Indian J. Fish., 58(1) : 31-34, 2011

Sudden emergence of fishery and some aspects of biology and population dynamics of *Aluterus monoceros* (Linnaeus, 1758) at Veraval

SHUBHADEEP GHOSH, R. THANGAVELU, GULSHAD MOHAMMED
H. K. DHOKIA, M. S. ZALA, Y. D. SAVARIA, J. P. POLARA AND A. A. LADANI
Veraval Regional Centre of Central Marine Fisheries Research Institute
Matsya Bhavan, Bhidiya, Veraval – 362 269, Gujarat, India
e-mail: subhadeep_1977yahoo.com

ABSTRACT

The sudden emergence of a fishery and selected aspects of biology and population dynamics of *Aluterus monoceros* landed by trawlers at Veraval was studied from January 2008 to December 2009. Total catch of 475 t recorded in September 2009, which increased to 7042 t in October dominated in the trawl landings with a contribution of 29.5%. However, in November and December, the catch decreased sharply to 1374 t and 94 t, respectively. The combined length-weight relationship was log W = -1.50 + 2.694 log L (r = 0.86) (n = 222) indicating allometric growth. Sex ratio was 1:1.05 (n = 129). Females attained sexual maturity at 50.2 cm total length. Zoobenthos, dominated by benthic invertebrates, cnidarians and worms, zooplankton dominated by copepods and nekton dominated by *Acetes* spp. and clupeid juveniles were the major food items of *A. monoceros*. The von Bertalanffy growth equation was $L_t = 63.53 [1 – e^{-0.22 (t + 0.077)}]$. Natural mortality, fishing mortality and exploitation ratio were 0.53, 0.58 and 0.52 respectively.

Keywords: *Aluterus monoceros*, Biology, Fishery, Population dynamics, Veraval

Introduction

Aluterus monoceros (Linnaeus, 1758), belonging to the family Monacanthidae and the order Tetraodontiformes is a reef associated subtropical fish occurring in the continental shelf down to 50 m depth. It is epipelagic in nature and popularly called as the unicorn leatherjacket. It is found solitary or in pairs, occasionally in groups of five or six. Juveniles are pelagic, often with large jellies and these bring them close to reefs and adults nest on sand flats adjacent to reefs in deep water or form large schools under weed-rafts (Kuiter and Tonozuka, 2001). It is caught as by-catch in bottom trawls all over the world (Lopez-Peralta and Arcila, 2002; Khemakorn *et al*., 2005; Tuan and Mai, 2005). Similar scenario was observed at Veraval landing centre earlier when sparse landings of *A. monoceros* in bycatch by trawlers were recorded, though only very rarely. However, from the beginning of 2008, quantum of catch gradually increased and this continued upto August, 2009. Then suddenly in September, October and November of 2009, their catch increased in such enormous proportions that there was targeted fishing for unicorn leatherjacket, which became the sole highest contributor to the trawl catches of not only Veraval but the entire Saurashtra coast. The price of *A. monoceros* increased to Rs. 60 and further to Rs. 120 per kg. Catches of unicorn leatherjacket were recorded also in multifilament gillnets during these months. There is no published information on the population parameters and biology of unicorn leatherjacket caught from the Indian waters. The present paper attempts to study the sudden emergence of the fishery and some aspects of biology and population dynamics of *Aluterus monoceros* landed at Veraval.

Materials and methods

Data on catch and effort expended for catching *Aluterus monoceros* were collected every week from the trawl (Bhidiya) and gillnet (Old Light House) landing centres at Veraval during January 2008 to December 2009. The monthly and annual estimates of catches were made following the stratified random sampling design as adopted by CMFRI. A total of 222 specimens of *A. monoceros* (length range: 41.0 to 60.9 cm) collected randomly every week from trawl landings were sampled for recording total length (cm) and body weight (g). The length weight relationship was calculated following the formula $W = aL^b$ (Le Cren, 1951). Sex ratio was determined from 129 specimens and Chi-square test was performed to test the homogeneity of male and female distribution. The size at first maturity (L_{50}) was determined from 66 female specimens by plotting the percentage of mature specimens (stage III and above) against their total length. The food and feeding intensity from 129 specimens was assessed based on the distension of their stomach and the volume of food contained in it and was classified as full, ¾ full, ½ full, ¼ full and empty (Ghosh *et al.*, 2009).

