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STUDIES ON MATURITY, SPAWNING AND FECUNDITY OF *NEMIPTERUS JAPONICUS* (BLOCH) OFF BOMBAY COAST

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ABSTRACT

Studies indicated spawning season of *N. japonicus* off Bombay coast to be during July to December with peak breeding during November to December. Females attained first maturity at the length range 110-120 mm; 50% maturity and spawning occured at 135 mm within one year of its age. Overall male : female ratio for the entire period of study was 1:1.01. Relationships of fecundity with total length of fish, total weight of fish, total ovary weight and per g fish weight were worked out as $F = (-72674.33) L^{739.73}$; $F = 65.44 W^{807.33}$; $F = 3112.57 W^{22383.27}$ and $F = 467.85 W^{4.96}$ with coefficient of correlation values (r) = 0.9090, 0.9443, 0.9911 and 0.8843 respectively.

INTRODUCTION

Process of maturation, age at first maturity, maturity at 50% level, frequency and extent of spawning and fecundity are some very important biological aspects to be studied for economically important fishes. Variation in any or in more than one of these aspects due to variations in geographical locations or in the environment are not uncommon. An understanding of these factors is essential for the preservation, development and exploitation of stock.

Predominance of nemipterids in experimental fishing along Indian coast has been reported (Silas *et al.* 1976, Natarajan, 1972 and Dhage *et al.* 1975). Reports of Exploratory Fishery Project (Joseph, 1974, 1976; Joseph *et al.*, 1976 a & b; Swaminath 1976, 1977, 1978 and Swaminath *et al.*, 1977 a, b & c) and Joint Indo-Polish Survey conducted by *M.T. Murena* in the Northwest coast of India (Dwivedi *et al.*, 1977 a, b & c) supported existance of better nemipterid fishery in surveyed areas. According to FAO (1987), during 1981-86 *Nemipterus* spp. contributed 81858-121149 metric tonnes in total world catch.

Out of five species - *Synagris striatus, S.tolu, S.bleekari, Nemipterus hexodon* and *N. japonicus* available in Indian coasts (Day, 1978), *N.japonicus* is the dominant species. Inspite, except the works of Kuthalingam (1971), Selvakumar (1971), Egglestone (1972), Krishnamoorthi (1971, 1973 & 1974), Acharya (1980), Acharya & Dwivedi (1985), on biology and resource assessment, biometry, condition factor and length weight relationship, works on the aspects of maturity and spawning particularly from Bombay region is scanty. Present paper deals with these aspects of *N. japonicus* off Bombay coast.

MATERIAL AND METHODS

In the present investigation 242 males ranging 96-250 mm and 244 females ranging 95-210 mm in total length, sampled at weekly intervals, during April 1977 to March 1978, from Sassoon Dock, Bombay, were utilised.

Maturity stages of the gonads were fixed on the basis of physical appearance and by observing under the microscope following the standards laid down by International Council for Exploration of Seas as established by Kestaven (1960), Ricker (1968), followed by Rao (1963), Egglestone (1972) and many others.

The males were categorised into four stages namely immature (I), maturing (II), ripe (III)

weight of fish and fecundity per g fish weight were worked out by least square method.

RESULTS AND DISCUSSION

Table I shows the commencement of appearance of females of IVth stage and above in the month of July. Concentration of those during October-November and appearance of partially spent and spent fishes in the month of November clearly indicated July as the month of commencement of spawning season and October-November as peak spawning period. Non occurrence of

