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Biology of *Atule mate* (Cuvier, 1833) with a note on species composition of Carangid landings from South Andaman coast, India

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Abstract

Andaman and Nicobar islands are reported to have 48 species of the family Carangidae under 13 genera. The present study has recorded 18 species under 12 genera. *Atule mate* is an important fishery resource along with the other scads coming under the genus *Selar.* The species is mostly caught and marketed with the scombrid *Rastrelliger* sp., the Indian Mackerel and other carangids mainly *Selar crumenopthalmus* and *Selar boops*. The study has showed that the dominant size group of *A. mate* in the landings was 191-210 mm. The length weight relationship analyses showed isometric growth. The diet composition of *A. mate* mainly consisted of copepods, shrimps, small fish and gastropods which was analysed on the basis of its gut contents. Based on the condition of gut contents, it could be ascertained that it swallows prey as a whole. The mature fishes were found mostly in the length class 231-250 mm, but few female specimens with mature ovaries were also observed in the length classes 170-190 mm and 191-230 mm. The mature specimens were observed to have a low gastrosomatic index. The present study recorded 19 species belonging 13 genera of the family Carangidae in Junglighat fish landing Centre. The species *Caranx ignobilis* (18.9%), *C. melampygus* (18.6%), *Atule mate* (17.8%), *Selar boops* (9.3%), *S. crumenophthalmus* (7.1%), *Carangoides talamparoides* (6.9%) and *C. malabaricus* (5.2%) are the major contributors for the Carangidae fisheries of Andaman waters.

Keywords: *Carangidae, Marine Fish Landings, South Andaman, Atule mate, Fish Biology*

Introduction

Andaman and Nicobar Islands have coastline of 1926 km and the Exclusive Economic Zone around these islands is 6,00,000 sq km forming 28% of the total EEZ area of the country (Rajan et al., 2013). Fish fauna of Andaman and Nicobar consists of an assemblage of about 1463 species spread over all the diverse habitats representing 586 genera belonging to 175 families (Rajan et al., 2013). FisherY is an important food resource as well as livelihood for the Bay islands. Carangids are marine pelagic fishes inhabiting in Atlantic, Indian and Pacific Oceans and include jacks (*Seriola* spp.), pompanos (*Alectis* spp.), trevallies (*Caranx* spp., *Ulua* spp.), runners (*Elegatis* spp.), scads (*Atule* spp., *Selar* spp.) and fast swimming predatory fishes (Froese et al., 2013). Carangids are highly favored food fish among the local community because of its taster meat, high nutritional value and year round availability. A total of 146 species reported so far belonging to 30 genera under the family Carangidae worldwide. Sixty two species were reported from Indian coast which includes 14 major species of commercial importance. The gears used for exploiting carangids are mainly trawl net, gillnets, hook and line, long lines and different types of seine nets. Carangids primarily feed crustaceans, fishes, with an interspecific interactive behaviour with the labrid wrasse *Bodianus rufus*.

The carangid species *Atule mate* commonly known as yellowtail cad ('Topi' locally) inhabit mostly mangroves, coastal bays and coral reefs and are mostly diurnal and most of the time found in schools. These fishes are fast swimmers and their diet mainly consists of small fish, crustaceans and cephalopods. The importance of studying exploited resources of carangids can help the fishery managers to get an overall idea about the changes in their significance, biomass and stock characteristics for better management and sustainable yield. The life history traits of the exploited marine species must be studied to understand the changes happening to the stock due to the commercial exploitation.

There are several studies conducted on the biology of carangids from Indian waters. Length-weight relationship including food and feeding habits of Indian Scad *Decapterus russelli* from the North west coast of India was studied by Jaiswar et al. (1993); reproductive biology of horse mackerel or torpedo scad *Megalaspis cordyla*; preferring planktonic crustaceans and fish juveniles (Sivakami, 1997). There are other studies also on these species except *Atule mate* ((Murty, 1991; Reuben et al., 1992; Sunil and Suryanarayanan, 1994; Moiseeva and Zhuk, 1995; Tamhane, 1996; Raje, 1997; Manojkumar, 2007; Sajina et al., 2010; Jadhav and Mohite, 2013 and Ashwini et al., 2016).

