MARINE RESEARCH

Estimates of SBT Catches in Bali Based on the CSIRO/RIMF Estimation Procedure and Sub-Samples of the Data Collected by the IOTC Coordinated Monitoring Program

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Abstract

Comparisons are made of estimates for SBT landing using the IOTC coordinated estimation procedure and the CSIRO/RIMF estimation procedure following recommendations from the CCSBT Indonesian Catch Monitoring Review Workshop held in April 2003. Comparisons are made using the full data set collected by IOTC from June 2002 through January 2003 and sub-samples of this data set for different coverage levels. However, there are a number of complications in attempting to appropriately mimic the sampling and "coverage levels to provide estimates comparable with the previous CSIRO/RIMF sampling program". The results suggest that as coverage levels decrease that this would not have induced substantial negative or positive biases when using the CSRIO/RIMF estimation procedure. However, because of the difficulties in knowing what constitutes a meaningful representation of the past CSIRO/RIMF sampling program from sub-samples of the IOTC coordinated data, the results should be interpreted with caution.

The results also suggest that there is a substantial amount of heterogeneity among individual processors (as defined in the IOTC coordinated monitoring program) and a marked change in the grading and marketing strategies among processors for the SBT landed. In addition, it appears that individual processors are not specializing in handling SBT and suggest that estimates of SBT catches would not be biased if based on only a sub-set of processors. However, such estimates may contain increased variability relative to estimates based on sampling the full set of processors if overall sampling levels were similar.

Introduction

The CCSBT conducted an Indonesian Catch Monitoring Review Workshop in April 2003 (Anon 2003a). The workshop conducted a review of the past CSIRO/RIMF catch monitoring and estimation methods that have been used in the past to provide estimates of the landed catch in Bali. The conclusions and recommendations of the workshop are to be submitted to the 8th CCSBT Scientific Committee meeting for discussion and comment and then to the 10th meeting of the CCSBT for consideration, approval and implementation.

The Indonesian Catch Monitoring Review Workshop identified two main issues as potential key contributors to errors or bias. These were the representativeness of the samples and the estimated raising factors. The workshop also recognized that the recent development of the IOTC coordinated catch monitoring program[1] has substantially improved the monitoring of catches and addresses a number of concerns about potential sources of biases in the past estimates. As such, the workshop considered that comparisons of estimates using the IOTC data using different estimation procedures might provide insights into possible biases, if any, in the past estimates from the CSIRO/RIMF monitoring system. Specifically, the workshop recommended the following:

[1] This is a collaborative program involving IOTC, CSIRO, ACIAR, OFCF, RIMF and DGGF.

In order to integrate[SIC] evaluation of potential biases across these two issues, for each of the export data set raising methods above, the following analyses should be compared:

- Run available IOTC data (preferably from July 2002 to March 2003) through the CSIRO/RIMF estimation procedure with a coverage level comparable to the CSIRO sampling program.
- Run through CSIRO/RIMF estimation procedure with the full IOTC coordinated data set.
- Run the IOTC estimation procedure with the full IOTC data set

The current paper presents results of analyses based on this recommendation. However, as of July 2003, data were only available from June 2002 through January 2003. As such the analyses present here are based on the data from these months. Although it would be preferable to have been able to include data through March 2003, in terms of the recommended comparisons and any insights they may provide on potential biases the lack of data for two months would not be expected to affect the results.

Material and Methods

Data from the IOTC coordinated monitoring program that could be used to provide catch estimates from Bali using the CSIRO/RIMF estimation procedure were obtained from the IOTC. This included data for January and with the catch by PSB fishing vessels separated from catches by other vessels – neither of which had been available previously. However, the data provided had been raised to whole weight and had to be converted to processed weight to provide comparable data to that used in the past. Whole weights were converted back to process weights using the IOTC conversion factors. The conversion to whole weight and then back again to processed weight appears to have resulted in small discrepancies (most likely due to rounding errors)[2]. Such small discrepancy would not affect the analyses presented here.

