Received: 14 & 23 October 2013

Data Collection and Processing System of Statistics for the Taiwanese Deep-Sea Longline Fishery

1. Preface

A comprehensive data collection and processing system regarding the statistical data of Taiwanese deep-sea tuna longline fisheries has been gradually established since the Overseas Fisheries Development Council (OFDC) took over the duty of data management in 1994. The historical data of Atlantic Ocean is the first part that had been further reviewed and revised. In 1996, the paper "Current status of Taiwan longline fisheries in the Atlantic Ocean (ICCAT-SCRS/1996/155)"was presented in the ICCAT-SCRS meeting as the provisional result of such review. Since any alteration in the fisheries statistics system will possibly have a significant influence on the stock assessment, in 1997, Dr. Peter Miyake, the ICCAT Assistant Executive Secretary, was sent to Taiwan and had cooperated with Taiwanese scientists to conduct an overall survey of Taiwan fisheries statistics system and longline fisheries data of Atlantic Ocean. And, the Commission subsequently produced an official document (ICCAT-SCRS/1997/17) in the 1997 ICCAT-SCRS meeting and provided useful advice for the improvement of our statistics system. Besides, in order to clarify our revision of historical data, Taiwan had also presented a paper "Review of the Taiwanese Data Collection and Processing System and Revision of Statistics for Taiwanese Deep-Sea Longline Fishery Operated in the Indian Ocean (IOTC-TWS/98/17)"in the IOTC meeting of 1998.

In response to the international trend of fishery management, from the year 2000, Taiwan has kept reforming its statistics system so as to obtain near-real-time fisheries information and to conform to the requirements of RFMOs. The said reformation includes the revision of logbook, the establishment of periodical catch data reporting system, the introduction of Statistical Document and the implementation of e-Logbook on bigeye tuna fishing fleet in Atlantic Ocean. The aforesaid two papers (ICCAT-SCRS/1996/155 and IOTC-TWS/98/17) have already introduced the development of Taiwan statistics system in former years, so this paper hereby mainly reviews the reformation of Taiwan statistics system after year 2000.

2. Overview of catch data (TASKI)

The catch data (TaskI) of Taiwan has been collected from the longline vessels operating in the three Oceans. Formerly, the catch data (Task I) had been calculated and corrected according to "Taiwan Tuna Longline Logbook (Ⅰ)", "Daily sheets of fishing condition recorded by Kaohsiung Fisheries Radio Station(Ⅱ)", "Trader sales

records(Ⅲ)", "Certified Weight Reports of the New Japan Surveyors and Sworn Measures Association (NJSSMA) (hereafter referred to as Reports of NJSSMA)(Ⅳ)", "Verification of fishing vessel sales settlements(Ⅴ)", catch amounts from transshipment declarations(Ⅵ) and information about fish returned to Taiwan for sales(Ⅶ).

Since 2002, Fisheries Agency of Taiwan has started implementing the system of periodical catch reporting (weekly or monthly, based on the vessel size) on Taiwan tuna longliners so that FA of Taiwan can effectively monitor the catch amounts or catch quotas of each vessel. In the same year, the Statistical Document (SD) mechanism has also been applied to catches of bigeye tuna(BET), bluefin tuna (BFT), southern bluefin tuna (SBT) and swordfish (SWO) captured by Taiwan fishing vessels. The SD data will then be verified with Reports of NJSSMA (Ⅳ). However, the NJSSMA stopped providing the Certified Weight Reports in 2003. Hence, the cross verification has then been done through the List of integrated Certified Weight records provided by the Organization for the Promotion of Responsible Tuna Fisheries (OPRT). As a result of the abovementioned reformation, the periodical catch data (Ⅷ), SD data (Ⅸ) and data provided by OPRT (Ⅹ) are also included as the sources for the estimation of Task I.

The estimated values of annual total catch data by species are calculated on the basis of Logbook (per vessel and per trip). Such estimated values are then corrected through the verification with source (Ⅱ)-(Ⅴ), (Ⅷ), (Ⅸ) and (Ⅹ); after that, the estimated total catch data will be sorted according to different ocean regions (Pacific, Indian or Atlantic). Taiwan thus divides the estimated annual total catch data (as denominator) by the sum of catch data displayed from Logbook (as numerator) to calculate the recovery rates of logbooks by year. In our view, the abovementioned commercial data can be considered to reflect reasonably the status of catch by Taiwanese deep-sea longline fishery.

