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Length-weight relationship of eight commercial fish species from Mumbai coast of India

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Short communication

Abstract

The length-weight relationship (LWR) of eight commercially important marine fish species belonging to 5 families landed by trawlers along the Mumbai coast of India from October 2015 to May 2016 is reported. Fish samples were collected from trawl catch of M.F.V NARMADA, training cum research vessel of ICAR-CIFE. The species studied were *Coilia dussumieri, Cynoglossus arel, Harpadon nehereus, Lepturacanthus savala, Johnius borneensis, Johnius macrorhynus, Johnius belangerii* and *Johnius glaucus*. The regression coefficient 'b' values were estimated as 2.781, 2.869, 3.345, 3.312, 3.132, 3.099, 3.152, and 3.059 respectively. The analysis include the first record of L-W relation of *J. glaucus,* not available in FishBase.

Keywords*: Length-weight relationship, coefficient of determination, Mumbai*

Introduction

Length-weight relationship of fish is an important tool for estimating the average weight at a given length and in assessing the relative well-being of a fish population (Bolger and Connolly, 1989). Length-weight relationship studies of any fish species is a pre-requisite for determining its population characteristics (Le Cren, 1951). The 'b' value of 3 indicates isometric growth, and a fair number of species seem to approach this 'ideal' value (Ricker, 1958). Length-weight relationships (LWRs) have considerable importance in fishery research especially for predicting the weight of fish from length data, life history, growth and stock assessment studies, and for estimating the biomass (Petrakis and Stergiou, 1995; Vaslet *et al*., 2008; Froese *et al*., 2011; Chu *et al*., 2012; Vega-Cendejas *et al*., 2017). It is generally easier to measure fish length than weight in fishery resource surveys. Length-weight relationships (LWR) are essential for fishery assessments.

Therefore, the present work was undertaken to study the length-weight relationships of *Coilia dussumieri* Valenciennes, 1848, *Cynoglossus arel* (Bloch & Schneider, 1801), *Harpadon nehereus* (Hamilton, 1822), *Lepturacanthus savala* (Cuvier, 1829), *Johnius borneensis* (Bleeker, 1851),

Johnius macrorhynus (Lal Mohan, 1976), *Johnius belangerii* (Cuvier, 1830) and *Johnius glaucus* (Day, 1876) from the Mumbai coast of India.

Material and methods

Samples were collected by trawl fishing (codend mesh size: 30 mm), conducted on the training cum research vessel of ICAR-CIFE; Mumbai, India; M.F.V NARMADA during October 2015 to May 2016 (Fig. 1). Fishes were identified using (Fischer and Bianchi (1984); Talwar and Kacker, (1984); Nelson et al. (2016); and Froese and Pauly (2019) and for each specimen, total length (TL) was measured to the nearest 0.1 centimeters (cm) and weighed to an accuracy of 0.1 gram(g).Total length and total body weight data were transformed logarithmically before deriving length-weight relationships. Initial $\log_{10}$ length - $\log_{10}$ weight plots were used to inspect the data visually, and extreme outliers were removed, following the procedure and recommendations of Froese (2006).

