LENGTH-WEIGHT RELATIONSHIP AND DIET COMPOSITION OF FRIGATE TUNA (*AUXIS THAZARD*) FROM PARANGIPETTAI, SOUTHEAST COAST OF INDIA

Yosuva Mariyasingarayan, Jeyapragash Danaraj, Manigandan Vajravelu, and Saravanakumar Ayyappan*

Centre of Advanced Study in Marine Biology Faculty of Marine Sciences, Annamalai University Parangipettai **-** *608 502, Tamilnadu, India*

ABSTRACT

Study investigated the Length-weight relationship (LWR) and diet composition of *Auxis thazard,* caught along Parangipettai coast. The 'b' value for *A. thazard* exhibited 3.46 and logarithmic data exhibited the exponent value of b>3, confirms positive allometric growth. The estimated logarithmic length-weight relationship for *A. thazard* is Log W = 3.4679 – 2.553 log L and the parabolic equations derived can be represented as $W = 0.0028 \times L^{3.4679}$. The correlation coefficient (r^2) was found to be 0.906. *Auxis thazard* feed on a large variety of fishes, crustaceans, and molluscs, where fishes comprised the higher proportion. The study concludes that LWR and diet composition studies should be carried out for more number of in order to enlighten the fishery biologist about the status and growth condition of the fishes in the natural waters and also useful for successful fishery management.

**Keywords:** *Auxis thazard*, Length, Weight, Diet composition, Allometric

INTRODUCTION

The family Scombridae (mackerels and tuna) has 15 genera and 49 species that frame the reason for probably the most imperative fisheries business in the world. Both neritic (*Auxis thazard, Auxis rochei, Euthynnus affinis, Sarda orientalis*) and oceanic tuna (*Thunnus albacares, Thunnus obesus, Katsuwonus pelamis*) are generally experienced along Tamilnadu coast [1]. Frigate tuna are small pelagic species for the most part gotten in tropical and subtropical regions [2, 3]. Length-Weight relationship of fishes constitutes a successful apparatus in fishery science and is required for setting up yield condition. Of the length and weight measurement, length is simpler to quantify and can be changed into weight in which the catch is perpetually communicated. Weight of the fish would differ as the cube of length [4, 5, 6], yet they may withdraw altogether from their real relationship [7] because fishes normally do not retain the same shape or body outline throughout their life span and the specific gravity of tissues may remain constant. This kind of nourishing biology of fish joins with the length-weight relationship and is important to concentrate the sustaining conduct of exceptionally transient fish species. There is recent information on the length-weight relationship and feeding behavior of fish species, these studies get to date back, after which there has been a change in the pattern of fish species as they do not retain their original shape and size throughout their life span.

Feeding is one of the main concerns of daily living in fishes and devotes large portion of its energy in search of food. Feeding and searching for food are factors, which regulate or at least influence the distribution, migration and growth of fish [8]. The study of feeding habits of on organism based upon analysis of stomach content became a standard practice [9] and is one of the foremost aspects in the study of its biology as opined [10]. Stomach content analysis provides an important insight into fish feeding patterns and quantitative assessment of food habits which is inevitable in fishery management. Accurate description of diets and feeding habits also provides the basis for understanding trophic interactions in aquatic food webs. Accurate description of diets and feeding habits also provides the basis for understanding trophic interactions in aquatic food webs. Diet of on organism represents integration of many important ecological components that include behavior, condition, habitat use, energy intake and inter/intra specific interactions. Various reports with respect to LWR showed encouraging conduct of these species at various shorelines of India. There is considerable information on the fishery and the exploitation status of coastal tunas from Tuticorin [11, 12, 13] Maharashtra waters [14], North Andhra Pradesh waters [15], Chennai [16], Vizhinjam [17], Cochin [18], Lakshadweep [19, 20] and Andaman and Nicobar Islands [21, 22], Gujarat Coast [23]. The present report records the length-weight relationship and diet composition of *Auxis thazard,* caught along Parangipettai coast.

