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Summary

Korea has two types of fishing gears, purse seine and longlines, that engage in fishing for tuna and tuna-like species in the North Pacific. Total number of longline vessels shows a steady trend from 122 vessels in 2010 to 125 in 2013. Recently, it has decreased to 113 in 2014 to 84 in 2015. Total number of purse seine vessels shows constant trend during 2010-2014 and has slightly decreased to 25 in 2015. Total catch of tuna and tuna like species caught by Korean distant water fisheries in the north Pacific was 64,324 t in 2015. Total catch of longline was 9,531 t, which is 48.1 % of the historical highest catch in 2004. That of purse seine was 54,793 t, which is corresponding to 54.4% of the historical highest catch in 2003. As for the catch composition of longline fishery, dominant species were bigeye, over 64% of total catch, yellowfin and swordfish for 16% and 8%, respectively. As for that of purse seine fishery, skipjack, yellowfin and bigeye tuna were 73%, 25%, and 1%, respectively. Pacific bluefin tuna (PBF) caught by offshore large purse seine fishery in the Korean EEZ was 676 mt in 2015. It was distributed in the South Sea around Jeju Island throughout the year with the highest in March to July and less than 10 t caught in August to November. 583 tissue samples of PBF were collected for close-kin analysis in 2015.

1. Introduction

About 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. Korean longline fishery has been mainly conducting in the waters of coastal states and the high seas of the South Pacific Ocean. . In early days, Korean longline vessels used foreign ports as fishing base near fishing grounds. However, as those started to equip with deep freezing facilities, fishing base generally moved to Korean domestic ports since 1972. And since 1999, all longline vessels have based in domestic ports. 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.

The Korean tuna purse seine fishery was initiated by accessing into the eastern Pacific Ocean 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 maintained at 27-28

until recently but decreased to 25 in 2015. Most of the catches were supplied to the packers for domestic consumption, and rest of them were exported to foreign canneries.

Both fisheries are managed by the Distant Water Fisheries Development Act put into effect on 4 February 2008, and the Act was revised for improving the data collection on 5 December 2012 and the data reporting system on 7 July 2015. Currently, over 80% of total catch of tuna and tuna-like species has occurred in the western and central Pacific Ocean area.

Pacific bluefin tuna has been caught by domestic fleet, mostly the offshore large purse seine fishery, which targets pelagic species such as mackerels operating within the Korean EEZ. The catch data and fishing information on this species had been rarely available until 2009 when the WCPFC adopted the CMM 2009-07. Then fisheries for PBF in the Korean EEZ have been managed under the Ministerial Directive put established on 26 May 2011. To strengthen management of Pacific bluefin tuna in Korea, the Ministerial Directive was revised on 29 Dec. 2014. Accordingly, the catch limits of juvenile Pacific bluefin tuna have been set, and catch reporting system has improved as well. This report provides the information on the Korean distant water tuna fisheries in the north Pacific Ocean and Pacific bluefin tuna catches by domestic fleets in the Korean EEZ.

2. Fisheries

2.1 Distant water fisheries

2.1.1 Fleet structure

The north Pacific Ocean is an integral part of the fishing ground for Korean distant water fishery belonging to the WCPFC and the IATTC convention areas of south of 20°N. All the vessels registered to both RFMOs could engage in fishing for tuna and tuna-like species in the North Pacific Ocean. 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 up to 1996 and had been maintained around 26-28 until recently. In 2015, it decreased to 25, of which 8 vessels were 501-1,000 GRT class, 12 vessels of 1,001-1,500 GRT class and 5 vessels of over 1,500 GRT class. The number of longline vessels reduced from 220 in 1991 to 108 in 2008, and slightly increased and ranged from 111 to 126 thereafter. In 2015, it also decreased to 84, of which 1 vessel was 51-200 GRT class and 83 vessels of 201-500 GRT class.

2.1.2 Fishing pattern

The 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. Purse seine fishing efforts in 2011 and 2013 were concentrated on the western areas, while concentrated relatively higher on the central areas in 2012 and 2014.

Especially, in 2015 the distributions of effort moved eastward further and concentrated on the eastern areas than previous years. Korean tuna longline fishery efforts were normally higher in both the central and eastern Pacific Ocean. The efforts in 2014 concentrated in the WCPO, but those of 2015 were relatively higher in the EPO

