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Feeding dynamics and reproductive biology of the obtuse barracuda *Sphyraena obtusata* (Cuvier, 1829) from Ratnagiri, central west coast of India

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Abstract

The obtuse barracuda *Sphyraena obtusata* (Cuvier, 1829) is a commercially important food fish belonging to the family Sphyraenidae and landed mostly as trawl bycatch along Ratnagiri. Investigations were carried out on the species with respect to the length-weight relationship, condition factor, morphometrics, feeding and reproductive biology. The length-weight relationship showed positive allometric growth in males, females and pooled individuals. All morphometric measurements showed a high degree of correlation with total length. The gut content analysis revealed *S. obtusata* to be a carnivore fish feeding mainly on fish juveniles, fish scales, crustaceans and cephalopod appendages. The male:female sex ratio was found to be 1:0.90. Gonado-somatic index (GSI), maturity and ova diameter studies indicated that *S. obtusata* has a prolonged spawning season with individuals spawning twice in a season. Absolute fecundity ranged from 68355 to 310615 eggs with an average of 137783 eggs. The mean length at sexual maturity for females was found to be 22.92 cm.

Introduction

Barracudas are commercially important food fishes belonging to the family Sphyraenidae. These fishes are widely distributed in all equatorial, tropical and warm temperate seas (Allam *et al.,* 2004; AkAdje *et al.,* 2013). In India, barracudas are distributed all along the coast with varied abundance. The fishery is good along the coasts of Tamil Nadu, Kerala, Andhra Pradesh, Gujarat and the Andaman islands (Kasim, 2000). There are twenty-eight valid species globally, with only nine species being reported from Indian waters (Fricke, 2021). *Sphyraena obtusata* (Cuvier, 1829) is a predominantly pelagic species living solitary or in schools, and is capable of adapting to diverse ecological conditions (Whitehead *et al.,* 1984). It is often found in marine to brackishwater environments at a depth of 5-200 m near coastal areas in bays, estuaries, lagoons, coral reefs and seagrass beds (Senou, 2001).

The landings of barracudas in India stood at 37749 t contributing to 1.2% of the total marine fish landings of the country (CMFRI, 2022). The landings of barracudas in Maharashtra were 1755 t and contributed to 0.44% to the total marine fish landings of the state (Anon., 2021). *Sphyraena jello, S. barracuda, S. obtusata, S. putnamae* and *S. forsteri* constitute the commercial barracuda fishery in India (Kasim, 2000; Rajesh *et al.,* 2020). Barracudas are exploited by various fishing gears all along the coast and are mainly caught in trawl nets, gillnets and outboard ring seines (Senou, 2001; Najmudeen *et al.,* 2015). They are consumed in fresh form or are frozen, dried, or salted (Fischer and Bianchi, 1984). Morphological measurements, length-weight relationship and relative condition factor of *S. obtusata* were reported by Abdurahimn *et al.* (2004), Jaiswar *et al.* (2004), Prasad *et al.* (2021) and Vinothkumar *et al.* (2022); food and feeding habits were studied by Chacko (1949), Dananjanie *et al.* (2006) and Meshram *et al.* (2022); aspects of reproductive biology were reported by Premalatha and Manojkumar (1990), Allam *et al.* (2004), Pattnayak (2019) and Rajesh *et al.* (2021). However, no studies on the biology of this species have been

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carried out from the Ratnagiri coast, Maharashtra. Studies on the length-weight relationship, morphometrics and condition factor provide information on growth of the fish and general wellbeing. Feeding and reproductive biology is a key to understand the fishery status, health status, feeding habits and spawning pattern. Such studies serve as tools for better understanding of the species and enable formulation of effective measures for sustaining the fishery of the species in the study region. Therefore, the present study was undertaken to investigate the biology of *S. obtusata* from the Ratnagiri coast of Maharashtra.

