

Length-weight relationship of commercially important marine fishes and shellfishes of the southern coast of Karnataka, India

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Abstract

The parameters of the length-weight relationship of the form $W = aL^b$ are presented for 51 species of commercially important marine fishes and shellfishes caught along the southern coast of Karnataka, India. Samples from commercial (trawl, purse seines, gill nets) and artisanal gears were taken during August 1999 to May 2001. The 'b' value ranged between 1.942 and 3.616 with a mean of 2.80, standard deviation of 0.32, and mode of 3.

Introduction

The length-weight relationship (LWR) is an important factor in the biological study of fishes and their stock assessments. The LWR is particularly important in parameterizing yield equations and in estimations of stock size. This relationship is helpful for estimating the weight of a fish of a given length and can be used in studies of gonad development, rate of feeding, metamorphosis, maturity and condition (Le Cren 1951). Methods to estimate the length-weight relationship of fishes are described by Pauly (1983).

Karnataka state, in southwest India, has a coastline of 300 km and a shelf area of about 25 000 km² (Fig. 1). Mohamed et al. (1998) studied marine fisheries and the state of commercially exploited species in this region. Karnataka's contribution to total marine fish production in India has varied between 6 per cent and 14 per cent. Pelagic and demersal finfishes, prawns and cephalopods are landed at 28 landing centers along the coast. The average annual production in the state was estimated at 112 500 t/year during 1950 to 1990. Mechanized boats employing purse seines and trawl gears

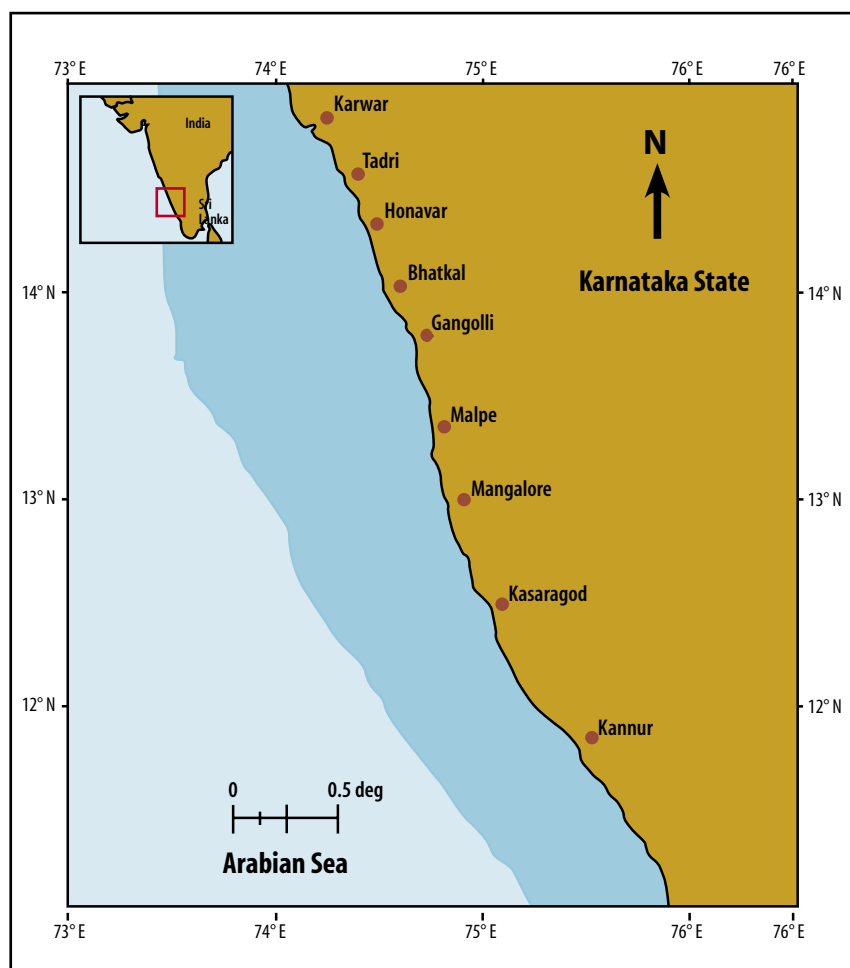


Fig. 1. Map of the southern coast of Karnataka, India.

obtained more than 95 per cent of the annual average catch in Karnataka during 1990-95.