2.1.3 Annual catch and effort

Annual catch and effort by gear and species in the north Pacific are tabulated in Tables 2, 3, and Figs. 4 and 5. The catches occurred in the areas south of 20°N. Longline catch was 9,531 t in 2015, which decreased 48.1% from the peak in 2004. Purse seine catch was 54,793 t in 2015 and decreased to 54.4% from the peak in 2003. As for the catch proportion by species caught by longline in 2015, bigeye, yellowfin, swordfish, blue marlin, black marlin, striped marlin and albacore were 64.3%, 15.9%, 8.1%, 5.6%, 0.9%, 0.5% and 0.4%, respectively. Bigeye catches decreased from 7,735 t in 2014 to 6,132 t in 2015 and the catches of all species were slightly decreased. For the purse seine, skipjack, yellowfin and bigeye tuna were 73.4%, 25.3 % and 1.3%, respectively. Skipjack catch in 2015 was 45.3% of the peak in 2003 and yellowfin catch in 2015 was 48.5% of the peak in 1993. Fishing effort of longline was 8,022 thousand hooks in 2015. That of purse seine decreased from 2,876 sets in 2003 to 1,296 sets in 2015.

2.2 Pacific bluefin tuna catch by coastal fisheries

2.2.1 Fleet structure

Pacific Bluefin tuna is mainly caught by offshore large purse (OLPS) fishery, which targets mackerels in the Korean EEZ. The number of offshore large purse seiners was 24 in 2015, continuously decreasing from 48 in 1994 due to fishing capacity control by the government. Pacific bluefin tuna is also caught by set net, troll and trawl fisheries as incidental.

2.2.2 Fishing pattern

The catch distribution is shown in Fig. 6. The catches were concentrated around Jeju Island in the South Sea throughout the year. The main fishing season was from January to March and December in 2015. 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 and monthly catches of Pacific bluefin tuna are presented in Table 4 and Figs. 7 and 8. The catch decreased from 1,305 t in 2014 to 676 t in 2015 under the WCPFC CMM 2014-04 on catch limit for Pacific bluefin tuna. The catch of Pacific bluefin tuna by set net and offshore trawl fisheries were 1 t and 0.3 t, respectively.

According to the historical catches, there was no catch of adult PBF prior to 2008. However, adult PBF has been continuously caught in the coastal waters of Korea in recent years, it even accounted for over 50% of total PBF catch, which is 469 t in 2016 (January-June).

The Pacific bluefin tuna catches throughout year with the highest from March to July, and less than 10 t caught from August to November during the past 5 years. Monthly peak of catch is slightly different annually (Fig. 8).

Quarterly fork length frequency of PBF by OLPS is presented in Fig. 9, which showed almost juvenile (<150 cm). In the second quarter, it showed above 110 cm of large PBF with four modes of 60 cm, 120 cm, 140 cm and 150 cm. The fourth quarter had distributed juvenile with the range of 40-60 cm. Most PBF caught by other coastal fisheries were juvenile. The range of PBF caught by set net fishery was 48-90 cm.

3. Data collection system

3.1 Distant water fisheries

Korean tuna catch statistics are obtained from two sources of data reporting. The Korea Overseas Fisheries Association (KOFA) collects monthly catch by gear and species from Korean tuna industries. The National Institute of Fisheries Science (NIFS) collects logsheet data from vessels filled out by captain onboard. In accordance with data reporting and submission requirement by RFMOs, necessary improvements have been continuously made in logbook coverage, accuracy and verification through cross-checking between NIFS and KOFA. To improve fisheries database management system and data cross-checking, in 2015 the NIFS and the Ministry developed an electronic logbook system capable of monitoring the state of data submission from fishing vessel in real time and to manage/cross-check the data.

3.2 Observer program

The scientific observer program of distant water fisheries of Korea was started in 2002. The NIFS is responsible for implementing and developing the program. The basic requirement 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 technical term of fisheries and biology, and the other 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 29 scientific observers at present.

3.3 Pacific bluefin tuna catch by coastal fisheries

The catch data of Pacific bluefin tuna for 1982-1999 were import products recorded by Japan,

those for 2000-2004 were the export data to Japanese markets obtained from Korean offshore large purse seine fisheries cooperatives, and for 2005-2015, monthly sale slips of Busan Cooperative Fish Market were compiled by the NIFS. 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 Pacific bluefin tuna has uncertainty due to lack of reporting system.

4. Research

4.1 Tissue sampling for close-kin analysis

The NIFS has collected 583 tissue samples of Pacific bluefin tuna for close-kin analysis in 2015. The collected fork length distribution was 38-179 cm, body weight was 1.1-126.4 kg. Large PBF (115 cm<FL) was sampled 7 fishes on March, but main size frequency (about 80% of total samples) showed in 40-50 cm FL.

4.2 Research cruise

Research cruise was conducted to find PBF larvae and juveniles in the southeast sea of Jeju Island during 20-27 June in 2016 by R/V Tamgu 21. The larvae and juveniles of Pacific bluefin tuna and other tuna and tuna-like species will be identified.

The research cruise had been carried out 5 times from 2010 to 2014 to collect the larvae and juveniles of Pacific bluefin tuna, and some larvae and juveniles of albacore, skipjack and longtail tuna were collected from these researches as well.

