OBSERVATIONS ON SOME ASPECTS OF BIOLOGY OF THE BLACK CROAKER *ATROBUCCA NIBE* (JORDAN AND THOMPSON) FROM KAKINADA

V. SRIRAMACHANDRA MURTY

Central Marine Fisheries Research Institute Centre, Kakinada

ABSTRACT

Observations on some aspects of biology of *Atrobucca nibe* are made from Kakinada. The length-weight relationship is described by the equation log W = −5.524308 + 3.213476 log L. The fluctuations in relative condition factor appear to be associated with fluctuations in gonad cycle. Individuals release ova in two batches during the spawning season which extends from Febuary to July in the area. The length at first maturity is estimated at 145 mm. The sex ratio indicates predominance of males in most months and length groups.

INTRODUCTION

The fishes of the family Sciaenidae form fisheries of considerable magnitude along Indian coasts; off Kakinada (16.15'-17.10' N Lat. and 82.22'-35' E long), an estimated 603.1 tonnes of these fishes were landed by the trawlers during April 1968-December 1970 (Muthu et al 1975). The catches of these fishes have been increasing with increased intensity of trawl fishing and during 1976 alone, an estmated 873.1 tonnes of these fishes were landed (CMFRI, 1976) from this area. The fishery is a multispecies one and *Atrobucca nibe* supports a rich fishery at Kakinada.

Though there is considerable information on the biology of sciaenid fishes from different localities along the Indian coasts (Rao 1967, Annigeri 1967, Rao K. V. S. 1968, Kutty 1968, Devadoss 1972), there is practically no information on the biology of *A. nibe* from any where in the world except for the work of Matsui and Takai (1951) from Japanese waters. The present paper gives information on some aspects of biology of this species from the trawler catches landed at Kakinada during the years 1975-1977.

MATERIAL AND METHODS

The samples were obtained from the trawler landings at weekly intervals. In the laboratory, the constituent species were separated and data taken on each species. For biological studies, data on length, weight, sex, stages of maturation and relative fullness of the stomachs were taken. Always the data from

fresh specimens only were taken. The length-weight relationship was calculated by the method of least squares using the formula $W = a L^n$ or $\log W = \log a + n \log L$ where W = weight in grams, L = length in mm, a = a constant and n = exponent. The relative condition factor (Kn) was calculated using the formula $Kn = W/\hat{W}$ (Le Cren 1951), where W = observed individual weight and $\hat{W}$ = weight calculated from the length-weight relationship for each length. The colour and general appearance of the gonads were noted in fresh condition and ova diameter measurements were taken from formalin-preserved ovaries. In taking the diameter measurements the procedure of Clark (1934) was followed. From each ovary about 400 ova were measured at a magnification where 1 md equals 0.014 mm. Spawning season is determined on the basis of the data on females only.

As *A. nibe* occurs in the catches seasonally, the biological data of corresponding months in different years were pooled for purpose of the present study.

Length-Weight relationship

The data of 125 females ranging from 122 to 235 mm length and from 14 to 136 g weight and 164 males ranging from 94 to 218 mm length and from 6 to 109 g weight, were used to calculate the length-weight relationship. The equations for both the sexes are:

Males: $\log W = -5.571216 + 3.234755 \log L$

Females: $\log W = -5.461329 + 3.185315 \text{ Log } L$

The regression coefficient of males and females were compared by analysis of covariance following Snedecor and Cochran (1967). The results (Table 1) show that there is no significant difference both in the slopes and in the elevations between sexes. Hence the data of sexes were pooled and a common relationship calculated (fig. 1) which can be expressed by the equation:

$\text{Log } W = -5.524308 + 3.213476 \log L.$

Relative condition factor

The values of relative condition factor calculated separately for each fish were added up and the mean for each month and for each length group obtained.

It is seen that Kn values in May, June and September are higher than the weighted average; whereas in other months the values are lower (fig. 2). It is also evident that the Kn value is minimum in March and maximum in September. As stated elsewhere in this paper (vide infra), the spawning season for *A. nibe* is February-July. The generally low values during January-April may perhaps be due to the peak activity of ripening of gonads and consequent spawning stress.

