OBSERVATION ON THE TUNA SHOALS ASSOCIATED WITH FLOTSAM IN THE OFFSHORE WATERS OF MINICOY ISLAND DURING 1982-83 SEASON

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The association of fishes with floating objects has been exploited by a number of fisheries. Tunas have long been known to aggregate around floating objects such as logs, masses of drifting seaweed, debris and other flotsam. Japanese pole-and-line fisheries and American purse seine and live-bait fisheries take advantage of the association of yellowfin tuna (*Thunnus albacares*) and oceanic skipjack (*Katsuwonus pelamis*) with logs and other flotsam (Uda 1983; Mc Neely 1961; Kimura 1954 and Inoue et al. 1963, 1968). The catch per set of yellowfin and other tunas in association with flotsam by purse seiners has increased in recent years.

This paper provides preliminary information on the catch pattern, ecology and behaviour of tuna species associated with floating objects in the waters around Minicoy during 1982-83 tuna fishing season.

These studies are based on data collected during 1982-83 tuna fishing season only for those fishing boats who fished on tuna shoals associated with flotsam. Distance and direction from Minicoy of flotsams and species and quantity of bait fishes used were recorded by enquiry with fishermen engaged in tuna fishing. Flotsam objects were physically examined by the author. Fork length of skipjack and yellowfin, their stomach condition, sex and maturity stages were recorded whenever it was possible.

**CHARACTERISTICS AND DISTRIBUTION OF FLOTSAM OBJECTS**

On most of the occasions, flotsam objects were wooden material drifting with sea currents towards Minicoy. Other objects which were associated along with tuna shoals were nylon nets, rubber pieces, nylon ropes and plastic pieces. Maximum flotsam were observed from October to December 1982 and April-May 1982. During February and March flotsam could not be observed around Minicoy waters. Distance of sightings from Minicoy varied from 2 km to 7 km and flotsam were observed in almost all the direction from the Island.

Most of the flotsam had some attached algal material and very rarely a few ascidians. Fishermen informed the author that very few small fishes were found around flotsam. When tuna fishing commenced around flotsam, these small fishes disappeared from sight. This may be the reason that tuna responded to bait fishes whenever it was thrown from the fishing boat.

**BAIT FISHES USED**

*Chromis* spp. were the main species followed by *Spratelloides delicatulus* used to attract tuna from floating objects to tuna fishing boats. Out of 75 fishing boats observed during these studies the amount of bait used could be recorded only for 28 boats which used 57.5 kg of bait fishes.

Monthwise amount of bait fishes used, catches from around flotsam and catch per unit of bait are given in Table 1. The maximum CPUB was recorded during October and lowest in December.

Always more than one fishing boat approached a floating object. The first boat used bait to chum tuna and on most of the occasions it was not necessary for other boats to throw bait since tuna shoals were already feeding on bait thrown by the first boat.

**TUNA CATCHES**

Totally 26 nos. of flotsam were observed from November 1982 to May 1983. 75 tuna fishing boats approached...
These shoals and caught 40,886.1 kg of fishes around them. The maximum catch was recorded from six flotsam during October when 14 fishing boats could catch 13,371.6 kg of fishes. This was followed in April when 17 boats fished 7,960.5 kg of fishes from around five flotsam and in November when 19 boats caught 7,121.5 kg of fishes from around 8 flotsams.

Specieswise, yellowfin (Thunnus albacares) dominated the catches and accounted for 18,875.5 kg (46.17%) of the total catches. It was followed by skipjack (Katsuwonus pelamis) 11,106.3 kg (27.16%), sharks 7,558 kg (18.48%), Elagatis bipinnulatus 2,677.8 kg (6.56%), Coryphaena 376.5 kg (0.93%), Acanthocybium 210 kg (0.52%), Sphyraena 10 kg (0.02%), Euthynnus affinis 15 kg (0.03%), Auxis 9 kg (0.02%), Caranx spp. 7.5 kg. (0.02%) and miscellaneous fishes 40.5 kg (0.09%) (Table 2).

On one occasion fishermen located a flotsam which was surrounded by sharks. When fishermen tried to catch them, they dispersed from the flotsam and did not return. Once a tuna shoal was located little away from the floating object. On some occasions biting by the tuna species was very poor and even with the help of bait fish they could not be chummed.