Kingston et al. (1999) had given a general idea on the feeding habits and feeding intensity of *Atule mate* from Gulf of Mannar and shown that the species exhibited two type of feeding pattern in which juveniles mainly fed on crustaceans while the adults fed on fish. It could also found that there are no studies from Andaman waters on the fishery and biology of *A. mate* so far. So, the present study provides preliminary observations on the commercial landings of carangids and biology of *Atule mate* from Andaman waters.

Materials and Methods

Detailed survey of Junglighat fish Landing Centre was conducted following Mini et al. (2005) survey method. Species wise catch composition of family Carangidae recorded during the study. The specimens were photographed, collected and identified following standard identification keys (Fischer and Bianchi, 1984; FAO 1995). The yellowfin scad (*Atule mate*) species was studied for its biology. The details of crafts and gears used for carangid exploitation were recorded along with the geographical details (Latitude/Longitude) and depth (meter) of fishing ground.

The total length (TL) was measured using a digital Vernier calliper with 0.1 cm accuracy and total body weight (BW) was determined by an electronic weighing balance with 0.1 gm accuracy. The length frequency distribution was studied separately for male and female, following the methods of Sivakami et al., (1997) and Khan et al., (1993). The LWRs for species were calculated using the equation: $TW = {}_aTL^b$ (Le Cren, 1951), where TW is the total body weight (gm), TL is the total length (cm), ***'a'*** is a coefficient related to body form and ***'b'*** is an exponent indicating allometric growth. The parameters '***a'*** and '***b'*** were estimated by a simple linear regression after logarithmic transformation of weight and length data. Further, the co-efficient of determination (r^2) was calculated.

$$Log\ W = Log\ a + b\ log\ L$$

The gut content was analysed and the stomachs were visually classified as Full, ¾ full, ½ full, ¼ full, Trace and Empty (Kingston et al., 1999) to study feeding intensity. The gastro-somatic index (GaSI) was calculated following the formula:

GaSI = (Fresh weight of the stomach / Total wet weight of fish) X 100.

Stomachs were opened and the contents were separated into major forage categories. Food items were identified to the lowest possible taxon. The number of food items was counted separately and frequency of occurrence was expressed in percentage.

Study the reproductive biology, the gonads were examined while dissecting the fish and the fish was identified as male or female. Maturity stages were identified based on Poojary et al. (2015). The Gonado-Somatic index was estimated based on the following formula:

GSI= (Weight of the gonad / Total wet weight of the fish) x100.

Results

The present study evolved 19 species belonging to 13 genera of the family Carangidae from Junglighat fish landing Centre of Andaman Islands (Fig. 2). The major species contributed to fishery of Carangids were *Caranx ignobilis* (18.9%), *C. melampygus* (18.6%), *Atule mate* (17.8%), *Selar boops* (9.3%), *S. crumenophthalmus* (7.1%), *Carangoides talamparoides* (6.9%) and *C. malabaricus* (5.2%).

