Recruitment Pattern, Virtual Population Analysis (Vpa) and Exploitation Status of *Lethrinus Lentjan* (Lacepede, 1802) Exploited in Thoothukudi Coast, Tamil Nadu, India

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Abstract A detailed fishery characteristic of *Lethrinus lentjan* was carried out from July 2011 to June 2012. The data were collected on weekly intervals for studying the length-weight relationship, growth parameters, recruitment pattern, spawning seasons, fishing pressure and MSY. A total of 5062 specimens of *L. lentjan* are collected during the study period to estimate the above said parameters. The total annual catch of *L. lentjan* was 7799.208 tonnes are obtained by 52,210 boat days. The CPUE was found to be high during the month of October and December, for *L. lentjan* and estimated MSY is 10683.84. The difference between the annual catch and MSY is 2884.632 tonnes. Study on maximum sustainable yield indicated that *L. lentjan* is underexploited. To maximize the catch, an increase in the fishing effort to 36.98 % with 31999 boat days may be made, the species, to get the Maximum Sustainable Yield.

Keywords Recruitment pattern; VPA; MSY; Lethrinus lentjan

1 Introduction

Indian coast is ornamented with the East coast, West coast and the coasts of Lakshadweep and Andaman and Nicobar islands, within the bounds of the tropics. The Indian coastal length measures about 8,129 km and the Exclusive Economic Zone extends up to about 2.0 million km² (Ramani et al., 2010). In South East Asia, the Gulf of Mannar was declared as the first Marine Biosphere Reserve. In the world marine biodiversity perspective, the Gulf of Mannar is the richest region of marine fisheries resources. The area of Gulf of Mannar has an area of about 10,500 km². In this region, totally 3600 species of fauna and flora have been identified. With an aim to conserve the valuable fauna and flora inhabiting in this region, the Gulf of Mannar Marine Biosphere Reserve was established during the year 1989 (Venkataramani et al., 2007). The family Lethrinidae, otherwise known as emperor fishes, contains some of the most common and economically important commercial and artisanal tropical demersal fish species. Emperor fishes are demersal carnivorous feeders. In general, emperor fishes consume a wide range of prey including polychaetes, molluscs (gastropods, bivalves, squids and octopus), echinoderms (sea urchins, sand dollars, star fish, brittle stars), crustaceans (crabs, shrimps) and small fishes. Lethrinid fishes are carnivorous bottom feeders and it actively works on feeding in day time and not active in late evening hours (Toor, 1964). Early studies on reproduction of lethrinids have identified several species as protogynous hermaphrodites (sex change from female to male) (Motlagh et al., 2010). The lethrinid fishes are utilized as good food resources from the areas of western Pacific Ocean to the Indian Ocean because of their dominance in fish catch (Ebisawa and Ozawa 2009). The lethrinid fishes form year around fishery along the Thoothukudi coast. Though detailed studies on the stock assessment and management of lethrinid fishes in Thoothukudi coast were not done so far. Hence, the attempt has been made with the objective of estimating the recruitment pattern, Virtual population analysis and exploitation status of *L. lentjan*.

2 Materials and Methods

The present study was carried out for a period of 12 months from July 2011 to June 2012. The abundance of lethrinid fish species in the Thoothukudi coast...
triggered this study on its fishery management aspects. The major letrinids species available along Thoothukudi coast were Lethrinus lentjan, L.nebulosus, L ornatus, L elongatus, L microdon, L mahsena, L harak, L ramak, L conchylatus, L rubiroperculatus, Gymnocranius robinsonii and G griseus. Among these twelve lethrinids species, L lentjan has been selected for this study. Since sexual dimorphism was not found in this species, So the sexes were treated as common to calculate the recruitment pattern, Virtual population analysis and exploitation status. The specimens were collected from Thoothukudi fishing harbour located along the Thoothukudi coast by trawl net. Figure 1.

2.1 Recruitment Pattern
Recruitment pulses of L lentjan were analyzed from the length frequency data using FiSAT.

2.2 Virtual Population Analysis (VPA)
The length structured VPA of FiSAT was used to find out the size of each length group of L lentjan their natural mortality and fishing mortality.

2.3 Exploitation Status
The total stock (Y/U) and the annual stock (Y/F) were estimated for L lentjan using annual catch (Y). The exploitation rate (U) was estimated using the equation \( U = F/Z \left(1 - e^{-z}\right) \) (Sparre and Venema, 1998). The MSY was estimated using the equation \( MSY = Z \left(\frac{Y}{F}\right) \times 0.5 \) described by Gulland (1979).

