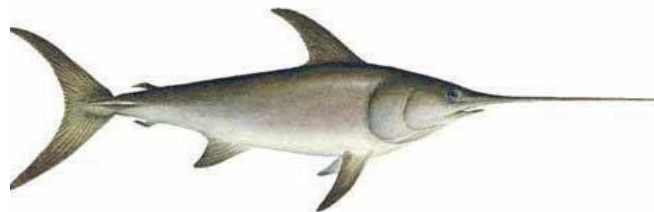
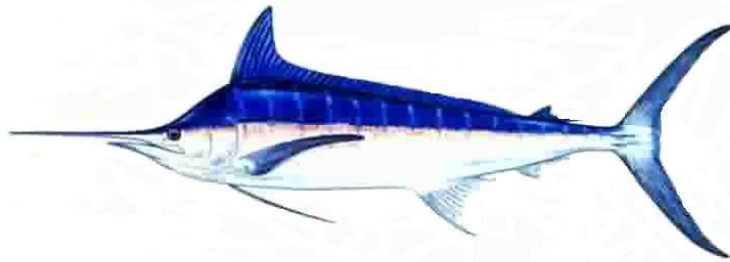




Updated Catch Amount of Swordfish (*Xiphias gladius*) by the Japanese Coastal, Offshore, and Distant-water Longline fishery in the Pacific*

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Introduction

The Billfish Working Group conducted the swordfish stock assessment using the two stock structure scenario in 2009. The Working Group is proposed the update of this stock assessment in 2014. This study re-estimated the catch amount of swordfish caught by Japanese coastal, offshore, and distant-water longliners and other coastal gears for the two stock scenario with a boundary between the Western-Central Pacific Ocean (WCPO) and the Eastern Pacific Ocean (EPO). The official catch table in the North Pacific was also provided in this paper.

Materials and Methods

Various types of data were used for the estimation of historical Japanese catch amount swordfish in the Pacific Ocean. The information on the operations of Japanese offshore and distant-water longliners in the Pacific Ocean was available since 1952 when the collection of log book has initiated by Fishery Agency of Japan (FAJ). There are two types of data for catch information, e.g. catch number and catch weight in the logbooks. Catch number data is available since 1952, while catch weight data of the Japanese offshore and distant-water longliners or of training longline vessels are only available since 1971 or 1994, respectively. The logbooks of the training vessels only in the period between 1973 and 1993 were compiled separately from other logbooks. In this study, aggregated catch data by month and 5x5 degree grids were used.

Catch amount of swordfish caught by Japanese offshore and distant-water longliners for the period between 1952 and 2012 was calculated by quarter in the WCPO (sub area1) and the EPO (sub area2) areas. Due to the lack of data of the catch weight, they were obtained by multiplying the catch number by the average weight, which was calculated by catch number and weight information in the period between 1971 and 1993. The catch amount before 1970 was estimated using the average weight in the period between 1971 and 1975. The catch amount by training longline vessels in the period between 1973 and 1990 was also estimated using the average weight in each year. The calculation was made by quarter and area. The area was stratified into 4 areas

in Figure 1, which basically has been used to estimate National catch table in the North Pacific for BILLWG.

Catch amount of swordfish caught by Japanese offshore and distant-water longliners in 1951 were obtained from the year books. The catch in 1951 was divided by the ratio between the catch in 1952 in the WCPO and the EPO areas to estimate the catch by stock in the year.

Historical Japanese catch amount in metric ton by several coastal gears was obtained from the logbook of Japanese coastal longliners and Japanese year books. FAJ started to collect the log book of Japanese coastal longliners (defined as the longliners less than 20 tons) in 1994. The year books also have been compiled by FAJ since 1951, which cover the catch by Japanese coastal longline, other longline, squid drift net, drift net, bait fishing, trap net, and others-primarily harpoon. These catches were included only in the WCPO area.