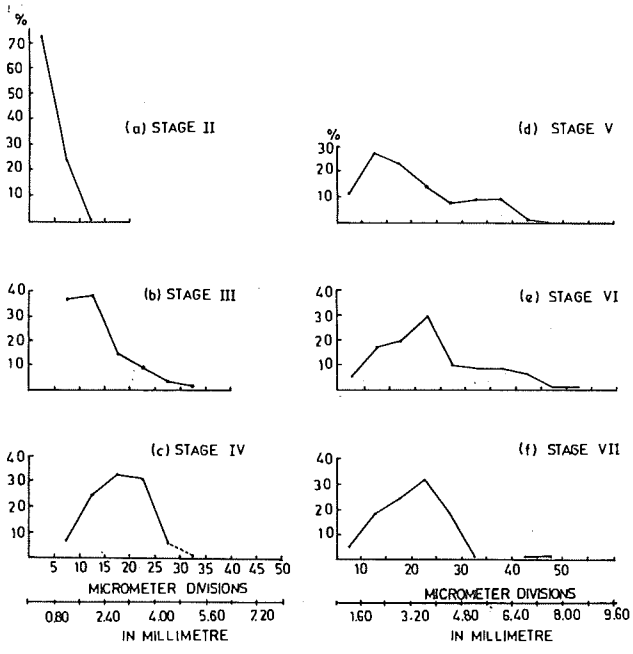

Fig. 1. *Ova diameter frequency polygon in different stages of Maturity*

penultimate stages of females in the month of December was indicative of closure of the season in December. However, stray breeding during January-March was reflected through the availability of a low percent of females of penultimate stages. Ova diameter study (Fig. 1 a-f) also indicated that from a stock of ova developed upto IVth stage a small percentage of ova (25%) were developed to Vth stage, subsequently to VIth stage and extruded leaving behind 75% of ova in IVth and Vth stage of development. The process was repeated till the stock of ova was exhausted through a long protracted but single spawning period of 9 months from July to March, sheding ova in small batches. Small testis of the males with little milt also suggests that the males were not capable of fertilizing a large number of ova at a time. Breeding occured in small intervals and also close a position of males and females were necessary for breeding. Through a long season they fertilized the ova repeatedly in sparts. Long spawning season may also be due to maturation of different batches of fishes in succession. These findings are in conformity with Egglestone (1972). Appearance of this fish in fishery at 115 mm length (Acharya, 1980) and nonavailability of females in oozing condition supported what Kuthalingam (1971) suggested that during spawning the fishes migrate to deep sea.

Kuthalingam (1971), Krishnamoorthi (1971) and Egglestone (1972), observed breeding of this fish at Portonovo, in Andhra-Orissa coast and in the northern part of the South China sea during the period December-January, November-March and May-October respectively. Difference in spawning season observed with that of Egglestone (1972), is mainly due to difference in ecological conditions between the tropical Indian Ocean and temperate South China Sea, and with that of Krishnamoorthi (1971), is mainly due to fluctuations in the weather conditions during the years of observation and also due to difference in geographical locations of the places of observations. According to Pillay (1954), who worked on *Mugil tade* for three years which have similar prolonged breeding season found that actual commencement of breeding season may fluctuate from year to year.

Fig. 2 indicates the size attained by *N. japonicus* off Bombay coast at its first maturity and at 50% level. Females having yolk laden ova of IVth stage commenced appearance in the sample in 110-120 mm length group and dominated in samples upto 180-190 mm length with gradual increase in percentage with concomitant increase in total length. Females over 190 mm were in recovering stages. The perpendicular drawn at 50% level on Y axis intersected the perpendicular drawn on X axis at 135 mm, indicating that females of *N.*

and spent (IV). The selected eight stages in female were immature (I), maturing (II), early mature (III), late mature (IV), ripe (V), oozing (VI), spent (VII) and spent recovering (VIII).

As it was not possible to differentiate sexes in fishes below 90 mm in total length even under microscope, 242 males and 244 females ranging 90-260 mm in total length whose sex could be determined undoubtedly have been considered for study of sex ratio.

Monthwise and length groupwise male-female sex ratio was determined by dividing the number of females with the number of males collected during different months and also forming different length groups respectively.

Period of spawning was determined from the availability of females of penultimate stages to the appearance of spent fishes in maximum percentages in the sample during the year. Size at 50% maturity level of females was worked out by plotting percentage of mature females (IVth stage and above) against different length groups of females sampled during July to December.

The gonads were preserved in 5% formalin. Spawning periodicity was determined by ova diameter study following Clark (1937) and Prabhu (1956), taking homogeneous samples of 1000 ova from different stages of ovary.

