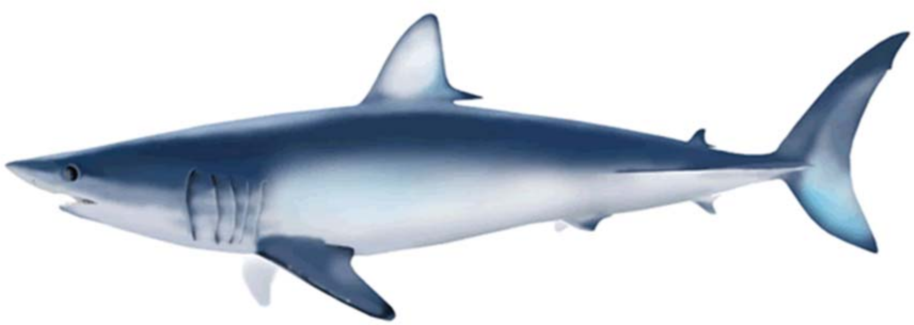
ISC/12/SHARKWG-1/09

Estimation of abundance indices for blue shark in the North Pacific

Yuko Hiraoka, Minoru Kanaiwa and Kotaro Yokawa

National Research Institute of Far Seas Fisheries, Fishery Research Agency
5-7-1 Orido, Shimizu-ku, Shizuoka 424-8633, JAPAN
Email: yhira415@affrc.go.jp



Working document submitted to the ISC Shark Working Group Workshop, 28 May – 4 June, 2012
National Research Institute of Far Seas Fisheries, Shizuoka, Japan

Abstract

Due to the resent analysis under the ISC shark working group, the abundance index of the north Pacific blue shark is estimated for 1975 – 1993 and 1994 - 2010 using the newly developed GLM model to standardize CPUE as well as the blue shark only catch and effort data of Japanese longliners. Following to these results, the estimation of abundance indices are conducted by developed methods in this study. The blue shark only catch data estimated by new method are used in the period between 1975 and 1993. Set by set data of shallow sets register to Hokkaido & Tohoku prefectures are directly used for the CPUE analysis with targeting effect for all periods. We recommend that the standardized CPUEs in this study were suitable as the abundance indices in the next stock assessment at the present stage, because it is seemed to be well developed.

Introduction

In Japanese tuna fishery, the blue shark were handled as "by-catch species" except part of longline and drift net fishing vessels registered in certain regions such as Tohoku (Yokawa and Ando, 2011; Hiraoka et al., 2011). Although the reliable data were needed to estimate the abundance indices of blue shark, the raw log-book data of Japanese longliners could not apply on it because of no information about dead-discards and live-releases.

The data by Hokkaido and Tohoku fleets with shallow sets were selected and applied in this study as highly reliable data. Hiraoka et al. (2012a) indicated that the longliners registered in Hokkaido and Tohoku region with shallower setting has becomes to target to blue shark mainly, and Takahashi et al. (2012) and Yokawa and Kimoto (2012) showed that their logbook constantly recorded almost 100% of blue shark catch. In these facts, their logbook data were judged only available and applicable data to estimate stock abundance of blue shark in North Pacific Ocean, accordingly, these data are chosen.

Materials and Methods

The same models and data described in Hiraoka et al. (2012a) are used to estimate the standardized CPUE. The blue shark only catch data estimated by Hiraoka et al. (2012b) as set by set level data of offshore longliners resister to Hokkaido & Tohoku are used for the CPUE analysis in the period between 1975 and 1993. Set by set data of shallow sets of Japanese offshore and distant-water longliners register to Hokkaido & Tohoku prefectures are directly used for the CPUE analysis in the period between 1993 and 2010. The standardized CPUE were calculated from the weighted mean of the area indices. The weighting factor of each area is decided by its approximate size. Bootstrap method was used to calculate 95% confidence interval of standardized CPUE with 100 or 300 times re-sampling. The calculations of GLM in this study were conducted using R 2.12.2.

