Length-weight relationships of marine fishes from the central Brazilian coast

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Abstract

Parameters of the length-weight relationship are presented for 85 fish species from the marine and estuarine regions of the central Brazilian coast (latitude 13° to 23° S). Three different methods were used. A non-linear iterative process using the quasi-Newton algorithm yielded a better fit for all data sets analyzed. The length-weight allometry coefficient *b* estimated from standard length data tended to be lower than from total length data. The difference between these estimates was significant for some species.

Introduction

The relationship between body length and weight is of great importance in fishery biology (Sparre et al. 1989; Gulland 1983). Biomass estimates obtained from the widely used analytical models, such as virtual population analysis (Pope 1972), require the calculation of mean weight of individuals per age or length class through the length-weight relationship (LWR). Therefore, obtaining accurate LWR parameter estimates is an important factor in the assessment of fish stocks.

Length-weight relationships are usually calculated through linear regression on log-transformed data. The ordinary least squares or "predictive" regression (Zar 1984) is the most commonly applied method for the estimation of LWR parameters. Ricker (1973) suggested the use of geometric mean (GM) functional regression in order to circumvent the problem that the independent variable (i.e., length) is subject to natural variability. In recent years, the use of non-linear procedures for the estimation of LWR, as well as other population parameters, has been increasing among researchers.

The parameter *b* of the LWR equation ($W = a.L^b$), also known as the allometry coefficient, has an important biological meaning, indicating the rate of weight gain relative to growth in length. Marked variability in estimates of *b* is usually observed among different populations of the same species, or within the same population at different times. On the one hand, this may reflect changes in the condition of individuals related to feeding, reproductive or migratory activities (King 1995). On the other hand, sampling related factors or calculation methods may often account for the significant difference in estimates. Among the first we quote sample size, length distribution in the samples and type of length measure, and among the second, regression models used for parameter estimation.

The central coast of Brazil is characterized by a generally narrow continental shelf (about 25 km) with bottom composed of calcareous sediment (Nonaka et al. 2000; Fig.1). The southward flow of the Brazil Current in this region represents a typical western boundary current regime (Castro and Miranda 1998) and brings warm, saline and oligotrophic waters to the coast. Sea surface temperatures between 24.0° to 26.4°C and 26.0° to 28.3°C have been recorded at 10 m depth over the Abrolhos Bank during winter-summer and autumn, respectively. The Royal Charlotte Bank and Abrolhos Bank (Fig.1) are offshore extensions of the shelf where coral and calcareous algal reef habitats predominate and that represent important fishing grounds for the snapper and grouper line fishery.

The main objective of this paper is to provide the LWR for a wide variety of fishes from the central Brazilian coast, including both the target species and by-catch species in commercial, recreational or subsistence fisheries. A secondary objective is to analyze the influence of fitting methods, sample size and types of length measure in the estimation of LWR parameters.

Materials and Methods

Samples were obtained during the period 1993-2000 using various fishing gears, such as hand lines, long lines, bottom trawls, gill nets and beach seines. Fishes were measured lying on their right side on a scaled board and different types of length measures were taken. Smaller species were measured to the nearest mm and larger species to the nearest five mm. Fishes up to 10 kg were weighed to the nearest decigram on a digital balance and heavier specimens were weighed to the nearest 100 g using a dynamometer. Three different methods were used to estimate the parameters of the length-weight equation: (i) ordinary "predictive" linear regression, based on log-transformed data; (ii) GM functional linear regression, also based on log-transformed data; and (iii) a non-linear iterative procedure using the quasi-Newton algorithm. Weights that differed more than 20 per cent from the predicted

