

**Reconstruction of catch for blue sharks caught by non-ISC countries in the  
western and central North Pacific from 1997 to 2020 <sup>1</sup>**

Mikihiko Kai<sup>2</sup>, Yasuko Semba<sup>2</sup>, Nicholas Ducharme-Barth<sup>3</sup>, Joel Rice<sup>4</sup>, Peter Williams<sup>5</sup>

<sup>2</sup> Fisheries Resources Institute, Japan Fisheries and Education Agency,  
5-7-1 Orido, Shimizu, Shizuoka, 424-8633, Japan

<sup>3</sup> NOAA Fisheries, Pacific Islands Fisheries Science Center, Honolulu, Hawaii USA

<sup>4</sup> Joel Rice Consulting, USA

<sup>5</sup> Pacific Community Oceanic Fisheries Program, B. P. D 5, 98848 Noumea, New Caledonia

Email: kaim@affrc.go.jp



---

<sup>1</sup> Working document submitted to the ISC Shark Working Group Workshop, 1-4 March 2022 (JST), Web-meeting. **Document not to be cited without author's permission.**

## Summary

This working paper provides a reconstruction of catch for blue sharks caught by longline and purse seine fisheries of non-ISC countries in the western and central North Pacific from 1997 to 2020. The reported annual catch of blue sharks caught by purse seine fleets was less than 0.1 metric tons and longline catch accounted for most of the catch. Since the public domain reported longline catch of blue sharks is likely to be underreported, the longline catches of four major non-ISC fleets including Micronesia, Kiribati, Republic of Marshall Islands and Vanuatu were estimated using the observed CPUE and reported total fishing effort, and the longline catches of the other four non-ISC fleets including Belize, Papua New Guinea, Palau, and Solomon Islands were estimated using an average of the CPUE for four major fleets and reported total fishing effort. The reconstructed annual catch fluctuated between 51 and 1864 MT, and those substantially decreased compared to catch previously estimated for non-ISC countries. In addition, the reconstructed annual catch after 2010 were similar to the annual reported catch except for 2011-2013. These results suggest that the recent reported longline catch is consistent with the level of reported catch in the observer data, in line with the increase of observer coverage. The reconstructed annual catches were lower than 1000 metric tons until 2016, thereafter markedly increased the catch over 1100 metric tons due to the significant increase in the fishing effort of longline fleets for tropical tunas.

## Introduction

Blue shark (*Prionace glauca*) is widely distributed from tropical to temperate waters around the globe and is the most abundant species of oceanic pelagic shark (Nakano and Steven 2008). Blue shark in the Pacific Ocean is thought to comprise two-stocks, roughly separated north and south along the equator (ISC 2017). The stock assessment of blue shark in the North Pacific is implemented by the ISC SHARK working group (WG). In the previous stock assessment in 2017, the WG used the annual catch of blue sharks (*Prionace glauca*) caught by the longline fleets of non-ISC member countries in the western and central North Pacific above equator from 1995 to 2015 (ISC 2017). The non-ISC member countries catching the North Pacific blue shark include eight countries: Belize, Kiribati, Palau, Papua New Guinea, Micronesia, Republic of Marshall Islands, Solomon Islands and Vanuatu, however, it is essential to note that the catch is incidental as the longline fleets target tropical tunas.

The non-ISC annual catch for 1995-2010 was provided by Pacific Community (SPC) Oceanic Fisheries Programme for the stock assessment in 2014 (ISC 2014). The annual catch was estimated as the sum-product of predicted standardized blue shark CPUE and reported non-ISC longline effort at the  $5 \times 5$  cell level, where the predicted CPUE came from a GLM analysis of all observer program data in SPC holdings. This summation was done annually to produce annual catch estimates. On the other hand, the non-ISC annual catch for 2011-2015 was estimated by the WG for the stock assessment in 2017 (ISC 2017). The annual catch for 2011-2014 was estimated by multiplying the average nominal CPUE (annual catch used for the assessment in 2014/annual fishing effort (number of hooks) from the public domain data) for 2000-2010 from the SPC analysis by the publicly available fishing effort for 2011-2014. In addition, the same value in 2014 was used for the annual catch in 2015 as the fishing effort in 2015 was unavailable.

