



Length–weight relationship of *Benthoosema pterotum* (myctophid) in the deep scattering layer (DSL) of the eastern Arabian Sea

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ABSTRACT

The samples were collected by using Isaac Kid-Midwater Trawl (IKMT) onboard FORV Sagar Sampada during the deep scattering layer (DSL) survey from 1998-2000 of the eastern Arabian Sea (AS). Length-weight (LW) relationships have been carried out for the most commonly occurring myctophid species *Benthoosema pterotum* of the DSL. The LW relationship was $W = 0.00000753 L^{3.13145}$ ($r = 0.973708$) for males and $W = 0.000007379 L^{3.13529}$ ($r = 0.974880$) for females. From the studies it has been noticed that growth in relation to length and weight deviate appreciably from the cube law. It is also found that there are no significant differences between males and females of the species.

Introduction

The deep scattering layer (DSL) is observed in all the oceans of the world. There are large aggregations of pelagic animals that live further down and are associated particularly with the DSL and have the potential to provide exploitable renewable resources (Hays, 2003). Mesopelagic fishes play an important tropic role in the open ocean as well as close to steep slopes. Myctophids in particular, display a high diversity that can be used as an indicator of biogeographic distinctness of a specific area (Wienerroither, 2003). For a group like myctophids, which has attracted many fishery investigators as a prospective resource for commercial exploitation, studies on length-weight (LW) relationship will be relevant in converting catch statistics to numbers in order to obtain abundance in space and time. There has been very limited literature on ageing studies of myctophids from tropical and subtropical regions, despite the overwhelming abundance and demonstrated importance of these fishes in low latitude oceanic ecosystems (Clarke, 1973; Gartner *et al.*, 1987). Based on the literature on ageing studies, it is found that myctophids are fast growing (Childress *et al.*, 1980), have relatively short life span and high mortality rates. Growth studies of myctophids based on otolith microstructure were carried out by Gjosaeter (1981), Gjosaeter *et al.* (1984), Prut'ko (1987), Young *et al.* (1988), Gartner (1991a; b), Giragosov and Ocharov (1993) and Nishimura *et al.* (1999). However, there have been absolutely no reports on the LW relationship studies of myctophids so far. Hence this present work was

undertaken in the species *B. pterotum*, the commonly occurring species of myctophids in the eastern Arabian Sea (AS).

Materials and methods

The samples were collected by using Isaac Kid-Midwater Trawl, IKMT (Isaacs and Kidd, 1951) onboard

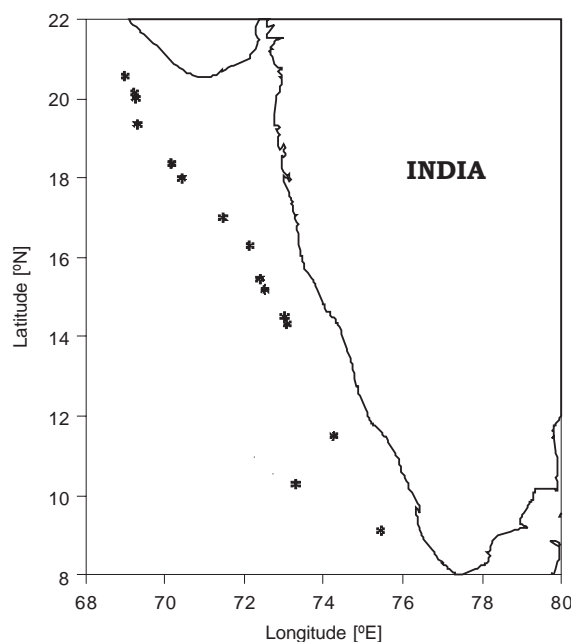


Fig. 1. Sampling locations of *Benthoosema pterotum* from the DSL of the eastern Arabian Sea.

FORV Sagar Sampada during DSL survey from 1998-2000 of the eastern AS in the area between latitude 9-20°N and longitude 69-74°E (Fig.1). The species was found to occur in a depth range of 50-532 m. The samples were preserved in 10% formalin and total length (TL) and total weight (TW) of the fish with guts and gonads intact were used for this investigation. Total length was measured in millimeters from the tip of the snout to the tip of the upper lobe of the caudal fin and the TW was measured to the nearest milligram. The sex and maturity stages of individual fishes were noted. The method was adopted uniformly throughout the investigations. During the study period, a total of 405 males and 294 females of *B. pterotum* were examined. They had a length range of 2.9 to 5.6 cm and weight range of 0.14 to 1.28 g in males and 3.1 to 5.8 cm and 0.21 to 1.6 g in females.

