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SUMMARY

Korean distant water fisheries for tuna and tuna-like species have two types of fishing gears - purse seine and longline - operating in the North Pacific Ocean. In 2018, the number of longline vessels was 96 which is the lowest level since the 1990s. That of purse seine vessels was 26, which is same of 2017. Total catch of tuna and tuna-like species caught in the North Pacific Ocean was 90,557 ton in 2018. Total catch of the longline fishery was 16,912 ton, which was similar level of 2017. In contrast, that of the purse seine fishery was 73,645 ton, which sharply increased more than twice compared to 2017. As for the catch composition of the longline fishery, dominant species were bigeye tuna for 64.1%, yellowfin tuna for 20.3% and blue marlin for 7.9%. As for that of the purse seine fishery, it was consisted of skipjack tuna for 80.8%, yellowfin tuna for 17.4% and bigeye tuna for 1.8%. Pacific bluefin tuna caught by offshore large purse seine fishery in the Korean waters was 523 ton, and total catch was 535 ton in 2018. It was mainly caught around Jeju Island. The large Pacific Bluefin tuna (30kg or larger than 30kg) was 5% in total. To support close-kin research for Pacific Bluefin tuna, 245 individuals were sampled in 2018.

1. Introduction

About a 60-year-old Korean distant water tuna longline fishery that commenced the first fishing in the Indian Ocean in 1957, has explored the Pacific Ocean since 1958 and the Atlantic Ocean since 1967. In early days, Korean longline vessels used foreign ports in which are near the fishing grounds. Since 1972, as longline vessels started to equip with deep freezing facilities onboard, fishing base was able to move to Korean domestic ports, and all longline vessels have been based on domestic ports from 1999. This change gave advantages in exporting the products to Japanese markets and others. In domestic markets, tuna sashimi demands have been increasing year by year.

Korean distant water tuna purse seine fishery was initiated by accessing into the eastern Pacific Ocean (EPO) with 3 vessels in 1971. Helicopter-aided mass operations were introduced in 1979 for the first time, and the number of active vessels was the highest of 39 in 1990 and sharply decreased to 27-28 during the early of 1990s and then maintained around 25-28 in the recent decade. Most of the catches were supplied to the packers for domestic consumption, and rest of them was exported to foreign canneries.

All Korean distant water fisheries are managed by the Distant Water Fisheries Development Act put into effect on 4 February 2008, and the act was revised for improving data collection on 5 December 2012. From 1 September 2015, electronic reporting (ER) system started to implement, and catch information of all vessels belonging to Korean distant water fisheries have been reported through this system.

PBF has been caught by domestic fleets, mostly OLPS, which targets pelagic species such as mackerels operating within the Korean waters. The catch data and fishing information on this species had been rarely available until 2009 when the WCPFC adopted the CMM 2009-07. After then fisheries related to PBF in the Korean waters have been managed under the Ministerial Directive put established on 26 May 2011. To strengthen management of PBF in Korea, the Ministerial Directive was revised on 29 December 2014. Accordingly, the catch limit of PBF has been set, and catch reporting system has improved as well.

This report provides the information on the Korean distant water fisheries for tuna and tuna-like species and PBF catches by domestic fleets in the Korean waters.

2. Fisheries

2.1 Distant water fisheries

2.1.1 Fleet structure

The NPO is an integral part of the fishing ground for Korean distant water fisheries belonging to the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC) convention areas. The number of active vessels by gear and size is presented in Fig. 1 and Table 1. The number of purse seine vessels once peaked at 39 in 1990, reduced to 28 in 1996 and since then has been maintained around 25-28. In 2018, 26 vessels operated which 6 vessels were 501-1,000 GRT class, 16 vessels of 1,001-1,500 GRT class and 4 vessels of over 1,500 GRT class. The number of longline vessels reduced from 220 in 1991 to 108 in 2008, and then slightly increased from 111 to 126 in 2012. Since 2013, it has been decreased to 96 up to now. Most of longline vessels belonging to 201-500 GRT class except one vessel of 51-200 GRT.

2.1.2 Fishing pattern

Distributions on catch of target species and effort by gear are shown in Figs. 2 and 3.

Korean tuna purse seine fishery has generally been operating throughout the year in the tropical area of the WCPO between 140°E-170°W and from time to time extended to the east subject to oceanographic conditions. Fishing efforts of purse seine fleets in 2014 were concentrated on the central area (170°E-165°W), while it moved further to eastward and concentrated on the eastern areas in 2015 (Fig. 2).