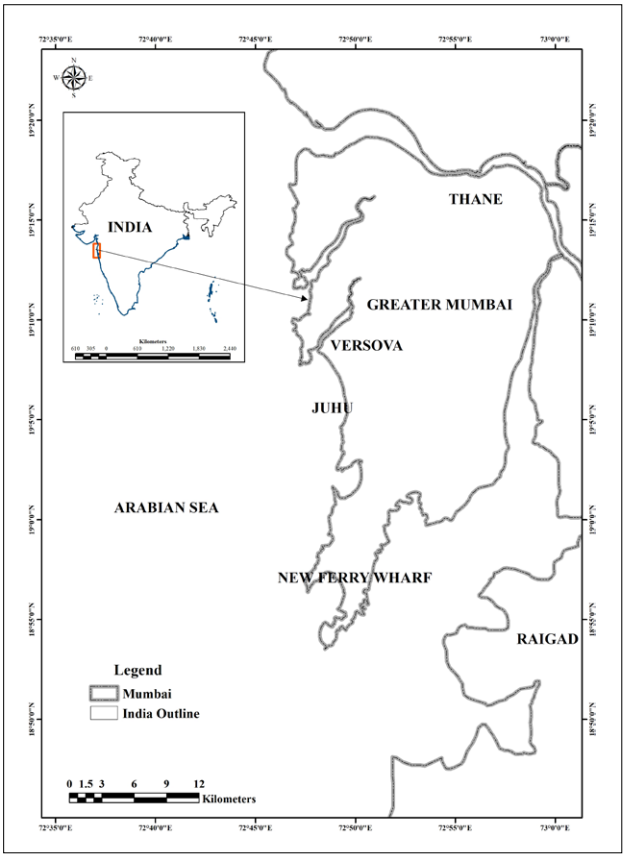

Fig. 1. Map showing the study area

The length-weight relationship was calculated using the equation proposed by Le Cren (1951): $W = a L^b$, Where W = total body weight, L = total length, a represents the intercept of the regression curve and b the regression coefficient or slope. Parameters 'a' and 'b' were estimated by the least square method of linear regression analysis: log (W) = log (a) + b log (L). The 95% confidence limits for the parameters 'a', 'b',and coefficient of determination 'r^2' were estimated.

Results and discussion

The significant results of the LWR including sample size (n), ranges of total length (cm) and weight (g), the parameters of LWR, 'a' and 'b' with their respective 95% confidence intervals and coefficient of determination (r^2) are described in Table 1. Total of 1992 individuals representing 8 species, 5 families, and 5 orders were analyzed. The values of 'a' ranged from 0.00012 (*L. savala*) to 0.0089 (*J. glaucus*), whereas the values of 'b' varied from 2.78 (*C. dussumieri*) to 3.35 (*H. nehereus*). The coefficient of determination (r^2) showed excellent fits for LWR, and the values of this index were greater than 0.95.

In general, the growth of fishes or any other animal increases with the increase in body length. Thus, it can be said that length and growth are interrelated.The species examined in this study included awide array of body shapes and sizes that was reflected in the estimated parameters.In addition, studies have shown that LWR in fish can be affected by

Table 1. Estimated length-weight relationship of *C. dussumieri, C. arel, H. nehereus, L. savala, J. borneensis, J. macrorhynus, J. belangerii* and *J. glaucus*

Family	Species	n	W_{min}-W_{max}	L_{min}-L_{max}	a	b	95% CL of a	95% CL of b	r^2
Engraulidae	*C. dussumieri*	290	1.2-15.7	7-18.4	0.00494	2.781	0.0056-0.0043	2.729-2.831	0.976
Cynoglossidae	*C. arel*	142	1.2-114.3	6.9-31.2	0.00604	2.869	0.0047-0.0078	2.779-2.958	0.966
Synodontidae	*H. nehereus*	310	0.8-126.8	6.6-28.3	0.00177	3.345	0.0015-0.0021	3.283-3.406	0.974
Trichiuridae	*L. savala*	175	0.9-100.4	13-59.7	0.00012	3.312	0.0001-0.0002	3.225-3.398	0.970
Sciaenidae	*J. borneensis*	321	0.8-157.2	4.7-23.9	0.00782	3.132	0.0072-0.0085	3.100-3.164	0.992
	J. macrorhynus	306	0.6-90.6	4.2-21	0.00773	3.099	0.0070-0.0085	3.062-3.136	0.989
	J. belangerii	89	2.7-61	6.8-17.5	0.00764	3.152	0.0061-0.0096	3.060-3.243	0.982
	J. glaucus	359	1.1-88.9	5-20.6	0.00887	3.059	0.0082-0.0096	3.029-3.090	0.991

n-Number of samples observed, min- Minimum, max- Maximum, a and b- Parameters of length-weight relationship, CL- Confidence limit; r^2- Coefficient of determination.

