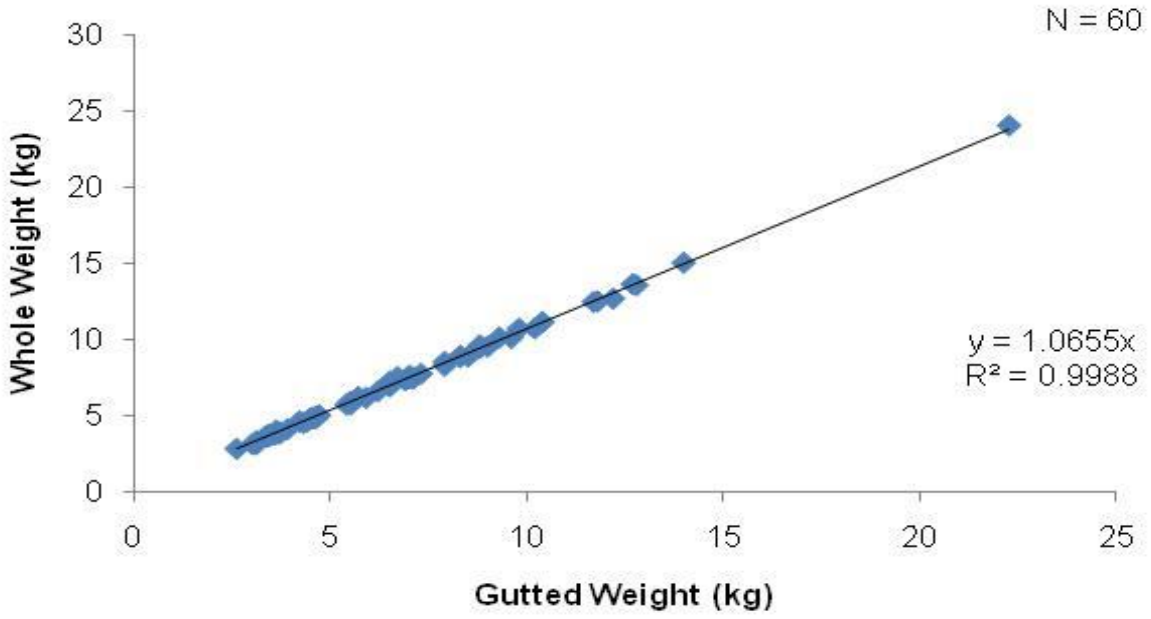

Figure 16. Gutted weight (kg) to whole weight (kg) relationship for king mackerel with intercept set at zero.

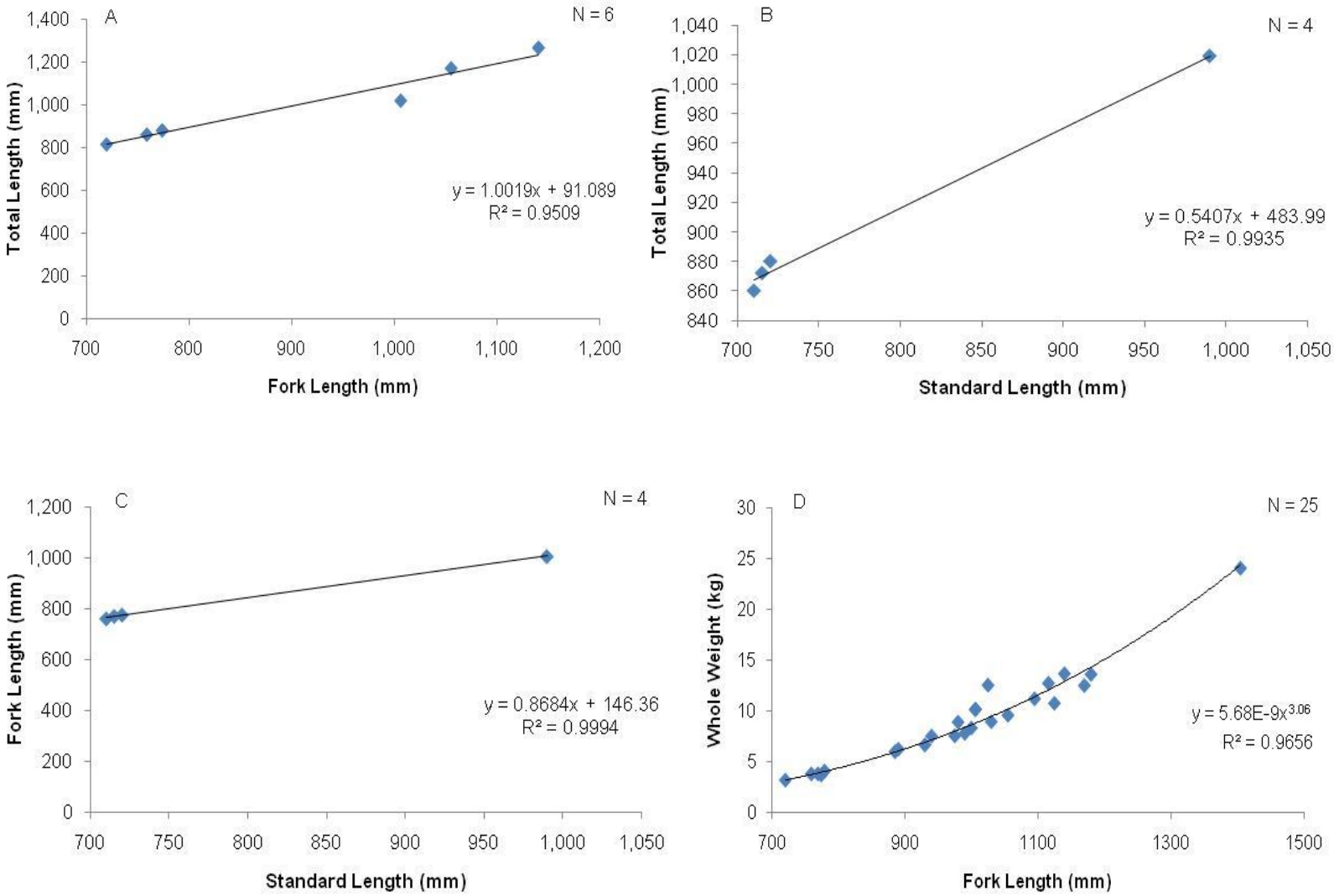

Figure 17. (A) Fork length (mm) to total length (mm), (B) standard length (mm) to total length (mm), (C) standard length (mm) to fork length (mm), and (D) fork length (mm) to whole weight (kg) relationships for king mackerel.