The CSIRO/ RIMF estimation procedure is described in Davis and Andamari (2003) and the IOTC coordinated estimation procedure is described in Anon (2003b). The calculations to produce the estimates for the last two recommendations listed above were straightforward to implement and were done using these documented procedures. In order to implement the first recommendation, it was necessary to decide how to most appropriately mimic the "coverage level comparable to the CSIRO/RIMF sampling program". There are a number of complications in attempting to replicate past CSIRO/RIMF estimates using the data collected by the IOTC coordinated:

1. The CSIRO/RIMF monitoring system was based on multi-stage sampling involving a sampling of landing within vessels and vessels within processors. The sampling of processors was limited because of administrative constraints which limited wider access. Moreover, processing arrangements and operational aspects of the longline fishery in Bali have evolved considerably over time. In particular,

[2] Estimates of total SBT catches differ by about 10 tonnes using the CSIRO/RIMF estimation procedure with the data provided previously by IOTC and the updated data covering the period from June through December 2002. There may also have been some small revisions of the IOTC data base which could have contributed to this difference.

the number of processing facilities has increased. Initially, there were limited processing facilities in Bali and a large fraction of the tuna being landed was processed at PSB. Subsequently, the amount of tuna being processed at this processor declined as both the size of the fleet and the number of processors increased. Thus, to determine what coverage level should be used to represent the past data is problematical.

2. The definition of a "processor" in the CSIRO/RIMF data is different to that in data from the IOTC coordinated program. In the CSIRO/RIMF data, the main "processor" was a company that operated more than one processing room which were leased by different companies, and monitoring was carried out at 2-3 of these rooms. Both the number and name of these processing companies varied over time. In the IOTC coordinated program, a processor represents an individual processing company. As such, it is not clear how to link "processors" in the IOTC coordinated data together to represent a "processor" in the past CSIRO/RIMF data.
3. The CSIRO/RIMF monitoring system attempted to collect a high level of coverage of the landing from the processing facilities that it did monitor. In contrast, the IOTC coordinated program is designed to monitor a random sample of landings from all processors. Coverage is estimated to be on the order of ~15-25%. It is not clear how one might compensate for this under sampling of the landings within processor data in the IOTC coordinated data relative to the CSIRO/RIMF monitoring program.
4. The CSIRO/RIMF raising excluded catches by PSB fishing company which were then added after the rest of the monitored catches were raised. This procedure was followed here, but only ~15-25% of PSB fishing company were monitored under the IOTC system whereas nearly all was monitored under the CSIRO/RIMF system. Under the IOTC system it is not necessary to separate PSB fishing company catches before raising[3].

A re-sampling approach was developed to provide estimates with the data collected by the IOTC coordinated program based on the CSIRO/RIMF estimation procedure. However, it is important to keep in mind the above complications in interpreting the results and drawing any conclusions.

The re-sampling approach that was taken was to form sub-samples of the IOTC coordinated data based on combinations of processors (as defined in this data set). As there were only 14 processing companies sampled (assumed to be the complete set of processing companies in Bali), there are only a finite and relatively low number of combinations. As such, estimates of the total SBT catch based on the CSIRO/RIMF estimation procedure were calculated for all possible combination of processors excluding combinations of processors for which no sampling existed in a given month. This resulted in a total of 162 unique sub-sample estimates of the catch based on the IOTC coordinated monitoring data using the CSIRO/RIMF estimation procedure. The resulting estimates were then analysed as both a function of the proportion of the total tuna catch sampled (based on the Dinas data) and as a function of the number of processors.

[3] Note this last factor is more of technical problem in the estimation procedure then a complication when attempting to mimic the CSIRO/RIMF coverage levels.

The basic data required for the CSIRO/RIMF estimation procedure are the catches of SBT landed and the proportions of all tunas (SBT, yellowfin and bigeye) landed that were exported by month. Tables 1 and 2 provide a summary of this information by processor based on the IOTC coordinated sampling program. These are the data which formed the basic sub-sampled data sets.