Results and Discussions

The standardized CPUEs of blue shark estimated by GLM during 1975 to 1993 and 1994 to 2010 (and their calculated 95% confidence interval) were shown in Tables 1-2 and Figure 1. The annual trend of estimated abundance index in 1975-1993 shows general decreasing trend till 1989 when it turn into increase. In contrast, that in 1994- 2005 is gradually increased up to 2005 and decreased till 2008 then recovered in 2009.

The CPUE trends of this study is demonstrated generally similar trends with the results for shallow sets by Kleiber et al. (2009), however, the estimation process in this study were improved from Kleiber et al. (2009) estimated standardized CPUE of this stocks with the filtered data set using assumption that a trip with more than 80% positive catch rate of sharks having all shark catch record in its log-book, and in the case of the data before 1994 when only species aggregated shark data is available, this filtered species aggregated shark catch were corresponding to blue shark catch. In this study, we mainly improved the method to estimate the abundance index at two points. First one is to extract "blue sharks only catch" from shark species combined data before 1994 using newly developed statistical method (Hiraoka et al., 2012b), second one is to select the cruses which reported their shark catches accurately. For the extraction method of blue shark, as Hiraoka et al. (2012b) mentioned, the filtering method of Kleiber et al. (2009) might be too simple and over estimate the actual catch because most of information used for estimation come from temperate area where is considered high density of blue shark (Nakano, 1994).

In the previous study by Kleiber et al. (2009), standardized CPUEs of deep sets as well as shallow set are conducted. We also standardized these CPUE (Hiraoka et al., 2012a) but decided only to use sallow set for the estimation of abundance index. This is primary due to the following facts; a) only shallow sets of Tohoku and Hokkaido are shown to target blue shark by the analysis of the relationship between cumulated landing and proportion of the blue shark in the trip (Hiraoka et al.. 2012), b) currently available information indicating that only data of offshore shallow sets has confidences high enough to be used for the estimation of the index primary (Takahashi et al., 2012; Yokawa and Kimoto, 2012) because they have been constantly targeted blue shark at least since the 1970s (Yokawa and Ando, 2012).

Also Clarke et al. (2011) standardized CPUEs of blue shark during 1993 to 2008 with some limitations. They applied other filtering method which is removal of the vessels with average positive catch rate lower than 94.6% in order to select the vessels which report sharks accurately and compare to Research/Training vessels. This means that they only used data catching shark almost every sets. But skippers of offshore surface longliners confirmed this is not the case when they are targeting swordfish of tunas, and some failed sets of blue shark targeted trips recorded zero catch of blue shark (part of them are effect of marine mammal interaction). And also in that case, 88,129 operations from 112 commercial vessels were utilized over 16 years and it caused the limitation of area defined as the region 1 (120E~170E, 20N~50N) by WCPFC. In this study, it is applied that 36 years time series data with appropriate extraction of blue shark and also selection of applicable data (Takahashi et al., 2012; Yokawa and Kimoto, 2012). In addition, 21-92% of estimated all catches of blue sharks in the North Pacific contribute to estimate standardized CPUEs in this study (Table 1).

Compared to the standardized CPUE series by Clarke et al. (2011), our results were smoother and less fluctuations. This difference could be due to the result of introduction of targeting effect as variable in this study. Although Clarke et al. (2011) reported the calculated targeting indicator showed clear trend of increase over the last ten years of their time series, which suggested the increase the ratio of blue shark directed sets, they could not consider this factor when constructed model forms for the estimation of abundance index. Thus the abundance indices of blue shark estimated in this study should be closer to the real than the ones estimated by two previous studies.

In conclusion, we recommend that the standardized CPUEs in this study were suitable as the abundance indices in the next stock assessment at the present stage, because it is seemed to be well developed.

Reference

Biseau, A. 1998. Definition of directed fishing effort in a mixed-species trawl fishery, and its impact on stock assessments, Aquat. Living Resour., 11, 119-136

Clarke, S., K. Yokawa, H. Matsunaga and H. Nakano 2011. Analysis of North Pacific Shark Data from Japanese Commercial Longline and Research/Training Vessel Records. WCPFC-SC7-2011/EB-WP-02.