Scamp

A total of 32 scamp were collected from Brunswick County (n=29) and Carteret County (n=3). The size of scamp ranged from 450 mm to 750 mm (Figure 18).

The gutted to whole weight conversion factor that is currently used by the NCTTP for all groupers is 1.25. The estimated conversion factor from this study was 1.04 and does not support using 1.25 as a conversion factor for this species (Table 5 and Figures 19 and 20). The relationship between various length measurements and between whole weight and length are reported in Tables 6 and 7 and illustrated in Figure 21.

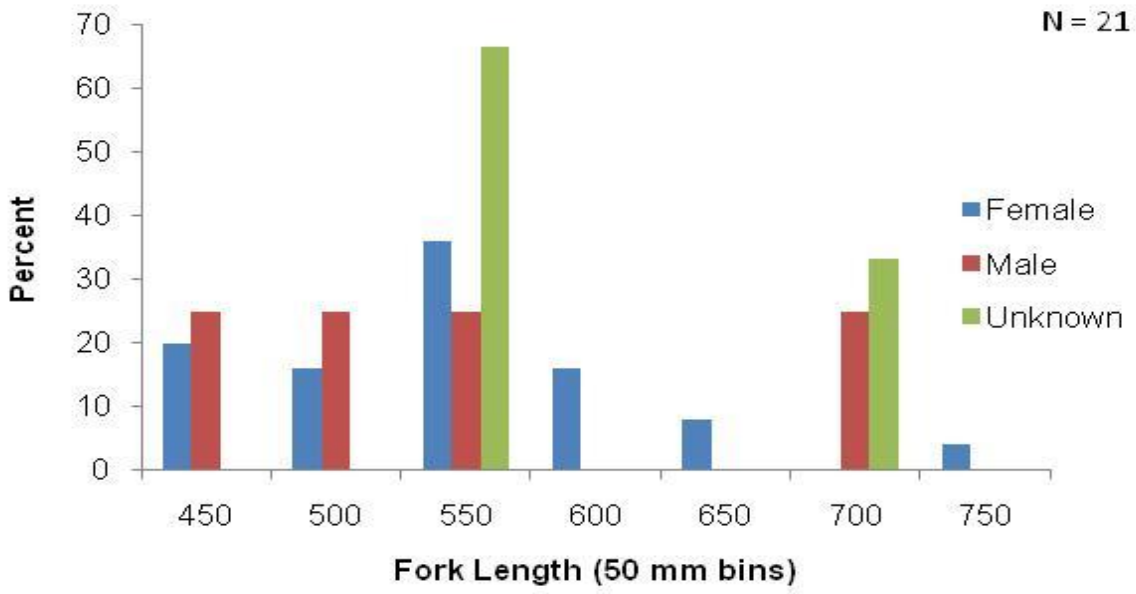

Figure 18. Fork length frequency (50 mm bins) for scamp.

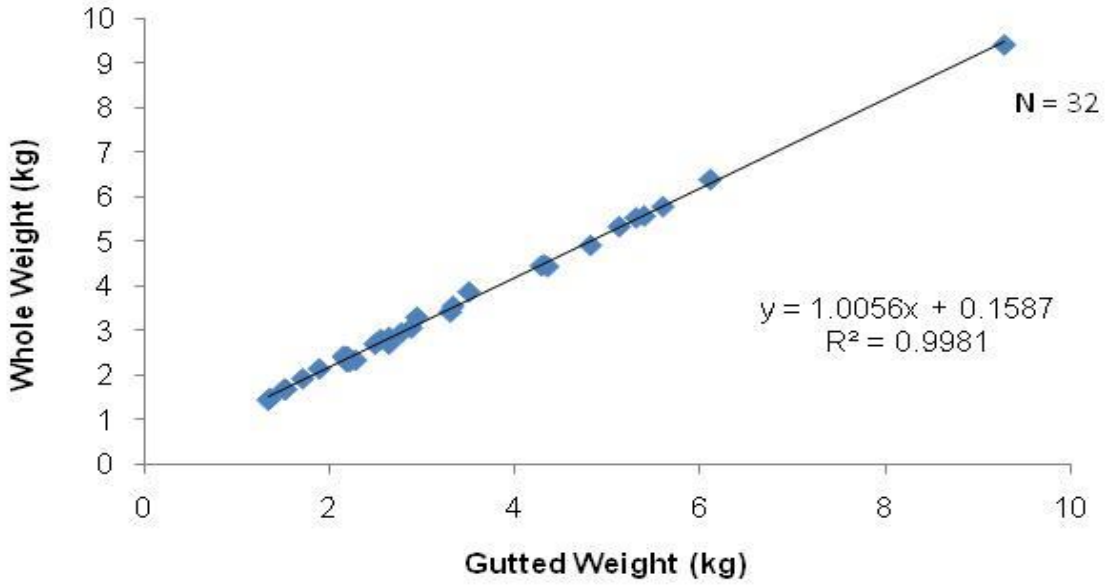

Figure 19. Gutted weight (kg) to whole weight (kg) relationship for scamp.