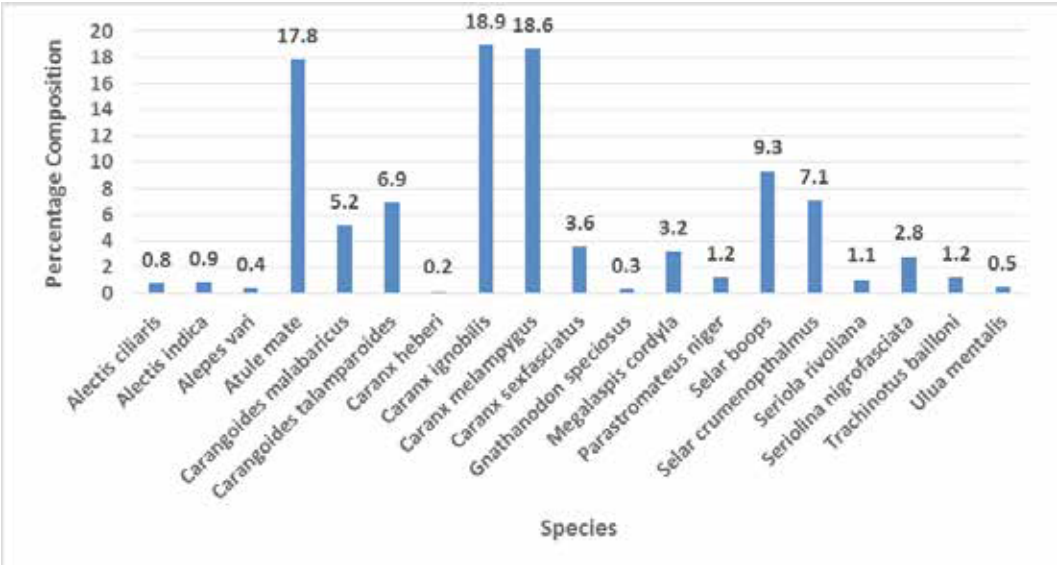
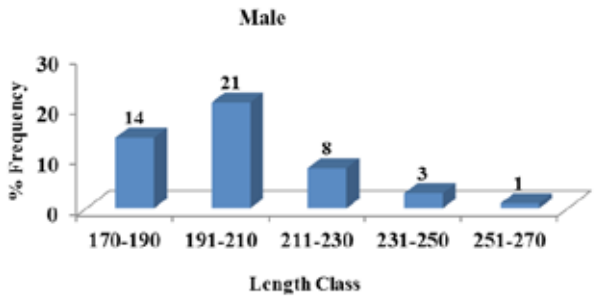


Figure 2. Composition of carangid landings at fish landings centre, Junglighat, Port Blair

The sex ratio observed for the studied species of *Atule mate* was 1 : 0.63 (M:F) significant in the lower length classes (170-190 mm and 191-210 mm) and was found to be insignificant overall as well as in the higher length classes (Table 1). The length frequency distribution analysis of *A. mate* showed that in males, the dominant length class was 191-210 mm followed by the length group 170-190 mm and the length classes 231-250 mm and 251-270 mm were the least (Fig. 3). The dominant length class for the females was also found to 191-210 mm, same as the males, followed by the length class 211-230 mm and the least from 170-190mm and 251-270 mm length classes.



