LENGTH-WEIGHT RELATIONSHIPS FOR TWENTY MARINE FISHES OF TEXAS

By

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ABSTRACT

Total length–whole weight relationships were developed for Atlantic bumper (*Chloroscombrus chrysurus)*, Atlantic midshipman (*Porichthys plectrodon*), banded drum ***(Larimus fasciatus*),** bigeye searobin (*Prionotus longispinosus*), blackwing searobin (*Prionotus rubio*), bluntnose jack (*Hemicaranx amblyrhynchus*), **diamond** killifish (*Adinia xenica*), fringed flounder (*Etropus crossotus*), inshore **lizardfish** (*Synodus foetens*), lined sole (*Achirus lineatus*), lookdown (*Selene vomer*), **pancake** batfish (*Halieutichthys aculeatus*), permit (*Tracinotus falcatus*), ***rock sea* bass** (*Centropristis philadelphica*), sailfin molly (*Poecilia latipinna*), shoal flounder (*Syacium gunteri*), silver seatrout (*Cynoscion nothus)*, southern hake (*Urophycis floridana*), **striped** anchovy (*Anchoa hepsetus*), **and** white **bass *(Morone chrysops*)** from Texas marine waters. Regression coefficients were estimated for log transformed weight as a function of log transformed total length using the equation Log_{10} W $=\text{Log}_{10}$ a + b Log_{10} TL. Total length–whole weight relationships determined in this study generally differed from other studies for the same species because other models often applied different measuring techniques.

INTRODUCTION

Length-weight relationships are useful tools in the study of fish biology and fishery management (Everhart *et al.* 1975). Prediction equations derived from regression analysis of the relationship between length and weight allow fishery managers to estimate one variable when the other is known. For example, length-weight relationships can be useful in estimating fisheries harvest by weight when only length data are available (Campbell 1984).

Other possible uses of length-weight relationships include estimating reef fish biomass, catch-at-age for fisheries analysis and estimating total catch weights for law enforcement purposes (Bohnsack and Harper 1988). Length-weight relationships are often reported in management plans for various species (Leard *et al.* 1993, 1995). Additionally, length-weight relationships can be useful in estimating weight when larger species exceed scale capacities or when use of scales or balances is impractical.

Many of the species in this study have few or no length-weight relationships previously documented from Texas marine waters. Some species are relatively uncommon and/or difficult to study. Nevertheless, some are important sport fish to Texas anglers, such as silver seatrout, (*Cynoscion regalis*) and it is important to document length-weight relationships for fishery management purposes.

Some species included in this study have length-weight relationships documented from other areas of the Gulf of Mexico, the Caribbean, and the Atlantic coast or freshwater. Swingle (1972) and Childress (1991) documented length-weight relationships for white bass (*Morone chrysops*) from freshwater in Alabama and Texas, respectively. Sheridan et al. (1984) published length-weight relationships for silver seatrout from Florida to Mexico.

Bohnsack and Harper (1988) reported length-weight relationships for lookdown (*Selene vomer*) and inshore lizardfish (*Synodus foetens*) from south Florida reefs and the Caribbean Sea. Ross (1988) reported length-weight relationships for banded drum (*Larimus fasciatus*) from North Carolina. Leffler and Shaw (1992) published length-weight relationships for Atlantic bumper (*Chloroscombrus chrysurus*) from Louisiana and Mississippi barrier islands.

The objective of this study was to develop total length-whole weight relationships for 20 marine fishes captured from Texas waters for use in life history studies and management of these species.

MATERIALS AND METHODS

Fish were collected during routine Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division resource and harvest sampling in eight Texas bay system and the Gulf of Mexico from November 1975 to December 1991. Resource sampling gears included gill nets, trammel nets, bag seines and otter trawls. Resource sampling techniques and gear descriptions are found in Rice et al. (1988), Hammerschmidt and McEachron (1986), Cody and Fuls (1984) and Hegen (1981). Harvest sampling techniques are described in Osburn arid Ferguson (1987). Data were also obtained from TPWD fish tag returns and from fish kill surveys (TPWD unpublished data). Total length (TL) of each fish was measured to the nearest millimeter (mm), and whole weight was determined by weighing each fish to the nearest 5 grams (g) as soon as possible after capture.

