WEIGHT-TOTAL LENGTH RELATIONSHIPS FOR 57 SALTWATER FISHES

by

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ABSTRACT

Weight (W)-total length (TL) regression equations were developed for 57 saltwater fishes. Regression coefficients for equations in the form of Y = a + bx were estimated for log transformed weight as a function of log transformed total length. Regression equations developed in this study generally differed from those for the same species reported from other studies because most authors did not measure total length.

INTRODUCTION

Weight-length (W-L) relationships are used in the study of fish biology and fishery management (Everhart et al. 1975). Prediction equations derived from regression analysis of the relationship between weight versus total length allow fishery managers to predict one variable when the other is known. For example, weight-total length conversions can be used to estimate harvest by weight when utilizing fish measured but not weighed (Campbell 1984).

Many species in this study have few or no weight-length regressions previously documented from Texas. Matlock and Strawn (1976) presented W-L relationships of ladyfish (Elops saurus), bay anchovy (Anchoa mitchilli), sheepshead minnow (Cyprionodon variegatus), gulf killifish (Fundulus grandis), spotfin mojarra (Eucinostomus argenteus), sand seatrout (Cynoscion arenarius), bighead searobin (Prionotus tribulus), white mullet (Mugil curema), rough silverside (Membras martinica), inland silverside (Menidia beryllina), and blackcheek tonguefish (Symphurus plagiusa) from Galveston Bay, Texas. The Texas Parks and Wildlife Department (TPWD) has developed W-L relationships for several species from Texas waters (Harrington et al. 1979, Campbell 1984, Campbell et al. 1988, Classen et al. 1988).

Some species have W-L regressions documented from areas other than Texas. Bohnsack and Harper (1988) presented W-L regressions on crevalle jack (Caranyx hippos), ladyfish, Atlantic spadefish (Chaetodipterus faber), striped burrfish (Chilomycterus schoepfi), southern stingray (Dasyatis americana), gray snapper (Lutjanus griseus), and pigfish (Orthopristis chrysoptera) from southern Florida. Swingle (1972) presented W-L regressions on Atlantic needlefish (Strongylura marina), bay anchovy, blue catfish (Ictalurus furcatus), common carp (Cyprinus carpio), longnose gar (Lepisosteus osseus), shortnose gar (Lepisosteus platostomus), skipjack herring (Alosa chrysochloris), smallmouth buffalo (Ictiobus bubalus), spotted gar (Lepisosteus oculatus), and threadfin shad (Dorosoma petenense) from Alabama. Dawson (1965) presented W-L relationships of bay anchovy, sand seatrout, gulf butterfish (Peprilus burti), bay whiff (Citharichthys spilopterus), hogchoker, and blackcheek tonguefish off Mississippi and Louisiana.

The objective of the present study was to develop weight-length conversion equations for 57 saltwater fishes caught in TPWD gear.

MATERIALS AND METHODS

Fish were collected during routine TPWD resource and harvest sampling in seven Texas bay systems and the Gulf of Mexico from November 1975 to February 1987. 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 and Ferguson (1987). Data were also obtained from TPWD fish tag returns and from fish kill surveys (TPWD unpublished data).

Fish were measured (nearest mm TL) and weighed (nearest 5 g). All fish were measured using the longest straight line distance from the front of the fish to the tip of the caudal fin, with the exception of the southern stingray and cownose ray, which were measured from wing tip to wing tip.

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

$$\text{Log } W = \log a + b \log TL$$

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 analyses (SAS Institute Inc. 1985).

RESULTS

The W-TL regressions for all species explained from 50% to 100% of the variation of W as a function of TL (Table 1).

DISCUSSION

The W-TL regressions determined in this study were difficult to compare to other studies due to different measuring techniques used by other authors. Bohnsack and Harper (1988) used fork length for their regressions. Swingle (1972) weighed fish in aggregate after separating fish into size groups. Matlock and Strawn (1976) used standard length for their regressions. Dawson (1965) used similar measuring techniques as in this study on bay anchovy, gulf butterfish, bay whiff, hogchoker, and blackcheek tonguefish. However, except for bay whiff, Dawson's calculated values fell outside the confidence intervals found in this study.