Results

Figure 2 shows the average weight by year, quarter, and area (Figure 1), which was calculated by catch number and catch weight between 1971 and 1993. These values were used to estimate the catch amount by training longline vessels, and it resulted in the catch amount ranging from 25 to 90 tons. The average weight was quite similar within each quarter in the period between 1971 and 1975, which was used to estimate the catch amount before 1970 (Table 1). The average weight were similar among areas 1, 2, and 4, and the values were between 45 and 50kg. The values in the area 3 were ranged between 60 and 65kg, and were slightly larger than the others.

Tables 2 and 3, and Figure 3a show the trends of swordfish catch (ton) by offshore and distant-water longline vessels in the North Pacific, and sub-areas. Because the WCPO area covers the most part of the North Pacific, the amount of catch shows similar trend in these areas. In the WCPO area, the catch amount was increased rapidly since the data was available in 1952. The historical highest levels were observed in 1960 and 1961, which were over 20,000 tons. It showed a rapid decrease since then, and the catch was fluctuated between 5,000 and 9,000 tons since then. The catch since the early '90s were gradually decreased. The further decreasing trend were observed since 2008, and it reached less than 3,000 tons in 2012.

In the EPO area, the catch amount was varied between 1,500 and 3,000 tons since '60s after the historical high catch was recorded in 1969. It mostly remained over 2,000 tons from the late 80s to the early 2000s. Although the catch amount was decreased to below 1,500 tons in the mid-2000s, they were gradually increased to about 3,000 tons and larger than the catch in the WCPO area in the recent years.

Finally, Table 2 and Figure 3b show the trends of swordfish catch (ton) by coastal gears in the WCPO area. The total catch amount by the coastal gears was varied between 1,000 and 2,000 tons in the '50s and '60s, and was mainly consisted by harpoon. Since the peak was recorded in 1976

with about 4,700 tons, it stayed in the same level about 2,500 tons. The catch in the recent years were decreased to about 1,500 tons mainly due to the Grate East Japan Earthquake. Most of catch were consisted by drift net and coastal longline since 1970. These catch by coastal gears were included in the WCPO area.

References

Ichinokawa, M., and Brodziak, J. 2008. Stock boundary between possible swordfish stocks in the northwest and southeast Pacific judged from fisheries data of Japanese longliners. ISC/08/Special Session on Billfish Stock Structure/#4

Table 1. Average weight (kg) of swordfish between 1971 and 1975 by quarter and area in Figure 1.

	qt1	qt2	qt3	qt4
area1	50.02	44.81	51.00	53.00
area2	51.62	46.68	45.95	54.57
area3	65.76	58.83	59.18	65.04
area4	47.82	52.83	47.36	46.93

Table 2. The swordfish catch amount by Japanese fisheries in the North Pacific in 1951-2012.
 Catch between 2011 and 2012 are preliminary, and some data in Tohoku area were not available due to the earthquake in 2011.