References

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- 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 Korean active vessels by gear and size, operating in the Pacific Ocean, 2008-2015

Year	GRT class by gear									
	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	113	-	1	112	-	28	-	10	13	5
2015	84	-	1	83	-	25	-	8	12	5

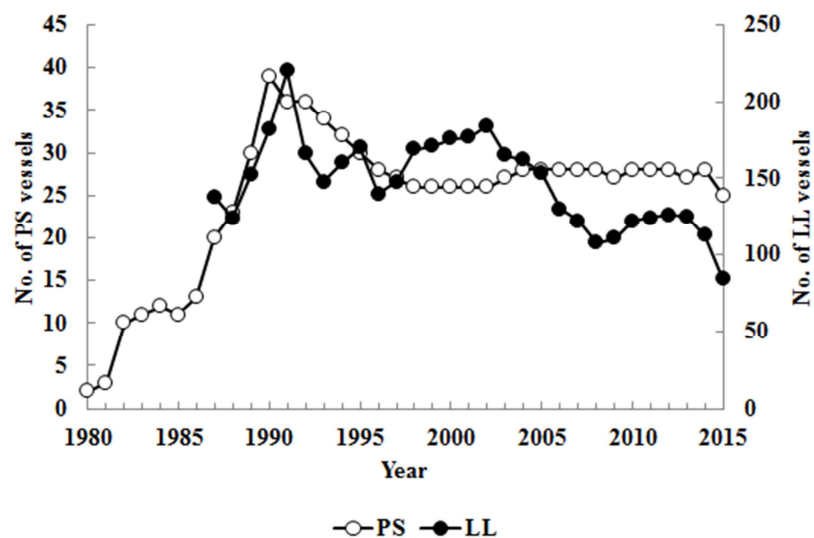


Fig. 1. Historical annual vessel numbers for the Korean tuna fisheries by gear in the WCPFC Convention Area during 1980-2015.