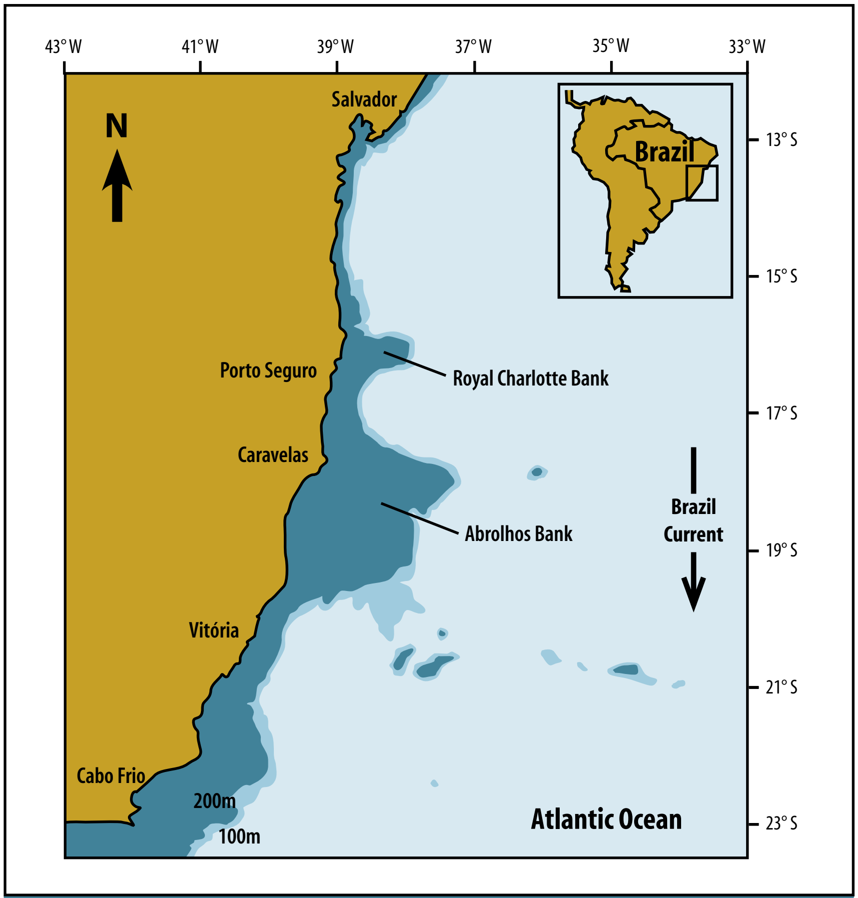

Fig. 1. Map showing central Brazilian coast, continental shelf and upper slope.

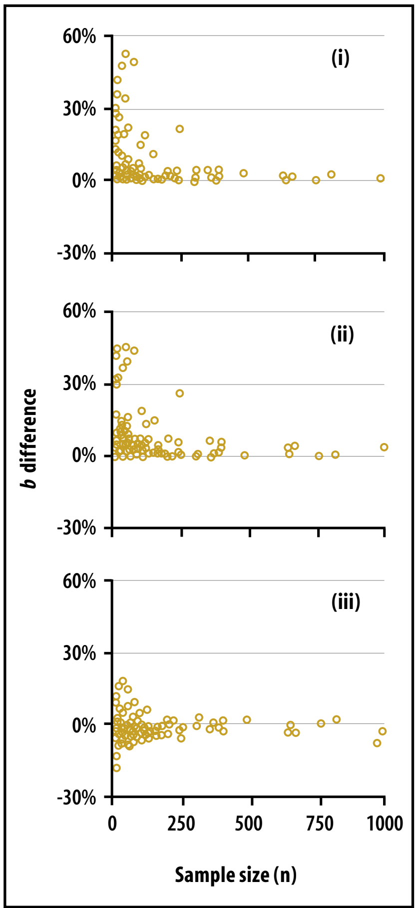

Fig. 2. Percentage difference between residual sum of squares (RSS) of three regression methods for 139 sets of length-weight data plotted against sample size. **(i)** ordinary - non-linear; **(ii)** functional - non-linear; **(iii)** ordinary -functional.

value in a preliminary ordinary regression were considered outliers and excluded from the analyses. Fits obtained from the different methods were compared in regard to their residual sum of squares (RSS).

The influence of length type on estimates of the LWR allometry coefficient *b* was investigated for 39 species. First we excluded outliers from the regressions on total length (TL), fork length (FL) and standard length (SL). Length-weight relationships were then calculated for each length type and data sets were composed of the same individuals for each species. Estimates of *b* obtained from different length types were compared using Wilcoxon matched pairs test (Zar 1984). For each species, covariance analysis was used to check whether values of *b* obtained from using different length types were statistically similar.