Regression equations calculated in this study are most appropriate for fish from Texas waters. The equations should be used with caution when comparing fish from other areas or when using lengths outside the size range used in this study. Regressions presented in this study can be used for estimating harvest by weight when only lengths are known.

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Table 1. Weight (W)-total length (TL in mm) relationships for 57 species caught in gulf and bay waters off the Texas coast from 1975 to 1987. Numbers in parenthesis are 95% confidence intervals.

Species	TL range	N	Log a	b	r^2
Atlantic cutlassfish	191-1,220	116	-5.22 (-5.37 to -5.07)	2.71 (2.66 to 2.76)	0.96
Atlantic needlefish	38-785	43	-5.33 (-5.72 to -4.94)	2.76 (2.60 to 2.92)	0.88
Atlantic spadefish	22-361	524	-3.81 (-3.92 to -3.70)	2.71 (2.66 to 2.76)	0.84
Atlantic threadfin	54-225	36	-4.95 (-5.13 to -4.77)	2.96 (2.87 to 3.05)	0.97
Bay anchovy	19-130	1,114	-5.17 (-5.22 to -5.12)	3.01 (2.98 to 3.04)	0.88
Bayou killifish	34-69	20	-5.05 (-5.29 to -4.81)	3.05 (2.91 to 3.19)	0.96
Bay whiff	26-145	28	-4.96 (-5.19 to -4.73)	2.98 (2.86 to 3.10)	0.96
Bighead searobin	18-425	84	-4.11 (-4.34 to -3.88)	2.67 (2.57 to 2.77)	0.89
Blackcheek tonguefish	21-176	30	-5.23 (-5.47 to -4.99)	3.13 (3.00 to 3.26)	0.95
Blacktip shark	396-1,846	462	-5.97 (-6.08 to -5.86)	3.27 (3.23 to 3.31)	0.94
Blue catfish	130-698	543	-5.94 (-6.02 to -5.86)	3.36 (3.33 to 3.39)	0.96
Bonnethead	127-1,041	538	-4.06 (-4.20 to -3.92)	2.53 (2.48 to 2.58)	0.82
Bull shark	650-1,800	1,029	-4.74 (-4.91 to -4.57)	2.86 (2.73 to 2.99)	0.71
Common carp	215-686	85	-5.07 (-5.22 to -4.92)	3.09 (3.03 to 3.15)	0.97
Cownose ray	300-970	241	-4.11 (-4.30 to -3.92)	2.76 (2.69 to 2.83)	0.87
Crevalle jack	36-1,168	182	-4.52 (-4.62 to -4.42)	2.84 (2.80 to 2.88)	0.97
Finescale menhaden	104-465	2,412	-4.73 (-4.80 to -4.66)	2.91 (2.88 to 2.94)	0.83
Finetooth shark	500-1,450	126	-5.04 (-5.39 to -4.69)	2.93 (2.81 to 3.06)	0.82
Florida pompano	40-515	168	-4.74 (-4.81 to -4.67)	2.94 (2.91 to 2.97)	0.99
Gray snapper	232-385	77	-3.79 (-4.14 to -3.44)	2.58 (2.44 to 2.72)	0.81
Gulf butterfish	32-266	52	-4.93 (-5.09 to -4.77)	3.07 (3.00 to 3.14)	0.97
Gulf killifish	20-130	807	-4.69 (-4.75 to -4.63)	2.90 (2.87 to 2.93)	0.91
Gulf kingfish	38-398	46	-5.25 (-5.35 to -5.15)	3.12 (3.08 to 3.16)	0.99
Gulf pipefish	56-275	53	-8.72 (-9.39 to -8.05)	4.32 (3.97 to 4.67)	0.74
Gulf toadfish	37-370	146	-4.81 (-4.92 to -4.70)	3.02 (2.97 to 3.07)	0.97
Harvestfish	65-390	292	-3.98 (-4.12 to -3.84)	2.68 (2.61 to 2.75)	0.87

Table 1. (Cont'd.)

