



Research Note

Length–weight Relationship of *Myctophum spinosum* (Steindachner, 1867) Caught off South-west Coast of India

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Length-weight relationship provides a means for calculating weight and biomass when only length measurements are available and has been used for the differentiation of taxonomic units and this relationship is seen to change with various developmental events in life (Le Cren, 1951; Anderson & Gutreuter, 1983; Venkataramanujam & Ramanathan, 1994; Petrakis & Stergiou, 1995; Dulcic & Kraljevic, 1996; Martin-Smith, 1996). An exhaustive review on studies of length-weight relationship was made by Froese (2006).

Studies on the abundance and biomass of lanternfishes in Indian waters by Menon (1990), Raman & James (1990), Jayaprakash (1996), Menon (2002), Menon (2004) and Karuppasamy et al. (2006) indicated that they were the most dominant group among mesopelagic fishes. Boopendranath et al. (2009) and Pillai et al. (2009) have reported that lanternfishes are the major components in the

bycatch of deep sea shrimp trawlers operating off Kerala. The available information on the length-weight relationships of lanternfishes from Indian waters are limited (Karuppasamy et al., 2008; Vipin et al., 2011; Manju et al., 2013).

The Spiny lanternfish, *Myctophum spinosum* (Steindachner, 1867) (Family: Myctophidae) is a bathypelagic, oceanodromous species that exhibits diurnal vertical migration and is widely distributed in tropical and sub-tropical waters of the Indian, Pacific, Indo-Pacific and Atlantic Oceans (Paxton, 2010). The aim of the study was to derive the length-weight relationship of *M. spinosum*, which is a common species in the bycatch of deep sea trawlers, operating off southwest coast of India.

The samples for analysis were collected from the bycatch landed by commercial deep sea shrimp trawlers off Kollam, southwest coast of India. The area of operation was between Latitude 8°00' - 9°07' N and Longitude 74°00' - 75°58' E, during September 2009 - May 2012, except the trawl ban period from 15 June to 31 July. The species were caught from the depth range of 300-400 m. Deep sea shrimp trawls with a head rope length of 32.4 m were used for fishing operations. Their mesh size ranged from 30 to 50 mm in the belly and 26 mm in the codend. Samples of last trip of multi-day fishing were stored in chilled condition until analysis (about two days). The samples collected during fishing along 200-400 m depth, using a 45 m four equal panel myctophid trawl with 25 mm codend meshes, off southwest coast of India, as part of cruise No. 313 (12 February 2013 - 2 March 2013) and 320 (4 October 2013 - 16 October 2013) onboard FORV Sagar Sampada (71.5 m L_{OA}; 2285 hp; Ice class IB) were also used for analysis.

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Total length (TL) to the nearest millimeter and total weight (TW) to the nearest milligram were recorded for each fish. Sex was determined by examining the gonads and by inspecting the presence of supracaudal light organ found only in mature males (Hulley, 1986). The relationship between weight (W ; g) and length (L ; cm) is denoted as $W = aL^b$. This represents a general linear equation and the value of ' a ' and ' b ' are estimated by the method of least square regression (Zar, 1984). The exponent b provides information on growth; being isometric when $b = 3$ and allometric when this is not the case (positive if $b > 3$, negative if $b < 3$). Analysis of covariance (ANCOVA) was carried to find if there is any significant change in the length-weight relationship between the sexes (Karuppasamy et al., 2008) and ' t '-test was used to find if the slope of the regression lines are significantly different from isometry. R version 2.12.0 was used for the data analysis.

A total of 113 specimens of *M. spinosum* were examined for the estimation of length-weight relationship. The total length of *M. spinosum* ranged from 64 to 90 mm, with a mean length of 72 mm and the weight of the fishes ranged from 2.1 to 6.2 g. Length, weight and length-weight regression summaries for *M. spinosum* males, females and both sexes combined are given in the Table 1. The graphical representation of length-weight relationships of the species are given in Fig. 1 to 3.

The length-weight relationships of *M. spinosum* were estimated as:

$W = 0.0129 L^{2.7372}$, for both males and females (pooled data);

$W = 0.0212 L^{2.4802}$, for males; and

$W = 0.0077 L^{2.9987}$, for females

There was no significant difference in the slopes ($p > 0.05$) between male and female fish (ANCOVA). Female fishes exhibited isometric growth (p value = 0.625, $df = 50$) and male fishes exhibited negative allometry (p value = 0.007, $df = 61$).

