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Fishery data and catch estimation of blue shark by Korean tuna longline fishery in the North Pacific Ocean[1]

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Abstract

This paper introduces the preliminary results on the Korean estimated catch of blue shark in the NPO. To estimate blue shark catch by Korean tuna longline fishery in the NPO, we divided area into two as A (North of 25ºN) and B (0º - 25ºN) by main target species. The catch of blue shark in the NPO was estimated by the sum of retained and discarded/released, and it was calculated by multiplying nominal CPUE with total effort. It shows a similar annual trend between last (2013 stock assessment) and new catch estimations because both of catch estimation methods were similar as using effort and CPUE. However, it should be updated and could be changed by methods for estimation, data and so on.

Introduction

The number of Korean tuna longline vessels reduced from 220 in 1991 to 108 in 2008, and slightly increased up to 126 thereafter. In 2015, it further decreased to 84, of which 1 vessel was 51-200 GRT class and 83 vessels of 201-500 GRT class. Fishing efforts of Korean tuna longline fishery were normally higher in the central and eastern Pacific Ocean (EPO). The fishing efforts in 2014 were concentrated in the western and central Pacific Ocean (WCPO), but those of 2015 were relatively higher in the EPO (Fig. 1).

Korean tuna longline fishery is managed by the Distant Water Fisheries Development Act put into effect on 4 February 2008, and the Act was revised in phases for improving data collection (5 December 2012) and data reporting system (7 July 2015).

Total catch of tuna and tuna like species caught by Korean distant water fisheries in the NPO was 64,324 t in 2015 (Fig.1). Total catch by longline fishery was 9,531 t, which is 48.1 % of the historical highest catch in 2004. Currently, over 80% of total catch of tuna and tuna-like species has occurred in the WCPO. Target species of Korean tuna longline fishery are tuna species, especially bigeye and yellowfin, and shark species are classified as incidental catches. This paper introduces the preliminary results on the Korean estimated catch of blue shark in the NPO.

Data collection system for Korean distant water fishery

Statistics on Korean tuna catch are obtained from two sources of data reporting. Korea Overseas

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Fisheries Association (KOFA) collects monthly catch by gear and species from Korean tuna industries. National Institute of Fisheries Science (NIFS) collects log-sheet data from vessels filled out by captain onboard. In accordance with data reporting and submission requirement by RFMOs, necessary improvements have been continuously made for increasing logbook coverage, accuracy and verification through cross-checking between NIFS and KOFA. To improve fisheries database management system and data cross-checking, NIFS and Ministry of Oceans and Fisheries (MOF) implemented an electronic logbook system capable of monitoring state of data submission from fishing vessels in real time and to manage/cross-check the data since 1st September 2015. They include operational information, effort and catch including the amount of discard/release by species (target and non-target, such as shark, seabird, marine turtle, etc.).

Method of catch estimation

The fishing area was divided into two as A (North of 25°N) and B (0° - 25°N) by main target species to estimate blue shark catch by Korean tuna longline fishery in the NPO (Fig. 2). Area B is main fishing ground for Korean tuna longline fleets targeting bigeye and yellowfin tunas. In the area A, there was some fishing records by vessels for catching albacore.

The catch of blue shark in the NPO was estimated by the sum of retained and discarded/released, and it was estimated by multiplying nominal CPUE with effort, as follows:

$$\mathbf{Catch}_{i,y} = \mathbf{CPUE}_{i,y} \mathbf{\ X\ effort}_{i,y}$$

$Catch_{i,y}$ is catch in number of area i and year y, $CPUE_{i,y}$ is Korean nominal CPUE (no. of fish/1,000 hooks) of area i and year y. i indicates area A and B, and y ranges from 1973 to 2015.

Because fishing information including catch and effort had not been reported 100% to NIFS in the past, effort should be adjusted by annual reporting rate. The annual reporting rate was calculated by the ratio of bigeye tuna catches between NIFS and Korean official statistics. Adjusted effort was calculated as follows:

$$\mathbf{Adjusted\ effort}_{i,y} = \mathbf{Reported\ effort}_{i,y} \mathbf{\ X\ reporting\ rate}_{y}$$

$$\mathbf{Reporting\ rate}_{y} = \mathbf{NIFS\ BET\ catch}_{y} \mathbf{\ /\ KOFA\ BET\ catch}_{y}$$

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Reported effort$_{i,y}$ is the number of hook reported in the logbook by vessel, area *i* and year *y*.

