Impact of rise in seawater temperature on the spawning of threadfin Breams

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MANY marine organisms have life-histories adapted to seasonal events in the environment. Fish have strong temperature preferences to spawning. Several species of marine fish are known to spawn only at favorable water temperature that is known to trigger the process of spawning activities. The annually recurring events of life-cycle such as timing of spawning can provide particularly sensitive indicators of changes in climatic change. Many evidences of phenological changes are now available for terrestrial organisms. There is now ample evidence of the effects of climatic change on various biota over the last decades, but the literature on the effects of climate on phenological aspects in marine ecosystems is meager (Marshall *et al.*, 2001). A common obstacle limiting marine phenological studies is the requirement of long time-series observations, of which there are few in the ocean because of the considerable effort required. Though sparsely investigated, phenological changes viz. seasonal shift in spawning season, and, as a consequence, early appearance of fish larvae was found in the North Sea (Greve *et al.*, 2005). The year-class size of marine fish is greatly influenced by the timing of spawning and the resulting match and mis-match with their prey and predators. This has been confirmed on the basis of remote sensing and a long-term data set of haddock recruitment (Platt *et al.*, 2003).

The threadfin breams *Nemipterus japonicus* (Fig.21.1a) and *N. mesoprion* (Fig.21.1b) are distributed along the entire Indian coast at depths ranging from 10 to 100 m. They are short-lived (longevity: about 3 years), fast growing, highly fecund and medium-sized fishes (maximum length: 32 cm). The annual threadfin bream catch was 1,11,345 tones along the Indian coast during 2006 contributing 4.7% to the total catch (CMFRI, 2007). They are caught almost exclusively by bottom trawls. After the introduction of bottom trawls in the early 1960s, the threadfin bream catches consistently increased in

Fig. 21.1a *Nemipterus japonicus*

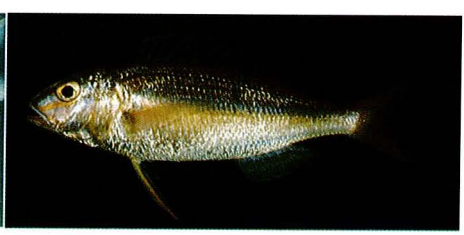

Fig. 21.1b *Nemipterus mesoprion*

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the last 45 years. The population characteristics of the threadfin breams have been extensively studied by CMFRI through several research projects. Vivekanandan and James (1986) reported that December to March as the peak spawning months of *N. japonicus* off Chennai that based on the data collected between 1981 and 84.

To find out the phenological changes in the spawning season of the threadfin breams, *Nemipterus japonicus* and *Nemipterus mesoprion* over the time-scale and examine the relationship to seawater warming.

METHODOLOGY

Data (except for 1988 to 1992) on the spawning season of *Nemipterus japonicus* and *N. mesoprion* off Chennai were collected from 1981 to 2004 by collecting and analyzing fortnightly fish samples from trawl landings at Chennai Fisheries Harbour. The fishes were dissected and maturity condition of ovary of females was recorded. Ovaries in maturity stages V and VI were considered as ripe and VII as spent (i.e. in condition where the eggs were just released (Qasim, 1973). Thus individuals in ovarian stages V to VII were considered as spawners. The months in which the spawning females occur are taken as the months of spawning, as males too spawn during those months. During 1980-87 and 1993-2004, a total of 18,975 specimens of *N. japonicus* were collected; of this, 9,539 were females and the rest were males and immature specimens. Of the females, 515 were spawners.

RESEARCH ACCOMPLISHMENTS

However, there were wide monthly fluctuations in the number of spawners, grouping the number of spawners in to two major seasons, i.e., warm (April to September) and cool (October to March) seasons showed a clear pattern in the shift of the spawning season. Whereas 35.3% of the spawners occurred during the warm months in 1980, the number of spawners gradually reduced and only 5.0% of the spawners occurred during the same season in 2004 (Fig. 21.2). In 1980, 64.7% of the spawners occurred between October and March, whereas as high as 95.0% of the spawners occurred during the same season in 2004. The number of spawners reduced during summer and shifted towards cooler months.

