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Reproductive Biology of the Japanese Threadfin Bream, *Nemipterus japonicus*, in the Northern of Persian Gulf

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Abstract: Since the *N. japonicus* comprises the most abundant commercial fish in the Persian Gulf, an evaluation of the stock status of this species is needed. Reproductive biology of *Nemipterus japonicus* in the northern part of Persian Gulf is described, based on 595 specimens collected between November 2006 and October 2007. Length range of females was 11.0-26.3 cm FL and their weight range was 21.7-325.65 g. Males ranged from 9.4-27.3 cm FL and 14.04-351.89 g in weight. The relationship between Body Weight (BW) and Fork Length (FL) for all individuals was estimated as $BW = 0.0181 \times FL^{3.0001}$ ($r^2 = 0.9797$, $n = 503$). The overall sex ratio was estimated as M: F = 1.0: 2.6. The length at 50% maturity was estimated to be 19.1 cm for females and 19.6 cm for males. The smallest size at first maturity was 9.4 cm for males and 11.0 cm for females. The spawning behavior was investigated based on macroscopic observations of gonads and determination of gonadosomatic index. The maximum GSI values were recorded in April (2.70%) and September (0.45%) for females and males, respectively. Spawning occurs in spring and autumn seasons.

Key words: *Nemipterus japonicus*, reproduction, maturity, Persian Gulf

INTRODUCTION

The Japanese Threadfin Bream, *Nemipterus japonicus*, (Nemipteridae) is a demersal species, very abundant in coastal waters, found on mud or sandy bottoms in 5 to 80 m, usually in schools. It has a wide distribution from the Red Sea and eastern shores of Africa to the Philippines and Japan. It is one of the major species in the southern Red Sea (Ben-Yami, 1964) and in the Gulf of Suez (Ben-Tuvia and Grofit, 1973). The presence of this fish in the Mediterranean is evidently due to migration from the Red Sea via the Suez Canal (Golani and Sonin, 2006).

The threadfin breams are valued food fishes in many parts of the world and are caught commercially by hook and line and bottom trawl (Puentes-Granada *et al.*, 2004).

Nemipterus japonicus constitutes an important part of the trawl catch in the South China Sea (Eggleston, 1972; Lee, 1974; Weber and Jothy, 1977), Andaman Sea (Senta and Tan, 1975), W. Bay of Bengal (Krishnamoorthi, 1971), Persian Gulf and Oman Sea (Valinassab *et al.*, 2006).

The *N. japonicus* has been studied on the population dynamics (Vivekanandan and James, 1986; Zacharia, 1998; Rajkumar *et al.*, 2003), reproductive biology (Eggleston, 1972; Krishnamoorthi, 1974; Murty, 1984; Bakhsh, 1994; Rajkumar *et al.*, 2003; Manojkumar, 2004), food habits and feeding (Bakhsh, 1994; Manojkumar, 2004; Kerdgari *et al.*, 2009), length-weight relationship (Murty, 1984; Bakhsh, 1994; Zacharia, 1998; Rajkumar *et al.*, 2003; Manojkumar, 2004) and morphology (Russell, 1990). Therefore, the objective of this study was to provide information on the reproductive biology of *N. japonicus* in the North-West of Persian Gulf. The results obtained can be used for stock assessments and fishery management.

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MATERIALS AND METHODS

Monthly samples of *N. japonicus* collected during the period from November 2006 to October 2007. A total of 595 specimens (360 females, 143 males and 92 immature) were caught by bottom trawlers in the northern part of Persian Gulf (Fig. 1). Length measurements of specimens were taken to the nearest 1 mm and body weight and gonads were weighed to the nearest 0.01 g.

The relationship between Body Weight (BW) and Fork Length (FL) was described:

$$BW = a \times FL^b$$

Where:

a = Intercept

b = Slope (Biswas, 1993)

The sex ratio was expressed as male to female.

According to Biswas (1993) the length at which 50% of fish reach sexual maturity (LM_{50}) is considered to be the length of onset of its sexual maturity.

The Gonado-Somatic Index (GSI) calculated as follows:

$$GSI (\%) = \text{Gonad weight (g)} \times 100 / \text{Body weight (g)}$$

A one-way Analysis of Variance (ANOVA) was used to test the homogeneity of GSI among months.