For estimating the von Bertalanffy growth parameters *viz*, asymptotic length (L_α) and growth co-efficient (K), the monthly data on length measurements from trawl landings during 2008 - 2009 were pooled and grouped into 1 cm class interval, and analysed using the ELEFAN I module of FiSAT software (Gayanilo *et al.*, 1996). Growth performance index (Ø) was calculated from the final estimates of L_α and K (Pauly and Munro, 1984). The size at first capture (L_c) was estimated as in Pauly (1984) and the age at zero length (t_0) from Pauly's (1979) empirical equation, $\text{Log}(-t_0) = -0.392 - 0.275 \text{ Log } L_\alpha - 1.038K$. The midpoint of the smallest length group in the catch was taken as length at recruitment (L_r) Natural mortality (M) was estimated as in Pauly (1980) and total mortality (Z) from length converted catch curve (Pauly, 1983) using FiSAT software. Fishing mortality (F) was estimated by $F = Z - M$. Length structured virtual population analysis (VPA) of FiSAT was used to obtain fishing mortalities per length class. Exploitation ratio (E) was estimated from the equation, $E = F/Z$.

Results and discussion

Prior to 2008, there were sparse landings of unicorn leatherjacket occasionally as bycatch in trawls to the tune of less than a tonne annually. The first record of substantial catch was in January, 2008 when 12.2 t was landed by trawlers. Subsequently monthwise catch ranging from 1 to 18.5 t were recorded between February, 2008 to August, 2009. A total catch of 23.6 t was recorded during 2008 at a catch rate of 0.016 kg h^{-1} forming 0.017% of the trawlnet landings. The catch increased in 2009 and from January to August a total of 41.9 t was recorded at a catch rate of 0.056 kg h^{-1} forming 0.073% of the trawlnet landings. In September, 475 t was landed contributing 2.76% to the trawl landings (Fig. 1). This increased to 7042 t in October when it was the single highest contributor to trawl catch contributing 29.5%. In November and December, the catch decreased sharply to 1374 t and 94 t, respectively. This spectacular increase in catch could be attributed to the fact that once catch started coming and increasing steadily from the early months of 2008 there was targeted fishing for the unicorn leatherjacket. Multiday trawlers of Saurashtra coast operating in the area of Bombay High around Ratnagiri and Satpatti, employing ribbonfish trawls targeted unicorn leatherjacket owing tothe decreasing catch of ribbonfish in trawls. Ribbonfish trawlnets possess large meshed codend (4 - 5 cm) and have large mesh openings in the wing sections of the trawl (45 – 60 cm). The multiday trawlers conducted voyage fishing lasting for 8 – 12 days at depth of 30 – 50 m for *A. monoceros*. Each trawler performed, on an average 4 hauls per day and carried, on an average 10 to 12 such

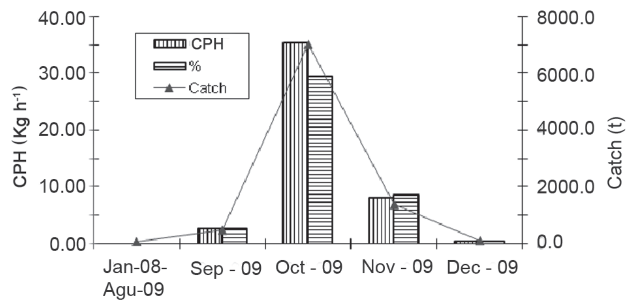

Fig. 1. Spurt in catch of *Aluterus monoceros* by trawlers at Veraval

nets and majority of fish was caught during the night time. A multifilament gillnet fishery for *A. monoceros* was observed from August, 2009 onwards. The catch and catch rate increased from 2.2 t and 2.45 kg unit^{-1} in August to a maximum of 78.9 t and 45.26 kg unit^{-1} in October, after which decreased to 34.7 t and 15.62 kg unit^{-1} in November (Fig. 2). There was no landing of *A. monoceros* in gillnets in December.

