Estimation of Sharks Production in Indonesia

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Abstract

This study examines the historical production trends of several shark species in Indonesia from 1950 to 2023. These species are blue shark (*Prionace glauca*), silky shark (*Carcharhinus falciformis*), oceanic whitetip shark (*Carcharhinus longimanus*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), and scalloped hammerhead (*Sphyrna lewini*). The data from 1950 to 2009 was the estimation of existing data from 2010-2023. The results indicate distinct temporal patterns among species, with some showing clear increases followed by recent declines. Blue shark production increased from 1990 to 2006 and continued to fluctuate before reaching a peak of approximately 1,800 tons in 2018, after which catches declined to around 800 tons in 2023. Silky shark production reached its highest level in 2006 at nearly 600 tons, followed by a gradual decline to about 100 tons by 2023. Oceanic whitetip shark production remained low, with catches below 100 tons in most years, except for a spike of approximately 1,300 tons recorded in 2011. Other species exhibited relatively low or sporadic production. Porbeagle sharks were absent from the records, with only a single catch event of approximately 4.5 tons in 2018. Shortfin mako production increased to a peak of more than 300 tons in 2016 before declining sharply to around 20 tons in 2023. Similarly, scalloped hammerhead production reached a maximum of about 85 tons in 2016 but decreased substantially afterward, with almost no reported catches in 2023.

Introduction

Sharks are among the important bycatch species in tuna and tuna-like fisheries operating in the Indian Ocean. In the framework of regional fisheries management, the Indian Ocean Tuna Commission (IOTC) regularly evaluates the status of shark populations and provides management advice through its scientific bodies. During the IOTC Working Party on Ecosystems and Bycatch (WPEB), particularly at the 20th Session of the IOTC Working Party on Ecosystems and Bycatch, recommendations were made for the Scientific Committee to consider management advice derived from draft resource stock status summaries for several shark species, as well as for other bycatch taxa such as marine turtles and seabirds. These recommendations emphasize the importance of reliable catch information to support stock assessments and ecosystem-based fisheries management.

Further attention to shark catches information was highlighted during the 27th Session of the IOTC Scientific Committee, where the IOTC Scientific Committee recommended that the Commission take note of management advice developed for a subset of shark species commonly caught in fisheries targeting tuna and tuna-like species. Accurate historical catch data are essential for producing robust stock assessments and for improving the scientific basis of management measures within the IOTC framework. Consequently, improving the quality and consistency of shark catch statistics has become an important priority for member countries, including Indonesia, which operates one of the largest tuna longline fisheries in the Indian Ocean.

In response to these needs, Indonesia initiated a process to re-estimate its historical shark catch data covering the period 1950–2023. A potential methodology was discussed during the Technical Workshop on Indonesian Catch Data Estimation, which proposed several steps including identifying target groups for each fishing gear, calculating ratios between pelagic shark catches and target species catches, and estimating shark species composition using available data sources such as observer records, landing statistics, and historical datasets. The methodology was further refined through consultation meetings where preliminary results and methodological approaches were reviewed, and feedback was provided by the IOTC Secretariat. These discussions aimed to finalize the re-estimation methodology and apply it to the full time series of Indonesian shark catches from 1950 to 2023, thereby improving the reliability of national catch statistics used in regional stock assessments and fisheries management.

Methods

Historical sharks catch data for Indonesia prior to 2010 were estimated using a backward simulation approach based on the available catch records from 2010–2023. The estimation framework was developed under several scientific assumptions regarding historical fishing activities and stock conditions. First, fishing technology has generally become more advanced over time, which can increase fishing efficiency and lead to decreasing catch per unit effort (CPUE) in later years as fish stocks decline. Second, fishing effort in earlier decades—reflected by the number of vessels, fuel use, and fishing gear—was assumed to be substantially lower than in recent years. Third, fish populations were assumed to be relatively larger in the past; however, limited fishing technology and lower effort likely constrained total catches. Consequently, the long-term catch trend was interpreted as a combined effect of biological stock dynamics and gradual technological development in fisheries.

To estimate shark catches for the period 1950–2009, a simulation was conducted using probability distributions derived from the fitting results of the observed data from 2010–2023. Among several candidate distributions, including lognormal, Poisson, and negative binomial, the negative binomial distribution was selected because it best represented the over-dispersed pattern observed in the recent catch data. Simulated catch values were generated annually for each fishing gear category. A backward scaling factor was then applied to represent declining fishing capacity and efficiency in earlier decades. This scaling factor was implemented as a gradual reduction in average yields when moving backward in time, either through an exponential decay function or a linear adjustment. The final output consisted of annual estimated catch values disaggregated by fishing gear.