TABLE. 1. *Comparison of Regression lines of the length-weight relationship of* A. nibe.

	df	Σx^2	Σxy	Σy^2	*Reg coefficient*	*Deviation from regression* df	*s.s.*	*M.S.*
Within								
Females	124	0.294305	0.93745	3.20119	3.185315	123	0.215110	0.0017488
Males	163	0.478141	0.54667	5.38772	3.234755	162	0.384623	0.0023742
						285	0.59977330	0.0021043
Pooled (within)	287	0.772446	2.4841	238.58892	3.215918	286	0.600178	0.0020985
					difference between slopes	1	0.000445	0.000445
Between	1	0.068986	0.21979	0.70027				
Total	288	0.841432	2.70392	9.28919		287	0.600195	
					between adjusted means	1	0.000017	0.000017

Comparison of slopes: F = 4.728764; df = 285, 1; F at 5% = 254; not significant

Comparison of elevations: F = 123.441176; df = 286, 1; F at 5% = not significant

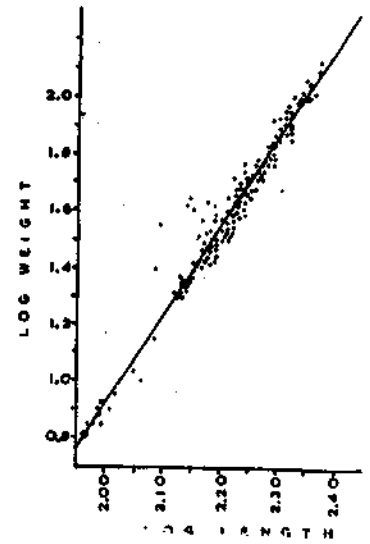

FIG. 1. Length-weight relationship in *A. nibe*

The Kn values in different lengths (fig. 3) show steep decline till 120-129 mm and thereafter show increase till 140-149 mm. *A. nibe* attains sexual maturity for the first time when the fish is 145 mm and the peak Kn value at this length may be associated with maturity. The Kn values show decline after 140-149 mm and reach another peak at 200-209 mm group. Extending the previous suggestion, it is possible that individuals of *A. nibe* attain maturity for the second time when they attain a length of 200-209 mm. A similar conclusion was drawn in the case of *Nemipterus japonicus* by Krishnamoorthi (1971).

Maturation and Spawning

The study is based on 357 specimens (224 males and 133 females) ranging from 994 to 235 mm in length.

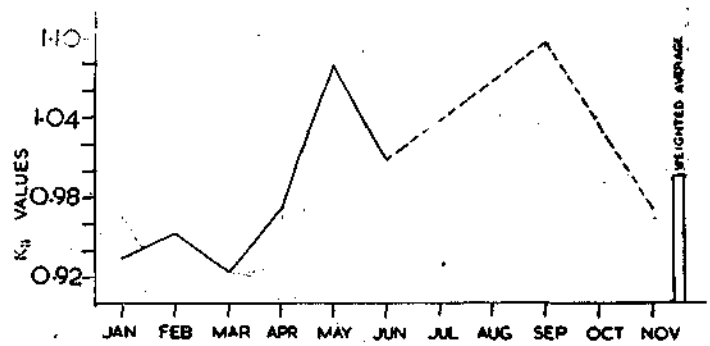

FIG. 2. Relative codition factor in different months in *A. nibe*.

Stage of maturation: The following stages of maturation are recognised in females of *A. nibe*:

Stage I (immature): Ovary thin, occupying less than half the length of body cavity; ova minute, irregularly-shaped, transparent, without yolk and with clearly visible nucleus. Ova range from 0.02 to 0.13 mm in diameter.

Stage II (maturing virgins): Ovary thin, occupying about half the length of body cavity, whitish; yolk deposition initiated in most ova which are translucent. Ova diameter ranges from 0.02 to 0.26 mm.

Stage III (maturing): Ovary yellow occupying about $\frac{3}{4}$ of the length of body cavity; ova visible to naked eye; majority of ova translucent, but opaque ova also are present. Maximum diameter at 0.60 mm.

Stage IV (ripening): Ovary pale yellow occupying almost the entire length of body cavity; ovarian wall thin, ova distinctly visible to naked eye; majority of ova are opaque with the maximum diameter at 0.73 mm.

Stage V (ripe): Ovary distended, occupying the entire length of body cavity; ova translucent with a distinct oil globule. Maximum ova diameter upto 1.03 mm. The diameter of the oil globule ranges from 0.19 to 0.26 mm.

