



Fishery of threadfin breams along Saurashtra coast (Gujarat), and some aspects of biology of *Nemipterus japonicus* (Bloch, 1791) and *N. mesoprion* (Bleeker, 1853)

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Abstract

During 1997-2002, threadfin breams contributed 10% to the annual average landings by trawlers at Veraval and Mangrol. Peak landing of 26,457 t was observed in 2000, with a catch rate of 11.6 kg per hour. *Nemipterus japonicus* and *N. mesoprion* dominated the threadfin bream fishery along this coast. The length range of *N. japonicus* and *N. mesoprion* in the landings was 60-390 mm and 80-280 mm respectively. Occurrence of larger individuals was more during October-January. Females dominated the catches. The size at first maturity was estimated as 141 mm for *N. japonicus* and 135 mm for *N. mesoprion*. The spawning peak in *N. japonicus* was found to occur during September-December, with a secondary peak in May. *N. mesoprion* had a prolonged spawning period extending from October to March. The constants of length-weight relationships derived were $a = 0.0000427$; $b = 2.777$ and $a = 0.0000983$; $b = 2.626$ for male and female *N. japonicus*, respectively and $a = 0.0000281$; $b = 2.895$ and $a = 0.0000277$; $b = 2.898$ for male and female *N. mesoprion*, respectively. The relationships were found to be significantly different between sexes in both the species.

Keywords: Threadfin breams; *Nemipterus japonicus*; *N. mesoprion*; Saurashtra coast; fishery biology

Introduction

Fishes of the family Nemipteridae are important constituents of the trawl landings in Gujarat. The bulk of the threadfin bream catch is formed by *Nemipterus japonicus* (Bloch, 1791) and *N. mesoprion* (Bleeker, 1853). *N. delagoae* Smith, 1941 also occurs occasionally. Monocle breams and dwarf monocle breams occur as stray landings in the winter months. The threadfin bream landing in Gujarat has shown a phenomenal increase over the past decade (Kizhakudan *et al.*, 2003; Nair *et al.*, 2003) and this resource contributes nearly 30% to the marine fish landings by trawlers in Gujarat. Information on threadfin bream fishery and population characteristics from the Gujarat coast is restricted to the works of Raje (1996) and

Manojkumar (2004). Vivekanandan (2001a, b) described the predatory behaviour and production efficiency of *N. japonicus* in the trawling grounds off Veraval.

The coastal districts of Junagadh and Porbandar in Saurashtra account for more than 60% of the marine fish landings and 80% of the trawl landings of the state (Kizhakudan *et al.*, 2001). Of the three important trawl landing centres, *viz.*, Veraval, Mangrol and Porbandar, the first two together accounts for nearly 40% of the landings. This paper provides information on the fishery of threadfin breams along the Saurashtra coast during the period 1997-2002, by commercial trawlers operating from Veraval and Mangrol landing centres. The length-weight relationship and some aspects of

reproductive biology of *N. japonicus* and *N. mesoprion* are also discussed.

Materials and methods

Data on catch, effort and species composition were collected from the trawl landing centres at Veraval and Mangrol. Biological data was collected from April 1998 to March 2002 for *N. japonicus* and from April 2000 to March 2003 for *N. mesoprion*. Fish samples for biological observations were collected once every fortnight. Fishing activities along the coast remain suspended every year during the monsoon months of June, July and August. Hence, no biological data could be collected during these months.

The length (mm) – weight (g) relationship for male and female of the two species was estimated separately by regression after logarithmic transformation (Snedecor, 1961) to obtain coefficients 'a' and 'b' for the exponential equation $W=aL^b$. For *N. japonicus*, the length and weight data of 472 males in the length range of 85-300 mm and weight range of 6-320 g and 561 females in the length range of 90-325 mm and weight range of 11-380 g were analysed. For *N. mesoprion*, 311 males in the length range of 95-230 mm and weight range of 15-200 g, and 534 females in the length range of 95-250 mm and weight range of 15-235 g were analysed. Monthly sex ratio (number of females for every male) was studied using Chi-square test (Fisher, 1970). A total of 3430 specimens of *N. japonicus* and 1916 specimens of *N. mesoprion* were used for the study. Ovarian development was classified into seven stages (Immature - I, early maturing - II, maturing - III, mature - IV, ripe - V, spawning - VI and spent - VII), following Thomas (1969). For assessing the size at first maturity and spawning period, 1964 females of *N. japonicus* and 845 females of *N. mesoprion* were analysed. The size at first maturity was arrived at by plotting the percentage of mature females (females in ovarian stages III and above) against total length (Thomas, 1969). The spawning period was assessed from the monthly distribution of mature females (females in ovarian stages III and above) and ripe/spawning females (females in ovarian stages V & VI).