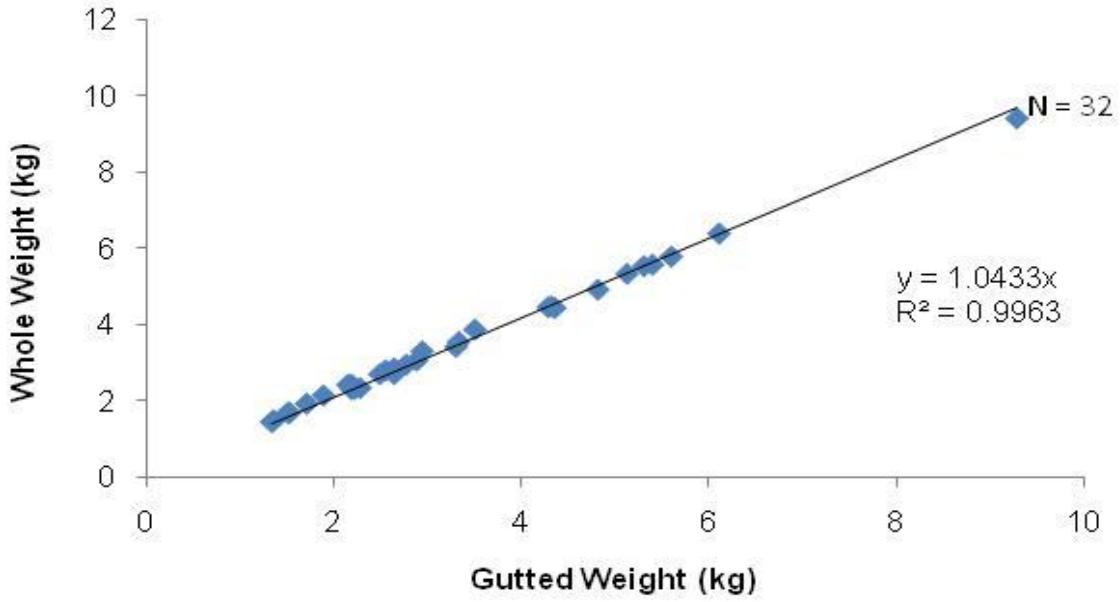

Figure 20. Gutted weight (kg) to whole weight (kg) relationship for scamp with intercept set at zero.

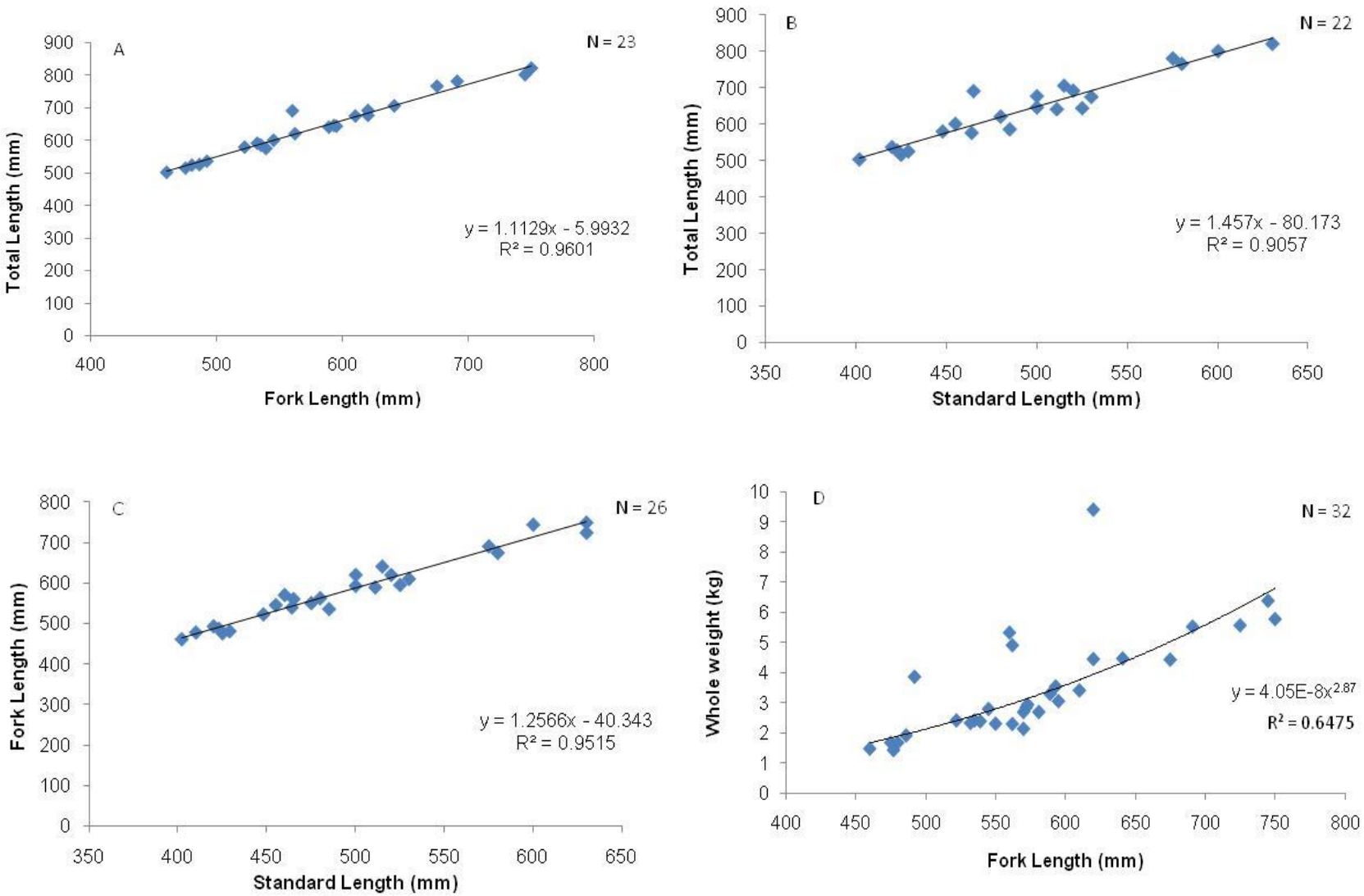

Figure 21. (A) Fork length (mm) to total length (mm), (B) standard length (mm) to total length (mm), (C) standard length (mm) to fork length (mm), and (D) fork length (mm) to whole weight (kg) relationships for scamp

Rock Hind

Samples of rock hind were collected from only Brunswick County (n=31). The size of rock hind ranged from 300 mm to 450 mm (Figure 22).

The gutted to whole weight conversion factor that is currently used by the NCTTP for all groupers is 1.25. The estimated conversion factor from this study was 1.05 and does not support using 1.25 as a conversion factor for this species (Table 5 and Figures 23 and 24). The relationship between various length measurements and between whole weight and length are reported in Tables 6 and 7 and illustrated in Figure 25.