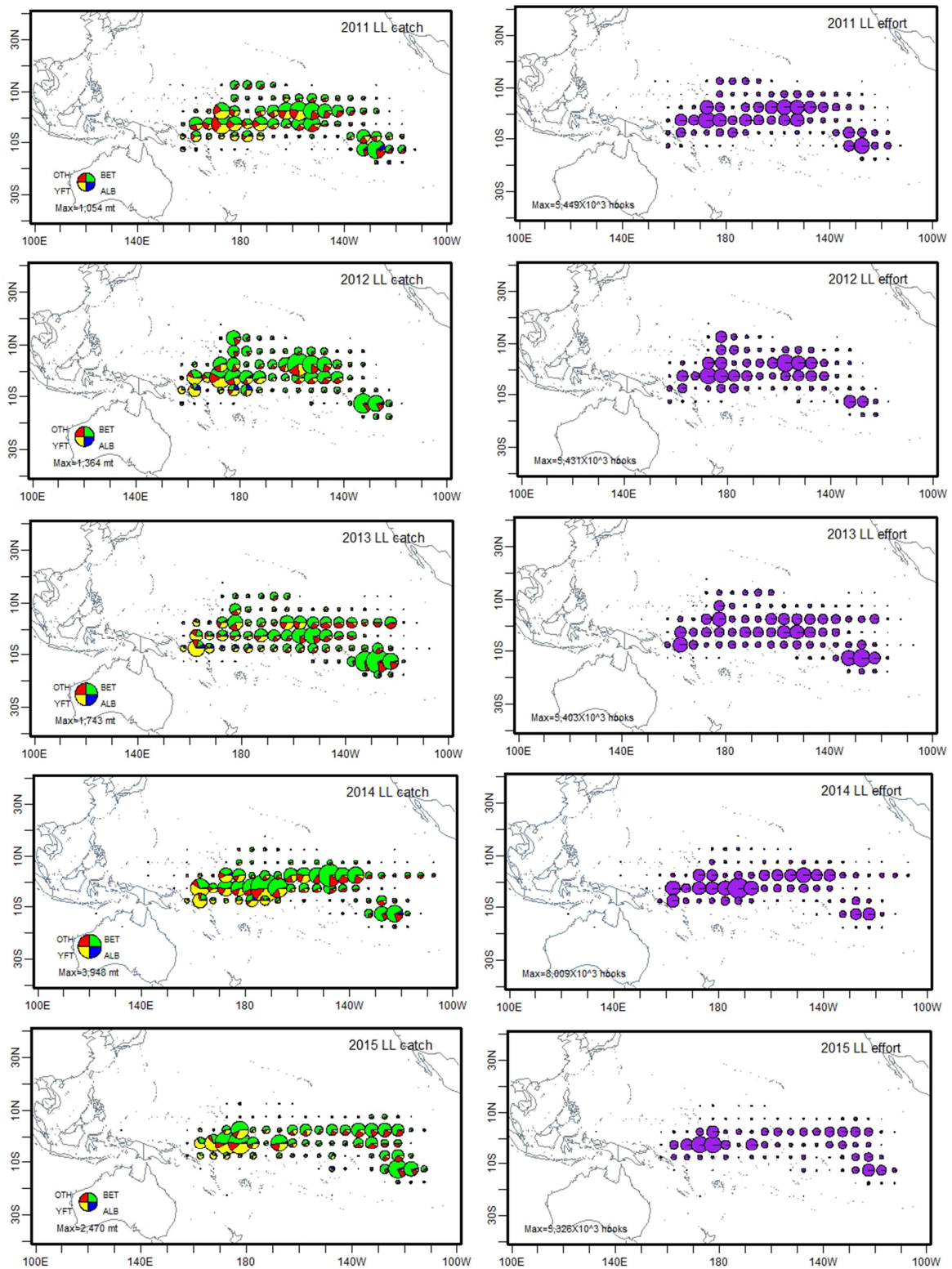


Fig. 2. Annual catch and effort distributions of target species by Korean distant water longline fishery operating in the Pacific Ocean, 2011-2015.

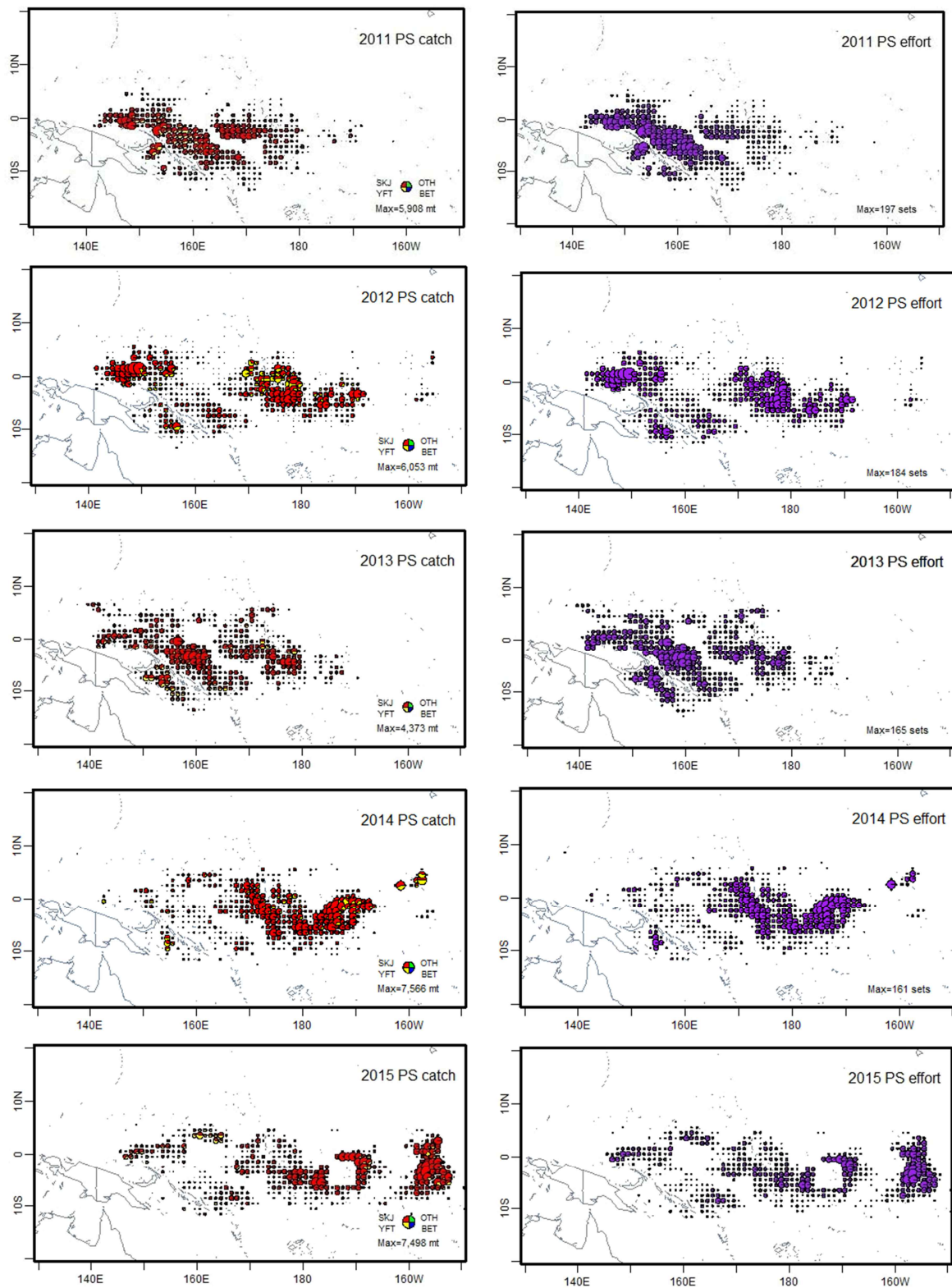


Fig. 3. Annual catch and effort distributions of target species by Korean distant water purse seine fleets operating in the Pacific Ocean, 2011-2015.