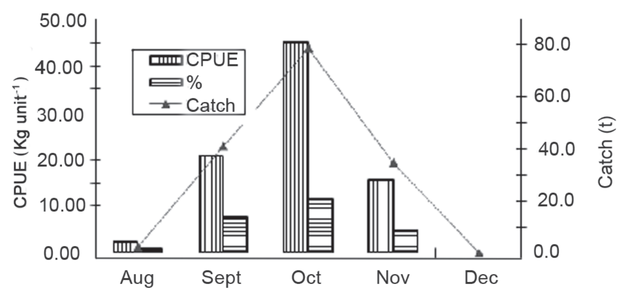

Fig. 2. Spurt in catch of *A. monoceros* by gillnetters at Veraval

The mean lengths exhibited an inverse relationship to the quantum of unicorn leatherjacket caught in trawl nets. The highest mean length of 52.93 cm was recorded in the month of September and the lowest of 46.19 cm in the month of October. In October, when the highest catch was recorded, juveniles were exploited in greater amounts and this could be an indication of growth overfishing of this species. The combined length-weight relationship was $\log W = -1.50 + 2.694 \log L$ ($r = 0.86$) ($n = 222$), whichindicated allometric growth for the species. This is in contrary to Garcia *et al.* (1998) who reported on isometric ($b = 2.960$) growth of *A. monoceros* from the Gulf of Salamanca, Colombia. This variation is possibly due to factors related to ecosystem and biological phenomena like maturity stages, feeding behaviour, competition for food, *etc*.

The overall sex ratio was 1:1.05 ($n = 129$). The chi-square values indicated significant (5%) dominance by females in the month of September and by males in the month of October. *A. monoceros* attained sexual maturity at a size of 50.2 cm total length (Fig. 3) ($n = 66$). However, gonadal development and sexual maturity in the species was observed to commence from 46 cm onwards. The percentage of mature and spawning females was 57.1 in

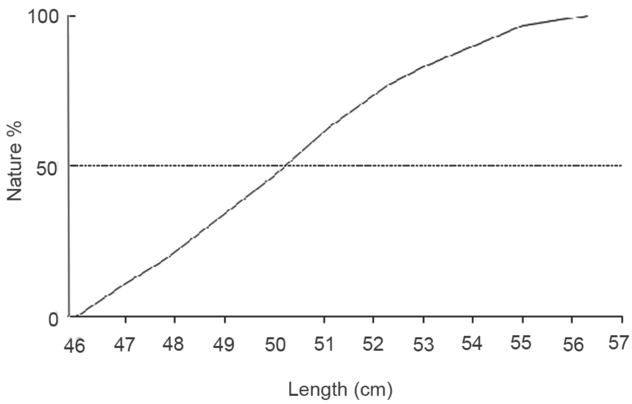

Fig. 3. Size at first maturity of females (n = 66) of *A. monoceros*

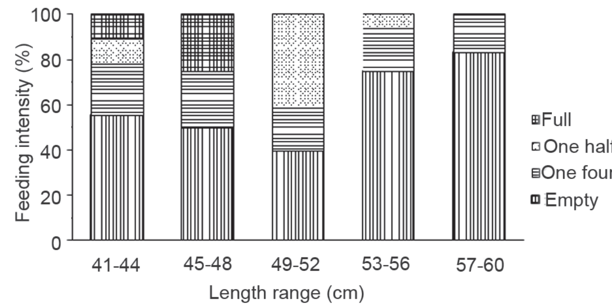

Fig. 4. Sizewise feeding intensity (n = 122) of *A. monoceros*

September which decreased to 28.6 in October and to no mature and spawning females in November and December, which is indicative of the fact that the monsoon months could be the breeding season of *A. monoceros* along the Saurashtra coast. Similar views were expressed by Qasim (1973) while studying the maturation and spawning of marine teleosts from the Indian waters and concluded that along the west coast, spawning takes place during monsoon.

Since there was not much difference in the food and feeding habits of males and females, the data (n = 129) on both the sexes were pooled. The food items in the diet of *A. monoceros* were classified broadly into three major groups: zooplankton, zoobenthos and nekton. Zooplankton and zoobenthos were encountered in the gut of most fishes and nekton was encountered in few. Benthic invertebrates, cnidarians (polyps – corals) and worms dominated the zoobenthos group and were the most important and preferred food item of *A. monoceros*. Among zooplankton found in gut, copepods dominated followed by decapods. The nonpenaeid prawn *Acetes* spp. and juveniles of clupeids constituted the nekton population found in the gut. Occasionally, seaweeds were also found to be consumed by the unicorn leatherjacket. Lopez-Peralta and Arcila (2002) studying the diet composition of *A. monoceros* form the southern continental shelf of Colombia reported on similar lines that zoobenthos, zooplankton and nekton were the major food items. Similar views from north-west Gulf of Mexico were expressed by Pattengill *et al*., (1997) and from south China Sea by Mohsin *et al*. (1986). The analysis of food items in relation to body size depicted that while adults fed almost entirely on zoobenthos, juveniles preferred all zoobenthos, zooplankton and nekton. The average contribution of fishes in the feeding conditions of full stomach, ¾ full stomach, ½ full stomach, ¼ full stomach and empty stomach were 6.1%, nil, 12.3%, 20.4% and 61.2%, respectively. The intensity of feeding was found to be more in juveniles than that of in adult mature fishes (Fig. 4). The length of the intestine was found to be on an average 3.06 times that of total body length. The relationship between total body length (TL) and intestine length (IL) was log IL = -0.4788 + 1.5628 log TL (r = 0.6) (n = 129), which indicated their omnivory nature and are in full agreement to the food items encountered in their gut.

