

REVIEW OF DATA COLLECTION AND PROCESSING SYSTEM, AND REVISION OF STATISTICS FOR THE TAIWANESE DEEP-SEA LONGLINE FISHERY OPERATED IN THE INDIAN OCEAN

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SUMMARY

Taiwan reorganized the catch statistics compiling group in 1996, with changes proposed in its data processing system. Through joint work between ICCAT experts and Taiwanese scientists, the system was carefully reviewed and verified. During the review, the need for revising the historical catch statistics was noted. The revision of Atlantic data was proposed and accepted by ICCAT in 1997. This paper gives the revision on Indian Ocean longline statistics with brief description on the new system.

Major changes in total catches were due to the re-estimation of landings of bigeye and yellowfin tunas for six years based on Japanese import information, recovery of sales records of swordfish and application of conversion factors to processed weight reported previously. Major changes for catch/effort data were mainly due to detailed screening of the logbook data and recalculated new coverage rates. The size data for albacore, yellowfin, bigeye and swordfish were also carefully reviewed on boat-time basis and adjusted new size data sets have been created.

Introduction

The catch statistics compilation group as well as the research group in Taiwan underwent a re-organization in 1996. The Overseas Fisheries Development Council (OFDC), a non-profit organization with funds endowed by both the Government and the private fishery sector, has been in charge of data collection (except for logbooks and traders' sales reports) and compilation since that time. Collections of logbooks and traders' sales reports of distant water tuna fisheries are carried out by the Fishery Department of Constructive Bureau, Kaohsiung Municipal Government (FDKMG), under the direction of the Fisheries Administration, Council of Agriculture. Research on stock assessment are independently dispensed to scientists in universities or research institutes on a project basis.

After the reorganization, some changes were proposed for the data collection and processing system of the longline fishery, and the revision of historical Atlantic catch statistics was reported to the International Commission for the Conservation of Atlantic Tunas (ICCAT) in late 1996. Because such a change may have substantial impacts on stock assessments, a recommendation was made by ICCAT to carry out a careful review of the system as well as of the database. Following this recommendation, Dr. Peter Miyake, Assistant Executive Secretary of ICCAT, visited Taiwan in July 1997 and worked with Taiwanese scientists for a three-week period for this purpose. The meeting was very fruitful and successful. The official document (ICCAT – SCRS/97/17 ICCAT: Critical review of the Taiwanese data collection and processing system and revision of statistics for the Taiwanese LL fleet (Taipei, Taiwan – July 1997)) describing details of this activity was reported to and accepted by the ICCAT Standing Committee on Research and Statistics (SCRS) and the Commission.

Apart from the historical data on Atlantic catch, a similar data set collected in the Indian Ocean needs to be revised. Following similar procedures, the OFDC staff worked with Drs. Y. C. Lee and C. Y. Chen, National Taiwan University and National Kaohsiung Institute of Marine Technology, reviewed and revised the historical Indian Ocean longline

statistics. This report provides a summary of the new data collection and compilation system, and the retroactive correction of Indian Ocean longline statistics. Detailed information on this system can be found in the ICCAT report (SCRS/97/17).

Total Catch Data

Data collection and compilation system

“Traders’ sales records” provided by the tuna brokers were the major source for the estimation of the total landings prior to 1994. These records include boat names, date of port entry, date of sale of catch and the exact weight of product unloaded (and sold) from each vessel. Before the mid 1980s, these traditional brokers handled mainly albacore and were accustomed to reporting their sales. In addition, until 1987, foreign currency exchange control was applied and fishing companies could not file their tax return unless a “verification on fishing vessels’ sales settlement” was provided, giving a strong motivation for submitting reports of all landings. The sales records provided therefore covered almost all landings up to the mid 1980s.

The situation changed as of the late 1980s when some Taiwanese longliners started to target bigeye and, to some extent, yellowfin tunas for the Japanese “sashimi” market using deep longlines. The bigeye and yellowfin tunas caught for the “sashimi” market were mostly landed directly at Japanese ports and handled by new fish brokers at the port of destination who did not submit sales report regularly. Besides, there was no longer an incentive to report shipments to the authorities because foreign currency exchange was then deregulated. As a consequence, the system which solely depended upon sales report became inadequate.

Since 1994, additional information is available and landing data are estimated based upon multiple sources including:

- (1) trader sales records,
- (2) verification of fishing vessel sales settlements,
- (3) certified weight reports of the New Japan Surveyors and Sworn Measures Association, NJSSMA, and

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- (4) verification records by Taiwan Tuna Boatowners and Exporters Association.

