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Updated catches of shortfin mako, *Isurus oxyrinchus*, caught by Japanese coastal fisheries[1]

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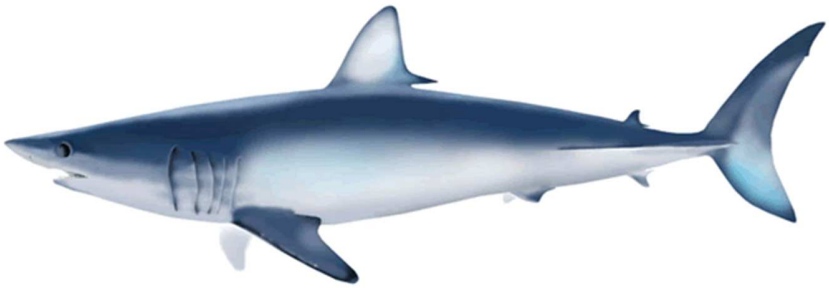

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Abstract

This working paper provides with updated catches of shortfin mako (*Isurus oxyrinchus*) caught by Japanese coastal fisheries for 1994-2019. We used the same estimation methods as those used in the previous analysis. Since the species-specific shark's data is not included in Japanese official coastal landing data, the catches of coastal fisheries are estimated using the available species-specific data. Annual catches for longline fisheries as well as large-mesh driftnet fishery accounted for more than 90 % of annual total catches except in 2005. The annual total catches of shortfin mako had a large fluctuation between 161 and 638 tons during 1994 to 2019. Recently, it had gradually decreased from 494 tons in 2016 to 213 tons in 2019. The trends of catches were almost similar between previous and updated analysis.

Introduction

Shortfin mako (*Isurus oxyrinchus*) is incidentally caught by Japanese coastal fisheries. Most of the Japanese coastal catches for pelagic sharks are occupied by the longline fisheries as well as large-mesh drift net fishery (Kai and Yano, 2016). Although the large-mesh driftnet fishery was banned in the open sea area in 1993 (Yokawa, 2012), the operation has been conducting within the economic exclusive zone (EEZ) of Japan. The coastal and other longline fleets were defined by tonnage of vessels less than 20 MT. This document paper provides with updated catches of shortfin mako caught by Japanese coastal fisheries during 1994 and 2019.

Materials and Methods

Data sources

We used three types of data sources to estimate the annual catches of shortfin mako.

1. Japanese statistical yearbook ('Nourin-toukei')

Japan Fishery Agency compiles this yearbook and opens the data to the public every year. The yearbook includes catch weight by gears, species, and prefectures. The yearbook covers various types of gears, wide areas from coastal to far-seas and a long-term from 1951 to 2019. The gear-specific annual catch weight (**Table A1**) is therefore commonly used in the estimation of annual catch for the shortfin mako. However, the catch statistics has one- or two-year time lag and shark species are aggregated into one category 'sharks' since 1968. To address this issue, we used the species-specific catch of the other data sources (i.e., RJB and Gyoseki), and then we estimated the catch ratio of shortfin mako to sharks.

2. Research project on Japanese bluefin tuna ("RJB")

Fisheries Resources Institute commenced the survey program since 1992 to accomplish collection of information on Pacific bluefin tuna landings by coastal and offshore fisheries. The RJB provides catch (Sales slips) and size sampling data collected at Japanese local fishing ports. The data includes information pertaining to the catch of tuna and tuna-like species. The collection of species-specific catch data for sharks was commenced in 2002. The pelagic sharks caught by Japanese coastal fisheries and large mesh driftnet fishery were mostly landed in the Northeast Japan. 'Kesennuma' is a major fishing port in the region regarding the landing of blue shark, shortfin mako, and salmon shark. The catch ratios of shortfin mako to sharks estimated from RJB were used in the estimation of the catches for Japanese large-mesh driftnet fishery, Japanese trap-net fishery, and Japanese other fisheries.

3. Logbook data ('Gyoseki')

Fisheries Resources Institute compiles the logbook data collected from Japanese longline fishery. The set-by-set data includes much information such as species of sharks, date of operation, catch number, and catch weight. Although the logbook data includes the species-specific catch in the coastal area, the data has an issue of underreporting of pelagic sharks due to discard and misreporting. We therefore used the logbook data to estimate the ratio of shortfin mako to sharks for Japanese coastal longline fishery and Japanese other longline fisheries.

Estimation methods of coastal catches

Shortfin makos in the coastal waters around Japan were mainly caught by the following five fisheries and the following equations were used to calculate the catch of shortfin mako.