Fig. 3 shows the trends in reported and adjusted number of hooks of Korean tuna longline fleet operating in NPO. Reporting rates before 2013 were not 100%, and those were especially low until early 1980s.

Fig. 4 shows a flowchart to estimate catch of blue shark caught by Korean tuna longline fishery in NPO, and key points are as follows:

i) Catch (in number) of aggregated sharks by area : two area stratificated by south and north of 25^{o}N

ii) Catch (in number) of blue shark by area : proportion of blue shark catch by aggregated sharks catch by area (area A : 0.84, area B : 0.34 based on Korean scientific observer data)

iii) Nominal CPUE of blue shark by area : catch (in number) of blue shark by effort (number of hooks) reported to NIFS

iv) Adjusted catch (in number) of blue shark by area : multiplying nominal CPUE with adjusted effort

v) Catch (weight) of blue shark by area : average catch (weight) of blue shark by area (area A: 66.1kg, area B: 41.0kg based on Korean scientific observer data)

vi) Catch (weight) retained, discarded or released : proportion of retained, discarded or released by aggregated sharks (1973-2010: observer data, 2011-2015: logbook data)

The Korean scientific observer data were collected from 2004 to 2015 in the Pacific Ocean.

Results

Korean catch of blue shark from 1973 to 2015, which was estimated according to the flowchart, is shown in Fig. 5, Tables 1 and 2. It shows a similar annual trend between last (2013 stock assessment) and new catch estimations because both of catch estimation methods were similar as

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using effort and CPUE. However, it presents quite different absolute catches in several years like 1976, 1982-1984 and 1998. With regard to higher catch estimated using new method in 1976 and 1982-1984, it was because that lower reporting rate during those periods makes number of hooks adjusted increase. On the other hand, the reporting rate in 1998 was similar to other years, however, effort of area B jumped more than double than previous year, so catch was also increased.

The proportion of catch retained and discarded or released was calculated 99.6% and 0.4%, respectively, based on Korean scientific observer data. In general, bigeye and yellowfin tunas are target species of Korean tuna longline fishery, while all shark species including blue shark were caught as bycatch. Proportion of catch retained and discarded or released could be changed by year and implementation of conservation management measures on shark species, however, it was applied the same proportion to all years due to lack of data.

The estimated Korean catch of blue shark in this paper is preliminary results, thus, it should be updated and could be changed by methods for estimation, data and so on.

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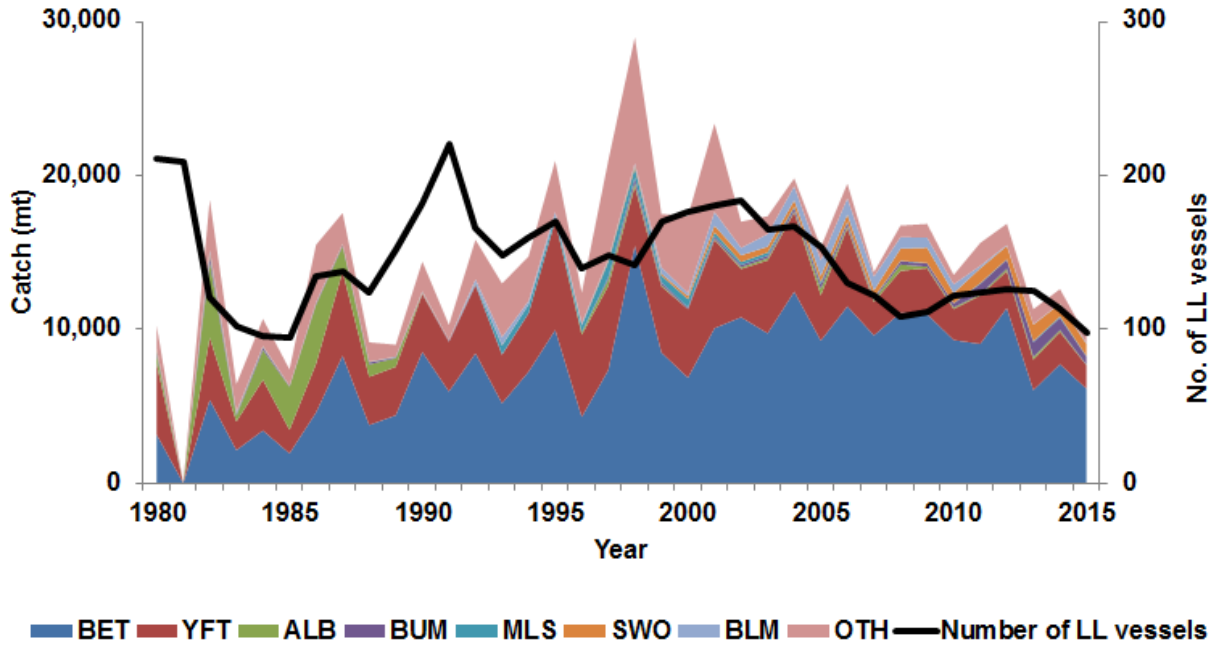

