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Catch and biology of *Alepocephalus bicolor* (Alcock, 1891) from the southwest coast of India

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Abstract

Data on catch, length-weight relationship and biology of *Alepocephalus bicolor* (Alcock, 1891) off southwest coast of India were collected from trawl surveys. Catch was obtained from 520 to 822 m depths, between 08° and 12° N lat. and 76° and 74° E long. The length-weight relationship is expressed as $W = 0.4236 L^{1.29}$. Feeding intensity was found to be very low. Shrimps, squids and myctophids were the food items identified in the diet. Length-related chi-square analysis revealed no significant difference from the ideal sex ratio. The spawning is during November.

Family Alepocephalidae (Order: Salmoniformes) includes twenty genera of deep-sea fish with more than ninety species. Some species are reported to be distributed over the continental slope in the North Atlantic (Golvan and Pakhorukov, 1980; Merret and Marshall, 1981; Gordon and Duncan, 1985; Haedrich and Merret, 1988; Merret *et al.*, 1991). Alepocephalidae, being one of the most diverse families, is predominant among the deep-sea fish fauna (Markle and Quéro, 1984).

In the western Indian ocean, the genus *Alepocephalus* is represented by *A. bicolor* and *A. blanfordii* (Alcock, 1891). The former was also reported from the eastern Indian ocean, northwest central and western Pacific. The biology of this species is not well known. Establishing length-weight relationship in fishes is of great importance in fisheries research as it serves as a tool for assessing the changes taking place in fish populations. The present paper gives an account on the catch and length-weight relationship of *A. bicolor* along the west coast of Indian EEZ.

Materials and methods

The study was conducted as part of Department of Ocean Development sponsored research project on "Stock assessment and biology of deep-sea fishes along the continental slope of Indian EEZ".

Samples of *A. bicolor* were collected from three cruises of FORV *Sagar Sampada* during September-October 2005, January-February 2006 and October-November 2006 covering 50 stations. These stations were selected randomly between latitudes 08°N and 12°N along the west coast. Trawling was conducted for one hour at each station from depths ranging between 200 and 1200 m. Catch and catch per unit effort were estimated. Random samples were collected from each haul for biological investigations such as length frequency, sex, maturity, food, etc. A total of 224 specimens ranging from 120 to 470 mm in total length and comprising of 119 females and 105 males were used for the analysis. For the length-weight studies the length of fish was measured from the anterior part of head with mouth closed to the farthest tip of caudal fin Le Cren (1951). Weight was taken in a top-loaded scale and was rounded to the nearest gram. The relationship between length and weight in fish could be expressed as:

$$W = a L^b \dots\dots\dots (1)$$

Logarithmic transformation of the above formula gives a linear equation

$$\text{Log } W = \text{log } a + b \text{ log } L \dots\dots\dots (2)$$

where W is weight in gram, L is length in

centimeter, b the regression coefficient, and a , the constant. This represents a general linear equation and the value of a and b were computed by the method of least square regression (Zar, 1984). The length and weight relationships were separately established for males and females and the regression coefficients were compared using Analysis of Covariance (ANACOVA) following Snedecor and Cochran (1967). Baily's test was conducted to test the departure of regression coefficients from isometrical value using the formula $t = b-3/S_b$, where S_b is the standard error of b .

Feeding intensity was studied following Muthiah (1994). Occurrence method was used to determine the importance of various food items. The maturity condition of gonad was determined by following Qasim (1973).

Results and discussion

Distribution and abundance: The trawl surveys indicated that *A. bicolor* is one of the important deep-sea resources of the continental slope of Indian EEZ. Of the 64 hauls operated, *A. bicolor* was caught in 12 hauls. Abundance of this species was observed at depth range of 525 to 550 m with high representation between 09° and 11° N lat. (Table 1).

The highest catch of *A. bicolor* (40.1 kg/h) was observed from a depth of 524 m at 09° 17' 50" N lat. and 75° 38' 93" E long. The highest catch and catch rate were observed during October-November followed by January-February (Table 2).

Sex ratio: The sex ratio of *A. bicolor* was 1:1.3. Sex ratio analysis revealed that in all the length groups, the variation from ideal sex ratio was not significant (Table 3).

Food and feeding: More than 70% of the stomachs were empty (Table 4). Full stomach condition was found only in 8.1% of females and 6.9% of males. *A. bicolor* is a carnivore and most of the food items encountered in the stomachs were in an advanced stage of digestion. Prey identification up to genus level was difficult. Tientcheu and Djama (1994) observed that regurgitation occurs due to stress during trawling

Table 1. Catch rate of *A. bicolor* in the continental slope of Indian EEZ

Latitude (°N)	Longitude (°E)	Depth (m)	Catch/hour (kg)
08° 05' 283''	76° 33' 758'	720	6.3
08° 05' 588"	76° 37' 829"	520	2.5
09° 17' 50"	75° 38' 93"	524	40.1
09° 24' 931"	75° 35' 293"	650	5.4
10° 08' 916"	75° 33' 718"	822	11.8
10° 34' 93"	75° 18' 68"	649	0.6
10° 40' 61"	75° 14' 95"	698	5.0
11° 07' 46"	74° 58' 34"	670	0.6
11° 14' 14"	74° 53' 62"	587	4.0
11° 56' 22"	74° 22' 79"	539	30.0
11° 59' 576"	74° 18' 730"	700	8.8
12° 04' 104"	74° 16' 77"	734	9.0