The growth parameters, L_α and K (annual) estimated using the ELEFAN I programme were 63.53 cm and 0.22, respectively at the highest Rn (goodness of fit index) value of 0.595. Growth performance index ϕ was 2.95 and t_0 was calculated at -0.077 years. The von Bertalanffy growth equation was $L_t = 63.53\ [1 - e^{-0.22\,(t + 0.077)}]$. L_c was estimated at 44.91 cm and L_r at 41.4 cm. The mortality rates M, F and Z computed were 0.53, 0.58 and 1.11, respectively. Exploitation ratio was 0.52. VPA indicated that main loss in the stock up to 48.5 cm size was due to natural causes. Fishes became more vulnerable to the gear after this size and mortality due to fishing increased and eventually outnumbered the natural losses at the highest recorded length of 60.5 cm. The mean value for fishing mortality was 0.15 and the mean value for exploitation ratio was 0.14.

Acknowledgements

The authors are thankful to Dr. G. Syda Rao, Director, CMFRI and Dr. N. G. K. Pillai, former Head, PFD, CMFRI for the encouragement and the facilities provided.

References

García, C. B., Duarte, L. O., Sandoval, N., von Schiller, D., Melo, G. and Navajas, P. 1998. Length-weight relationships of demersal fishes form the Gulf of Salamanca, Colombia. *Naga ICLARM Q*. (in press).

Gayanilo, F. C. Jr., Sparre, P. and Pauly, D. 1996. The FAO-ICLARM Stock Assessment Tools (FiSAT) User's Guide. *FAO computerised information series (Fisheries)*. No. 8, Rome, FAO, 126 pp.

Ghosh, S., Mohanraj, G., Asokan, P. K., Dhokia, H. K., Zala, M. S. and Bhint, H. M. 2009. Trophodynamics and reproductive biology of *Otolithoides biauritus* (Cantor) landed by trawlers at Vanakbara, Diu along the west coast of India. *Indian J. Fish*., 56(4): 261-265.

Khemakorn, P., Kongprom, A., Dechboon, W. and Supongpan, M. 2005. Trash fish: The links between capture fisheries and aquaculture in Thailand. *Regional Workshop on Low Value and "Trash fish" in the Asia - Pacific Region*, Hanoi, Vietnam, p. 49-106.

Kuiter, R. H. and Tonozuka, T. 2001. Pictorial guide to Indonesian reef fishes, Part 3. Jawfishes - Sunfishes, Opistognathidae - Molidae. *Zoonetics*, Australia, p. 623-893.

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*., 20: 201-219.

López-Peralta, R. H. and Arcila, C. A.T. 2002. Diet composition of fish species form the southern continental shelf of Colombia. *Naga, World Fish Centre Q*., 25(3&4): 23-29.

Mohsin, A. K. M., Ambak, M. A., Said, M. Z. B. M., Sakiam, M. and Hayase, S. 1986. A study on the feeding habits of fishes in the south-western portion of the South China Sea. In: Mohsin, A. K. M., Rahman, R. A. and Ambak, M. A. (Eds.), *A study on the offshore water of the Malaysian EEZ*. Faculty of Fisheries and Marine Science, University Pertanian, Malaysia, 197 pp.

Pattengill, C. V., Semmens, B. X. and Gittings, S. R. 1997. Reef fish trophic structure at the Flower Gardens and Stetson Bank, NW Gulf of Mexico. *Proceedings of the 8th International Coral Reef Sympossium,* 1:1023-1028.

Pauly, D. 1979. Theory and management of tropical multi-species stocks. A review with emphasis on the south-east Asian demersal fisheries. *ICLARM Studies and Reviews 1*, 35 pp.

Pauly, D. 1980. On the interrelationships between natural mortality, growth parameters and mean environmental temperature in 175 fish stocks. *L. Cons. Ciem*., 39 (2): 175-192.

