Estimation of Japanese purse seine catch by species in the eastern Indian Ocean based on the port sampling program

Takayuki Matsumoto 1/ and Tom Nishida 2/

National Research Institute of Far Seas Fisheries (NRIFSF),
5-7-1, Orido, Shimizu City, Shizuoka, Japan 424-8633

1/ matumot@enyo.affrc.go.jp

2/ tnishida@enyo.affrc.go.jp

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1. Introduction

Japanese distant water purse seine vessels mainly operate in the tropical area of central and western Pacific Ocean and partly in the Indian Ocean (most of them operate in the eastern Indian Ocean). Purse seine fishing companies submit their logbooks to the Fisheries Agency of Japan (FAJ), which make the annual official catch statistics. However, it has been recognized that they are not always accurate because of mis-identification between small yellowfin and bigeye.

Same problem also occurs in another catch information, 'landing statistics by market category' (refer to Table 1 for details) compiled at the landing sites, i.e., some of small bigeye tuna are usually mis-reported as yellowfin tuna. Therefore, bigeye tuna catch in the 'landing statistics' is usually underestimated and that of yellowfin tuna is usually overestimated.

In order to solve this problem, FAJ started the port-sampling program of the purse seine catch in 1994 in Yaizu and Makurazaki ports. In the port samplings, catch from the Pacific Ocean (equatorial fishery) is primarily investigated, while the catch from in the Indian Ocean is occasionally investigated because majority of Japanese vessels operates in the Indian Ocean, which usually unloads at foreign ports (Singapore or Phuket) (Matsumoto *et al*., 2000). In fact, in 1999, only three vessels from the Indian Ocean could be investigated at the Makurazaki port in Japan.

In this paper, we newly estimate catch by species based on the port sampling information and compare with those in the "landing statistics" and the "logbook data". Then, we evaluate discrepancies among these three information and discuss importance of the port-sampling program. In addition, we also estimated size specific catch by species.

2. Materials and methods

2.1 Port sampling program and landing statistics

In 1999, the port sampling for Japanese purse seine catch in the Indian Ocean was conducted only for three fishing trips (from November, 1998 to July, 1999) at the Makurazaki fishing port (Kagoshima Prefecture, Japan), which is one of major landing ports of the distant water purse seiners.

During the unloading, catch are sorted by 'market category (refer to Table 1)' for each species at the landing site. Sorted fish are stored in the containers at the landing site by market category. During the port sampling, fish are sampled from these containers, i.e., 100 fish are randomly collected from each market category by species (skipjack, yellowfin or bigeye tunas). During the sampling, species are also checked if they are correctly identified because, as mentioned previously, there are some mis-identification problems between small yellowfin and bigeye. Sizes (fork length) of all sampled fish were also measured by 1 cm interval.

Table 1 List of market category at the Makurazaki fishing port.

Species	Market category
Skipjack tuna	**Under 0.5 ?**
	Under 1.8 ?
	Over 1.8 ?
	Over 2.5 ?
	Over 4.5 ?
	Over 6?
	Over 8?
	Bruised
Yellowfin tuna	**Under 1.5 ?**
	Over 1.5 ?
	Over 3?
	Over 5?
	Over 10?
	Bruised
Bigeye tuna	**Over 1.5 ?**
	Over 3?
	Over 10kg

In addition, information of each fishing trip (date, time, location of fishing operation, log or FAD associated operation) was acquired from logbooks. Fig. **1** shows the locations of the fishing operation of three fishing trips. Based on that information, it was resulted that composition of natural log and FAD associated operations were 12% and 88% respectively and there were no free swimming operations.