Specifically, depending on the attributes of various data resources and management measures for various species, the estimation principle is different by species. In recent years, for BET, SBT and SWO, periodical catch data(Ⅷ) has been used as the basic reference for calculating the annual catches of deep-sea tuna longline fisheries. It will be corrected and revised through the cross-check with the verified Statistical Documents data. As for the data of other species, , annual catches will be mainly corrected and revised according to the cross-check with the verification of fishing vessel sales settlements(Ⅴ) and catch amounts from transshipment declarations(Ⅵ). In addition, the information about fish returned to Taiwan for sales(Ⅶ), the catches onboard, the trader sales records(Ⅲ) and the data provided by OPRT (Ⅹ) will also be

used as the supporting data for the calculation of annual catches of other species.

3. Overview of logbook data

The main framework of Taiwan Tuna Longline Logbook is composed of general information per trip, information per operation, catch data and size data. The general information per trip includes vessel information, cruise information (departure and arrival dates and ports). As for the information per operation, it includes date of set, position, length of branch line, length of floating line, total hooks, numbers of hook per basket, sea surface temperature and type of bait used in the set. For catch data, total numbers and weights of catches and the total numbers of discards by species are the main required fields. With regard to size data, it is collected from the records of length and weights on the initial 30 numbers of catches. Except for paper-based logbooks, Taiwan has also introduced the e-logbook mechanism in order to control and monitor the near-real-time catch amounts of Bigeye Tuna. The e-logbook mechanism has firstly implemented on the longliners targeting Bigeye Tuan in Atlantic Ocean. These vessels shall daily report back their catches through the way of satellite transmission. The framework of the e-logbook is consistent with the paper-based logbook.

From 2002, FA of Taiwan has requested that one shall apply to the Statistical Documents for catches of BET, SBT and SWO prior to their export to foreign countries. Furthermore, several measures of Fisheries Management and Monitoring, such as VMS and e-logbook, have gradually carried out. At that time, certain amounts of fishing vessels had also re-flagged to Taiwan. The aforesaid reasons contribute to the rising recovery rate of logbooks. As shown in Fig.1, from the ratio of catches of main target species (ALB, BET, YFT and SWO) recorded on logbooks, one can see that the recovery rate of logbooks has rapidly ascended since 2003. Recently, the recovery rate of logbooks has reached 80-90%.

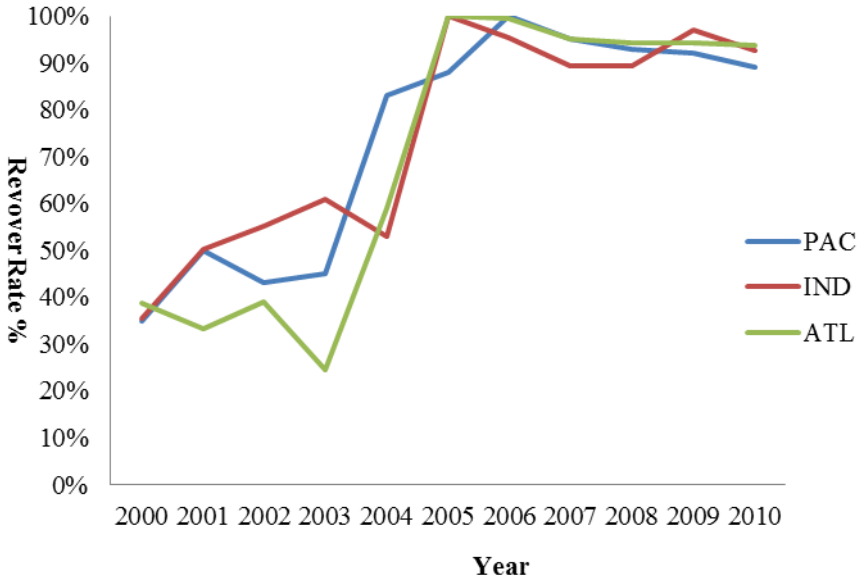

Fig.1 The recovery rate of logbooks in three Oceans

Since the fisheries management of RFMOs has become stricter, the types of key species have increased, and the value of ecology and conservations has awakened, by-catch species turn into one of the most important issues in RFMOs. Accordingly, Taiwan has updated and revised the Taiwan Tuna Longline Logbook for several times. The updated Taiwan Tuna Longline Logbook has the design of serial numbers and carbon papers. There are overall 3 species of marlins and 10 species of sharks added to the updated Logbook. And, the main target species are recorded their total numbers and weights by size. In the updated Logbook, the records of size data include not only the lengths but also the weights of the initial 30 numbers of catches.