Fig. 1. Annual number of Korean tuna longline vessels and total catch in the north Pacific Ocean.

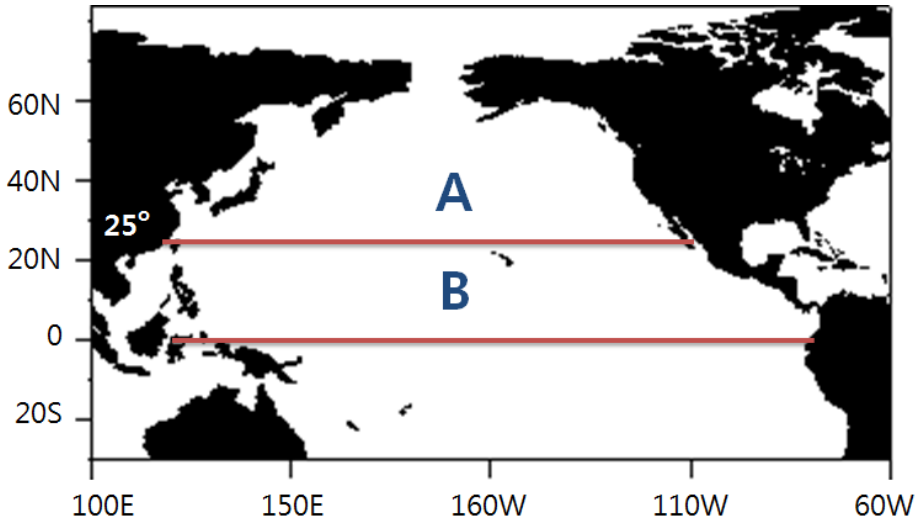

Fig. 2. Area stratification used for estimating Korean catch of blue shark in the north Pacific Ocean.

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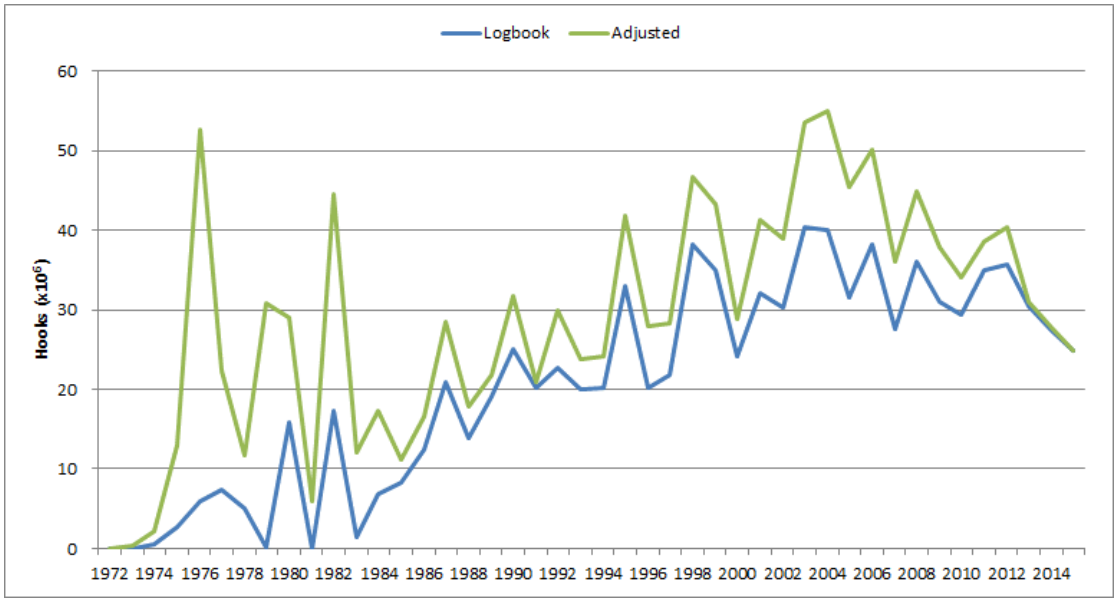