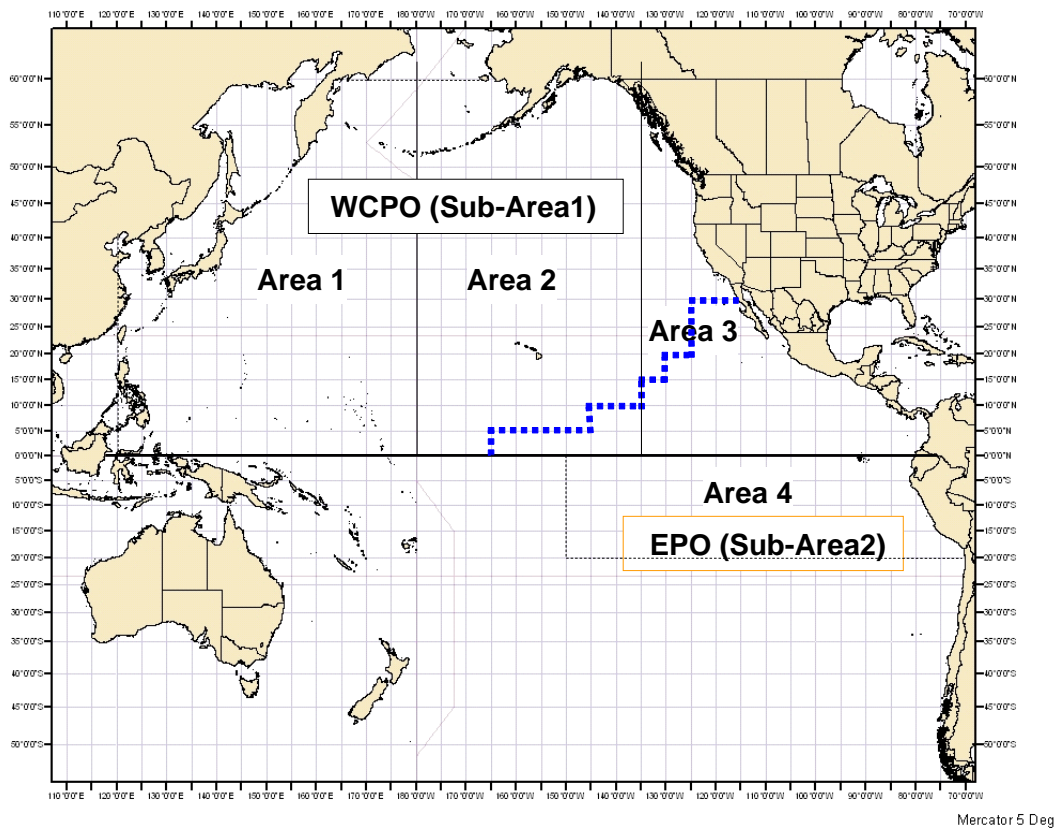
	Offshore and distant-water logline	Coastal longline	Other longline	Squid drift net	Drift net	Bait fishing	Net fishing	Trap net	Others ¹⁾	Total
1951	7246	-	115	-	10	88	10	78	4131	11678
1952	8890	-	152	-	0	6	6	68	2569	11691
1953	10796	-	77	-	0	20	87	21	1407	12408
1954	12563	-	96	-	0	104	17	18	813	13611
1955	13064	-	29	-	0	119	41	37	821	14111
1956	14596	-	10	-	0	66	7	31	775	15485
1957	14268	-	37	-	0	59	11	18	858	15251
1958	18525	-	42	-	0	46	21	31	1069	19734
1959	17236	-	66	-	0	34	10	31	891	18268
1960	20058	-	51	-	1	23	7	67	1191	21400
1961	19715	-	51	-	2	19	11	15	1335	21147
1962	10607	-	78	-	0	26	18	15	1371	12115
1963	10322	-	98	-	0	43	16	17	747	11243
1964	7669	-	91	0	4	40	26	16	1006	8852
1965	8742	-	119	0	0	26	182	14	1908	10991
1966	9866	-	113	0	0	41	4	11	1728	11763
1967	10883	-	184	0	0	33	5	12	891	12008
1968	9810	-	236	0	0	41	9	14	1539	11649
1969	9416	286	10	0	0	42	14	11	1557	11336
1970	7324	391	36	0	0	36	3	9	1748	9547
1971	7037	332	18	0	1	17	31	37	473	7946
1972	6796	520	11	0	55	20	2	1	282	7687
1973	7160	404	10	0	720	27	2	23	121	8467
1974	6015	508	146	0	1304	27	2	16	190	8208
1975	7057	602	18	0	2672	58	2	18	205	10632
1976	8095	691	59	0	3488	170	12	14	313	12842
1977	8421	834	46	0	2344	71	2	7	201	11926
1978	8038	984	47	0	2475	110	1	22	130	11807
1979	8654	973	65	0	983	45	4	15	161	10900
1980	6049	824	25	0	1746	29	1	15	398	9087
1981	7114	675	52	0	1848	58	3	9	129	9888
1982	6124	839	35	0	1257	58	1	7	195	8516
1983	7753	955	44	71	962	30	2	9	166	9992
1984	7234	1141	36	82	971	98	0	13	117	9692
1985	9388	980	19	107	1026	69	0	10	191	11790
1986	8778	960	77	94	1170	47	0	9	123	11258
1987	9551	819	41	141	910	45	0	11	87	11605
1988	8639	665	13	186	1048	19	0	8	173	10751
1989	6740	742	10	199	1397	21	0	10	362	9481
1990	5908	687	3	48	1026	13	0	4	128	7817
1991	4883	799	8	74	424	20	0	5	153	6366
1992	7324	1173	8	47	840	16	0	6	381	9795
1993	8383	1394	0	-	292	43	1	4	309	10426
1994	7366	1357	0	-	421	37	0	4	308	9493
1995	6422	1386	1	-	561	34	0	7	423	8834
1996	6916	1063	4	-	428	45	0	4	597	9057
1997	7002	1213	1	-	365	62	0	5	346	8994
1998	6233	1186	4	-	471	68	0	2	476	8440
1999	5557	1047	2	-	724	47	0	5	416	7798
2000	6180	1112	9	-	808	49	0	5	497	8660
2001	6932	899	9	-	732	30	0	15	230	8847
2002	6230	955	10	-	1164	29	0	11	201	8600
2003	5376	1058	5	-	1198	28	0	4	149	7818
2004	5395	1505	4	-	1062	30	0	4	229	8229
2005	5359	1288	6	-	956	337	0	3	187	8137
2006	6181	1506	3	-	796	342	1	5	244	9078
2007	6109	2014	2	-	829	367	1	2	122	9446
2008	4402	1785	2	-	648	349	0	3	173	7363
2009	4400	1536	1	-	682	249	0	3	239	7110
2010	4240	1085	2	-	483	230	0	8	110	6158
2011 ²⁾	3046	884	2	-	189	233	0	2	10	4366
2012 ²⁾	2821	951	4	-	370	288	0	8	59	4502

