Bycatch Composition of Myctophid Mid-water Trawls in Iranian Waters of the Oman Sea

Saeed Kiaalvandi*, 1, Seyed Yousef Paighambari1, Toraj Valinassab2, Seyed Abas Hosseini1

1Department of Fisheries, Faculty of Fisheries and Environment, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
2Iranian Fisheries Research Organization

*Corresponding Author: saeedkiaalvandi@gmail.com, Tel: 00989119617340

This study was carried out in Iranian water of Oman Sea to estimate bycatch (incidental and discard) of myctophidae caught by trawlers. Total of 140 mid-water trawl hauls was performed during a period of September 2010 and March 2011 by using a net with mesh sizes of 10 mm at the cod-end. The study area extended from longitude 57° 00’ to 58° 30’ E. At present study 19 families (16 species of Teleosts, 3 species of Elasmobranchs and 3 species of invertebrate) were identified. Bycatch composition included 7.31% discards and 92.69% incidental catch. Percentage of total bycatch biomass to total myctophidae biomass was estimated 29.64% to 70.36%. Of the bycatch species, Trichiurus lepturus and Pennhia macrophthalmus had highest portion from total catch with 57% and 14%. Three elasmobranch families were caught in the myctophid midwater trawling. In in September to October the bycatch value was higher, which corresponded to the peak abundance of T. lepturus. Therefore the bycatch value for others months were lower than September and October. This study is the first comprehensive study of the Myctophid Midwater trawl bycatch from Iranian waters and it can provides basic information for fishery managers.

Key words: bycatch, mid-water trawl, myctophidae, Oman Sea.

1. INTRODUCTION

One of the most urgent threats to the world’s remaining fish stocks is commercial fishing especially the indiscriminate capture of non-target organisms, typically referred to as ‘bycatch’. The amount of bycatch produced by a given fishery depends on the type of fishing gear used, However, trawl fisheries generally produce the greatest overall amount of bycatch by weight (Eayrs, 2007; Kelleher, 2005). The incidental capture of marine organisms is now recognized as a serious problem in fisheries management. In the worldwide, 27 million tons of trawl bycatch is discarded each year (Alverson et al., 1994). Non target species that have a commercial value (bycatch) and unwanted species that do not valuable and back to sea (discards) are important challenge in fisheries with greatly diverse communities, such as tropical trawl fisheries. Trawl fishing product highly bycatch due to trawl fishing is a non-selective fishing method. Whilst bycatch may be sold, it may also be unusable or unwanted for a variety of regulatory and economic reasons and, subsequently thrown back to sea, often dead or dying.

This unutilized subset of bycatch is known as ‘discards’. bycatch is so pervasive that it spans the spectrum of marine fauna and fishing gear including turtles on hooks, juvenile fish in nets, and benthic invertebrates in trawl and dredge gear. The role of bycatch in degrading marine ecosystems has made this one of the most significant nature conservation issues in the world today. However, a consistent understanding of bycatch is lacking due to several unresolved issues: definition, measurement and quantification. To date, bycatch has largely been determined by establishing that element of the catch which is not targeted. The fundamental problem is that differing value judgments lead to differing perceptions of what is considered a non-target catch, especially with the emergence of fisheries where no specific species appear to be targeted. For example, in many tropical shrimp trawl fisheries, much of the catch other than shrimp has traditionally been considered as bycatch and was usually discarded. However, socio-economic factors and an eroding resource basement cause were created for this bycatch and therefore discarding in these fisheries has been reduced. From the viewpoint of the fishers, these former discards are now considered less as bycatch, but rather an important part of what should more accurately be described as a multi-species fishery. The incidental capture of marine organisms is now recognized as a serious problem in fisheries management and marine
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However, myctophids midwater trawl has been begun since 2006 in the Iranian waters of Oman Sea but we have little information about bycatch value. have a little data on incidental catch and discarding rates can lead to biased estimates of fishing effort and mortality and can give rise to inaccurate estimates of stocks status. The skinny cheek lantern fish *Benthosema pterotum* (Myctophidae) represents a virgin resource in the Oman Sea. Because of its potential importance for fishmeal production there has been great interest during the last decade in starting commercial exploitation. Myctophids or lantern fishes are the most abundant group of mesopelagic fishes in the world's oceans. They range from the Arctic to Antarctic and can be found in surface waters to depths exceeding 2000 m. The Oman Sea is relatively rich in fisheries resources, with considerable quantities of mesopelagic fish occurring on, and Sea ward, of the continental slope and through the deep zone of the Oman Sea waters (Gartner, 1993). No studies have examined the potential effects of a commercial lantern fish fishery on other mesopelagic fish populations, and few have dealt with other organisms that ecologically interact with lantern fishes. As fishing efforts and ecological impacts are linked (in a complicated and unknown way), the absence of any data on future probable effort levels confounds evaluation of potential impacts.