Results

Figure 1 presents estimates of SBT landed in Bali based on re-sampling of the IOTC coordinated monitored catch data using the CSIRO/RIMF estimation procedure as a function of the proportion of Dinas exports sampled in the various re-sampling subset of processor data. Relative to the estimate based on the full IOTC coordinated data set, there is no indication of any systematic bias as the sampling coverage decreases. As would be expected, the range of possible estimates increases as sampling coverage decreases and the full range of possible estimates is quite wide at lower coverage rates. This suggests that there is a fair amount of variability among processors and that variability among processors is a substantial source of variance (see also Polacheck et al. 2003).

Figure 2 presents similar results to those in Figure 1 except that the estimates of SBT catch are presented as a function of the number of processors sampled. In this case, there is some apparent bias relative to the estimate based on the full IOTC coordinated data set. When the number of processors included in the re-sampled data sets is less than 4, the estimated SBT catch tends to be negatively biased. This appears to be because those combination of processors which had sampled landing in each month tended to have lower catches of SBT.

Figure 3 presents estimates of the SBT landing as a function of the number of processors included in the re-sampled estimates for only those re-sampled estimates which had a coverage rate between 9 and 10% in terms of the Dinas export statistics. In this case, estimates of SBT catches tended to be somewhat negatively biased when based on a low number of processors and positively biased when based on a large number of processors. This is because processors in which the quantity of tunas graded as export quality was large, tended to have lower overall catches of SBT (Figure 4). Thus, processors with low SBT catches will dominate sub-samples of the full data with low number of processors and a coverage level of ~10% and vice-a-versa for sub-samples with high number of processors since a 10% coverage rage is approximately half of the total sampled catch.

Table 3 compares estimates of SBT landing for the period from July to December 2003 based on the data collected under the IOTC coordinated program using the IOTC coordinated estimation procedure on the full data, the CSIRO/RIMF estimation procedure on the full IOTC data set and from sub-samples of the IOTC data with a coverage of ~10% using the CSIRO/RIMF estimation procedure. Two estimates are provided for the full data set estimates based on the CSIRO/RIMF estimation procedure because of slight differences in the March and June data sets and lack of all the data to replicate the IOTC estimation procedure with the more recent data. The results in this table indicate that the CSIRO/RIMF estimation procedure underestimated the total SBT landings by ~18% and that there is no substantive difference on average in the CSIRO/RIMF estimate if only a sub-sample of processors

had been monitored and the overall sampling coverage in terms of the Dinas data were around 10%.

Discussion

The results of these analyses do not suggest that as coverage levels decrease that this would have induced substantial negative or positive biases when using the CSRIO/RIMF estimation procedure. However, for the reasons noted above, it is difficult to know what constitutes a sub-sample from the IOTC coordinated data that can be considered to be a meaningful representation of the past CSIRO/RIMF sampling program. As such, the results presented should be interpreted with caution.

The results suggest that there is a substantial amount of heterogeneity among individual processors (as defined in the IOTC coordinated monitoring program). As shown in Figures 5 and 6, the major source of this variation appears to be the proportion of the landed catch which is SBT. Thus, the proportion of SBT landed ranged from 0 to 17% of the catch landed at individual processors. The variation in the proportion of tunas exported among processors is comparably smaller, but still not negligible (46-67%). The IOTC coordinated data suggests that there has been a marked change and a large degree of heterogeneity in the grading and marketing strategies among processors for the SBT landed. Thus, the proportion of SBT graded as export quality is generally substantially less then the proportion of all tunas graded as such (i.e. compare Figures 6 and 7). This is consistent with the decreasing trend in the proportion of SBT that was graded as export quality in the data from the CSIRO/RIMF monitoring program (Polacheck et al, 2003). Interestingly, there is no apparent relationship between the proportion of SBT graded as export quality and the quantity of SBT landed at a processor (Figure 9), although there is increased variability with lower catches. If anything the trend is slightly negative. This suggests that processors are not specializing in handling SBT. The increased variability at lower catch levels probably reflects the variability in the condition of the SBT being caught (which is known to be large for fish caught on the spawning grounds) combined with variability in market prices for fresh SBT. Such a conclusion would also suggest that estimates of SBT catches would not be biased if based on only a sub-set of processors, but may contain increased variability relative to estimates based on the full set of processors if overall sampling levels were similar.