There are a limited number of studies on the LWR of the commercially important fishes from the southern Karnataka region (Dulkhed 1963; Muthiah 1994; Rao 1997, 1988; Mohamed and Rao 1997; Kalitha and Jayabalan 1997; Sukumaran and Neelakantan 1997; Zacharia 1998). As part of an Indian Council of Agricultural Research (ICAR) project on application of trophic modelling to the marine ecosystem of southern Karnataka, biological data on length, weight, length-frequency and diet composition of all major commercial species occurring in the region was collected. Here we report on the LWR of key species in the region.

Materials and Methods

The fishes used for the study were collected during the period August 1999 to May 2001 from the Mangalore and Malpe fishing harbors, two important landing centres on the southern coast of Karnataka. The fishing gears used in this region include trawl, purse seines, gillnets and indigenous gears. Total length (TL) was measured from the tip of the snout (mouth closed) to the extended tip of the caudal fin. Fork length (FL) was measured from the tip of the snout to the end of the middle rays of the caudal fork. Body weight of individual fish was measured to the nearest gram with an electronic balance after removing the adhered water and other remains from the surface of body. Species identification was made based on Smith and Heemstra (1986) and FAO Species Identification sheets (Fischer and Bianchi 1984).

The length-weight relationship (LWR) was estimated by using the equation

$$W = aL^b$$

where W = weight in grams, L = total length in centimeters, a is a scaling constant and b the allometric growth

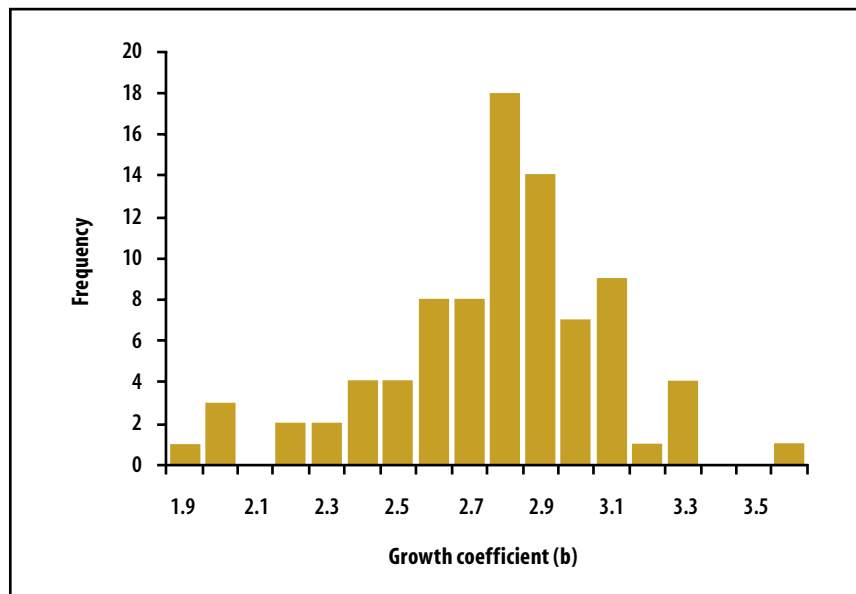


Fig. 2. Frequency distribution of allometric growth coefficients for 51 marine species from southern Karnataka, India.

parameter. A logarithmic transformation was used to make the relationship linear:

$$\log W = \log a + \log b L$$

For each species a regression was used to estimate the intercept ($\log a$) and the regression coefficient or slope (b), using Microsoft Excel™. For species with sufficient data the LWR was determined separately for each sex. LWR parameters for additional species were obtained from the literature, as part of the preparation for the trophic modeling study.