1): It contains trolling and harpoon but majority of catch obtained by harpoon.

2): Catch between 2011 and 2012 are preliminary, and some data in Tohoku area were not available due to the earthquake in 2011.

Table 3. The swordfish catch amount by Japanese offshore and distant-water longliners in the WCPO and the EPO areas in 1951-2012. Catch between 2011 and 2012 are preliminary, and some data in Tohoku area were not available due to the earthquake in 2011.

	WCPO	EPO
1951	7245	1
1952	8888	1
1953	10794	3
1954	12543	20
1955	13050	14
1956	14590	9
1957	14207	124
1958	18510	80
1959	17181	81
1960	19983	118
1961	19398	527
1962	9950	961
1963	9644	1592
1964	5594	3066
1965	7506	1718
1966	8809	2029
1967	9845	1523
1968	8067	2350
1969	7508	5944
1970	5280	3995
1971	5437	2118
1972	4814	2653
1973	4833	3491
1974	4791	1869
1975	5835	2037
1976	6386	2951
1977	7452	2573
1978	7532	2149
1979	8168	1674
1980	5655	2131
1981	6638	1926
1982	5312	1806
1983	7318	1752
1984	7001	1039
1985	9114	1039
1986	8160	2054
1987	8695	2683
1988	8144	2670
1989	5942	2158
1990	5390	2645
1991	4377	2739
1992	6911	3676
1993	7955	2696
1994	7015	2507
1995	6005	2140
1996	6260	2116
1997	6250	2755
1998	5590	2949
1999	5292	1551
2000	5398	2001
2001	5194	3735
2002	5199	2824
2003	4794	2615
2004	4939	1809
2005	5054	1408
2006	5805	1297
2007	5916	1386
2008	3979	1634
2009	3729	2079
2010	3660	2653
2011	2430	3094
2012	2446	2986



Adapted from Ichinokawa and Brodziak (2008; Figure 7d)

Figure 1. Area stratifications used in the analysis of average weight for the two stock scenario (WCPO and EPO stocks). North Pacific was divided into 3 areas (Areas1-3), and Area4 was set in the south of equator in the EPO area.