This work aimed to study bycatch composition of myctophid mid-water trawls in Iranian waters of the Oman Sea due to lack documentations related to myctophids. Therefore, all results of the present study are considered as the first base information of this Iranian fishery.

2. MATERIALS AND METHODS

2.1. Study area

The study was carried out between September 2010 and March 2011 in northwest Oman Sea (from 57° 00′ to 58°30′ E.) (Fig. 1).

![Fig. 1. Map of the Oman Sea, showing the study site of Iranian waters of Oman Sea. White circles indicate sampling locations](image)

2.2. Data Collection

Data were collected by observers aboard C/V ‘Fanoos-3’ (Stern trawler with 56 m length, with 10 beam and 4/6 draft) in the fishing grounds of myctophidae in the Iranian waters of Oman Sea. At each towing, trawl duration ranged approximately from 1.5-4 h at speeds of about 4.2 knots. Then of the hauling, total biomass unloaded on the deck of the ship and bycatch species separated of target catch. Bycatch obtained of each trawl separated into 2 groups: 1. species have commercial value (incidental catch), 2. discard species.

2.3. Statistical analysis

We based CPUE (catch per unit effort) estimates on all trawls (n=140). Statistical analyses evaluating temporal and spatial variation in bycatch included only those trawls with nonzero bycatch observation. The analysis required the data or their residuals to be normal, this was achieved
by inverse hyperbolic sine transformations following exclusion of zeros (Zar, 1984).

3. RESULTS AND DISCUSSION

In this study 22 species belonging to 19 families identified that it contained 16 species of Teleost, 3 species of Elasmobranchs and 3 species of invertebrate (Table 1). Proportion of total bycatch biomass to total myctophid biomass was estimated 29.64% to 70.36% that discard with 7.31% and incidental catch with 92.69% constituted total bycatch biomass.

Table 1. Percentage occurrence and CPUE of bycatch (incidental catch+ discard) species in the autumn and winter (September, October, November, December, January, February, March)