Results

The parameters of the length-weight relationship estimated for 51 species belonging to 29 families comprising a total of 19 726 individuals are presented in Table 1. The LWR pertaining to 11 species comprising cephalopods and crabs were taken from published data. Most of the parameters were based on large samples and thus may be considered reasonably representative and reliable. The estimated values of b ranged between 1.94 (*Loligo duvauceli*) and 3.62 (*Portunus pelagicus*) (Fig. 2). The mean value for all species was 2.80 (SD = 0.32). The median and mode values of b were 2.85 and 3,

respectively. The sample size ranged from 20 individuals for *Carcharhinus limbatus* to 2 819 for *Saurida tumbil*. The parameters as shown in Table 1 can be used for studying growth and population dynamics for any of the 51 species of fish exploited from this coast.

Acknowledgements

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References

- Dhulkhed, M. H. 1963. The length-weight and volume relationship of the Indian oil sardine, *Sardinella longiceps* Valenciennes. Indian. J. Fish. 10(A): 40-47.
- Fischer, W. and G. Bianchi (eds.) 1984. FAO. Species identification sheets for fishery purpose - Western Indian Ocean (Fishing Area 51). Food and Agricultural Organization of the United Nations, Rome. Vol. I-IV.

Table 1. Sex-wise length-weight relationship parameters and minimum and maximum length and weights. The source is from the present study unless otherwise stated.

Taxa	Sex	Length (cm)		Weight (g)		n	a	b	r	Source
		min	max	min	max					
Rock Cods (Serranidae)										
<i>Epinephelus diacanthus</i>	Pooled	14.7	38.7	156.0	720.0	200	0.058	2.516	0.87	
Flatheads (Platycephalidae)										
<i>Grammoplites suppositus</i>	M	14.3	26.9	19.0	139.0	200	0.013	2.798	0.88	
	F	17.9	27.9	37.0	171.0	193	0.012	2.846	0.88	
Bulls Eye (Priacanthidae)										
<i>Priacanthus hamrur</i>	M	17.0	26.8	57.5	237.0	38	0.017	2.905	0.97	
	F	15.8	28.5	48.0	275.0	165	0.02	2.787	0.90	
Seer Fish (Scombridae)										
<i>Scomberomorus commerson</i>	Pooled	25.0	100.0	150.0	7200.0	232	0.016	2.802	0.99	
<i>Scomberomorus guttatus</i>	Pooled	32.0	51.0	310.0	1500.0	200	0.023	2.782	0.93	
Tunas (Scombridae)										
<i>Euthynnus affinis</i>	Pooled	19.5	70.0	134.0	3900.0	253	0.026	2.836	0.96	Muthiah (1985)
<i>Thunnus tonggol</i>	Pooled	32.0	79.0	460.0	4600.0	260	0.055	2.636	0.98	"
<i>Auxis thazard</i> (<i>Auxis thazard thazard</i> *)	Pooled	22.3	45.0	146.0	1800.0	261	0.008	3.228	0.92	"
Barracudas (Sphyraenidae)										
<i>Sphyraena jello</i>	M	16.6	27.0	27.5	187.0	177	0.005	3.059	0.96	
	F	16.7	28.2	25.0	189.0	188	0.004	3.170	0.95	
<i>Sphyraena obtusata</i>	M	16.6	27.0	27.5	142.0	175	0.004	3.120	0.94	
	F	16.7	28.2	25.0	152.0	191	0.004	3.110	0.96	
Sharks (Sphyrnidae)										
<i>Sphyrna lewini</i>	M	43.5	52.5	350.0	700.0	21	0.002	3.285	0.95	
	F	46.0	56.5	460.0	790.0	22	0.046	2.417	0.88	
Sharks (Carcharhinidae)										
<i>Rhizoprionodon acutus</i>	M	27.0	53.5	92.0	763.0	19	0.003	3.108	0.98	
	F	32.6	144.0	52.4	640.0	22	0.002	3.142	0.98	
<i>Scoliodon laticaudus</i>	Pooled	34.0	52.0	150.0	510.0	37	0.010	2.745	0.84	
<i>Carcharhinus limbatus</i>	Pooled	56.0	68.0	790.0	1500.0	20	0.221	2.070	0.66	
Ribbon Fish (Trichiuridae)										
<i>Trichiurus lepturus</i>	M	36.0	90.0	28.0	466.0	200	0.001	2.819	0.91	
	F	39.0	103.0	36.0	960.0	200	0.001	3.029	0.95	
Sardines (Clupeidae)										
<i>Sardinella longiceps</i>	Pooled	11.5	21.2	13.5	77.0	259	0.021	2.669	0.93	
Mackerels (Scombridae)										
<i>Rastrelliger kanagartha</i>	Pooled	6.6	28.2	2.5	241.0	266	0.005	3.261	0.99	
Carangids (Carangidae)										
<i>Megalaspis cordyla</i>	M	15.5	37	46.5	731.0	200	0.032	2.582	0.85	
	F	15.6	43.0	36.0	810.0	200	0.020	2.748	0.98	
<i>Decapterus russelli</i>	M	8.3	22.9	6.2	111.0	199	0.073	2.306	0.86	
	F	14.0	22.5	27.0	100.0	150	0.024	2.647	0.93	