It was difficult to select proper ovary for determination of absolute fecundity because the fish breed over a long period probably in deep sea. Its ovary was observed to remain full with ova of progressive developmental stages. Hence avoiding spawned or immature fishes 16 ovaries of penultimate stages weighing 0.3526 to 3.9030g, collected at the earlier part of the season, from the females weighing 24.8 to 86.3 g in total weight and 119 to 187 mm in total length, were utilised for fecundity studies.

Fecundity was determined by gravimetric method following the simple formula $F=\frac{W}{W1}$ X no. of ova of penultimate stages counted in the sample, where F is fecundity and W and W^1 are total weight and sample weight of ovary in g respectively. Relation between fecundity and total weight of fish, fecundity and total length of fish, fecundity and total ovary

Table I : *Occurance of females of N. japonicus (%) in different stages of maturity during April 1977 to March 1978.*

Months	Stage I	Stage II	Stage III	Stage IV	Stage V	Stage VI	Stage VII	Stage VIII	No. of samples taken
Apr. '77	94.73	5.26	-	-	-	-	-	-	19
May	89.47	10.52	-	-	-	-	-	-	19
June	95.23	4.76	-	-	-	-	-	-	21
July	-	5.88	52.94	17.64	23.52	-	-	-	17
Aug.	19.04	38.09	23.80	14.28	4.76	-	-	-	18
Sept.	-	3.70	33.33	33.33	29.62	-	-	-	27
Oct.	-	-	4.76	61.90	28.57	4.76	-	-	21
Nov.	11.11	5,55	-	11.11	16.65	-	16.66	38.88	19
Dec.	-	-	4.54	-	-	-	18.18	77.27	22
Jan. '78	52.38	19.04	4.76	4.76	14.28	-	4.76	-	21
Feb.	77.27	9.09	-	-	4.54	-	4.54	4.54	22
Mar.	86.66	6.66	-	-	-	-	6.66	-	15

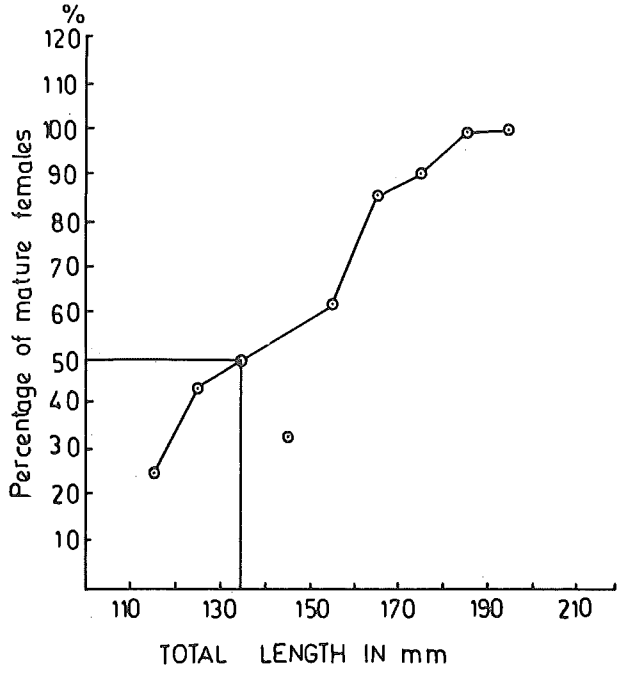

Fig. 2. *Relation between length and maturity in females at 50% level*

japonicus off Bombay coast commenced to mature at 115 mm and 50% of these mature as early as at 135 mm. Length frequency studies (Acharya, 1980) indicated growth of this fish as 165 mm in one year. 50% maturity being at 135 mm *N.japonicus* off Bombay coast started to breed within one year of its life. Krishnamoorthi (1971) observed 50% maturity at 165 mm at Andhra-Orissa coast which is not in agreement with the present observation, whereas Egglestone (1972), observed this fish to breed within one year of its age at below the length of 140 mm in the northern part of the South China Sea. Sea around India being warmer, growth of fish and development of gonad off Bombay coast at 135 mm is quite logical.