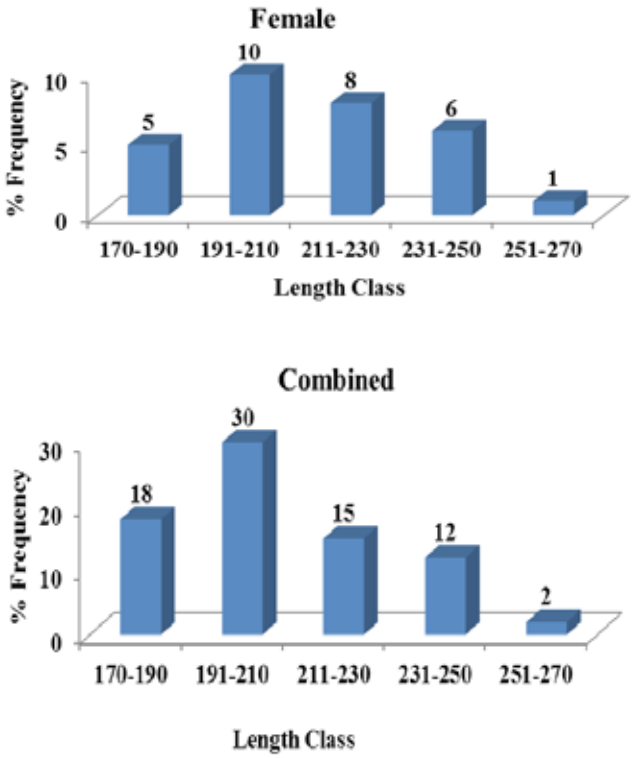


Figure 3: Length frequency distribution of *Atule mate*

Table 1: Sex Ratio and Chi square analysis of *Atule mate*

Length group	No. of Fish	Males	Females	Ratio	Expected	Chi square	Significance
170-190	19	14	5	1 : 0.36	9.50	**4.26316**	**S***
191-210	31	21	10	1: 0.48	15.50	**3.90323**	**S***
211-230	16	8	8	1 : 1	8.00	0	NS
231-250	9	3	6	1 : 2	4.50	1	NS
251-270	2	1	1	1 : 1	1.00	0	NS
Overall	77	47	30	1 : 0.64	38.5	3.75	NS

*Significant

The length weight relationship analysis showed positive allometric growth (Fig. 4) for the species with b value more than 3 and the regression value was statistically significant in male, female and combined.

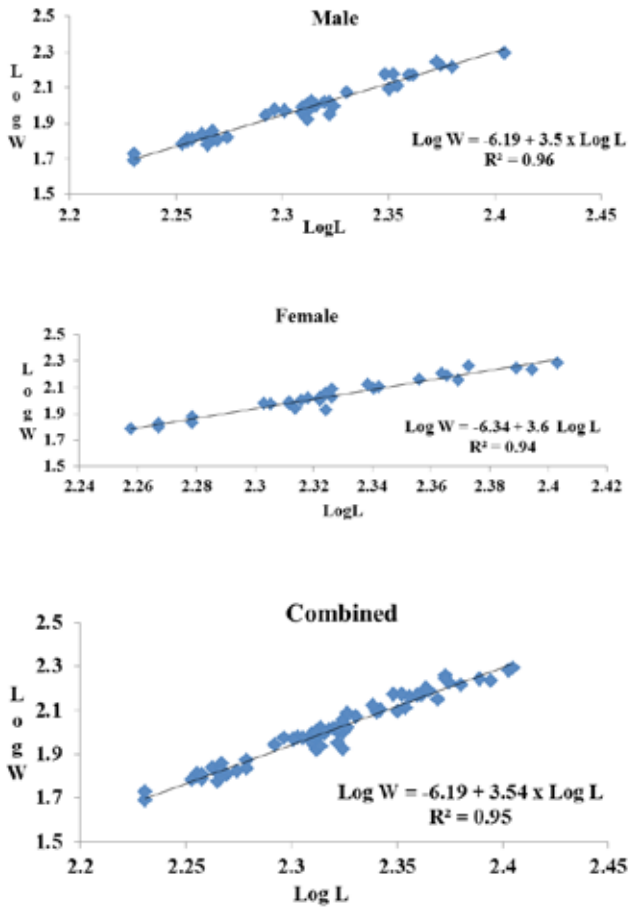


Figure 4: Length weight relationship of *Atule mate* (Male, Female and combined)

The regression equation for *A. mate* obtained is as follows:

Males : Log W = -6.19 + 3.5 x Log L

Females : Log W = -6.34 + 3.6 x Log L

Combined : Log W = -6.19 + 3.54 x Log L

Feeding intensity was observed to be higher for *A. mate* during the study with half (22.66%), full (21.33%) and three-fourth (21.33%) of stomachs (Fig. 5). The average GaSI in the length class 190-210 mm was found to be the highest (2.125), this was followed by the length class 211-230mm (1.701) and 170-190mm (1.606). Interestingly, the higher length classes 231-250 mm (1.247) and 251-270mm (0.968) have shown lowest GaSI (Fig. 6).