Recently Korean tuna longline fishery has mainly operated in the area of 15°N-15°S and 160°E-110°W. Fishing efforts of longline fleets were normally higher in both the central and eastern Pacific Ocean during the last four years (2014-2017). In 2018, however, the distribution of longline fishing effort concentrated on the area of 150°-170°W compared to the previous years. While bigeye tuna was caught throughout the tropical area, yellowfin tuna was concentrated in the central Pacific of the tropical area (Fig. 3).

2.1.3 Annual catch and effort

Annual catch and effort by gear and species in the NPO are tabulated in Tables 2-3 and Figs. 4-5. Most catches by the longline and purse seine fisheries were from the areas of south of 20°N.

Total catch of the longline fishery was 16,912 ton in 2018, which was similar level of 2017. In contrast, that of the purse seine fishery was 73,645 ton, which sharply increased more than twice compared to 2017. Especially, the catch of skipjack tuna sharply increased compared to 2017, which was higher than the average catch (41,443 ton) for recent 5 years (2013-2017). The 2018 catches of yellowfin and bigeye tunas also increased 45% and 55%, respectively, compared to 2017.

As for the catch proportion by species of the longline fishery in 2018, bigeye tuna, yellowfin tuna, blue marlin and swordfish accounted for 64.1%, 20.3%, 7.9% and 4.2% in total, respectively, and the proportion was similar to that of 2017 (Table 2, Fig. 4). For the purse seine fishery in 2018, skipjack, yellowfin and bigeye tunas accounted for 80.8%, 17.4 % and 1.8% in total catch, respectively (Table 3, Fig. 5).

Fishing effort of the longline fishery (no. of hooks) was 38,018 thousand hooks in 2018, which is the highest in recent years (Table 2). As for that of purse seine fishery (no. of sets), it was 2,141 sets in 2018, which was higher than in 2017 (Table 3).

2.2 PBF catch by coastal fisheries

2.2.1 Fleet structure

PBF is mainly caught by OLPS, which targets mackerels in the Korean waters. Due to strategy for controlling fishing capacity by the government, the number of vessels belonging to OLPS had been decreased from 32 in 2002 to 24 in 2012, thereafter it has been maintained at 24 up to date. PBF is also caught by set net, troll and trawl fisheries (Table 4).

2.2.2 Fishing pattern

Most PBF was caught around Jeju Island during the first quarter of 2018, which was similar distribution pattern of the previous year. The reason why the PBF catch by OLPS existed only during the first quarter of 2018 is that vessels belonging to OLPS were prohibited to catch PBF from 26th March. It was precautionary measure to not exceed the PBF catch limit in accordance with the WCPFC CMM 2016-04 (Fig. 6). For the purpose of research, 5 tons of PBF caught by set net located in the costal water of Gyeongsangbuk-do. The main fishing season was on February in 2018, same as 2017. The fishing ground was the area of 32-35°N, 126-131°E with some seasonal fishing ground shifts.

2.2.3 Annual catch and effort

The annual PBF catch by fishery are presented in Table 5 and Fig. 7. The catch by OLPS decreased from 1,029 ton in 2016 to 523 ton in 2018, because Korea voluntarily cut the catch limit for paying back of the over-catch of large PBF of 2016. The catches by set net and offshore trawl fisheries were 7 ton and 5 ton, respectively.

According to the historical catches, there was no catch of large PBF (30kg or larger than 30kg) prior to 2008. Since then, large PBF has been continuously caught in the coastal waters of Korea, it was even caught about 469 ton which accounted for over 46% in total catch of 2016. In 2018, the catch proportion of large PBF was about 5% in total catch. The proportion of monthly catch of PBF was high on February for small PBF and March for large PBF in 2018, whereas, both small and large PBFs were high on March in 2017 (Fig. 8).

The mean fork length of PBF in 2017 and 2018 were 63.1 cm and 83.3 cm, respectively, and it was gradually increased during recent years (Fig. 9). Those samples were obtained only during the first quarter due to the fishing closure for PBF.

3. Data collecting system

3.1 Distant water fisheries

The National Institute of Fisheries Science (NIFS) is responsible for data collection and management of Korean distant water fisheries. In accordance with data reporting and submission requirement by the RFMOs, necessary improvements have been continuously made in data coverage, accuracy and verification through cross-checking between NIFS and Korea Overseas Fisheries Association (KOFA). Since 1st September 2015, the Act on Fisheries Information and Data Reporting has obliged fishers of distant water fisheries to report catch information to the NIFS in real time through the electronic reporting (ER) system. It includes data collection and

reporting requirements recently adopted by the all RFMOs regarding especially ecologically important species, discard/release and bycatch mitigation measures used.