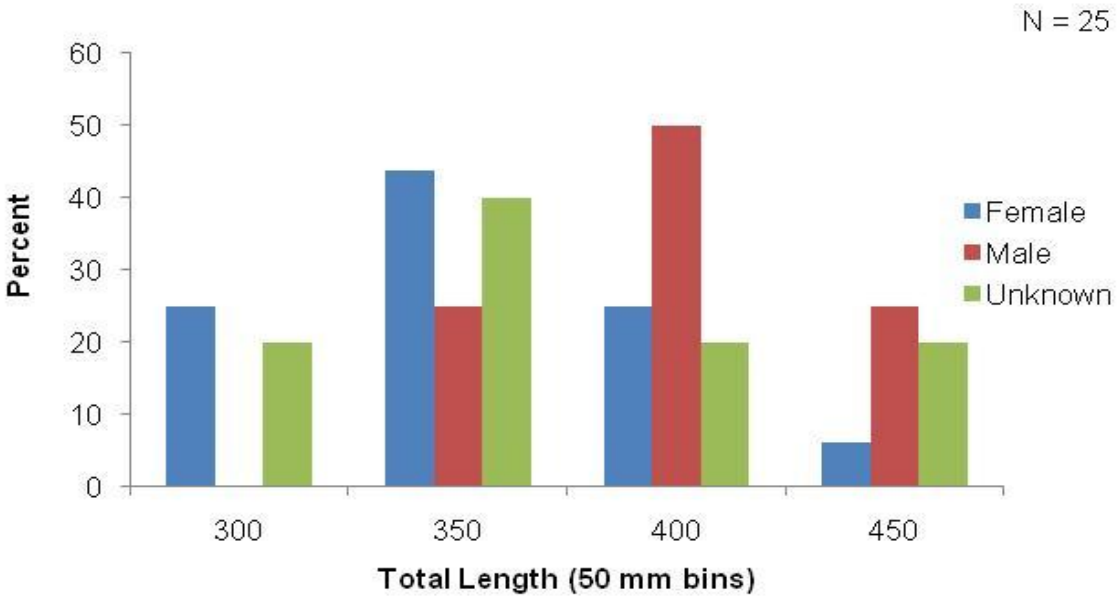

Figure 22. Total length frequency (50 mm bins) for rock hind.

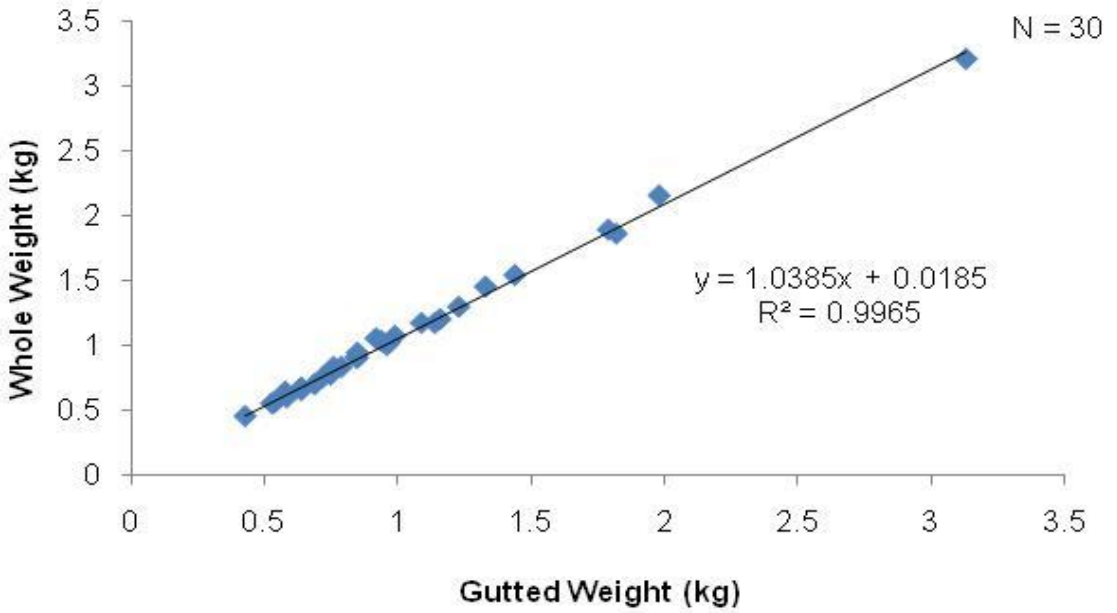

Figure 23. Gutted weight (kg) to whole weight (kg) relationship for rock hind.

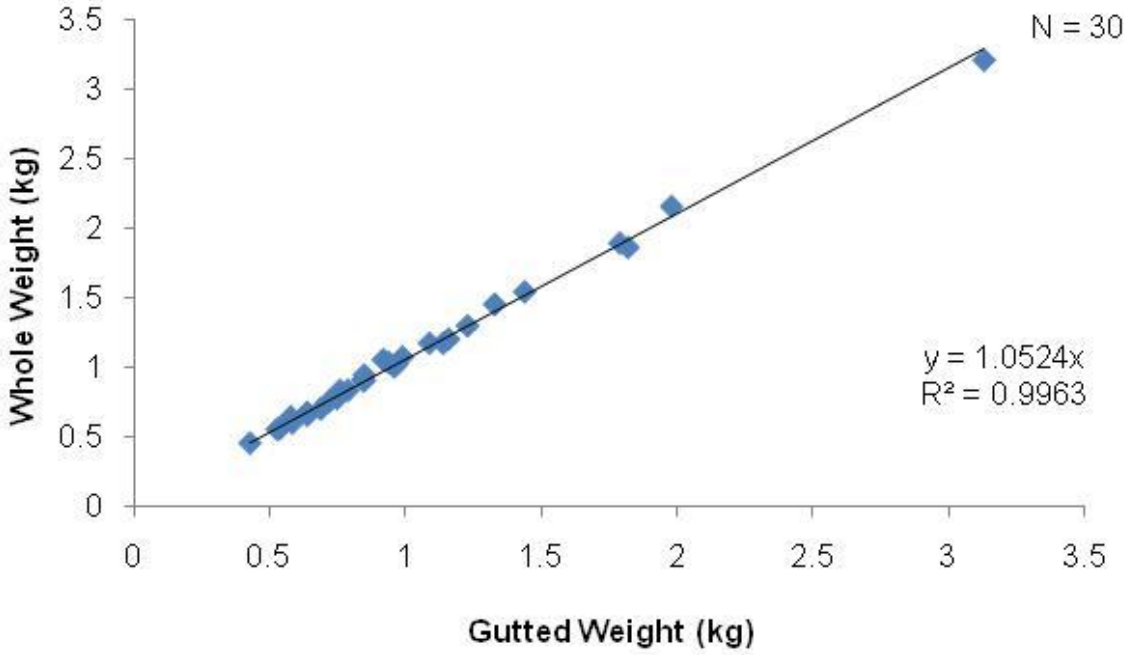

Figure 24. Gutted weight (kg) to whole weight (kg) relationship for rock hind with intercept set at zero.