The general equation $W = aL^b$ is transformed into linear form by using logarithms.

The transformed equation is,

$\text{Log } W = \text{Log } a + b \text{ Log } L$; $Y = A + BX$; $Y = \text{log } W$, $X = \text{log } L$, $A = \text{log } a$, $B = \text{log } b$.

The parameters A and B were estimated by the method of least squares (Snedecor and Cochran, 1968).

Results

Length weight relationship

Males: The TL and TW scatter diagram gave the exponential form of the equation as $W = 0.00000753 L^{3.13145}$. The Log-log transformation gave the equation as $\text{Log } W = -5.12318 + 3.13145 \text{ Log } L$ ($r = 0.973708$) (Fig. 2).

Females: The exponential equation obtained from the TL-TW scatter diagram was $W = 0.000007379 L^{3.13529}$. The Log-log transformation equation can be written as $\text{Log } W = -5.13199 + 3.13529 \text{ Log } L$ ($r = 0.974880$) (Fig. 2).

Pooled: The LW relationship of males and females were tested for significance by ANACOVA (Snedecor and Cochran, 1968) and as there was no significant difference in the slopes and elevations of the two sexes, the data was pooled to arrive at a common formula for the species.

The exponential form of the equation can be given as $W = 0.00000748 L^{3.13250}$.

The Log-log transformation equation was $\text{Log } W = -5.12606 + 3.13250 \text{ Log } L$ ($r = 0.974209$).

The significance of the variation in the estimated 'b' value from the cube law was tested by the 't' test following the formula $t = \frac{b - 3}{Sb}$

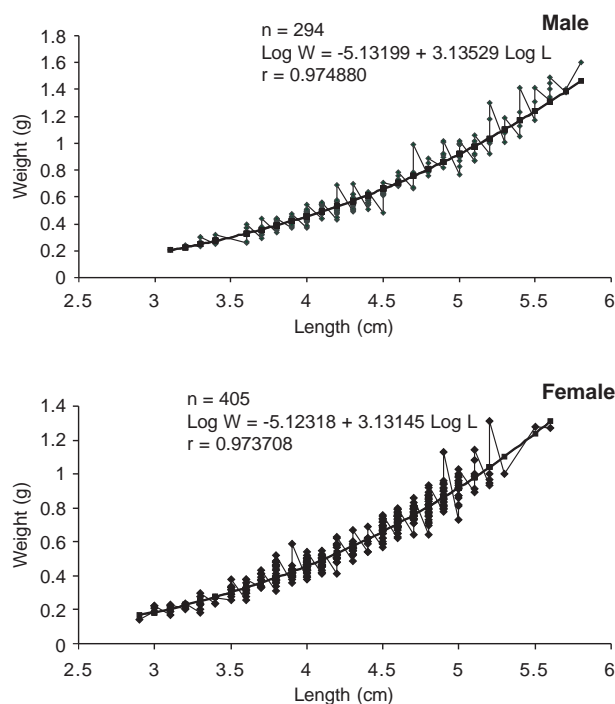


Fig. 2. Length-weight relationship of *Benthosema pterotum*

$$= \frac{3.13250 - 3.00000}{0.00604} = 21.94$$

The 't' value was found to be significant which shows that cube law does not hold good for *B. pterotum*.

Discussion

The present study on the LW relationship in *B. pterotum* shows that growth in relation to these two parameters deviate appreciably from the cube law. The studies also show that there are no significant differences between males and females of the species. However, according to Hulley (1981) and Linowski (1987; 1993) some myctophids show differences in the growth pattern in males and females. As per their studies, females of certain species attain larger size and live longer and the growth in females was found to be linear. Further, studies on the growth rates of *B. pterotum* (Gjosaeter, 1987) showed that the growth rates varied from region to region and that they had faster growth rates than another commonly occurring myctophid *B. fibulatum*. Such variations in growth pattern in different species are due to the variations in response to the changing environmental conditions they come across as a result of their migrations and also of their diurnal changes in growth (Childress, 1980; Young *et al.*, 1988; Linowski, 1991; Linowski *et al.*, 1993).