MATERIALS AND METHODS

Specimens of *Auxis thazard* were caught along Annangkovil Parangipettai coastal water (N $11^0$30'06.4", E $079^0$46 19.8") (Fig. 1). The length and weight were measure by calibrated centimetre scale and weighing balance (accuracy 0.05 g), respectively. Totally, 618 different size groups of individuals were collected with maximum total length of 49 cm and minimum of 18 cm. The total weight was found to be maximum of 2 kg and minimum of 70 g. The length-weight relationship of can be described by the exponential function $W = aL^b$, Since linear transformation is necessary to deal with length-weight data in terms of regression, the log of length is plotted against the log of weight thus making the relationship linear with an equation Log W = Log a + b Log L. The specimens of *Auxis thazard* stomach was 50 numbers of each fish was dissected out and keep it laboratory for further analysis the gut contents were preserved in 5% formaldehyde for further study. The above fish were analyzed for dietary composition. Food items of the above fishes were identified under a high power microscope using the pictorial keys.
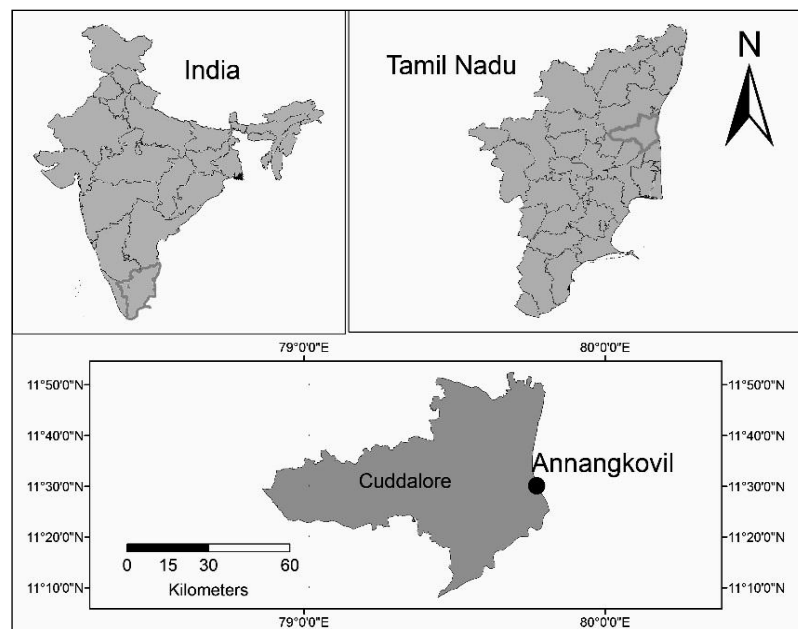
**Figure 1:** Map showing the study area

RESULTS

The length-weight relationship, regression parameters and significance of correlation for *A. thazard* of values of constant 'a' and exponent 'b' were determined from the logarithmic data in order to verify the "cube law" for the species studied and the 'b' value exhibited 3.46. The logarithmic data exhibited the exponent value of b>3, confirms that *Auxis thazard* species showed positive allometric growth. The estimated logarithmic length-weight relationship for *A. thazard* is:

Log W = 3.4679 – 2.553 log L

The parabolic equations derived can be represented as follows

W = 0.0028 x $L^{3.4679}$

The correlation coefficient 'r^2' was found to be in *A. thazard* (0.9066). The logarithmic length and weight of tuna species differ significantly in accordance to regression coefficients or slopes of the species.