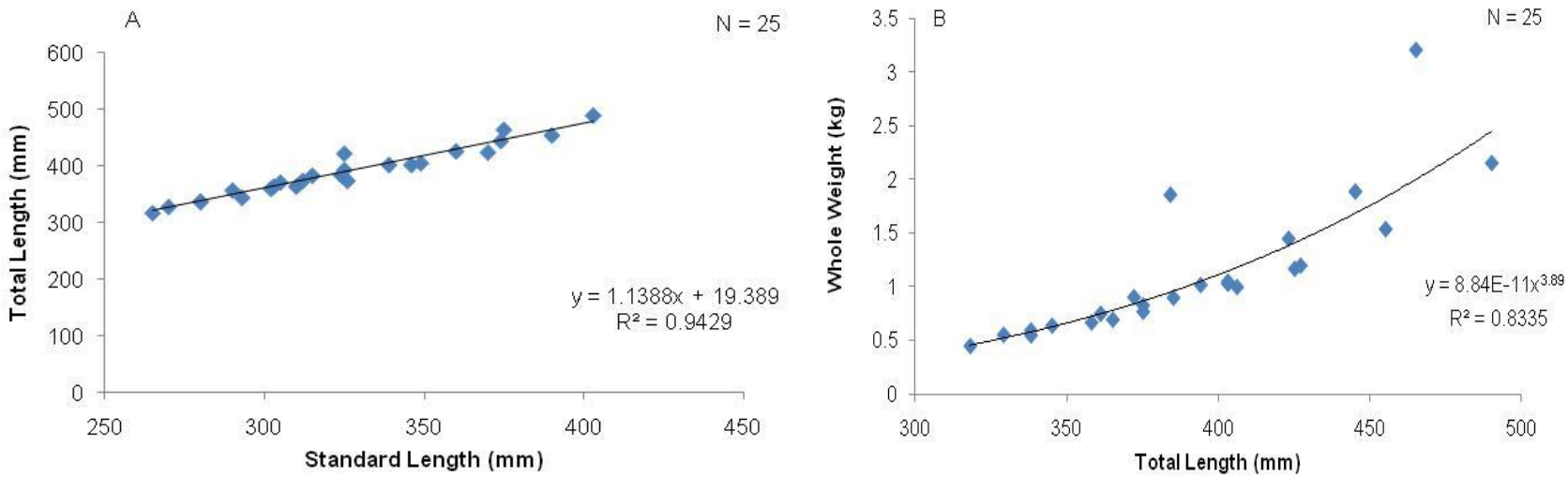

Figure 25. (A) Standard length (mm) to total length (mm) and (B) total length (mm) to whole weight (kg) relationships for rock hind

SHELLFISH RESULTS

Although a large number of individual shellfish were sampled (Table 1), the number of marketed units (bushels, bags, etc.) was relatively small. In total, four bushels of oysters, one bag of clams, and one bushel of bay scallops were sampled during this study. Several soft and peeler blue crabs were also collected.

Oyster

A total of 1,258 individual oysters were sampled from four bushels during this study Samples of oysters were obtained from Brunswick, Carteret, and Hyde counties and ranged from 20 to 190 mm in shell length (Figure 26).

The current conversion factor used by the NCTTP to convert oysters from bushels to pounds of meat is 5.29 pounds of meat per bushel. Table 8 shows the meat weight obtained from each bushel during the project period and the average meat weight across all bushels. All estimates were below the 5.29 conversion except for one bushel that produced 7.05 pounds of meat (Table 8). Average pounds of meat per bushel were 5.09, which is very close to the currently used conversion factor.

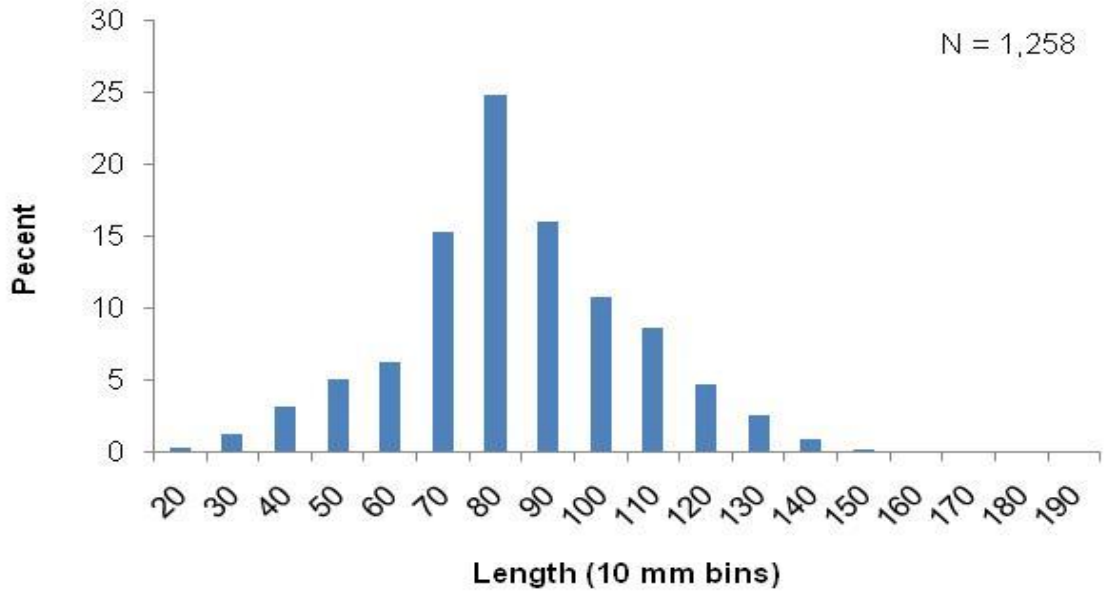

Figure 26. Shell length frequency (10 mm bins) for oysters.

Table 8. Meat weight for oysters obtained from four different bushels.

Bushel	Meat weight
1	7.05 lb (3.20 kg)
2	4.61 lb (2.09 kg)
3	4.72 lb (2.14 kg)
4	4.03 lb (1.83 kg)
Average	5.09 lb (2.31 kg)

Bay Scallop

A total of 445 bay scallops were sampled from Carteret County during this study that equated to only one bushel of scallops. The shell length frequency of bay scallops sampled ranged from 40 mm to 70 mm (Figure 27).