Results

The LWR was estimated for 139 data sets corresponding to 85 fish species (80 teleosts and 5 elasmobranchs) from 41 families. Sample size ranged from 10 to 986 individuals (mean = 114). Sample size, length and weight ranges, parameter estimates and determination coefficients (r^2) from non-linear regressions for each species are presented in Table 1.

For all 139 data sets, RSS yielded by the non-linear procedure was lower than those from both the ordinary and functional regression methods. Non-linear RSS was on average 5.5 per cent and 6.3 per cent lower than that from the ordinary and functional regression methods, respectively. The difference was greater for the smaller sample sizes (Fig.2). For $n<100$, the mean difference between non-linear RSS and either the ordinary or the functional RSS was around 7 per cent, dropping to less than 2 per cent for $n>300$. Ordinary regression yielded a better fit than functional regression for 93 data sets and a Wilcoxon test indicated a significant difference in residuals from these linear methods ($P = 0.0032$).

For 104 data sets, the allometry coefficient *b* calculated by functional regression was higher than that of the non-linear procedure and a Wilcoxon test showed a highly significant ($P < 0.0001$) difference in estimates of *b* between these methods. As predicted by Ricker's model (1973), values of *b* obtained by functional regression were always

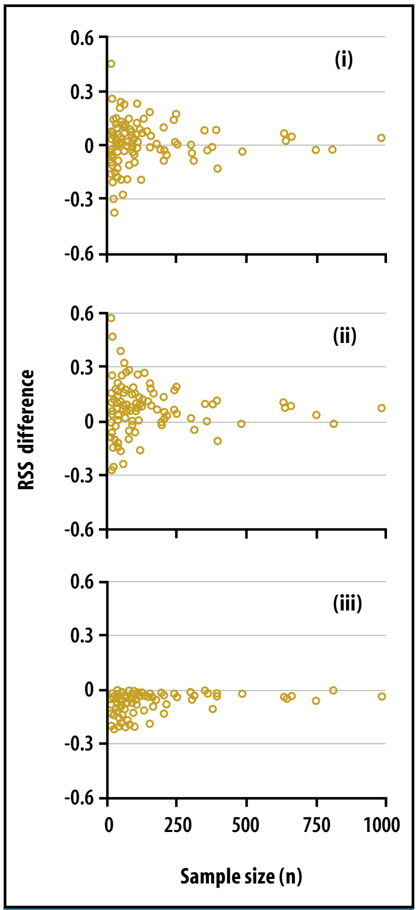

Fig. 3. Absolute differences between estimates of LWR allometry coefficient *b* from three regression methods for 139 sets of length-weight data plotted against sample size. **(i)** ordinary - non-linear; **(ii)** functional - non-linear; **(iii)** ordinary - functional.

higher than those obtained by ordinary regression. No statistical difference was detected between values of *b* estimated by ordinary regression and by the non-linear method. Differences among values of *b* estimated by the different regression models were greater for smaller sample sizes (Fig.3).

In terms of the influence of length type, SL data yielded a lower allometry coefficient *b* than TL data for 23 out of 39 species analyzed, and estimates obtained from these length types differed significantly (P = 0.0075). The Wilcoxon test did not show significant statistical difference between estimates of *b* obtained from FL and either TL or SL data. Allometry coefficients calculated from different length types are plotted in Fig.4.

The estimate of *b* obtained from SL data was statistically different from that of TL data for four species, namely *Dermatolepis inermis* ($P < 0.0001$), *Malacanthus plumieri* ($P = 0.0012$), *Holocentrus ascensionis* ($P = 0.0102$) and *Pseudopercis numida* ($P = 0.0171$). When comparing *b* obtained from TL and FL data, significant differences were found for *Balistes capriscus* ($P < 0.0001$), *M. plumieri* ($P < 0.001$), *Ocyurus chrysurus* ($P = 0.0075$), *P. numida* ($P = 0.0202$) and *Lopholatilus villarii* ($P = 0.0458$). Only for *Balistes vetula* we found a significant difference between estimates of *b* obtained from FL and SL data ($P < 0.0001$).