3.1 The verification of logbook

In order to avoid man-made errors, before conducting data entry, the staffs will collate the logbook data beforehand. During the process of data entry, a general debugging procedure will also be carried out. After the data entry has been done, the staff will once again conduct a collation based on the comparison between the logbook data and the input data retrieved from database system. Since 2000, the data verification has become more accurate because that the data sources for such verification have been enlarged. Several measures of fisheries management have been implemented, such as the periodical catch data system, the Statistical Document mechanism, VMS and the observer data, thereby increasing the availability of data sources. The illustrations for each measure are as follows:

(1) The periodical catch data reporting system has been applied to longline fisheries

in order to control and manage the near-real-time catch data of each vessel. In doing so, it can help FA of Taiwan to facilitate the control and regulation for the quota allocation of main target species. The vessel owners are required to weekly (or monthly) report back the total catch amounts of main target species during the week (or month). Such data will then be used to verify the logbook data.

(2) To know well the movements and locations of fishing vessels, FA of Taiwan has requested all Taiwanese deep-sea tuna loneline vessels to equip with at least one set of VMS. The VMS data will be used to verify the vessel locations recorded in logbooks.

(3) Fishing vessels shall approach to FA of Taiwan for the application of the Statistical Documents, or, they will not be allowed to conduct the exports of regulated species (e.g. BET, SWO, SBT, etc.). The Statistical Documents will have the records about the fishing dates of the catches; therefore, such information can be used to verify the catch amounts recorded in logbooks.

(4) Since 2002, the national scientific observers have been dispatched to Taiwan fishing vessels to observe the condition of fishing operation and to implement the collection of biological data. The information about fishing operations and the catch data recorded by observers will also be the source to verify the accuracy of logbook data.

For the reason that periodical catch data and Statistical Document data can only verify the logbook data on weekly or monthly basis, the verification between these data tells merely whether or not the logbook data has significant difference from the periodical catch data or SD data. As for the observer data, it is a rather important source for data verification because of the similarity between the required fields of observer trip report and logbook.

3.2 Distribution of catch and effort of Taiwanese fleet

Since 2005, Taiwan-flagged fishing vessels have annually been divided into specific groups for better management of the quota allocation of main target species. In other words, fishing vessels of each ocean region have to be registered a specific group so can they be authorized to fish in their designated ocean regions (Pacific, Indian and Atlantic). For the fishing vessels operating in Atlantic Ocean, they are divided into BET group, N-ALB group and S-ALB group. As for vessels in Pacific Ocean, they are divided into BET group and ALB group. The groups of vessels in Indian Ocean are BET group, ALB group and seasonal-targeting group (BET-with-other group) respectively. In each ocean region, each group has its own catch quota and specified fishing area. As shown in Fig.2, the area from 15° North to 15° South is the main

fishing ground of BET; on the other hand, the remaining area is the main fishing ground of ALB.