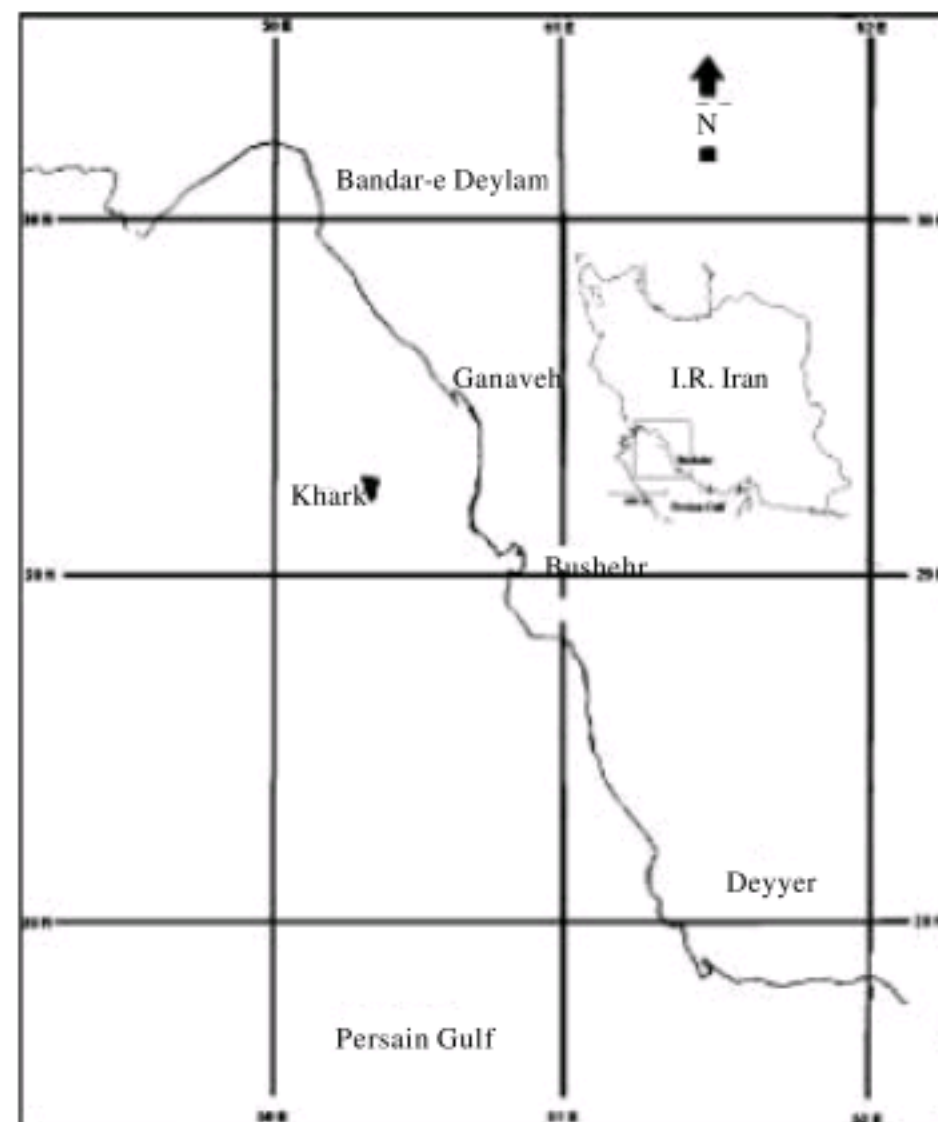


Fig. 1: Position of sampling site

RESULTS

Length-Weight Relationship

The length and weight frequency distributions indicated that males were in the range of 9.4-27.3 cm FL at body weights of 14.04-351.89 g and females were 11.0-26.3 cm FL at body weights of 21.70-325.65 g (Fig. 2, 3).

Relationships between FL and BW were estimated as:

- $BW = 0.0183 \times FL^{2.9924}$ ($r^2 = 0.9857$, $n = 143$) for males
- $BW = 0.0178 \times FL^{3.0073}$ ($r^2 = 0.9767$, $n = 360$) for females
- $BW = 0.0181 \times FL^{3.0001}$ ($r^2 = 0.9797$, $n = 503$) for both sexes combined (Fig. 4)

Sex Ratio

For *Nemipterus japonicus*, in the northern of Persian Gulf, the calculated sex ratio of collected mature samples (360 females, 143 males) was M:F = 1.0: 2.6, which significantly differed from 0.5 ($\chi^2 = 93.616$, $df = 1$, $p < 0.05$). The results indicate that females predominate males throughout the year. The highest percentage of females and males is recorded in February (84.4%), October (47.4%), respectively (Fig. 5).