Several initial assumptions regarding the historical development of fishing gears were also incorporated into the simulation process. Traditional fishing gears—such as danish seine (DS), gillnet (GI), handline (HL), liftnet (LN), and pole-and-line (PL)—were assumed to have existed since 1950, but with relatively small catch volumes. For these gears, average yields were assumed to decline by approximately 20–40% per decade when projecting backward from the baseline period. Semi-modern fishing gears, including coastal longline (LLCO) and troll line (TL), were assumed to have emerged only during the 1970s–1980s; therefore, catches from these gears were set to zero for the period 1950–1969. More modern fishing gears, such as industrial longline (LLTU), small-scale purse seine (PSSS), and handline offshore (HLOF), were considered to have appeared only after the 2000s, and thus their catches were assumed to be absent during the earlier decades. These assumptions allowed the reconstruction of a plausible historical time series of shark catches in Indonesia from 1950 to 2009. The complete method can be referred to the Indonesian paper that presented at the WPDCS-21 in 2025.

Results

Shark production trends in Indonesia from 1950 to 2023 show considerable variation among species. Blue shark (*P. glauca*) production remained relatively low for several decades but began to increase noticeably from around 1990 to 2006. After this period, catches fluctuated but continued at relatively high levels, reaching a peak in 2018 with approximately 1,800 tons. Following this peak, production declined substantially, dropping to around 800 tons by 2023 (Figure 1).

Silky shark (*C. falciformis*) production showed a different pattern. Catches increased until reaching their highest level in 2006 at nearly 600 tons. After this peak, production fluctuated but generally followed a declining trend through the subsequent years, eventually decreasing to approximately 100 tons by 2023 (Figure 2). Oceanic whitetip shark (*C. longimanus*) production remained consistently low throughout most of the time series, typically staying below 100 tons per year. However, an exceptional spike occurred in 2011 when reported production surged to about 1,300 tons before returning to low levels in the following years (Figure 3).

Other species showed more sporadic or lower catch levels. Porbeagle sharks (*L. nasus*) were virtually absent from the production records, with no reported catches throughout the time series except for a small catch of approximately 4.5 tons recorded in 2018 (Figure 4). Shortfin mako (*I. oxyrinchus*) production increased gradually and reached a peak in 2016 at more than 300 tons, after which catches declined sharply, falling to around 20 tons by 2023 (Figure 5). Similarly, scalloped hammerhead (*S. lewini*) production peaked in 2016 at approximately 85 tons but declined dramatically afterward, with almost no reported catch by 2023 (Figure 6). These patterns indicate substantial interannual variability and recent declines in the production of several shark in Indonesia.

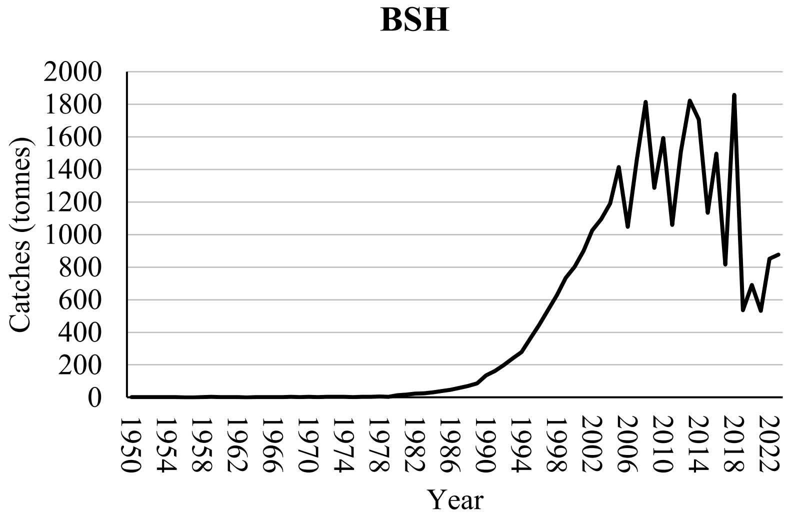

Figure 1. The production of blue shark (*P. glauca*) in Indonesia from 1950-2023.