3.2 Observer program

The scientific observer program of Korean distant water fisheries was started in 2002. The basic requirements for observers is college graduate with major in nature science or fisheries high school graduate with at least 1-year experience on board and certificate of qualification to deck officer. Candidates for observer, who have passed the paper review (including medical check) and oral interview, have to take three-weeks training program. Observer training program includes basic safety training for seafaring, operations of navigation devices, biological information training on target and non-target species and data collecting/reporting method for fishing activities. During the training program, they have two kinds of test. One is for a scientific information for marine species and technical term of fisheries, and another is for species identification. The person who scored 70% out of 100 points in the two tests and attended 100% of the course timetable can be qualified for a scientific observer and deployed on board. Korea has a total of 48 scientific observers at present.

3.3 PBF catch by coastal fisheries

The catch data of PBF for 1982-1999 were from the import products information recorded by Japan, those for 2000-2004 were from the export data to Japanese markets obtained from Korean offshore large purse seine fisheries cooperatives. Since 2005, monthly sale slips of Busan Cooperative Fish Market compiled by the NIFS were used as PBF catch data. Of them, 2000-2008 were revised based on the box weight (Yoo et al., 2011; Yoo et al., 2012). Unfortunately, the historical catch data of PBF has uncertainty due to lack of reporting system.

4. Research

4.1 PBF close-kin analysis

Since 2016, the NIFS have been collecting tissue samples of PBF caught by OLPS for the PBF close-kin analysis, which collected 1,045 tissue samples in 2016, 348 in 2017 and 245 in 2018, respectively. In 2018, 96 PBF were used for developing microsatellite (MS) markers for analysis of PBF stock as a part of ISC PBF close-kin project, and 33 MS markers were finally selected.

References

Yoo J.T., Z.G. Kim, K. Choi, S. Kang, J.B. Lee, S.I. Lee, D.N. Kim, K.J. Seok, D.Y. Moon and D.W. Lee. 2011. Update of Pacific bluefin tuna catch in Korea waters. ISC/11-1/PBFWG/15

Yoo J.T., Z.G. Kim, S. I. Lee, I. J. Yeon, S. C. Yoon and D.W. Lee. 2012. Recent update of Pacific bluefin tuna catch in Korea waters. ISC/12-1/PBFWG/19.

Table 1. The number of active vessels by size of the Korean distant water tuna fisheries operating in the Pacific Ocean, 2008-2018

Year	GRT class by fishery									
	Longline					Purse seine				
	Total	0-50	51-200	201-500	500+	Total	0-500	501-1000	1001-1500	1500+
2008	108	-	-	108	-	28	-	15	12	1
2009	111	-	-	111	-	27	-	13	11	3
2010	122	-	-	122	-	28	-	13	13	3
2011	124	-	-	124	-	28	-	12	11	5
2012	126	-	-	126	-	28	-	12	11	5
2013	125	-	1	124	-	27	-	12	10	5
2014	110	-	1	112	-	28	-	10	13	5
2015	98	-	1	97	-	25	-	7	13	5
2016	96	-	1	95	-	25	-	7	14	4
2017	96	-	1	95	-	26	-	7	15	4
2018	96	-	1	95	-	26	-	7	15	4

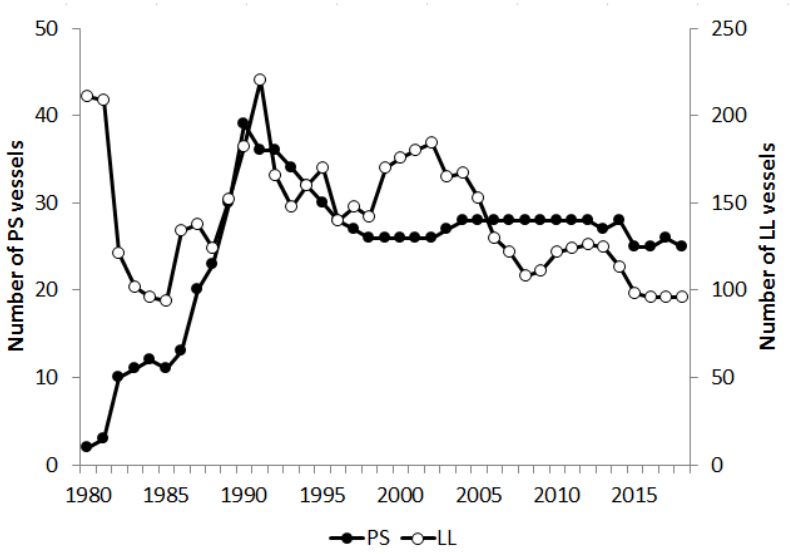

Fig. 1. Historical number of active vessels by the Korean distant water tuna fisheries operating in the Pacific Ocean during 1980-2018.