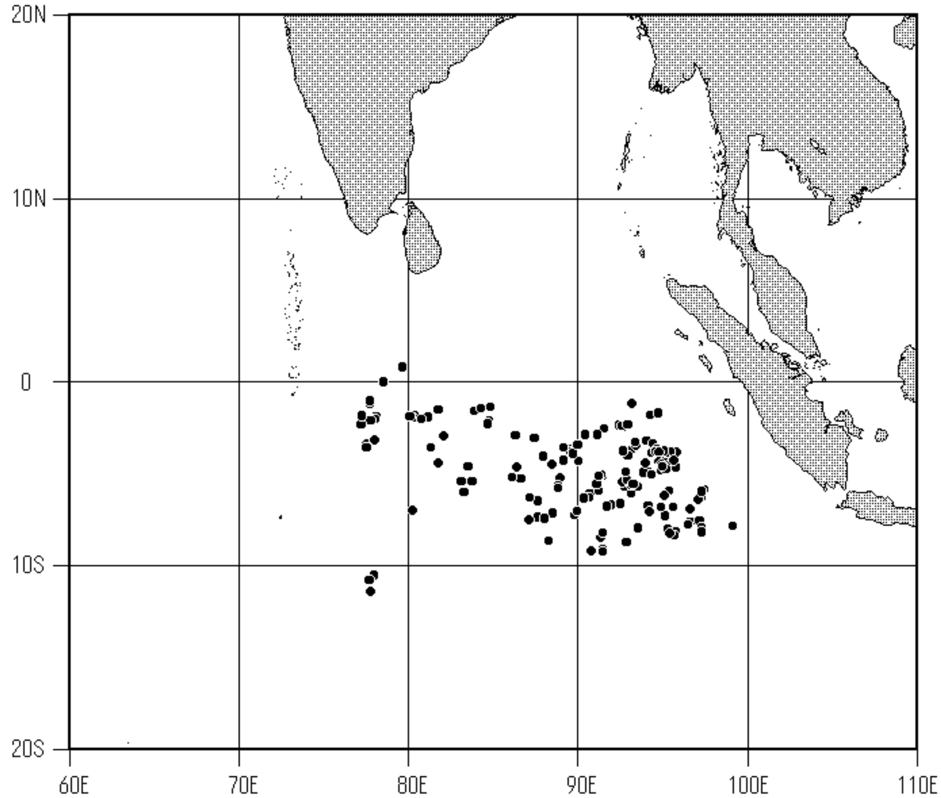

Fig. 1 Locations of Japanese purse seine fishing operations in 1998/99 based on the logbook information obtained by the port sampling information in at the Makurazaki port.

Landing statistics by species and market category were obtained from the Makurazaki fishing port authority and they were complied at National Research Institute of Far Seas Fisheries. Then, we compared catch by species between two sources (port sampling and landing statistics). Then, we found that some small bigeye tuna were often mixed into the yellowfin categories in the landing statistics. This result is based on the assumption that the port sampling figures are correct.

2.2 Estimation of catch by species and catch by species and size

(1) Estimation of catch by species

After the port sampling was over, sample catch were compiled by species and market category. Then sample catch by species were computed by adding those in market category. Then, the total catch by species was estimated by the following equation:

Catch by species

= (species composition based on port sampling) x (total landed catch) ------------------(a)

(2) Estimation of landed catch by species and size

Sample size data are compiled by species and size. Then, percentage size frequency distributions were computed. Then, landed catch by size are estimated by following equations:

Landed catch by species and size = (percent size frequency distribution) x (a)

(3) Summary

Fig. 2 shows the summary of the estimation procedures.