Table 2. Number of hooks (1,000 hooks) and catch (t) of tuna and tuna-like species by the Korean distant water longline fishery in the North Pacific, 2008-2014. Data for 2014 is provisional

Year	No. of hooks (1,000)	ALB	YFT	BET	SKJ	BUM	MLS	SWO	BLM	SFA	SHK	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

ALB : Albacore tuna, YFT : Yellowfin tuna, BET : Bigeye tuna, SKJ : Skipjack tuna, BUM : Blue marlin, MLS : Striped marlin, SWO : Swordfish, BLM : Black marlin, SHK : Sharks, OTH : Others

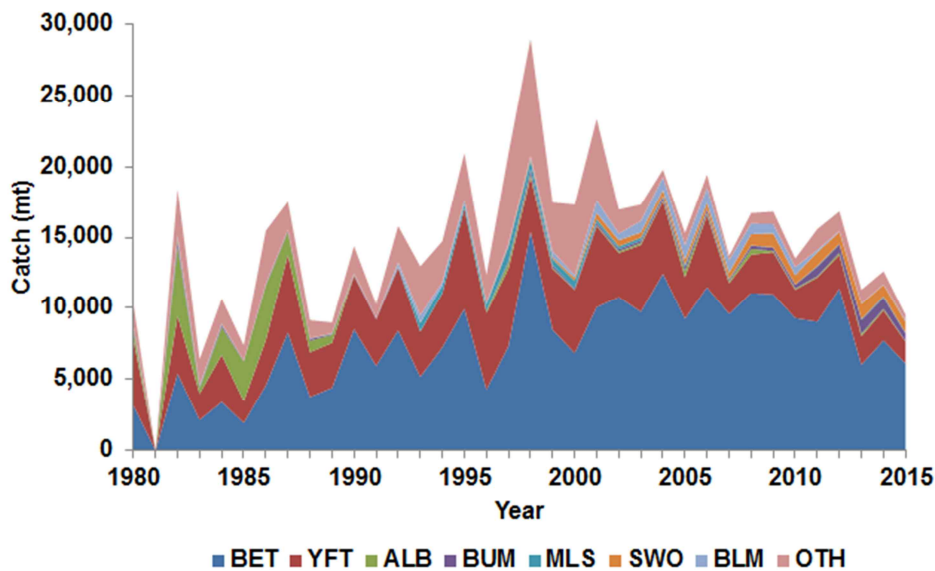


Fig. 4. Annual catch of Korean distant water longline fishery by species in the North Pacific, 1980-2015.

Table 3. Fishing effort (sets) and catch (t) of tunas by the Korean distant water purse seine fishery in the North Pacific, 2002-2014. Data for 2014 is provisional