Hiraoka, Y., M. Kanaiwa and K. Yokawa 2012a. Estimation of total blue shark catches including releases and discards Japanese longline fisheries during 1975 and 2010 in the North Pacific. Document submitted to the ISC Shark Working Group Workshop, 28 May-4 June, 2012. ISC/12/SHARKWG-1/xx(Document submitted to this meeting).

Hiraoka, Y., M. Kanaiwa and K. Yokawa 2012b. Extraction of blue shark catches from species-combined catches of sharks in the log-book data of Japanese offshore and distant-water longliners operated in the North Pacific in the period between 1975 and 1993. Document submitted to the ISC Shark Working Group Workshop, 28 May-4 June, 2012. ISC/12/SHARKWG-1/xx(Document submitted to this meeting).

Hiraoka, Y, M. Taguch, M. Kanaiwa and K. Yokawa 2011. The operation pattern of Japanese tuna Longline fishery with the information for belonging region of vessels and reporting rate in the North Pacific Ocean, 1994-2010. ISC/11/SHARKWG-2/09

Kleiber, P., S. Clarke, K. Bigelow, H. Nakano, M. McAllister and Y. Takeuchi 2009. North Pacific Blue Shark Stock Assessment. WCPFC-SC5-2009/EB-WP-01.

Takahashi, N., Y. Hiraoka, A. Kimoto, K. Yokawa and M. Kanaiwa 2012. Comparison of CPUEs of Blue Shark Reported by Logbook of Japanese Commercial Longliners with Japanese Research and Training Longline Data. Document submitted to the ISC Shark Working Group Workshop, 28 May-4 June, 2012. ISC/12/SHARKWG-1/xx(Document submitted to this meeting).

Yokawa, K. and T. Ando2011. Review of soecies aggregated sharks data caught by Japanese offshore and distant-water longliners in the north Pacific in 1975-1993.

Table 1 Percentage of estimated catches using standardized CPUE

Year	Estimated catches using standardize CPUE*	Estimated catches of all blue shark*	Percentage(%)
1975	197210	409849	48%
1976	292693	796178	37%
1977	374653	997180	38%
1978	288267	883403	33%
1979	326173	1142250	29%
1980	319286	1278760	25%
1981	284287	1363961	21%
1982	255541	1133302	23%
1983	318212	1218210	26%
1984	287103	1185692	24%
1985	303533	1150921	26%
1986	372556	1033283	36%
1987	282680	812589	35%
1988	256085	901435	28%
1989	234574	969194	24%
1990	218759	757439	29%
1991	260608	791076	33%
1992	294163	765476	38%
1993	315525	920640	34%
1994	285545	773235	37%
1995	271118	778711	35%
1996	310201	720532	43%
1997	428546	767956	56%
1998	423219	780655	54%
1999	532569	826001	64%
2000	679230	946907	72%
2001	815174	1089482	75%
2002	694289	879337	79%
2003	698300	913967	76%
2004	668784	814344	82%
2005	748464	941969	79%
2006	657089	859391	76%
2007	525305	583875	90%
2008	482755	552460	87%
2009	580408	629028	92%
2010	514523	630059	82%

*: after Hiraoka et al. (2012)

Table 2 Annual estimated catches, standardized CPUEs (n/1000 hooks), nominal catches and nominal CPUEs using for estimation of abundance indices during 1975 to 1993

Year	Estimated Catch	Standardized CPUE	Nominal Catch	Nominal CPUE
1975	199036	1.085	198396	14.608
1976	297453	1.164	295452	17.148
1977	379035	1.205	375465	17.105
1978	291091	1.010	287764	13.892
1979	327254	1.120	328590	14.202
1980	322938	1.214	321143	15.169
1981	291160	1.036	289801	13.074
1982	260408	1.043	260383	12.784
1983	325390	0.988	324037	12.384
1984	292278	0.853	291954	10.664
1985	308349	0.772	307247	9.543
1986	376171	0.858	375942	11.447
1987	288241	0.636	287429	8.385
1988	259669	0.678	259543	8.910
1989	237292	0.568	236852	8.146
1990	221531	0.642	219986	8.591
1991	263904	0.812	262362	10.317
1992	296494	0.803	298094	10.871
1993	316685	0.879	315246	12.987

