Lead-trap Net Fishing in the Gulf of Mannar region, Southeast Coast of India

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Received 21 January 2014; revised 12 September 2014

In the present study the qualitative and quantitative fishery data obtained from lead-trap net operation in the Gulf of Mannar was analyzed. Length weight distribution of the 8 fish species caught in the Lead-trap nets was estimated. The ‘b’ values ranged between 0.468 and 3.398 and differed significantly from 3, which revealed allometric growth for most of the fishes except Sardine and Scromberoides sp. Von Bertalanffy’s Growth parameters of fish catch was estimated using FISAT tool. The condition factor (k) ranged from minimum 0.310 for Loligo sps to a maximum 1.292 for Scromberoides sps. In terms of quantity, Leiognathus sp was dominant (17.07%) followed by Siganus (15.59%), Sardine (15.9%), Thryssa (13.48%), Scromberoides (13.09%), Pellona (11.09%), Terapon (7.9%) and Loligo (5.04%) species. It was found more juveniles and brooders are harvested indiscriminately by operation of lead-trap nets which is a major threat to the biodiversity and sustainable fishery of the Gulf of Mannar region.

**Keywords:** Lead-trap net, Qualitative and qualitative data, Gulf of Mannar, Sustainable fishery.

Introduction

The Gulf of Mannar (GOM) region recorded more than 3,600 species of flora and fauna including soft corals, hard corals, sea grasses, seaweeds and marine animals such as sea turtle, sharks, dugongs and dolphin making it one of the richest coastal regions in Asian continent. Henceforth, it has been declared as Biosphere reserve. Fishermen along the coastal villages of the Gulf of Mannar pursue fishing as their primary occupation. Fishing gears like drift gill nets, bottom-set gill net, boat seines or bag nets, shore seines, hooks and lines, traps and lead-trap nets are used along the southeast coast of India with special reference to the Palk Bay and Gulf of Mannar in the vicinity of the Mandapam. Lead-trap nets are stationary gears may be about 4 - 5 feet high and are typically fishing in water up to 150 feet away from shore hence installed in the shallow waters. The installation and operation of the lead - trap net in the GOM region was described by Venkatesan.

Growth of fish is usually indicated through increase in length and weight which determines the wealth of the population at a particular time. Length and weight data are essential to estimate growth rates, length and age structures, and other components of fish population dynamics. Length-weight relationships are also useful for comparing life history and morphological aspects of populations inhabiting different regions. The number of lead-trap nets operated in the GOM region has increased over the decade. Being a non-selective fishing practice, the operation of lead- trap nets may arise threat of harvesting juveniles and undersized fishes in the GOM region. Hence the present study was aimed to evaluate the qualitative and quantitative fishery data obtained from lead-trap net operations from the GOM region.
Materials and Method
The Gulf of Mannar (Fig. 1) with its tropical monsoon climate having primarily a day with a maximum temperature of 37.8°C and minimum temperature of 22.3°C and a mean annual rainfall of 37", influenced both by monsoons, the North-East and the South-West. The South-West monsoon extends from April over a period of 6 or 7 months, whereas the North-East monsoon commences in November and ceases during February or early March. The present study was carried out during North-East monsoon. There were totally sixteen traps in the study area located between N-09°15.917’, E-079°06.578’ and N-09°16.450’ E-079°07.770’ near Vedalai fishing village. Lead-Trap nets are large sized nets, anchored or fixed to stakes, as enclosure using nets of various mesh size and bamboo poles. Lead Trap net is divided into compartments that are closed at the base with a layer of net (Fig. 2a and 2b).
Bamboo poles are one of the main building materials for the lead trap net. For the construction of the lead trap net, approximately 60 – 90 wooden poles are used. It totally depends upon the distance of the trap net from the shoreline. But the height of the wooden poles varies and depends on the depth of the water. The design and installation of the lead-trap net in the Gulf of Mannar region were explained by Venkatesan.

