J. mar. biol. Ass. India, 1994, **36** (1 & 2) : 181 – 187

FISHERY AND BIOLOGY OF *ATROPUS ATROPOS* (BLOCH AND SCHNEIDER) FROM VERAVAL*

SADASHIV G. RAJE

Central Marine Fisheries Research Institute, Cochin 682 014

ABSTRACT

The fishery of *Atropus atropos* formed on an average 7.86% and 0.37% of the total carangids landing in trawl and gill nets respectively at Veraval. There is no significant difference in the regression coefficient between males and females and common equation for length-weight relationship is fitted. The minimum size at first maturity for females was found to be 210 mm. The relative condition factor have been interpreted sexwise in relation to various months. The rise and fall in Kn values in the case of females seen more correlated with the maturity of gonads. Maturity studies indicated that spawning period of prolonged nature. The estimated fecundity varied from 31,432 to 372,344 in fish size of 165-253 mm length and increased with increase in size of fish. Empty stomachs were evident in most of the months and low feeding intensity appears to be associated with breeding period during certain months. This species is pelagic, comivorous feeder. The food items found in gut, in the order of preference are *Acetes* spp., cephalopods, teleost, copepods and *squilla* spp.

INTRODUCTION

IN THE COURSE of studies on the fishery and biology of various carangids from the Veraval area, it was observed that *Atropus atropos* (Bloch and Schneider) which is locally known as 'Naryala' (Gujarati) occurred in small quantities in the commercial catches throughout the year. Nothing is known about the fishery and biology of *A. atropos* from Indian waters except a brief account of its presence in carangids landing by Sreenivasan (1974), Rao and Kasim (1985) and Kasim and Khan (1986). Therefore the present investigations were undertaken from 1984 to study the fishery and biological aspects such as length-weight relationship, maturation and spawning, and food and feeding habit of *A. atropos* at Veraval and the results are presented in this paper.

* Presented at the 'Symposium on Tropical Marine Living Resources' held by the Marine Biological Association of India at Cochin from January 12 to 16, 1988.

The author is thankful to Dr. P. S. B. R. James, Director, Central Marine Fisheries Research Institute for encouragement and Shri V. M. Deshmukh for critically going through the manuscript. The sincere effort shown by Shri H. K. Dhokia, M. S. Zala and B. P. Thumber, during the collection of data is acknowledged.

MATERIAL AND METHODS

The details of craft and gears in use at Veraval have been described by Rao and Kasim (1985), and Kasim and Khan (1986). The total *A. atropos* landings were estimated regularly from the catches of trawlers and gill netters during the period from April, 1984 to December, 1986. Random sample from both the gears were examined in the laboratory for total length (from tip of snout to tip of upper caudal lobe) in mm and weight in g, sex ratio, stages of

maturity food and feeding intensity. The length-weight relationship was studied by using the formual $W = aL^n$, where 'a' and 'b' are constant. Relative condition factor was calculated following Le Cren (1951) method. The different stages of maturity were classified according to the I.C.E.S. system. For fecundity estimation, only matured ovaries of stage V were considered. The intensity of feeding was determined based on the degree of distension of stomachs. The volumetric and occurrence methods of food analysis were followed. The method described by Natarajan and Jhingran (1961) was used for the index of preponderance to food items.

THE FISHERY

Among the carangid landings of trawl and gill net at Veraval, *A. atropos* formed only 7.86% and 0.37% respectively. But it has local importance. In case of gill net the catches of this species are poor as shown in Table 1. The trawler landing of *A. atropos* was ranged from 3593 kg in 1986-87 to 36486 kg in 1984-85. Though the catch shows a declining trend, the percentage of *A. atropos* in carangids catch showed a slight increase in 1986-87 (Table 1). In general carangid catches are also show declining trend. The declining trend of the carangids landing in trawl net was already reported by Rao and Kasim (1985).