Trader sales records (1) and verification of fishing vessel sales settlement (2) which continue to be used are particularly important for albacore catch data. However, as these documents have become less important as discussed above, two new sources i.e., (3) and (4) were introduced. These supplementary sources are important for estimating landings of species other than albacore.

In 1993, an agreement was reached between Taiwanese and Japanese tuna fisheries associations, limiting the amount of frozen sashimi tuna exported from Taiwan to the Japanese market. In order to monitor Taiwanese exports to Japan, Shin Nihon Kentei Kaisha (NJSSMA) (source 3) was contracted to provide certificate weight reports. These data include records of landings (weight) by species, by vessel, and by shipment. In addition, because of this export limit, the Taiwan Tuna Boatowners and Exporters Association introduced a system to monitor exports by issuing "verification of the quantity of exports" (source 4) to all the boat owners for all catches exported to the Japanese market. These verification records thus became available.

Retroactive correction of historical total catches

Since changes in data compilation system were applied to the 1993 data and further improvements were also made to the 1994 data, it was recognized that the total landings estimated based upon trader's sale records did not cover catches (mostly, bigeye and partially yellowfin and swordfish) unloaded to the Japanese markets and handled by new brokers. Unfortunately, sources 3 and 4 described above were not available before 1993. Thus, OFDC staff, using every possible channel, started to collect historical information on the sales of bigeye and other species from those companies which handled the sales, especially for 1991 and 1992.

However, it was very difficult to estimate unreported landings for 1990 or earlier years. On the whole, the exports reports should be considered the minimum estimates for landings, since Taiwanese fisheries could not export more products than their landings. These reported landings, for most years, exceeded Japanese import data except for 1989 through 1991 where landings were less than imports. Recognizing the quantity of Japanese import being the minimum estimate for Taiwanese landings, reported landings between 1989 and 1991 were raised proportionally, based upon Japanese import data (Table 1). The 1992 data were revised based upon the aforementioned information. The Indian Ocean landings extrapolated from Japanese import statistics might still be under-estimated. Nevertheless, they should be better than the catch data currently used.

Some of the longliners targeted Indian Ocean swordfish in the early 1990s. During the early years, swordfish catches were not reported and were not reflected in the catch data. Therefore, with the help of Taiwan Tuna Boatowners and Exporters Association, the sale records of 1993 and 1994 were collected from brokers in late 1996 and early 1997 and swordfish catches for the two years were updated accordingly.

Conversion factors

While reviewing data collection and compilation procedures, it was found that the landing data previously reported to IPTP was the weight of the products (round weight for albacore, gilled-and-gutted weight for yellowfin and bigeye, and dressed weight for billfishes and swordfish). Since albacore are generally handled in round weight, it was not necessary to apply any conversion, although IPTP suggested a conversion factor of 1.10 for frozen albacore (IPTP Data Summary No. 17). For the yellowfin, bigeye, swordfish and billfishes, the round weights need to be estimated by applying conversion factors to landed weight. IOTC has suggested some conversion factors based upon several programs and the factors used by Australian scientists (personal communication with Dr. David Ardill, 1998). After consulting with fishermen and conducting a small trial, the following factors were used for Taiwanese catches: yellowfin 1.161, bigeye 1.156, albacore 1.00, southern bluefin tuna 1.155, other tunas 1.00, swordfish and billfishes 1.54, sharks 1.55, and others 1.0. The final revised and raised total catch data of Taiwan longline fishery of 1970-1997 are shown in Table 2.

Catch and effort data

Collection of catch and effort data

All catch/effort data were compiled based upon logbooks that have to be submitted mandatorily to the authorities for each boat. This policy has not changed since the beginning of the data collection system. However, the accuracy, format, and coverage of the logbook have changed from time to time, particularly when the policy for implementation of regulations changed.

The information recorded in the logbook includes daily position, number of hooks used, catches in number, and weight by species. Data on southern bluefin and northern bluefin tuna were not separated until 1994. Information on the number of hooks per basket used has been requested since 1994.

These logbooks were collected by the Taiwan Fisheries Bureau up to 1991 and since then by the FDKMG. These data were handed to the Council of Agriculture and to National Taiwan University and, recently, to the OFDC. Data processing was carried out by the Institute of Oceanography, National Taiwan University up to 1995, and then transferred to the OFDC.

