

Stock assessment and exploitation status of *Lethrinus nebulosus* (Lacepede, 1802) exploited off Thoothukudi coast, Tamil Nadu, India

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Lethrinus nebulosus (Lacepede, 1802), although a commercially important fish species, has not been studied (population studies) in Thoothukudi coast of Tamil Nadu, India. Research on recruitment pattern, virtual population analysis and exploitation status of *L. nebulosus* off Thoothukudi coast was conducted from July 2011 to June 2012. During the study period, 4590 specimens of *L. nebulosus* were collected for studying the above said parameters by using FiSAT software. Recruitment pattern of the species expressed continuously with one peak each in April and August. The fishing pressure occurred more in the length group of 43 cm onwards. The results revealed that the total annual catch of 7566.28 tonnes was obtained from 52210 boat days. The maximum catch per unit was during December and January. The maximum sustainable yield (MSY) was estimated at 12203.68 tonnes. The discrepancy between MSY and annual catch was 4664.399. The present fishing effort may be increased to 61.29% to achieve MSY with 19310 boat days. It was revealed that *L. nebulosus* is underexploited in this region.

[Keywords: *Lethrinus nebulosus*; Stock assessment; Thoothukudi coast]

Introduction

India has a coastline of 8129 km with the water expanse of continental shelf as 0.5 million sq km and EEZ of 2.02 million sq km¹. Good perch grounds are found in the north-east coasts from the depth of 60-70 m, located in the range between 18° to 20° N and 84° to 87° E, as recorded². In south-east Asia, the Gulf of Mannar was declared as the first Marine Biosphere Reserve to protect the invaluable fauna and flora inhabiting this region³. Among the maritime districts of Tamil Nadu, Thoothukudi is considered one of the most potential fishing areas covering 163.5 km in the Gulf of Mannar Marine Biosphere⁴. Perches contribute about 5.1% of the total marine fish catch of Tamil Nadu state, out of which Thoothukudi district alone contributes around 11.08% of total marine fish catch of the state⁵. The Lethrinidae family fish also known as emperor is economically important among the demersal fish species. The lethrinid juveniles preferred the sea grass-replenished reefs only and not the sea grass-free reefs⁶. Fisheries management assigns due weightage to fish population dynamics aspects while determining the biological parameters, size at maturity, spawning season, as well as growth and mortality estimates⁷. Sustainable fisheries management of fish stocks is a challenge,

since stock assessments are based on accurate information from relevant quantitative and qualitative sources of uncertainty⁸. *Lethrinus nebulosus* is widespread broadly not beyond the Indo-West Pacific region and expanding from Red Sea and east Africa to southern Japan and Samoa⁹. Studies on population parameters from Tamil Nadu coast, particularly from the Gulf of Mannar region are limited. Therefore, the study was carried out on the recruitment pattern, virtual population analysis and exploitation status of *L. nebulosus*.

Materials and Methods

The present research was conducted from July 2011 to June 2012 in Thoothukudi Coast. The major lethrinids species available along Thoothukudi coast are: *Lethrinus nebulosus*, *L. nebulosus*, *L. ornatus*, *L. elongatus*, *L. microdon*, *L. mahsena*, *L. harak*, *L. ramak*, *L. conchyliatus*, *L. rubioperculatus*, *Gymnocranius robinsonii*, and *G. griseus*. From this 12 lethrinid species, *L. nebulosus* was preferred for this investigation. A total of 4590 individuals were collected on weekly basis from Thoothukudi coast (Fig. 1). Data on frequency, catch and effort were loaded in FiSAT software to assess the recruitment pattern, virtual population analysis and exploitation

status. Both the sexes were pooled as common to calculate the above said parameters.

Recruitment pattern: Length frequency data were used as input to determine the recruitment pattern of *L. nebulosus* in FiSAT software.

Virtual population analysis (VPA): The length structured VPA of FiSAT was used to find out the size of each length group of *L. nebulosus* and their natural mortality and fishing mortality.