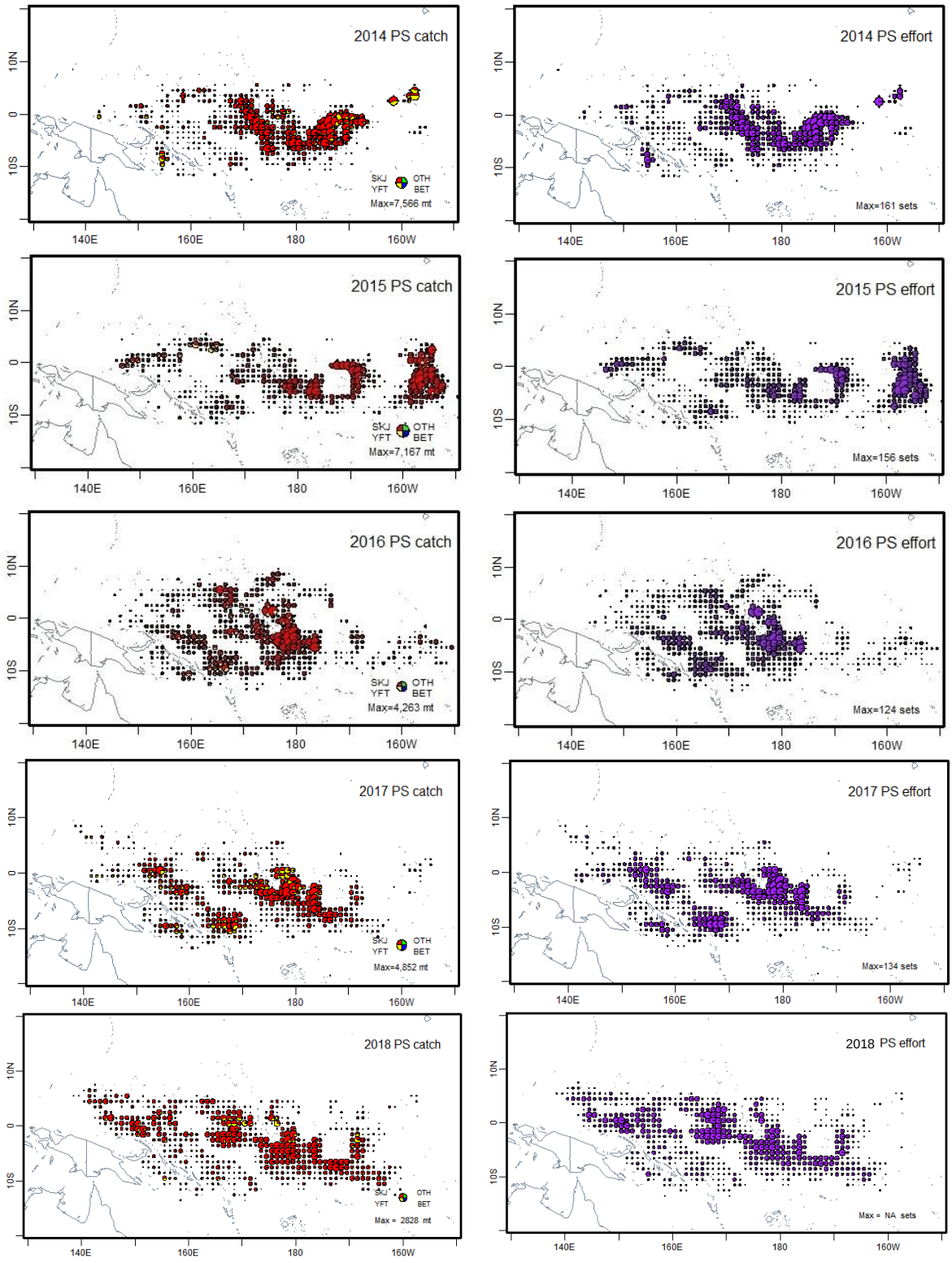

Fig. 2. Distributions on catch (left) and effort (right) of target species by the Korean tuna purse seine fishery operating in the Pacific Ocean, 2014-2018.

