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# Length-weight relationship of neon flying squid *Ommastrephes bartramii (Cephalopoda: Ommastrephidae)* caught from Indian sector of Southern Ocean.

*Aneesh Kumar K. V[1#]., Pravin P[1]., Ragesh N[2] & Meenakumari B[3].

[1]Central Institute of Fisheries Technology, Matsyapuri, Willingdon Island. Cochin-682029, India,
[2]Central Marine Fisheries Research Institute, Cochin- 682018, India,
[3]Indian Council of Agricultural Research, Krishi Anusandhan Bhavan 2, New Delhi-110012, India

#Present address: Centre for Marine Living Resources and Ecology Kendriya Bhavan, CSEZ P.O., Cochin-682037, India
*[E. Mail: aneeshmenan12@gmail.com]

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Length-weight relationship of the Neon flying squid *Ommastrephes bartramii,* caught from the Indian Sector of Southern Ocean was estimated as male $W= 0.0235 L^{3.05}$ ($R^2 = 0.990719$) and females $W= 0.0283 L^{2.99}$ ($R^2 = 0.919944$). The species follows an isometric growth pattern and no significant difference was observed between both sexes.

[Key words: Length- Weight Relation, Squid, *Ommastrephes bartramii*, Southern Ocean]

## Introduction

*Ommastrephes bartramii* (Lesueur, 1821) is a widely distributed oceanic ommastrephid species throughout the subtropical and temperate waters of both northern and southern hemisphere and excluded from the equatorial waters of all three oceans[1] and forms a major fishery in the Japanese squid fisheries in the Pacific Ocean[2]. This species is reported to be inhabiting up to a depth of 1500 m and prefer to stay at a water temperature not below than 10° C[3]. *O. bartramii* is distributed between 20° S and 40° S in the southern part of the Indian Ocean. This species attains over 50 cm mantle length (ML) and carries out extensive seasonal migrations between subarctic and subtropical waters, the area where they spawn[4]. The growth pattern of these species has been studied using length-weight frequency distributions and tagging techniques[5]. The cephalopods are fast growing mollusks and the growth rate is greatly influenced by the biotic and abiotic factors[6]. The length-weight relationships are used for estimating the weight from length of fish or vice versa and also can indicate the taxonomic differences and events in the life history of fish[7]. The statistical analysis of morphometric characters gives a better idea for understanding the relationship between the species and to compare same species in different geographical areas[8]. The study of the individual growth pattern gives an insight about the population dynamics of the species such as growth and mortality rates which are commonly used for the stock assessments and life history studies. There is not much information available on the length-weight relationship of *O. bartramii* from Southern Ocean waters. The length-weight relation of the neon flying squid *O. bartramii* is discussed in this paper.

## Materials and Methods

Samples of *O. bartramii* were collected from Indian sector of Southern Ocean onboard ORV *Sagar Nidhi* during the second week of January 2012 in connection with India's Sixth Southern Ocean Expedition (SOE 2011-12), carried out by National Centre for Antarctic Ocean and Research (NCAOR) under the Ministry of Earth Sciences, Govt of India. The species were caught from 40° S Lat. and 53° to 58° E Long. Squid jigs of various makes and types were rigged onboard for hand jigging. Squid jigging operations were carried out during nights and different types of jigs were

operated (local jigs, jigs with LED lights and imported jigs). Morphometric measurements were taken as per the scheduled proforma and species identification and determination of the sex of the squids was carried out onboard. The mantle length (ML) was measured up to the nearest mm with scale. The specimens were cleaned with water, mopped with blotting sheet to remove the moisture for taking accurate measurement of the weight. The length-weight relationship was calculated by the method of least square regression[9, 10]. *t*-test was used to understand if the slope of regression line differs significantly from the value 3, which would be an indicative of allometric growth. The analysis of covariance (ANACOVA) on the regression equations and comparisons of slopes were carried out according to Snedecor and Cochran (1967) [11].

$W = a.\ L^{b}$

Where, W = weight of the fish in grams, L= length of the fish measured in centimeters (Mantle length) and '*a*' and '*b*' are exponents ('*b*' is regression coefficient and '*a*' a constant). This represents a general linear equation and the values '*a*' and '*b*' are estimated.

## Result

Total of 56 specimens were measured for length-weight and morphometric studies, which included 19 males and 37 females. The length of males ranged from 21.2 to 32.8 cm (mean 29 cm) and weight 230 to 1020 g (mean 698 g). Length of females ranged from 19.4 to 44.9 cm (mean 31 cm) and weight 115 to 2410 g (mean 847 g). Female squids are found to be bigger than male. The length-weight relationships of male, female and both sexes combined are discussed in Table 1 and Fig. 1, 2 and 3, respectively.

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

| Sex | n | Length (cm) | | Weight (g) | | Length-weight regression | | Parameters of relationships | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | *a* | *b* | S.E. (*a*) | S.E. (*b*) | $R^2$ |
| Male | 19 | 21.2 | 32.8 | 230 | 1020 | 0.0235 | 3.0509 | 0.0276 | 0.3466 | 0.9108 |
| Female | 37 | 19.4 | 44.9 | 115 | 2410 | 0.0283 | 2.9878 | 0.0149 | 0.1478 | 0.919944 |
| Combined | 56 | 19.4 | 44.9 | 115 | 2410 | 0.0314 | 2.960 | 0.0123 | 0.1115 | 0.918466 |

The '*b*' value obtained for both male and female was 3.0509 and 2.9878 and it was found to be statistically insignificant from the isometric value 3 (*t*-test, $P<0.005$). All these results confirm that both male and female *O. bartramii* showed an isometric growth pattern. Length weight relations showed no significant difference between male and female. When the length weight relationship of both male and female was combined, the '*b*' value obtained was 2.960 was very similar to the '*b*' value of females which can be due to the predominance of females in the samples studied.