Length weight data was collected between January, 2011 and March, 2011. Two samplings per month were carried out. The fishes caught were identified using FAO species identification sheets of fishing area 57 and FAO species catalogue Vol 3. Cephalopods of the world. The fishes recorded during the study period include Leiognathus sp, Loligo sp, Thyrssa sp, Sardinella sp, Siganus sp, Terapan sp, Pellona sp and Scromberoides sp. Total length (cm) was measured from the tip of the snout (mouth closed) to the tip of the longest lobe of the caudal fin for all fishes except Loligo sp. For Loligo sp, the length was measured from the tip of the tentacles to the lower part of the body.

Standard length (cm) was measured from the tip of the snout to the posterior lobe. For Loligo sp, only the body part was measured leaving the tentacles. The weight of the fish (g) was measured using a mono-pan weighing balance.

The parameters of the length-weight relationship of identified fish species were estimated using the equation: \( W = aL^b \) (Eq.1)

\[
W = \text{Weight in grams, } L = \text{Length in mm, } 'a' \text{ is intercept or the initial growth coefficient, } 'b' = \text{Slope or the growth coefficient.}
\]

The values of the constants ‘a’ and ‘b’ were estimated after logarithmic transformation using least square linear regression. The maximum age \( (t_{\text{max}}) \) was determined according to the following equation \( t_{\text{max}} = \frac{3}{k} \) and the age at zero or the birthday of the fish was calculated using Pauly & Gaschutz empirical formula: \( t_0 = -0.3922 - 0.2752 \log L_\infty - 1.038 \log k. \)

The growth performance index \( (\phi) \) was computed according to Pauly and Munro

\[
\phi = \log_{10} K + 2 \log_{10} L_\infty.
\]

The growth parameters were analyzed using an ELEFAN module of FISAT II for estimation of Von Bertalanffy’s Growth parameters.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Genus/species Name</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>Total catch (Kg.)</th>
<th>Total catch Percent %</th>
<th>Price/kg (Average Rs.)</th>
<th>Total value (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leiognathidae</td>
<td>439</td>
<td>411</td>
<td>371</td>
<td>1,221</td>
<td>17.07%</td>
<td>80</td>
<td>4,482.08</td>
</tr>
<tr>
<td>2</td>
<td>Clupeidae</td>
<td>431</td>
<td>393</td>
<td>313</td>
<td>1,137</td>
<td>15.9%</td>
<td>60</td>
<td>2,869.80</td>
</tr>
<tr>
<td>3</td>
<td>Siganidae</td>
<td>423</td>
<td>381</td>
<td>309</td>
<td>1,113</td>
<td>15.56%</td>
<td>40</td>
<td>149.12</td>
</tr>
<tr>
<td>4</td>
<td>Engraulidae</td>
<td>367</td>
<td>346</td>
<td>251</td>
<td>964</td>
<td>13.48%</td>
<td>20</td>
<td>806.92</td>
</tr>
<tr>
<td>5</td>
<td>Thyrsidae</td>
<td>331</td>
<td>363</td>
<td>242</td>
<td>936</td>
<td>13.09%</td>
<td>110</td>
<td>3,220.80</td>
</tr>
<tr>
<td>6</td>
<td>Scrombridae</td>
<td>343</td>
<td>297</td>
<td>211</td>
<td>851</td>
<td>11.90%</td>
<td>30</td>
<td>1,069.17</td>
</tr>
<tr>
<td>7</td>
<td>Terapanidae</td>
<td>325</td>
<td>39</td>
<td>202</td>
<td>566</td>
<td>7.91%</td>
<td>10</td>
<td>86.97</td>
</tr>
<tr>
<td>8</td>
<td>Loliginidae</td>
<td>147</td>
<td>121</td>
<td>93</td>
<td>361</td>
<td>5.04%</td>
<td>160</td>
<td>2,003.20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2712</td>
<td>2331</td>
<td>1932</td>
<td>7,149</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results

The month wise composition of fish species and total catch, their percentage in total catch and value by rupees was given in Table 1. In terms of quantity, *Leiognathus* sp was dominant (17.07%) followed by *Siganus* (15.59%), *Sardine* (15.9%), *Thryssa* (13.48%), *Scromberoides* (13.09%), *Pellona* (11.09%), *Terapon* (7.9%) and *Loligo* (5.04%). In terms of values (price per kg), *Loligo* priced Rs 160 per kg followed by *Scromberiodes* (Rs 110 per kg), *Leiognathus* (Rs 80 per kg), *Sardine* (Rs 60 per kg), *Siganus* costs (Rs 40 per kg), *Pellona* costs (Rs 30 per kg), *Thryssa* (Rs 20 per kg) and *Therapon* (Rs 10 per kg).