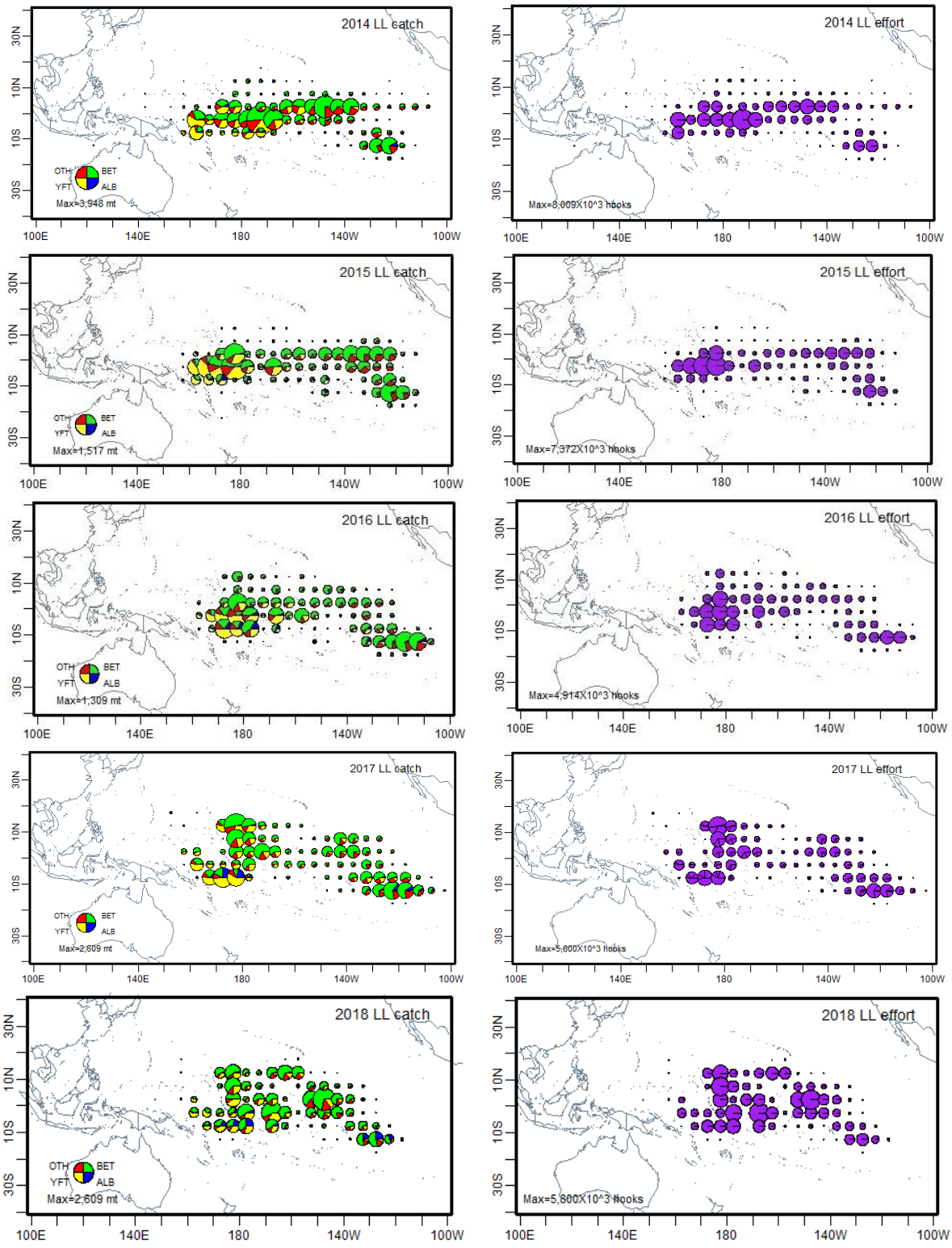

Fig. 3. Distributions on catch (left) and effort (right) of target species by the Korean tuna longline fishery operating in the Pacific Ocean, 2014-2018.

Table 2. The number of hooks (1,000 hooks) and catch (ton) of tuna and tuna-like species by the Korean tuna longline fishery in the North Pacific Ocean, 2002-2018

Year	Hook (X1000)	ALB	YFT	BET	SKJ	BUM	MLS	SWO	BLM	SFA	SKH	OTH	Total
2002	16,478	112	3,137	10,786	0	152	188	439	479	123	185	1,400	17,001
2003	21,431	146	4,741	9,739	6	159	206	381	819	129	95	931	17,352
2004	18,746	78	5,144	12,453	101	227	75	410	919	1	8	404	19,819
2005	14,955	420	2,958	9,257	35	304	136	404	997	0	10	820	15,340
2006	18,259	135	5,096	11,494	0	217	56	465	1,063	0	0	941	19,468
2007	15,441	137	2,175	9,606	0	121	47	453	887	0	1	291	13,718
2008	16,466	400	2,730	11,075	0	220	30	795	748	0	4	741	16,742
2009	13,286	95	2,992	10,979	0	224	23	994	654	0	13	878	16,852
2010	14,729	107	2,011	9,303	0	257	18	663	570	0	69	532	13,531
2011	16,654	78	3,146	9,047	0	684	48	962	159	1	546	941	15,614
2012	15,553	157	2,398	11,385	8	587	34	856	57	1	499	876	16,859
2013	13,780	173	1,988	6,041	22	963	65	1,071	41	2	735	204	11,306
2014	11,646	116	2,102	7,735	50	801	82	829	31	3	610	256	13,208
2015	8,022	38	1,520	6,132	41	531	44	776	82	2	250	115	9,531
2016	26,241	56	1,626	6,871	73	1,116	61	582	30	11	9	158	10,593
2017	36,780	202	3,775	10,303	147	1,453	81	583	17	13	31	262	16,867
2018	38,018	101	3,426	10,838	99	1,336	70	708	35	13	56	230	16,912