Table 2. Catch (kg) and catch rate (kg/h) of *A. bicolor*

Season	Catch (kg)	Catch rate (kg/h)
January-February	34.60	9.90
September-October	6.35	3.18
October-November	70.45	17.60

operations. The preferred food items of *A. bicolor* were myctophids, shrimps and squids. Similar dietary composition was found in other deep-sea species like *Halelurus hispidus*, *Eridacnis radcliffei* and *Iago omansensis* (Nair and Appukuttan, 1973) and *Centroscyllium fabricii* and *Etmopterus princeps* (Clara, 2001) and *Psenopsis cyanea* (Venu and Kurup, 2002).

Maturation and spawning: In the present study mature females of *A. bicolor* (37%) were recorded in November. Juveniles were predominant (44%) during January-February. A higher percentage of spent females (24%) were observed during January-February. During September-October, the females were found to be maturing (30%). Male and female attain length at first maturity at 23 cm and 27 cm respectively. The reported maximum length is 47 cm. *A. rostratus* is reported to attain a maximum size of 55 cm and the sexual maturity is at 35 cm (Golvan and Pakhorukov, 1980).

Table 3. Sex ratio of *A. bicolor*

Length group(cm)	Sample	Ratio (M:F)	Chi square value	Remarks
12-13	15	1:1.4	0.07	NS
14-15	21	1:1.1	0.05	NS
16-17	23	1:1.1	0.04	NS
18-19	26	1:1.9	2.46	NS
20-21	14	1:1.8	1.14	NS
22-23	16	1:0.8	0.25	NS
24-25	16	1:1.3	0.25	NS
26-27	25	1:0.9	0.04	NS
28-29	10	1:0.4	1.60	NS
30-31	13	1:2.2	1.92	NS
32-33	13	1:1.6	0.69	NS
34-35	8	1:0.6	0.50	NS
36-37	9	1:0.8	0.11	NS
38-39	7	1:0.5	0.14	NS
40-41	8	1:1	0.00	NS

NS = Not significant

Table 4. Feeding intensity of *A. bicolor*

Stomach condition	Female (%)	Male (%)
Empty	74.9	77.0
Trace	7.5	9.3
¼ full	3.4	4.5
½ full	4.2	2.3
¾ full	1.9	0.0
Full	8.1	6.9

Table 5. Regression values relating to the length and weight of *A. bicolor*

	Length (cm)			Weight (g)			b	a	r
	n	min.	max.	min.	max.				
Female	119	12.0	47.0	88.2	800.0	1.3417	0.9824	0.8564	
Male	105	13.0	36.7	80.0	378.1	1.1643	-0.5859	0.8632	
Pooled	224	12.0	47.0	80.0	800.0	1.2856	-0.8590	0.8567	

The dominance of mature and spent females in November, which was indicated by appearance of juveniles during January-February shows that the spawning period of *A. bicolor* commences in November.

Length-weight relationship: The total length of *A. bicolor* ranged from 120 to 470 mm and the weight from 80 to 800 g. Majority of the specimens analyzed was between 250 and 357 mm. The length-weight relationship for females, males and pooled samples is shown in Table 5.

The exponential length-weight equation of males and females can be expressed as

$$\text{Females: } W = 0.3744 \times L^{1.3417}$$

$$\text{Males: } W = 0.5566 \times L^{1.1643}$$

A comparison of regression coefficients in the length-weight relationships of males and females using ANACOVA revealed that the respective b values did not vary significantly (F=1.23). Therefore, the length-weight relationship of pooled population of *A. bicolor* was established as follows:

$$W = 0.4236 \times L^{1.2856}$$

Baily's test revealed that the exponential values in males and females of *A. bicolor* do not follow the cube law and growth was found to be negatively allometric for females (t = 21) and males (t = 27). The 'b' value computed for females and males were 1.3 and 1.2 respectively. A negative allometric growth could also be noted in the pooled samples of males and females (t = 32). According to Martin (1949) the values of exponential b usually ranges between 2.5 and 4.0. Allen (1938) suggested

that the value of b remains constant at 3.0 for an ideal fish. Slope value less than 3 indicates that fish becomes more slender as it increases in length and a slope value greater than 3 denotes stoutness indicating allometric growth (Grover and Juliano, 1976). The low b value indicates that the species is not maintaining dimensional equality during growth. The growth of fish is much influenced by extrinsic factors such as temperature, food availability and physico-chemical parameters prevailing in the environment. The deep-sea environment beyond 300m depth is characterized by low temperature and sparse availability of preferred food items (Mamaev and Tkachuk, 1979). The stomach contents examined in *A. bicolor* have shown that feeding intensity was very less in all the seasons. The distribution of this species was found mainly in the depths beyond 300m and hence the growth is negatively allometric.

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