Pauly, D. 1983. Length converted catch curves. A powerful tool for fisheries research in tropics (Part-1). *ICLARM Fishbyte*, 1(2): 9-13.

Pauly, D. 1984. Length converted catch curves. A powerful tool for fisheries research in tropics (Part-II). *ICLARM Fishbyte*, 2 (1): 13-14.

Pauly, D. and Munro, J. L. 1984. Once more, on the composition of growth in fish and invertebrates. *Fishbyte*, 2(1): 21.

Qasim, S. Z. 1973. An appraisal of the studies on maturation and spawning in marine teleosts from the Indian waters. *Indian J. Fish*., 20(1): 166-181.

Tuan, V. A. and Mai, B. T. Q. 2005. Trash fish use as a food source for major cultured species in An Giang and Dong Thap provinces, Mekong Delta, Vietnam. *Regional Workshop on Low Value and "Trash fish" in the Asia - Pacific Region,* Hanoi, Vietnam, p. 211-222.

Date of Receipt : 26.05.2010
Date of Acceptance : 28.02.2011

Indian J. Fish., 58(1) : 35-38, 2011

Length-weight relationship of *Tor putitora* (Hamilton) from Kosi River Uttarakhand considering different stages of its lifespan

N. OKENDRO SINGH, DEBAJIT SARMA AND N. GOPIMOHON SINGH*
Directorate of Coldwater Fisheries Research, Bhimtal – 263 136, Nainital, Uttarakhand, India
**Department of Statistics and Mathematics, Central Agricultural University, Iroisemba, Imphal, Manipur, India*
e-mail: nosingh2000@yahoo.com

ABSTRACT

The length-weight relationship of *Tor putitora* was studied from Kosi River, Ramnagar, Uttarakhand, considering four different stages of its lifespan. ANCOVA results suggested the existence of two distinct stages of *T. putitora* with respect to its length-weight relationship, which do not follow isometric growth. Further, the datasets of two distinct stages were meaningfully fitted to allometric models with expected value parameters.

Keywords: Allometric model, Distinct stages, Expected value parameters, Length-weight relationship, *Tor putitora*

Introduction

Establishment of length-weight relationship of fish is a useful indicator for fishery biology studies. It has enormous advantages as it allows the estimation of the average weight of the fish of a given length group by developing a mathematical relationship between length and weight (Beyer, 1987). It is also useful for assessing the relative well being of the fish population (Bolger and Connolly, 1989). Like any other morphometric character, the length-weight relationship can also be used for the differentiation of taxonomic units and this relationship is seen to change with various developmental events in life such as metamorphosis, growth and the onset of maturity. Besides this, the length-weight relationship can also be used in setting yield equations for estimating the number of fish landed and comparing the population in space and time (Beverton and Holt, 1957). *Tor putitora* is an endangered coldwater fish species that is popular as food fish and as source of recreation for anglers. Many researchers have already established length-weight relationship of *T. putitora* from time to time. However, a detailed analysis on length-weight relationship of this important species has not been attempted. The present study aims to develop length-weight relationship of *T. putitora* considering different stages of its lifespan for direct use in fishery assessment.

Materials and methods

The well known allometric model in fishery is defined by:

$$W = aL^b \qquad (1)$$

where 'L' and 'W' represent the length and weight of the fish respectively, 'a' and 'b' are parameters.

'Nonlinear estimation procedures' assuming an additive error term is recommended for estimating the parameters involved in the above nonlinear model (Venugopalan and Prajneshu, 1998) since the linearisation of the above equation needs multiplicative error assumption that tends to be valid when the variability of dependent variable weight increases with increasing values of weight (Ratkowsky, 1990). However, this does not seem logical since variability of weight increases as weight of fish increases. Further, when we deal with nonlinear estimation procedures for estimating the parameters, high parameter correlation may be detected which is indeed undesirable. Ratkowsky (1990) suggested to use expected value parameters for choosing the values of the explanatory variable in such a way to make the parameter correlations low. Expected value parameters can be advantageously used, as they are nearly unbiased, normally distributed and minimum variance estimators.

We can get the expected values from equation (1) by choosing values L_1 and L_2 of the explanatory variable L, within the observed range of L as follows:

$$W_1 = aL_1^b$$

and

$$W_2 = aL_2^b$$

Solving these equations, we get

$$a = W_1 \Big/ L_1^{\log(W_1/W_2)/\log(L_1/L_2)}$$