* ALB : Albacore tuna, YFT : Yellowfin tuna, BET : Bigeye tuna, SKJ : Skipjack tuna, BUM : Blue marlin, MLS : Striped marlin, SWO : Swordfish, BLM : Black marlin, SKH : Sharks, OTH : Others.
** Data for 2018 is provisional.

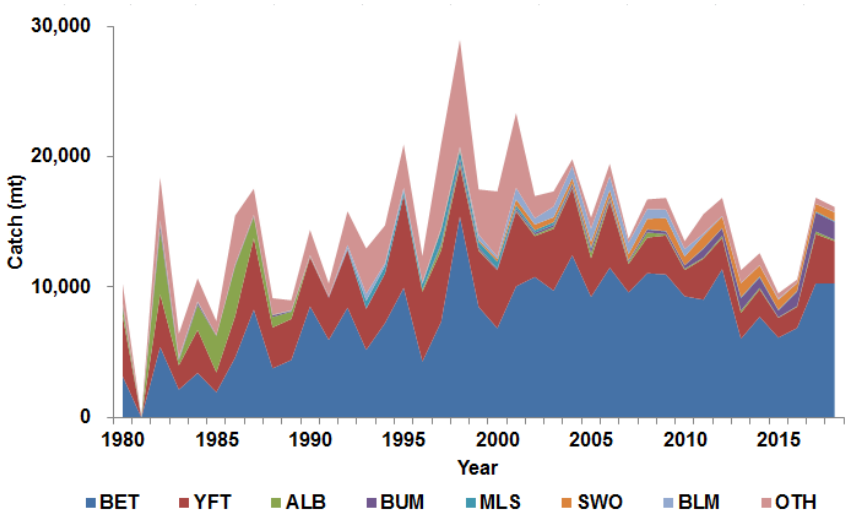

Fig. 4. Historical catch by species caught by the Korean tuna longline fishery in the North Pacific Ocean, 1980-2018.

Table 3. The number of sets and catch (ton) of tunas by the Korean tuna purse seine fishery in the North Pacific Ocean, 2002-2018

Year	Effort (No. of sets)	Catch (ton)				Total
		SKJ	BET	YFT	OTH	
2002	2,537	64,897	0	16,389	0	81,286
2003	2,876	88,654	319	11,714	0	100,687
2004	1,633	43,797	48	7,426	0	51,271
2005	1,035	49,724	0	11,027	0	60,751
2006	510	67,564	13	15,394	0	82,970
2007	543	18,270	0	3,585	0	21,855
2008	490	9,233	4	7,842	0	17,079
2009	1,237	38,436	15	7,232	0	45,683
2010	727	20,751	374	4,020	0	25,145
2011	770	18,331	216	5,256	0	23,803
2012	2,402	67,448	404	19,467	1	87,320
2013	1,644	40,809	232	4,344	0	45,386
2014	1,732	40,690	265	11,343	0	52,298
2015	1,296	40,195	739	13,859	0	54,793
2016	2,379	62,849	1,025	10,088	31	73,993
2017	863	22,672	858	8,829	2	32,361
2018	2,141	59,479	1,327	12,838	1	73,645

* SKJ : Skipjack tuna, BET : Bigeye tuna, YFT : Yellowfin tuna, OTH : Others.