$$y = 0.0028x^{3.4679}$$
$$R^2 = 0.9066$$
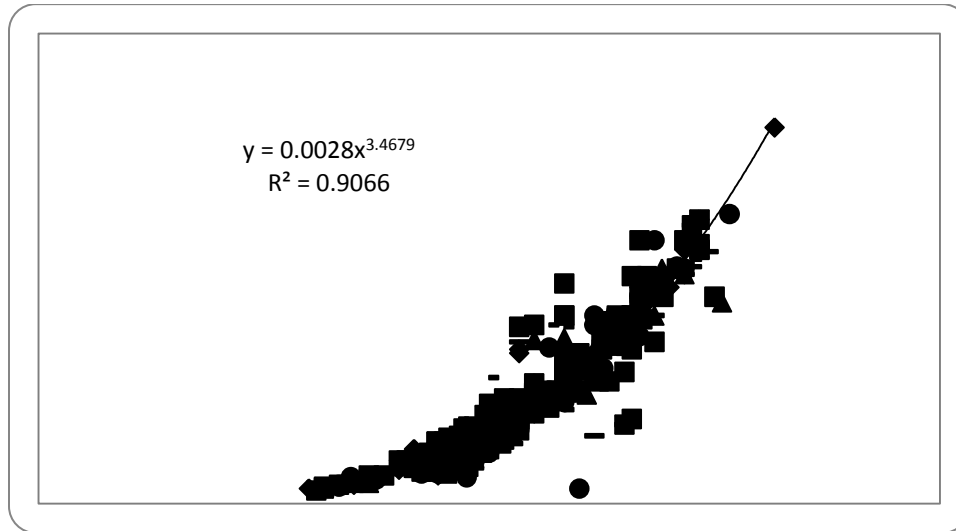
Figure 2: Parabolic length-weight relationship of *Auxis thazard*

$$y = 3.4679x - 2.553$$
$$R^2 = 0.9066$$
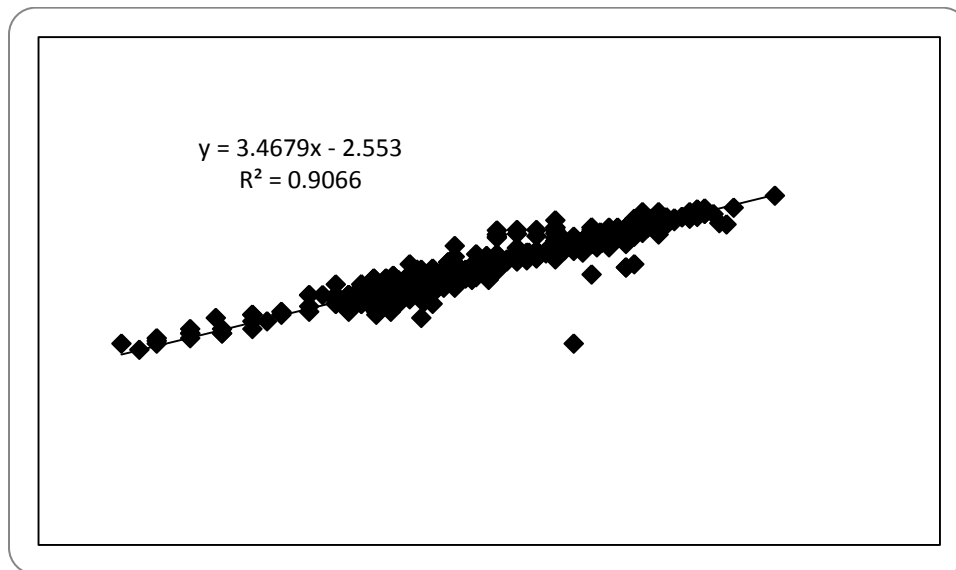
Figure 3: Logarithmic length-weight relationship of *Auxis thazard*

Diet Composition of Auxis thazard:

Auxis thazard feed on a large variety of fishes, crustaceans, and molluscs. Fishes comprised the greatest volume with crustaceans next in rank. *A. thazard* fed on small pelagic organisms, anchovies,