(1) Japanese coastal longline fishery

Catch of shortfin mako = Catch of sharks ('Nourin Toukei') × Ratio of shortfin mako to sharks ('Gyoseki'),

(2) Japanese other longline fisheries

Catch of shortfin mako = Catch of sharks ('Nourin Toukei') × Ratio of shortfin mako to sharks ('Gyoseki'),

(3) Japanese large mesh drift net fishery

Catch of shortfin mako = Catch of sharks ('Nourin Toukei') × Ratio of shortfin mako to sharks ('RJB'),

(4) Japanese trap-net fishery

Catch of shortfin mako = Catch of sharks ('Nourin Toukei') × Ratio of shortfin mako to sharks ('RJB'),

(5) Japanese other fisheries

Catch of shortfin mako = Catch of sharks ('Nourin Toukei') × Ratio of shortfin mako to sharks ('RJB'),

where the annual catch of spiny dogfish (**Table A2**) was excluded from the annual catch of sharks ('Nourin Toukei') for (2), (4), and (5) because these fisheries can catch the spiny dogfish and the annual catch of spiny dogfish was included in the annual catch of sharks for 'Nourin

Toukei'. Noted that the annual catch of spiny dogfish was not included in the annual catch of sharks in the RJB and the logbook data.

The annual catches of the large-mesh driftnet fishery and the other driftnet fisheries were included in the catch of sharks for 'Nourin Toukei'. The ratios of shortfin mako to sharks for (4) and (5) were calculated based on the data for large-scale trap-net fishery (S2) and the other fisheries (O1 and O2) of RJB (**Table A3**).

Results and Discussion

Japanese coastal catch of shortfin mako was estimated based on the Japanese statistical yearbook from 1994 to 2019. Annual catch of shortfin mako for three fisheries (i.e., two longline fisheries and large-mesh driftnet fishery) accounted for more than 90 % of annual total catches except in 2005 (**Table 1** and **Figure 1**). In contrast, the annual catches of shortfin mako caught by the other two fisheries (i.e., trap-net fishery and other fisheries) were very small for 1994-2019 and the mean annual catch was 12.5 tons. The annual total catches had a large fluctuation between 161 and 638 tons during 1994 and 2019. Recently, it had gradually decreased from 494 tons in 2016 to 213 tons in 2019. The trends of the annual catches were almost similar between previous and updated analysis (**Figure 2**). The estimated catches of shortfin mako had remarkably increased in 1996 and 2009 (**Figure 1**) due to the increase in the ratio of catch for longline fisheries (**Table A4**). Meanwhile, the remarkable increase of the catch in 2016 was mainly caused by the increase of catch for large-mesh driftnet fishery.

References

Kai, M., and Yano, T. 2017. Estimation of catches of shortfin mako, *Isurus oxyrinchus*, caught by Japanese coastal fisheries. ISC/17/SHARKWG-1/02.

Yokawa, K. 2012. Blue sharks caught by Japanese large mesh drift net fishery in the north Pacific in 1981 – 1993. ISC/12/SHARKWG-1/10.

Table

Table 1. Annual catch (tons) of shortfin mako caught by Japanese coastal fisheries for 1994-2019.

Year	Coastal longline (tons)	Other longline (tons)	Large mesh drift net (tons)	Trap net (tons)	Other fisheries (tons)	Total (tons)
1994	44.6	24.4	123.0	13.5	7.1	213
1995	37.2	28.2	103.1	10.7	4.0	183
1996	253.7	145.0	101.1	10.1	7.0	517
1997	138.2	67.7	127.5	13.0	2.9	349
1998	15.1	5.9	130.2	10.7	1.9	164
1999	160.0	58.9	176.4	11.2	2.5	409
2000	71.7	32.7	155.6	11.2	4.0	275
2001	156.8	53.4	155.7	11.4	3.5	381
2002	88.4	32.0	121.9	4.1	0.6	247
2003	13.7	5.6	228.7	5.2	0.5	254
2004	19.2	7.1	133.5	0.4	0.3	161
2005	45.6	15.7	154.9	41.7	1.2	259
2006	7.1	2.4	177.9	5.4	0.3	193
2007	30.8	12.3	243.8	12.2	2.4	302
2008	79.9	41.2	212.5	12.5	1.2	347
2009	225.3	116.6	294.2	1.0	0.5	638
2010	85.3	65.6	272.0	18.4	1.3	443
2011	3.3	44.4	163.0	11.0	0.0	222
2012	5.0	4.6	229.5	1.0	0.9	241
2013	30.1	16.7	344.7	7.1	2.0	401
2014	3.4	3.8	263.2	3.3	0.0	274
2015	1.3	0.9	334.1	10.7	0.3	347
2016	20.2	12.1	445.7	15.4	0.3	494
2017	14.4	8.9	271.1	8.9	0.9	304
2018	12.0	7.3	223.2	27.9	0.4	271
2019	8.7	6.9	195.5	2.0	0.4	213