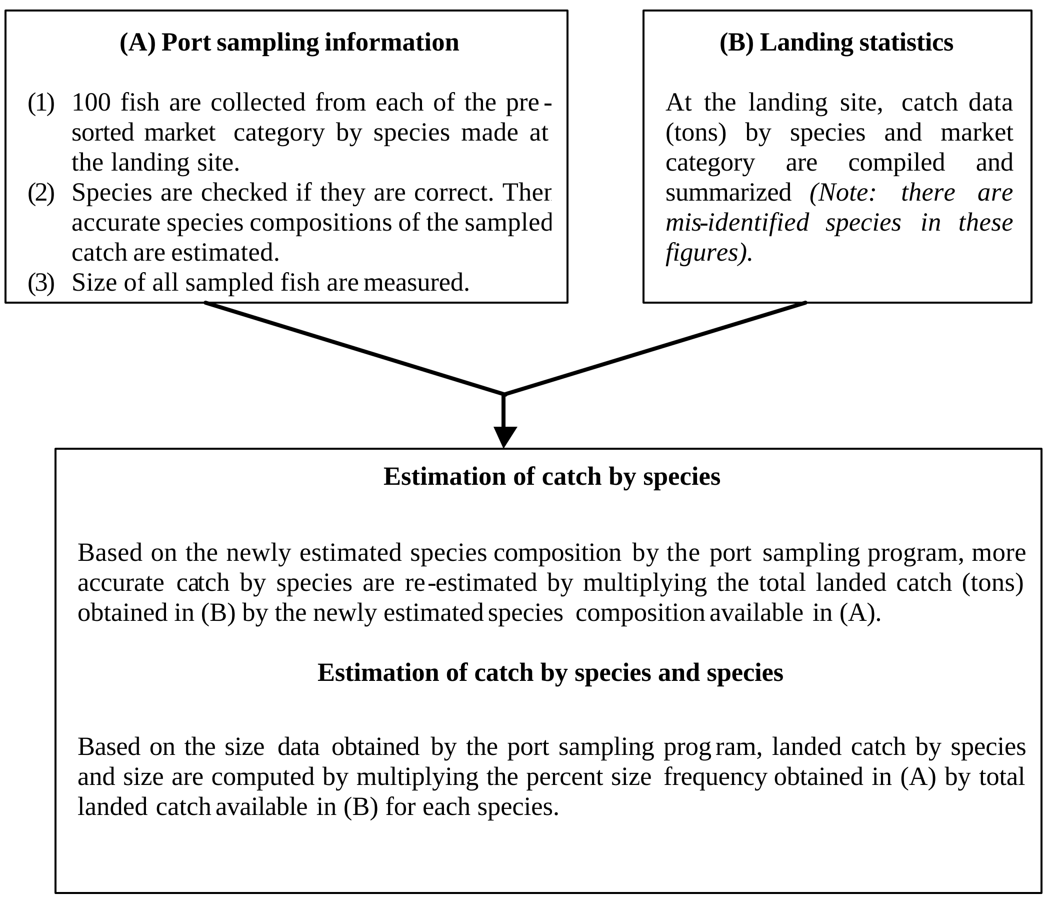

Fig. 2. Flowchart on the estimation procedure for catch by species and also catch by species and size based on the information of the port sampling program and the landing statistics.

3. Results and discussions

Number of fish sampled (measured) and the landed catch (tons) by species and market category are shown in Table 2. A total of 4,557 fish were measured in the three times of the port samplings. Species composition based on this port sampling is resulted as follows: skipjack (64%), yellowfin (23%) and bigeye (14%).

Table 2 Total catch (tons) based on the landing statistics and number of fish measured by the port-sampling program by species and market category.

Species	Market category	Landed cat ch in MT	Number of fish measured
Skipjack tuna	**Under 0.5 ?**	31.5	326
	Under 1.8 ?	443.5	324
	O ver 1.8 ?	187.5	343
	O ver 2.5 ?	290.4	339
	O ver 4.5 ?	53.0	320
	O ver 6 ?	10.8	192
	O ver 8 ?	2.2	24
	Bruised	71.8	606
	Total skipjack	**1090.8**	**2474**
Yellowfin tuna	**Under 1.5 ?**	138.8	338
	O ver 1.5 ?	75.1	304
	O ver 3 ?	60.8	284
	O ver 5 ?	8.8	205
	O ver 10?	93.4	233
	Bruised	10.7	0
	Total yellowfin	**387.7**	**1364**
Bigeye tuna	**O ver 1.5 ?**	100.9	313
	O ver 3 ?	67.1	239
	O ver 10kg	67.5	167
	Total bigeye	**235.6**	**719**
Total		**1714.0**	**4557**