The conversion factor used to determine the meat weight of bay scallops from bushels used by the NCTTP is 5.0 pounds of meat to one bushel. The bushel of bay scallops that was sampled produced a meat weight of 4.88 pounds (2.215 kg) which is very close to the current conversion factor.

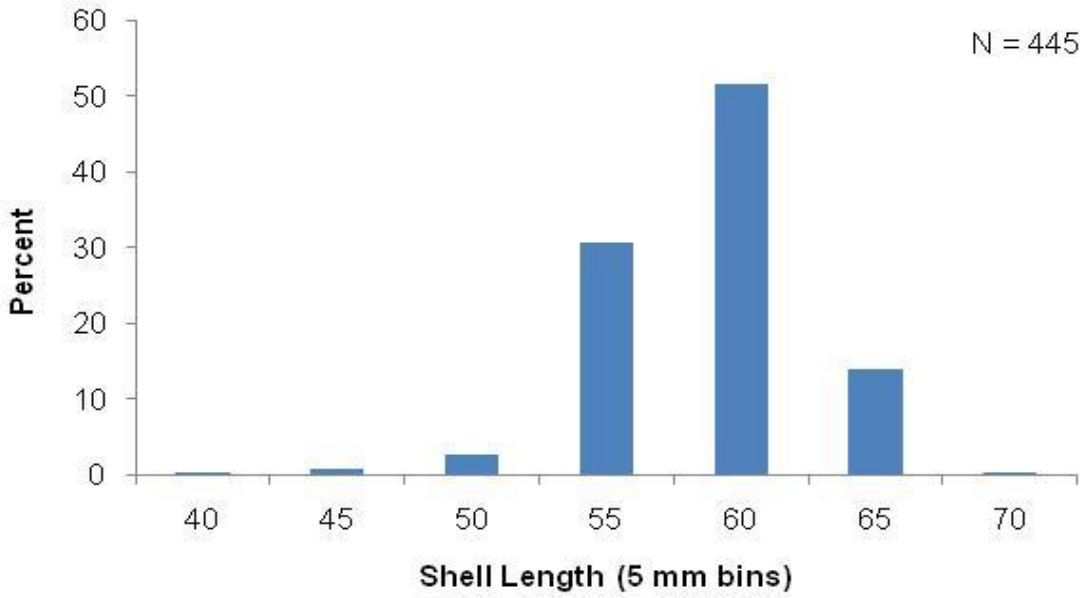

Figure 27. Shell length frequency (5 mm bins) for bay scallops.

Hard Clams

Three hundred and fifty-seven clams were sampled during the project period from Carteret County and ranged from 40 mm to 80 mm in shell thickness (Figure 28).

Hard clams are typically marketed by market grade in numbers or bags. Hard clams sampled for this project were from three market grades: cherries, little necks and top necks, however, most of the samples were little necks and top necks. The current conversion for each market grade and the estimated conversion for each market grade are reported in Table 9. All of the estimated conversions were higher than the currently used conversion factor.

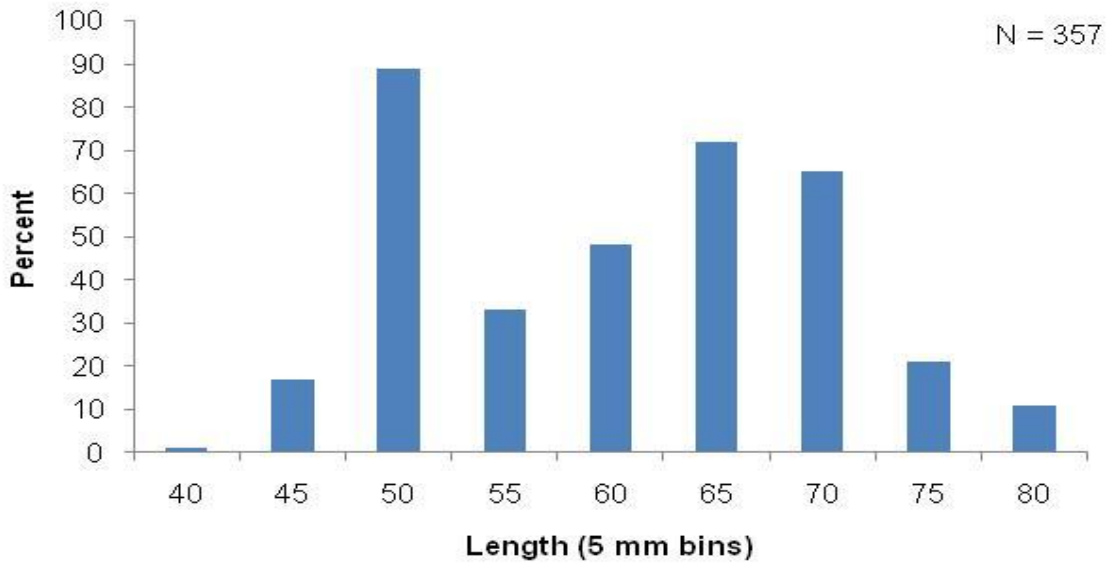

Figure 28. Shell length frequency (5 mm bins) for hard clams.

Table 9. Total number of hard clams by market grade, sampled meat weight, estimated conversion and current conversion used by the NCTTP.

Market grade	Observations	Meat weight	Estimated conversion	NCTTP conversion
Cherry	62	2.84 lb (1.288 kg)	0.046	0.029
Little necks	133	4.39 lb (1.993 kg)	0.033	0.013
Topneck	162	5.94 lb (2.697 kg)	0.037	0.019

Soft Shell Crabs

Soft shell crabs were sampled from two counties, Carteret (n=286) and Beaufort (n=22). Soft shell crabs were sampled across market grades (from extra small to jumbo) and ranged from 70 mm to 170 mm in carapace width (Figure 29).

The majority of soft shell crabs are reported in numbers harvested and the current conversion factor used by the NCTTP to determine the total weigh landed is 0.33 pounds per crab. The estimated conversions from this study report 0.28 pounds for males to 0.30 for females and when the samples are combined across sexes, a conversion of 0.30 pounds per crab is obtained (Table 10). The relationship between carapace width and weight can be seen in Figure 30 and Table 12.