Discussion

When comparing LWRs available in the literature, one might find wide variability in parameter estimates for a single species. This is due to the fact that the LWR is greatly affected by many factors related to population variability and to sampling and estimation methods. Sampling related factors include sample size, length distribution in the sample and type of length measure, while nutritional conditions account for intrinsic biological variability (Ricker 1975). Parameter estimates are only good enough for the population studied and awareness of time of sampling is essential. Efficient sampling must include the widest possible range of lengths, generally obtained with large samples and non-selective fishing techniques. In this study, we estimated the LWR for some data sets with small sample size and homogeneous length distribution in order to analyze variability in parameter estimates related to sample characteristics.

Different mathematical models used for the calculations may also significantly affect LWR parameter estimates. For all data sets analyzed in this study, a non-linear method (using the quasi-Newton algorithm) yielded lower RSS when compared to both ordinary and functional linear regressions. Our results are in accordance with those reported by Haimovici and Velasco (2000) and strongly suggest that, whenever possible, the LWR should be calculated using non-linear procedures.

The GM functional regression model predicts that the resulting estimate of the slope *b* will always be higher than that of the ordinary regression (Ricker 1973). In the present study, we found that functional regression estimates of *b* were also significantly higher than those yielded by the non-linear method. As the non-linear method always produces a better fit and, therefore, best represents the relationship between the variables length and weight, this result suggests that the GM functional regression may lead to overestimation of the LWR allometry coefficient *b*, especially when sample size is small.

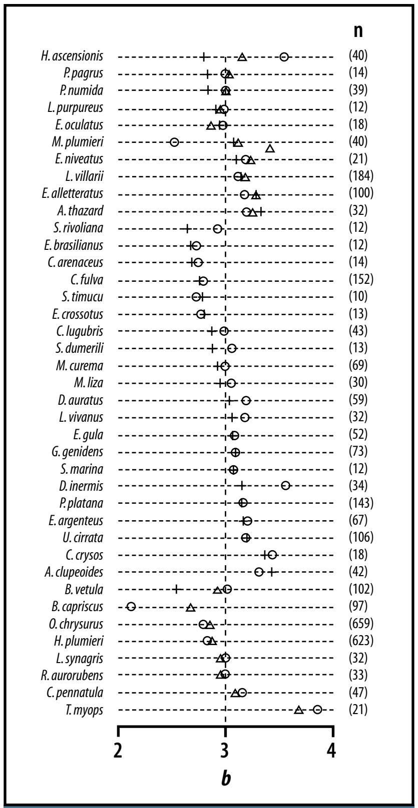

Fig. 4. LWR allometry coefficients *b* calculated based on (o) TL data, (Δ) FL data and (+) SL data for 39 species of marine fishes from the central Brazilian coast (n).

Table I. Non-linear length-weight relationships of 85 species of marine fishes from eastern Brazil.