**Seasonal Variation in occurrence of different species**

During the course of these investigations both the species of tunas i.e. Katsuwonus pelamis and Thunnus albacares, Sharks (Carcharias spp.) and Elagatis bipinnulatus were available from September to May. Other species such as Caranx spp., Coryphaena spp., Auxis, Euthynnus affinis and Acanthocybium were caught occasionally. The percentage occurrence of different species is given in Table 2 from which it can be seen that yellowfin dominated in flotsam catches during September to November and April, while skipjack dominated during December, January and May. Sharks supported the catches substantially during November, December and April. Catches of Elagatis bipinnulatus were good during September, October and December.

**Catch per unit effort:** Average catch per unit of effort for the season as a whole from flotsam associated catches was 908.58 kg. The maximum cpue as can be seen from Table 3 was recorded during October being 1593.05 kg which was followed during December 1,150.5 kg, September 1,040.33 kg, April 780.44 kg, May 722.83 kg, November 624.70 kg and lowest during January 507.67 kg.

It is interesting to note here that the average cpue from flotsam catches was about three times higher than the average cpue for pole-and-line catches during 1982-83 tuna fishing season. The main reason for the higher cpue for flotsam associated catches is, the availability of fishes in good numbers around these floating objects.

![Table 1. Amount of bait used and fish catch from flotsam objects](image)

<table>
<thead>
<tr>
<th>Month</th>
<th>No. of Units operated</th>
<th>Bait used in kg</th>
<th>Fish catch in kg</th>
<th>Catch per unit of bait in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>3</td>
<td>14</td>
<td>2201.5</td>
<td>157.25</td>
</tr>
<tr>
<td>October</td>
<td>8</td>
<td>14</td>
<td>7061.1</td>
<td>407.57</td>
</tr>
<tr>
<td>November</td>
<td>11</td>
<td>11.5</td>
<td>4264.5</td>
<td>370.83</td>
</tr>
<tr>
<td>December</td>
<td>2</td>
<td>9</td>
<td>1052.5</td>
<td>103.61</td>
</tr>
<tr>
<td>May</td>
<td>4</td>
<td>9</td>
<td>2776</td>
<td>308.44</td>
</tr>
<tr>
<td>Total for the season</td>
<td>28</td>
<td>57.5</td>
<td>15880.6</td>
<td>276.18</td>
</tr>
</tbody>
</table>

**Table 2. Percentage contribution of different species of fish from flotsam associated catches**

<table>
<thead>
<tr>
<th>Month</th>
<th>Katsuwonus pelamis</th>
<th>Thunnus albacares</th>
<th>Shark</th>
<th>Elagatis bipinnulatus</th>
<th>Coryphaena sp.</th>
<th>Sphyraena sp.</th>
<th>Coryphaena sp.</th>
<th>Auxis</th>
<th>Caranx</th>
<th>Euthynmys affinis</th>
<th>Misc.</th>
<th>Total in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>21.87</td>
<td>61.73</td>
<td>6.45</td>
<td>9.45</td>
<td>0.45</td>
<td>0.14</td>
<td>0.11</td>
<td>0.21</td>
<td>0.10</td>
<td>0.10</td>
<td>3,121</td>
<td>5.05</td>
</tr>
<tr>
<td>October</td>
<td>11.46</td>
<td>59.81</td>
<td>16.65</td>
<td>11.33</td>
<td>0.45</td>
<td>1.49</td>
<td>7.30</td>
<td>0.10</td>
<td>0.10</td>
<td>1,532</td>
<td>13,571.6</td>
<td>0.16</td>
</tr>
<tr>
<td>November</td>
<td>30.33</td>
<td>37.84</td>
<td>24.40</td>
<td>5.40</td>
<td>0.06</td>
<td>0.14</td>
<td>0.11</td>
<td>0.21</td>
<td>0.10</td>
<td>1,532</td>
<td>7,121.5</td>
<td>3,451.5</td>
</tr>
<tr>
<td>December</td>
<td>35.94</td>
<td>19.62</td>
<td>22.72</td>
<td>10.60</td>
<td>3.82</td>
<td>7.30</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>1,532</td>
<td>3,451.5</td>
<td>3,451.5</td>
</tr>
<tr>
<td>January</td>
<td>78.04</td>
<td>6.70</td>
<td>14.18</td>
<td>0.10</td>
<td>0.78</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>1,532</td>
<td>1,532</td>
<td>1,532</td>
</tr>
<tr>
<td>February</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
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<td>...</td>
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<td>...</td>
</tr>
<tr>
<td>March</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>April</td>
<td>24.50</td>
<td>49.44</td>
<td>24.62</td>
<td>0.96</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>7,980.5</td>
<td>4,537</td>
<td>4,537</td>
</tr>
<tr>
<td>May</td>
<td>43.49</td>
<td>35.55</td>
<td>10.01</td>
<td>0.95</td>
<td></td>
<td>...</td>
<td>...</td>
<td></td>
<td>...</td>
<td>40,886.1</td>
<td></td>
<td>40,886.1</td>
</tr>
<tr>
<td>Total</td>
<td>11,106.3</td>
<td>18,875.5</td>
<td>7,558</td>
<td>2,677.8</td>
<td>210</td>
<td>10</td>
<td>376.5</td>
<td>9</td>
<td>15</td>
<td>40.5</td>
<td>40,886.1</td>
<td>40,886.1</td>
</tr>
<tr>
<td>Percentage</td>
<td>27.16</td>
<td>46.17</td>
<td>18.48</td>
<td>6.56</td>
<td>0.52</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
<td>0.09</td>
<td>189</td>
<td>189</td>
</tr>
</tbody>
</table>