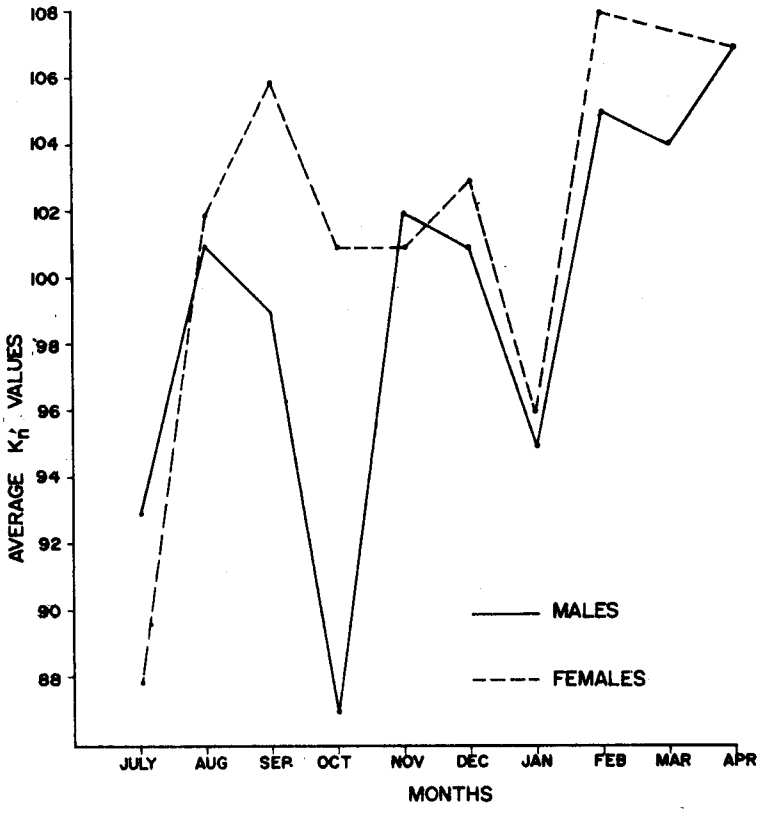

Fig. 1. The Average K_n value in *A. atropos* in different months.

TABLE 1. *Estimated catch of* A. atropos *in kg (c), catch per unit effort in kg (CPUE), its percentage in the carangid catch (%) and percentage of carangid catch in total fish landing in parenthses in trawl and gill net during April 1984 to December 1986*

	1984-85			1985-86			1986-87			Average		
	C	CPUE	%	C	CPUE	%	C	CPUE	%	C	CPUE	%
TRAWL NET												
April	6025	0.78	17.26 (0.27)	2070	0.31	10.23 (0.46)	267	0.07	1.37 (0.73)	8362	0.39	9.79 (0.49)
May	2423	0.60	9.74 (0.44)	-	-	-	-	-	-	807.7	0.20	3.25 (0.15)
Sept.	-	-	-	-	-	-	763	0.26	15.62 (0.20)	254.3	0.09	5.24 (0.07)
Oct.	-	-	-	-	-	-	1483	0.25	6.15 (0.19)	494.3	0.08	2.05 (0.06)
Nov.	641	0.14	15.41 (0.09)	-	-	-	516	0.13	0.11 (0.71)	385.7	0.09	5.17 (0.27)
Dec.	8150	1.48	19.21 (0.42)	1424	0.24	1.33 (2.40)	264	9.09	0.72 (7.32)	3279.3	6.51	7.09 (3.38)
Jan.	17553	4.13	22.46 (1.50)	3423	0.56	7.14 (1.13)	-	-	-	6992	1.56	9.87 (0.88)
Feb.	1694	0.39	14.66 (0.22)	3743	0.87	16.62 (0.69)	-	-	-	1812	0.42	10.43 (0.30)
Mar.	-	-	-	2735	0.50	8.45 (0.40)	-	-	-	911.6	0.17	2.82 (0.13)
Total	36486	0.82	14.02 (0.47)	13395	0.33	3.58 (0.98)	3593	0.12	5.99 (0.03)	17824.7	0.42	7.86 (0.49)
GILL NET												
April	-	-	-	-	-	-	146	0.06	0.36 (13.62)	48.7	0.02	0.12 (4.54)
May	277	0.09	3.19 (2.42)	-	-	-	-	-	-	92.3	0.03	1.06 (0.81)
July	-	-	-	-	-	-	60	0.03	0.76 (9.16)	20.0	0.01	0.25 (3.05)
August	-	-	-	-	-	-	1196	0.34	1.91 (5.77)	398.0	0.11	0.64 (1.92)
Sept.	369	0.15	0.58 (13.15)	-	-	-	-	-	-	123.0	0.15	0.19 (4.38)
Feb.	147	0.05	0.56 (5.66)	106	0.03	0.24 (8.24)	-	-	-	84.3	0.03	0.27 (4.63)
Total	793	0.03	0.39 (4.89)	106	0.004	0.03 (8.03)	1402	0.07	0.69 (6.06)	767.0	0.03	0.37 (6.33)