Results and Discussion

Fishery: The annual average landings of threadfin breams by trawlers at Veraval and Mangrol during the period 1997-2002 was 12,990 t, with peak landing of 26,457 t in 2000 (Fig. 1). During this period, the threadfin breams formed

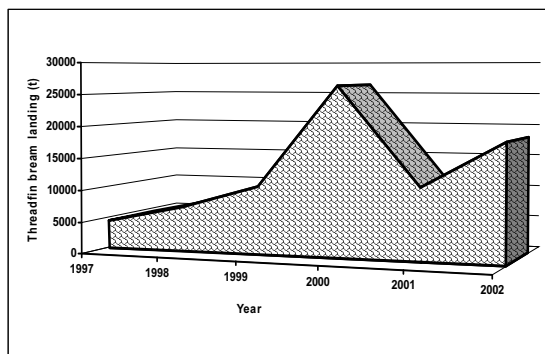


Fig. 1. Threadfin bream landing (tonnes) by trawlers at Veraval and Mangrol during 1997-2002

about 10% of the annual average trawl landings with the contribution increasing from 3.4% in 1997 to 20.4% in 2002 (Fig. 2). Maximum fish catch during the years 1997 to 2002 was recorded in 2000. The CPUE ranged from 35.5 kg/unit in 1997 to 369.8 kg/unit in 2002 and the CPH ranged from 3.3 kg/hour in 1997 to 9.1 kg/hour

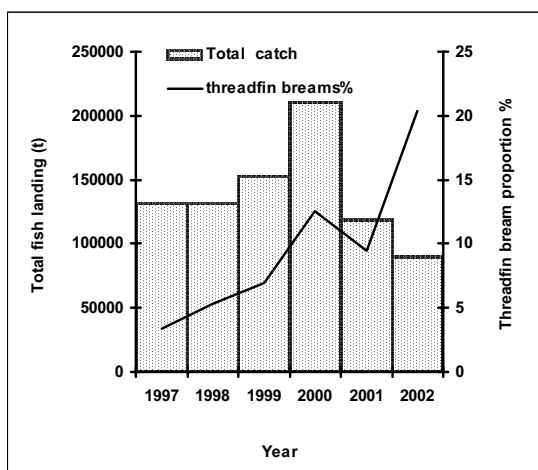


Fig. 2. Total marine fish landing (tonnes) by trawlers at Veraval and Mangrol (1997-2002) and relative proportion of threadfin breams (%)

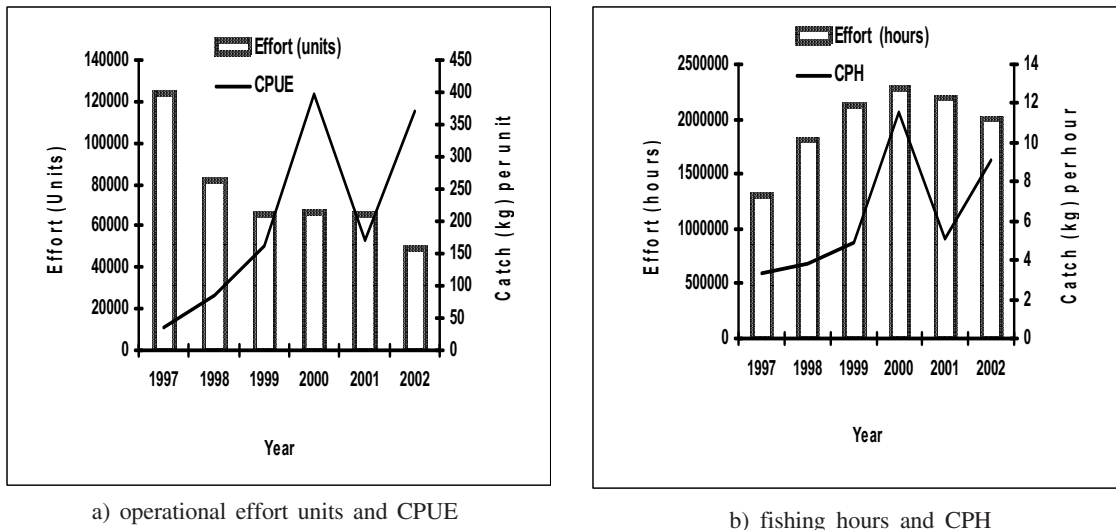


Fig. 3. Annual fishing effort and catch rate of threadfin breams landed by trawlers at Veraval and Mangrol