** Data for 2018 is provisional.

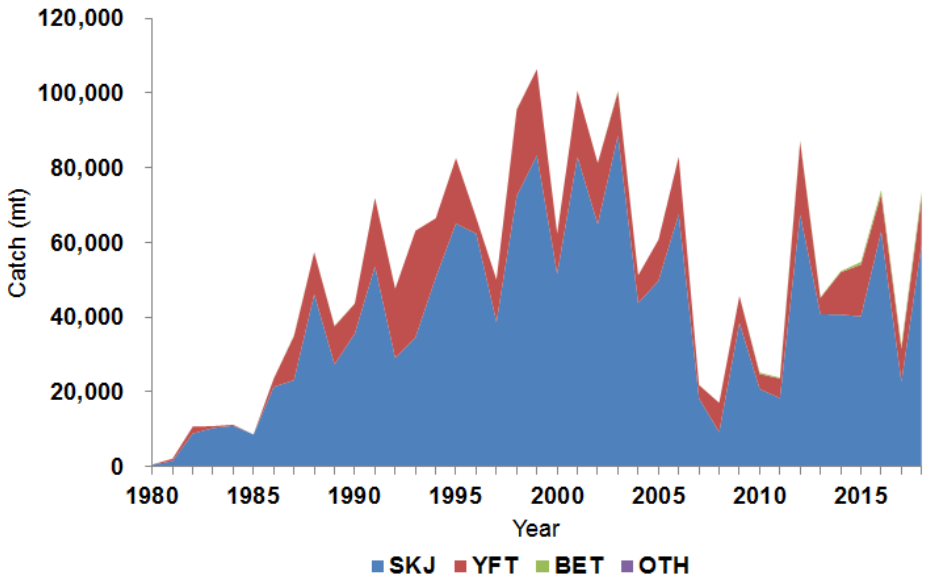

Fig. 5. Historical catch by species caught by the Korean tuna purse seine fishery in the North Pacific Ocean, 1980-2018.

Table 4. Annual catch of Pacific bluefin tuna by fishery and fishing effort (no. of OLPS vessels) operating in the Korean waters, 2002-2018

Year	Catch (ton)				
	OLPS (no. of vessels)	Set Net	Troll	Trawl	SUM
2002	932(32)	0	0	1	933
2003	2,601(29)	0	0	0	2,601
2004	773(29)	0	0	0	773
2005	1,318(29)	0	0	9	1,327
2006	1,012(29)	0	0	3	1,015
2007	1,281(29)	0	0	4	1,285
2008	1,866(29)	0	0	10	1,876
2009	936(27)	0	0	4	940
2010	1,196(25)	0	0	16	1,212
2011	670(25)	0	0	14	685
2012	1,421(24)	0	1	2	1,424
2013	604(24)	1	0	0	605
2014	1,305(24)	6	0	0	1,311
2015	676(24)	1	0	0	677
2016	1,024(24)	3	0	2	1,029
2017	734(24)	3	0	6	743
2018	523(24)	7	0	5	535

* Data for 2018 is provisional.

