Indian J. Fish., ***49***(4) : 433-440, Oct.-Dec., 2002

Observations on the biology of *Nemipterus japonicus* (Bloch) from Veraval

S.G. RAJE
Bombay Research Centre of Central Marine Fisheries Research Institute, Bombay - 400 001, India.

ABSTRACT

The length-weight relationship for *Nemipterus japonicus* was not significantly different between sexes, hence the common regression equation for the species was calculated as log W = 4.88606 + 3.00437 log L. The K_n values were calculated separately for males and females in relation to various months. Females attain 50% maturity at 155 mm. Intraovarian investigations indicated that the spawning period of this species extends from September to April, with a peak during September-November. The fecundity ranged from 10,260 to 184,960 and increased with the increase in the length and weight of fish. Sex ratio showed preponderence of males, with a male to female ratio of 2.2:1. In general, feeding intensity appeared to increase from September to May. This species is a carnivore, feeding mainly on crustaceans, teleosts, annelids, molluscs and echinoderms.

Introduction

The commercial importance of *N. japonicus*, a threadfin bream, is on the increase. However information on its biology is not available from the north west coast. Hence, the investigations were carried out at Veraval during October 1982 to March 1987, the results of which are presented here.

Materials and methods

Biweekly random samples were collected from the landings of commercial trawlers. The details like length, weight, sex, stages of maturity in females and food and feeding conditions were taken from fresh specimens. Seven maturity stages were fixed as described in *N. japonicus* by Dan (1977). After noting the length and weight of fish, the ovaries in stage V were preserved in 5% formalin for fecundity estimates. The relationship of fecundity with length and weight of fish was calculated by least squares method. The observed sex ratios in each month and different size groups were tested against the expected ratio of 1: 1 by the Chi-square equation. Food items were identified up to species level wherever possible and analysed by volumetric displacement method.

Results and discussion

Length-weight relationship

The study of length-weight relationship is based on 696 males ranging from 55 to 314 mm in total length measured from the tip of snout to tip of lower caudal lob and from 1.5 to 510.0g weight, and 294 females ranging from 69 to 272 mm

in total length and 3.9 to 283.0 g in weight, collected during March 1985 to March 1987. The regression equation for both the sexes were:

Male:

Log W = -4.83473 + 2.99499 Log L; r = 0.97722

Female:

Log W = -4.95860 + 3.04463 Log L; r = 0.93386

An analysis of covariance (Snedecor and Cochran, 1967) showed that both the slopes and elevations were not significantly different at 5% level (Table 1). Hence, the data for both the sexes were combined and a single regression equation calculated as:

Log W = -4.88606 + 3.00437 Log L; r = 0.96677

Vinci and Nair (1974), Hoda (1976) and Vivekanandan and James (1986) also did not find significant difference between males and females of *N. japonicus* from the coasts of Kerala, Pakistan and Madras respectively.

Relative condition factor

The relative condition factor (K_n) was estimated as per the method of Le Cren (1951). The seasonal variation in mean K_n values of the females and males were

TABLE 1. *Analysis of covariance for comparison of regression lines of length-weight relationship of males and females of* N. japonicus.

Source of variation	DF	Regression coefficient	Deviation from regression DF	SS	MS
Within males	695	2.99499	694	10.33279	0.01489
Within females	293	3.04463	292	9.84616	0.03372
			986	20.17895	0.02046
Pooled (within)	988	3.00382	987	20.20628	0.02047
Difference between slopes			1	0.02733	0.02733
Total	989	3.00437	988	20.24932	0.02049
Between adjusted means			1	0.04304	0.04304

Comparison of slopes : F = 1.33578 (df = 1,986), Not significant.
Comparison of elevations : F = 2.10259 (df = 1,987), Not significant.

TABLE 2. *Monthly percentage occurrence of adult females of* N.japonicus *in different stages of maturity (data from October 1982 to March 1987)*

Month	No. of females examined	No. of females from length at first maturity	% of maturity stages I	II	III	IV	V	VI	VII
September	22	15	-	-	-	13.33	60.00	26.67	-
October	131	99	7.07	2.02	8.08	19.19	43.44	19.19	1.01
November	89	65	1.54	1.54	16.92	15.35	53.85	10.76	-
December	181	161	24.84	32.92	6.83	7.45	21.12	6.84	-
January	270	246	32.52	49.59	3.25	0.81	8.54	4.88	0.41
February	271	154	13.64	57.14	5.19	11.04	4.55	7.79	0.65
March	180	127	7.87	59.06	6.30	14.96	6.30	4.72	0.79
April	64	59	6.78	86.44	1.69	1.69	1.70	1.70	-
May	31	17	41.18	58.82	-	-	-	-	-