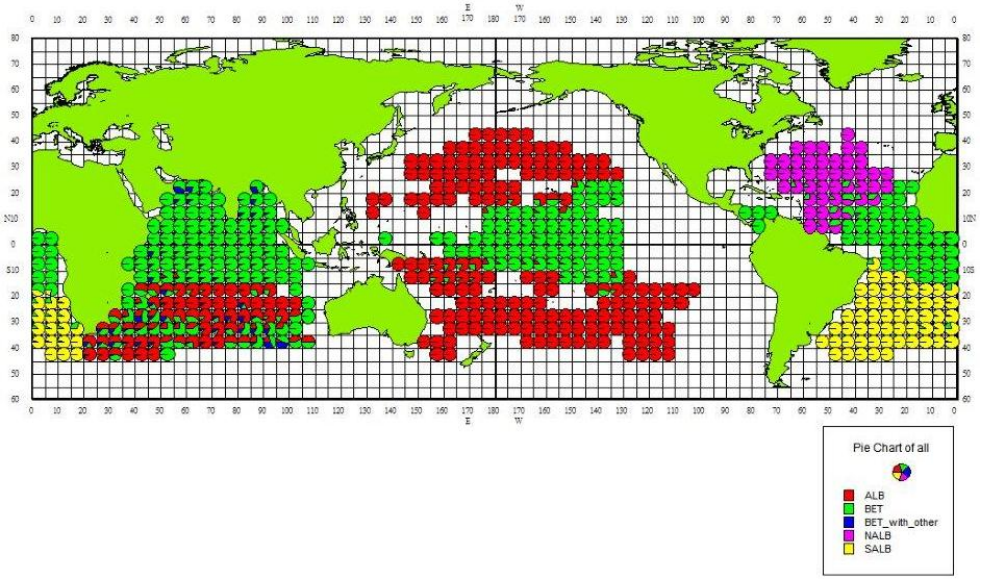

Fig.2 Distribution of catch and effort of each group of vessels in three Oceans

4. Overview of catch and effort (Task2)

The weight of fish recorded in logbook was in weight of products (round weight for albacore, gilled-and-gutted weight for yeallowfin and bigeye, and dresses weight for billfishes and swordfish).Before the compiled the Task2, conversion factor was applied to the different ocean. In the Indian Ocean and Pacific Ocean, conversion factor of 1.16 was applied to the gilled and gutted weights of bigeye and yellowfin, conversion factor of 1.54 was used for swordfish. In the Atlantic Ocean, conversion factor of 1.13 was applied to the gilled and gutted weights of bigeye and yellowfin, conversion factor of 1.54 was used for swordfish and no conversion was applied for albacore in any ocean due to the recorded weight of albacore in logbook was round weight.

Up to now, the recovery rates of logbooks have always been calculated through dividing the estimated total catches of main target species by the total catches of main target species from logbook. During 1994-2002, the reciprocals of the aforesaid recovery rates have been regarded as the coefficients of raised catch-and-effort data (raised TASK Ⅱ). However, from 2000, the BET-targeting fisheries have been gaining popularity in Taiwan. Consequently, the raised TASK Ⅱ data had become inaccurate and shown the inconsistency between catches of main target species estimated from

raised TASK Ⅱ and total catch data. To solve such problem, from 2003, the raised rates of TASK Ⅱ have been estimated through statistical method on basis of fishing areas (BET fishing area and ALB fishing area). The reformation of raised principle also lowers the inaccuracy resulted from the different recovery rates of logbooks among different group of vessels. Nevertheless, there are still several existing problems of the current raised principle. First, the inconsistency between total catches of non-target species (e.g. striped marlin, blue marlin, black marlin and skipjack) and catches estimated from raised TASK Ⅱ remains to be solved. Second, if there is a particular year that the recovery rate of logbooks is rather low and the fishing locations are concentrated in certain fishing areas, the current raised principle still cannot avoid the inconsistency between raised TASK Ⅱ and total catches by species. The problem will be more conspicuous while one conducts the comparison of small-area analysis, so the interpretation of such data shall be more careful and cautious.

The vessels targeting BET in Atlantic Ocean have started using VMS e-logbook or fax machine to report back the catch and size data to FA of Taiwan since 2006. The recovery rate of these vessels has already reached 100%; therefore, there is no need for the procedure of raising TASK Ⅱ. In addition, the overall recovery rate of logbooks in Atlantic Ocean has exceeded 90% from 2007(please refer to Fig.1 for the information on recovery rate).In according to the requirements of TASK Ⅱ set forth by ICCAT, flag States can provide raised logbook statistics or aggregated logbook statistics by 5° by 5° area and by month (without raising procedure) for the submission of TASK Ⅱ data. Hence, from 2007, Taiwan has provided to ICCAT the aggregated logbook statistics of our N-ATL ALB fishing vessels, S-ATL ALB fishing vessels and BET fishing vessels (rather than raised data) as TASK Ⅱ data.

5. Overview of size data

The source of size data is from the logbook records. Our fishermen are required to record the length and weight of the initial 30 fish in logbooks. Therefore, the sampled data is mainly composed of main target species (e.g. BET and ALB). The size samples of other by-catch species (e.g. marlins or sharks) would be rather less than those of main target species. Please refer to Fig.3“Proportion of species regarding the size samples in three Oceans (2010-2012)”.