The WG decided to revisit the non-ISC catch calculation as there is no clear description about the estimation method for the 1995-2010 catch and because there appears to be a large difference between the previous 1995-2010 catch estimates and 2011-2020 estimates based on non-ISC observer data. The objective of this working paper is to reconstruct the annual catch of North Pacific blue sharks caught by longline and purse seine fisheries of the non-ISC countries for 1997-2020.

## Materials and Methods

Onboard observer data collected from four major non-ISC member countries (i.e., Kiribati, Micronesia, Republic of

Marshall Islands and Vanuatu) in the North Pacific Ocean were aggregated by the SPC to the year and fleet level, and then the cells with activity representing less than three vessels were removed (to satisfy the WCPFC rules for public domain data). These summarized observer data were then used to calculate the catch rate (catch number per 1000 hooks) of blue shark. In addition, aggregated logbook data collected from the eight countries in the North Pacific Ocean were used to estimate the total catch number through multiplying the catch rate by the total fishing effort (**Table 1**). In the estimation of annual catch number of each flag, the flag-specific average annual catch rates for the four major fleets were used when the proportion of observed hooks was 0. The average catch rate across the four major fleets was also used in the catch calculation of the other four countries which had no observer data available for this study (i.e., Belize, Papua New Guinea, Palau, and Solomon Islands). The estimated catch in number for the eight countries for 1997-2020 was then converted to catch in weight to match the unit for the catch used in the previous stock assessment in 2017. The average body weight of blue shark was estimated from the length frequency data of non-ISC countries (i.e., Kiribati, Micronesia, Palau, Republic of Marshall Islands and Vanuatu) for 1994-2020. The body length was converted into the body weight using the sex-specific length-weight relationships (Nakano 1994);

$$WT = 3.293 \times 10^{-6} PCL^{3.225} \text{ for male,}$$

$$WT = 5.388 \times 10^{-6} PCL^{3.102} \text{ for female,}$$

where WT is body weight (kg) and PCL is precaudal length (cm). For the size data of unknown sex, we used a sex-combined length-weight relationships (Harvey 1989);

$$WT = 2.57 \times 10^{-5} TL^{3.05},$$

where TL is total length (cm). Since the length frequency data compiled by the WG data manager is a basis of PCL, the TL was converted into PCL using the following equation (Fujinami et al., 2017);

$$PCL = 0.78 TL - 3.75.$$

Then an average body weight was calculated from the weight frequency data.

The maximum value was chosen between estimated and observed longline catch to the year and fleet level and finally the reported annual catch of blue shark caught by purse seine fleets was added to the longline catch.

These public domain data are available through the data manager of WCPFC after getting the permission from the WCPFC secretariat.

## Results

The annual catch rate of blue shark was highly variable by year and flag (**Table 2**). The average catch rate for three countries (i.e., Kiribati, Republic of Marshall Islands, and Vanuatu) was between 0.16 and 0.60, and the average catch rate of Micronesia (1.03) was much higher than that of any other countries due to the highest catch rate from 1997 to 2008 (an average of 1.55). The average catch rate for the other four countries (i.e., Belize, Papua New Guinea, Palau, and Solomon Islands) was 0.68. The observer data coverage (observed number of hooks/reported number of hooks) for Vanuatu was lower than those of any other countries (**Table 3**). The estimated average body weight of blue sharks was 39.55 kg which is reasonable because adult blue shark is distributed in this tropical area (Nakano 1994). The estimated annual catch number and weight were mostly occupied by Micronesia and Vanuatu and the total catch for all countries was higher in 1999, 2007, 2017-2020 and those for Vanuatu after 2015 were significantly higher compared to those for any other countries (**Tables 4, 5**), probably due to the Vanuatu fleet also operating in more temperate waters/higher latitudes in the North Pacific, where blue shark catch rates are higher. The reported annual catch of blue shark caught by purse seine fleets was less than 0.1 metric tons and longline catch accounted for most of the catch (**Table 6**). The reconstructed annual catch fluctuated between 51 and 1864 MT, and was substantially lower than previously estimated non-ISC catch. In addition, the reconstructed annual catch after 2010 were almost similar to the annual reported catch except for 2011-2013 (**Fig. 1**). These results suggested that the recent reported annual longline catch estimates for these fleets is consistent with the observed catch rates. However, this is an expected

result since in recent years the annual longline catch estimates for these fleets is based on estimations using their observer data. This is done in acknowledgment that the logbook-reported shark species catches are typically under-reported. The reconstructed annual catches were lower than 1000 metric tons until 2016, thereafter markedly increased the catch over 1100 metric tons (**Fig. 1**) due to the significant increase in the fishing effort of longline fleets for tropical tunas (**Table 1**).