Year	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

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

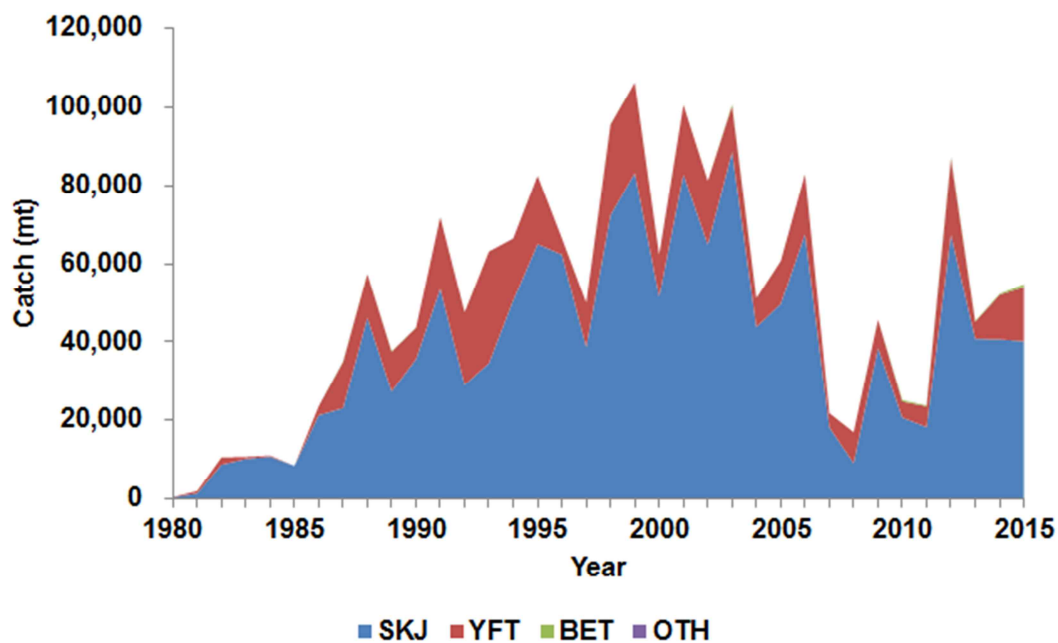


Fig. 5. Annual catch of Korean distant water purse seine fishery by species in the North Pacific, 1980-2015.

Table 4. Annual catch of Pacific bluefin tuna by fishing gears in Korean waters, 1982 - 2015

unit: ton

Year	Number of OLPS* vessel	Purse Seine	Set Net	Troll	Trawl	SUM
1982	48	31				31
1983	48	13				13
1984	48	4				4
1985	48	1				1
1986	48	344				344
1987	48	89				89
1988	48	32				32
1989	48	71				71
1990	48	132				132
1991	48	265				265
1992	48	288				288
1993	48	40				40
1994	48	50				50
1995	36	821				821
1996	36	102				102
1997	36	1,054				1,054
1998	36	188				188
1999	36	256				256
2000	32	2,401			0	2,401
2001	32	1,176			10	1,186
2002	32	932			1	933
2003	29	2,601			0	2,601
2004	29	773			0	773
2005	29	1,318			9	1,327
2006	29	1,012			3	1,015
2007	29	1,281			4	1,285
2008	29	1,866			10	1,876
2009	27	936			4	940
2010	25	1,196			16	1,212
2011	25	670		0	14	685
2012	24	1,421		1	2	1,424
2013	24	604	1	0	0	605
2014	24	1,305	6		0	1,311
2015**	24	676	1		0	677