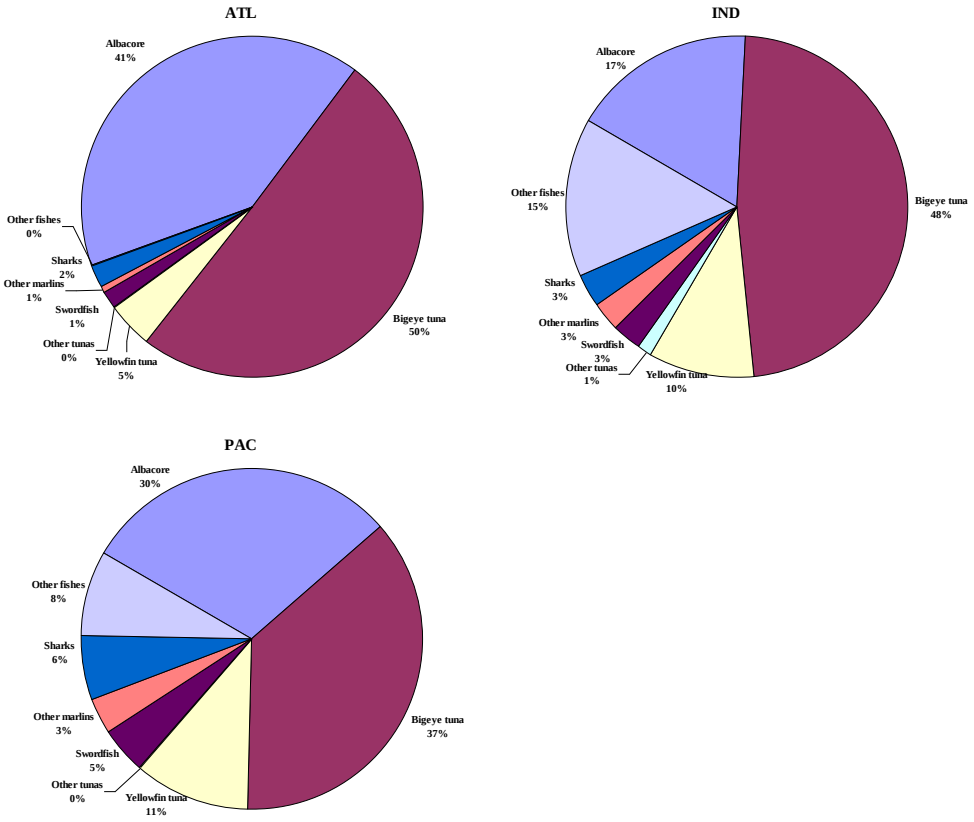

Fig.3 Proportion of species regarding the size samples in three Oceans (2010-2012)

The measurement standard for tuna species and shark species is upper jaw fork length (UJFL), whereas the measurement standard for SWO is lower jaw fork length (LJFL).Before 1995, size data was recorded in a separate form out of logbook. Nevertheless, in the year 1995, size data record has been combined with logbook so that the size data can correspond with the catch and effort data. In 2009, FA of Taiwan had once again revised the logbook form, requiring fishermen to fill in both the length and weight data of the initial 30 fish. Through the revision of logbook, the size data collected by Taiwan not only can meet the data submission requirements of RFMOs but also can be used to calculate the data of catch-at-size (CAS) and catch-at-age (CAA) for purpose of stock assessment and scientific research.

Fig.4 displays the sample numbers by year by ocean region and the proportion of size samples to total catch numbers by vessel by day. In three Oceans, all of the numbers of size samples by 2005 are the highest during1981-2012.This situation can attribute to the rather high recovery rate of logbooks (Fig.1). The size sample numbers has decreased since 2005. It is because that Taiwan has implemented the fleet size reduction program in that year aiming at Responsible Tuna Conservation and

Management, which results in the reduction of vessel numbers.