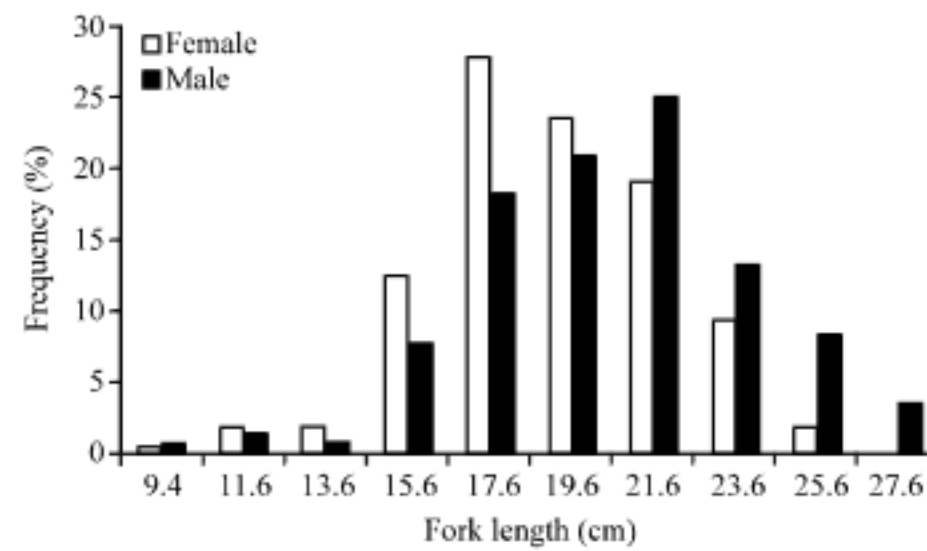


Fig. 2: Frequency distribution of fork length for male and female *N. japonicus* in the Northern of Persian Gulf (Nov. 2006 to Oct. 2007)

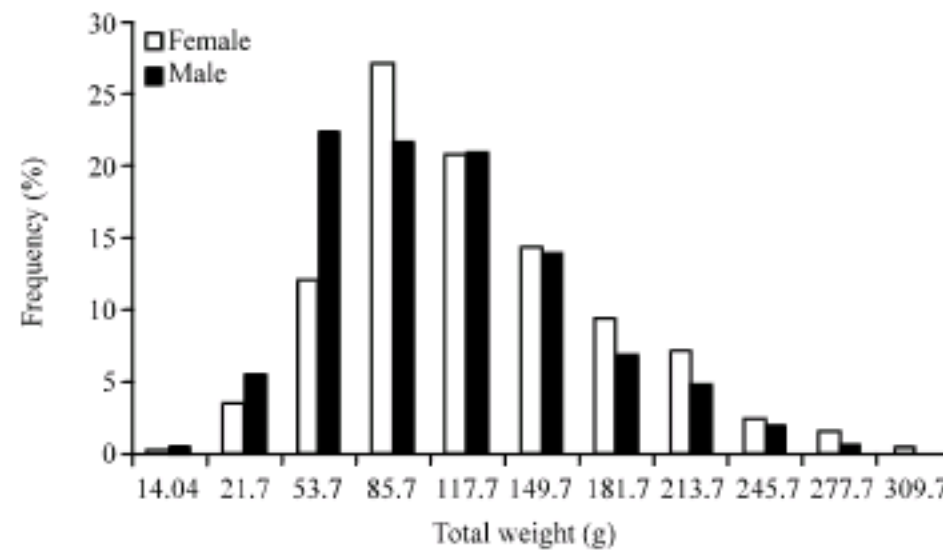


Fig. 3: Frequency distribution of total weight for male and female *N. japonicus* in the Northern of Persian Gulf (Nov. 2006 to Oct. 2007)