* : OLPS is Offshore Large Purse Seine

** : Data for 2015 is provisional

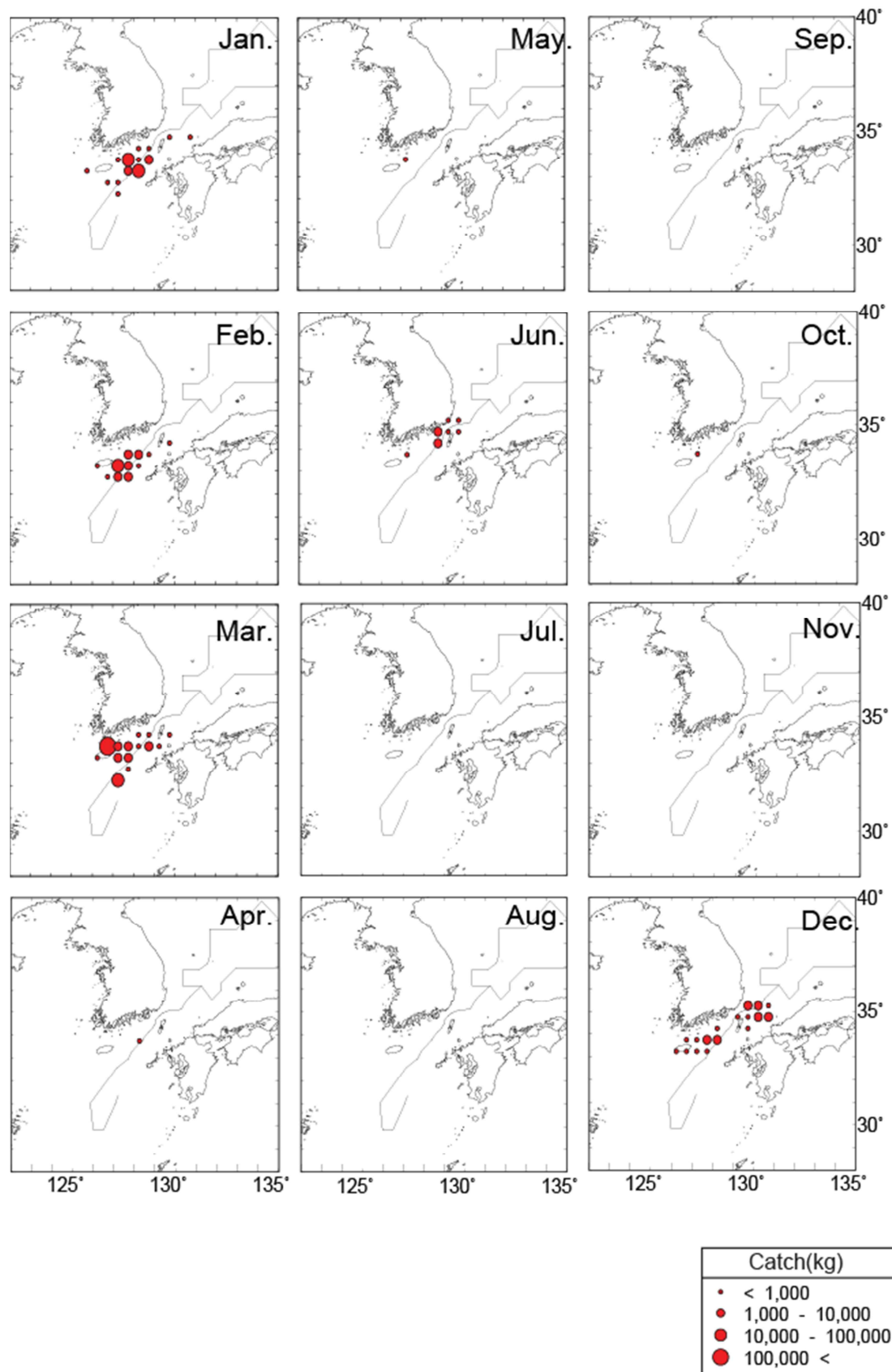


Fig. 6. Monthly distributions of Pacific bluefin tuna caught by offshore large purse seine in Korean waters, 2015.

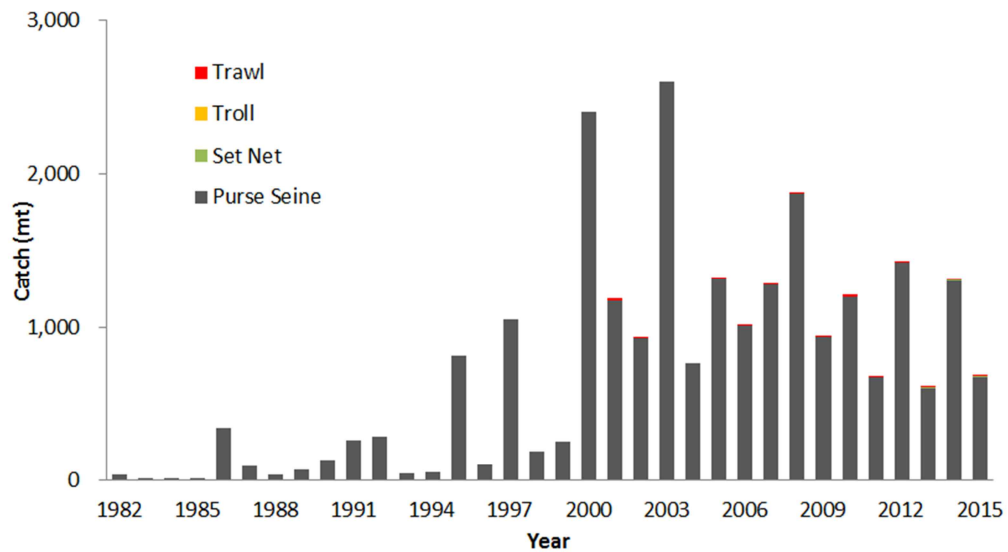


Fig. 7. Annual catch of Pacific bluefin tuna caught by fishing gear, 1982-2015.