Estimation status: The annual catch data (Y) were used to estimate the total stock (Y/U) and annual stock (Y/F) of *L. nebulosus*. The exploitation rate (U) of the stock was analysed by using the equation $U = F/Z (1 - e^{-Z})^{10}$. $MSY = Z (Y/F) * 0.5$ is the equation to calculate the maximum sustainable yield (MSY) of the stock¹¹.

Yield Isopleths: The values of M/K and Lc were used as input to derive the yield isopleths diagram for *L. nebulosus* in FiSAT software.

Results and Discussion

Recruitment pattern: Using a length frequency data as input in FiSAT, it was found that *L. nebulosus* showed a continuous recruitment pattern with one peak occurring in April to August (Fig. 2). It is clear that during monsoon period only *L. nebulosus* shows the major recruitment figure. From the Thoothukudi coast of India, the recruitment pattern of *L. lentjan* occurs throughout the year with two peaks in April and July-August¹². The recruitment pattern of *Epinephelus malabaricus* exploited from Andaman

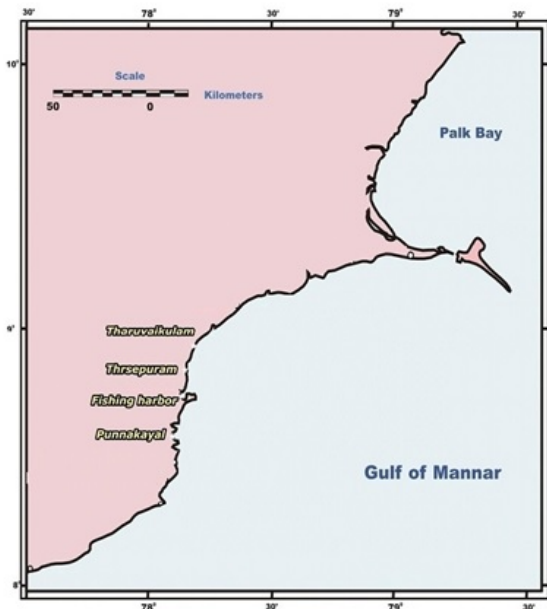


Fig. 1 — Fish landing centres at Thoothukudi

Islands, which is closely to the related family of *Lethrinus* species, was unimodal with one major peak in April to July¹³. Recruitment pattern of *Thunnus tonggol* caught along the Indian coast was bimodal with a major pulse in recruitment during May-June and minor pulse in August-September¹.

Virtual population analysis: The mortality level of different length groups of *L. nebulosus* is analysed by using the outcome of the length structured virtual population analysis (VPA) (Fig. 3), the vulnerability to fishing gears of the stock was high from the length group of 43.00 cm to 68.00 cm and the removal of the stock by natural causes was low particularly from 57.5 cm onwards (Fig. 3). In an earlier study, it was reported that the fishing pressure of *L. nebulosus* was high in 56 cm to 65 cm and that natural mortality of the same stock was shown less from 59 onwards¹¹. Present investigation was similar to virtual population analysis of *Nemipterus japonicas*, which showed that natural mortality exceeded the fishing mortality up to 16 cm thereafter fishing pressure was more than the mortality caused naturally from veraval waters¹⁴.

Exploitation status: The total stock of *L. nebulosus* were estimated as 20535.99 tonnes with annual catch being 7566.281 tonnes against the exploitation rate of 0.37 (Table 1). Exploitation rate of *L. lentjan* was