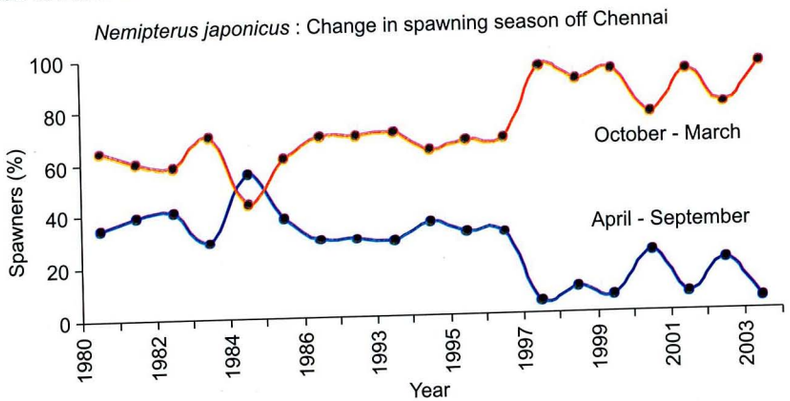

Fig. 21.2 Change in spawning season of *Nemipterus japonicus* off Chennai

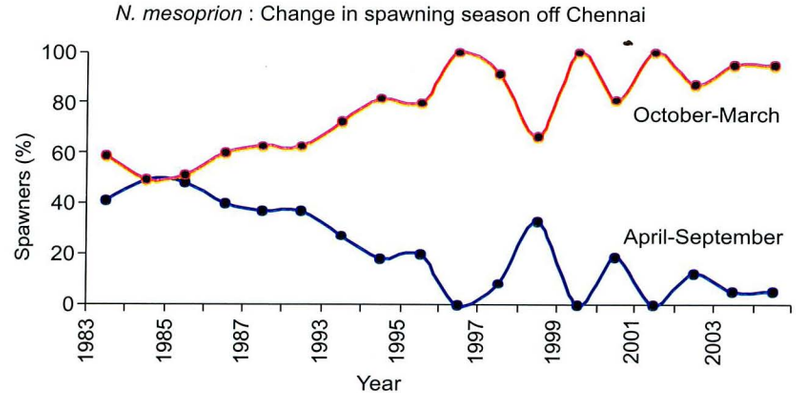

Fig. 21.3 Change in spawning season of *Nemipterus mesoprion* off Chennai

A similar trend was observed in *Nemipterus mesoprion* too. Between 1983-1987 and 1993-2004, a total of 11,503 specimens of *N. mesoprion* were collected; of this, 5,739 were females and the rest were males and immature specimens. In all the years, a total of 505 female spawners were collected. Whereas 41.4% of the spawners occurred during April-September in 1983, the spawning activity in the warm months reduced and only 5.3% of the spawners were recorded in 2004 (Fig. 21.3). The contribution of spawners between October and March increased from 58.6% in 1983 to 94.7% in 2004.

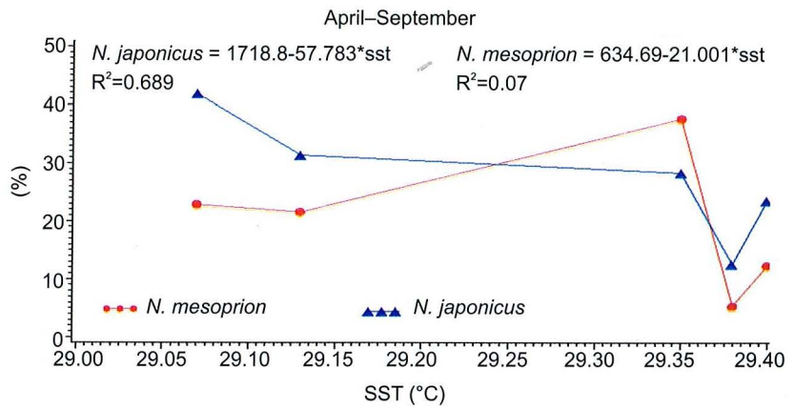

Fig. 21.4 Relationship between sea surface temperature (°C) and % of spawners from April to September in the annual number of spawners between 1981 and 2004.

The data derived from ICOADS indicated that during April to September, the annual average sea surface temperature off Chennai increased from 29.07°C from 1981-85 to 29.38°C by 2001-04; and from 27.86°C to 28.01°C between October and March. There was good correlation between sea surface temperature and spawning activity of the 2 species of threadfin breams. Whereas the occurrence of spawners (per cent of spawners

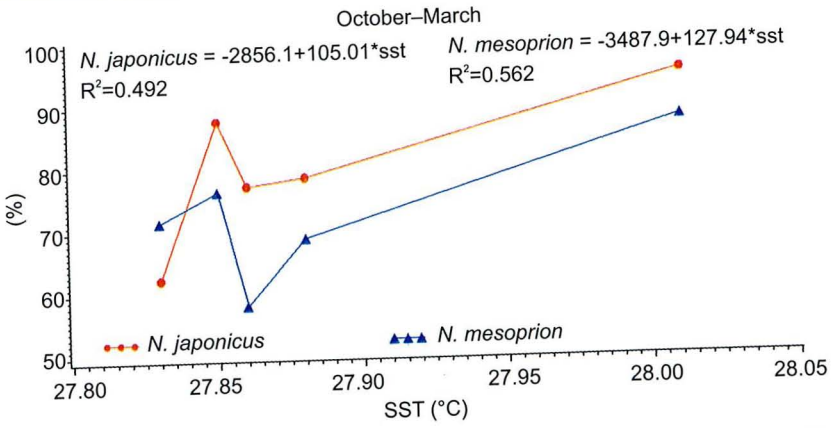

Fig. 21.5 Relationship between sea surface temperature (°C) and % of spawners from October to March in the annual number of spawners between 1981 and 2004

in the annual total number of spawners) of *Nemipterus japonicus* linearly decreased with increasing temperature (r^2 = 0.689) from April to September (Fig. 21.4), the occurrence increased positively (r^2 = 0.562) from October to March (Fig. 21.5).

CONCLUSION

Sea surface temperature between 28° and 29°C may be the optimum but when it exceeds 29°C, the fish are adapted to shift the spawning activity to seasons when the temperature is around the preferred optima.

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