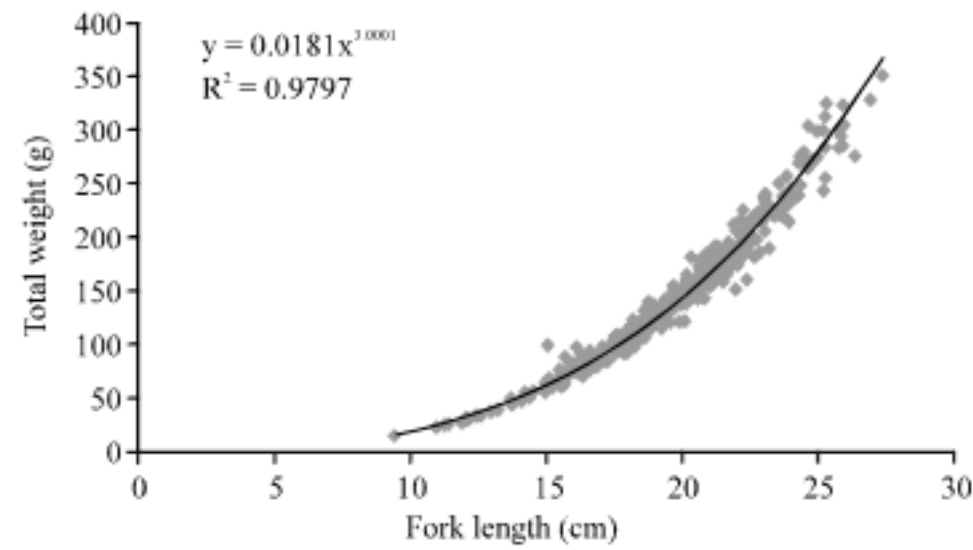


Fig. 4: Relationship between body weight (BW) and Fork Length (FL) of *N. japonicus* (sexes combined)

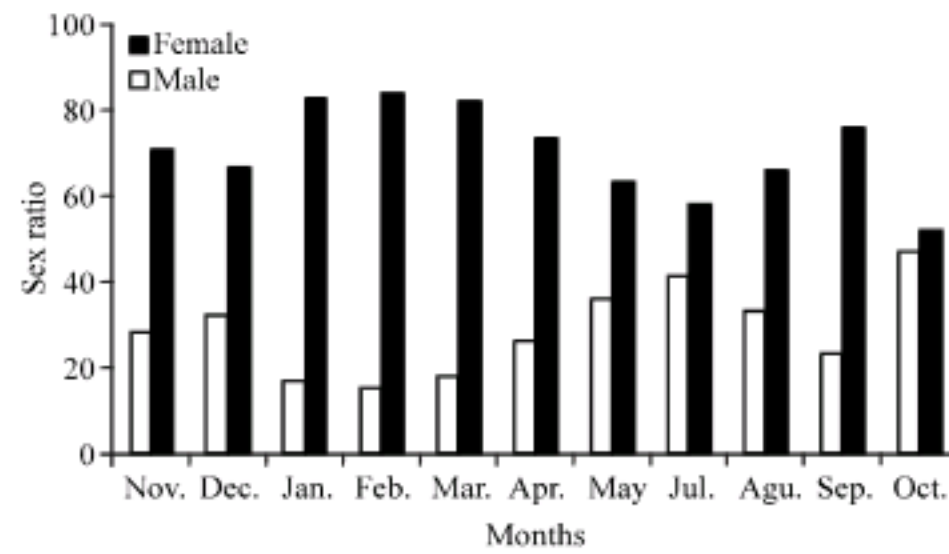


Fig. 5: Monthly variations in sex ratio of *N. japonicus* in the Northern of Persian Gulf (Nov. 2006 to Oct. 2007)