*Valid name on FishBase (www.fishbase.org)

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Taxa	Sex	Length (cm)		Weight (g)		n	a	b	r	Source
		min	max	min	max					
<i>Caranx kalla</i> (<i>Alepes djedaba</i> *)	M	6.3	15.7			196	0.064	2.871	0.92	Kalitha and Jayabalan 1997
	F	6.3	15.7			361	0.009	3.026	0.93	"
<i>Scomberoides tol</i>	M	14.3	41.0	17.1	490.0	59	0.007	2.937	0.99	
	F	14.0	43.0	18.7	520.0	66	0.007	2.955	0.99	
White Fish (Lactariidae)										
<i>Lactarius lactarius</i>	M	8.5	20.5	8.3	10.3	250	0.018	2.853	0.93	Zacharia unpublished
	F	10.0	26.5	9.2	200.0	274	0.015	2.905	0.96	"
Thread Fin Breams (Nemipteridae)										
<i>Nemipterus japonicus</i>	Pooled	9.5	30.8	20.0	350.0	408	0.039	2.664	0.99	Zacharia (1998)
<i>Nemipterus mesoprion</i>	M	14.5	25.5	41.0	189.0	210	0.035	2.673	0.96	Zacharia unpublished
	F	12.9	22.7	27.0	180.0	200	0.018	2.898	0.96	"
Rays & Skates (Rhinobatidae)										
<i>Rhinobatos granulatus</i>	M	30.0	78.0	70.0	1750.0	89	0.004	2.910	0.94	
	F	23.4	72.0	30.0	1630.0	85	0.005	2.889	0.97	
Snappers (Lutjanidae)										
<i>Pristipomoides filamentosus</i>	M	15.2	54.9	40.1	1450.0	42	0.014	2.898	0.99	
	F	15.5	49.5	37.5	1150.0	25	0.013	2.910	0.99	
Pomfrets (Stromateidae)										
<i>Pampus argenteus</i>	M	9.0	25.5	23.0	289.0	90	0.120	2.485	0.96	
	F	10.3	28.2	33.4	382.0	54	0.387	2.036	0.98	
Pomfrets (Carangidae)										
<i>Formio niger</i> (<i>Parastromateus niger</i> *)	M	17.2	35.0	90.0	644.0	23	0.053	2.655	0.98	
	F	19.3	36.3	130.0	734.0	12	0.069	2.573	0.96	
King Fish (Rachycentridae)										
<i>Rachycentron canadum</i>	M	29.4	55.0	132.0	960.0	16	0.010	2.876	0.93	
	F	26.0	53.6	95.0	920.0	22	0.004	3.092	0.99	
Other Clupeids (Clupeidae)										
<i>Kowala coval</i>	M	7.5	11.5	3.8	16.9	178	0.006	3.213	0.93	
	F	7.5	11.4	3.7	16.0	149	0.006	3.187	0.92	
<i>Dussumieria acuta</i>	M	11.0	20.4	9.8	58.9	162	0.009	2.938	0.98	
	F	11.4	20.2	11.6	64.9	177	0.010	2.894	0.97	
Wolf Herring (Chirocentridae)										
<i>Chirocentrus dorab</i>	M	26.4	61.0	59.0	700.0	109	0.007	2.801	0.97	
	F	29.0	58.0	77.0	585.0	76	0.003	2.990	0.97	
Anchovies (Engraulidae)										
<i>Stolephorus commersonii</i>	M	9.5	14.0	6.2	20.3	80	0.004	3.351	0.95	
	F	9.1	14.4	5.1	24.9	82	0.004	3.326	0.97	
<i>Stolephorus devisi</i> (<i>Encrasicholina devisi</i> *)	M	5.5	9.7	1.5	8.0	216	0.031	2.307	0.87	
	F	6.0	10.0	1.5	7.5	228	0.035	2.249	0.82	
<i>Thryssa mystax</i>	M	10.0	19.0	7.0	60.7	184	0.008	2.954	0.91	
	F	12.0	20.5	12.0	70.0	199	0.007	3.019	0.92	