Literature Cited

Anon. 2003a. Report of the Indonesian Catch Monitoring Review Workshop, 10-11 April 2003, Queenstown, New Zealand.

Anon. 2003b. Notes on IOTC data collection activities in Indonesia. CCSBT-ICM/0304/17.

Davis, T.L.O. and Andamari, R. 2003.The CSIRO/RIMF monitoring systems used to determine the catch of SBT by the Indonesian longline fishery. CCSBT Indonesian Catch Monitoring Review, 10-11 April 2003, Queenstown, New Zealand. CCSBT-ICM/0304/6.

Polacheck, T., T. Patterson and T.L.O. Estimates of precision and sampling biases associated with SBT catch estimates from the CSIRO/RIMF monitoring system. CCSBT Indonesian Catch Monitoring Review, 10-11 April 2003, Queenstown, New Zealand. CCSBT-ICM/0304/9.

Table 1: : The total amount (tonnes) of landed tuna graded as export quality monitored by month and processor in the IOTC coordinated monitoring program

				2002				2003
Processor	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
1	0.00	5.72	13.09	14.32	38.01	11.37	42.61	17.01
2	0.00	13.85	6.93	11.97	6.88	14.23	4.23	19.44
3	27.17	39.72	63.13	46.59	52.66	50.94	30.84	28.66
4	0.00	9.71	6.08	7.11	7.27	9.01	0.42	8.60
5	16.39	19.91	6.68	7.76	12.43	20.37	15.88	15.38
6	18.76	22.41	11.76	18.84	22.74	15.35	24.57	19.04
7	0.00	0.00	0.00	0.00	0.00	2.22	8.91	20.60
8	0.00	1.34	2.06	8.71	8.10	3.40	19.20	0.00
9	17.80	28.64	15.01	32.39	8.95	0.00	0.00	0.00
10	7.71	2.44	23.14	5.04	9.55	9.00	5.01	20.38
11	5.18	26.61	16.90	18.91	39.79	49.78	71.52	26.22
12	0.00	12.29	10.78	10.96	10.47	7.01	6.94	4.73
13	3.24	5.21	13.68	10.72	4.75	6.03	7.03	10.24
14	0.00	0.00	0.00	0.00	0.00	14.20	5.39	1.68

Table 2: The total amount (tonnes) of landed tuna graded as export quality monitored by month and processor in the IOTC coordinated monitoring program.

				2002				2003
Processor	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
1	0.00	0.00	0.00	4.31	12.35	2.54	10.13	4.27
2	0.00	0.00	0.00	0.24	2.59	0.09	0.00	3.46
3	0.00	0.00	0.73	2.83	11.51	4.54	4.38	3.02
4	0.00	0.00	0.00	0.11	0.28	0.50	0.00	0.61
5	0.00	0.00	0.00	1.56	2.46	0.09	2.64	5.88
6	0.00	0.16	0.40	0.22	0.78	1.23	4.82	1.21
7	0.00	0.00	0.00	0.00	0.00	0.00	0.71	2.60
8	0.00	0.00	0.00	1.61	4.83	1.13	4.44	0.00
9	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00
10	0.00	0.00	0.10	0.29	3.55	3.08	1.74	7.71
11	0.00	0.00	0.00	0.96	3.16	0.00	2.24	1.49
12	0.00	0.00	0.11	0.69	9.26	1.37	0.37	0.56
13	0.00	0.00	0.00	0.35	0.19	0.08	0.35	0.18
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Comparison of the estimates (tonnes) of the landed SBT catch in Bali using data collected by the IOTC Coordinated monitoring program for the period from July 2002 through December 2002.
The estimates labelled CSIRO/RIMF estimation procedure use the Dinas export data to estimate the raising factor. There are two estimates for the full data set derived from the two versions of the available data set (see text). The estimate from IOTC coordinated estimation procedure is based on the March version of the data set, while the sub-sampled estimates using the CSIRO/RIMF estimation procedure are based on the June version. The mean is the mean of all possible combinations of sub-samples with a coverage level between 9.5 and 10.5%. N is the total number of combinations of processors that yielded a coverage level between 9.5 and 10.5%.