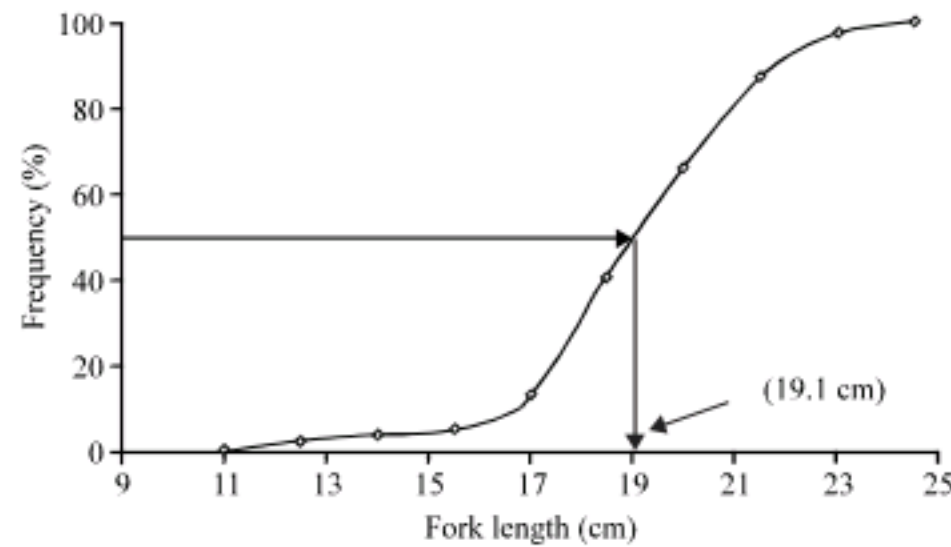


Fig. 6: Length at first sexual maturity for female *N. japonicus* in the Northern of Persian Gulf (Nov. 2006 to Oct. 2007)

Length at First Sexual Maturity

The length of male and female *N. japonicus* at first sexual maturity was determined for each length group. The fork length at 50% maturity was estimated as 19.1 cm for females and 19.6 cm for males (Fig. 6, 7). The smallest ripe female and male was 11.0 and 9.4 cm, respectively. All females larger than 24.5 cm and males than 27.4 cm fork length are mature.

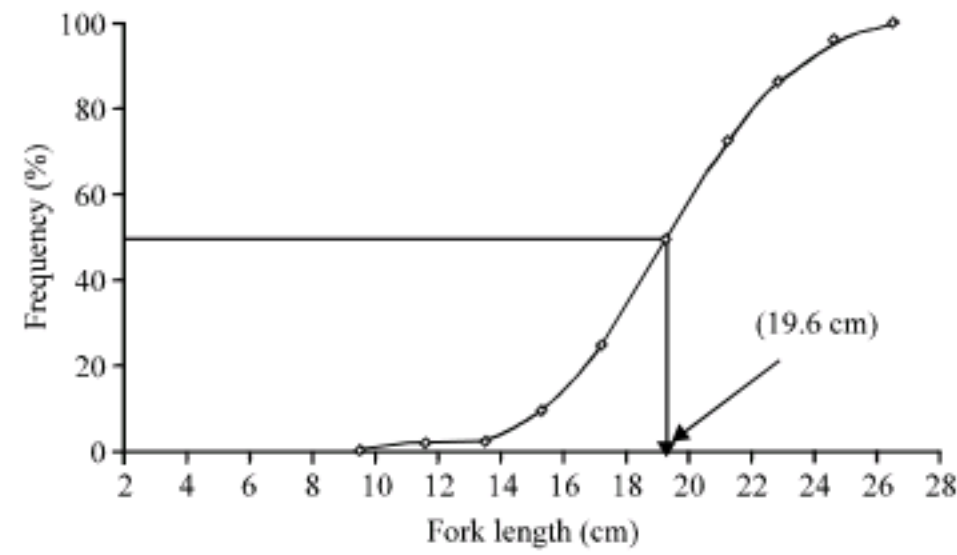


Fig. 7: Length at first sexual maturity for male *N. japonicus* in the Northern of Persian Gulf (Nov. 2006 to Oct. 2007)

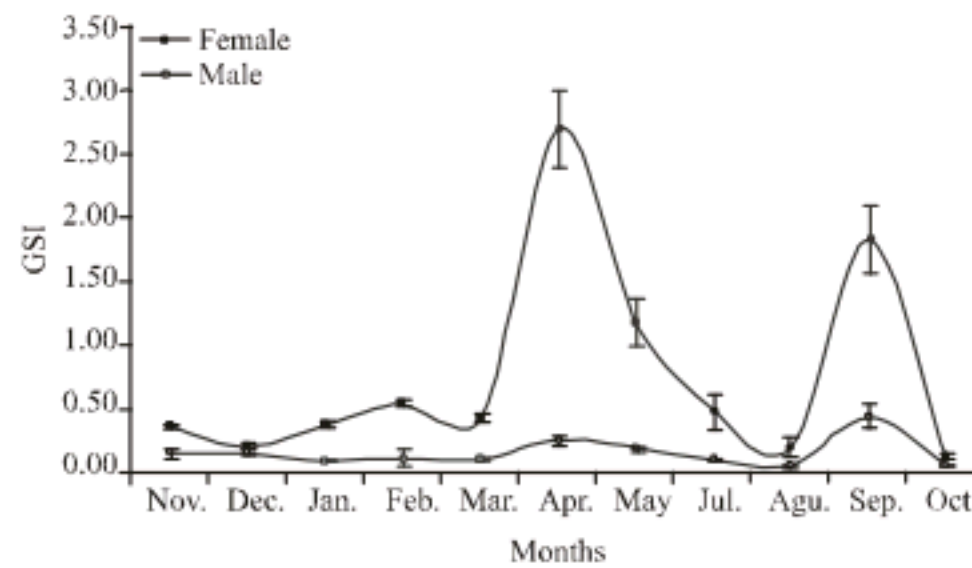


Fig. 8: Monthly variation of the average Gonadosomatic index of *N. japonicus* in the Northern of Persian Gulf