## Discussions

This working paper provided a reconstruction of catch for blue sharks caught by longline and purse seine fleets of non-ISC countries in the western and central North Pacific from 1997 to 2020. Although the procedure of the reconstruction of the annual catch is reasonable given the available data, there is a large uncertainty in the estimation of the catch for eight non-ISC countries for 1997-2015 due to a lack of observed catch rates (**Table 2**). Additionally, these estimates are sensitive to the assumption on what catch-rate to use when the proportion of observed effort is 0 within and across fleets. The lower estimated annual catch for Kiribati and Marshall Islands is attributed to the lower catch rates for those countries (**Table 2**). The magnitude of the catch rate around 0.1-1.0 per 1000 hooks largely differed from that around 4.0 per 1000 hooks for Japanese deep-set longline fishery operated around Hawaii islands (Kai 2021). However, it is difficult to directly compare the mean catch rate among longline fleets because the non-ISC countries, except for the Vanuatu fleet, typically operate around equator between 0 and 10 °N. In contrast many ISC member nations (such as Japan) operate in the subtropical water around Hawaii islands between 20 and 30 °N. Meanwhile, the Vanuatu longline fleet operates in the wide area including higher latitudes of the North Pacific where BSH are more abundance in recent years (**Fig. 2**). According to the average annual CPUE and percent positive catch of blue shark by latitude (Table 2 in the paper of Rice and Harley, 2014), the catch rate tended to increase as the latitude band increased and the catch rates in 2009 at the 2.5 and 7.5 latitude bands were 0.086 ( $0.271 \times 0.319$ ) and 0.33 ( $0.669 \times 0.494$ ) per 1000 hooks respectively. These facts suggested that the annual catch rate after 2010 for non-ISC countries is conceivable.

We note large differences in annual catch for 1997-2010 between the previous analysis and this study (**Fig. 1**). Possible explanations for this discrepancy include the implementation of CMM-2011-04 or the designation of Micronesia, Palau, and the Republic of the Marshall Islands as shark sanctuaries which might have impacted the catch through shifting the target species/operational areas, increase of the discards, decrease of reporting, or changing gear configuration. Another possibility is that the previous analysis conducted in 2014 included observer data of ISC countries which could have impacted the predicted catch rates of non-ISC countries.

The average catch rate of Micronesia for 1997- 2008 provided by WCPFC in this study was 1.55 per 1000 hooks. The catch rate was much higher than those after 2010 (**Table 2**). These data indicated that the higher catch of blue shark before 2011 for Micronesia (Tables 4, 5) was caused by the high catch rates in the end of 1990s and 2000s. On the other hand, the higher catch rate (0.60) of Vanuatu before 2015 was largely affected by the high catch rates in recent years, so that the estimated annual catch also includes a large uncertainty. For the average catch rate, it might be better using the lower catch rates in closest years such as 2011 and 2015 instead of merely a mean value of all years. Further research on the catch rates is recommended but nothing that available observer data have very low coverage. Additionally, further research on catch rate reconstruction for these fisheries should be conducted using the non-public domain data, and should quantify the uncertainty in the catch time series. If possible, this research should be done in collaboration with the scientists and fisheries officers of the non-ISC countries.

## References

Fujinami, Y., Semba, Y., Okamoto, H., Ohshimo, S., Tanaka, S., 2017. Reproductive biology of the blue shark (*Prionace glauca*) in the western North Pacific Ocean. Mar. Freshw. Res. 68:2018-2027