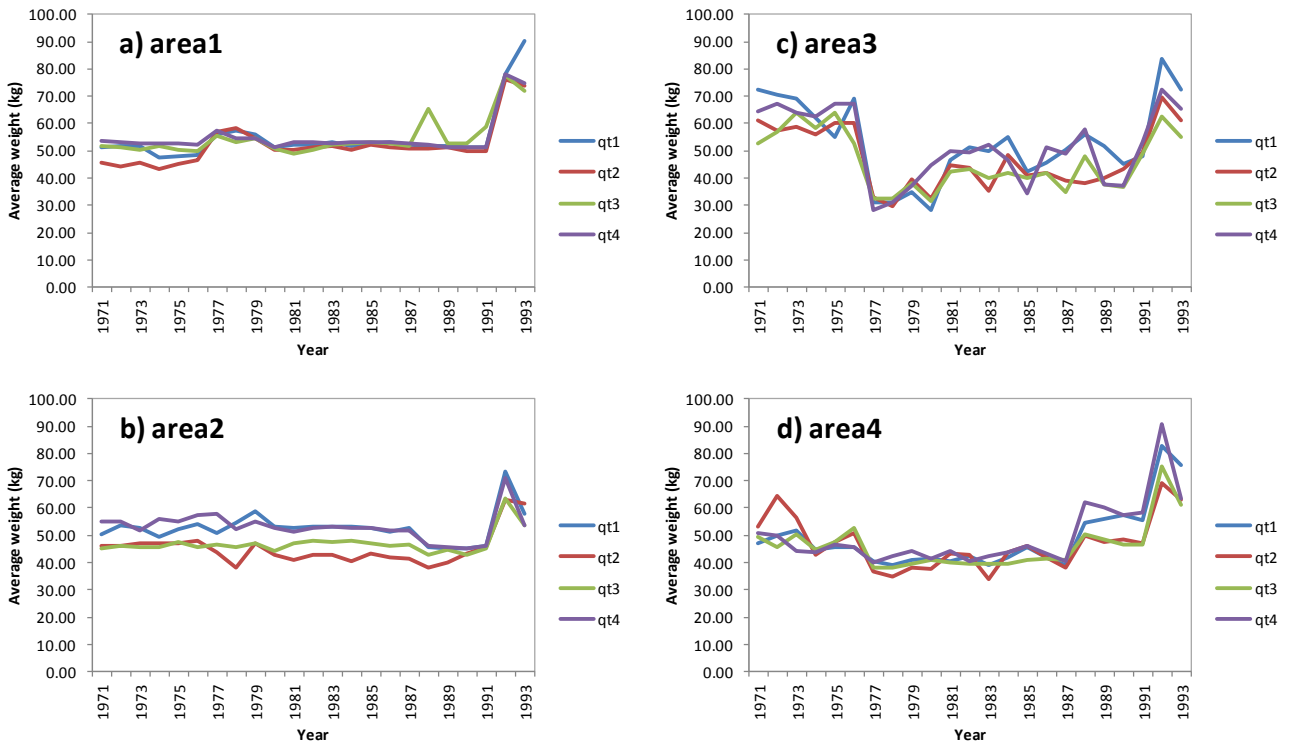


Figure 2. Average weight (kg) of swordfish for the period between 1971 and 1993 by year, quarter, and area. Area stratification (areas1-4: panels a-d) was shown in Figure 1.