IOTC Coor. Estimation Procedure	CSIRO/RIMF Estimation Procedure				
	Full data		Sub sampled – coverage between 9.5 to 10.5%		
	March Version	June Version	Mean	S.D.	N
570.1	471.4	482.5	470.5	123.4	162

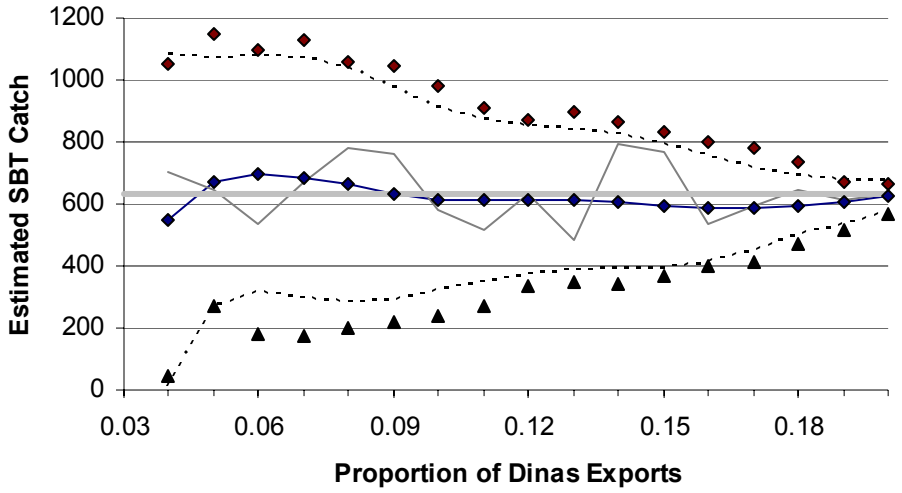

Figure 1: Estimates of SBT landed in Bali based on re-sampling of the IOTC coordinated monitored catch data using the CSIRO/RIMF estimation procedure as a function of the proportion of Dinas exports sampled.
The solid line with diamonds is the mean for each level of coverage (+/- 0.005 of the plotted coverage level). The thinner solid grey line is the median; the solid triangles are the maximum and minimum estimates; the dash lines are the mean plus or minus two standard deviations; and the horizontal solid line is the estimate based on the full data set.

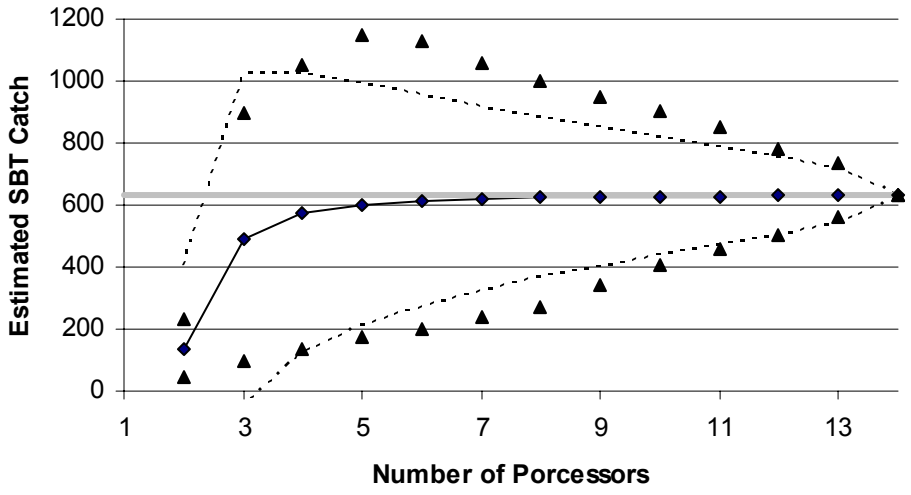

Figure 2: Estimates of SBT landed in Bali based on re-sampling of the IOTC coordinated monitored catch data using the CSIRO/RIMF estimation procedure as a function of the number of processors sampled.
The solid line with diamonds is the mean for each number of processors. The thinner solid grey line is the median; the solid triangles are the maximum and minimum estimates; the dash lines are the mean plus or minus two standard deviations; and the horizontal solid line is the estimate based on the full data set.