The monthly average percentage of *A. atropos* in trawl net for three season indicated that the peak period of abundance was during April and from December to February.

Length-weight relationship

A total of 216 specimens of *A. atropos* were used to study the length-weight relationship. These included 116 males ranging from 116 to 264 mm in length and from 28.5 to 230.0 g in weight, and females ranging from 129 to 283 mm in length and 30.0 to 292.0 g in weight. The values for males and females obtained by formula :

$$W = aL^b$$

which can also be written as :

$$\text{Log } W = \log a + b \log L.$$

After calculating, the values are :

Males : log W = -4.08479 + 2.6699 log L

Females : log W = -3.8017 + 2.5471 log L

As there was no significant difference in regression coefficients and covariance by using 'F' test (Snedecor and Cochran, 1967) for males and females (Table 2). The data for both the sexes were pooled together. The relationship obtained is expressed below :

$$\text{Log } W = -3.9535 + 2.6133 \log L.$$

Relative condition factor

The mean Kn values were calculated sexwise by using the formula $K_n = \frac{W}{\hat{W}} \times 100$ (Le Cren, 1951), where W represents the observed weight of fish and $\hat{W}$ the calculated weight. The values obtained were plotted against the months (Fig. 1).

The average Kn values of males were higher during August, November, February and April, while in females these values were higher in September, December, February and April, probably this may be due to higher percentage of matured ovaries (Table 3).

TABLE 2. *Comparison of regression line of length-weight relationship of males and females and ANOVA of* A. atropos

RAW SUMS						ANOVA				
Sex	Df	X^2	Y^2	XY	Regression coefficient	Source of variation	Df	SS	MS	'F' Value
Males	116	3212.670	2526.670	2839.914	2.6699	Between the sexes	2	0.278	0.139	0.9266
Females	100	2721.743	2073.577	2368.587	2.5471	Within the sexes	214	28.213	0.1288	Remark : Not significant at 5% level
Total	216	5934.413	4599.875	5208.501	2.6133					

TABLE 3. *Monthly percentage frequency distribution of females of* A. atropos *in different stages of maturation (Oct. '85 to Sept. '86)*

Months	% of maturation stages		
	I & II	III & IV	V & VI
October	—	100	—
November	66.67	20.00	13.33
December	33.33	33.33	33.34
January	83.33	16.67	—
February	87.50	4.17	8.33
March		No females	
April	42.86	14.28	42.86
July	100	—	—
August	46.15	46.15	7.70
September	—	—	100

TABLE 4. *Percentage occurrence of males and females of* A. atropos *in different months*

Months	No. of specimens examined	% of males	% of females
October	11	73	27
November	48	68	31
December	6	50	50
January	42	43	57
February	48	50	50
March	4	100	—
April	12	42	58
July	12	42	58
August	24	59	41
September	10	60	40
Total	217	53	47

Sex ratio

The distribution of the two sexes in the population of *A. atropos* in different months is given in Table 4. The sex ratio for the period as whole was 53 : 47. Males dominated during the months of April to November and in March. In rest of the months females dominance was observed.