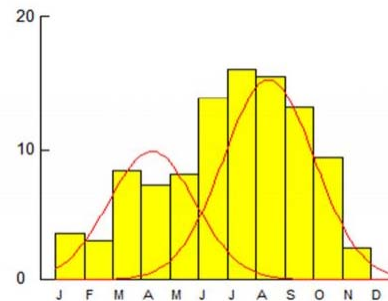


Fig. 2 — Recruitment pattern of *L. nebulosus*

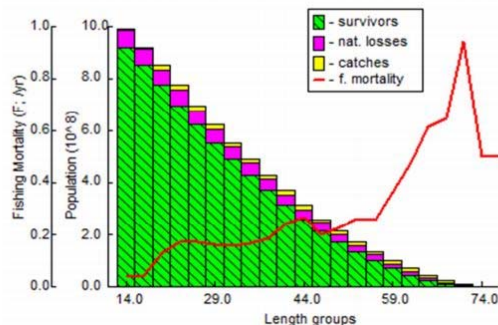


Fig. 3 — Length structured virtual population analysis of *L. nebulosus*

Table 1 — Exploitation status of *L. nebulosus* from Thoothukudi coast

Species	Annual catch (Y) (tonnes)	Exploitation rate (U)	Total stock (Y/U)	Annual stock (Y/F) (tonnes)	(E = F / Z)	status
<i>L. nebulosus</i>	7566.28	0.37	20535.99	12203.68	0.54	Less exploited

Table 2 — Optimum effort for the exploitation of *L. nebulosus* from Thoothukudi coast

Species	MSY (tonnes)	Difference between catch and MSY (tonnes)	Present effort (boat days)	CPUE	Boat days to be increased	% of increase in effort	Optimum boat days for MSY
<i>L. nebulosus</i>	12203.68	4664.399	52210	0.1449	31999	61.29	84209

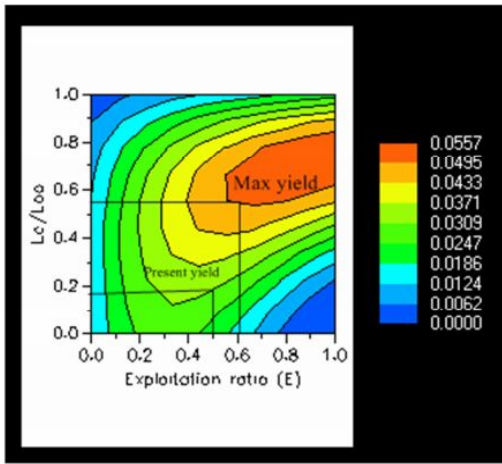


Fig. 4 — Yield isopleths of *L. nebulosus*

0.41, recorded in Thoothukudi Coast, India¹¹. The estimated exploitation rate of *Trichurus lepturus* was 0.14 and 0.45 which is exploited from northern Bay of Bengal and northern Arabian Sea, respectively¹⁴.

Optimum effort for the exploitation of *L. nebulosus* is shown in Table 2. Results on MSY illustrated that the species of *L. nebulosus* is underexploited. The estimated MSY for the stock was 12203.68 tonnes against the annual catch of 7566.281 tonnes. To augment the catch, the effort could be maximized to the tune of 61.29% by increasing the number of boat days up to 31999. The MSY of *Lethrinus lentjan* shows at 10683.68 tonnes against the annual catch of 7799.208 from Thoothukudi Coast, India¹¹. The MSY was investigated from Soudan bank for *Lethrinus rubrioperculatus* standpoint at 236 tonnes¹⁵. The MSY and annual average catch of *Epinephelus malabaricus* was 1,107 tonnes and 1,296 tonnes, respectively as observed from Andaman Islands¹⁶.

Yield isopleths: The L_c/L_∞ for the present exploitation ratio (0.54) of *L. nebulosus* is 0.18 and it has been predicted that MSY can be possible with the exploitation rate and L_c/L_∞ of 0.58 and 0.54,

respectively, (Fig. 4). Vasantharajan *et al.*, 2015 suggested that MSY for *L. lentjan* can be obtained with the exploitation rate and L_c/L_∞ of 0.6 and 0.58, respectively¹¹. The optimum relative yield per recruit of *Nemipterus japonicus* could be attained at L_{c50}/L_∞ of 0.55 and E of 0.5 from veraval waters¹³.

Conclusion

Among the major perches, *L. nebulosus* forms good fishery in Thoothukudi region throughout the year. The recruit pattern found two peaks in April–August. The present study revealed that the stock was underexploited in Thoothukudi coast. The present level of effort for this species may be increased to achieve the MSY from this region

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