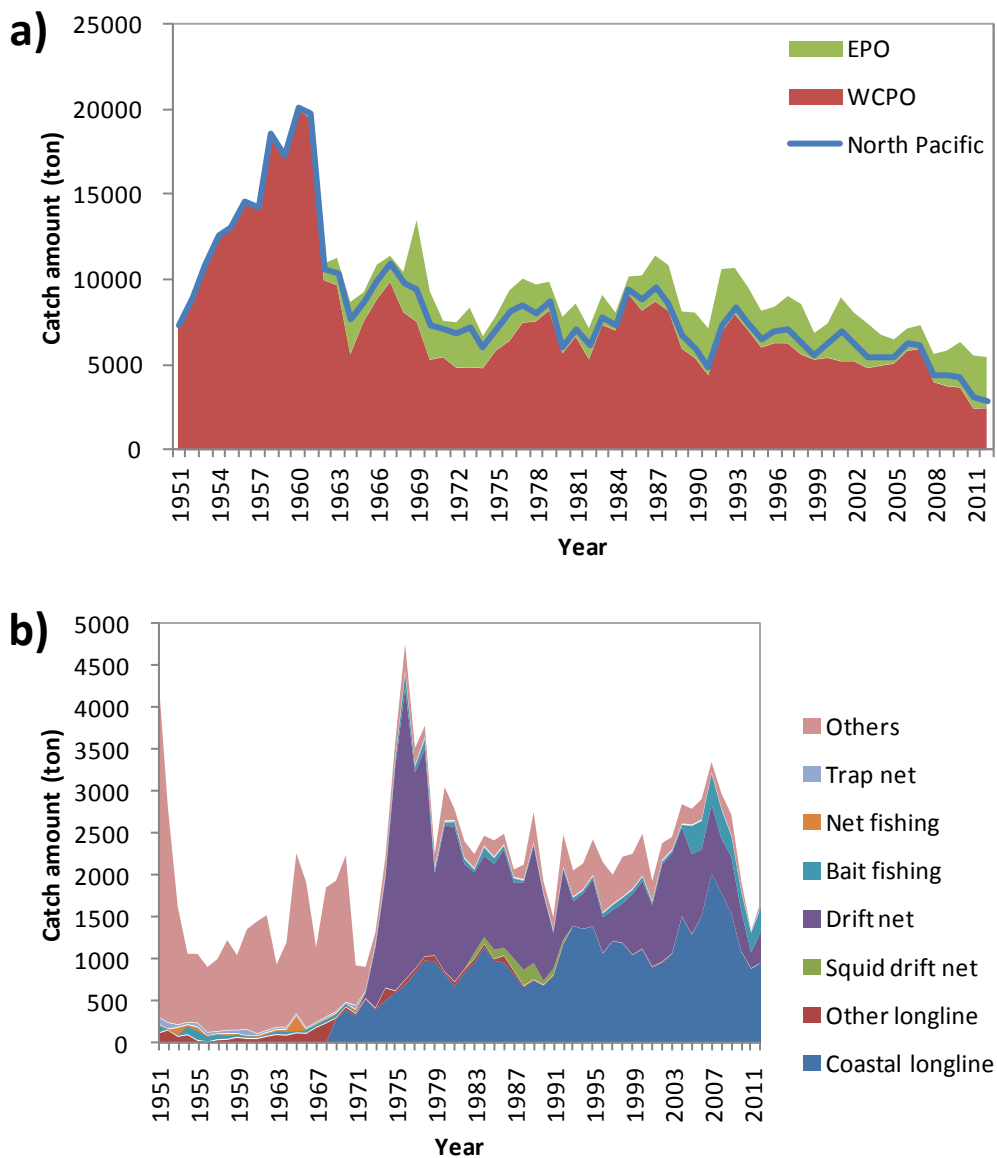


Figure 3. The estimated catch amount (ton) by year, gear, and sub-area. a) offshore and distant-water longline in the North Pacific (blue line), in WCPO and EPO areas, b) other gears only in WCPO area.