Family	Species	*n	Length	Length (cm)		Total weight (g)		LWR		
			Type	min.	max.	min.	max.	a	b	r²
Triakidae	*Mustelus canis*	121	TL	57.0	111.0	586,2	4789.7	0.0034	3.006	0.967
Carcharhinidae	*Prionace glauca*	74	TL	183.0	288.0	24000.0	100000.0	0.0110	2.828	0.885
	Carcharhinus signatus	10	TL	95.5	230.3	4391.0	59700.0	0.0091	2.886	0.998
Squalidae	*Squalus megalops*	24	TL	49.5	79.0	486.6	2342.0	0.0038	3.042	0.955
	Squalus mitsukurii	34	TL	59.4	89.8	838.1	3301.8	0.0021	3.176	0.943
Elopidae	*Elops saurus*	16	SL	16.2	36.3	34.5	573.0	0.0040	3.290	0.988
Muraenidae	*Gymnothorax moringa*	212	TL	51.0	103.0	200.0	2287.4	0.0003	3.431	0.957
	Gymnothorax polygonius	22	TL	55.2	80.8	298.7	988.0	0.0011	3.113	0.949
Engraulidae	*Anchoa januaria*	35	SL	5.0	6.9	1.9	4.3	0.0396	2.412	0.842
	Anchovia clupeoides	200	SL	9.8	15.2	12.4	54.2	0.0081	3.219	0.891
	A. clupeoides	47	TL	13.8	17.9	15.4	38.1	0.0045	3.149	0.884
	Cetengraulis edentulus	17	SL	9.2	10.9	15.6	25.4	0.0149	3.123	0.889
Clupeidae	*Opisthonema oglinum*	75	TL	7.5	25.3	3.0	125.6	0.0140	2.790	0.987
	Platanichthys platana	240	SL	2.5	9.7	0.3	16.1	0.0198	2.945	0.955
	P. platana	144	TL	3.5	11.0	0.3	12.2	0.0072	3.102	0.946
	Sardinella brasiliensis	40	FL	15.8	18.5	51.7	88.9	0.0086	3.155	0.891
Ariidae	*Genidens genidens* (juvenile)	153	SL	5.0	8.8	1.8	9.4	0.0179	2.888	0.971
	G. genidens	92	SL	9.0	26.2	9.9	335.5	0.0089	3.198	0.990
	G. genidens	77	TL	8.3	32.3	4.1	267.0	0.0042	3.190	0.995
Synodontidae	*Trachinocephalus myops*	21	FL	20.6	30.0	88.7	394.1	0.0007	3.881	0.976
	T. myops	21	TL	22.5	32.6	88.7	394.1	0.0004	3.972	0.981
Polymixiidae	*Polymixia lowei*	10	TL	25.2	46.3	204.3	1398.5	0.0119	3.039	0.981
Ophidiidae	*Genypterus brasiliensis*	41	TL	35.4	96.2	306.0	4637.7	0.0147	2.766	0.996
Phycidae	*Urophycis cirrata*	251	TL	24.0	53.5	95.4	1191.6	0.0042	3.166	0.968
	U. cirrata	108	SL	22.5	48.0	116.5	1294.3	0.0059	3.177	0.975
Merlucciidae	*Merluccius hubbsi*	151	TL	16.6	50.5	26.8	955.0	0.0090	2.937	0.967
Lophiidae	*Lophius gastrophysus*	19	TL	41.0	67.5	1040.0	4340.0	0.0086	3.140	0.973
Mugilidae	*M. curema* (juvenile)	246	SL	2.1	8.4	0.2	17.7	0.0262	3.004	0.994
	Mugil curema (adult)	200	SL	10.3	28.3	23.9	489.4	0.0493	2.710	0.970
	M. curema (adult)	72	TL	17.4	35.7	58.7	489.4	0.0108	2.969	0.974
	Mugil liza	104	SL	13.9	37.1	42.7	816.5	0.0398	2.767	0.966
	M. liza	32	TL	17.5	42.2	42.7	657.8	0.0078	3.032	0.991
Belonidae	*Strongylura marina*	24	SL	35.3	73.4	62.3	674.8	0.0011	3.108	0.990
	S. marina	12	TL	37.6	78.3	62.3	674.8	0.0007	3.175	0.993
	Strongylura timucu	10	SL	34.0	47.4	62.5	161.7	0.0037	2.769	0.964
	S. timucu	10	TL	36.7	51.4	62.5	161.7	0.0043	2.672	0.955
Holocentridae	*Holocentrus ascensionis*	67	TL	26.5	37.9	213.0	613.7	0.0079	3.076	0.847
	H. ascensionis	60	FL	20.1	31.1	137.5	650.0	0.0121	3.147	0.911
	H. ascensionis	55	SL	17.5	28.4	137.5	605.1	0.0734	2.682	0.878
Dactylopteridae	*Dactylopterus volitans*	11	TL	35.2	44.0	496.4	802.6	0.0851	2.424	0.959
Scorpaenidae	*Pontinus rathbuni*	17	TL	21.6	33.4	126.6	641.6	0.0039	3.398	0.977
Triglidae	*Prionotus nudigula*	11	TL	26.6	38.1	226.3	887.4	0.0010	3.738	0.966
Serranidae	*Cephalopholis fulva*	751	TL	16.5	40.0	75.8	1177.3	0.0114	3.128	0.950
	C. fulva	165	SL	15.7	32.7	141.0	919.3	0.0755	2.727	0.928
	Dermatolepis inermis	56	TL	42.3	92.5	1236.1	15700.0	0.0015	3.551	0.973
	D. inermis	47	SL	33.1	79.0	1236.1	15700.0	0.0111	3.243	0.994
	Epinephelus adscensionis	11	SL	31.5	46.0	847.0	3044.8	0.0125	3.224	0.966

