Creation of a database to identify factors affecting CPUE of the Japanese equatorial purse seine fishery.

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1. Introduction
The development of reliable abundance indices from the tuna purse seine fishery has been problematic (ICCAT 1999). One of the reasons is that factors affecting CPUE of this fishery have not been collected routinely since the changes in fishing technique or introduction or improvement of fishing or navigation equipment have occurred unpredictably and quickly.

The catch of yellowfin by this fishery has surpassed the catches made by other fisheries such as longline and pole-and-line in most waters since more than or nearly two decades ago. In assessing status of such stock, the analysis of such catch statistics is essential, although this is not possible.

When the fishery was simple in fishing technique and performance of boats were considered to be relatively homogeneous, CPUE was adjusted to only mode of operation such as type of school, area, etc. This became difficult in recent years due to the complicated nature of the fishery. To overcome it, some attempts (Anon. 1999) were already taken in several national fleets. This paper summarizes the continued work along that line for the Japanese purse seine fishery. Shono et al. (in press) presents preliminary results of CPUE standardization using data obtained in this study.

2. Description of the fishery
Japanese equatorial purse seine vessels have been operating in tropical area in the western Pacific Ocean since the late 1960s mostly fishing on fish schools associated with drifting log. They are mainly targeting skipjack and yellowfin tuna and bigeye is also caught. In recent years 32 to 35 vessels (most of them range 340 to 500 gross tonnage (GRT)) have been licensed, and this number has been relatively stable. Until around 1990, there were several group seiners (135 GRT) seasonally operated in the equatorial waters, but these were substituted with single seiners thereafter.

Total annual catch amount in recent years is about 160,000 – 170,000 MT (Fig. 1). Of that about 70-80 % is skipjack, followed by yellowfin with very minor amount of bigeye (usually less than 3 %). In recent years over the half of the sets are made on log-associated schools as shown in Fig. 2. Hereafter, school type is classified into either 1) associated school or 2) free swimming school, i.e., all types of associated school (log, FADs, whale, shark, dolphin) except for boat associated are categorized as log school. Majority of skipjack is caught by the associated school (Fig. 3), and this is true for yellowfin to the lesser extent. Proportion of skipjack catch is higher in associated school sets than in free swimming school sets, and the opposite is true for yellowfin especially for recent years (Fig. 4). This fact is well coincides with the observation that mixed schools (skipjack, yellowfin) are more common for associated schools than free swimming school, and large yellowfin of free swimming school tends to form pure school.

Fishing days of purse seiner are composed of days with sets made and days used for no set but searching. The frequency of searching days versus days with sets is shown in Fig. 5. The proportion of searching days has been slightly increasing. This tendency appeared to be related to the change of fishing area; namely the expansion of fishing area to the east which occurred in around 1997.

3. Factors considered in this study
Several devices are equipped in the purse seine vessels which are considered to improve fishing efficiency, such as sonar, bird radar, GPS (global positioning system), and so on, and many of these have developed during the course of time. Fishing efficiency of purse seine fishery is considered to be more subject to these devices than in longline fishery, and this perhaps makes it difficult to precisely assess CPUE for purse seine fishery. There are few detailed studies about the effect of devices to catch rates. As Ogura and Shono (1999) reported about the factors affecting fishing effort of Japanese distant water pole and line fishery, we tried to accumulate information on what devices are influential and when those were introduced to purse seine fishery.

A questionnaire was prepared and distributed to the each fishing company who owns purse seiner. The items included in the questionnaire are listed in Table 1.

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The information collected from this survey regarding fishing and navigation devices are shown in Fig. 6 and Fig. 7. It is interesting to note that the introduction of such devices has started during the early 1980s. The improvement of performance in several devices (power block, ship speed, purse winch and bird radar) and new introduction of devices (GPS, high frequency sonar) occurred in around 1990, this is when many new boats were constructed. Now, most vessels own GPS, sonar, bird radar and tele-sounder. On the contrary, fishing net size has been stable for these 20 years.