in 2002. The maximum CPUE (397.9 kg/unit) and CPH (11.6 kg/hour) were recorded in the year 2000. The fishing effort (in terms of units of operation) decreased greatly from 1, 24,134 units in 1997 to 49,455 units in 2002 (Fig. 3a). The number of fishing hours on the other hand, increased from 13,18,476 in 1997 to 20,17,766 in 2002 (Fig. 3b).

The average monthly landing of threadfin breams during the years 1997 to 2002 was the highest in December (28% of the annual landings), followed by November (21%). Maximum fishing activities take place during the postmonsoon and winter months of October to January and the peak landings of threadfin breams were recorded during this period. The diversion of trawling activities along the Saurashtra coast from the mid-1990s towards deeper fishing grounds (80 – 120 m depth), primarily for the exploitation of cephalopods, brought in higher catches of threadfin breams. This in turn led to the establishment of a surumi plant at Porbandar, in addition to an already existing one at Chorwad (near Mangrol). The high landings along the Saurashtra coast in the year 2000 resulted in Gujarat contributing the maximum (45,642 t) to the all-India nemipterid catch in that year (Murty *et al.*, 2003).

Species composition: The contribution of *N. japonicus* to the average annual threadfin bream

catch was the highest in the year 1998 (73.6%) and thereafter, it declined steadily to 21.4% in 2002. *N. mesoprion*, on the other hand, increased from 24.3% in 1998 to 78.0% of the threadfin bream catch in 2002. The dominance of *N. japonicus* was suppressed by the increase in the quantum of *N. mesoprion* from the year 2001 (Fig. 4.). The maximum contribution of *N. delagoae* (5.7%) was observed in the year 2000.

Length composition: The catch of *N. japonicus* comprised of fishes in the length range of 60 – 390 mm. The mean length ranged from 111.5 to 212.3 mm, and larger individuals were dominant during October - January (Fig. 5a).

The length range of *N. mesoprion* in the commercial catch was 80 – 280 mm. The mean length ranged between 120.6 mm and 175.3 mm. As in the case of *N. japonicus*, the larger individuals were dominant during October - January (Fig. 5b).

A correlation between the body length of nemipterids and depth of occurrence has been reported from the South China Sea (Pauly and Mortosubroto, 1980), Arabian Sea along the Cochin coast (Nair and Jayaprakash, 1986), Madras coast (Vivekanandan, 1991) and the coastal waters of Malaysia (Weber and Jothy, 1977). The availability of relatively larger fish during the period October