Stage Va (Partially spawned): Same as stage V but the ovary does not occupy entire length of body cavity. Ripe, translucent ova with oil globule are present but majority are opaque.

Stage VI (spent): Not encountered in the samples.

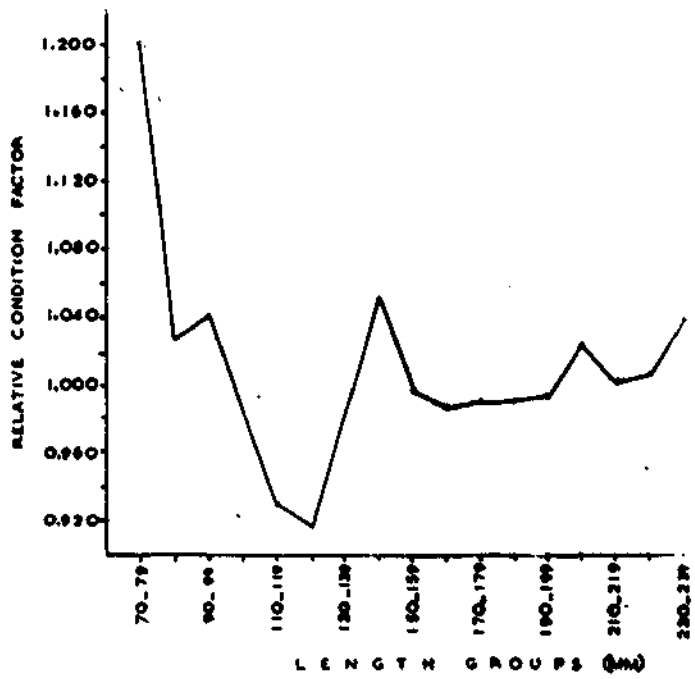

FIG. 3. Relative condition factor in different length goups in *A. nibe*

Males are recognised as immature, maturing and mature only, on the basis of macroscopic examination of fresh testes.

Length at first maturity: For the purpose of determining the minimum length at first maturity, maturing, ripening and ripe (stage III-V) females and mature males were taken into account. The percentage of these mature fish in relation to immature fish in different lengths are presented in figure 4. It may be seen that untill a lentgh of 200 mm, the percentage of mature individuals show progressive increase and that in specimens above this length, all are mature. On the basis of these observations, it may be concluded that *A. nibe* mature first at the length of 145 mm (50% mature).

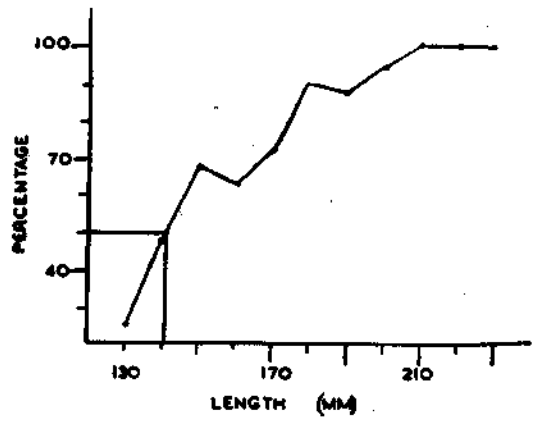

FIG. 4. Frequency distribution of mature individuals in different length groups of *A. nibe*.

Spawning: The ova diameter frequency distribution in ovaries of stages II, III, IV and V of maturation are presented in firure 5. It may be noted that there is only one mode at 5 md in the diameter frequency distribution in ovary of stage II of maturation. In stage III, a new mode appeared at 32 md. In stage IV, there are two modes in addition to the one at 11 md: one at 32 md and the other at 41 md in the dameter frequency distributian of mature ova. Obviously, certain fast growing ova have got separated from the batch of ova that formed a single mode at 32 md in stage III, by the time the ovary passed on to stage IV. In stage V, the ripe translucent ova got separated from other ova and formed a mode at 59 md. This mode must have resulted by the further