Ratios of males were higher than their counterpart in 120-130, 170-180, 190-200 and 200-210 mm length groups, females dominated over males in length groups 90-100, 100-110, 110-120, 130-140, 140-150, 150-160 and 180-190 mm (Fig. 3). In the length groups 160-170 and in 210-220 mm, male female ratio were 1:1. Length groupwise male female ratio never went beyond 1:2 rather it was confined within the range of 1:0.66 to 1:1.50 except in length group 90-100 where females were twice the number of males. This might be due to faster growth of males in 90-100 mm length group than females. For the same reason i.e. due to lesser growth of females than males or due to migration of larger females to deep seas, above 220 mm there was no female although male as large as 285 mm could be sampled from Sassoon Dock, Bombay.

Monthwise fluctuations (Fig. 4) in male female ratio indicated that in most of the

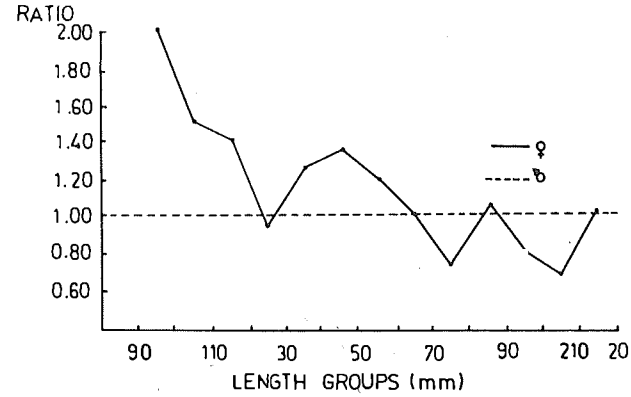

Fig. 3. *Male female sex ratio (length group wise)*

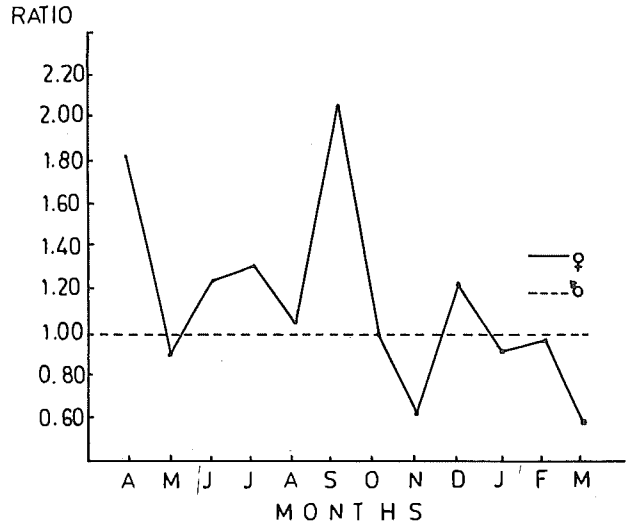

Fig. 4. *Male female sex ratio (monthwise)*

months ratio was confined within a narrow range of 1:0.57 to 1:1.30, except in the months of April (1:1.8) and in September (1:2.07), females became nearly and more than double in proportion respectively. Possible reason for increase in the ratio of males in the catch from October onwards upto March, might be due to migration of larger females to deeper sea. Data when pooled for the