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Table 3. Monthwise total effort, nos of flotsams, total fish catch and catch per unit of effort for flotsam associated fish landings during 1982-83 tuna fishing season

<table>
<thead>
<tr>
<th>Months</th>
<th>Effect</th>
<th>Flotsam nos.</th>
<th>Total fish catch in kg.</th>
<th>Catch per unit of effort in kg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>3</td>
<td>1</td>
<td>3121</td>
<td>1040.33</td>
</tr>
<tr>
<td>October</td>
<td>8.4</td>
<td>6</td>
<td>13371.6</td>
<td>1593.05</td>
</tr>
<tr>
<td>November</td>
<td>11.4</td>
<td>8</td>
<td>7121.5</td>
<td>624.70</td>
</tr>
<tr>
<td>December</td>
<td>3</td>
<td>1</td>
<td>3451.5</td>
<td>1150.5</td>
</tr>
<tr>
<td>January</td>
<td>3</td>
<td>2</td>
<td>1523</td>
<td>507.67</td>
</tr>
<tr>
<td>April</td>
<td>10.2</td>
<td>5</td>
<td>7960.5</td>
<td>780.44</td>
</tr>
<tr>
<td>May</td>
<td>6</td>
<td>3</td>
<td>4337</td>
<td>722.83</td>
</tr>
</tbody>
</table>

Catch per flotsam object; As can be seen from Fig. 1 the maximum catch per flotsam was recorded during December being 3,451.5 kg which was followed in September 3,121 kg, October 13,371.6 kg, November 7,121.5 kg, December 3,451.5 kg, January 1,523 kg, April 7,960.5 kg and May 4,337 kg. The average catch per flotsam object for the season as a whole was 1,572.54 kg.

Length frequency distribution of tunas; The fork length of two main species of tunas namely skipjack (Katsuwonus pelamis) and yellowfin (Thunnus albacares) were recorded and analysed.

![Fig. 1. Total catch of tunas from around flotsam at Minicoy, 1982-83.](image1)

![Fig. 2. Length frequency distribution of K. pelamis taken from around flotsam at Minicoy, 1982-83 (Sept.-Nov. 1982 and April-May 1983).](image2)

*Katsuwonus pelamis;* As can be seen from Fig. 2, during September the length of the fish ranged from 400 mm to 620 mm and size group 440-540 mm dominated. The next month, the length ranged between 340 to 560 mm. During November it ranged from 320 to 640 mm with 3 size groups 380-420 mm, 480-500 mm and 580-600 mm dominating. During April it ranged from 280 to 600 mm when the size range 300 to 380 mm was dominant. Next month the range was 260 to 440 mm with size group 280-420 mm showing dominance.

*Thunnus albacares;* As can be seen from the Fig. 3, during September the length of yellowfin ranged from 420 to 640 mm and size group 520 to 560 mm...
Domination by younger fish in October-November was noted, with sizes ranging from 400-440 mm. In November, size group 480-500 mm dominated. During April, fish lengths ranged from 320 to 600 mm, with two modal sizes at 340-380 mm and 560 to 580 mm. May catches were dominated by small fish, between 300 to 360 mm, with a total range of 280 to 560 mm.