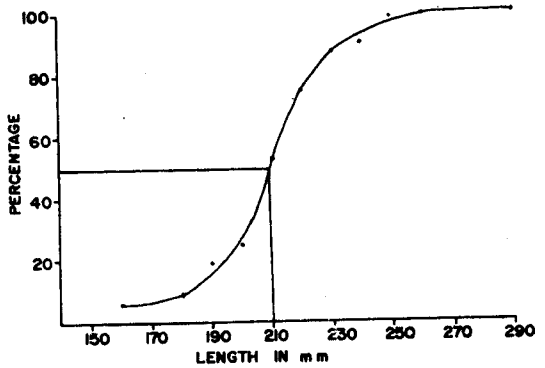

Fig. 2. Size at first maturity of *A. atropos*.

Size at first maturity

During the course of investigations, 217 fishes were examined. Females alone were considered for this studies. Maturing and matured females in stage III-VI were considered for this study and they were grouped at an interval of 10 mm and the percentage drawn. The percentage of such females in each size groups is plotted in Fig. 2. The 50% of females matured at the size of 210 mm. Hence, the size at first maturity is considered as 210 mm.

Spawning season

To determine the period of spawning of *A. atropos*, the monthwise percentage composition of females in different stages of maturity are given in Table 3. It is seen from Table 3 that the ripe specimens of *A. atropos* are available in major part of the year, but spent specimens were not observed in the catches. Depending on the ripe specimens it can be said that it has a prolonged spawning period with two peaks. Further investigations are needed to confirm the spawning season.

Fecundity

The fecundity study was based on total number of 11 specimens, where size ranging from 165-253 mm and weight ranging from 88.0 to 208.5 g. Only stage V ovaries were considered for fecundity. The ovary weight for eggs estimation ranged from 1.140 to 11.025 g. The fecundity ranged from 31,432 to 372,344 eggs, with an average of 141,515 eggs per fish (Table 5). The fecundity data show considerable variations between fishes of the same or comparable length. In general, the number of ova increased with increase in the size of fish.

TABLE 5. *Fecundity in* A. atropos *at maturity stage V*

Length (mm)	Weight (g)	Ovary weight (g)	Fecundity
165	88.0	1.140	31432
193	118.8	1.690	46596
207	135.0	3.570	42840
210	127.5	3.254	58572
218	158.0	5.010	92327
219	148.7	7.032	151188
224	159.0	5.242	146252
226	174.5	3.270	56408
233	172.5	10.895	188266
241	187.0	10.302	372344
253	208.5	11.025	370440

Similar finding was reported by Kagwade (1968) in case of *C. kalla.*

Food and feeding

For this study, 217 fresh specimens of *A. atropos* were examined. The fullness of stomachs were classified according to its distension as full, 3/4 full, 1/2 full, 1/4 full, trace and empty.

Food composition : The percentage composition of the food items of this species is presented in Table 7. *Acetes* spp. formed most important food item followed by cephalopods, teleost, *Squilla* spp. and copepods.

Acetes spp. : *Acetes* spp. formed 46.25% of the diet and encountered in most of the months. Only small sized *Acetes* spp. were observed in the diet.

TABLE 6. *The percentage occurrence of stomach in different degrees of fullness in* A. atropos *during October, 1985 to Sept. 86*

	No. of specimens examined	Conditions of stomach					
		Full	3/4 full	1/2 full	1/4 full	Trace	Empty
Oct.	11	9.10	—	18.18	27.27	18.18	27.27
Nov.	48	12.5	2.8	18.75	14.58	10.42	41.67
Dec.	6	—	—	—	—	16.67	83.33
Jan.	42	7.14	—	9.52	16.67	16.67	50.00
Feb.	48	8.33	4.16	12.50	12.50	8.33	54.17
Mar.	4	—	—	50.00	—	25.00	25.00
Apr.	12	8.33	—	—	8.33	16.67	66.67
July	12	8.33	—	—	16.67	8.33	66.67
Aug.	24	4.17	—	—	4.17	20.83	70.83
Sep.	10	—	—	20.00	40.00	20.00	20.00

TABLE 7. *Percentage volume of different food items of* A. atropos

Food items	Oct. 85	Nov.	Dec.	Jan. 86	Feb.	Mar.	Apr.	July	Aug.	Sept.
Acetes spp.	38.74	79.18	100.00	24.41	77.81	82.14	9.68	—	—	50.52
Teleost	11.26	6.79	—	1.72	14.15	—	—	—	88.00	39.18
Cephalopods	—	8.59	—	68.52	3.54	—	86.02	—	—	4.12
Copepods	—	—	—	3.21	1.93	17.86	—	—	4.00	5.15
Squilla spp.	—	2.26	—	—	—	—	—	92.86	—	—
Digested matter	50.00	3.18	—	2.14	2.57	—	4.30	7.14	9.00	1.03

Feeding intensity : To ascertain the seasonal variations in the feeding intensity, monthly analysis of the data was carried out, the result of which is given in Table 6. It is evident that the percentage of empty stomachs were quite high in almost all the months.