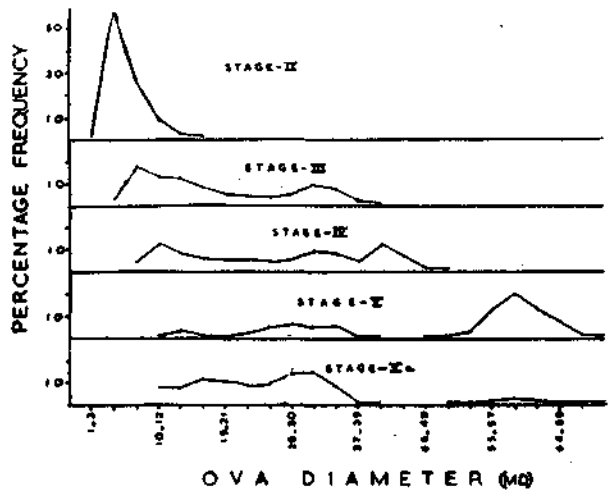

FIG. 5. Ova diameter frequency distribution in ovaries of diffeent stages of maturation in *A. nibe*.

growth of ova that formed a mode at 41 md in the dameter frequency distribution of ovary in stage IV. There is another mode at 29 md in the diameter frequency distribution of stage V ovary. In the partially spawned stage Va ovary, the ripe translucent ova form a minor mode at 59 md while the majority of the ova are opaque forming a mode at 32 md.

The fact that: 1) there are two closer modes in the diameter frequency distribution of mature ova in ovary of stage IV, 2) there are two modes one each in the mature and ripe ova in the ovary in stage V and 3) a partially-spawed stage occurs with a major mode at 32 md and a minor mode at 59 md indicate a possibility that each adult female of *A. nibe* spawns twice during a single but extended spawning season. The evidence is not strong enough to believe that there may be two distinct spawning seasons in a year because the batch of ova that are destined to be released in the second batch are already

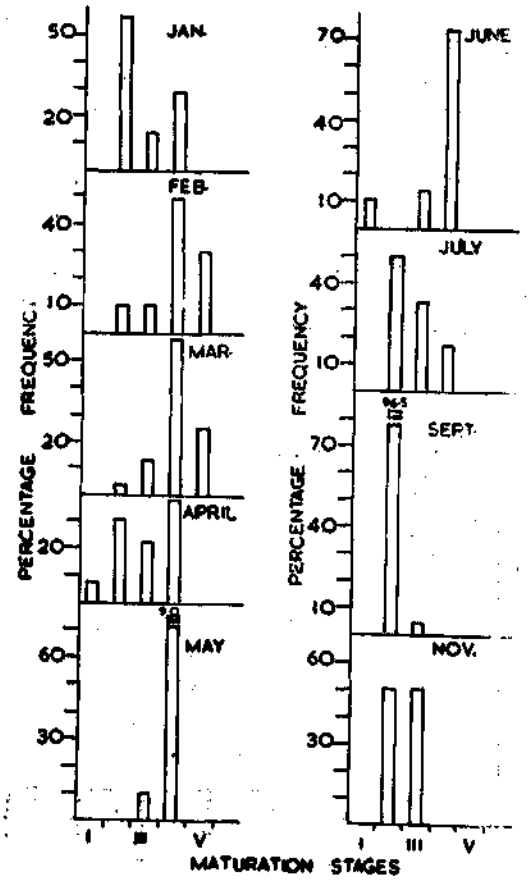

FIG. 6. Frequency distribution of different stages of maturation in different months in females of *A. nibe*

mature and opaque and have reached a modal diameter of 32 md in stage Va (fig. 5) and judging from the sequence of maturation process, it may not take more time for these ova to become ripe and be realeased. Similar conclusions were drawn in the case of *Pseudosciaena diacanthus* (Rao, KVS. 1968) and *Johnius dussumieri* (Devadoss, 1972). In other sciaenid species studied: *Otolithus argenteus* (Annigeri 1967), *Pseudosciaena aneus* and *P. bleekeri* (Rao, T. A. 1967) and *Otolithus ruber* (Devadoss 1972) the ripe ova are stated to be released in only one spawning act.

The frequency distribution of maturation stages in females in different months are presented in figure 6. It may be seen that felales with ripe ovaries (stages V nda Va) occur in the catches during February and March but fishes with ripening ovaries (stage IV) occur in several months from January to July. Further, the ripening females dominate others during February-June period.