Gonadosomatic Index (GSI)

Monthly variations in GSI of both sexes were quite apparent (Fig. 8). Maximum values in April (2.70) and September (1.84) for females and September (0.45) and April (0.27) for males. Significant differences were detected for GSI among months for both sexes, according to ANOVA ($p < 0.05$). These cyclic changes in GSI indicate two peaks per year (April-May and September).

DISCUSSION

The length-weight relationship (LWR) is an important factor in the biological study and stock assessment of fishes (Abdurahiman *et al.*, 2004). This relationship is helpful for estimating the weight of a fish of a given length in which can be used in studies of gonad development, rate of feeding, metamorphosis, maturity and condition (Le Cren, 1951). Murty (1984) estimated values of slope for males (2.43) and females (2.95) from Kakinda in Indian waters. Bakhsh (1994) found it 2.42 for males and 2.76 for females from the Jizan Region of Red Sea. Mathews and Samuel (1989) found that this value was 2.97 for Kuwait waters whereas Vivekanandan and James (1986) estimated it 2.94 for Madras waters in India. In addition, this value was 2.66 for Karnataka region in India (Zacharia, 1998). Manojkumar (2004) reported it 2.99 from Veraval waters, Gujarat, India. In the present study, slope (b) obtained for males (2.99) and females (3.00) that indicate this species has symmetrical or isometric growth.

In this study, the sex ratio was 1.0:2.6 with percentage of 28 and 72% for male and female, respectively and the females outnumbered the males. Percentage of males was low in all months. In addition, Bakhsh (1994) in the Jizan Region found that the sex ratio of *N. japonicus* was 1.0:1.75 and the females outnumbered the males. Manojkumar (2004) reported the sex ratio between males and females was 1.0:1.01 in the Gujarat, India whereas Murty (1984) has shown that males outnumbered the females in the Kakinada area of Indian waters. In addition, Raje (2002) in the Veraval showed preponderance of males with ratio of 2.2: 1.0. Differences in the sex ratio can be due to ratio of catchability, size, age, longevity, sexual dimorphism, migration and differences in growth and behavior among sexes (Fumio, 1960; Beverton, 1964).

The results showed that the smallest male attained first maturity at 9.4 cm fork length and the smallest female at 11.0 cm fork length this means that males reach first sexual maturity sooner than females. In addition, the percentage of sexual mature fish increases with the increase of fish length. About 50% of males and females were mature at the fork length of 19.6 and 19.1 cm, respectively. Manojkumar (2004) determined sexual maturity of females at length 140 mm and 50% maturity at 183 mm. Rajkumar *et al.* (2003) recorded the length at first maturity was 128 mm. Bakhsh (1994) reported the smallest size at first maturity was 10.0 and 9.5 cm for males and females, respectively. Spawning of *N. japonicus* occurs over an extended period and is reported to take place from May to October in the South China Sea (Eggleston, 1972); Year-around with peak November- May in the Jizan area (Bakhsh, 1994); from November to February in East Malaysian waters (Weber and Jothy, 1977); January and February off coast of Mangalore, India (Kuthalingam, 1965); December to February and June and July at Waltair, India (Dan, 1977); September to November (Krishnamoorthi, 1971); August to April at Kakinada, India (Murty, 1984); November to December and in February at Veraval waters Gujarat, India (Manojkumar, 2004); September to April, with a peak during September-November in Veraval (Raje, 2002); July to April with a peak in September in Visakhapatnam (Rajkumar *et al.*, 2003). In this study, the spawning season extended within 2 peaks, namely April- May and September; on the basis of GSI values and macroscopic observations of gonads. It was found to occur from April- May and September. As a conclusion, *N. japonicus* is a spring and autumnal spawner and main spawning occurs in spring season.

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