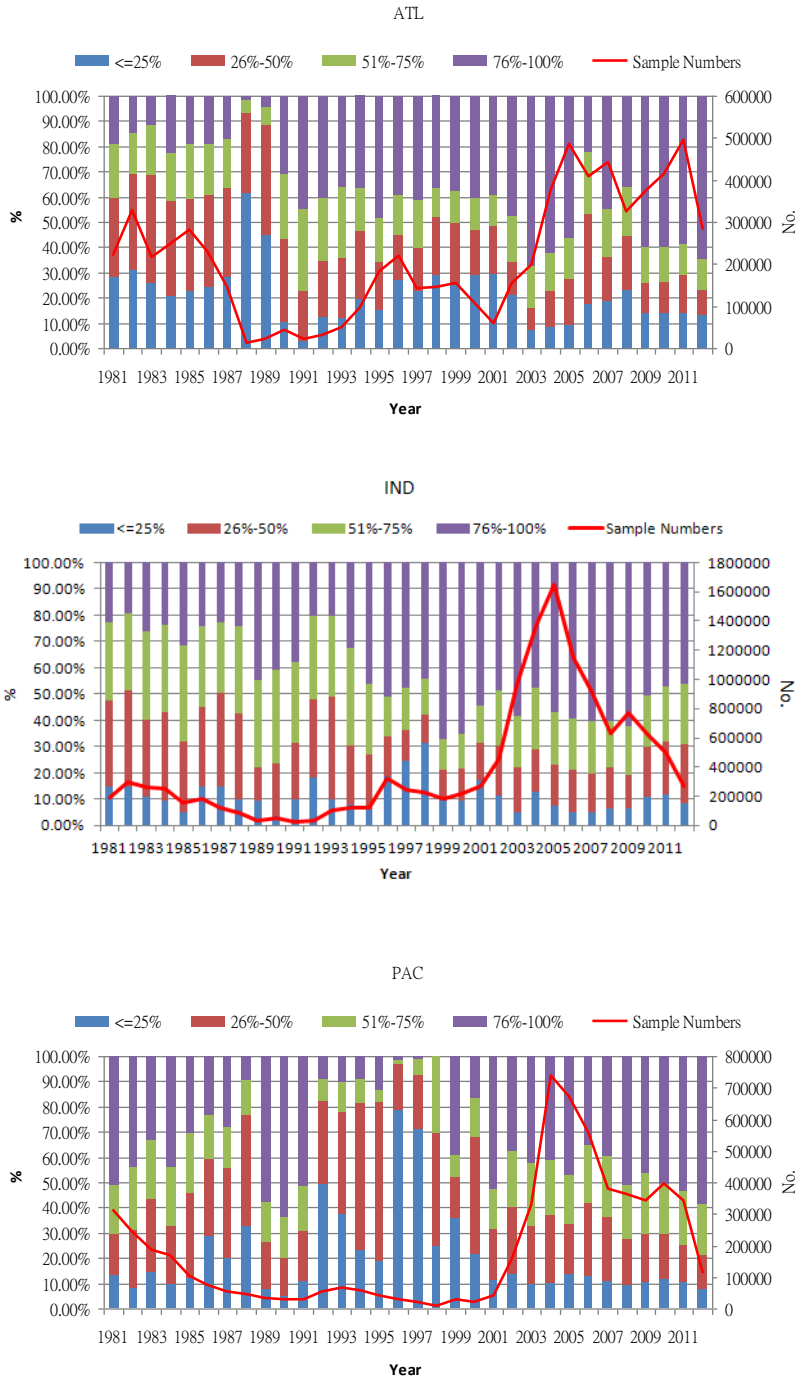

Fig.4 The sample numbers by year and the proportion of size samples to total catch numbers by vessel by day

References:

Chang, S.K, T.Y. Tsay,1996,*Current Status of Taiwan Longline Fisheries in the Atlantic Ocean*, Madrid, Spain, October 27 to November 1, 1996, ICCAT-SCRS/1996/155.

ICCAT-SCRS, 1997, *Critical Review of the Data Collection and Processing System of Chinese Taipei, and Revision of Statistics for ITS Longline Fleet*, Taipei, Taiwan, July, 1997, ICCAT-SCRS/1997/017.

Chang,Shui-Kai, Wang, Shyh-Bin, 1998, *Review of the Taiwanese Data Collection and Processing System and Revision of Statistics for Taiwanese Deep-Sea Longline Fishery Operated in the Indian Ocean*, Victoria, Seychelles, 9-14, November, 1998, IOTC-TWS/98/17.