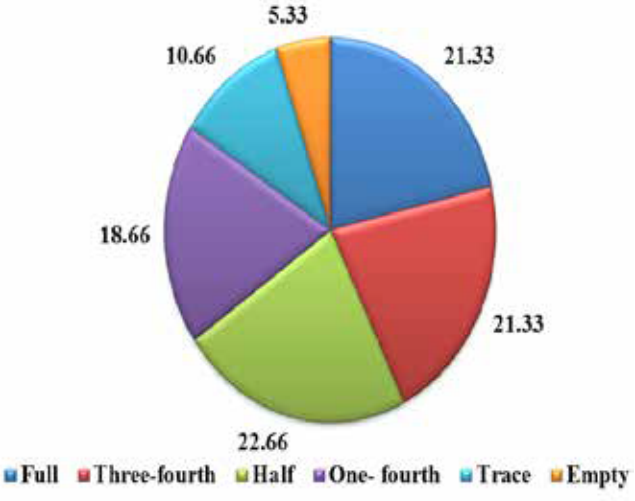


Figure 5: Feeding intensity for *Atule mate*

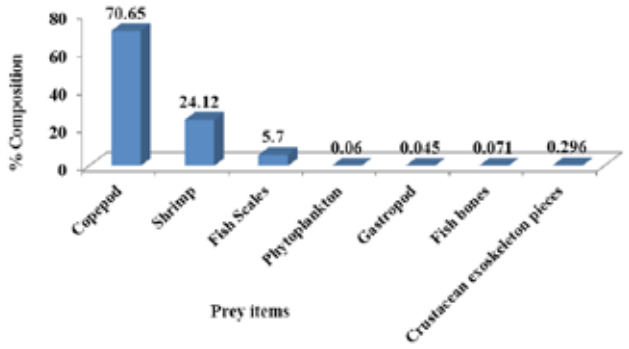


Figure 6: Food Composition of *Atule mate*

The gut content mainly consisted of copepods (70.65%), which were found almost intact with minimal digestion (Fig. 7). Shrimps (24.12%) particularly shrimp larvae, fish scales (5.7%) of large as well as extremely small sizes along with few fish bones and few pieces of crustacean exoskeleton were also found in the gut. The prey items that were found in least quantities were phytoplankton (0.06%) and gastropods (0.045%) the rest was digested completely.

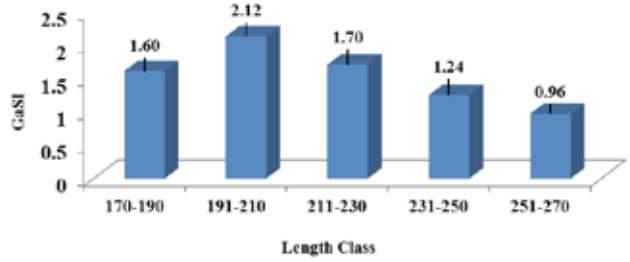


Figure 7: Gastrosomatic Index of *Atule mate*

The GSI was analysed according to the length class. The average GSI was the highest in the length class 231-250 mm (2.84) followed by the length class 251-270 mm (1.166). The first three length classes had the lowest average GSI (Fig. 8), which was 211-210 mm (0.471), 170-190 mm (0.455) and 191-210mm (0.403). The stages of maturity of *Atule mate* were analysed on the basis of length class (Fig. 9). Most of the specimens were immature or maturing in the lower length classes, whereas, mature and ripe stages dominated in the higher length classes. The specimens in ripe stage were only found in the 211-230 mm and 231-250 mm length class in males and females, respectively.