The corresponding exponential formulae in the form of $W= a L^{b}$ can also be expressed as follows

Male : $W = 0.0235\ L^{3.0509}$
Female : $W = 0.0283\ L^{2.9878}$
Both sexes combined : $W= 0.0314\ L^{2.960}$

## Discussion

Inter and intra species growth pattern variability is observed in squids and the value of exponent variable '*b*' varies from 2.5 to 4 mainly depending on sex, maturity stage and feeding intensity[12]. The present study indicated that both male and female *O. bartramii* follows the isometric growth pattern. The '*b*' exponent value for male and female was found to be slightly deviate from the isometric value 3. The deviation was found to be statistically not significant and can be considered that these species follows Cubes Law. The '*b*' value of the sexes pooled was not significantly different from the '*b*' value of the individual sexes. The results of the present study are in accordance with the length–weight relationship estimated for *O. bartramii* collected from North Pacific Ocean indicated an isometric growth[13]. Suzuki et al. (1986) [14] reported the isometric growth pattern of ommastrephid squid *Stenotuthis oualaniensis* collected from Hawaiian waters. Dawe (1984) [15] indicated that growth pattern in *Illex illicebrosus* differed significantly for males and female populations and found to be positively allometric. High level of variability in length-weight relationship in squids are expressed among male and female[16, 17]. A positive allometric growth was observed in the matured males and negative allometry for females in the *Illex coindetti* collected from Galician waters in Spain[18]. An isometric and positive allometric growth pattern was observed in the male and female populations of *Illex coindetti*

from Central Mediterranean Sea[19]. Nair *et al.* (1992) [20] reported a negatively allometric growth pattern in *Loligo duvauceli*. Similarly, a negatively allometric growth has been reported in coastal squid *Sepioteuthis lessoniana* collected from Sri Lankan waters[21]. Karnik and Chakraborty[8] indicated a slightly negatively allometric growth pattern in coastal squid *Loligo duvauceli* collected from Mumbai waters, west coast of India.

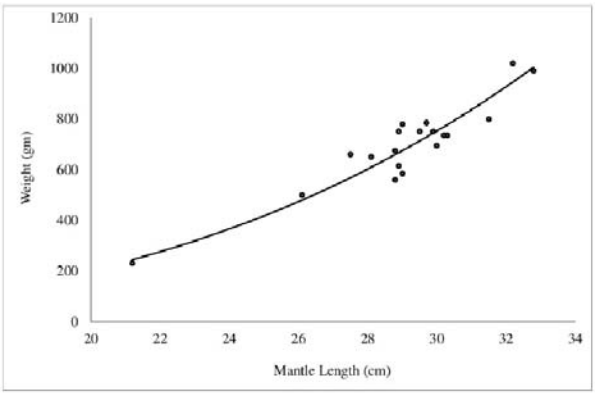


Fig. 1. Length-weight relationship of male *O. bartramii*

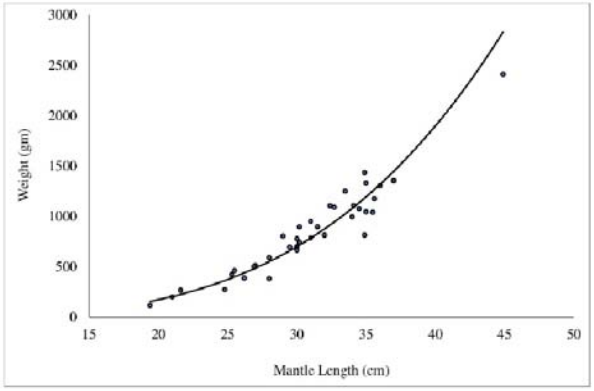


Fig. 1. Length-weight relationship of female *O. bartramii*

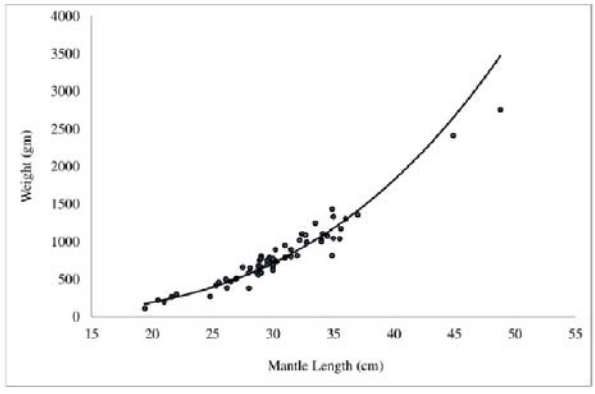


Fig. 3. Length-weight relationship *O. bartramii* (sexes combined)

Similar results were observed from the studies on *Sepia ramani* collected from Thoothukudi coast, southeast coast of India[22]. The analysis of the previous works suggests that oceanic squids generally follow an isometric to positively allometric growth pattern compared with coastal squids which shows negatively allometric growth. Information available on the length-weight relationship of the *O. bartramii* is very scanty. The seasonal variations in the length-weight relationship were not considered for this study. Fluctuation in the growth pattern can be changed due to variation in ecology, geographic conditions and food availability[13, 21]. Further studies are needed with large sample size is highly imperative for the precise estimation of length-weight relation in *O. bartramii*.

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