- Harvey, J. T., 1989. Food habits, seasonal abundance, size, and sex of the blue shark, *Prionace glauca*, in Montrey bay, California. Calif. Fish Game, 75, 33-44.
- ISC. 2014. Stock assessment and future projections of blue shark in the North Pacific Ocean. ISC Plenary report and documents. Annex 13.
- ISC. 2017. Stock assessment and future projections of blue shark in the North Pacific Ocean through 2015. ISC Plenary report and documents. Annex 13.
- Kai, M. 2021. Update of Japanese annual catches for blue shark caught by Japanese offshore and distant water longliner in the North Pacific Ocean from 1994 to 2020. ISC/21/SHARKWG-2/04.
- Nakano, H., 1994. Age, reproduction and migration of blue shark (*Prionace glauca*) in the North Pacific Ocean. Bull. Nat. Res. Inst. Far, Seas Fish. 31:141-256
- Nakano, H., Stevens, J. D. 2008. The biology and ecology of the blue shark, *Prionace glauca*. In: Camhi, M. D., Pikitch, E. K., Babcock, E. A., editors. Sharks of the open ocean: biology, fisheries and conservation. Oxford: Blackwell Scientific. p. 140–51.
- Rice, J., Harley, S. 2014. Standardization of blue shark catch per unit effort in the North Pacific Ocean based on SPC held longline observer data for use as an index of abundance. ISC/14/SHARKWG-2/04.

**Table 1.** Estimated number of longline hooks for eight fleets from the non-ISC countries from 1997 to 2020 (Source: aggregated WCPFC data).

Year	Micronesia	Kiribati	Marshall Islands	Vanuatu	Belize	Papua New Guinea	Palau	Solomon Islands
1997	1,728,591			25,245	269,050	606		
1998	4,125,971				272,686	16,015		
1999	4,232,411				429,128	5,535		
2000	7,146,408				197,060		775,721	
2001	4,930,334				474,236	24,505	316,201	
2002	6,046,157			4,342,001	1,940,776	12,489		
2003	5,149,182	73,400		5,001,744	810,067	34,058		
2004	5,725,997	23,600	38,300	15,949,798	3,955,626		176,400	
2005	2,344,450			11,914,482	7,075,428			
2006	2,243,129			11,561,757	3,280,502			
2007	10,918,299		29,500	9,239,875	247,800			
2008	6,338,360	326,342	2,427,372	8,047,381	139,200	811,371		
2009	8,071,566		2,061,807	5,404,406		71,918		
2010	8,488,405		1,682,774	5,432,718	1,354,377			142,027
2011	9,456,417	20,764	1,676,310	8,585,999				
2012	11,048,312	1,224,310	2,067,900	4,708,503	163,650	91,036		
2013	7,736,636	616,254	628,600	6,049,986	28,160	162,748		
2014	11,727,524	77,550		7,589,414	500	8,443		1,434,618
2015	12,322,827	1,078,381	58,450	13,249,253		3,575		645,881
2016	12,641,478	2,558,063	6,322,031	9,095,148		533,045	62,600	
2017	16,465,606	1,744,934	13,879,691	13,484,008		522,017	8,910,008	134,400
2018	35,184,202	2,590,594	10,415,062	11,997,655			11,273,862	653,150
2019	23,766,086	4,484,071	9,589,365	13,272,019		2,046,355	9,213,967	950,827
2020	20,714,464	4,918,759	7,956,465	7,863,880			5,700	300,641

**Table 2.** Catch rate (catch number per 1000 hooks) of blue shark calculated from longline observer data for four major fleets (Micronesia, Kiribati, Republic of Marshall Islands and Vanuatu) from the non-ISC countries. Red value denotes the average catch rate of each country for 1997-2020. Blue value denotes an average catch rate of four major countries.

Year	Micronesia	Kiribati	Marshall Islands	Vanuatu	Belize	Papua New Guinea	Palau	Solomon Islands
1997	0.64			0.07	0.68	0.68		
1998	2.42				0.68	0.68		
1999	5.59				0.68	0.68		
2000	0.71				0.68		0.68	
2001	1.52				0.68	0.68	0.68	
2002	0.80			0.60	0.68	0.68		
2003	0.41	0.16		0.60	0.68	0.68		
2004	1.24	0.16	0.25	0.60	0.68		0.68	
2005	0.99			0.60	0.68			
2006	1.24			0.60	0.68			
2007	1.76		0.25	0.60	0.68			
2008	1.25	0.47	0.93	0.60	0.68	0.68		
2009	1.03		0.25	0.60		0.68		
2010	1.03		0.25	0.60	0.68			0.68
2011	1.03	0.16	0.25	0.07				
2012	1.03	0.16	0.25	0.60	0.68	0.68		
2013	1.03	0.16	0.25	0.60	0.68	0.68		
2014	0.11	0.16		0.60	0.68	0.68		0.68
2015	0.08	0.16	0.25	0.02		0.68		0.68
2016	0.18	0.04	0.22	0.03		0.68	0.68	
2017	0.21	0.03	0.08	0.60		0.68	0.68	0.68
2018	0.12	0.04	0.03	0.79			0.68	0.68
2019	0.18	0.11	0.23	2.10		0.68	0.68	0.68
2020	0.08	0.30	0.01	0.60			0.68	0.68
Average	1.03	0.16	0.25	0.60				
Average of all	0.68							