Fig. 3 shows estimated landed catch by species and size (yellowfin, bigeye andskipjack) based on the port sampling information and the landing statistics. For yellowfin tuna, most fish were under 70cm in fork length (FL) with two clear modes (around 40cm and 55cm FL) were observed. For bigeye, the range and modes of length were similar to those of yellowfin, though the mode around 55cm was less clear. For skipjack, most fish sizes were between 30cm and 60cm, and modes of length were similar to those of other two species.

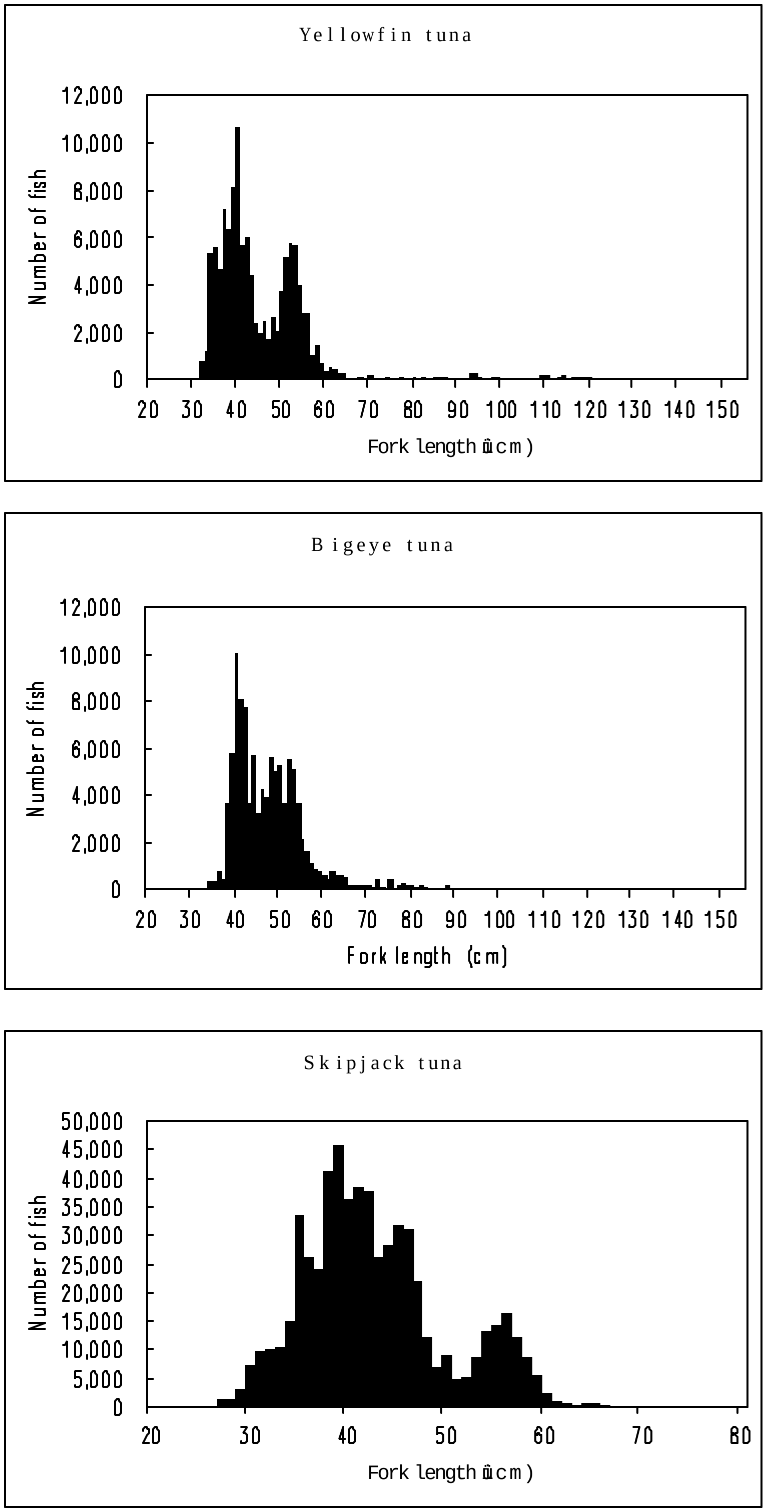

Fig. 3 Estimated landed catch by species and size (yellowfin, bigeye and skipjack) based on the port sampling information and the landing statistics.

Newly estimated catch by species based on by the port sampling programs were compared with those in the landing statistics and the logbook (Table 3 and Fig. 4).

Table 3 Comparisons of catch (tons) by species among three different sources of information.

Source	SKJ	YFT	BET	Total
Landing statistics	1091	388	236	1714
Port sampling program	1091	327	296	1714
Logbook data	1140	285	145	1570

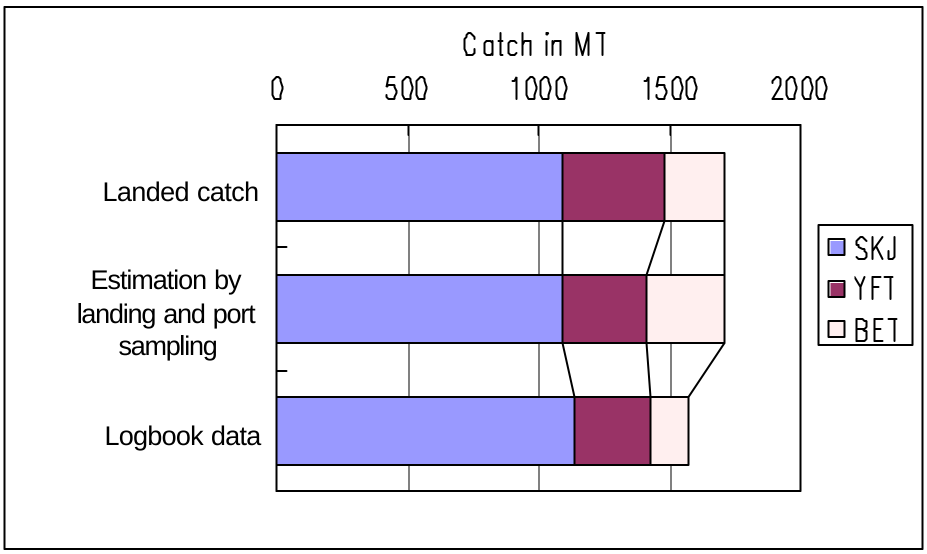

Fig. 4 Comparisons of catch (tons) by species among three different sources of information.

Newly estimated catch (in tons) of bigeye tuna increased 60 MT (26%) from the landing statistics and that of yellowfin decreased 60 MT (16%). This result is similar to that for the catch in the central and western Pacific Ocean (Miyabe *et. al.*, 2000) but the ratio of decrease of the catch of yellowfin was larger than that for Pacific Ocean, probably because fish size was smaller than that of Pacific due to natural log or FAD operations (note: in the Pacific, there are also free-swimming school associated operations).

For comparison between the newly estimated catch and the logbook catch data, yellowfin and bigeye catch of the new figures are less than those of the logbook, while skipjack catch is larger. For bigeye catch of the new figure is remarkably high, i.e., twice of the logbook figure.

These differences are probably caused by the mis -identification between small yellowfin nd bigeye tuna in the logbooks, which are recorded by purse seine fishers during the fishing operation.

It is concluded that port-sampling program is very important to obtain more realistic (accurate) catch statistics by species. Hence, it should be continued as long as possible.

References

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