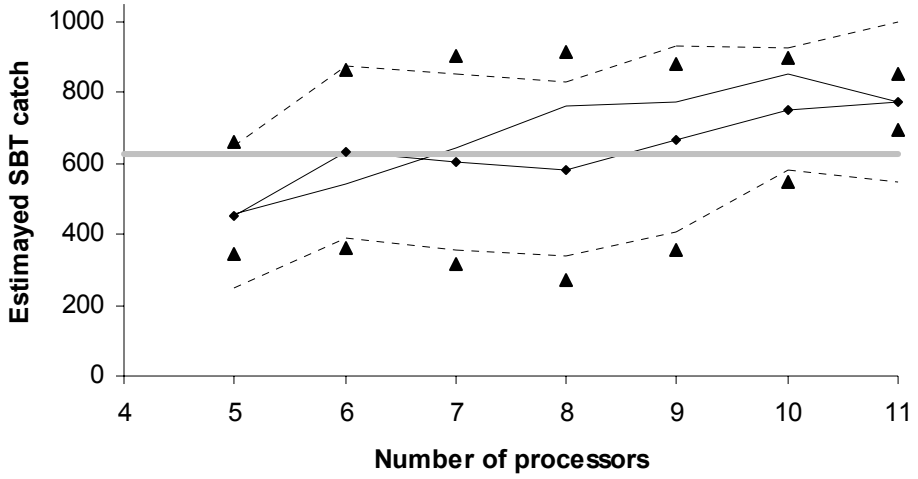

Figure 3: Estimates of SBT landed in Bali based on re-sampling of the IOTC coordinated monitored catch data with a Dinas coverage level of 10% (plus or minus 1%) using the CSIRO/RIMF estimation procedure as a function of the number of processors sampled.
The solid line with diamonds is the mean for each number of processors. The thinner solid grey line is the median; the solid triangles are the maximum and minimum estimates; the dash lines are the mean plus or minus two standard deviations; and the horizontal solid line is the estimate based on the full data set.

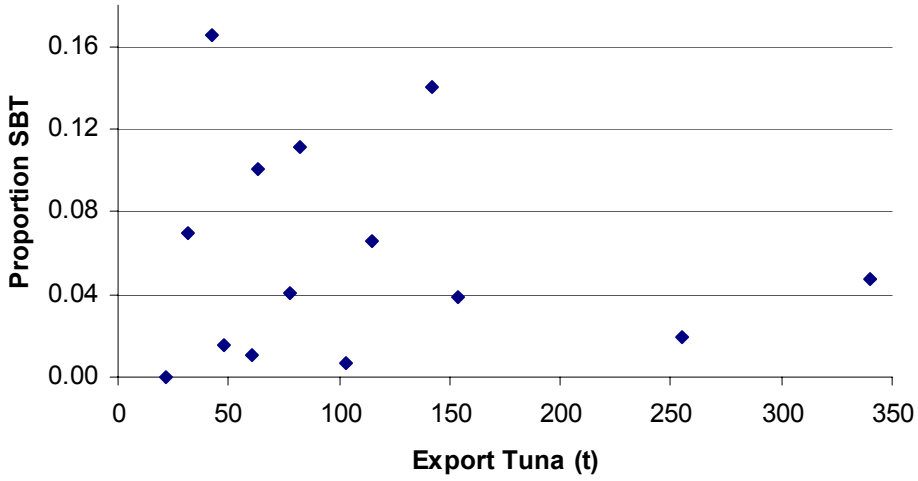

Figure 4: Comparisons of the proportion of SBT in the landed tuna catch in different processors as a function of the quantity of all tuna graded as export quality from that processor.