Figures

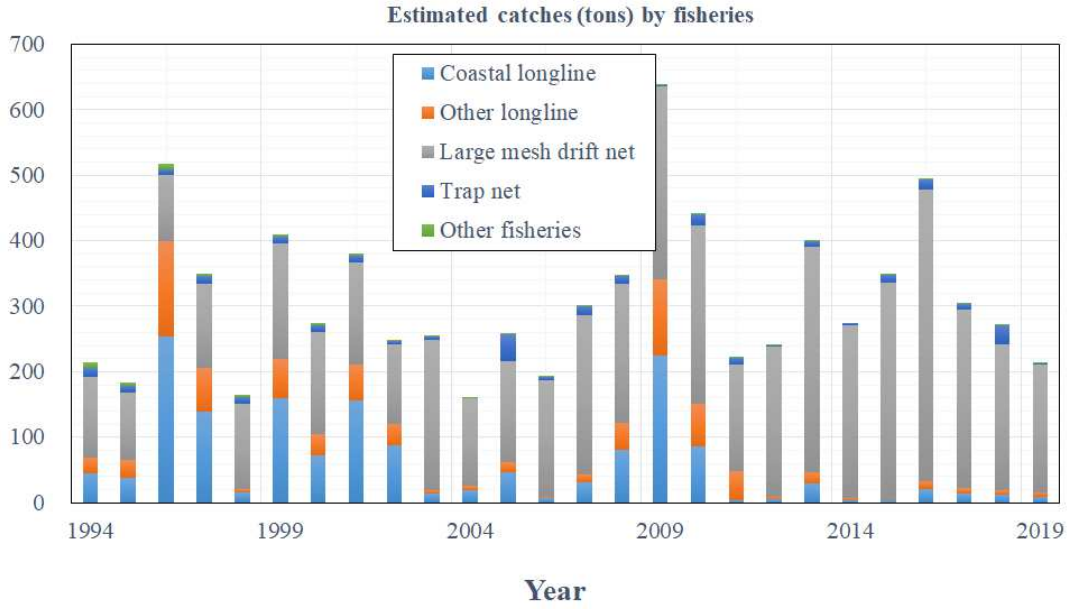

Figure 1. Annual catch (tons) of shortfin mako caught by Japanese coastal fisheries for 1994-2019.

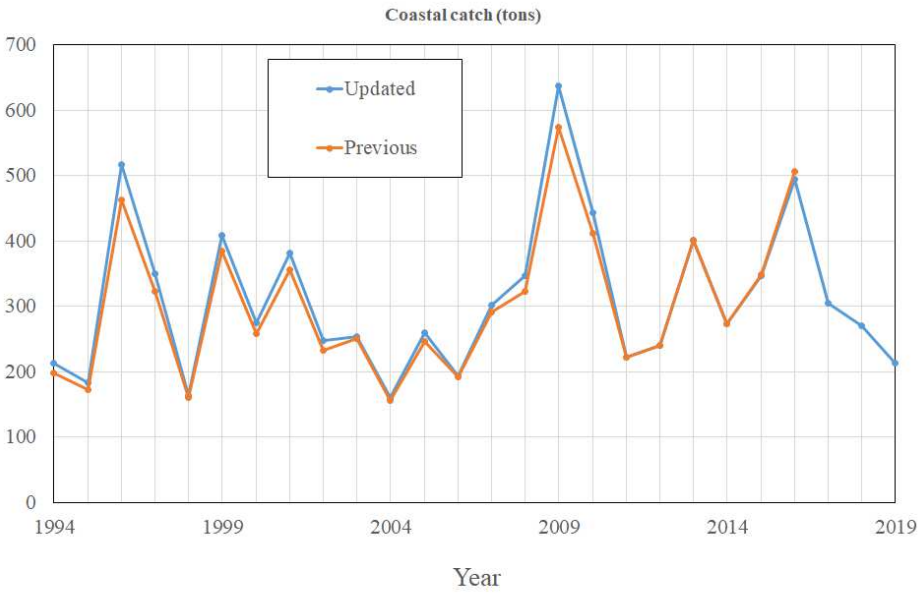

Figure 2. Comparisons of annual catch (tons) of shortfin mako caught by Japanese coastal fisheries between previous and updated analysis.