silversides, and other small fishes (Fig. 4). *A. thazard* consumed anchovy as the principal food and other items were infrequent. Spotted mackerel, (*Scornber australasicus*) is the most common among the fish species consumed. Among pre-adult *A. thazard* (170-252 mm), fishes constituted 42% by volume and were found in 80% of the samples. Those that were important were *Sardinella* spp., Anchovie sp., *Leiognathus* sp., and carangids. Crustaceans were next in importance accounting for 24% by volume and found in 77% of the samples. The most common crustaceans consumed by Auxis *thazard* were *Rhopolophthalmus* sp., *Hyperia bengalensis*, *Oxycephalus clausi*, *Pseudophausia latifrons*, *Acetes erythreus*, and Squilla larvae. Cephalopods formed 22% of the food consumed. Other items of food occasionally seen were chaetognaths, Halobates, and polychaetes.
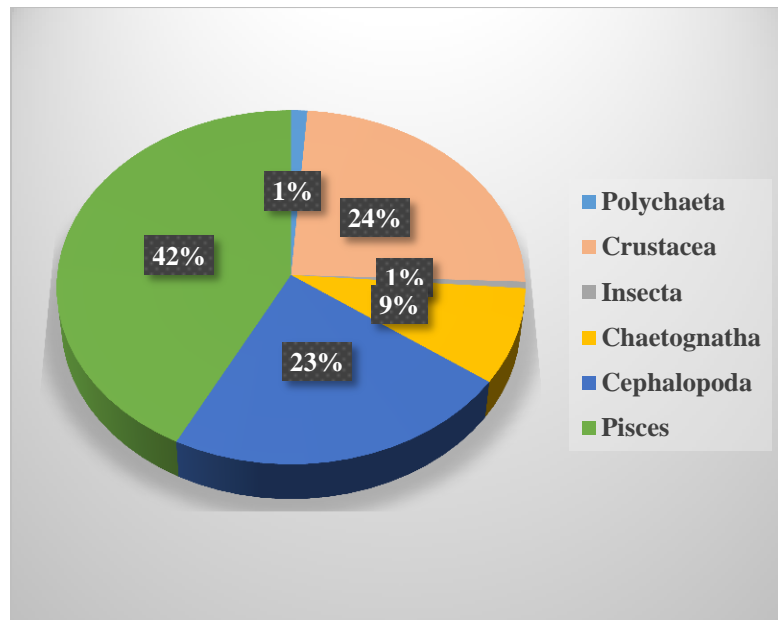
Figure 4: Overall % of diet composition of *A. thazard*

DISCUSSION

The length-weight relationship of *A. thazard* exhibited positive allometric growth in the present study. Similar exponent values for frigate tuna were recorded from Mangalore by Muthiah [23], where the growth parameters of length-weight relationship of both sexes of b values recorded as 3.30 for males and 3.02 for females which coincide with the present study. Ghosh *et al.* [24] studied length and weight relationship results of b = 3.17, r^2 values 0.96 and a value were -2.08 at West and coast of India. Noegroho et al. [25] studied feeding habits and length and weight relationship form Eastern Indian Ocean results obtained b value of 2.805, and r^2 = 0.955, Frigate tunas by the number of samples 65 stomach contents were analyzed dominant groups unidentified fish (fish ruined) 41%, empty stomach 32%, and some material were can be identified are as sardines (*Sardinella* sp; 14%), crustaceans (*Acetes* spp; 10%), Anchovies (*Stolephorus sp;* 2%) and Squids (Lolingidae; 1%). Ghosh *et. al.* [24]also found an empty stomach conditions dominate the *Auxis thazard* (74%). The food items in the diet of *A. thazard* were classified broadly into three major groups:

crustaceans, cephalopods and finfishes. Crustaceans comprised mainly non-penaeid prawn, *Acetes* spp. and crabs. The squid, *L. duvaucelli* dominated among cephalopods. Sardines, anchovies, mackerels, scads and tuna juveniles were dominant among finfishes. The feeding intensity was more in the months of March, April, June and December in the Indian Water. The studies on the feeding habits of *A. thazard* by Kumaran [26] analyzed and collected along Vizhinjam coast, the results consists of fishes (88%), crustaceans (12%) in that squid were totally absent. The fish's species are dominant by *Anchoviella spp.* and *Leiognathus spp.*