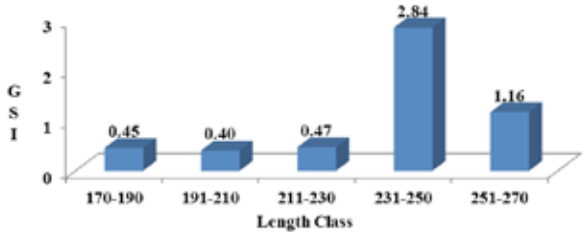


Figure 8: Gonadosomatic Index of *Atule mate*

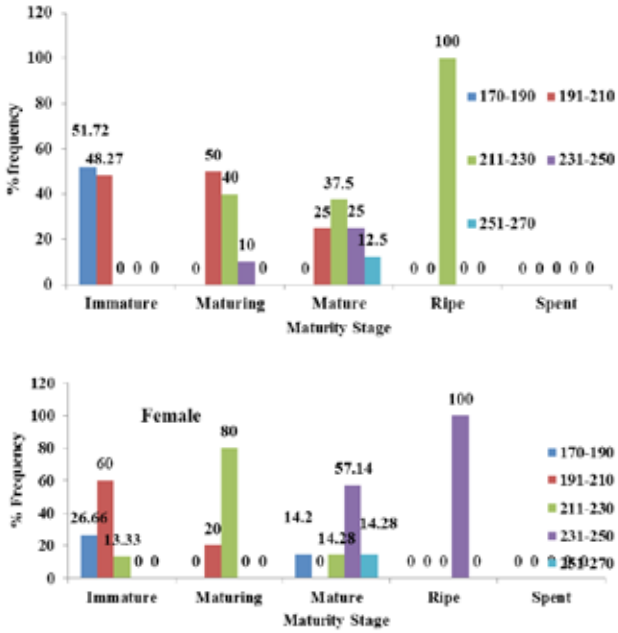


Figure 9: Maturity Stages of *Atule mate*

Discussion

The carangid landings in the Junglighat fish landing centre were mainly dominated by *Caranx ignobilis*, *C. melampygus*, *Atule mate*, *Selar boops*, *S. crumenophthalmus*, *Carangoides talamparoides* and *C. malabaricus*. It was interesting to observe from the present results that most of the carangids contributing to the fishery are medium or small species except *Caranx ignobilis*. This medium to small fishes contributed more to the local consumption. Mustafa (1983) have recorded *Selar* sp., *Decapterus* sp., *Elagatis* sp., *Caranx* sp. and *Megalaspis cordyla* were the major carangid landings in Andaman. *Carangoides malabaricus*, *Decapterus russelli*, *Alepes djedaba*, *Megalaspis cordyla*, *Caranx carangus*, *Selaroides* sp., *Alepes kalla*, *A. djedaba*, *Alectis* sp., *Scombroides* sp., *Elagatis* sp., and *Atule mate*

were the most common carangid species contributing to fishery in other maritime states of India (Reuben et al, 1992; CMFRI, 2015).

The fishery of *Atule mate* was found to be dominated by 191-210 mm and male fishes. The length weight relationship have shown a positive allometry and hence showed a normal growth. The food preference of the species showed mainly of carnivory. Kingston et al. (1999) reported that the food preference of *A. mate* changed from crustaceans to fishes when it grows to adult. The present study could not find such variation, but studied fishes preferred a mixed diet. The smaller length group of fishes feed more than the higher length groups. The GaSI was found to be high in the lower length classes and less in the lower length classes which shows an inverse relationship with maturity in fish. While in the previous studies, it was found that the feeding intensity was comparatively less in *Decapterus dayi* and *Megalaspis cordyla* (Sreenivasaan, 1981a, b), *Alectis indicus* (Venkataramanujam and Ramamoorthi, 1983) and *A. mate* (Kingston et al., 1999), in general.

The maturity stages of most of the individuals were exhibited in the higher length classes (231-25-mm) and immature stage in the length class 170-190 mm and 191-230 mm. The absence of spent fishes in the landings and higher percentage of immature fishes could mean that spawning season is mostly towards the end of Pre-Monsoon (Inter-monsoon) season for this species in Andaman waters. Many carangid species from Indian waters show prolonged spawning seasons (Tiews, 1958; Tiews et al., 1975; Sreenivasan, 1981; Raje, 1997; Reuben et al., 1992; Murty, 1991; Manojkumar, 2007).

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