The Table 2 reveals the composition of fishes, the total number of fishes examined, their size range, mean, Standard Deviation (SD) and Standard Error (SE). The table also includes the local names of fishes, their growth parameters (a and b), the correlation coefficients ($r^2$) for the log transformed L-W data, the number of individuals (N) and the length range fish species. The parameter ‘b’ of the fishes studied ranged from a minimum of 0.468 to a maximum of 3.39 at 95% confidence level.

The estimated Von Bertalanffy growth parameters indicate about the age growth distribution where $L_\infty$ is the asymptotic length, W the asymptotic weight, K the growth coefficient, and $t_0$ the theoretical age at zero length are given in Table 3. The size range of *Loligo* and *Pellona* were discontinuous, hence it has been divided into three different size groups depending upon their length frequency range. For *Loligo* sp, the size range was divided into 7-17, 20-35 and 40-60cm. Similarly, for *Pellona* sp the size range was divided into 4-13, 15-24 and 38-52cm.

Discussion

The regression analysis for most of the fishes revealed the negative pattern of growth indicating that lead trap net catch contains more juveniles than the adult. Studies of trap fisheries in other parts of the world have reached similar conclusions. For example, in Kenya an average 39% of the fish caught in small traps and 49% in big traps were juveniles. For one of these species (*Lethrinus xanthochilus*) juveniles comprised 100% of the catch while in five others, the figure was 75% or more.

Exploitation of more juveniles may result in disturbance of marine resources.

The length weight relationship for *Sardine* sp and *Scromberoides* sp was calculated and the results showed that the regression coefficients are around 3 which exhibit isometric growth pattern. A similar study carried out on *Sardinella* sp by Sekharan has found out the regression coefficients of the 20-39 mm groups are higher than those of the larger size-groups. A partial explanation for this could be the change in the body outline of these fishes as they increase in length. The t-tests showed that the regression coefficients of the length-weight relationship in these species differed significantly from 3. The regression coefficients of other observed species did not show statistically significant results. This may be due to insufficient data and the presence of lot of juveniles. The regressions may not be as accurate for relatively small fish (less than 2 inches) or for very large fish that tend to have high variability16.
In the present study also the juveniles were dominant in all the species recorded. From the obtained ‘b’ values of *Sardine sp* (3.398) and *Scromberiodes sp* (3.13) it reveals that both were exhibiting isometric growth and the other species were having allometric growth. Their corresponding $r^2$, correlation coefficient values indicated that other than *Siganus sp* and *Terapon sp* all the other species were having a high degree of positive correlation between their total length and their total weight. The length weight regressions of the fishes were less than the average value ‘3’ indicating the fishes are relatively skinny denoting mostly juveniles except for *Sardines* and *Scromberoides*.

The Von Bertalanffy Growth Parameters (VBGP) derived in this study helped to calculate the age growth distribution. $L_\infty$ (maximum length attained) and K (growth coefficient) are inversely proportional to each other. There was a limited study on the growth performance parameters of the Trap net fishes in the Gulf of Mannar region. Juanes *et al.* suggested that various growth groups were related to size-at-maturity: faster growing populations have larger sizes at maturity. Life history theory would also predict a negative relationship between the Brody growth coefficient (K) and the maximum asymptotic length. Such a relationship exists with both global and US marine waters bluefish von Bertalanffy parameters. Likewise, the age growth parameters of our present study, the value K ranged from 1.220 to 1.700 cm/year, $t_0$ range from -0.9878 to -0.1991, $L_\infty$ range from 13.13 to 55.13 cm showed the fishes of our study were ranging from juveniles to intermediate ones.