**Table 3.** Estimated coverage of public domain Observer data based on fishing effort (number of hooks reported by onboard observer/total reported number of hooks fished) for four major fleets from the non-ISC countries from 1997 to 2020.

Year	Micronesia	Kiribati	Marshall Islands	Vanuatu
1997	0.027	0.000	0.000	1.000
1998	0.007	0.000	0.000	0.000
1999	0.005	0.000	0.000	0.000
2000	0.011	0.000	0.000	0.000
2001	0.009	0.000	0.000	0.000
2002	0.006	0.000	0.000	0.000
2003	0.008	0.000	0.000	0.000
2004	0.023	0.000	0.000	0.000
2005	0.049	0.000	0.000	0.000
2006	0.122	0.000	0.000	0.000
2007	0.012	0.000	0.000	0.000
2008	0.016	0.091	0.018	0.000
2009	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.018
2012	0.000	0.000	0.000	0.000
2013	0.003	0.000	0.000	0.000
2014	0.055	0.000	0.000	0.000
2015	0.028	0.000	0.000	0.019
2016	0.045	0.028	0.064	0.020
2017	0.002	0.038	0.041	0.000
2018	0.016	0.009	0.077	0.010
2019	0.029	0.051	0.040	0.008
2020	0.043	0.024	0.013	0.000



**Table 4.** Estimated annual catch number of blue sharks caught by longline fleets for eight fleets from the non-ISC countries from 1997 to 2020.