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Taxa	Sex	Length (cm)		Weight (g)		n	a	b	r	Source
		min	max	min	max					
Sciaenids (Sciaenidae)										
<i>Johnieops sina</i> (<i>Johnius dussumieri</i> *)	M	10.0	215.0	11.2	49.2	150	0.052	2.420	0.85	
	F	10.0	19.3	10.9	75.7	229	0.017	2.869	0.94	
<i>Otolithes cuvieri</i>	M	11.2	29.5	13.6	300.0	108	0.014	2.897	0.98	
	F	11.3	35.3	12.0	353.5	177	0.011	2.961	0.94	
Silver Bellies (Leiognathidae)										
<i>Leiognathus bindus</i>	M	7.3	11.0	6.0	22.0	149	0.044	2.521	0.85	
	F	7.6	10.7	8.0	19.8	141	0.126	2.054	0.67	
<i>Secutor insidiator</i>	M	6.6	10.4	4.3	16.6	101	0.023	2.782	0.94	
	F	7.0	11.3	5.0	18.0	101	0.018	2.907	0.94	
Lizard Fishes (Synodontidae)										
<i>Saurida tumbil</i>	Pooled	101.0	480.0			2819	3.432-6E	3.142	0.99	Muthiah (1994)
<i>Saurida undosquamis</i>	Pooled	72.0	316.0			2774	1.34-6E	3.306	0.99	"
Flat Fishes (Paralichthyidae)										
<i>Pseudorhombus arsius</i>	M	13.7	30.0	23.0	260.0	147	0.004	3.256	0.98	
	F	14.0	31.5	22.4	313.0	160	0.003	3.378	0.99	
<i>Pseudorhombus natelensis</i>	M	14.0	26.5	33.0	175.0	28	0.019	2.839	0.93	
	F	13.2	21.7	30.0	131.0	46	0.029	2.708	0.92	
Flat Fishes (Cynoglossidae)										
<i>Cynoglossus macrostomus</i>	Pooled	10.5	15.8	7.8	24.9	199	0.027	2.420	0.88	
Prawns (Penaeidae)										
<i>Metapenaeus monoceros</i>	M	7.0	14.6	2.4	23.1	96	0.004	3.240	0.98	
	F	7.5	18.0	3.5	53.0	105	0.006	3.084	0.98	
Crabs (Portunidae)										
<i>Portunus pelagicus</i>	M	Carapace width				111	3.2-6E	3.616	0.98	Sukumaran and Neelakantan
		Carapace length				111	3.52-4E	3.178	0.98	(1997)
	F	Carapace width				106	1.63-5E	3.253	0.98	"
		Carapace length				106	8.874-4E	2.930	0.98	"
<i>Portunus sanguinolentus</i>	M	Carapace width				86	3.62-5E	3.099	0.98	"
		Carapace length				86	3.974-4E	3.172	0.99	"
	F	Carapace width				84	6.58-5E	2.960	0.98	"
		Carapace length				84	8.287-4E	2.953	0.97	"
Stomatopods (Squillidae)										
<i>Oratosquilla nepa</i>	M	4.0	11.2	1.0	15.5	107	0.017	2.786	0.97	
	F	6.0	11.4	2.3	15.3	109	0.014	2.884	0.97	
Cephalopods (Sepiidae)										
<i>Sepia aculeata</i>	M					363	0.001	2.649	0.95	Rao (1997)
	F					462	0.001	2.855	0.98	"
Cephalopods (Loliginidae)										
<i>Loligo duvauceli</i>	M	5.8	36.6			580	0.005	1.942	0.98	Rao (1988)
	F	6.7	22.8			595	0.001	2.242	0.96	"
	Pooled	3.0	34.0			372	0.003	2.105	0.97	Mohamed and Rao (1997)