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Family	Species	*n	Length	Length (cm)		Total weight (g)		LWR		
			Type	min.	max.	min.	max.	a	b	r^2
	Epinephelus marginatus	19	TL	53.3	93.5	2431.5	15000.0	0.0107	3.126	0.991
	Epinephelus morio	69	FL	49.0	84.0	2000.0	8000.0	0.0606	2.661	0.892
	Epinephelus niveatus	120	TL	34.5	121.6	595.6	23030.0	0.0259	2.867	0.978
	E. niveatus	25	SL	28.3	95.5	595.6	20000.0	0.0249	2.990	0.980
	Mycteroperca bonaci	359	FL	42.2	143.0	1016.6	46000.0	0.0069	3.153	0.979
	Mycteroperca acutirostris	23	FL	32.7	46.2	543.3	1457.2	0.0130	3.033	0.957
	Mycteroperca interstitialis	22	FL	44.5	75.5	911.5	5000.0	0.0009	3.582	0.956
Malacanthidae	*Caulolatilus chrysops*	10	TL	38.9	55.4	604.5	1920.0	0.0065	3.130	0.955
	Lopholatilus villarii	483	TL	37.5	98.0	603.0	12500.0	0.0054	3.181	0.988
	L. villarii	193	FL	40.9	89.8	874.4	10474.1	0.0054	3.216	0.991
	L. villarii	192	SL	35.0	79.0	874.4	10474.1	0.0111	3.155	0.984
	Malacanthus plumieri	51	TL	35.4	69.5	313.1	1879.8	0.0206	2.692	0.926
	M. plumieri	45	SL	42.2	60.5	556.3	1879.8	0.0047	3.147	0.946
	M. plumieri	44	FL	46.2	69.5	556.3	1879.8	0.0240	2.655	0.918
Pomatomidae	*Pomatomus saltatrix*	67	TL	48.0	75.5	977.8	3143.8	0.0595	2.509	0.968
Coryphaenidae	*Coryphaena hippurus*	302	FL	54.0	138.5	1417.1	21500.0	0.0202	2.799	0.940
Carangidae	*Alectis ciliaris*	11	FL	84.5	114.0	7000.0	16300.0	0.0786	2.579	0.851
	Caranx crysos	380	FL	23.3	43.1	242.4	1485.4	0.0306	2.861	0.938
	C. crysos	18	SL	31.5	48.2	630.0	3002.1	0.0043	3.465	0.980
	C. crysos	16	TL	34.5	43.2	463.4	830.1	0.0459	2.593	0.913
	Caranx latus	300	FL	34.1	89.0	780.1	10400.0	0.0674	2.668	0.987
	Caranx lugubris	48	SL	32.7	61.5	922.9	5655.6	0.0572	2.794	0.982
	C. lugubris	48	TL	42.0	73.0	922.9	4484.3	0.0187	2.900	0.966
	Seriola dumerili	313	FL	60.0	150.5	3000.0	40400.0	0.0363	2.771	0.973
	S. dumerili	22	TL	43.6	140.0	937.9	29500.0	0.0144	2.949	0.987
	S. dumerili	16	SL	43.5	77.5	2094.3	11363.0	0.0159	3.089	0.982
	Seriola rivoliana	87	FL	47.5	93.0	1500.0	11000.0	0.0359	2.801	0.958
	S. rivoliana	18	TL	51.0	98.4	1351.5	9649.1	0.0122	2.957	0.993
	S. rivoliana	12	SL	41.9	69.4	1351.5	5565.3	0.0409	2.783	0.974
Lutjanidae	*Etelis oculatus*	27	TL	56.5	99.5	1590.5	8476.8	0.0128	2.908	0.975
	E. oculatus	26	SL	41.7	74.0	1590.5	8476.8	0.0495	2.783	0.962
	E. oculatus	22	FL	45.8	80.5	1590.5	8476.8	0.0198	2.937	0.975
	Lutjanus analis	393	FL	37.0	83.0	972.4	10500.0	0.0282	2.890	0.967
	Lutjanus jocu	392	FL	24.5	81.1	278.3	12100.0	0.0057	3.287	0.969
	Lutjanus purpureus	17	FL	27.3	44.9	340.2	1608.8	0.0084	3.186	0.977
	L. purpureus	17	TL	30.4	49.8	340.2	1608.8	0.0072	3.143	0.972
	L. purpureus	12	SL	29.0	36.7	677.6	1352.4	0.0348	2.928	0.917
	Lutjanus synagris	86	FL	20.0	48.5	145.6	1881.8	0.0216	2.917	0.987
	L. synagris	34	TL	26.2	51.5	225.6	1812.1	0.0113	3.031	0.987
	Lutjanus vivanus	242	FL	26.2	54.0	333.7	2601.0	0.0191	2.966	0.974
	L. vivanus	65	TL	41.5	76.8	945.5	6687.7	0.0169	2.948	0.956
	L. vivanus	34	SL	32.0	56.0	945.5	4753.5	0.0232	3.051	0.929
	Ocyurus chrysurus	986	FL	23.0	53.5	214.5	2145.3	0.0328	2.812	0.975
	O. chrysurus	661	TL	28.0	63.8	214.5	2119.6	0.0235	2.740	0.973
	Rhomboplites aurorubens	46	FL	25.3	46.5	260.3	1495.9	0.0232	2.894	0.977
	R. aurorubens	33	TL	36.0	51.5	525.8	1495.9	0.0168	2.896	0.957
Gerreidae	*Eucinostomus argenteus*	350	SL	2.0	10.7	0.2	32.9	0.0313	2.919	0.986
	E. argenteus	77	TL	3.7	12.6	0.6	26.0	0.0113	3.045	0.986