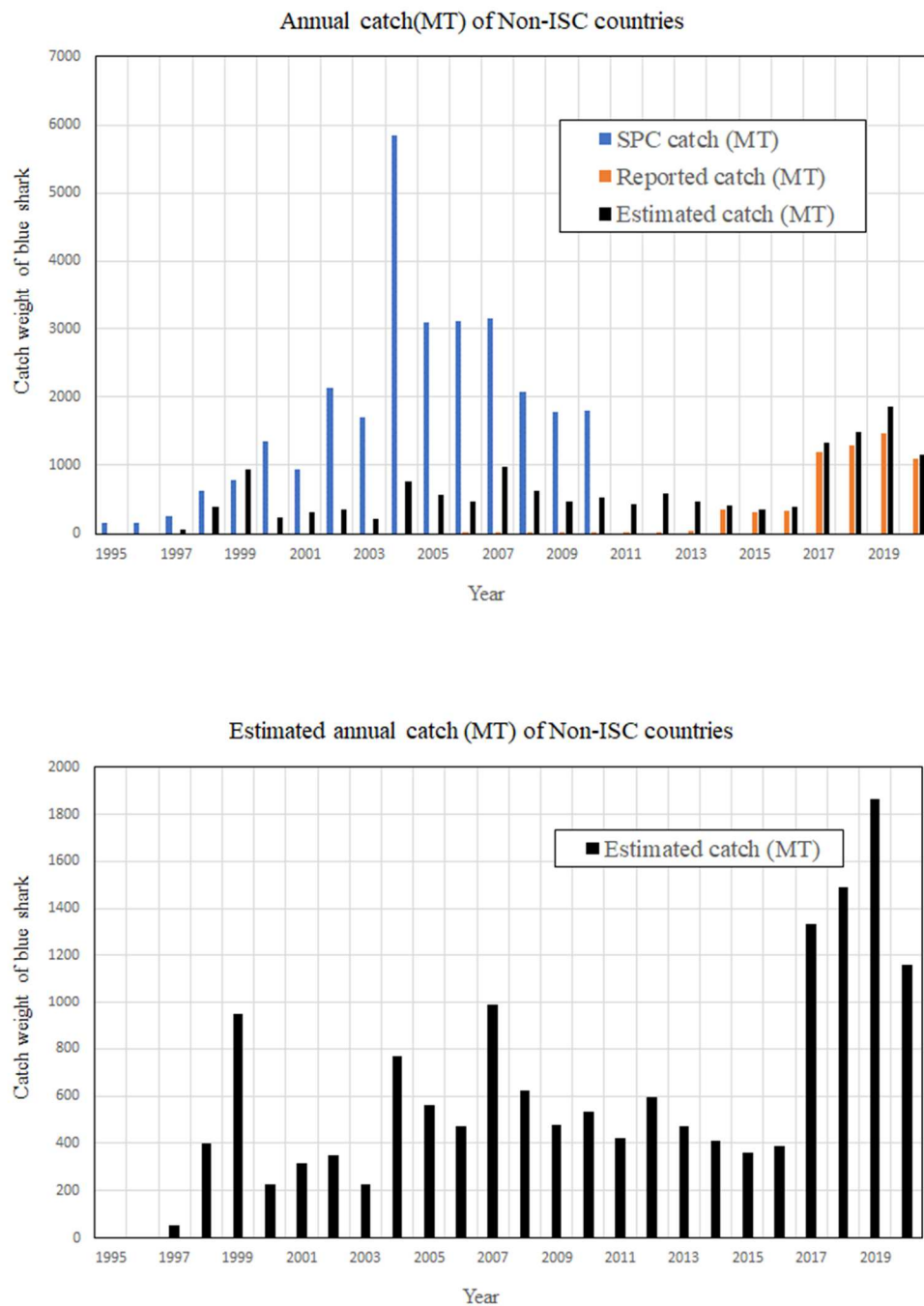
Year	Micronesia	Kiribati	Marshall Islands	Vanuatu	Belize	Papua New Guinea	Palau	Solomon Islands	Total
1997	1,111	0	0	2	182.4	0.4	0.0	0.0	1,296
1998	9,977	0	0	0	184.8	10.9	0.0	0.0	10,172
1999	23,638	0	0	0	290.9	3.8	0.0	0.0	23,933
2000	5,103	0	0	0	133.6	0.0	525.8	0.0	5,762
2001	7,474	0	0	0	321.4	16.6	214.3	0.0	8,027
2002	4,831	0	0	2,605	1315.4	8.5	0.0	0.0	8,760
2003	2,101	12	0	3,001	549.1	23.1	0.0	0.0	5,686
2004	7,072	4	10	9,570	2681.1	0.0	119.6	0.0	19,455
2005	2,323	0	0	7,149	4795.6	0.0	0.0	0.0	14,268
2006	2,777	0	0	6,937	2223.5	0.0	0.0	0.0	11,938
2007	19,216	0	7	5,544	168.0	0.0	0.0	0.0	24,935
2008	7,929	153	2,253	4,828	94.3	549.9	0.0	0.0	15,808
2009	8,314	0	515	3,243	0.0	48.7	0.0	0.0	12,121
2010	8,743	0	421	3,260	918.0	0.0	0.0	96.3	13,438
2011	9,740	3	419	567	0.0	0.0	0.0	0.0	10,729
2012	11,380	196	517	2,825	110.9	61.7	0.0	0.0	15,090
2013	7,969	99	157	3,630	19.1	110.3	0.0	0.0	11,984
2014	1,255	12	0	4,554	0.3	5.7	0.0	972.4	6,799
2015	998	173	15	265	0.0	2.4	0.0	437.8	1,890
2016	2,250	107	1,416	300	0.0	361.3	42.4	0.0	4,478
2017	3,507	52	1,096	8,090	0.0	353.8	6039.1	91.1	19,230
2018	4,046	106	344	9,478	0.0	0.0	7641.2	442.7	22,058
2019	4,373	489	2,244	27,858	0.0	1387.0	6245.1	644.5	43,240
2020	1,554	1,451	72	4,718	0.0	0.0	3.9	203.8	8,002

**Table 5.** Estimated annual catch (metric tons) of blue sharks caught by longline fleets for eight fleets from the eight main non-ISC countries from 1997 to 2020.