Table 2. Comparison of length-weight parameters of *C. dussumieri, C. arel, H. nehereus, L. savala, J. borneensis, J. macrorhynus, J belangerii* and *J. glaucus* from Indian waters

Species	Location	Sex	a	b	r^2	Source
C. dussumieri Valenciennes, 1848	Mumbai coast	Combined	0.01650	2.423		Dhanya *et al.*, 2004
	North-East Coast of India	Combined	0.01412	2.409	0.880	Mahapatra *et al.*, 2015
	Mumbai coast	Unsexed	0.00494	2.781	0.976	Present study
C. arel (Bloch & Schneider, 1801)	Porto Novo, India	Unsexed	0.00781	2.912	0.826	Rajaguru, 1992
	South West coast of India	Pooled	0.000002	2.975	0.956	Jayaprakash, 2001
	Mumbai coast	Unsexed	0.00604	2.869	0.966	Present study
H. nehereus (Hamilton, 1822)	Maharashtra	Unsexed	0.00580	2.915	-	Biradar, 1989
	Mumbai coast	Unsexed	0.00177	3.345	0.974	Present study
L. savala (Cuvier, 1829)	Ratnagiri, Maharashtra	Mixed	0.00025	3.229	0.920	Pakhmode *et al.*, 2013
	Mumbai coast	Unsexed	0.00012	3.312	0.970	Present study
J. borneensis (Bleeker, 1851)	Mumbai coast	Female	0.00468	3.173	0.996	Chakraborty, 1992
	Mumbai coast	Male	0.00264	3.277	0.956	Chakraborty, 1992
	Mumbai coast	Female	0.00280	3.281	0.992	Muthiah, 1982
	Mumbai coast	Male	0.00264	3.286	0.990	Muthiah, 1982
	Mumbai coast	Unsexed	0.00782	3.132	0.992	Present study
J. macrorhynus (Lal Mohan, 1976)	Mumbai coast	Female	0.01040	3.014	0.998	Chakraborty, 1992
	Mumbai coast	Male	0.00583	3.085	0.984	Chakraborty, 1992
	Mumbai coast	Unsexed	0.00773	3.099	0.989	Present study
J. belangerii (Cuvier, 1830)	Mumbai coast	Unsexed	0.00764	3.152	0.982	Present study
J. glaucus (Day, 1876)	Mumbai coast	Unsexed	0.00887	3.059	0.991	Present study

factors such as habitat, stomach fullness, gonad maturity, sex, health, age, etc. (Tesch, 1971; Wootton, 1999; Wigley *et al.*, 2003). In this study, the values of the shape parameter 'b', for the eight fish species, were found in the expected range of 2.5-3.5, as proposed by Froese (2006). Length-weight parameters of eight species recorded by different researchers from Indian waters is given in Table 2. During the present study, LWR estimates of *J. glaucus* was described for the first time; not reported earlier in FishBase (Froese and Pauly, 2019). The application of these relationships should be limited to the size ranges of the sample used to estimate the parameters (Petrakis and Stergiou, 1995; Wang *et al.*, 2011). Considering the economic value and the role played by these species in providing nutrition and livelihood, it is crucial to manage their fisheries in a sustainable manner. Therefore, this baseline information on LWR would be helpful for further studies on the population assessment of these species in Indian waters and neighboring countries for sustainable fisheries management.

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References

Biradar, R. S. 1989. Stock assessment of Bombay duck (*Harpadon nehereus*) off Maharashtra, India. In: FAO/DANIDA/ICAR Natl Follow Train Course Fish Stock Assessment, Cochin (India), 2-28 Nov 1987, FAO.I:GCP/INT/392/DEN/1

Bolger, T. and P. L. Connolly. 1989. The selection of suitable indices for the measurement and analysis of fish condition. *J. Fish. Biol.*, 34(2): 171-182.

Chakraborty, S. K. 1992. Length weight relationship and biometric study on three species of sciaenids from Bombay water. *J. Indian Fish. Assoc.*, 22: 41-48.

Chu, W. S., Y. Y. Hou, Y. T. Ueng and J. P.Wang. 2012. Length-weight relationship of largescale mullet, *Liza macrolepis* (Smith, 1846), off the southwestern coast of Taiwan. African. *J. Biotechnol.*, 11(8): 1948-1952.

Le Cren, E.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Ecol.*, p. 201-219.

Dhanya, V. M. R., A. K. Jaiswar, R. Palaniswamy and S. K. Chakraborty. 2004. Morphometry and length-weight relationship of *Coilia dussumieri*, Valenciennes, 1848 from Mumbai waters. *J. Indian Fish. Assoc.*, 31: 65-70.