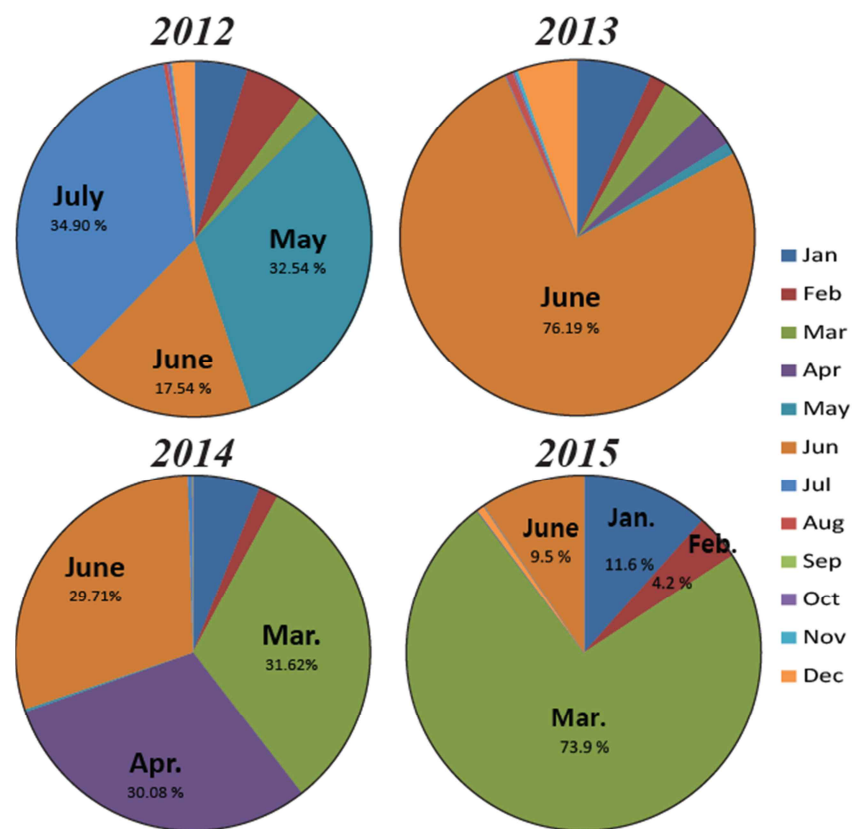


Fig. 8. Monthly catches of Pacific bluefin tuna caught by offshore large purse seine, 2011-2015.

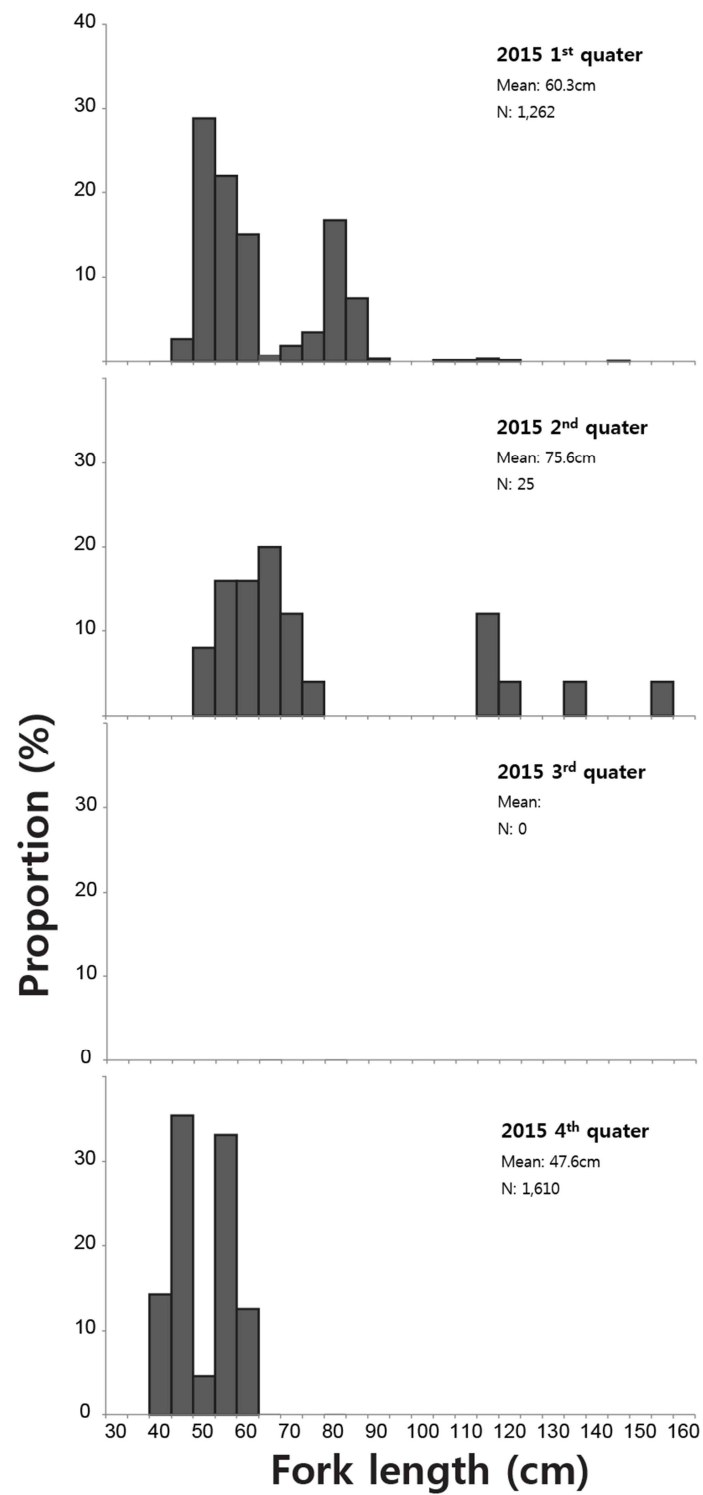


Fig. 9. Quarterly length proportion of Pacific bluefin tuna caught by offshore larger purse seine, 2015.