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Family	**Species**	***n**	**Length**	**Length (cm)**		**Total weight (g)**		**LWR**		
			Type	**min.**	**max.**	**min.**	**max.**	**a**	**b**	**r²**
	Eucinostomus gula	110	SL	3.8	11.0	1.3	33.8	0.0209	3.122	0.972
	E. gula	59	TL	5.0	14.2	1.3	33.3	0.0124	3.015	0.977
	Eugerres brasilianus	21	SL	10.9	17.5	39.9	182.4	0.0200	3.176	0.981
	E. brasilianus	12	TL	14.6	19.5	39.9	85.6	0.0309	2.686	0.945
	Diapterus auratus	105	SL	5.9	14.4	6.9	105.7	0.0423	2.932	0.974
	D. auratus	60	TL	12.1	17.4	21.0	66.5	0.0185	2.896	0.945
Haemulidae	*Haemulon plumieri*	635	FL	15.2	34.6	81.3	891.8	0.0417	2.809	0.962
	H. plumieri	639	TL	17.1	39.1	81.3	891.8	0.0335	2.772	0.959
	Orthopristis ruber	152	TL	16.9	24.4	65.6	183.1	0.0265	2.748	0.872
Sparidae	*Calamus pennatula*	50	TL	17.3	31.2	80.0	510.0	0.0119	3.093	0.986
	C. pennatula	48	FL	14.8	28.0	80.0	510.0	0.0463	2.810	0.984
	Pagrus pagrus	809	TL	17.0	64.5	76.0	3781.3	0.0206	2.898	0.991
	P. pagrus	14	FL	24.8	42.3	336.2	1711.8	0.0160	2.965	0.989
	P. pagrus	14	SL	21.7	38.0	336.2	1711.8	0.0307	2.910	0.984
Sciaenidae	*Menticirrhus americanus*	33	TL	12.3	33.2	22.8	428.0	0.0068	3.157	0.991
	Umbrina canosai	84	TL	24.7	41.5	222.8	981.2	0.0275	2.804	0.949
Mullidae	*Mullus argentinae*	95	TL	13.6	26.0	32.2	235.7	0.0086	3.129	0.857
Pinguipedidae	*Pseudopercis numida*	97	TL	44.8	98.7	862.9	9674.5	0.0125	2.954	0.991
	P. numida	45	FL	44.2	95.8	1036.1	9674.5	0.0152	2.939	0.988
	P. numida	45	SL	38.3	86.0	1036.1	9674.5	0.0562	2.715	0.985
Percophidae	*Percophis brasiliensis*	90	TL	41.6	68.5	328.4	1501.3	0.0046	3.000	0.911
Sphyraenidae	*Sphyraena barracuda*	77	FL	58.3	139.0	1234.3	18000.0	0.0070	2.972	0.944
Gempylidae	*Lepidocybium flavobrunneum*	35	TL	71.0	180.0	4400.0	60000.0	0.0255	2.840	0.962
Trichiuridae	*Trichiurus lepturus*	111	LPA	21.4	63.0	115.0	2275.0	0.0338	2.653	0.966
Scombridae	*Acanthocybium solandri*	43	FL	82.6	176.0	2900.6	36000.0	0.0016	3.275	0.978
	Auxis thazard	34	SL	23.0	29.3	214.8	511.2	0.0080	3.273	0.944
	A. thazard	34	TL	26.9	34.8	214.8	511.2	0.0060	3.194	0.951
	A. thazard	33	FL	24.6	31.7	214.8	511.2	0.0089	3.170	0.926
	Euthynnus alletteratus	104	TL	25.9	39.5	192.2	691.6	0.0065	3.153	0.966
	E. alletteratus	103	FL	23.4	35.2	192.2	691.6	0.0072	3.225	0.968
	E. alletteratus	103	SL	22.0	32.7	192.2	691.6	0.0094	3.216	0.966
	Scomberomorus cavalla	100	FL	55.7	151.0	1217.9	23000.0	0.0164	2.821	0.974
Scombridae	*Thunnus albacares*	71	FL	82.0	136.5	8000.0	39700.0	0.0147	3.013	0.967
	Thunnus atlanticus	130	FL	45.5	90.0	1799.4	12500.0	0.1250	2.551	0.883
Xiphiidae	*Xiphias gladius*	31	LJF	90.0	226.0	7500.0	150000.0	0.0056	3.150	0.985
Paralichthyidae	*Citharichthys arenaceus*	36	SL	3.5	9.6	0.7	16.1	0.0101	3.280	0.989
	C. arenaceus	14	TL	4.3	5.5	0.7	1.5	0.0127	2.760	0.885
	Etropus crossotus	14	SL	3.8	6.8	1.1	6.3	0.0162	3.092	0.983
	E. crossotus	13	TL	4.7	8.6	1.1	6.3	0.0111	2.937	0.989
Balistidae	*Balistes capriscus*	119	FL	19.7	36.9	165.0	1005.0	0.0240	2.942	0.974
	B. capriscus	97	TL	21.3	46.7	165.0	895.0	0.1823	2.215	0.962
	Balistes vetula	174	FL	26.2	49.0	520.1	3345.0	0.0205	3.064	0.956
	B. vetula	102	SL	21.2	43.0	520.1	3101.8	0.2328	2.513	0.923
Tetraodontidae	*Lagocephalus laevigatus*	11	SL	25.9	38.9	360.1	1102.8	0.3382	2.223	0.910