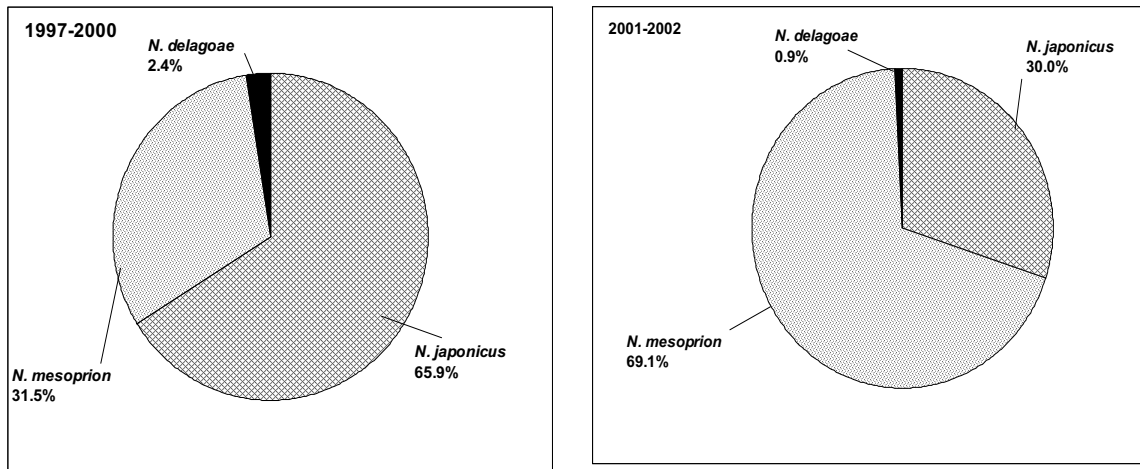
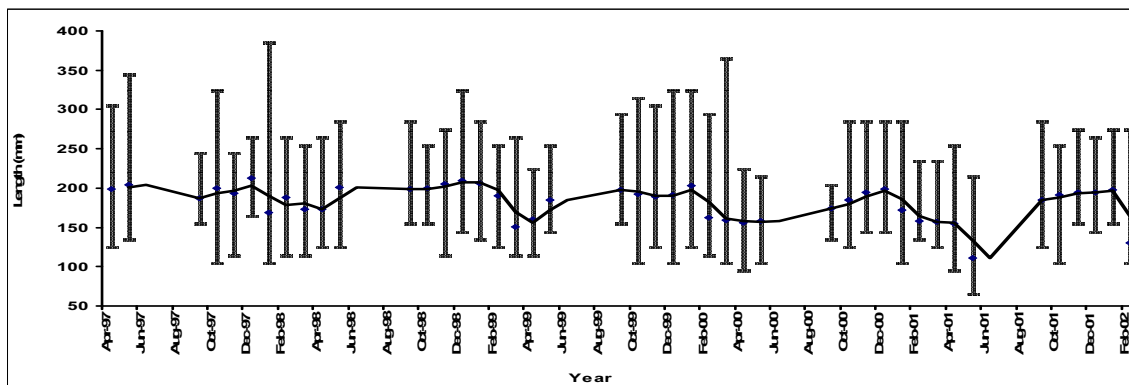
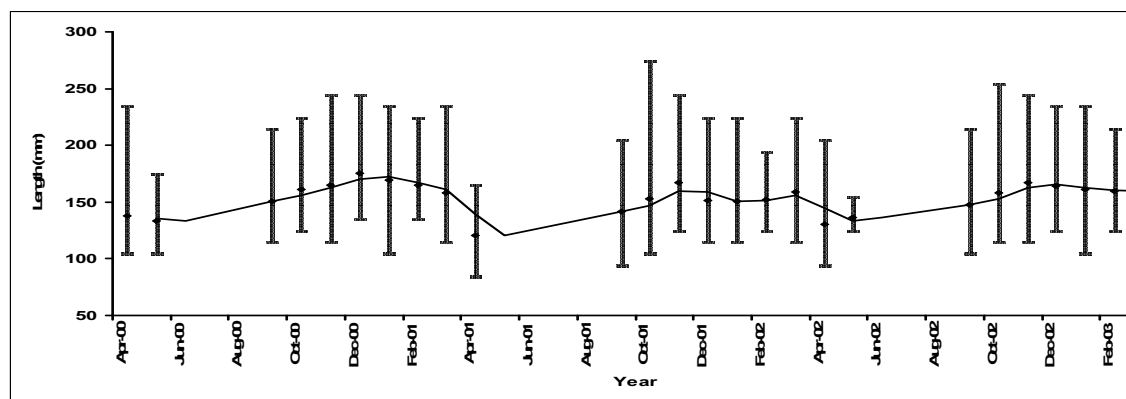


Fig. 4. Change in composition of threadfin bream landings by trawlers at Veraval and Mangrol



a) *N. japonicus*



b) *N. mesoprion*

Fig. 5. Monthly mean length and length range of threadfin breams in the trawl landings at Veraval and Mangrol (April 1997-March 2002)

to January in the present study coincides with the peak fishing activities along the Saurashtra coast, particularly in deeper waters (beyond 80 m depth). Nair and Jayaprakash (1986) attributed the high monsoon landings of threadfin breams along the Kerala coast to the movement of these fishes from relatively deeper waters into the shallow depths following upwelling. Joshi (2005) observed the dominance of larger fish in the monsoon months.

Sex ratio: Females dominated the catches of *N. japonicus* in most of the months during the period of study, except in April '98, March '99, October-December '99, April-May 2000 and April-May 2001. Chi-test on the average monthly male-female sex ratio for the period April 1998-March 2002 revealed the ratio to be highly significant in all the months except in April and May (Table 1a). Manojkumar (2004) reported the dominance of females in the trawl landings of *N. japonicus* at Veraval during 1994-'95.