Materials and methods

The identification of *S. obtusata* was carried out as per Fischer and Bianchi (1984). A total of 535 specimens of *S. obtusata* predominantly landed by trawl gear, gillnets and outboard ring seines were collected at weekly intervals during December 2021 to October 2022 from Ratnagiri (Arabian Sea), central west coast of India (17.0004669°N, 73.2778085°E) . No samples were collected during June and July due to 'closed season' along the entire west coast of India. Total length (cm) and body weight (g) were recorded for each individual. Twenty morphometric measures were regressed on the total length (Zar, 2005). The length-weight relationship (LWR) was calculated by linear regression on the transformed equation: log W = log a + b log L, where W is body weight (g), L is length (cm), a is the intercept and b is slope of linear relationship analysis (Froese, 2006). A t-test was employed to check whether estimated b values differed significantly from 3, which would indicate the type of growth to be isometric, negative or positive allometric. Condition factor "Kn" was calculated as per Le Cren's (1951) formula:

$$Kn = \frac{W}{W_c}$$

where, Kn is relative condition factor, W is observed weight of fish and W_c is estimated fish weight.

The fishes were dissected to identify the sex and stages for maturity stages classification. Data on sex ratio were analysed using χ^2 test to find the domination of sex, if any. Gonads were carefully removed and weighed using analytical balance to nearest 1 mg and preserved in 5% neutral formalin for further study. Stomach contents were analysed by Frequency of Occurrence and Points (Volumetric) methods (Hynes, 1950). Food items found in the stomachs of *S. obtusata* were graded using an index of preponderance (Natarajan and Jhingran, 2011). Gonadosomatic index (GSI) was estimated as per Bal and Rao (1984). The female maturity stages were classified as immature (I), early maturing (II), maturing (III), matured (IV), ripe (V) and spent (VI) based on physical appearance of the ovary and ova diameter. The mean length at sexual maturity (L_m) was estimated following the method proposed by King (1995). Fecundity was estimated by gravimetric method (Sinha, 1995). Ova diameter of intraovarian eggs were measured from ova taken from a small portion of the ovary from the anterior, middle and posterior regions. The development of ova was studied using ocular micrometer and frequency polygons of ova diameter in different stages of maturity were drawn.

Results

Length-weight relationship and morphometrics

Length-weight relationship (LWR) of four groups *viz,* indeterminants, males, females and pooled individuals were calculated separately. Estimated parameters of the LWR including total length (TL) and total weight (TW), number of specimens (n), values of parameters 'a' and 'b' and the coefficient of determination (r^2) are given in Table 1. The correlation coefficient (r) of total length against twenty other morphometric characters of *S. obtusata* ranged from 0.8108 to 0.9938 showing a strong linear correlation between morphometric lengths and total length (Table 2).

Condition factor (Kn)

Condition factor is a value measuring the well-being and robustness of fish in numerical terms and is considered as an index of general well-being. In the present study, the condition factor for pooled individuals showed an increasing trend from August (0.98) to February (1.01).

Food and feeding

Frequency of occurrence

The average proportion of the gut contents by frequency of occurrence method for entire study period were dominated by fish juveniles (66.37%) followed by, semi-digested matter (32.86%), fish scales (7.22%), cephalopod appendages (0.87%) and crustaceans (0.82%) (Table 3).

Points (Volumetric) method

Fish juveniles (63.08%) formed major portion of the diet followed by semi-digested matter (30.73%), fish scales (5.35%), cephalopod appendages (0.20%) and crustaceans (0.64%) according to the points (volumetric) method (Table 4).

Index of preponderance

According to the Indices of Preponderance, the dominant food items were fish juveniles (79.96%), semi-digested matter (19.23%), fish scales (0.74%), crustaceans (0.01%), and cephalopods (0.003%) (Table 5).

Feeding intensity

Among the 535 stomachs analysed, 23.52% were full, 37.41% were partially full and 39.08% were empty. Maximum individuals of *S. obtusata* with empty stomachs were recorded from August to February. Individuals with full stomachs were mostly observed from March to May. Feeding intensity was higher in maturing and spent individuals, whereas lower feeding intensity was observed in spawners (Table 6).

Reproductive biology

In the present investigation, the overall male:female ratio was found to be 1:0.90. Chi-square test showed no significant difference ($p>0.05$) between the sexes. In females GSI was noted to be highest from August to February with a peak during October and February. Similar GSI trends were observed for males (Fig. 1). The maturity stages I

Table 1. Estimated length-weight relationship (LWR) for *S. obtusata* of Ratnagiri coast and LWR reported from different locations