The format of logbook changed in 1994. The fishermen were requested to enter catch and effort data and size measurement on the same data sheet. Since data processing has been transferred to OFDC, data entry has also been changed. Catches in number and weight by species and size are now included in the same database. This makes it easier to cross-reference the catch and size, and to verify the data entries.

Data verification

All logbooks were first verified for their accuracy and validity by scientists before entering into the database. This verification requires experience and knowledge of the fisheries. In general, the following items are checked regularly:

- (1) Whether the recorded location is logical, such as traveling too far a distance in one day, etc.
- (2) Fishing locations are verified based on the radio reports recorded by Kaohsiung Fishery Radio Station.

As from 1994, the following checks have also been introduced when entering the data.

- (1) Catch in weight by boat-trip is added and then compared with the commercial sales records as indicated in section 2.1 where the total catch data are taken.
- (2) The average weight of fish is calculated based upon the recorded number of fish and weight of catches on each day to signal any abnormal values.
- (3) This average weight is also compared with size data to signal any anomaly.
- (4) The size data are also checked for their range.

Verification of fishing grounds (based upon trip tracking method)

In addition, a computer program which allows to trace the historical locations of each vessel was developed by OFDC to check the distribution of fishing grounds for each vessel in each year. This method has not only been applied to data sets collected in recent years but also to the historical logbook data to screen and correct unreasonable data. Any boat showing randomly distributed course or several clearly separated locations was further examined for its detailed operation. The following procedures have been used to correct the data. If the fishing ground in any specific date was not consistent with locations in the past and next few days, appearing to be a recording error, its fishing ground (i.e., location) and catches were then corrected accordingly. Those boats only showing very limited data records in a year were deleted from the data set. In total, there were 16 trips corrected for 1979-1986 data.

Adjustment of landings in the logbook database

After 1994 when detailed input in the database was initiated, the sum of daily landings (recorded in the logbook) estimated by captains (or actually weighed on deep sea longline fishing boat) were compared with sales records. All the landings in the logbook were compared and adjusted on boat-trip basis, so that the sum would be as close to the commercial landing records (i.e., sales records) as possible. It is believed that the commercial sales records are the most accurate records. However, the number of fish recorded in the logbook was not adjusted, since it was believed that fishermen estimated the number of fish without reference to landing weight.

In view of the difficulties in applying these procedures retrospectively to the historical data, no attempt was made for the database prior to 1994.

Coverage rate

The official reported coverage rates were given in Table 3 (COV_1). By 1993, the coverage rate was in principle, calculated based upon information on the number of logbooks recovered (or days of operations) and the total

number of trips (or total days of operations). The total number of trips was obtained based upon daily radio reports. However, since the mid 1980s, radio reports have become less available with the introduction of radio vocal communication through SSB, which is not recorded by land radio station which only record Morse signals. In addition, at the outset of the deep longline fishery, reporting rates of catches or locations of these boats were even lower. Therefore, the official reported coverage rates were suggested to be used only for data between 1967 and 1985.

For the aforementioned reasons, it was decided that the coverage rates of 1986-1993 logbooks be estimated by dividing (the sum of catches recorded in logbook for albacore, bigeye and yellowfin) by (the total of landings of albacore, bigeye and yellowfin). These species are the major target species for the Taiwanese longline fishery and this method has been adopted for 1994 to 1996 data. Thus, one coverage rate is estimated for each year, which should also be applied for all the species and efforts. This procedure is the same as used for the revision of Atlantic catch/effort data (ICCAT -SCRS/97/17). The new coverage rates are given in Table 3 (COV_2).

With these procedures (i.e., the adjustment of logbook data on boat-trip basis (Section 3.4) and the derivation of coverage rate on an overall basis from the comparisons with commercial landings), the discrepancies have been reduced.

Creation of monthly aggregated catch/effort data

Despite the revision of the original logbook data, the monthly aggregated catch/effort database was established. There are three major differences between aggregated data and logbook data. That is, the aggregated data (1) are aggregated by month, without daily operation and vessel information; (2) have been raised by applying coverage rates (COV_1 for 1967-1985 and COV_2 for 1986-1996) (Section 3.5); (3) have been converted to whole weight by applying conversion factors (Section 2.3).

Size data

Collection of size data

There has been no change in the policy of collecting size data. Fishermen are requested to report measurements of the first 30 fish landed each day, regardless of the species. As a result, there have been more records on the measurement of the major species (e.g., albacore) but less on the non-target species (e.g., bigeye, yellowfin and/or swordfish in earlier years).