The occurrence of running ripe females during February-March and the occurrence of ripening females in large numbers during February-June period indicate that *A. nibe* spawns during February-July period in th sea off Kakinada. It may be stated in this connection that according to Matsui and Takai (1951; as cited by Trewavas 1977), this species "probably" spawns "during the period April-June" in shallow waters between China and Japan. The spawning seasons of other sciaenid species from India are determined as June-August in *P. diacanthus* off Bombay (Rao, K. V. S. 1968), October-January in *O. argenteus* in the sea off Mangalore (Annigeri 1967), February-May in *P. bleekeri* and January-April in *J. carutta* off Waltair (Rao, T. A. 1967) and July-October in *O. ruber* and June-September in *J. dussumieri* of Bombay (Devadoss 1972).

TABLE 2. *Sex ratio in different months in* A. nibe.

Months	*No. of fish examined*	*Percentage of males*	*Percentage of females*
January	31	77.4	22.6
February	46	78.2	21.8
March	43	44.2	55.8
April	37	64.9	35.1
May	26	57.7	42.3
June	38	18.4	81.6
July	25	76.0	24.0
August	No data	——	——
September	68	57.4	42.6
October	No data	——	——
November	43	95.3	4.7
December	No data	——	——
Pooled	357	63.7	37.3

TABLE 3. *Sex ratio in different length groups of* A. nibe

Length groups (mm)	*No. of fish examined*	*Percentage of males*	*Percentage of females*
140-149	24	83.3	16.7
150-159	52	75.0	16.7
160-169	75	64.0	36.0
180-189	48	58.3	41.7
170-179	71	59.2	40.8
190-199	28	42.9	57.1
200-209	19	42.1	57.9
210-219	11	54.5	45.5
220-229	7	28.6	71.4

SEX RATIO

The sex ratio in different months and in different length groups are presented in Tables 2 and 3 respectively. It may be seen that males outnumber females in all months except March and June (Table 2). Similarly, males dominate females in all length group upto 189 mm. The preponderance of males in the catches in different months and in different length groups upto 189 mm and the general preponderance of females from and above 190 mm is noteworthy and may indicate differential growth rate of sexes as shown by Qasim (1966) in some freshwater fishes of India.

REFERENCES

ANNIGERI, G. G. 1967. Maturation of the intraovarian eggs and the spawning periodicities in a few fishes of Mangalore. *Indian J. Fish.*, 10: 23-32 (1963).

CLARK, F. N. 1934. Maturity of the California sardine (*Sardina caerulea*), *Calif. Div. Fish Game*, 42: 49 pp.

CMFRI. 1976. *Annual Report for* 1976. Central Marine Fisheries Research Institute, Cochin, 123 pp.

DEVADOSS, P. 1972. Maturity and spawning in *Otolithus ruber* (Schn.) and *Johnius dussumieri* (C. & V.). *Indian J. Fish.*, 16: 117-128 (1969).

KRISHNAMOORTHI, B. 1971. Biology of the threadfin Bream, *Nemipteus japonicus* (Bloch) *Indian J. Fish.*, 18: 1-21.

KUTTY, M. N. 1968. A note on the biology of the 'koth' *Otolithoides brunneus* (Day). *J. mar. biol. Ass. India*, 9: 197-198.

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.

MATSUI, J. AND T. TAKAI. 1951. Ecological studies on the black croaker, *Nibea nibe* (Jordan & Thompson). *Contr. Shimonoseki Coll. Fish.*, 1951: 65-89.

MUTHU, M. S., K. A. NARASIMHAM, G. S. RAO, Y. A. SASTRY AND P. RAMALINGAM. 1975. The commercial trawl fisheries off Kakinada during 1967-70. *Indian J. Fish.*, 22: 171-186.

QASIM, S. Z. 1966. Sex ratio in fish populations as a function of sexual difference in growth rate. *Curr. Sci.*, 35: 140-142.

RAO, K. V. S. 1968. Some aspects of biology of 'Ghol' *Pseudosciaena diacanthus* (Lacepade). *Indian J. Fish.*, 10: 413-459 (1963).

RAO, T. A. 1967. Maturity and spawning habits of some sciaenids in offshore waters at Visakhapatnam. *Indian J. Fish.*, 11: 121-126 (1964).

SNEDECOR, G. W. AND W. G. COCHRAN. 1967. *Statistical Methods.* Sixth Edition, Oxford and IBH publishing Co., New Delhi, 593 pp.

TREWAVAS, E. 1977. The sciaenid fishes (croakers ordrums) of the Indo-west-Pacific. *Trans. Zool. Soc. Lond.* 33: 253-541.