Fig. 3. Trends in number of hooks reported (blue line) and adjusted (green line) used by Korean tuna longline fishery in the north Pacific Ocean.

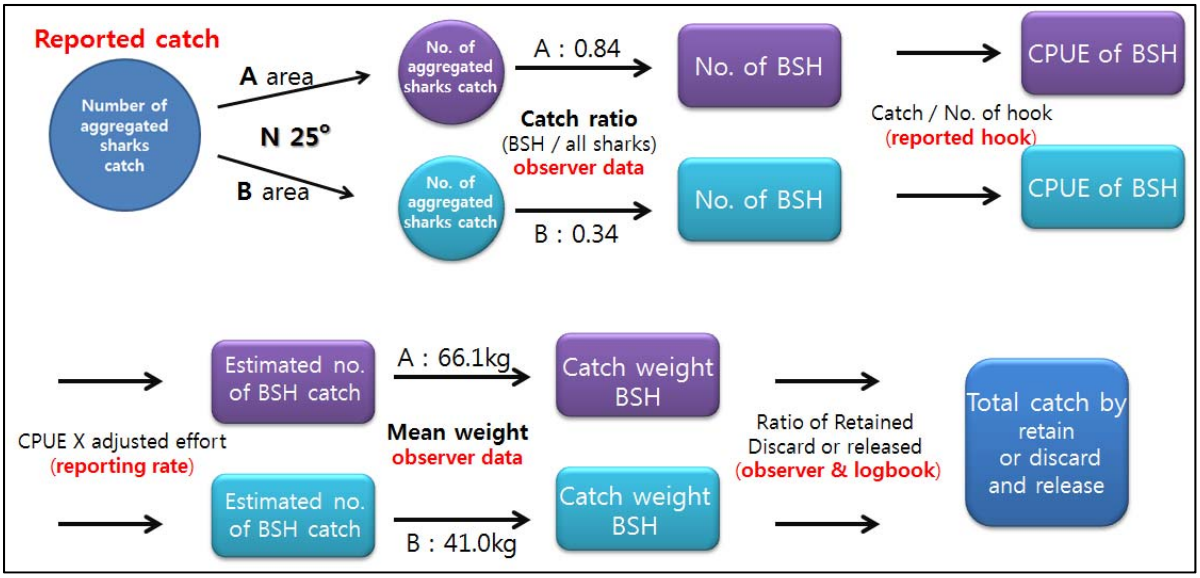

Fig. 4. Flowchart to estimate catch of blue shark caught by Korean tuna longline fishery in the north Pacific Ocean.