Group	n	Total length range (cm)	Body weight range (g)	a	b	r^2
Males	210	17.7 - 27.0	36.2 - 125.8	-2.4357	3.1770	0.8824
Females	189	17.8 - 27.6	24.0 - 146.2	-2.5844	3.2831	0.8913
Indeterminants	136	14.6 - 21.4	19.0 - 88.5	-2.6166	3.3160	0.8921
Pooled individuals	535	14.6 – 27.6	19.0 – 146.2	-2.5154	3.2345	0.9553

n - Number of specimens; a - Intercept; b - Slope of linear relationship; r^2 - Coefficient of determination

Locality/Country	Sex	Size (cm)	a	b	Reference
Bombay waters	Males	-	0.0000008	3.4541	Kothare (1973)
	Females	-	0.0000013	3.3542	
Gulf of Mannar, India	Unsexed	16.0-40.0	0.0041	3.131	Somavanshi (1989)
Kochi, India	Sexed	11.5-37.0	-	-	Premalatha and Manojkumar (1990)
Gulf of Mannar, India	Unsexed	11.0-43.5	0.00001	2.381	Kasim and Balasubramanian (1990)
Visayas, Philippines	-	-	0.0070	3.000	Federizon (1993)
Western Region Indonesia	Unsexed	12.0-50.0	0.0095	2.868	Pauly and Martosubroto (1996)
New Caledonia	Unsexed	19.0-26.5	0.0370	2.472	Letourneur *et al.* (1998)
Malaysia	Unsexed	-	0.0070	2.870	Ahmad *et al.* (2003)
Karnataka	Male	16.6-27.0	0.004	3.120	Abdurahiman *et al.* (2004)
	Female	16.7-28.2	0.004	3.110	
Bombay, India	Sexed	18.1-43.5	0.000024	2.722	Jaiswar *et al.* (2004)
New Caledonia	Unsexed	19.0-26.5	0.0257	2.588	Kulbicki *et al.* (2005)
Jaffna Lagoon	Sexed	14.0-33.4	0.0133	2.857	Shivasanthini *et al.* (2009)
Andhra Pradesh	Sexed	-	0.00016	2.83	Pattnayak (2019)
Gulf of Mannar, India	Unsexed	18.2-39.0	0.005	3.017	Roul *et al.* (2020)
Vizhinjam, India	Sexed	20.8-21.5	-5.1909	3.090	Shaila Prasad *et al.* (2021)
Mangaluru, India	Sexed	16.5-30.1	0.01945	2.654	Meshram *et al.* (2021a)
Gulf of Mannar, India	Sexed	17.7-40.9	0.013	2.722	Vinothkumar *et al.* (2022)
Ratnagiri coast, India	Males	17.7- 27.0	-2.4357	3.177	Present study
	Females	17.8- 27.6	-2.5844	3.2831	
	Indeterminants	14.6- 21.4	-2.6166	3.3160	
	Pooled	14.6-27.6	0.003059	3.234	

FL- Fork length, TL- Total length, a - Intercept, b - Slope

Table 2. Comparison of various morphometric characters of *S. obtusata*

Regression tested	Observations (n)	Coefficient of correlation (r)
TL *vs* Fork length	535	0.9938
TL *vs* Standard length	535	0.9584
TL *vs* Head length	535	0.9682
TL *vs* Snout length	535	0.8604
TL *vs* Eye diameter	535	0.8941
TL *vs* Body depth	535	0.8845
TL *vs* First Pre-dorsal length	535	0.9868
TL *vs* Second Pre-dorsal length	535	0.9927
TL *vs* Pre-anal length	535	0.9924
TL *vs* Pre-pelvic length	535	0.9850
TL *vs* Pre-pectoral length	535	0.9753
TL *vs* First Dorsal base length	535	0.8108
TL *vs* Second Dorsal base length	535	0.9267
TL *vs* Anal base length	535	0.9277
TL *vs* First Dorsal height	535	0.8852
TL *vs* Second Dorsal height	535	0.8847
TL *vs* Anal height	535	0.9082
TL *vs* Pelvic height	535	0.9052
TL *vs* Pectoral fin length	535	0.9247

(Immature) and Stage II (Early maturing) were noted mainly during the months of April, May, August and September. Stage III (Maturing) was found in August, September, December and January. The ova in maturity stages IV (Matured) and V (Ripe) were recorded to be maximum during September, October, December, January, and February, while, stage VI (Spent) ova were seen during September, October and December (Fig. 2). The maturity stages were not entirely discrete as some degree of overlap with respect to periodicity was evident. A total of 35 ovaries of either stage IV or stage V were collected to estimate fecundity. In the present study, the absolute fecundity of *S. obtusata* ranged from 68355 to 310615 eggs with an average of 137783 eggs. Ova diameters recorded at different stages of oocyte development are given in Table 7. In all maturity stages, the ova diameters progressed in a unimodal fashion barring the Stage V ovaries, which displayed two modes. Stage V ova displayed two modal values of 0.29 mm and 0.76 mm. The length at first maturity for females of *S. obtusata* from Ratnagiri coast was estimated to be 22.92 cm total length (Fig. 3).