Species	TL range	N	Log a	b	r^2
Hogchoker	21-180	68	-5.06 (-5.16 to -4.96)	3.21 (3.16 to 3.26)	0.98
Inland silverside	19-102	3,007	-4.93 (-4.96 to -4.90)	2.89 (2.87 to 2.91)	0.91
Ladyfish	110-672	762	-4.61 (-4.70 to -4.52)	2.75 (2.72 to 2.78)	0.90
Least puffer	18-260	135	-4.10 (-4.19 to -4.01)	2.71 (2.66 to 2.76)	0.95
Leatherjacket	40-270	50	-4.68 (-4.82 to -4.54)	2.77 (2.70 to 2.84)	0.97
Lemon shark	573-1,010	62	-5.52 (-5.83 to -5.21)	3.11 (2.99 to 3.21)	0.93
Leopard sêarobin	37-295	29	-4.54 (-4.70 to -4.38)	2.88 (2.81 to 2.95)	0.98
Longnose gar	453-1,295	368	-4.03 (-4.19 to -3.87)	2.50 (2.44 to 2.56)	0.84
Longnose killifish	19-132	1,555	-5.13 (-5.16 to -5.10)	3.11 (3.09 to 3.13)	0.96
Ocellated flounder	143-265	25	-4.75 (-5.33 to -4.17)	2.97 (2.72 to 3.22)	0.85
Pigfish	22-357	873	-4.64 (-4.76 to -4.52)	2.91 (2.86 to 2.96)	0.79
Rainwater killifish	21-130	141	-5.29 (-5.43 to -5.15)	3.24 (3.14 to 3.34)	0.89
Rough silverside	20-108	262	-5.25 (-5.32 to -5.18)	3.05 (3.01 to 3.09)	0.96
Sand seatrout	34-520	746	-5.19 (-5.24 to -5.14)	3.08 (3.06 to 3.10)	0.96
Scaled sardine	41-362	38	-4.88 (-4.94 to -4.82)	2.92 (2.89 to 2.95)	1.00
Scalloped hammerhead	489-2,540	60	-2.76 (-3.22 to -2.30)	2.07 (1.91 to 2.23)	0.73
Sheepshead minnow	16-58	2,118	-5.04 (-5.08 to -5.00)	3.25 (3.22 to 3.28)	0.88
Shortnose gar	147-769	128	-1.73 (-1.93 to -1.53)	1.71 (1.64 to 1.78)	0.81
Silver jenny	34-105	83	-4.67 (-4.79 to -4.55)	2.87 (2.80 to 2.94)	0.96
Silver perch	21-266	381	-4.44 (-4.51 to -4.37)	2.81 (2.78 to 2.84)	0.95
Skipjack herring	207-511	99	-4.20 (-4.81 to -3.59)	2.69 (2.45 to 2.93)	0.56
Smallmouth buffalo	229-647	21	-5.54 (-7.39 to -3.69)	3.24 (2.53 to 3.95)	0.50
Southern stargazer	67-410	29	-2.88 (-3.13 to -2.63)	2.27 (2.17 to 2.37)	0.95
Southern stingray	135-860	44	-4.29 (-5.08 to -3.50)	2.93 (2.62 to 3.24)	0.67
Spanish sardine	42-158	34	-4.57 (-4.98 to -4.16)	2.77 (2.53 to 3.01)	0.80
Spotfin mojarra	15-104	118	-4.91 (-4.99 to -4.83)	3.00 (2.95 to 3.05)	0.97

Table 1. (Cont'd.)

Species	TL range	N	Log a	b	r^2
Spotted gar	160-985	1,074	-4.03 (-4.15 to 3-3.91)	2.54 (2.50 to 2.58)	0.76
Striped burrfish	24-340	365	-2.71 (-2.84 to -2.58)	2.24 (2.18 to 2.30)	0.81
Threadfin shad	68-355	95	-4.70 (-4.87 to -4.53)	2.89 (2.82 to 2.96)	0.94
Tripletail	29-583	186	-5.27 (-5.53 to -5.01)	3.23 (3.13 to 3.33)	0.84
White mullet	26-191	556	-4.86 (-4.89 to -4.83)	2.95 (2.93 to 2.97)	0.98

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