2.4 Yield Isopleths
Yield isopleth diagrams of L lentjan were derived by FiSAT using M/K and Lc values.

3 Results and Discussion
3.1 Recruitment Pattern
The recruitment pattern of L lentjan is shown in Figure 2 The analysis of length frequency data using FiSAT revealed that L lentjan showed a continuous recruitment pattern throughout the year with two peaks in April and July – August. This suggests that the major recruitment season for both the L lentjan and L nebulosus was during the monsoon period. (Kribushankar et al., 2013) reported the recruitment pattern of Epinephelus malabaricus from Andaman Islands which belongs to the related family of Lethrinus species was unimodal with the major peak occurring during April to July.

3.2 Virtual population analysis
The result of the length structured virtual population analysis (VPA) employed to recognize the level of mortality on various length groups of L lentjan is shown in Figure 3 and The fishing pressure on L lentjan was more in the length group of 56.0 cm to 65.0 cm and the natural mortality was low in the length group of 59.0 cm onwards. This finding was similar to (Swatipriyanka et al., 2014) reported that Virtual population analysis of Nemipterus japonicas showed that natural mortality exceed the fishing mortality upto length of 160 mm after which fishing mortality was found to be more than natural mortality.
3.3 Exploitation status

The total stock, annual catch and the exploitation rate were estimated for *L. lentjan* is presented in Table 1. The total stocks of *L. lentjan* were estimated as 18941.88 tonnes with annual catch being 7799.208 tonnes against the exploitation rate of 0.41. The present study is similar to findings of Ghosh et al analyzed the exploitation rate of *Trichurus lepturus* form northern Arabian sea and northern Bay of Bengal and it was 0.14 and 0.45 respectively.

Optimum effort for the exploitation of *L. lentjan* is shown in Table 2. Study on maximum sustainable yield indicated that the species of *L. lentjan* is underexploited. The estimated total instantaneous mortality (Z) and natural mortality (M) of *L. lentjan* was found to be 1.28 and 0.55 respectively. The fishing mortality co-efficient (F) of *L. lentjan* were 0.73. The MSY estimated was 10683.84 tonnes against the annual catch of 7799.208 tonnes for *L. lentjan*. To maximize the catch, the effort for *L. lentjan* could be increased to the tune of 36.98% by increasing the numbers of boats or increasing the fishing duration from existing 16 hrs to 21 hrs with 31999 boat days. The MSY of *Lethrinus rubrioperculatus* stands at 236 tonnes from soudan bank recorded by Hanoomanjee and Soondron 1998; (Kribushankar et al., 2013) reported that in Andaman Islands the maximum sustainable yield and annual average catch of *Epinephelus malabaricus* was 1,107 tonnes and 1.107 tonnes respectively.

### Table 1

<table>
<thead>
<tr>
<th>Species</th>
<th>Annual catch (Y) (tonnes)</th>
<th>Exploitation rate (U)</th>
<th>Total stock (Y/U)</th>
<th>Annual stock (Y/F) (tonnes)</th>
<th>(E = F / Z)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>L. lentjan</em></td>
<td>7799.208</td>
<td>0.41</td>
<td>18941.88</td>
<td>10683.846</td>
<td>0.57</td>
<td>Less exploited</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Species</th>
<th>MSY (tonnes)</th>
<th>Difference between catch and MSY (tonnes)</th>
<th>Present effort (boat days)</th>
<th>CPUE</th>
<th>Boat days to be increased</th>
<th>% of increase in effort</th>
<th>Optimum boat days to achieve MSY</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>L. lentjan</em></td>
<td>10683.84</td>
<td>2884.632</td>
<td>52210</td>
<td>0.1494</td>
<td>19310</td>
<td>36.98</td>
<td>71520</td>
</tr>
</tbody>
</table>

3.4 Yield isopleth

The yield per recruit for *L. lentjan* is shown in Figure 4. The Lc/L∞ for the present exploitation ratio (0.57) of *L. lentjan* is 0.152 and it has been predicted that maximum yield can be possible with the exploitation rate and Lc/L∞ of 0.6 and 0.58 respectively. The optimum relative yield per recruit of *Nemipterus japonicus* could be obtained at Lc50/L∞ of 0.55 and E of 0.5 from veraval waters reported by (Swatipriyanka et al., 2014).
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