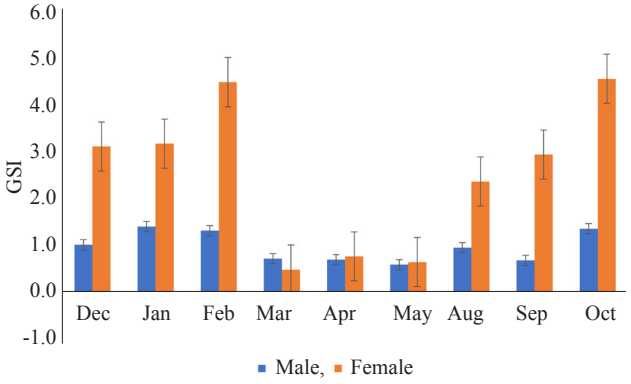

Fig.1. Monthly GSI in males and females of *S. obtusata*

Table 3. Month-wise food composition in *S. obtusata* by frequency of occurrence method

Food items	Dec.	Jan.	Feb.	March	April	May	August	Sept.	Oct.	Avg.
Fish juveniles	79.45	92.68	93.48	81.40	55.56	75.00	66.67	30.43	22.64	66.37
Crustaceans	2.74	2.44	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.82
Cephalopod appendages	4.11	0.00	0.00	0.00	0.00	0.00	3.70	0.00	0.00	0.87
Fish scales	6.85	17.07	4.35	9.30	0.00	0.00	0.00	21.74	5.66	7.22
Semi-digested matter	17.81	24.39	21.74	23.26	3.70	37.50	25.93	56.52	84.91	32.86

Table 4. Month-wise food composition in *S. obtusata* by Points (Volumetric) method

Food items	Dec.	Jan.	Feb.	March	April	May	August	Sept.	Oct.	Avg.
Fish juveniles	70.07	69.54	85.93	68.10	79.84	80.54	73.74	21.36	18.58	63.08
Crustaceans	1.57	2.06	0.00	2.14	0.00	0.00	0.00	0.00	0.00	0.64
Cephalopod appendages	0.31	0.00	0.00	0.00	0.00	0.00	1.52	0.00	0.00	0.20
Fish scales	3.06	3.60	0.25	3.89	0.00	0.00	0.00	32.04	5.31	5.35
Semi-digested matter	24.98	24.81	13.81	25.87	20.16	19.46	24.75	46.60	76.11	30.73

Table 5. Index of Preponderance (IP) of food items in the gut content of *S. obtusata*

Food component	% of occurrence (Oi)	% of total points (Vi)	(Oi × Vi)	IP	Grade
Fish juveniles	66.73	63.08	4186.472	79.96	I
Semi-digested matter	0.82	0.64	1009.701	19.28	II
Fish scales	0.87	0.20	38.62865	0.7378	III
Crustaceans	7.22	5.35	0.525932	0.010	IV
Cephalopod appendages	32.86	30.73	0.176839	0.00338	V

Table 6. Size-wise distribution of degree of feeding intensity of *S. obtusata*

Size-class	No. of individuals (n)	Empty %	Part full %	Full %
< 18.0	84	30.95	21.43	47.62
18.0-21.0	126	46.03	15.08	38.10
21.0-24.0	215	52.09	13.49	34.42
24.0-27.0	110	35.45	19.09	45.45