In the entire catch of Lead-trap net, all the fishes entrapped were common shallow water fishes of Gulf of Mannar Region except the *Loligo sp* which may be an accidental entry in the Lead-Trap net. Trapping is a multi-species fishing technique, with low impacts on the habitat. It produces much unwanted by catch that is commercially useless and could be a threat to biodiversity. In the present study also by catches comprise lots of juveniles, low ground fishes, brooders and some ornamental fishes (Fig 3).

**Table 3. Von Bertalanffy growth parameters**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Species</th>
<th>$L_\infty$ (cm)</th>
<th>K (cm/year)</th>
<th>$t_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leiognathus sp</td>
<td>16.28</td>
<td>0.770</td>
<td>-0.1991</td>
</tr>
<tr>
<td>2</td>
<td>Sardine sp</td>
<td>16.28</td>
<td>0.480</td>
<td>-0.3956</td>
</tr>
<tr>
<td>3</td>
<td>Siganus sp</td>
<td>15.23</td>
<td>1.200</td>
<td>-0.7996</td>
</tr>
<tr>
<td>4</td>
<td>Thryssa sp</td>
<td>16.28</td>
<td>0.640</td>
<td>-0.5253</td>
</tr>
<tr>
<td>5</td>
<td>Scromberiodes sp</td>
<td>15.71</td>
<td>1.292</td>
<td>-0.836</td>
</tr>
<tr>
<td>6</td>
<td>Pellona sp (40-130mm)</td>
<td>13.13</td>
<td>1.700</td>
<td>-0.9378</td>
</tr>
<tr>
<td>7</td>
<td>Pellona sp (150-240mm)</td>
<td>24.68</td>
<td>0.790</td>
<td>-0.6694</td>
</tr>
<tr>
<td>8</td>
<td>Pellona sp (380-540mm)</td>
<td>54.08</td>
<td>0.380</td>
<td>-0.4323</td>
</tr>
<tr>
<td>9</td>
<td>Therapon sp</td>
<td>15.23</td>
<td>0.530</td>
<td>-0.4322</td>
</tr>
<tr>
<td>10</td>
<td>Loligo sp (70-170mm)</td>
<td>17.33</td>
<td>0.400</td>
<td>-0.3208</td>
</tr>
<tr>
<td>11</td>
<td>Loligo sp (200-350mm)</td>
<td>34.13</td>
<td>0.310</td>
<td>-0.2862</td>
</tr>
<tr>
<td>12</td>
<td>Loligo sp (390-520mm)</td>
<td>55.13</td>
<td>0.770</td>
<td>-0.7542</td>
</tr>
</tbody>
</table>

Fig 3: Juveniles (A), Brooder (B) and Ornamental fish (C) trapped in Lead-trap fishing and discarded on-shore
These were thrown away by the fishermen to trash on land. And hence more juveniles and brooders are exploited indiscriminately, which affects their sustainable development. In this way, the marine biodiversity is exploited due to the non-selectiveness of the lead trap nets. But, still it gives a good living for local fishermen in GOM region and so could not be banned as it has in some parts of the world. This can be solved by giving advice to the fishermen to leave the by-catch back into the sea. The management practices to be framed for proper lead-trap net fishing in the GOM region.

**Conclusion**

The operation of Lead-trap net fishing not only harvests the marketable-sized target species but also traps under-sized target and non-target organisms along with juveniles and brooders that concentrate along the shallow waters. In the present study, the available data did not allow us to quantify the risk of environmental degradation by lead-trap fishing, but the ever increasing lead-trap numbers along the coastal villages of Mandapam warrant due attention for management of natural resources and sustainable fishing along the coasts of the Gulf of Mannar region.

**Acknowledgements**

This article is part of an M. Phil., thesis submitted to the School of Energy, Environment and Natural Resources, Madurai Kamaraj University. Authors are grateful to the Department of Marine and Coastal Studies, Madurai Kamaraj University for providing lab space in the Marine Field Research Facility at Pudhumadam for successful completion of this work.

**References**