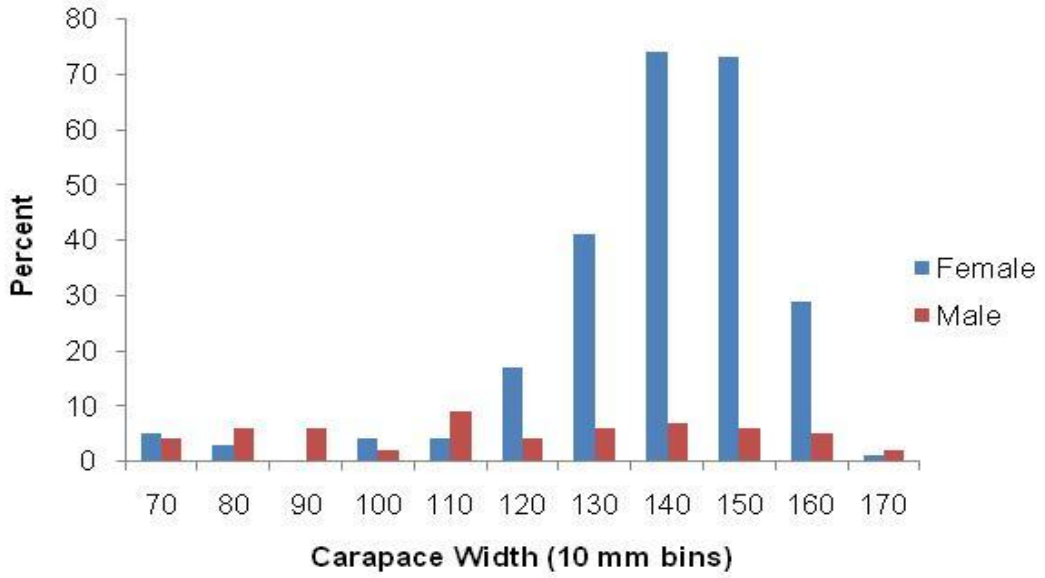

Figure 29. Carapace width (10 mm bins) frequency for soft shell blue crabs.

Table 10. Total number of soft shell crabs sampled by sex and weight.

Gender	Observations	Pounds	lb / #	kg
Female	251	75.91	0.30	34.44
Male	57	15.80	0.28	7.17
Combined	308	91.71	0.30	41.61

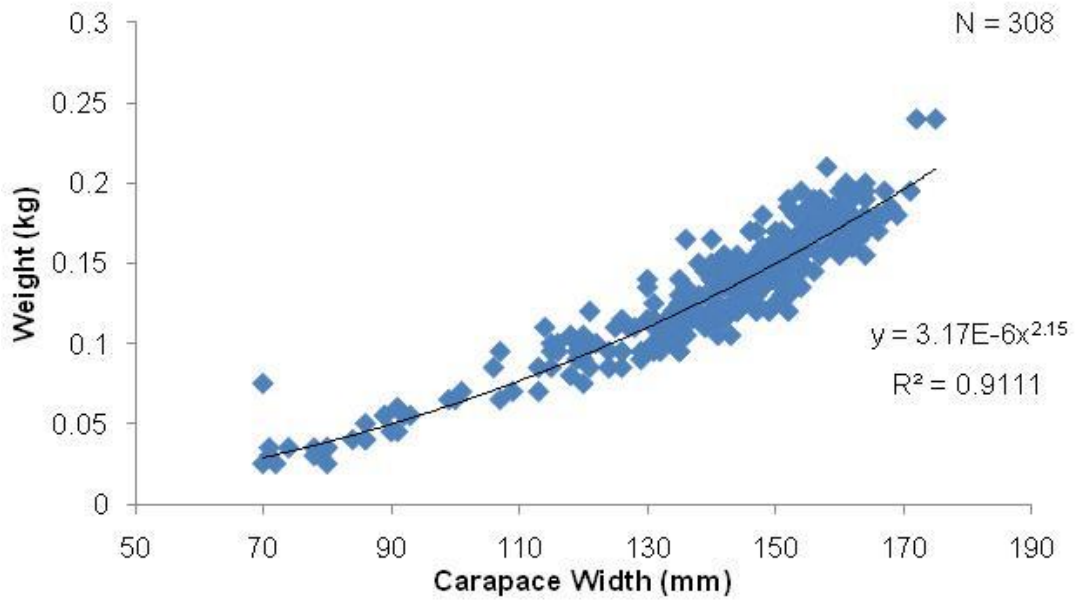

Figure 30. Carapace width (mm) and weight (kg) relationship for soft shell blue crabs.

Peeler Crabs

Peeler crabs were sampled in only Beaufort County (n=45) and ranged from 80 mm to 160 mm in carapace width (Figure 31).

The majority of peeler crabs are reported in numbers harvested and the current conversion factor used by the NCTTP to determine the total weight landed is 0.33 pounds per crab. The estimated conversions from this study report 0.23 pounds for females and 0.32 pounds for males and when the samples are combined across sexes a conversion of 0.30 pounds per crab is obtained (Table 11). The relationship between carapace width and weight can be seen in Figure 32 and Table 12.

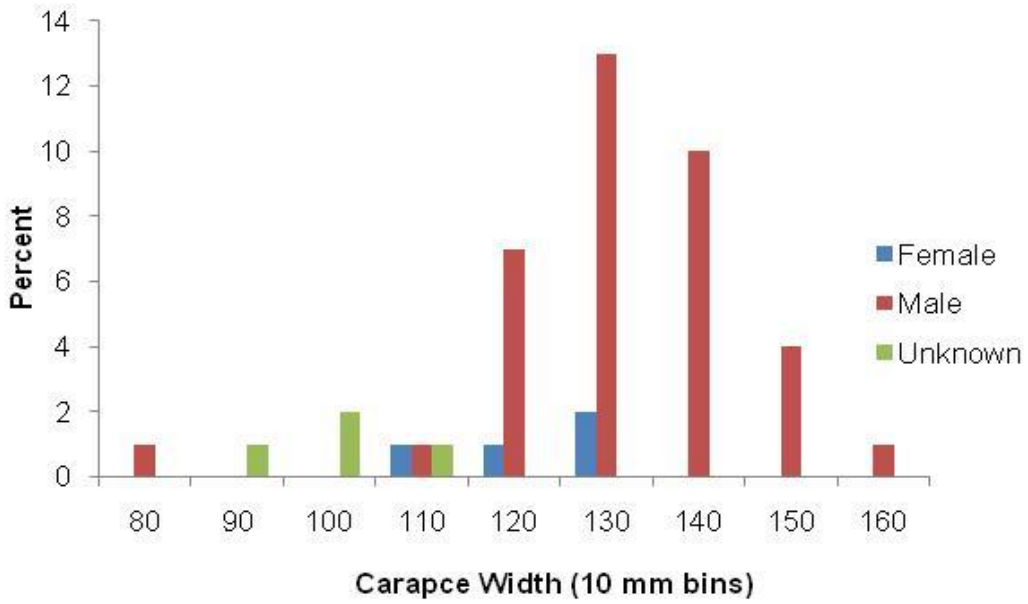

Figure 31. Carapace width (10 mm bins) frequency for peeler blue crabs.