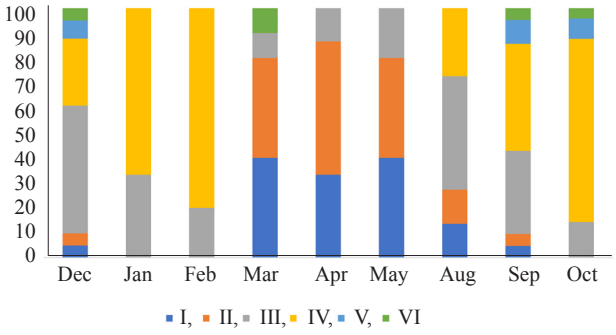

Fig. 2. Monthly variation in maturity stages of females of *S. obtusata*

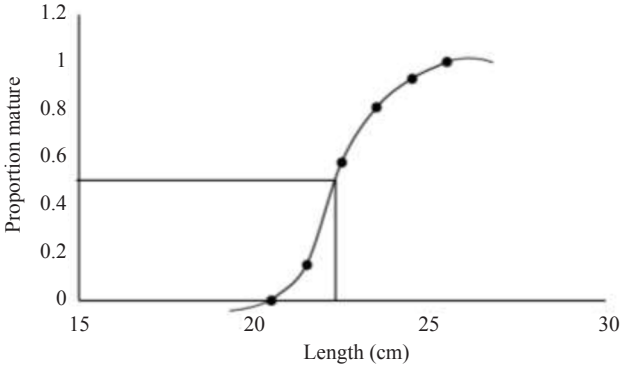

Fig. 3. Length at sexual maturity of *S. obtusata* along the Ratnagiri coast

Discussion

Length-weight relationship and morphometrics

The estimated 'b' values showed positive allometric growth in males, females, indeterminates and pooled individuals. All r^2 values were >0.88 indicating the effect of size or influence of the length on the weight in all the groups. Therefore, in the present study, a generalised

Table 7. Observations on ova diameter of *S. obtusata*

Stage		Avg. % of females in different maturity stages	Ova diameter (mm)	No. of modes	Modal value (mm)
Immature	I	10.05	0.027-0.20	One	0.18
Early maturing	II	11.64	0.21-0.28	One	0.27
Maturing	III	29.10	0.32-0.40	One	0.37
Matured	IV	41.27	0.42-0.50	One	0.46
Ripe	V	4.76	0.53-0.61	Two	0.29, 0.76
Spent	VI	3.17	0.08-0.16	one	0.12

length-weight relationship equation for total individuals was given by W = 0.003059 L 3.2345. Most of the earlier studies on length-weight relationship in *S. obtusata* have indicated negative allometric growth (Kasim and Balasubramanian, 1990; Pauly and Martosubroto, 1996; Letourneur *et al.,* 1998; Ahmad *et al.,* 2003; Jaiswar *et al.*, 2004; Kulbicki *et al.,* 2005; Shivasanthini *et al.,* 2009; Pattnayak, 2019; Meshram *et al.,* 2021a; Vinothkumar *et al.,* 2022), except Federizon (1993), who reported isometric growth from Visayas (Philippines). The present study on the length-weight relationship has exhibited positive allometric growth which is similar to the findings of Kothare (1973), Somavanshi (1989), Abdurahiman *et al.* (2004), Roul *et al.* (2020) and Prasad *et al.* (2021) (Table 1). The b values in the present study are observed to be in the expected range of 2.5 to 3.5 (Froese, 2006). The difference in b values can be affected by a variety of factors, including geographic, ecological, physiological, environmental (temperature, salinity), biological (season, food availability, habitats, gonad development, health) and variations in the specimen (number and length range) analysed (Froese, 2006: Kende *et al.,* 2020; Bandkar *et al.*, 2022).

In the present study, fork length (0.9938) showed highest correlation while lowest correlation was observed in first dorsal base length (0.8108). Meshram *et al.* (2021a) reported the maximum correlation between standard length, fork length and pre-dorsal length among the various morphometric variables of *S. obtusata* from south-eastern Arabian Sea. The coefficient of correlation of total length against other morphometric characters of *S. obtusata* from Bombay waters, west coast of India ranged from 0.928 to 0.995 (Jaiswar *et al.,* 2004). Morphometrics is widely used in stock differentiation studies. Morphological variability among different geographical populations could be attributed to the different genetic structures of populations and to different environmental conditions prevailing in each geographic area and animals with same morphometric measurements are often assumed to constitute a stock (Natarajan *et al.,* 2011).