As for bird radar, which is considered to be useful to search schools, vessel started to equip since 1986, the earlier models of low output (10kw or 30kw) had been replaced with high power 60kw device thereafter. As for sonar, mainly two types (high frequency: 75-107 KH, and low frequency, 24-45KHZ) have been used. Low frequency type was equipped in most vessels from the beginning of the 1980s. High frequency type has been increasing and reached at 60% in recent years. Several vessels are using two types simultaneously. GPS has been equipped in all the vessels analyzed in the present study since 1992.

4. Creation of a database for the CPUE standardization

Information on devices collected in this study were combined with catch data in order to make a database for the analysis of CPUE standardization. Catch data were compiled at the National Research Institute of Far Seas Fisheries based on logbooks. This resulted in total of 67,092 records (29 vessels) of days fishing (set + searching) as shown in Table 2.

Acknowledgements

We are thankful to Messrs Koichiro Sato, Chihiro Kino and Minoru Honda of Japan Far Seas Purse Seine Fishing Association, who cooperated with us in preparation of questionnaires as well as identifying factors to be considered. We are also obliged to Furuno Electric Co., Ltd. and Japan Radio Co., Ltd. for their kind advice and explanation on electronic devices. We are also thankful to the vessels that answered to the question for the devices.

References


Table 1. Items covered in the questionnaire that distributed to the vessels. The times when equipped and modified were also questioned.

| Item                                | Content                                                        |
|-------------------------------------|                                                               |
| Date of construction                | Date                                                           |
| Duration of engagement in fishery    | Date (start and end)                                           |
| Ship speed                          | Cruise and maximum (knot)                                      |
| Gross tonnage of vessel (domestic)  | Tonnage                                                        |
| Capacity of well                    | Tonnage                                                        |
| Power block                         | Power (Ton x m/sec), Maker and model                          |
| Purse winch                         | Power (Ton x m/sec), Maker and model                          |
| Fishing net                         | Total size (width and depth), Mesh size and maker              |
| Bird radar                          | Number, Power (kw), Maker and model                           |
| Sonar                               | Number, Type, Frequency (KHZ), Maker and model                |
| Tele-sounder*                       | Maker and model                                                |
| GPS                                 | Maker and model                                                |
| Satellite weather display           | Maker and model                                                |
| Name of fishing master              | Full name                                                      |
| Comment                             | Comments made by the fishermen regarding the fishing or navigation devices that they believed to improve fishing efficiency. |

*The device which transmits the image of the sonar in the skiff boat to mother boat.

Table 2. Number of daily catch records from which information in Table 1 was obtained.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of catch records (from logbooks)</th>
<th>Number of catch records with information in Table 1</th>
<th>Percentage (%)</th>
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<td>4,684</td>
<td>863</td>
<td>18.4</td>
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<td>7,737</td>
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<td>27.1</td>
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<tr>
<td>1984</td>
<td>9,093</td>
<td>2,865</td>
<td>31.5</td>
</tr>
<tr>
<td>1985</td>
<td>8,917</td>
<td>2,827</td>
<td>31.7</td>
</tr>
<tr>
<td>1986</td>
<td>7,460</td>
<td>2,723</td>
<td>36.5</td>
</tr>
<tr>
<td>1987</td>
<td>7,502</td>
<td>3,089</td>
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<tr>
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<tr>
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<tr>
<td>1999</td>
<td>6,567</td>
<td>4,578</td>
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<tr>
<td>Total</td>
<td>141,548</td>
<td>67,092</td>
<td>47.4</td>
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</table>
Fig. 1 Catch trend by Japanese equatorial purse seine fishery in the Pacific Ocean.

Fig. 2 Number of sets by school type.

Fig. 3. Catch trend of skipjack and yellowfin tuna by school type by Japanese distant water purse seine fishery in the Pacific Ocean.
Fig. 4. Species composition in the catch by school type.

Fig. 5. Annual trend of days with set and searching days.
Fig. 6. Annual changes of the statistics (average) in fishing and navigation devices collected from the purse seiners. Vertical bars in the graph denote maximum and minimum values.
Fig. 7. Appearance of fishing and navigation devices by the purse seiners viewed in terms of number of records. The number of records denotes days fished (both for days with set and days for searching).