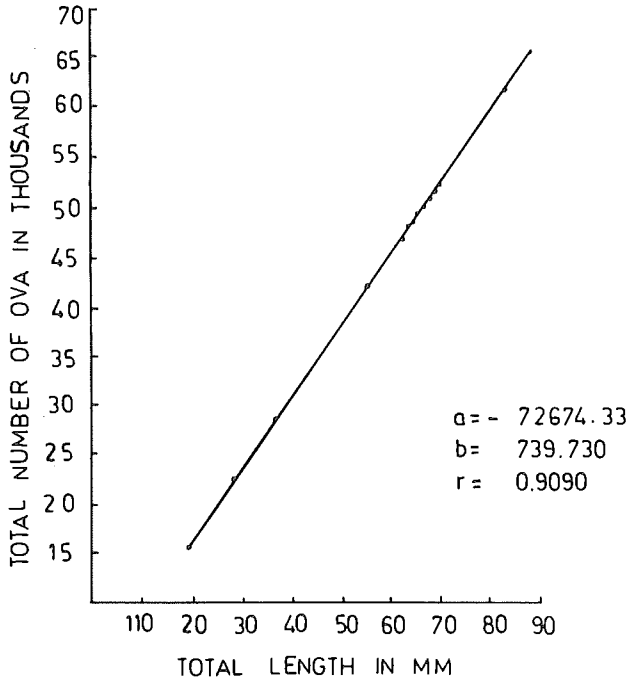

Fig. 5. *Relationship between total length of fish and fecundity.*

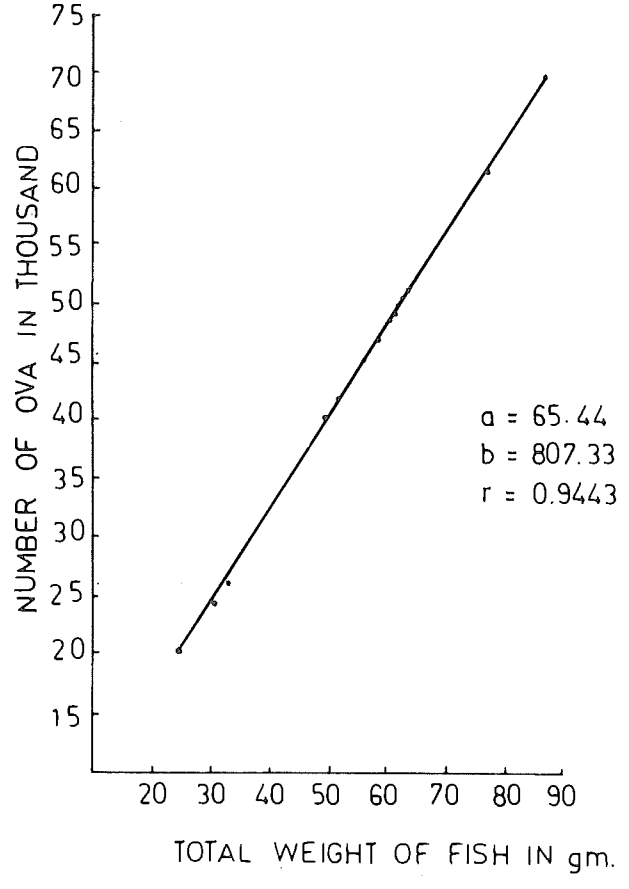

Fig. 6. *Relationship between total weight of fish and fecundity.*

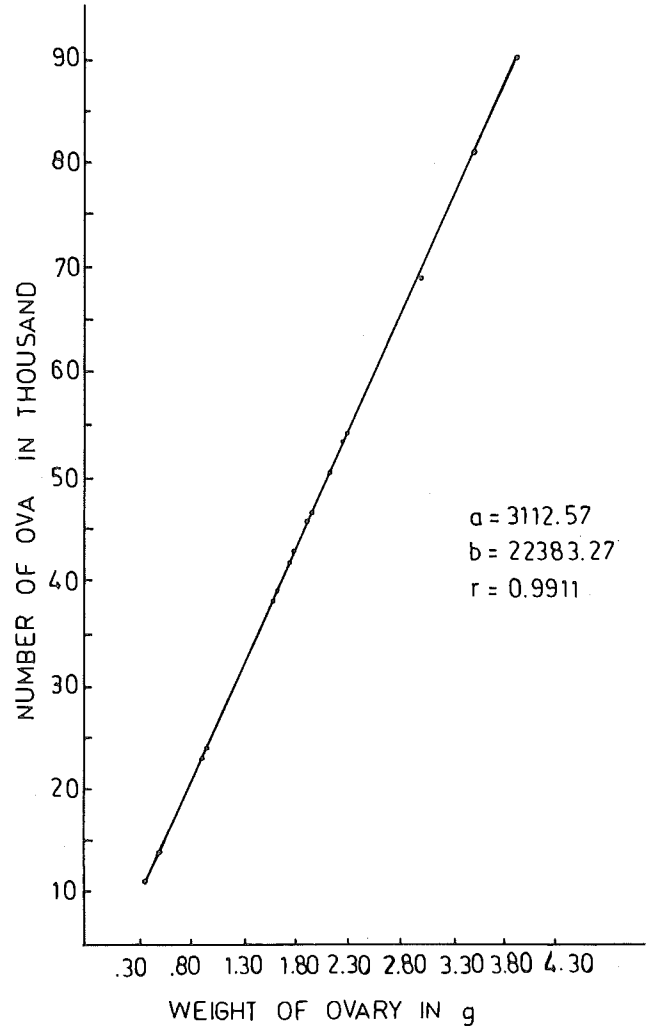

Fig. 7. *Relationship between ovary weight and fecundity.*

whole year, male female ratio was observed to be nearly equal (1:1.0082).

Total number of mature ova in the mature ovaries of *N. japonicus* off Bombay coast ranged from 5,578 to 93,948 nos. Relation between total length of fish and fecundity; total weight of fish and fecundity and total ovary weight and fecundity were worked out to be