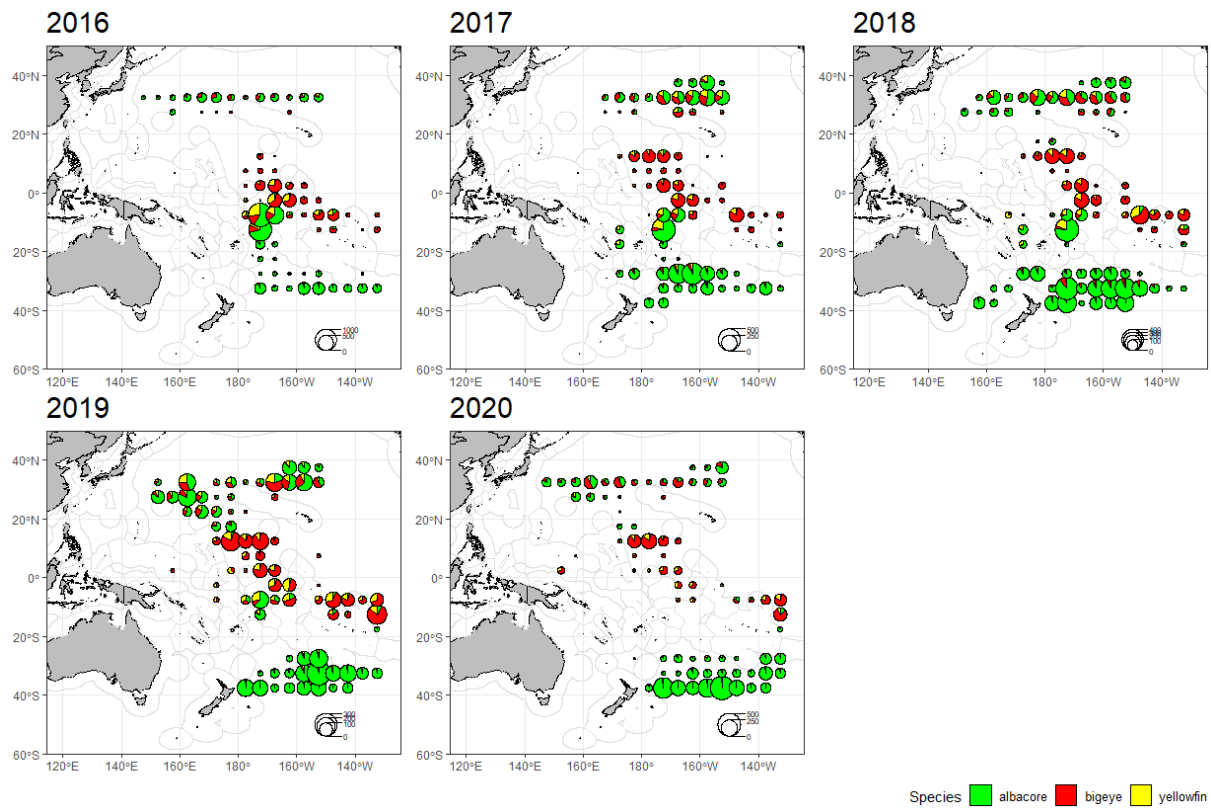
Year	Micronesia	Kiribati	Marshall Islands	Vanuatu	Belize	Papua New Guinea	Palau	Solomon Islands	Total
1997	44.0	0.0	0.0	0.1	7.2	0.0	0.0	0.0	51.3
1998	394.6	0.0	0.0	0.0	7.3	0.4	0.0	0.0	402.3
1999	934.9	0.0	0.0	0.0	11.5	0.1	0.0	0.0	946.5
2000	201.8	0.0	0.0	0.0	5.3	0.0	20.8	0.0	227.9
2001	295.6	0.0	0.0	0.0	12.7	0.7	8.5	0.0	317.5
2002	191.1	0.0	0.0	103.0	52.0	0.3	0.0	0.0	346.5
2003	83.1	0.5	0.0	118.7	21.7	0.9	0.0	0.0	224.9
2004	279.7	0.1	0.4	378.5	106.0	0.0	4.7	0.0	769.5
2005	91.9	0.0	0.0	282.7	189.7	0.0	0.0	0.0	564.3
2006	109.8	0.0	0.0	274.4	87.9	0.0	0.0	0.0	472.1
2007	760.0	0.0	0.3	219.3	6.6	0.0	0.0	0.0	986.2
2008	313.6	6.1	89.1	191.0	3.7	21.7	0.0	0.0	625.2
2009	328.8	0.0	20.4	128.2	0.0	1.9	0.0	0.0	479.4
2010	345.8	0.0	16.6	128.9	36.3	0.0	0.0	3.8	531.5
2011	385.2	0.1	16.6	22.4	0.0	0.0	0.0	0.0	424.3
2012	450.1	7.7	20.4	111.7	4.4	2.4	0.0	0.0	596.8
2013	315.2	3.9	6.2	143.6	0.8	4.4	0.0	0.0	474.0
2014	49.6	0.5	0.0	180.1	0.0	0.2	0.0	38.5	268.9
2015	39.5	6.8	0.6	10.5	0.0	0.1	0.0	17.3	74.8
2016	89.0	4.2	56.0	11.9	0.0	14.3	1.7	0.0	177.1
2017	138.7	2.1	43.4	320.0	0.0	14.0	238.8	3.6	760.6
2018	160.0	4.2	13.6	374.9	0.0	0.0	302.2	17.5	872.4
2019	173.0	19.3	88.7	1101.8	0.0	54.9	247.0	25.5	1710.1
2020	61.4	57.4	2.8	186.6	0.0	0.0	0.2	8.1	316.5