Cephalopods : Among the cephalopods *Loligo* spp. and *Sepia* spp. formed 17.08%.

Teleost : The teleost food items comprised 16.11% in the diet of *A. atropos* were, juveniles of Ribbonfish, *Myctophids* spp. and other fish larvae.

Squilla spp. : It was represented by Alima larvae of *Squilla* spp. and formed only 9.50% of diet.

Copepods : Copepods formed only 3.22%. These were obtained either in whole form or in the form of reddish pulp.

December, April, August and September showing low feeding intensity and which, however happen to be months when females were in maturing and matured condition. Such relationship was noticed by Kagwade (1967) in the case of *C. kalla.*

TABLE 8. *Index of preponderance to food items of* A. atropos

Food items	% occurrence	% volume		
Acetes spp.	52.14	51.83	2702.42	83.18 (1)
Teleost	11.11	8.39	93.21	2.87 (4)
Cephalopods	10.26	27.36	280.71	8.64 (2)
Copepods	5.98	1.89	11.30	0.35 (5)
Squilla spp	3.42	1.36	4.65	0.14 (6)
Digested matter	17.09	9.17	156.71	4.82 (3)
Total	100.00	100.00	3249.00	100.00

Index of preponderance : The result of index of preponderance was calculated and presented in Table 8, with ranking in parenthesis. According to the ranking the food items were *Acetes* spp., cephalopods, digested food matter, teleost, copepods and *Squilla* spp.

In the course of observation large number of empty stomachs were encountered during

Foregoing account indicates that *A. atropos* is pelagic carnivore, whose diet is mainly composed of small size teleosts, crustaceans and cephalopods.

Similar type of feeding habit among other carangids were observed in the case of *M. cordyla* (Sreenivasan, 1974) and *C. kalla* (Kagwade, 1967).

REFERENCES

KAGWADE, V. N. 1967. The food and feeding habit of the horse-mackerel *Caranx kalla* (Cuv. & Val.). *Indian J. Fish.*, **14** : 85-96.

——— 1968. Maturation and spawning of the horse-mackerel *Caranx kalla* (Cuv. & Val.). *Ibid.*, **15** (1 & 2) : 207-220.

KASIM, H. MOHAMAD AND MAHAMAD ZAFAR KHAN 1986. A preliminary account of the gill net fishery off Veraval during 1979-82. *Ibid.*, **33**(2) : 155-162.

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.

NATARAJAN, A. V. AND V. G. JHINGRAN 1962. Index of preponderance — a method of grading the food elements in the stomach analysis of fishes. *Indian J. Fish.*, **8**(1):54-59.

RAO, SUDHAKARA G. AND H. M. KASIM 1985. On the commercial trawl fishery of Veraval during 1979-1982. *Ibid.*, **32** (3) : 296-308.

SNEDECOR, G. W. AND W. G. COCHRAN 1967. *Statistical Methods.* Oxford and IBH Publishing Co., New Delhi. 6th Edn. 593 pp.

SREENIVASAN, P. V. 1974. Observation on the food and feeding habits of the 'Torpedo Trevally' *Megalospis cordyla* (Linnaeus) from Vizhinjam Bay. *Indian J. Fish.*, **21** (1) : 71-84.

——— 1974. On two records of carangid fishes from Indian Seas. *Ibid.*, **21** (1) : 20-28.

——— 1978. Observation on the fishery and biology of *Megalospis cordyla* (Linnaeus) at Vizhinjam. *Ibid.*, **25** (1 & 2) : 122-140.