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References

- Childress, J. J., Taylor, S. M., Cailliet, G. M. and Price, M. H. 1980. Patterns of growth, energy utilization and reproduction in some meso and bathy pelagic fishes off Southern California. *Mar. Biol.*, 61 : 27 – 40.
- Clarke, T. A. 1973. Some aspects of the ecology of lanternfishes (Myctophidae) in the Pacific Ocean near Hawaii. *Fish. Bull.*, NOAA / NMFS, 71 (2) : 401 – 435.
- Gartner, J. V. Jr. 1991a. Life histories of three species of lanternfishes (Pisces : Myctophidae) from the eastern Gulf of Mexico. (i) Morphological and micro structure analysis of sagittal otoliths. *Mar. Biol.*, 111 : 11 – 20.
- Gartner, J. V. Jr. 1991b. Life histories of three species of lanternfishes (Pisces: Myctophidae) from the eastern Gulf of Mexico. ii. Age and growth patterns. *Mar. Biol.*, 111 : 21 – 27.
- Gartner, J. V. Jr., Hopkins, T. L., Baird, R. C. and Milliken, D. M. 1987. The lanternfishes of the Eastern gulf of Mexico. *Fish. Bull. U. S.*, 85 : 81 – 98.
- Giragosov, B. and Ocharov, Y. 1993. Age and growth of lanternfish *Myctophum nitidulum* (Myctophidae) from the tropical Atlantic. *J. Ichthyol.*, 32: 34– 42.
- Gjosaeter, J. 1981. Growth, production and reproduction of the myctophid fish *Benthoosema glaciale* from Western Norway and adjacent seas. *Fisk Dir. Skr. Ser. Hav Unders.*, 17 : 79 – 108.
- Gjosaeter, J., Dayaratne, P., Bergstad, O. A., Gjosaeter, H., Sousa, M. I. and Beck, I. M. 1984. Ageing tropical fish by growth rings in the otoliths. *FAO Fish. Circ.*, 776 : 1 – 54.
- Gjosaeter, H. 1987. Primary growth increments in otoliths of six tropical myctophid species. *Biol. Oceanog.*, 4 : 359-382.
- Hulley, P. A. 1981. Results of the research cruises of FRV 'Walther Herring' to South America. LVIII. Myctophidae. *Archiv fur Fischereiwissenschaft*, 31(1):1–300.
- Hays, G. C. 2003. A review of the adaptive significance and ecosystem consequences of zooplankton diel vertical migrations. *Hydrobiologia*, 503: 163-170.
- Isaacs, J. D., Kidd, L. W. 1951. *Isaacs Kidd-Midwater Trawl*. Final reports. Scripps Institute of Oceanography (Reference 53), 3: 1– 18.
- Linkowski, T. B. 1987. Age and growth of four species of *Electrona* (Myctophidae). In : Kullander, S. O. and Fernhom, B. (Eds.), *Proceedings of the Fifth Congress of European Ichthyologists*. Swedish Mus. Nat. Hist. Stockholm, p. 435 – 442.
- Linkowski, T. B. 1991. Otolith micro structure and growth patterns during early life history of lantern fishes (Family Myctophidae). *Can. J. Zool.*, 69 : 1777 – 1792.
- Linkowski, T. B., Radke, R. L. and Lenz, P. H. 1993. Otolith micro structure, age and growth of two species of *Ceratoscopelus* (Osteichthyes : Myctophidae) from the Eastern North Atlantic. *J. Exp. Mar. Biol. Ecol.*, 167 : 237 – 260.
- Nishimura, A., Nagasawa, K., Asanuma, T., Aoki, H. and Kubota, T. 1999. Age, growth and feeding habits of lanternfish, *Stenobranchius leucopsaurus* (Myctophidae) collected from the near surface layer in the Bering Sea. *Fish. Sci.*, 65 (1) : 11 – 15.
- Prut'ko, V. G. 1987. On age and growth rate of *Diaphus suborbitalis* (Myctophidae) from the Equatorial Indian Ocean. *Vopr. Ikhiol, J. Ichthyol.*, 27 (3) : 478 – 487.
- Snedecor and Cochran, 1968. *Statistical methods*. Oxford and IBM publishing Co., Culcutta, 593 pp.
- Wienerroither, R. M. 2003. Species composition of mesopelagic fishes in the area of the Canary Islands, Eastern Central Atlantic. Fritz (Ed.), *6th GFBS Annual Congress Abstracts*. Org. Divers. Evol. 3, Electr. Suppl. 17.
- Young, J. W., Bulman, C. M., Blaber, S. J. M. and Wayte, S. E. 1988. Age and growth of the lanternfish *Lampanyctodes hectoris* (Myctophidae) from Eastern Tasmania, Australia. *Mar. Biol.*, 99 : 569 – 576.

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