**Table 6.** Estimated annual catch (metric tons) of blue sharks caught by longline and purse seine fleets for eight countries in the non-ISC countries from 2011 to 2020.

Year	Micronesia	Kiribati	Marshall Islands	Vanuatu	Belize	Papua New Guinea	Palau	Solomon Islands	Total
1997	44.0	0.0	0.0	0.1	7.2	0.0	0.0	0.0	51.3
1998	394.6	0.0	0.0	0.0	7.3	0.4	0.0	0.0	402.3
1999	934.9	0.0	0.0	0.0	11.5	0.1	0.0	0.0	946.5
2000	201.8	0.0	0.0	0.0	5.3	0.0	20.8	0.0	227.9
2001	295.6	0.0	0.0	0.0	12.7	0.7	8.5	0.0	317.5
2002	191.1	0.0	0.0	103.0	52.0	0.3	0.0	0.0	346.5
2003	83.1	0.5	0.0	118.7	21.7	0.9	0.0	0.0	224.9
2004	279.7	0.1	0.4	378.5	106.0	0.0	4.7	0.0	769.5
2005	91.9	0.0	0.0	282.7	189.7	0.0	0.0	0.0	564.3
2006	109.8	0.0	0.0	274.4	87.9	0.0	0.0	0.0	472.1
2007	760.0	0.0	0.3	219.3	6.6	0.0	0.0	0.0	986.2
2008	313.6	6.1	89.1	191.0	3.7	21.7	0.0	0.0	625.2
2009	328.8	0.0	20.4	128.2	0.0	1.9	0.0	0.0	479.4
2010	345.8	0.0	16.6	128.9	36.3	0.0	0.0	3.8	531.5
2011	385.2	0.1	16.6	22.4	0.0	0.0	0.0	0.0	424.3
2012	450.1	7.7	20.4	111.7	4.4	2.4	0.0	0.0	596.8
2013	315.2	3.9	6.2	143.6	0.8	4.4	0.0	0.0	474.0
2014	49.6	0.5	0.0	319.8	0.0	0.2	0.0	38.5	408.6
2015	39.5	6.8	0.6	296.6	0.0	0.1	0.0	17.3	360.9
2016	89.0	4.2	56.0	209.3	0.0	27.5	1.7	0.0	387.8
2017	188.0	2.1	113.8	739.9	0.0	46.3	238.8	3.6	1332.6
2018	205.6	34.2	37.8	890.7	0.0	0.0	302.2	17.5	1487.9
2019	289.8	19.3	88.7	1101.8	0.0	91.6	247.0	25.5	1863.7
2020	296.4	57.4	138.0	656.8	0.0	0.0	0.8	8.1	1157.5



**Figure 1.** Annual catch (metric tons) of blue shark caught by longline fleets of non-ISC countries for 1995-2020. Blue bar (upper panel) denotes annual catch estimated by ISC (2014), orange bar (upper panel) denotes annual catch of logbook data and black bar (upper and lower panels) denotes annual catch estimated in this study.



**Figure 2.** Operational area and catch amounts (metric tons) of tunas caught by longline fleets of Vanuatu in the WCPFC area for 2016-2020. (Source : WCPFC Annual Catch and Effort Estimates (ACE) Tables by fleet; <https://www.wcpfc.int/ace-by-fleet>)