Relative condition factor (Kn)

In the present study, the relative condition factor (Kn) indicated an increasing trend from August to February coinciding with the spawning season and declined afterwards. Pattnayak (2019) recorded 'K' values for *S. obtusata* to peak during the months of March and September which is indicative of spawning period of the species. The relative condition factor was estimated as 1.04±0.13 for the total population of *S. obtusata* from Vizhinjam coast (Prasad *et al.,* 2021). The monthly mean values of relative condition factor for *S. obtusata* along the south-eastern Arabian Sea were highest in December and lowest in October for males; while in females the highest and lowest values were recorded in November and March respectively (Meshram *et al.,* 2021a). The Kn value of fish is affected by the feeding intensity, dietary habits, existence of food, amount of fat in the diet consumed or muscular development, age, sex and developmental stages of the gonads (Abowei, 2010).

Food and feeding

The comparative account on the food and feeding habit of *S. obtusata* reported by different authors is given in Table 8. The carnivorous feeding habit of *S. obtusata* from Ratnagiri coast is in conformation with the earlier studies which reported that the species feed mainly on juveniles (Chacko, 1949; Premalatha and Manojkumar, 1990; Dananjanie *et al.,* 2009; Pattnayak, 2019; Rajesh *et al.,* 2021; Meshram *et al.,* 2022). The gut content analysis of *S. obtusata* also showed that the presence of fish scales, crustaceans, cephalopod appendages and semi-digested matter. Variations in individual food items consumed by *S. obtusata* may be due to the dominance of respective food items during different months in different regions (Bandkar *et al.,* 2022). Fish juveniles and fish scales were found in all size groups of *S. obtusata.* Cephalopod appendages were observed in matured fishes. The semi-digested matter was recorded almost throughout the entire study period.

During the present study, most of stomachs analysed were empty during September to February which coincided with the spawning period. Stomachs were full during the months of March to May having good quantity of food. It is well understood that most of the dietary energy is diverted for gonadal maturation leading to increased feeding. Similarly, reduced feeding is observed to cope up with the spawning stress. A decrease in feeding intensity during peak spawning months was earlier reported by Premalatha and Manojkumar (1990), Bertoni and Dip (1997), Allam *et al.* (2004), Hosseini *et al.* (2009) and Osman *et al.* (2019) in *S. jello, S. obtusata, S. novaehollandiae, S. chrysotaenia* and *S. flavicauda,* respectively.

In the present study, feeding intensity was recorded to be higher in maturing individuals and lower in spawners. However, the feeding intensity of *S. putnamae* from the Bay of Bengal, northern Indian Ocean was found to increase with an increase in the body size of the fish (Ghosh *et al.,* 2021). The differences in the feeding intensity between the small and large-sized fish could also be attributed to the consequence of the digestion process in the small-sized fish (Garrido *et al.,* 2008).

Table 8. Food composition of *S. obtusata* from different localities

Species	Locality	Main food items	Feeding habit	Author
S. obtusata	Gulf of Mannar	*Sardinella gibbosa, Leiognathus* sp., *Stolephorus* sp., *Mugil troschelii, Leptocephalus* larva	Carnivorous	Chacko (1948)
	South-west coast of India	Fish (anchovies)	Carnivorous	Premalatha and Manojkumar (1990)
	Coastal waters of Negombo, Sri Lanka	Fish species, crustaceans (*Stolephorus indicus*), molluscs, zooplankton and phytoplankton	Carnivorous	Dananjanie *et al.* (2009)
	Coastal waters of Andhra Pradesh	Teleostean fishes, crustaceans, cephalopods, bivalves, detritus material, semi-digested and digested matters	Carnivorous	Pattnayak (2019)
	South-eastern Arabian Sea	Fish, crustaceans (*Acetes* sp.) and cephalopods (*U. duvauceli*)	Carnivorous	Meshram *et al.* (2021)
	South-west coast of India	Fish (*E. devisi, Bregmoceros* sp., *M. cordyla*), crustaceans (shrimp), cephalopods (*Loligo* sp.)	Carnivorous	Rajesh *et al.* (2021)
S. obtusata	Ratnagiri coast, Maharashtra	Fish juveniles, fish scales, crustaceans, cephalopod appendages, semi-digested matter	Carnivorous	Present

Reproductive biology

In the present study, no significant difference ($p>0.05$, χ^2 test) from the theoretical sex ratio of 1: 1 was found, indicating an equal proportion of males and females during the entire study period. The results conformed to the findings of Pattnayak (2019). The sex ratio (male: female) of *S. obtusata* from the south-west coast of India was found to be 1:0.93 showing the dominance of males most of the months (Rajesh *et al.,* 2021). The overall sex ratio of *S. obtusata* along Karnataka coast revealed that the population had significantly higher ($p<0.05$, χ^2 test) proportion of females than males (Meshram *et al.,* 2021b). The change in sex ratio from the Mendelian ratio of 1:1 may be attributed to partial segregation of mature habitat preferences (Reynolds, 1974), migration (Collignon, 1960) or behavioural differences between sexes (Polonsky and Termosova, 1969).