Table 11. Total number of peeler crabs sampled by sex and weight.

Gender	Observations	Pounds	LB / #	KG
Female	4	0.93	0.23	0.42
Male	37	11.80	0.32	5.36
Unknown	4	0.60	0.15	0.27
Combined	45	13.32	0.30	6.05

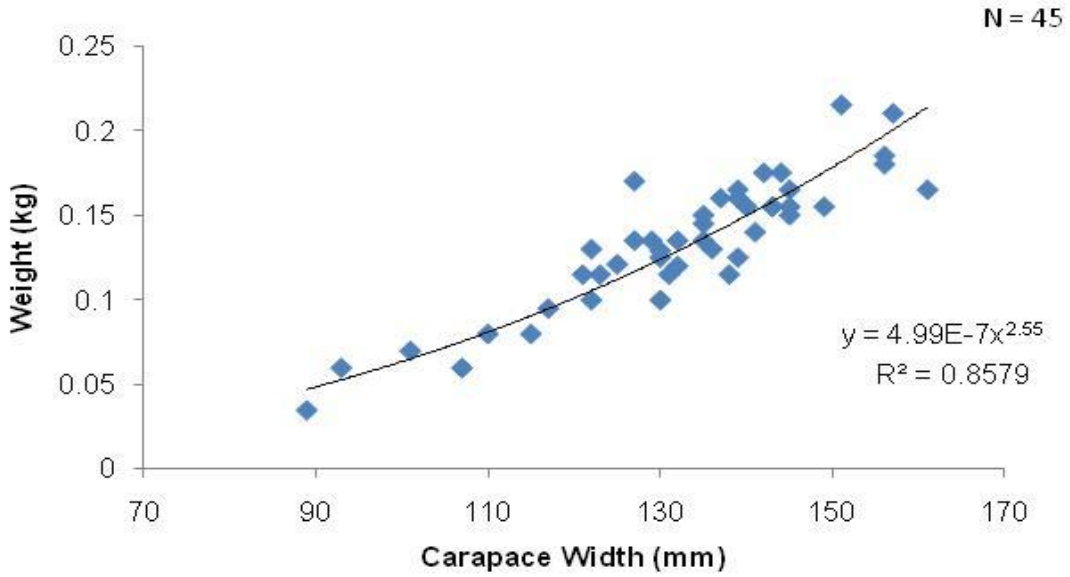

Figure 32. Carapace width (mm) and weight (kg) relationship for peeler blue crabs.

Table 12. Carapace width (mm) and weight (kg) relationship for soft and peeler blue crabs.

Species	$WW = a*CW^b$	R^2
Soft shell blue crab	$W = 3.17^{-6}CW^{2.15}$	0.9111
Peeler blue crab	$W = 4.99^{-7}CW^{2.55}$	0.8579

DISCUSSION

Although it is a common practice to use conversion factors to determine the whole weight for commercial landings, different factors are used from state to state. Hesselman and Kemp (2006) noted this inconsistency in a preliminary assessment of conversion factors used by states along the Atlantic Coast that were sent to the Atlantic Coast Cooperative Statistics Program (ACCSP). This inconsistency between states is also commonly noted during the SouthEast Data, Assessment, and Review (SEDAR) Workshops. As a result, the SEDAR Data Workshops generally use a calculated gutted to whole weight conversion factor from independent sampling programs and apply that conversion factor to commercial landings for modeling purposes.

Comparisons between estimated and current conversion factors were variable by species. Gutted to whole weight conversion factors currently used by the NCTTP for groupers (gag grouper, red grouper, scamp, and rock hind) appear to be overestimated at 1.25 when the estimated conversion factor for these groupers sampled in this study ranged from 1.04 to 1.09. However, the conversion factor used by the NCTTP for vermilion snapper (1.08) was confirmed with this study and the conversion factor currently used for king mackerel (1.04) was closely

estimated by this study (1.07) (Table 5). For shellfish species, the preliminary results indicate the conversion factor for oysters from bushels to pounds of meat used by the NCTTP of 5.29 might be overestimating the total meat weight (Table 8), whereas the bushel conversion for bay scallops of 5.00 pounds of meat weight was similar to the results of this study. For hard clams, preliminary results indicate the market grade conversions currently used by the NCTTP are too low and may be underestimating the meat weight of hard clams (Table 9). For soft and peeler crabs, the NCTTP uses a conversion of 0.33 pounds per crab and the preliminary results from this study ranged from 0.15 to 0.32 pounds per crab (Tables 10 and 11).

All results from this study should be considered preliminary because the majority of the samples collected during this pilot study were primarily from only two counties: Carteret and Brunswick. Obtaining samples from more counties would help to account for variability from different areas. Also, sampling could not be conducted throughout the year for many of these species because of staffing changes over the project period therefore; seasonal variability was limited in this analysis. Further statistical analysis is also needed to determine if there are any significant effects on conversion factors from temporal changes, spatial distributions, gear type, sex or size distributions.

The number of samples collected across shellfish species were relatively low for this study. It is also likely that the conversion factor for oysters, hard clams, bay scallops and blue crabs will be influenced by area or by water body. For example, it is typical for oysters to be smaller in the southern regions of the state. Also, oysters in the southern part of the state are more likely to clump up and form “coon” oysters. As a result of this effect, we sampled a number of undersized oysters which could have an effect on conversion calculations.

CONCLUSION

Although more work is required to evaluate and validate the conversion factors used by the NCTTP, the results of this study indicate that the validation is warranted. These preliminary results imply that many of these conversion factors need to be updated, and conversion factors generally used across groups of species (ex. 1.25 for all groupers) may not be appropriate and species specific conversions may be needed. It is recommended this work be continued and expanded across all species affected by pre-processing at sea and shellfish fisheries. The results of this study will help the NCTTP produce more accurate statistics on North Carolina’s commercial harvest and will update the state’s documentation on all conversion factors currently employed.

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