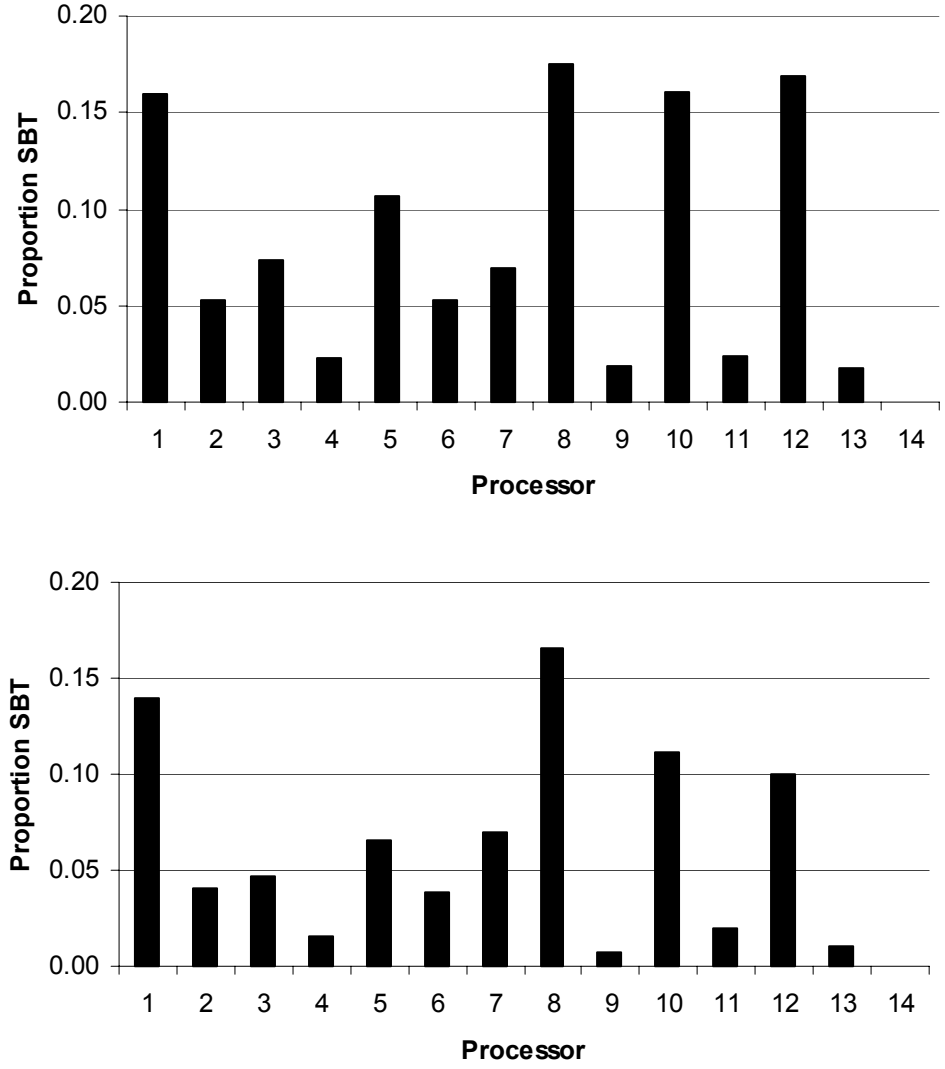

Figure 5: Comparison of the proportion of SBT in the landed tuna catch among the different processors sampled in the IOTC coordinated monitoring program. The upper panel is for the months of September through January. The bottom panel is for the full data set (June through January).