The data format requesting fishermen to keep measurement records has been changed. Size data recorded in the file were independent of catch and effort data, but can be matched with these data later on if necessary. From the data of 1995 onwards, as described earlier, the size data have been recorded on the same data sheet as the logbook, and are entered together with the catch/effort data. It would be easier now to associate the size data with catch/effort data.

Verification and revision

The historical size data for albacore, bigeye, yellowfin and swordfish have been reviewed and a revision has been decided, based on close examination on the size measurements aboard the vessels. With this procedure to reveal vessel characteristics at vessel-time level (in a simple case, vessel-year level), many unreasonable or inappropriate samples were screened out or adjusted. There were examples such as some vessels measured the swordfish using the upper jaw fork length (FL) although they were instructed to

measure it with the lower jaw fork length (LJFL); some vessels reported fish measurements in a 2 cm, 5 cm or even 10 cm class intervals and some vessels provided a large quantity of measurements in a single length class, etc. Efforts have been made to screen out and adjust/smooth those cases, and new historical actual size data have been created for the four species.

A protocol and clear procedure for creating catch-at-size data has also been developed and will be used to create the database in the future for the application of stock assessment models (i.e., Virtual Population Analysis).

Table 1: Comparison of current reported and revised landings of bigeye and yellowfin tunas against Japanese customs data

YEAR	Reported landings		Revised landings		Revised landings of the three Oceans		Japanese Imports	
	BET	YFT	BET	YFT	BET	YFT	BET	YFT
1985	10,541	5,917	10,541	6,306	11,854	7,729	11,725	7,729
1986	14,564	13,967	14,564	13,967	15,714	15,728	14,154	10,557
1987	15,257	18,373	15,257	19,219	16,939	20,686	19,118	20,687
1988	16,752	16,547	16,752	19,578	18,640	22,704	17,586	22,705
1989	14,963	15,221	17,244	19,283	18,977	20,995	18,977	20,994
1990	17,297	12,399	17,947	27,175	24,000	37,250	23,990	37,250
1991	17,817	8,595	25,050	26,449	38,043	31,401	38,042	31,677
1992	16,366	21,141	20,767	48,223	31,746	31,746	30,171	57,742
1993	34,206	75,819	34,206	75,819	46,887	81,517	27,482	93,701
1994	23,990	29,271	23,990	29,271	42,400	37,183	35,298	56,624
1995	28,240	19,870	28,240	19,870	44,778	25,572	42,834	42,824
1996	25,796	23,988	25,796	23,988	45,505	30,817	46,055	38,768

Table 2. Revised total catches (round weight, t) by species of Taiwanese longline and gillnet fisheries in the Indian Ocean, 1970-1997

Year	ALB	BET	YFT	SKJ	TUN	BLZ	BLM	MLS	SFA	BIL	SWO	SKX	OTH	KGX
1970	7,191	9,966	14,867	19	38	2,376	1,146	1,702	-	852	1,217	-	-	-
1971	6,976	5,522	11,840	-	209	1,964	844	865	-	668	918	-	-	-
1972	6,976	5,522	11,840	-	2	1,964	844	865	-	668	916	-	-	-
1973	11,959	3,962	5,702	-	13	1,277	505	624	-	132	638	-	-	-
1974	17,421	6,023	4,397	-	-	1,247	835	1,173	-	214	963	-	-	-
1975	6,378	5,341	4,630	-	26	1,055	467	821	-	1,261	935	-	-	-
1976	9,748	4,181	3,355	-	3	735	188	1,885	-	645	867	-	-	-
1977	9,803	6,183	8,079	-	-	999	266	3,159	-	72	878	-	-	-
1978	12,808	4,942	4,245	7	1	1,190	157	3,959	-	145	562	-	-	-
1979	14,990	7,379	3,704	15	3	1,398	200	2,378	-	120	1,110	-	-	-
1980	10,971	8,928	3,806	10	2	1,358	436	3,867	-	165	1,257	-	-	-
1981	12,326	6,840	4,101	24	2	1,281	350	4,366	-	37	1,092	-	-	-
1982	21,930	11,313	4,715	15	1	1,341	286	1,845	-	186	1,452	-	-	-
1983	16,958	11,322	5,580	9	1	1,717	711	2,583	-	46	1,910	-	-	-
1984	13,932	10,862	5,812	26	4	2,270	482	2,087	-	26	1,725	-	-	-
1985	6,876	12,201	7,321	44	2	2,050	628	3,025	-	126	1,988	-	-	-
1986	26,228	17,111	16,249	32	2	3,622	759	4,757	11	189	3,231	-	-	-
1987	25,316	17,740	22,365	13	21	4,169	955	4,270	-	271	3,831	-	-	-
1988	25,489	21,284	22,765	59	-	2,835	736	2,902	-	235	5,401	-	-	-
1989	21,454	20,399	22,425	96	1	1,935	565	2,157	-	1,490	4,070	-	-	-
1990	26,898	20,915	31,638	105	32	1,182	271	910	-	328	3,844	-	-	-
1991	22,103	29,075	30,713	34	80	1,415	313	1,862	-	1,244	4,715	-	-	42
1992	12,425	24,024	55,988	76	37	2,741	930	1,697	-	970	8,993	-	-	-
1993	11,890	39,542	88,026	218	505	3,251	242	4,729	1,275	-	15,345	1,031	-	-
1994	14,407	27,732	33,984	88	193	1,420	422	2,815	675	-	12,454	668	349	-
1995	14,209	32,645	23,069	106	118	2,162	570	3,637	531	-	18,261	1,353	696	-
1996	16,930	29,820	27,850	59	40	1,943	368	2,966	171	-	17,620	1,001	370	-
1997*	15,204	34,027	18,390	59	40	1,943	368	2,966	109	-	17,163	825	423	-