<table>
<thead>
<tr>
<th>Bycatch groups</th>
<th>family</th>
<th>Species</th>
<th>Autumn</th>
<th>Winter</th>
<th>Autumn</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teleosts</td>
<td>Trichiuriidae</td>
<td><em>Trichiurus lepturus</em></td>
<td>57.64</td>
<td>56.34</td>
<td>410.70</td>
<td>491.11</td>
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<tr>
<td></td>
<td>scianida</td>
<td><em>Pennahia macrophthalmus</em></td>
<td>14.13</td>
<td>13.68</td>
<td>96.64</td>
<td>112.67</td>
</tr>
<tr>
<td></td>
<td>Nemipteridae</td>
<td><em>Nemipterus japonicas</em></td>
<td>3.92</td>
<td>3.94</td>
<td>29.32</td>
<td>33.29</td>
</tr>
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<td></td>
<td>Serranidae</td>
<td><em>Epinephelus coioides</em></td>
<td>2.05</td>
<td>1.40</td>
<td>13.80</td>
<td>12.69</td>
</tr>
<tr>
<td></td>
<td>synodontidae</td>
<td><em>Saurida tumbil</em></td>
<td>2.81</td>
<td>4</td>
<td>20.61</td>
<td>33.91</td>
</tr>
<tr>
<td></td>
<td>platicephalidae</td>
<td><em>Grammoplites suppositus</em></td>
<td>0.35</td>
<td>0.28</td>
<td>2.59</td>
<td>2.54</td>
</tr>
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<td></td>
<td>Muraenesocidae</td>
<td><em>Muraenoesox cinereus</em></td>
<td>1.46</td>
<td>1.36</td>
<td>10.56</td>
<td>12.10</td>
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<tr>
<td></td>
<td>caranjidae</td>
<td><em>Lactarius lactarius</em></td>
<td>0.91</td>
<td>2.45</td>
<td>7.49</td>
<td>20.39</td>
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<tr>
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<td>Arridae</td>
<td><em>Arios thalassinus</em></td>
<td>0</td>
<td>0.46</td>
<td>0</td>
<td>3.65</td>
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<tr>
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<td>solidae</td>
<td><em>Solea elongate</em></td>
<td>0.80</td>
<td>0.58</td>
<td>5.41</td>
<td>5.30</td>
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<td></td>
<td>caranjidae</td>
<td><em>Carangoides talampanoides</em></td>
<td>0.25</td>
<td>0.45</td>
<td>1.92</td>
<td>3.65</td>
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<td></td>
<td>caranjidae</td>
<td><em>Selar crumenophthalmus</em></td>
<td>2.35</td>
<td>1.47</td>
<td>19.01</td>
<td>12.84</td>
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<td>sphyraenidae</td>
<td><em>Sphyraena forsteri</em></td>
<td>0.95</td>
<td>1.37</td>
<td>7.99</td>
<td>12.77</td>
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<td>caranjidae</td>
<td><em>Atropus atropos</em></td>
<td>1.34</td>
<td>1.97</td>
<td>10.66</td>
<td>16.59</td>
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<tr>
<td></td>
<td>Sparidae</td>
<td><em>Achanthoparus latus</em></td>
<td>0</td>
<td>0.45</td>
<td>0</td>
<td>3.08</td>
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<td>Pomadasidae</td>
<td><em>Pomadasys kaakan</em></td>
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<td>Elasmobranshs</td>
<td>Carcharhinidae</td>
<td><em>Carcharhinus dussumieri</em></td>
<td>2.75</td>
<td>1.54</td>
<td>20.42</td>
<td>13.49</td>
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<tr>
<td></td>
<td>Carcharhinidae</td>
<td><em>Galeocerdo cuvieri</em></td>
<td>1.75</td>
<td>1.24</td>
<td>14.05</td>
<td>10.24</td>
</tr>
<tr>
<td></td>
<td>invertebrates</td>
<td><em>Rhinobatus annandalei</em></td>
<td>0.21</td>
<td>0.31</td>
<td>1.39</td>
<td>2.82</td>
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<td>Loliginidae</td>
<td><em>Stenotenithis oualoniensis</em></td>
<td>5.65</td>
<td>4.76</td>
<td>44.34</td>
<td>45.51</td>
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<td>Portunidae</td>
<td><em>Portunus sp.</em></td>
<td>0.25</td>
<td>0.14</td>
<td>1.81</td>
<td>1.30</td>
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<td>Potamididae</td>
<td><em>Terebralia palustris</em></td>
<td>0.43</td>
<td>0.26</td>
<td>3.00</td>
<td>2.35</td>
</tr>
</tbody>
</table>

The portion Invertebrates, Elasmobranchs and Teleost to the total bycatch weight were 5.52, 3.64 and 90.84% respectively. The majority of the bycatch comprised two *Trichiurus lepturus, Pennahia macrophthalmus* and has formed a large proportion of the total catch 57 and 14 percent respectively. Three elasmobranch families were caught in the myctophid midwater trawling (Table
In total, Elasmobranchs accounted for 7.8% of the total bycatch. Of the Elasmobranch bycatch, Carcharhinus dussumieri was the most frequently taken (93.7%) and Galeo cerdo cuievieri was the second most frequency (5.2%) of total elasmobranch catch. Carcharhinus dussumieri were less than 1 m in length usually and were discarded. No by-catches of marine mammals took place during any of the 140 fishing hauls. The mean catch value of the total bycatch biomass have not different significant between autumn and winter (P<0.01). Only for Lactarius lactarius had significantly different mean bycatch between two seasons and there isn’t differ significantly among other species in two seasons. Amount of bycatch in autumn was higher than the winter (fig2, 3 and table2).

Overall in this study, proportion target to bycatch was 70 to 30 approximately (Fig. 4).

| Table 2. Percentage occurrence of target and bycatch (incidental catch+ discard) in the autumn and winter. |
|---------------------------------------------------|----------------|----------------|-------------|
| Autumn                                            | Target: 63.76  | Bycatch: 36.24 | Incidental catch: 92 | Discard: 8 |
| Winter                                            | Target: 76.97  | Bycatch: 23.03 | Incidental catch: 93.38 | Discard: 6.62 |
| Total                                             | Target: 70.36  | Bycatch: 29.64 | Incidental catch: 92.69 | Discard: 7.31 |
Target

Bycatch

Fig. 4. Proportion of bycatch and target fishing in total.