Appendix tables

Table A1. Annual catches (tons) of sharks for different gears of Japanese statistical yearbook ('Nourin-toukei'). The values in 2019 are provisional.

Year	Coastal longline (tons)	Other longline (tons)	Large mesh drift net (tons)	Trap net (tons)	Other fisheries (tons)	Total (tons)
1994	44.6	24.4	123.0	13.5	7.1	213
1995	37.2	28.2	103.1	10.7	4.0	183
1996	253.7	145.0	101.1	10.1	7.0	517
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2014	3.4	3.8	263.2	3.3	0.0	274
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2016	20.2	12.1	445.7	15.4	0.3	494
2017	14.4	8.9	271.1	8.9	0.9	304
2018	12.0	7.3	223.2	27.9	0.4	271
2019	8.7	6.9	195.5	2.0	0.4	213

Table A2. Annual catches (tons) of North Pacific spiny dogfish of Japanese statistical yearbook ('Nourin-toukei'). The values in 2019 are provisional. Note that the catches of the other gears (i.e., coastal longline fishery and large-mesh driftnet fishery) unrelated to the shortfin mako catch are not included in this table.

Year	Other longline (tons)	Other bait fishing (tons)	Trap net (tons)	Other fishery (tons)
1994	661	25	58	4
1995	753	25	60	3
1996	658	25	59	4
1997	615	40	57	3
1998	590	26	52	3
1999	509	13	43	4
2000	546	9	50	7
2001	528	15	67	4
2002	428	9	44	3
2003	365	14	40	3
2004	338	19	42	3
2005	468	14	58	3
2006	438	14	51	3
2007	514	10	48	4
2008	577	8	66	3
2009	605	6	56	3
2010	586	6	62	2
2011	556	19	52	1
2012	521	16	53	0
2013	501	15	67	1
2014	485	10	76	1
2015	407	15	58	1
2016	298	10	80	2
2017	374	9	72	2
2018	204	7	52	1
2019*	204	7	52	1

* The same values as those in 2018 was given.

Table A3. Annual catch ratio of shortfin mako to sharks caught by three types of gears for RJB.

Year	Trap net	Other fisheries	Large mesh drift net in Kesennuma
1994	0.23	0.12	0.08
1995	0.23	0.12	0.08
1996	0.23	0.12	0.08
1997	0.23	0.12	0.08
1998	0.23	0.12	0.08
1999	0.23	0.12	0.08
2000	0.23	0.12	0.08
2001	0.23	0.12	0.08
2002	0.09	0.03	0.06
2003	0.11	0.03	0.08
2004	0.01	0.02	0.05
2005	0.97	0.05	0.07
2006	0.16	0.03	0.07
2007	0.41	0.04	0.09
2008	0.24	0.03	0.07
2009	0.03	0.02	0.09
2010	0.32	0.05	0.08
2011	0.23	0.01	0.08
2012	0.07	0.12	0.08
2013	0.23	0.08	0.10
2014	0.24	0.15	0.07
2015	0.23	0.13	0.09
2016	0.21	0.10	0.14
2017	0.16	0.43	0.08
2018	0.37	0.38	0.06
2019	0.04	0.42	0.06

Table A4. Annual catches (kg) of shortfin mako, sharks, and the ratio of shortfin mako to sharks caught by coastal and other longline fisheries for logbook data ("Gyoseki").

Year	Shortfin mako (kg)	Sharks (kg)	Ratio
1994	7,213	332,188	0.02
1995	17,747	802,804	0.02
1996	173,819	1,338,926	0.13
1997	65,829	1,013,575	0.06
1998	2,915	491,354	0.01
1999	1,791	26,252	0.07
2000	1,565	44,339	0.04
2001	2,673	44,882	0.06
2002	2,986	67,813	0.04
2003	667	73,767	0.01
2004	2,319	187,704	0.01
2005	1,398	70,857	0.02
2006	419	127,914	0.00
2007	1,129	80,080	0.01
2008	19,991	475,389	0.04
2009	46,410	408,773	0.11
2010	26,409	399,968	0.07
2011	23,783	504,113	0.05
2012	3,128	606,798	0.01
2013	20,534	1,049,041	0.02
2014	4,680	1,013,403	0.00
2015	1,183	881,543	0.00
2016	51,623	2,158,076	0.02
2017	58,975	4,189,246	0.01
2018	78,138	3,716,377	0.02
2019	67,151	3,872,341	0.02