- Kalitha, B. and N. Jayabalan. 1997. Length-weight relationship and relative condition factor of the Golden Scad, *Caranx kalla* Cuv. from Mangalore coast. Indian. J. Fish. 44(1):87-90.
- Le Cren, C.P. 1951. Length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (*Perca fluviatilis*). Journal of Animal Ecology 20(2): 201-219.
- Mohamed, K.S., C. Muthiah, P.U. Zacharia, K.K. Sukumaran, P. Rohit and P.K. Krishnakumar. 1998. Marine fisheries of Karnataka state, India. *Naga*, ICLARM Q. 21(2):10-15.
- Mohamed, K.S. and G.S. Rao. 1997. Seasonal growth, stock-recruitment relationship and predictive yield of the Indian squid *Loligo duvauceli* exploited off Karnataka coast. Indian J. Fish. 44(4):319-329.
- Muthiah, C. 1985. Fishery and bionomics of tunas at Mangalore. CMFRI Bull. 36: 51-70.
- Muthiah, C. 1994. Studies on the fishery and biology of the Lizardfish, *Saurida* sp. from the Karnataka coast. Ph. D. Thesis, Univ. of Karnataka. 185 p.
- Pauly D. 1983. Some simple methods for the assessment of tropical fish stocks. FAO. Fisheries Technical Pap. No. 234. FAO, Rome.
- Rao, G. S. 1997. Aspects of biology and exploitation of *Sepia aculeata* Orbigny from Mangalore area, Karnataka. Indian. J. Fish. 44(3):247-254.
- Rao, G. S. 1988. Biology of inshore squid, *Loligo duvauceli* Orbigny with a note on its fishery of Mangalore. Indian. J. Fish. 35(3):121-130.
- Smith, M. M. and C.P. Heemstra. 1986. *Smiths Sea Fishes*. 6th ed. Springer-Verlag, Berlin.
- Sukumaran, K.K. and B. Neelakantan. 1997. Length-weight relationship in two marine portunid crabs; *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) from the Karnataka coast. Indian J. Mar. Sci. 26:39-42.
- Zacharia, P.U. 1998. Dynamics of the thread fin bream, *Nemipterus japonicus* exploited off Karnataka. Indian. J. Fish. 45(3):265- 270.

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