Males dominated the catches of *N. mesoprion* in almost all the months during the period from

Table 1 a. Average monthly sex ratio of *N. japonicus* in trawl catches along Saurashtra coast (April 1998 – March 2002)

Month	Number of fish examined	Number of Males	Number of Females	Sex Ratio M : F	χ^2 value
January	347	137	210	1:1.53	15.36*
February	440	169	271	1:1.60	23.65*
March	400	160	240	1:1.50	16*
April	412	219	193	1:0.88	1.64
May	203	105	98	1:0.93	0.24
June	0				
July	0				
August	0				
September	204	73	131	1:1.79	16.49*
October	420	177	243	1:1.37	10.37*
November	410	175	235	1:1.34	8.78*
December	594	251	343	1:1.37	14.25*

*Significant ($P = 0.01$)

April 2000 to March 2003, except from December 2000 to March 2001, December 2002 and March 2003. Chi-test on the average monthly male-female sex ratio for the period April 2000-March 2003

revealed that the ratio was highly significant in May, September, October and November (Table 1b). The predominance of males in the trawl catches of *N. mesoprion* has been reported by Raje (1996) off Veraval, Rao (1989) off Waltair (Visakhapatnam), Zacharia and Nataraja (2003) off Mangalore-Malpe and Manojkumar (2007) along Malabar coast.

Size at maturity: The length at which 50% of the females attain first maturity was estimated as

Table 1b. Average monthly sex ratio of *N. mesoprion* in trawl catches along Saurashtra coast (April 2000 – March 2003)

Month	Number of fish examined	Number of Males	Number of Females	Sex Ratio M : F	χ^2 value
January	224	124	100	1:0.81	2.57
February	220	121	99	1:0.82	2.20
March	231	117	114	1:0.97	0.04
April	352	187	165	1:0.88	1.48
May	74	49	25	1:0.51	7.78*
June	0				
July	0				
August	0				
September	217	136	81	1:0.60	13.94*
October	205	123	82	1:0.67	8.20*
November	160	97	63	1:0.65	7.23*
December	233	117	116	1:0.99	0.05

*Significant ($P = 0.01$)

141 mm for *N. japonicus* (Fig. 6a). Manojkumar (2004), from a study during January 1994 – December 1995, reported the length at first maturity of *N. japonicus* as 183 mm off Veraval. Murty (1984) and Rajkumar *et al.* (2003) reported the length at first maturity as 125 mm and 128 mm off Kakinada and Visakhapatnam, respectively. Vivekanandan and James (1986) reported the same as 145 mm off Madras. Krishnamoorti (1971) had observed the length at first maturity of *N. japonicus* off Visakhapatnam to be as high as 165 mm. This however, may be due to the fact that the author had considered only fishes of maturity stage V and above as mature. In the present study females in the length range of 90-325 mm were analysed and late maturing and mature ovaries were observed in females above 100 mm length.