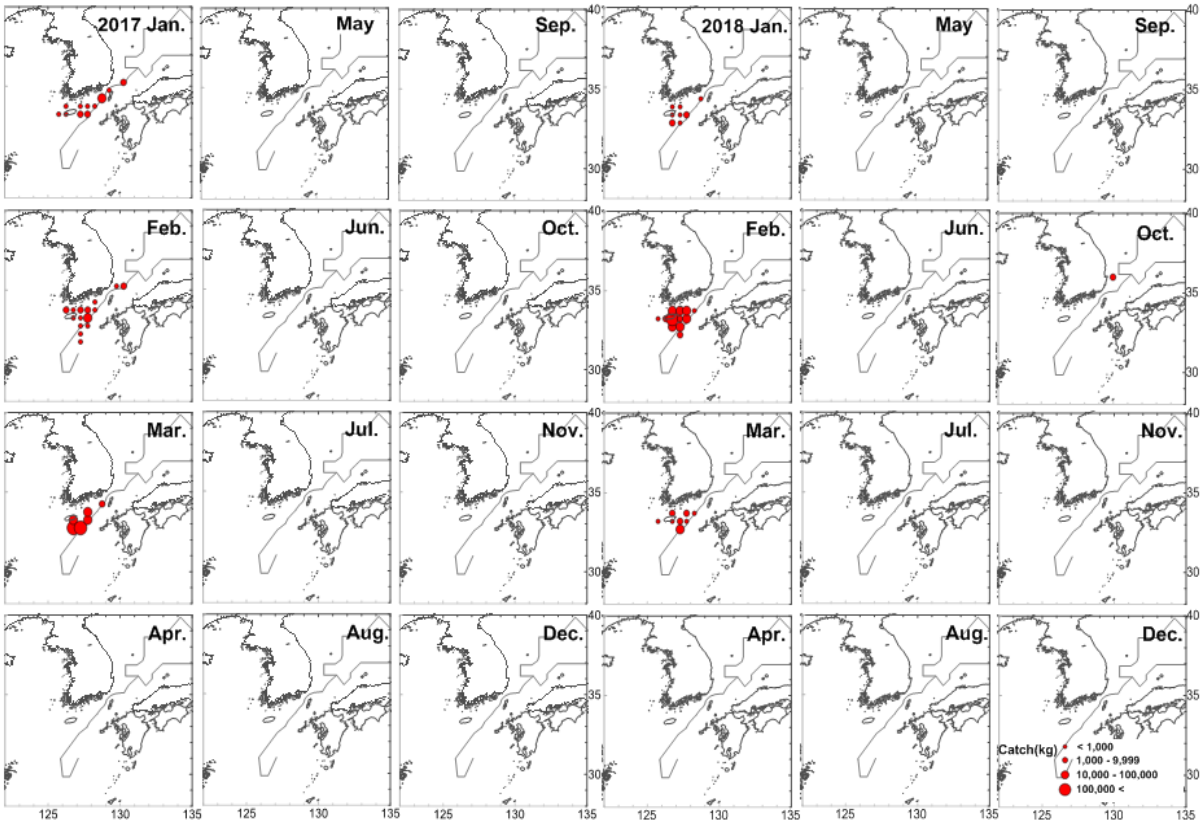

Fig. 6. Monthly distributions on catch of Pacific bluefin tuna caught by the Korean coastal fisheries in 2017 and 2018.

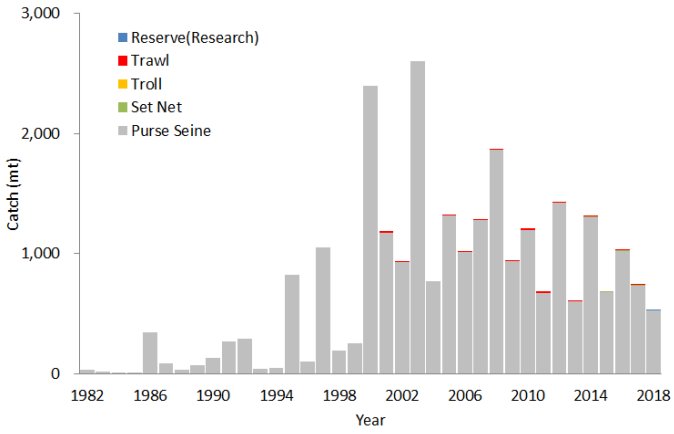

Fig. 7. Historical catch of Pacific bluefin tuna by fisheries operating in the Korean waters, 1982-2018.

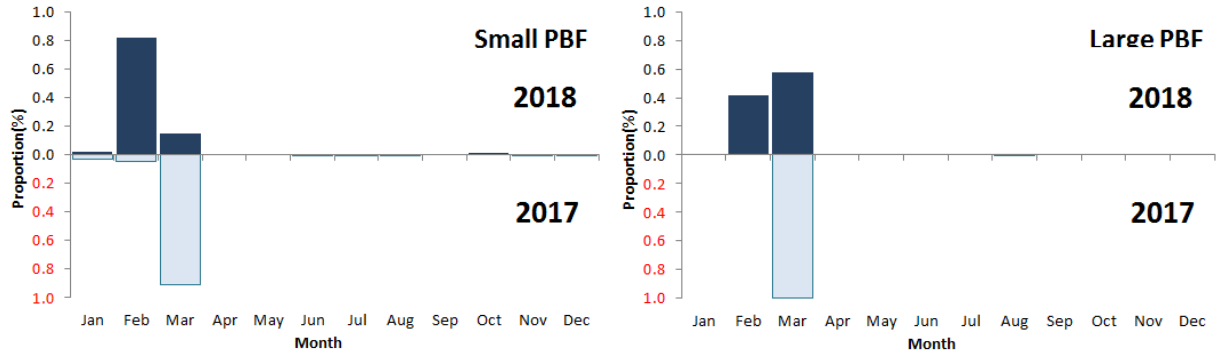

Fig. 8. Monthly catch proportion by size of Pacific bluefin tuna in 2017 and 2018.

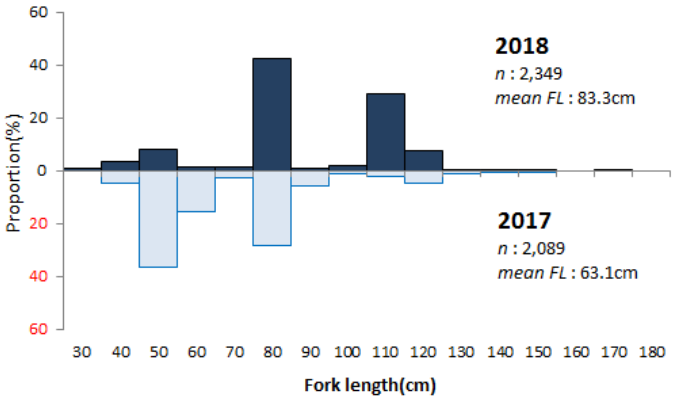

Fig. 9. Proportion on length distribution of Pacific bluefin tuna in 2017 and 2018.