The results of length-weight relationship values b = 3.8 showed a Positive allometric growth and present study also coincided with Pon Siraimeetan, [27] and studied the feeding habits of *A. thazard* mainly feeds on crustaceans, copepods and decapod larvae. Yu tao *et al*. [28] studied the relationship between total weight and fork length b values were 3.38 and Frigate tuna in Taiwan Strait is carnivorous, its trophic level is 3.3 as it feeds mainly on fishes like Bregmacerotidae and Clupeidae (trophic level: 2-3), and in a minor level on Macrura (trophic level: 1.8) [29]. In the present study conclude that length-weight relationship of the species showed positive allometric growth pattern with an exponent 'b' value more or less than 3 (b>3 or b<3) and have not followed the cubic relationship. Therefore, LWR and diet composition studies should be carried out for more number of in order to enlighten the fishery biologist about the status and growth condition of the fishes in the natural waters and also useful for successful fishery management.

REFERENCES

1. Kasim, H. M. and Mohan, S. 2009. Tuna fishery and stock assessment of component species off Chennai coast. Asian Fish. Sci., 22(1): 245-256.

2. Randall, J.E. 1995. Coastal fishes of Oman. Crawford House Press, Bathurst, Australia, 439 pp.

3. Liu, R.Y. 2008. Checklist of marine biota of China Seas. Science Press, Beijing, 1267 pp.

4. Brody, S. 1945. Bioenegetics and growth. Reinhold publishing Corporation, New- York.

5. Largler, K. F. 1952. Freshwater fishery biology. Wm. C. Brown Co., Dubuque, Iowa, 317 pp.

6. Brown, M. E. 1957. The physiology of fishes. 1. Metabolism. Academic press. Inc., New York, 371 pp.

7. Le Cren, E.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (Perca fluviatilis). J. Animal Ecol., 20: 201-219.

8. Papaconstantinou, C. and Caragitsou, E. 1994. Feeding ecology of juvenile hake (*Merluccius merluccius*) on the nursery grounds. Proc. 1st Int. Fish. Congr., Athens, 4–9.

9. Hyslop, E.J. (1980) Stomach content analysis: a review of methods and their application. J Fish Biol 17:411–422.

10. Qasim, S. Z. 1972. The dynamics of food and feeding habits of some marine fishes. Indian J. Fish., 19: 11-28.

11. Abdussamad, E. M., Pillai, P. P., Kasim, H. M. and Balasubramaniam, T. S. 2005. Fishery and population characteristics of coastal tunas at Tuticorin. J. Mar. Biol. Ass. India, 47 (1): 50-56.

12. James, P. S. B. R., Pillai, P. P., Jayaprakash, A. A., Pillai, N. G. K., Gopakumar, G., Kasim, H. M., Sivadas, M. and Said Koya, K. P. 1993. Fishery, biology and stock assessment of small tunas. In: Sudarsan, D. and John, M. E. (Eds.), Tuna Research in India, Fishery Survey of India, Bombay, India, p. 123-148.

13. Kasim, H. M. 2002. Fishery, growth, mortality rates and stock assessment of Auxis thazard (Lacepede) along Tuticorin coast, Gulf of Mannar. In: Ayyappan, S., Jena, J. K. and Mohan Joseph, M. (Eds.), The Fifth Indian Fisheries Forum Proceedings, Bhubaneswar, Orissa, p. 351-355.

14. Zafar Khan, M. 2004. Age and growth, mortality and stock assessment of E. affinis (Cantor) from Maharashtra waters. Indian J. Fish., 51 (2): 209-213.

15. Sujatha, K. and Deepti, V. A. I. 2006. Tuna fish resources of north Andhra Pradesh – sustainable development. In: Kurup, B. M. and Ravindran, K. (Eds.), Sustain Fish, School of Industrial Fisheries, Cochin University of Science and Technology, Cochin, p. 421-433.

16. Kasim, H. M. and Mohan, S. 2007. Tuna fishery and stock assessment of component species off Chennai coast. In: Modayil, M. J. (Ed.), Book of Abstracts, 8th Asian Fisheries Forum, 58-59 p.