From July to November, wind and upwelling caused clockwise and anticlockwise surface sea currents in the Lakshadweep and Maldives region (Silas and Pillai, 1982). Every year, during August to October, large numbers of Coelenterates, especially pelagic Siphonophores (Porpita spp.) and Physalia physalis, are washed ashore along the western shore of Minicoy. During September 1982, an unusual invasion of Minicoy lagoon by Ctenochaetus strigosus was observed for the first time in the history of Minicoy Island. Schools of this species almost covered the Minicoy lagoon, stock of which certainly originated elsewhere but reached Minicoy alongwith strong sea water currents. This clearly indicates a strong sea surface current towards Minicoy bringing alongith flotsam objects. Strong wind also plays an important role in the floating and drifting of wooden objects. So the occurrence of flotsam objects around Minicoy from September to December and again during April and May may be because of mixed processes of strong sea surface current and strong winds towards Minicoy.

The occurrence of very young skipjack ranging from 30 to 40 cm associated with flotsam objects during October and again during April-May is significant. Shoals of such small skipjack may be available far away from Minicoy, but they are reaching Minicoy only when they are associated with floating objects. Generally length of the skipjack at recruitment to the commercial catches at Minicoy is more than 40 cm.

But in the case of yellowfin, young fishes between 30 to 50 cm were found associated mostly with flotsam. Even in commercial catches at Minicoy, yellowfin available is more than 50 cm in length. Big yellowfin of more than 70 cm long are caught only by the troll line gear during the monsoon season. So it can be said that in one way floating objects help in the recruitment of young tunas to commercial pole-and-line tuna fishing.

HYPOTHESIS

Several hypothesis have been proposed to explain the association of fishes with floating objects, but the reasons for the attraction of fishes to floating objects have not been fully substantiated. Some of them are:

1. Fish are attracted to the object to feed on associated forage organisms, algae or decaying matter.
2. Fish seek shade under the object.
3. The object provides shelter from predators.
4. The object is used as a substrate on which the fish lay their eggs.
5. The object functions as a cleaning station where pelagic fishes congregate to have their parasites removed by other fishes.

Gooding and Magnuson (1967) and Hunter and Mitchell (1967) have examined these hypothesis. While the former authors concluded that shelter from predators was probably the most significant drawing force in attracting fish to a floating object, Hunter and Mitchell, on the other hand, found no evidence in support of the hypothesis. They concluded:

1. Fishes associate with floating objects because the object serve as a schooling companion and,
2. In the case of non-pelagic species and others undergoing a change from pelagic to other modes of existence and object may function as a substitute for a reef or some other type of substrate.

As far as hypothesis with regard to feeding is concerned the floating objects examined during these studies did not contain much food except some algal encrustation. On one occasion one small plastic piece served as floating object and nothing was attached to it. Moreover, for juvenile and non-piscivorous adult fishes this hypothesis would not apply. Food content analysis of tunas revealed that mostly bait fish used for chumming tuna were present. The only possibility of food may be the visible macro-plankton under the shadow of the object. But it is not clear how a small floating object can provide plankton aggregation for large shoals of fish.

As for the hypothesis regarding laying of eggs, most of the species caught from flotsam such as skipjack, yellowfin, Elagatis bipinnulatus and Coryphaena spp. are pelagic in nature and they shed their eggs in open sea.

During these studies floating objects such as nylon rope or nylon nets were also encountered which cannot give shelter to even very small school of fishes.

Most of the species caught from the floating objects generally school at the surface and some of them occur together. At Minicoy skipjack and yellowfin are found schooling together. On most of the occasions Elagates bipinnulatus and dolphin fish are also caught along with tunas. Tuna schools are found sometimes with shoals of sharks and dolphins.

After examining all the above hypothesis it appears that association of tunas with floating objects is nothing but merely a coincidence. Since almost all the species are found at one time or other schooling together their occurrence with floating objects does not show any change in their schooling pattern. Whenever a tuna shoal with other species of fish move with the sea water currents incidentally they observe a floating object as reference point and aggregate around it. In short, floating objects appear to serve only as companions drifting in the same direction with tuna shoals. It helps tuna fishermen in locating tuna shoals and makes their task easier for scouting of tuna schools.
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