Least squares linear regression was performed on the log transformed power functions of $W=aTL^b$ (LeCren 1951) resulting in the regression equation:

$$\mathrm{Log}_{10}\, W = \mathrm{Log}_{10}\, a + b\, \mathrm{Log}_{10}\, TL$$

Where: a = Y intercept
b = slope of regression line
W = whole weight
TL = total length

Coefficients of determination (r^2) were calculated for each regression line; 95% confidence intervals were calculated for each Y-intercept and slope (Sokal and Rohlf 1969). SAS procedures were used for all analysis (SAS Institute Inc. 1985).

RESULTS

Total length-weight {TL-W) regression equations were calculated for 20 fish species found in Texas marine waters. The TL-W regressions for all species explained from 83% to 100% of the variation of W as a function of TL (Table 1).

DISCUSSION

Direct comparisons of the length-weight relationships presented in this study with other studies are difficult, as different measuring techniques were used to determine these relationships. Bohnsack and Harper (1988) used fork length to detemine the length-weight regressions on lookdown and inshore lizardfish. Swingle (1972) used aggregate weights of white bass separated into different size groups to detemine the length-weight regression relationship for this species. Leffler and Shaw (1992) used standard lengths measured primarily on juvenile Atlantic bumper (8.0 to 32.0 mm) from the Louisiana and Mississippi coast, and also oven dried the fish for six hours prior to weighing them in order to determine the length weight relationship for this species. Lane (1967) calculated standard length-weight relationships for preserved specimens of Atlantic midshipman (*Porichthys plectrodon*) collected from the Texas coast. Lane also reported a 2-3% length loss after 48 hours of formaldehyde preservation.

Ross (1988) reported standard length-whole weight relationships for banded drum from North Carolina. Ross also reported standard length to total length relationships for this species. When North Carolina banded drum standard lengths were converted to total lengths and compared to Texas banded drum, the values fell outside the confidence intervals calculated in the present study. It should be noted that published equations converting standard length to total length are only valid for the same group of fish. If these assumptions are correct, then Texas banded drum appear to be heavier per total length than North Carolina specimens. Differences in fish weight have previously been attributed to different growing seasons, nutrition, water quality, or genetic variation (Matlock and Strawn 1976). Standard and Chittenden (1984) also reported total length-whole weight relationships for banded drum from Gulf of Mexico waters off Freeport, Texas and their results fell within the confidence intervals calculated in this study.

Sheridan et al. (1984) studied silver seatrout and determined standard length-whole weight relationships for fish from the offshore Gulf of Mexico waters from Pensacola Bay, Florida to Brownsville, Texas. However, their findings cannot be directly compared to those in the present study due to different measuring techniques. DeVries and Chittenden Jr. (1982) also published standard length-whole weight relationships and standard length-total length relationships for silver seatrout from the Gulf of Mexico waters off Port Aransas, Texas. Their results are comparable to the total length-weight relationships found in this study.

Two studies have published total length weight relationships for some of the species evaluated in this study. Dawson (1965) published total length-whole weight relationships for Atlantic bumper, fringed flounder (*Etropus crossotus*), inshore lizardfish, line sole (*Achirus lineatus*), southern hake (*Urophycis floridana*), shoal flounder, and striped anchovy (*Anchoa hepsetus*) off the Mississippi and Louisiana coast, which were comparable to the present study. Childress (1991) published total length-whole weight relationships for white bass from Texas fresh waters, which correspond to the total length-weight relationships for salt water specimens in this study.

No previous studies have documented total length-weight relationships for bigeye searobin (*Prionotus longispinosus*), blackwing searobin (*Prionotus rubio*), bluntnose jack (*Hemicaranx amblyrhynchus*), diamond killifish (*Adinia xenica*), pancake batfish (*Halieutichthys aculeatus*), permit (*Trachinotus falcatus*), rock sea bass (*Centropristis philadelphica*), or sailfin molly (*Poecilia latipinna*) from Texas waters.