17. Gopakumar, G. and Sadasiva Sarma, P. S. 1989. The present status of coastal tuna fishery at Vizhinjam, Trivandrum. Mar. Fish. Infor. Serv., T & E Ser., 97: 1-7.

18. Silas, E. G., Pillai, P. P., Srinath, M., Jayaprakash, A. A., Muthiah, C., Balan, V., Yohannan, T. M., Siraimeetan, P., Mohan, M., Livingston, P., Kunhikoya, K. K., Pillai M. A. and Sarma, P. S. S. 1985. Population dynamics of tunas: stock assessment. In: Silas, E. G. (Ed.), Tuna fisheries of the exclusive economic zone of India: biology and stock assessment, Bull. Cent. Mar. Fish. Res. Inst., Cochin, 36: 20–27.

19. Sivadas, M. 2002. Present status of tuna fishery in Minicoy, Lakshadweep. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), Management of Scombroid Fisheries, Central Marine Fisheries Research Institute, Cochin, p. 62-68.

20. Nasser, A. K. V., Sivadas, M., Gopakumar, G. and Pillai, P. P. 2002. Tuna live-bait fishes – their exploitation, conservation and management in Lakshadweep. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), Management of Scombroid Fisheries, Central Marine Fisheries Research Institute, Cochin, p. 148-154.

21. Madhu, K., Madhu, R., Ahlawat, S. P. S., Ravindran, E. K. and Dam Roy, S. 2002. Status of exploitation of tuna, mackerel and seerfish in Andaman and Nicobar Islands. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P.

and Ganga, U. (Eds.), Management of scombroid fisheries, Central Marine Fisheries Research Institute, Cochin, p. 49-55.

22. Ghosh, S., Pillai, N. G. K. and Dhokia, H. K. 2010. Fishery, population characteristics and yield estimates of coastal tunas at Veraval. Indian J. Fish., 57 (2): 7-13.

23. Muthiah, C.1985. Fishery and bionomics of tunas at Mangalore. Bull. Cent. Mar. Fish. Res. Inst., Cochin, 36: 51-70.

24. Ghosh S, Sivadas M, Abdussamad EM, Rohit P, Koya KPS, Joshi KK, Anuleksmi C, Muthu Rathinam M, Prakasan D, and Manju S. 2012. Fishery, population dynamics and stock structure of frigate tuna Auxis thazard (Lacepede, 1800) exploited from Indian waters. Indian J Fish 59(2):95-100.

25. Noegroho, T., T. Hidayat and Amri, K. 2013. Some Biological Aspects of Frigate Tuna (Auxis thazard), Bullet Tuna (*Auxis rochei*), and Kawakawa (*Euthynnus affinis*) in West Coasts Sumatera IFMA 572, Eastern Indian Ocean. IOTC–2013–WPNT03–19.

26. Kumaran, M. (1964) . Studies on the food of Euthynnus affinis affinis (Cantor), Auxis thazard (Lacepede) Auxis thynnoides Bleeker and Sarda orientalis (Temminck and Schlegel). In: Proceedings of the Symposium on Scombroid Fishes, Part 2; MBAI, 12-15 January 1962, Mandapam.

27. Pon Siraimeetan. 1985. Fishery and bionomics of tuna in Tuticorin. Bull. Cent. Mar. Fish. Res. Inst., 36: 86 - 103.

28. Yu Tao, Chen Mingru, Du Jianguo, Lu Zhenbin and Yang Shengyun. 2012. Age and growth changes and population dynamics of the black pomfret (*Parastromateus niger*) and the frigate tuna (*Auxis thazard thazard*), in the Taiwan Strait. Lat. Am. J. Aquat. Res., 40(3): 649-656.

29. Zhang, Q., L. Qiumian, L. Youtong & Z. Yueping. 1981. Food web of fishes in Minnan-Taiwanchientan Fishing Ground. Acta Oceanol. Sinica, 3(2): 275-290.