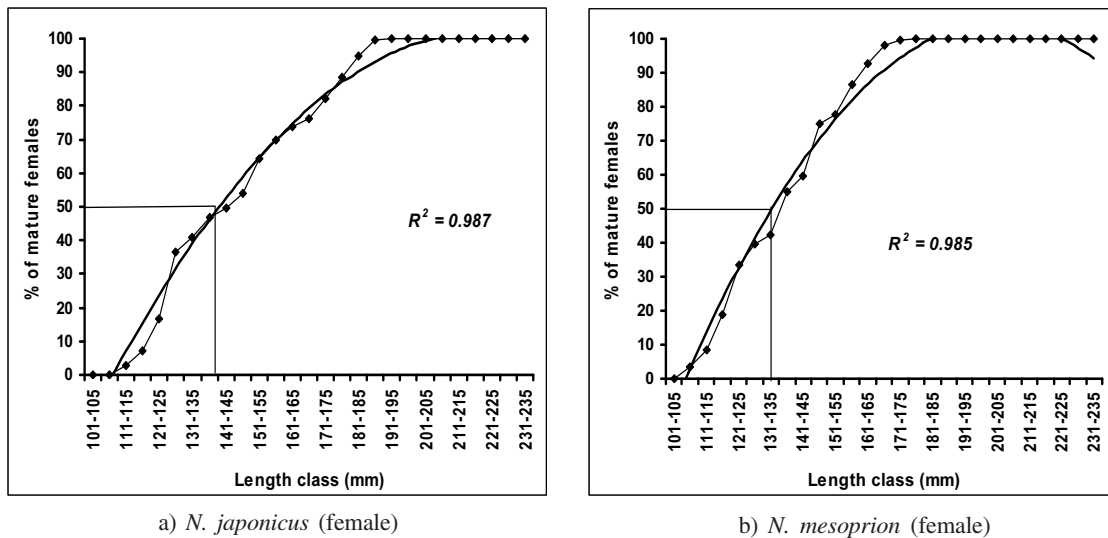


Fig. 6. Size at first maturity of threadfin breams

The length at first maturity was estimated as 133 mm for *N. mesoprion* (Fig. 6b). Raje (1996) reported the length at first maturity of *N. mesoprion* off Veraval as 134 mm. Murty (1981) reported the same as 100 mm off Kakinada, while Vivekanandan (1991) and Zacharia and Nataraja (2003) reported the length at first maturity as 115 mm off Madras and Mangalore, respectively. Joshi (2005) estimated the length at first maturity of *N. mesoprion* as 106 mm off Cochin and Manojkumar (2007) reported the value as 128 mm along the Malabar coast. Apte (1998) reported a very high value of 150 mm as the length at first maturity of *N. mesoprion* off Bombay. Joshi (2005) has reported the presence of mature ovaries in fishes above 95 mm total length (off Cochin). In the present study, late maturing and mature ovaries were observed in fish above 100 mm total length and all fishes above 170 mm were mature.

Spawning period: The monthly distribution of immature (ovarian stages I & II) and mature (ovarian stages III and above) females in the samples of *N. japonicus* reveals the dominance of mature fishes in the postmonsoon months of September to December, at times extending upto February (Fig. 7a). With the exception of May 1999 and March 2002, the occurrence of ripe and spawning fishes was maximum during these months, indicating

protracted spawning activity of this species along the Saurashtra coast with a major peak during the post monsoon months from September to December and a minor spawning peak in May.

The monthly distribution of ovarian maturity stages in the samples of *N. mesoprion* reveals the presence of ripe and spawning fishes from September to March and the presence of spent fishes in January, March and December (Fig. 7b). This clearly indicates the prolonged spawning by *N. mesoprion* along the Saurashtra coast, extending from October to March. The catches in April were dominated by immature fishes or those in the early stages of maturation. The occurrence of spent females coincides with the dominance of ripe and spawning females in January, March and December, indicating peak spawning activity during these months. Prolonged spawning periods with more than one major spawning spell has often been reported in this species. Zacharia and Nataraja (2003) reported a prolonged spawning season (August-November and January-May) for *N. mesoprion* along Mangalore-Malpe coast. Based on the variations in GSI, they concluded that the main spawning periods were September-December and March-April. Murty *et al.* (1992) reported that spawning in *N. mesoprion* takes place throughout the year along the Bombay coast, with peak