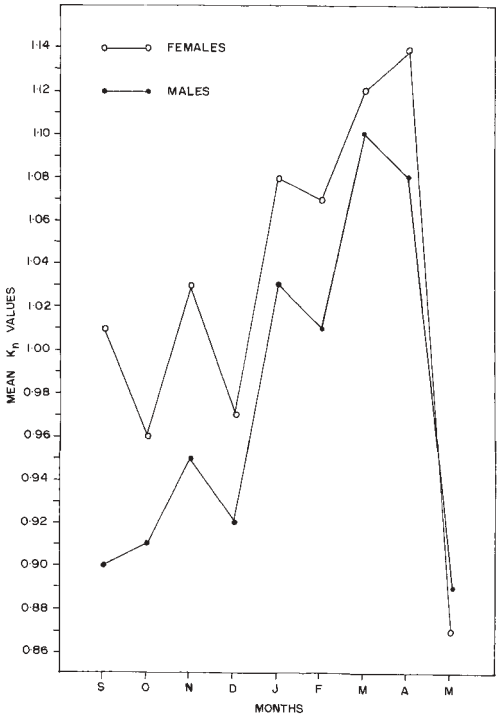

Fig.1. Mean 'Kn' values of *N. japonicus* in different months.

observed (Fig. 1). The gradual increase in K_n value from October to April in females may be attributed to the increase in feeding intensity and also probably indicates the recovery of fish from peak spawning strain (Table 2). The lowest K_n value found in May seems to be due to low feeding intensity and immature condition of females. Acharya and Dwivedi (1984) reported that from August onwards, though the spawning continues, the general condition of the females tends to improve mainly due to increase in their feeding intensity off the Bombay coast. The low K_n value noticed in October appears to be related to the peak strain in spawning. Acharya and Dwivedi (1984) also observed fall in K_n value in October.

In males there is a gradual rise in Kn values from September to March and fall in values from April to May.

The mean Kn values for females were more than those of males in all the months except in May. Acharya and Dwivedi (1984) also found better general condition in females than males in all the months except in May and December.

Length at first maturity

The length-maturity data for 1,239 females ranging in size from 69 to 272 mm were analysed. Females in stages III-VII were considered as mature. Mature females recorded a minimum of 130 mm length. The maturity curve (Fig.2.)

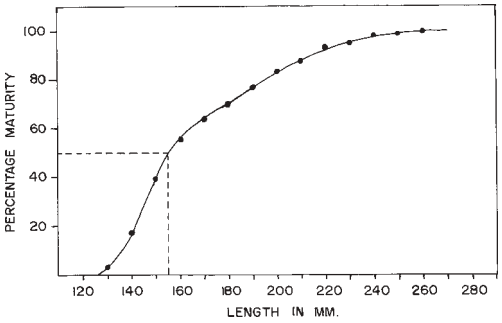

Fig.2. Percentage frequency distribution of mature females of *N. japonicus* in relation to length.

showed that 50% of the females matured at length of 155 mm. This was considered to be the length at first maturity. Krishnamoorthi (1971) and Vivekanandan and James (1986) reported the length at first maturity in females of *N. japonicus* from Visakhapatnam and Madras as 165 and 145 mm respectively.

Spawning

For determining the spawning season of *N. japonicus* only females ranging above the length at first maturity were considered. The percentage frequency of various maturity stages of females as obtained by pooling the data for corresponding months during the entire study period is given in Table 2. The occurrence

of specimens in stage IV to VI from September to April, with higher percentage during September-November and specimens in stage VII in October and January-March suggests that the population of *N. japonicus* spawns from September to April, with the peak in September-November. The low Kn value noticed in October also supports this finding. The recruitment of juveniles from 40 to 86 mm into the fishery was also observed from December to March.

Acharya and Dwivedi (1984) observed the main spawning period of this species to be from August to November off Bombay. Murty (1984) noted that the spawning period of *N. japonicus* at Kakinada extended from August to April. The spawning in this species extend from June to March in Madras (Vivekanandan and James, 1986). Samuel (1990) suggested the occurrence of two spawning periods in this fish : during March-May and September-October from Kuwait.

Fecundity

The fecundity of 36 mature females (stage V) ranging in size between 130 and 252 mm and weight 31.0 and 248.0 g was estimated. The number of ova ranged from 10,260 to 184,946. The number of ova increase with increase in length and weight of fish (Figs. 3 and 4). The relationship between fecundity (F) and total length of fish (L) was estimated to be: F = -150511.00 + 1163.58 L, r = 0.7626. The relation between fecundity (F) and weight of fish (W) can be expressed as: F = -9709 + 686.54 W, r = 0.8086.