* n - sample size; TL - total length; FL - fork length; SL - standard length; LPA - pre-anal length; LJF - lower jaw-fork length; a, b - regression coefficients; r² - determination coefficient

The LWRs have been computed using different types of length and weight measures. The combination most frequently used in fishery studies is FL and fresh total body weight (Ricker 1975). In this study, we found that different length types can lead to statistically different estimates of the LWR allometry coefficient *b* and SL data tended to yield lower values of *b* than TL data. Choosing the use of TL, FL or SL for fish population studies means choosing total or partial inclusion or exclusion of the caudal fin in the length measure, and this can be a controversial matter.

Fins are highly compressed structures, devoid of muscle. Therefore, there is a considerable difference in growth allometry and relative weight gain of the caudal fin as compared to the rest of a fish body. This becomes even more significant if we consider fishes with odd shaped caudal fins. We found significant differences in estimates of *b* from TL and either SL or FL data for species such as *B. capriscus, M. plumieri* and *L. villarii*, all characterized by a filamentous prolongation in the distal tips of the caudal fin. The same occurred for *O. chrysurus* and *H. ascensionis*, which have deeply forked caudal fins with relatively long lobes.

Fishery researchers must be aware that the LWR can be significantly affected by sampling and computational procedures, and efforts should be made to obtain appropriate and comparable parameter estimates.

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