The regression models determined in this study can be useful when estimating harvest by weight if only total lengths of the fish are known. The data provided in this study represents total length-weight relationships for fish collected from Texas marine waters and do not take into account variations due to sex, seasonality, or geography. However, these regression models may not be applicable when used to determine weight of fish collected outside of Texas marine waters or when calculating weights from total lengths outside the range used in this study.

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TABLE 1. Total length (TL)-whole weight (W) relationships for 20 species of marine fish from Texas. Numbers in parentheses are 95% confidence intervals. Log W (g) = Log_{10} **a** + b Log_{10}TL (mm)

Species	TL range (mm)	N	Log *a*	b	r^2
Atlantic bumper *Chloroscombrus chrysurus*	22-240	1088	-4.07 (-4.12 to -4.02)	2.52 (2.49 to 2.55)	0.90
Atlantic midshipman *Porichthys plectrodon*	69-205	37	-4.70 (-4.91 to -4.49)	2.91 (2.81 to 3.01)	0.96
Banded drum *Larimus fasciatus*	30-203	295	-4.75 (-4.83 to -4.67)	2.95 (2.91 to 2.99)	0.95
Bigeye searobin *Prionotus longispinosus*	42-300	174	-4.92 (-5.02 to -4.82)	3.02 (2.97 to 3.07)	0.95
Blackwing searobin *Prionotus rubio*	30-167	124	-4.42 (-4.60 to -4.24)	2.75 (2.66 to 2.84)	0.88
Bluntnose jack *Hemicaranx amblyrhynchus*	32-122	14	-4.40 (-4.49 to -4.31)	2.73 (2.68 to 2.78)	1.00
Diamond killifish *Adinia xenica*	18-42	63	-5.08 (-5.30 to -4.86)	3.21 (3.06 to 3.36)	0.88
Fringed flounder *Etropus crossotus*	53-143	369	-4.59 (-4.69 to -4.49)	2.85 (2.80 to 2.90)	0.89
Inshore lizardfish *Synodus foetens*	48-235	111	-5.27 (-5.38 to -5.16)	3.02 (2.97 to 3.07)	0.97
Lined sole *Achirus lineatus*	25-104	17	-5.24 (-5.58 to -4.90)	3.32 (3.12 to 3.52)	0.95
Lookdown *Selene vomer*	41-308	18	-4.29 (-4.64 to -3.94)	2.75 (2.59 to 2.91)	0.94
Pancake batfish *Halieutichthys aculeatus*	41-72	23	-4.49 (-4.98 to -4.00)	2.91 (2.63 to 3.19)	0.83
Permit *Tracinotus falcatus*	37-289	21	-4.40 (-4.72 to -4.08)	2.82 (2.68 to 2.96)	0.95
Rock sea bass *Centropristis philadelphica*	51-144	29	-4.69 (-5.03 to -4.35)	2.92 (2.75 to 3.09)	0.92
Sailfin moly *Poecilia latipinna*	26-50	14	-4.65 (-4.97 to -4.33)	2.90 (2.70 to 3.10)	0.94
Shoal flounder *Syacium gunteri*	51-152	211	-5.37 (-5.49 to -5.25)	3.27 (3.21 to 3.33)	0.93
Silver seatrout *Cynoscion nothus*	36-197	1157	-5.01 (-5.06 to -4.96)	3.01 (2.99 to 3.03)	0.93
Southern hake *Urophycis floridana*	77-247	39	-4.95 (-5.32 to -4.58)	2.95 (2.78 to 3.12)	0.89
Striped anchovy *Anchoa hepsetus*	50-150	44	-5.52 (-5.75 to -5.29)	3.21 (3.09 to 3.33)	0.95
White bass *Morone chrysops*	101-411	26	-5.46 (-5.60 to -5.32)	3.24 (3.18 to 3.30)	0.99