Fischer, W. and G. Bianchi. 1984. FAO Species Identification Sheets for Fishery Purposes: Western Indian Ocean (Fishing Area 51), Vols. 1-6. Food and Agriculture Organization of the United Nations, Rome, Prepared and printed with the support of the Danish International Development Agency (DANIDA).

Froese, R. 2006. Cube law, condition factor and weight-length relationships: history, meta□analysis and recommendations. *J. Appl. Ichthyol.*, 22(4): 241-253.

Froese, R. and D. Pauly. 2019. Fishbase. World Wide Web electronic publication. [Accessed 2020 May 7]. www.fishbase.org, version (12/2019)

Froese, R., A. C. Tsikliras and K. I. Stergiou. 2011. Editorial note on weight-length relations of fishes. *Acta Ichthyol. Piscat.*, 41(4): 261-263.

Jayaprakash, A. A. 2001. Length weight relationship and relative condition in *Cynoglossus macrostomus* Norman and *C. arel* (Schneider). *J. Mar. Biol. Ass. India*, 43(1 & 2): 148-154.

Mahapatra, B. K., A. Pradhan and W. S. Lakra. 2015. Morphometrics, Length-Weight Relationship and Condition Factor of *Coilia dussumieri* Valenciennes, 1848 from North-East Coast of India. Intlernation. *J. Fish. Aquat. Stud.*, 3(2): 35-39.

Muthiah, C. 1982. Biology of *Johnieops vogleri* (Bleeker) of Bombay waters [India]. *Indian J. Fish.*, 29(1 & 2): 118-133.

Nelson, J. S., T. C. Grande and M. V. H. Wilson. 2016. Fishes of the World. John Wiley & Sons. 707 pp.

Pakhmode, P. K., S. A. Mohite, S. D. Naik and A. S. Mohite. 2013. Length-frequency analysis and length-weight relationship of ribbon fish *Lepturacanthus savala* (Cuvier1829) off Ratnagiri coast Maharashtra. *Int. J. Fish. Aquat. Stud*., 1: 25-30.

Petrakis, G. and K. I. Stergiou. 1995. Weight-length relationships for 33 fish species in Greek waters. *Fish Res*., 21(3-4): 465-469.

Rajaguru, A. 1992. Biology of two co-occurring tonguefishes, *Cynoglossus arel* and *C.lida* (Pleuronectiformes: Cynoglossidae), from Indian waters. *Fish Bull*., 90(2): 328-367.

Ricker, W. E. 1958. Handbook of computations for biological statistics of fish populations. *Bull. Fish. Res. Board Canada*, p. 119:300.

Talwar, P. K. and R. K. Kacker. 1984. Commercial sea fishes of India. Zoological survey of India. Kolkata, 997 pp.

Tesch, F. W. 1971. Age and growth. In: Ricker WE, editor. Methods Assess fish Prod fresh waters. Blackwell Scientific Publications, Oxford; p. 99-130.

Vaslet, A., Y. Bouchon-Navaro, M. Louis and C. Bouchon. 2008. Weight-length relationships for 20 fish species collected in the mangroves of Guadeloupe (Lesser Antilles). *J. Appl. Ichthyol*., 24(1): 99-100.

Vega-Cendejas, M. E., M. A. Peralta-Meixuiero and M. H. De Santillana. 2017. Length-weight relations of fishes inhabiting a hyperhaline coastal lagoon in Yucatan, Mexico. *Acta Ichthyol. Piscat*., 47(4): 411-415.

Wang, X. H., Y. S. Qiu, G. P. Zhu, F. Y. Du, D. R. Sun and S. L. Huang. 2011. Length-weight relationships of 69 fish species in the Beibu Gulf, northern South China Sea. *J. Appl. Ichthyol*., 27(3): 959-961.

Wigley, S. E., H. M. McBride and N. J. McHugh. 2003. Length-weight relationships for 74 fish species collected during NEFSC research vessel bottom trawl surveys, 1992-99. NOAA Tech Memo, NMFS NE 171.:26.

Wootton, R. J. 1999. Ecology of Teleost Fishes. 2nd Edition. Springer Netherlands (Fish & Fisheries Series, No. 24). 386 pp.