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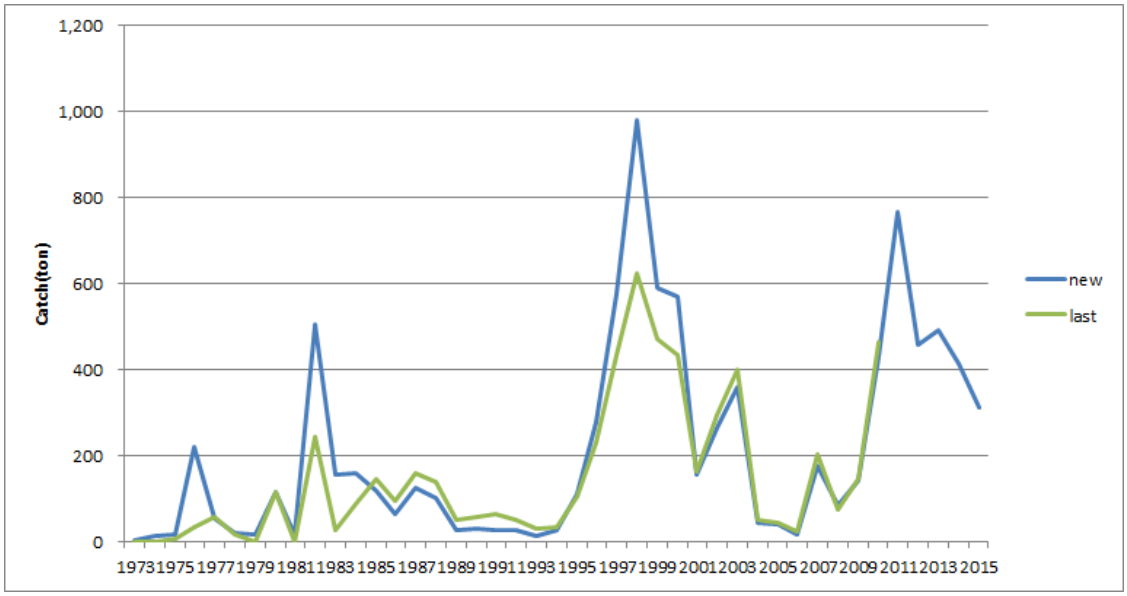

Fig. 5. Trends in catch of blue shark caught by Korean tuna longline fishery calculated using new (blue line) and last (green line) estimation methods. The last estimation methods was used in the 2013 blue shark stock assessment.

Table 1. Catch of blue shark caught by Korean tuna longline fishery calculated using new (blue line) and last (green line) estimation methods

Year	Catch(ton)		Year	Catch(ton)	
	Last	New		Last	New
1973	0	1	1995	104	110
1974	0	13	1996	231	277
1975	5	17	1997	433	578
1976	32	218	1998	623	979
1977	55	52	1999	471	588
1978	17	18	2000	433	571
1979	0	16	2001	163	155
1980	114	114	2002	293	265
1981	0	16	2003	399	360
1982	242	505	2004	50	42
1983	27	156	2005	44	40
1984	88	158	2006	21	17
1985	145	117	2007	203	175
1986	95	64	2008	75	82
1987	159	123	2009	146	140
1988	140	102	2010	466	429
1989	49	26	2011		765
1990	58	31	2012		459
1991	65	27	2013		490
1992	49	28	2014		413
1993	28	13	2015		310
1994	33	25			

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Table 2. Catch of blue shark retained and discarded or released caught by Korean tuna longline fishery calculated using new estimation method

(unit : ton)

Year	Retained	Discarded or released	Total	Year	Retained	Discarded or released	Total
1973	1	0	1	1995	109	0	110
1974	13	0	13	1996	276	1	277
1975	17	0	17	1997	576	2	578
1976	218	1	218	1998	976	4	979
1977	52	0	52	1999	586	2	588
1978	18	0	18	2000	569	2	571
1979	15	0	16	2001	155	1	155
1980	114	0	114	2002	265	1	265
1981	16	0	16	2003	359	1	360
1982	503	2	505	2004	42	0	42
1983	155	1	156	2005	39	0	40
1984	157	1	158	2006	16	0	17
1985	116	0	117	2007	175	1	175
1986	64	0	64	2008	82	0	82
1987	123	0	123	2009	139	1	140
1988	101	0	102	2010	428	2	429
1989	26	0	26	2011	706	59	765
1990	31	0	31	2012	304	155	459
1991	27	0	27	2013	449	42	490
1992	28	0	28	2014	369	44	413
1993	13	0	13	2015	223	87	310
1994	25	0	25				

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