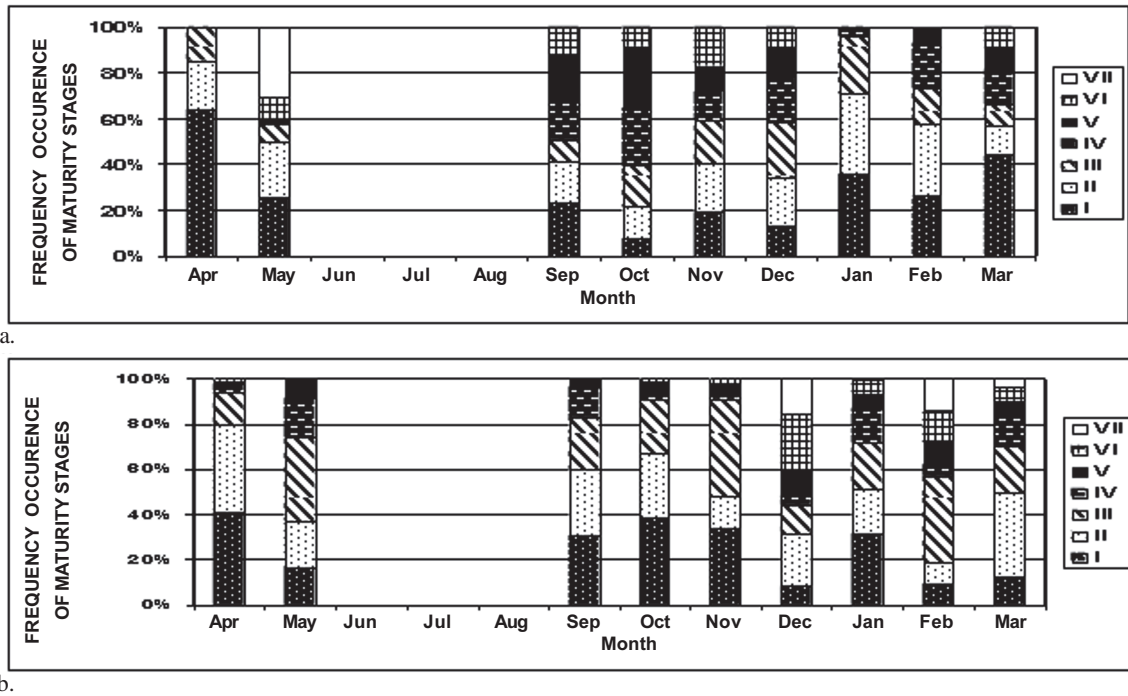


Fig. 7. Monthly distribution (%) of different maturity stages in threadfin breams a) *N. japonicus* (female); b) *N. mesoprion* (female)

spawning during June-August, while along the Veraval coast, *N. mesoprion* spawns from October to March, with peak during December-February. Vivekanandan (1991) also reported two spells of spawning activity in *N. mesoprion* along the Madras coast with a period of intense spawning during February-March and a mild spawning spell during August-October.

Length-weight relationship: The length weight equations obtained for male and female *N. japonicus* are as follows :

Male : $W = 0.0000427 L^{2.777}$ (r = 0.93)

Female : $W = 0.0000983 L^{2.626}$ (r = 0.92)

ANCOVA, following Snedecor (1961) revealed that the slopes and elevation of the two regression lines differ significantly ($\alpha = 0.05$) (Table 2a).

The length weight equations obtained for male and female *N. mesoprion* are as follows:

Table 2a. Comparison of length-weight regression of male and female *N. japonicus* by Analysis of Covariance

Source	d.f.	Deviation from regression	
		d.f.	MS
Males	471	470	0.0083
Females	560	559	0.0061
Pooled		1029	0.0071
Common	1031	1030	0.0071
Regression coefficients		1	0.0333
Total	1032	1031	0.0072
Adjusted means		1	0.1049

Comparison of slope: 4.699 ($F = 3.851$; $\alpha = 0.05$, 1, 1029 d.f.) significant

Comparison of elevation: 14.733 ($F = 3.851$; $\alpha = 0.05$, 1, 1029 d.f.) significant

Male : $W = 0.0000281 L^{2.895}$ ($r = 0.98$)

Female : $W = 0.0000277 L^{2.898}$ ($r = 0.98$)

ANCOVA revealed that the slopes of the two regression lines do not differ significantly ($\alpha = 0.05$) but the elevations differ significantly (Table 2b).

Differential growth in nemipterids has been reported in several instances (Eggleston, 1973).

Table 2 b. Comparison of length-weight regression of male and female *N. mesoprion* by Analysis of Covariance

Source	d.f.	Deviation from regression			
		d.f.	SS	MS	
Males	310	2.8947487	309	0.0017	0.0000055
Females	533	2.8983335	532	0.0014	0.0000026
Pooled			841	0.0031	0.0000037
Common	843	2.896915	842	0.0031	0.0000037
Regression coefficients			1	0.0000106	0.0000106
Total	844	2.8987927	843	0.0038	0.0000045
Adjusted means			1	0.007	0.0007

Comparison of slope: 2.884 ($F = 3.853$; $\alpha = 0.05$, 1,841 d.f.) Not significant

Comparison of elevation: 188.4 ($F = 3.853$; $\alpha = 0.05$, 1,841 d.f.) Significant

Krishnamoorthi (1976) found significant difference in the length-weight relationships derived for male and female *N. japonicus* caught from the Andhra-Orissa coast. Males were found to grow to larger sizes. Significant difference between the sexes was also found in the monthly mean size that occurred in the catches. Zacharia and Nataraja (2003) reported significant difference in the elevations of the length-weight relationships derived for male and female *N. mesoprion* exploited from the Mangalore-Malpe coast. Results of the present study are indicative of differential growth between sexes in both *N. japonicus* and *N. mesoprion* along the Saurashtra coast.

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