This study is the first attempt to estimate the length-weight relationship of *M. spinosum*. The maximum length of *M. spinosum* recorded was 90 mm. In the length-weight relationship, the ' b ' value of *M. spinosum* (2.737) indicated a negative allometric growth. Generally, the ' b ' value ranges between 2.5 and 4.0 for fishes. A ' b ' value of 3 indicate that the growth of the fish is symmetric or isomeric (Hile,

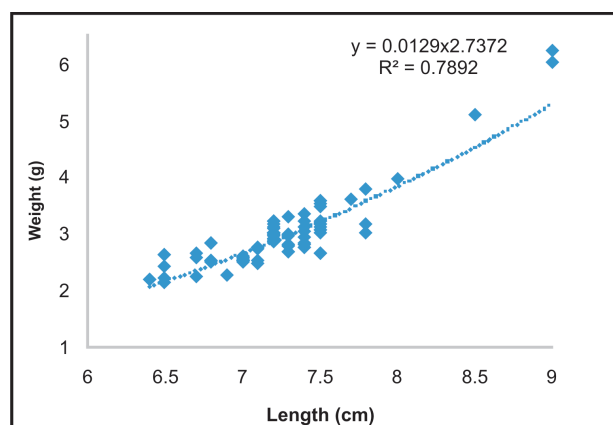


Fig. 1. Length-weight relationship of *Myctophum spinosum* (Pooled)

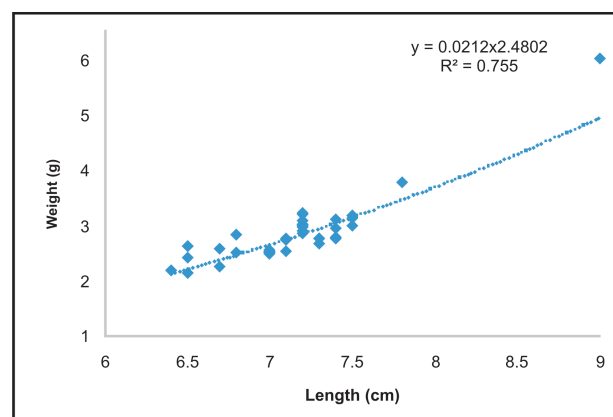


Fig. 2. Length-weight relationship of *Myctophum spinosum* (Male)

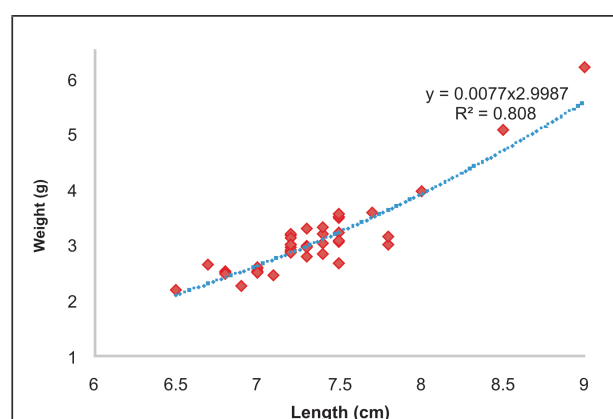


Fig. 3. Length-weight relationship of *Myctophum spinosum* (Female)

Table 1. Length, weight and length-weight regression summaries for *Myctophum spinosum* males, females and both sexes combined

Sex	n	Length (mm)		Weight (g)		Log (a)	b	SE (a)	SE (b)	R ²
		Min	Max	Min	Max					
Male	62	64	90	2.1	6	-1.672	2.480	0.155	0.182	0.76
Female	51	65	90	2.2	6.2	-2.115	2.999	0.180	0.209	0.81
Combined	113	64	90	2.1	6.2	-1.890	2.7372	0.115	0.134	0.79

1936). The exponent value other than 3 indicate allometric growth. A 'b' value greater than 3.0 indicates that the fish fattens when it increases in length and a value less than 3.0 indicates fish becoming more lean (Grower & Juliano, 1976).

Lanternfishes are generally small in size and majority of the fishes are under 150 mm standard length (Nafpaktitis, 1982; Hulley, 1985; FAO, 1997; Karuppasamy et al., 2008). Karuppasamy et al. (2008) reported that the length-weight relationship of *Benthosema pterotum* (Family: Myctophidae) showed a positive allometric growth, with an exponent value of 3.13. Thomas et al. (2003) recorded that out of 22 species of the deep sea fishes from the continental slope beyond 250 m depth along the west coast of India, *Cubiceps pauciradiatus*, *Polymixia nobilis*, *Cyttopsis rosea*, *Hoplostethus mediterraneus*, *Saurida undosquamis*, showed isometric growth and all other species deviated from isometric growth to negative and positive allometric growth.

The findings of this study, will serve as a baseline for comparison with other stocks of this species in different parts of the Indian Ocean. Since the samples were aggregated for the analysis, seasonal variations in the length-weight relationships were not considered. Seasonal variations in the relationships with respect to sexes could provide a more accurate representation of the length-weight relationships.

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