$F = (-72674.33)\ L^{739.730}$; $F = 65.44\ W^{807.33}$ and $F = 3112.57\ W^{22383.27}$

where 'F' is fecundity 'L' is the total length, W and W_1 are total weight of fish and total ovary weight respectively. In case of fecundity per g fish weight the relationship was calculated to be

$F = 467.85\ W^{4.96}$.

Figures 5-8 depict their relationships. Coefficient of correlation (r) values of the relationships

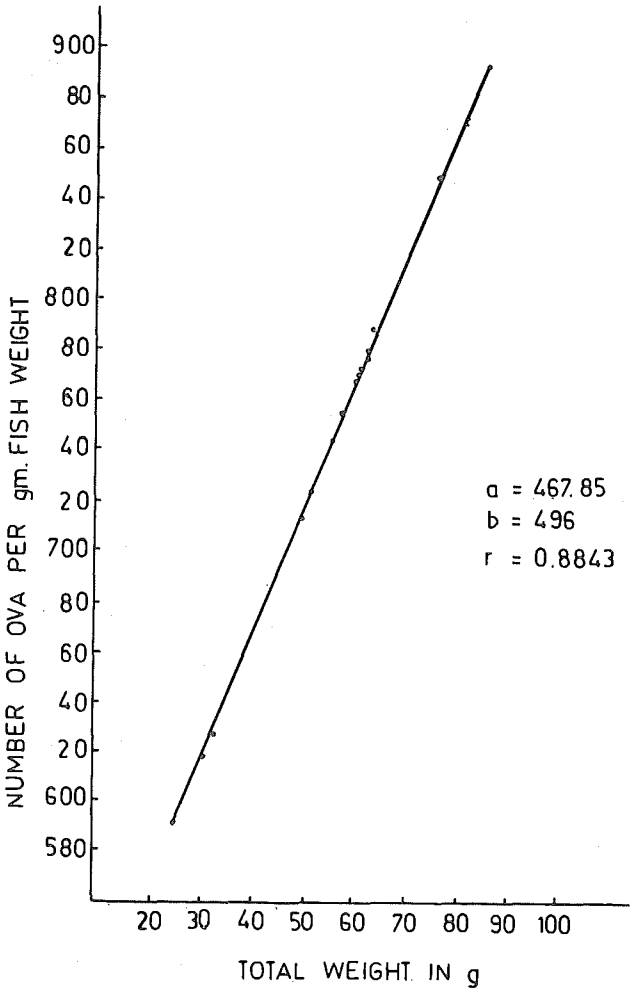

Fig. 8. *Relationship between total weight of fish and number of ova per gm. fish weight.*

0.9090, 0.9443, 0.9911 and 0.8843 indicated that good degree of correlations existed in between the compared characteristics.

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