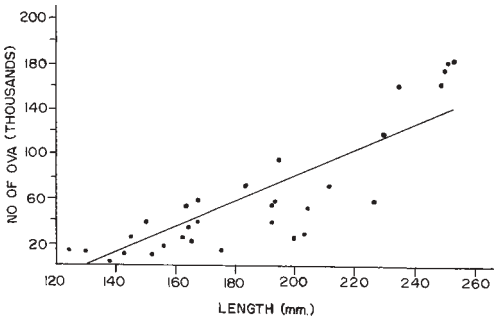

Fig.3. Fecundity of *N. japonicus* in relation to total length.

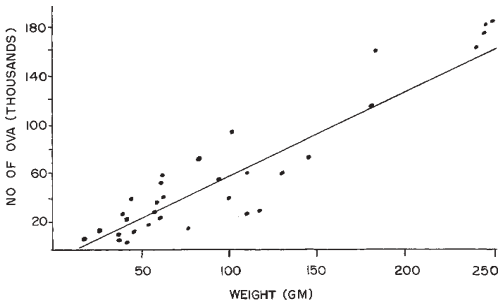

Fig.4. Fecundity of *N. japonicus* in relation to weight of fish.

According to Dan (1977) the average fecundity ranged from 13,900 to 58,400 in *N. japonicus* of the length range from 138 to 205 mm from Waltair.

Sex Ratio

A total of 4,016 specimens of *N. japonicus* were examined. The sex ratio

TABLE 3. *Sex ratio in* N. japonicus *in different months (pooled data of the corresponding months of the period from October 1982 to March 1987).*

Months	No. of specimens examined	Male : Female ratio	Chi-square
September	29	0.3:1	7.7*
October	492	2.8:1	108.2*
November	472	4.3:1	183.1*
December	789	3.4:1	231.0*
January	684	1.5:1	30.3*
February	752	1.8:1	58.6*
March	488	1.7:1	33.6*
April	217	2.4:1	36.5*
May	92	2.0:1	9.8*
Pooled	4016	2.2:1	589.0*

Degree of freedom = 1 * Significant at 1% level.

TABLE 4. *Sex ratio in* N. japonicus *at different length groups*

Length groups (mm)	No. of males	No. of females	Male: Female ratio	Chi-square
50-59	2	-	2.0:00	2.00
60-69	4	1	4.0:1	1.80
70-79	15	3	5.0:1	8.00*
80-89	10	8	1.2:1	0.22*
90-99	8	9	0.9:1	0.06
100-109	43	31	1.4:1	1.95*
110-119	78	44	1.8:1	9.48*
120-129	101	46	2.2:1	20.58*
130-139	90	53	1.7:1	9.57*
140-149	137	100	1.4:1	5.78*
150-159	156	131	1.2:1	2.18*
160-169	233	143	1.5:1	17.49*
170-179	293	183	1.6:1	25.42*
180-189	356	146	2.4:1	87.85*
190-199	366	129	2.8:1	113.47*
200-209	290	76	3.8:1	125.12*
210-219	180	57	3.2:1	63.84*
220-229	138	36	3.8:1	59.75*
230-239	113	17	6.6:1	70.89*
240-249	73	11	6.6:1	45.76*
250-259	42	8	5.3:1	23.12*
260-269	27	6	4.5:1	13.36*
270-279	13	1	13.0:1	10.29*
280-289	3	-	3.0:1	3.00
290-299	7	-	7.0:1	7.00
300-309	6	-	6.0:1	6.00
310-319	2	-	2.0:1	2.00
320-329	1	-	1.0:0	1.00
Mean length (mm)	183.7	170.7		

Degree of freedom = 1; * Significant at 5% level.

for the entire period of observation was statistically significant with 2.2:1 males to females. The analysis of sex ratio in different months (Table 3) showed a significant defference from the expected 1:1 ratio due to preponderance of females in September and dominance of males during October-May. Murty (1984) observed that males outnumbered females in all months except August and December in 1979.

Sex ratio in different length groups (Table 4) showed preponderance of males in all the length groups except in 90-99 mm while no females have been observed beyond 280 mm. The mean size of males in the catch was slightly more than that of females. These features of sex ratio in this species may be the result of differential growth rate of sexes as suggested by Qasim (1966). Murty (1984) also reported that males outnumbered females in most of the length groups and females were not represented in groups beyond 215 mm. The present finding support the findings of Krishnamoorthy (1974) that size difference between males and females among *N. japonicus* are real and females are generally smaller in size than males.

Food and feeding

Stomach contents of 2,773 males and 1,237 females of *N. japonicus* ranging from 55 to 320 mm in total length were examined. The fishes were considered actively fed when the stomachs were gorged, full and ¾ full, moderately fed when ½ full and poor when ¼ full and empty.