*preliminary

Table 3. Comparison of raised tuna landings based on reported and re-calculated coverage rates against revised total landings. All landings are in processed weight (MT). Shaded area indicates the final coverage rates used.

YEAR	Based on reported coverage rates					Based on recalculated coverage rates					Total landing		
	COV 1	Hooks	ALB	BET	YFT	COV 2	Hooks	ALB	BET	YFT	ALB	BET	YFT
1979	64 %	57,660	12,310	7,336	3,623	57 %	65,041	13,886	8,275	4,086	14,990	6,383	3,190
1980	88 %	57,789	9,416	7,764	3,336	76 %	66,808	10,886	8,976	3,856	10,971	7,723	3,278
1981	84 %	50,345	10,077	6,065	3,592	71 %	59,523	11,914	7,170	4,247	12,326	5,917	3,532
1982	74 %	78,894	18,601	10,804	4,355	66 %	89,046	20,995	12,194	4,916	21,930	9,786	4,061
1983	70 %	83,851	14,179	10,231	5,231	61 %	96,103	16,251	11,725	5,996	16,958	9,794	4,806
1984	59 %	83,194	11,791	10,340	5,832	54 %	91,512	12,970	11,373	6,415	13,932	9,396	5,006
1985	63 %	64,812	4,877	11,595	6,123	55 %	73,871	5,558	13,216	6,979	6,155	10,541	6,306
1986	63 %	65,792	7,095	11,256	11,922	43 %	96,095	10,363	16,440	17,414	11,052	14,564	13,967
1987	60 %	75,469	8,862	9,898	13,706	37 %	122,932	14,435	16,123	22,326	13,137	15,257	19,219
1988	32 %	122,583	9,409	17,950	16,900	27 %	147,058	11,288	21,534	20,274	11,048	16,752	19,578
1989	22 %	131,409	4,345	18,026	12,474	15 %	186,839	6,178	25,629	17,735	7,097	17,244	19,283
1990	19 %	122,862	4,081	17,490	14,044	12 %	199,666	6,632	28,424	22,823	5,756	17,947	27,175
1991	12 %	152,507	5,770	24,004	12,027	7 %	267,038	10,103	42,030	21,060	13,102	25,050	26,449
1992	7 %	149,589	12,155	23,509	22,261	5 %	231,894	18,843	36,444	34,509	11,103	20,767	48,223
1993	21 %	252,329	17,165	28,618	55,290	15 %	343,551	23,370	38,964	75,278	11,890	34,206	75,819
1994	28 %	216,472	17,527	32,998	25,073	28 %	216,472	17,527	32,998	25,073	14,407	23,990	29,271
1995	23 %	243,929	12,149	31,207	26,906	23 %	243,929	12,149	31,207	26,906	14,209	28,240	19,870
1996	33 %	212,908	16,448	30,912	27,314	33 %	212,908	16,448	30,912	27,314	16,930	25,796	23,988