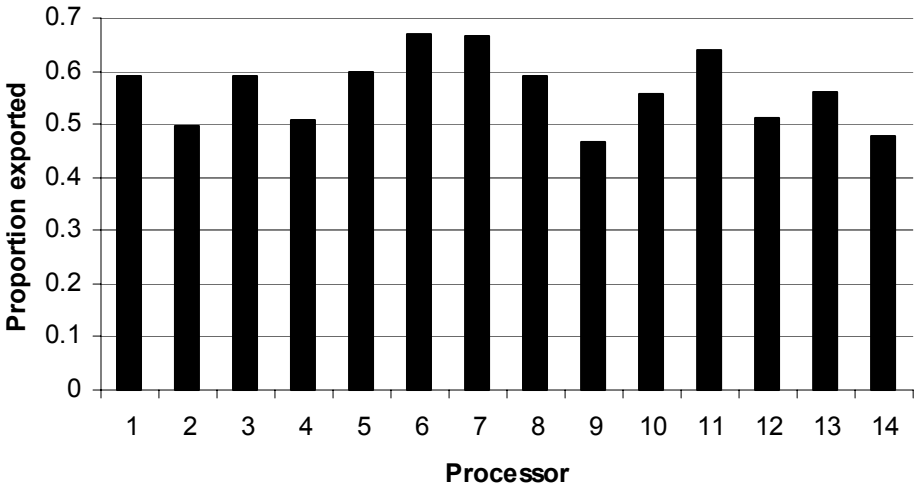

Figure 6: Comparison of the proportion of all tunas which were graded as export quality among the different processors sampled in the IOTC coordinated monitoring program

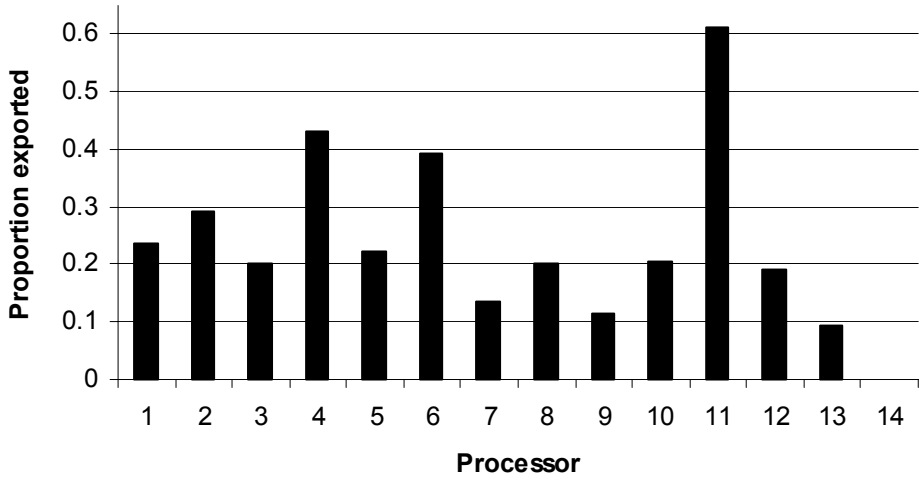

Figure 7: Comparison of the proportion of SBT which was graded as export quality among the different processors sampled in the IOTC coordinated monitoring program.

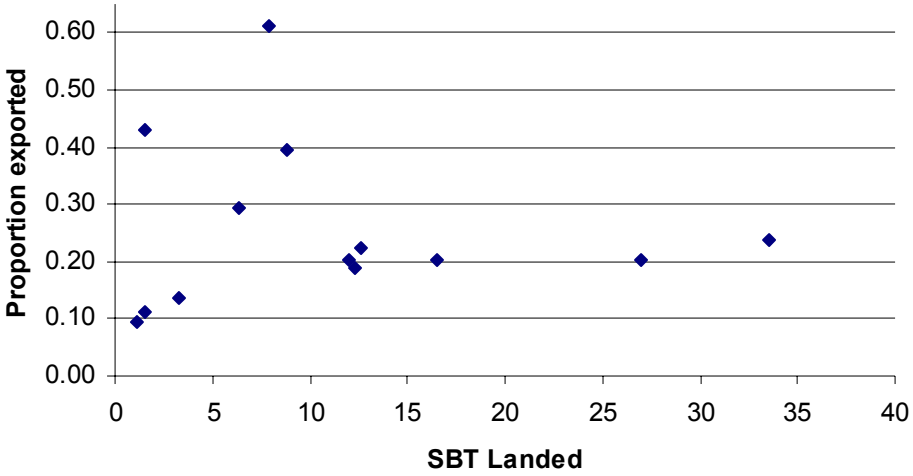

Figure 8: Proportion of SBT graded as export quality versus the quantity (tonnes) of SBT landed among the different processors sampled in the IOTC coordinated monitoring program.