Incidence of active feeding increased from 3.45 (September) to 15.21% (April) while that of empty stomachs decreased from 82.76 (September) to 29.35% (May) (Table 5) Average volume of food in the gut increased from 0.10 ml (September) to 0.77 ml (April). In general, feeding intensity increased as spawning activity decreased. Gradual increase in feeding intensity in the postmonsoon months has been reported by Acharya and Dwivedi (1984) for the Bombay area. According to Krishnamoorthi (1971) the feeding intensity was lowest during the winter months and highest during the summer months. In males, the average volume of food per fish was 0.57 ml and in females 0.37 ml (Table 6). The average volume of food in males ranged from 0.11 ml (September) to 1.10 ml (October). In females, it ranged

TABLE 5. *Month wise feeding intensity in* N. japonicus *from October 1982 to March 1987*

Month	No. of specimens	Condition of stomachs (%)			
		Active feeding	Moderate feeding	Poor feeding	Empty
September	29	3.45	-	13.79	82.76
October	493	12.78	10.95	24.54	51.73
November	472	12.08	11.23	24.36	52.33
December	789	11.79	12.29	30.54	45.38
January	684	9.36	10.96	34.60	45.18
February	752	11.84	14.63	34.18	39.35
March	488	11.27	14.34	41.60	32.79
April	217	15.21	12.90	32.26	39.63
May	92	10.87	23.91	35.87	29.35
Total	4016	465	509	1280	1762
%		11.58	12.68	31.87	43.87

TABLE 6. *Monthly average volume of stomach contents of males and females of* N. japonicus

Month	Total No. of fish	Average volume of food (in ml) per fish		
		Males	Females	Pooled
September	29	0.11	0.10	0.10
October	493	1.10	0.64	0.58
November	472	0.54	0.16	0.47
December	789	0.87	0.38	0.50
January	684	0.62	0.49	0.49
February	752	0.79	0.24	0.43
March	488	0.54	0.55	0.54
April	217	0.79	0.73	0.77
May	92	0.82	0.16	0.60
Average volume of food per fish (in ml)	4016	0.57	0.37	0.51

from 0.10 ml (September) to 0.73 ml (April). It indicates that feeding intensity was more in males than in females in most of the months. Krishnamoorthi (1971) made similar observations at Visakhapatnam.

The percentage volume of different food items in the total volume of the stomach contents was calculated for each month. Pooling the data for all months, it is seen that 48.10% of the volume of stomach contents consisted of crustaceans, 20.32% teleosts, 7.73% annelids, 7.50% molluscs, 0.10% echinoderms and the rest miscellaneous food items.

Among the crustaceans, *Acetes* spp. (27.90%) formed the main bulk of the diet, followed by *Solenocera* spp., penaeid prawns, crabs, *Squilla* spp. *Nematopalaemon tenuipes and Exhippolysmata ensirostris,* in the total volume of food. Crustaceans formed the dominant food item in almost all the months, its percentage being the highest in September and lowest in April. Teleost food items, represented by sciaenids, *Nemipterus mesoprion, N. japonicus, Lactarius lactarius, Apogon* spp. *Myctophum* spp.

Trichiurus spp. *Cynoglossus* spp, *Saurida* spp, *Bregmaceros macclellandi*, *Leiognathus* spp. and fish larva in decreasing order of abundance, ranked second to crustaceans in almost all the months. Teleosts were maximum during April and minimum during March. Annelids comprised mainly *Neries* spp. which occurred in all the months with the maximum in May and minimum in December. Molluscs constituted by *Sepia* spp, *Loligo* spp, bivalves and gastropods, were maximum in October and minimum in March. Echinoderms consisting of only brittle-stars, were found during March and April only.

N. japonicus is a predacious carnivore exhibiting a tendency to feed at the bottom, as evidenced by the presence of benthic organisms mixed with mud in diet. Its carnivorous feeding habit has been reported by Kuthalingam (1965), Krishnamoorthi (1971) and Vinci (1982).

Vinci (1982) found that the major food items were crustaceans with *Acetes indicus* forming the main individual item in the stomach content of this species from Kerala. Cannibalistic habit of feeding as reported by Kuthalingam (1965) was noticed in specimens above 162 mm length in the present study.

Acknowledgements

The author is grateful to Dr. P.S.B.R. James, former Director, CMFRI, Cochin and Dr. P. Bensam, former Head of Demersal Fisheries Division, for their encouragement and Dr. V.D. Deshmukh, Scientist (SG) for critically going through the manuscript. The assistance from Shri. H.K. Dhokia, Shri B.P. Thumber, Shri. J.D. Sarang and Shri M.S. Zala, Technical Assistants in collecting the data is gratefully acknowledged.

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