The GSI was used as a proxy for ascertaining the attainment and the extent of maturity of the gonads in the studied fish. Based on both the GSI data and the maturity stages, prolonged spawning season in *S. obtusata* from September to February was noted along Ratnagiri coast of Maharashtra. Two spawning seasons for *S. obtusata* during January to March and July to December from coastal waters of Andhra Pradesh has been reported (Pattnayak, 2019). Premalatha and Manojkumar (1990) recorded high GSI during October to March indicating the breeding period of *S. obtusata* along the south-west coast of India. The pattern of GSI of both the sexes suggested bimodal spawning activity during October-November and April-May in *S. obtusata* from the south-west coast of India (Rajesh *et al.,* 2021). As per Bal and Rao (1984), the spawning season of *S. obtusata* extends from November-February. The spawning season coinciding with higher GSI values noted in the present study agrees with the findings of Premlatha and Manojkumar (1990) along the south-west coast of India and that of Pattnayak (2019) from coastal waters of Andhra Pradesh. The temporal difference in spawning season of *S. obtusata* reported by different authors may be attributed to the spatial, environmental and stock level differences (Bandkar *et al.,* 2022).

Knowledge of the total number of eggs produced by a fish during a year is important in determining the spawning potential of fish. In the present study, the fecundity of *S. obtusata* ranged from 68355 to 310615 eggs with an average of 137783 eggs, implies that the species is a moderately fecund fish. The fecundity of *S. obtusata* from the south-west coast of India varied from 82722 to 379421 eggs with an average of 201240 (Rajesh *et al.,* 2021). Kasim (2000) noted that the fecundity of *S. obtusata* ranged from 30000 to 100000. Rajesh *et al.* (2020) stated that positive correlation was found between fecundity and fork length, body weight and gonad weight of obtuse barracuda indicating that larger females produce a greater number of eggs compared with smaller ones. The fecundity of *S. obtusata* ranged from 30625 to 94500 eggs along the coastal waters of Andhra Pradesh (Pattnayak, 2019). The fecundity of *S. obtusata* noted in the present study is similar to that reported by Rajesh *et al.* (2021). The fecundity varies from species to species and within the species from region to region in accordance to the reproductive potential of the stocks (Gurjar *et al.,* 2017: Kende *et al.,* 2020).

Ovaries were classified in to six stages based on their development (Premlatha and Manojkumar, 1990). Size of the ova diameter ranged from 0.027 to 0.99 mm. Two modes appeared in stage V (Ripe) which shows the possibility of spawning two times in a season along Ratnagiri coast. The spawning of *S. obtusata* was reported to be continuous or protracted along the coastal waters of Andhra Pradesh (Pattnayak, 2019). Pillai (1981) noted multiple spawning of barracudas in a season on the Indian coast. Kasim (2000) stated that the barracudas in Indian waters breed more than once a year.

The size at sexual maturity in females of *S. obtusata* from Ratnagiri coast was determined to be 22.92 cm. Length at first maturity reported by different workers (Kothare, 1973; Premlatha and Manojkumar, 1990; Pattnayak, 2019; Kasim, 2000) for *S. obtusata* ranged from 16.1-20.1 cm. According to Rajesh *et al.* (2021), male fishes (L_m - 20.5 cm) mature earlier as compared to female fishes (L_m - 21.3 cm). The differences in size at first maturity within a species may be possibly due to the presence of distinct stocks, variation in growth rate, maximum size reached by different species under the influence of varying environmental conditions and food availability (Bandkar *et al.,* 2022; Pawase *et al.,* 2022)

The present study revealed *S. obtusata* to be a carnivorous fish highlighting its importance with respect to trophic level. *S. obtusata* was found to be a moderately fecund fish and a multiple spawner. The biological information will prove helpful in recommending minimum legal size (MLS) for the species in the region.

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