Table 3 Annual estimated catches, standardized CPUEs (n/1000 hooks), nominal catches and nominal CPUEs using for estimation of abundance indices during 1994 to 2010

Year	Estimated Catch	Standardized CPUE	Nominal Catch	Nominal CPUE
1994	285545	0.485	276373	5.428
1995	271118	0.563	258767	5.923
1996	310201	0.594	301402	5.432
1997	428546	0.718	418182	12.428
1998	423219	0.720	419957	6.543
1999	532569	0.762	533873	7.164
2000	679230	0.919	674914	6.702
2001	815174	0.983	791492	16.106
2002	694289	0.935	663042	15.175
2003	698300	1.120	683882	15.171
2004	668784	1.076	645109	15.087
2005	748464	1.134	737087	12.984
2006	657089	1.050	631764	13.457
2007	525305	0.809	522642	11.583
2008	482755	0.667	454693	7.493
2009	580408	1.025	521044	14.120
2010	514523	0.941	459781	13.671

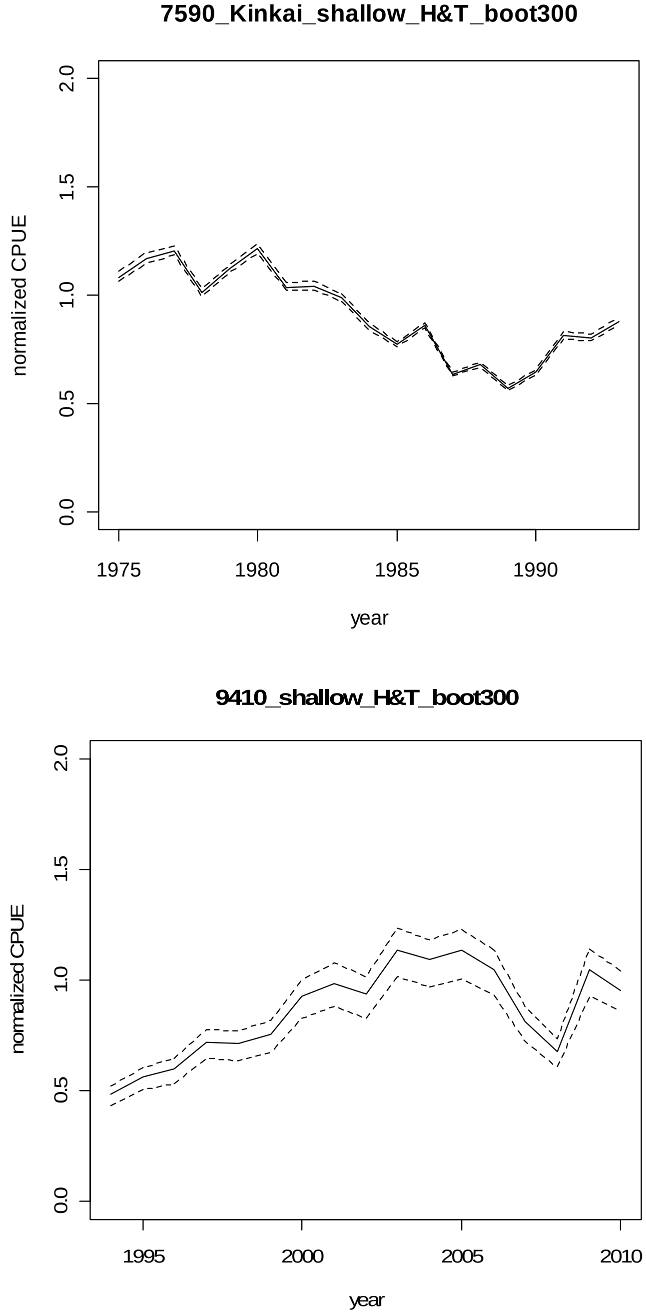


Figure 1 Trend of Standardized CPUE and their 95% confidence interval by 300 times re-sampling in the period between 1975 and 1993 (upper), and in the period between 1994 and 2010 (lower). All values were normalized to their mean which set at 1.0.

* The confidence interval by 1000 times re-sampling of the former index will be added during meeting