Sustainability of bycatch populations in tropical fisheries has become an increasing concern of managers and government. This has led to substantial research into methods to assess and monitor the sustainability of their catches (Stobutzki et al., 2001; Milton, 2001; Griffiths et al., 2006). Several reports of shrimp trawl fishery were conducted in the Iranian waters (Paighambari et al., 2003; Valinassab et al., 2006; Paighambari and Daliri, 2012) but we don’t have any information about midwater trawl bycatch. In this study we try to estimate mean total bycatch value and species composition in myctophid midwater trawl in Iranian waters of Oman Sea. There is no doubt that lantern fish have an important role in the food chain of the Oman Sea. However, according to Valinassab et al. (2007) the total harvesting percentage is very low (<10% of the total biomass) and exploitation of the D2 layer (depth 250-400 m) is not proposed. Thus with their life cycle of 1 year (or less) and their high abundance in deeper waters, the lantern fish exploitation is not expected to have harmful effects on these virgin resources.

In September to October the bycatch value was higher, which corresponded to the peak abundance of *T. lepturus*. Therefore the bycatch value for others months were lower than September and October. These results indicate that the highest bycatch rates occurred during September and October in the northwest Oman Sea.

The wide fluctuation in *T. lepturus* catch rates observed here are likely typical off in fish assemblages captured by midwater trawl. This is probably attributable to then on random distribution of *T. lepturus* populations. In this study we observed a tendency for fishermen to avoid areas where large quantities of by-catch were caught. The latter could explain the high variances of the large ratio estimates in September, October and November, when myctophidae catches were poor.

It is our belief that this area represents about 80% of that covered by the myctophid midwater commercial fishing. It was observed during this study that discarded tiny fish were fed upon by sea birds. Possibly crabs (most of the crabs in the by-catch were returned to the sea alive) and other organisms may also be attracted to the sea discards (Saila, 1983). However, it is generally believed that most of the discards usually decompose and become remain realized into nitrogen and other nutrients (Cushing, 1981; Sheridan et al., 1984).

In the Australian shrimp trawl fisheries amount of bycatch has been significantly declined due to use of Bycatch Reduction Device (BRDs) since 2000 (Brewer et al., 2006 and Petra et al 2010). In shrimp trawls only 6% of the bycatch is marketed, unlike most artisanal trawl fisheries where most bycatch is retained (Saila, 1983). An estimated 1,500,400 kg of finfish and crabs are discarded annually from this artisanal trawl fishery. In this study bycatch-to-myctophidae ratio was 30%-to-70% that indicate myctophid midwater trawl have lesser than bycatch in comparison shrimp trawl fishery, in the other hand more than 90% bycatch was incidental catch that can be used as target fish for economic purpose.

4. CONCLUSION

In the bycatch of the myctophid midwater trawl fisheries main family are Trichiuridae, Scianidae, Nemipteridae and Caranjidae. Greatest amount of discard were Elasmobranches that are at or near the apex of marine food webs and thus their removal can have a significant impact on the trophic structure of an ecosystem (Camhi et al., 1998;
Stevens et al., 2000; Shepard and Myers, 2005). Furthermore certain biological characteristics Elasmobranches, such as their long life spans, low fecundities, and late ages at maturity, limit their ability both to withstand fishing pressure, either when targeted or caught incidentally, and to recover from overexploitation (Stevens et al., 2000; Walker, 2005a; Gallucci et al., 2006). In general, the populations of endemic species or those that have localized distributions tend to be most prone to over-fishing (Stevens et al., 2000). Moreover, there are little or no data on the reproductive biology of most bycatch species. Such data are required for determining the resilience of these species to fishing pressure, thereby enabling the development of management plans for conserving their populations (Frisk et al., 2001; Stobutzki et al., 2002; Walker, 2005b).

In the myctophid midwater trawl fisheries BRDs are not used, use of BRDs in myctophid midwater trawl fisheries can reduce the amount of bycatch.

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REFERENCES