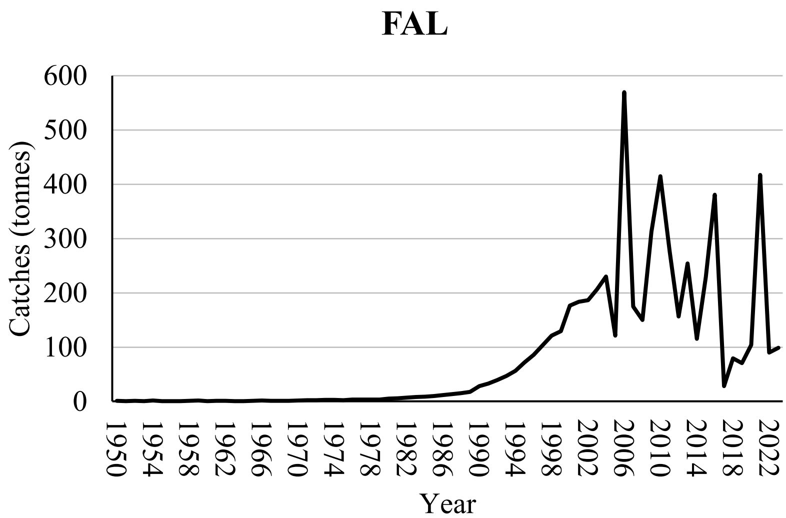

Figure 2. The production of silky shark (*C. falciformis*) in Indonesia from 1950-2023.

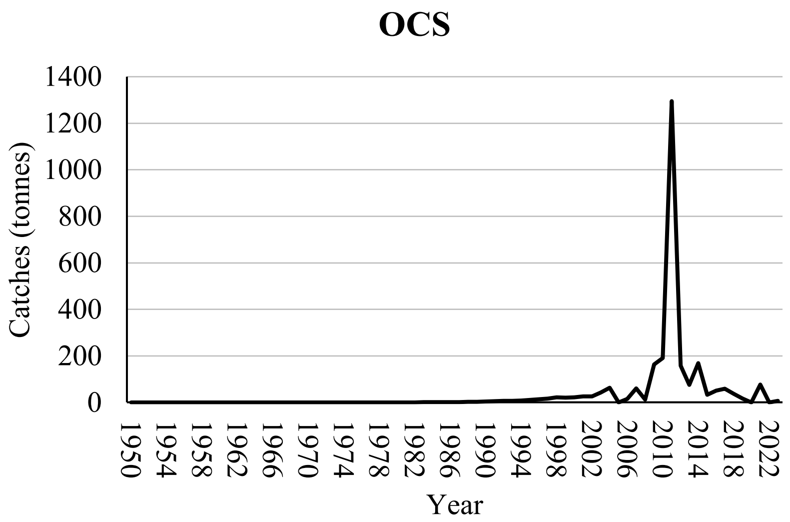

Figure 3. The production of oceanic whitetip shark (*C. longimanus*) in Indonesia from 1950-2023.

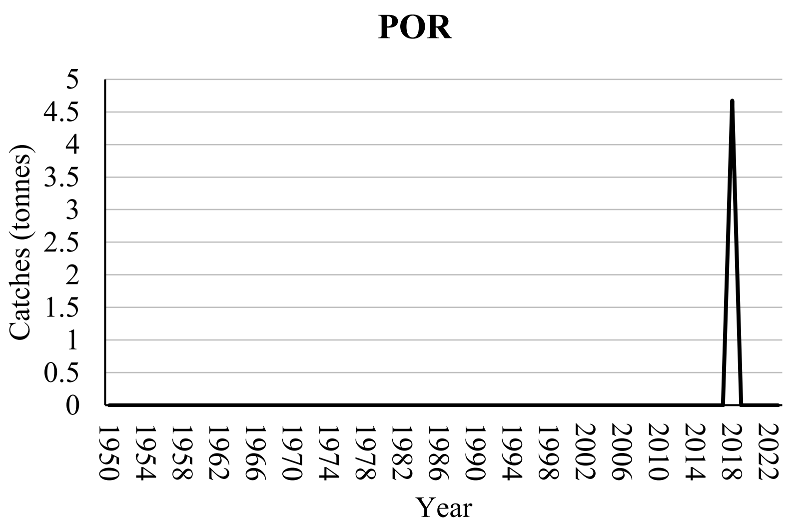

Figure 4. The production of porbeagle (*L. nasus*) in Indonesia from 1950-2023.

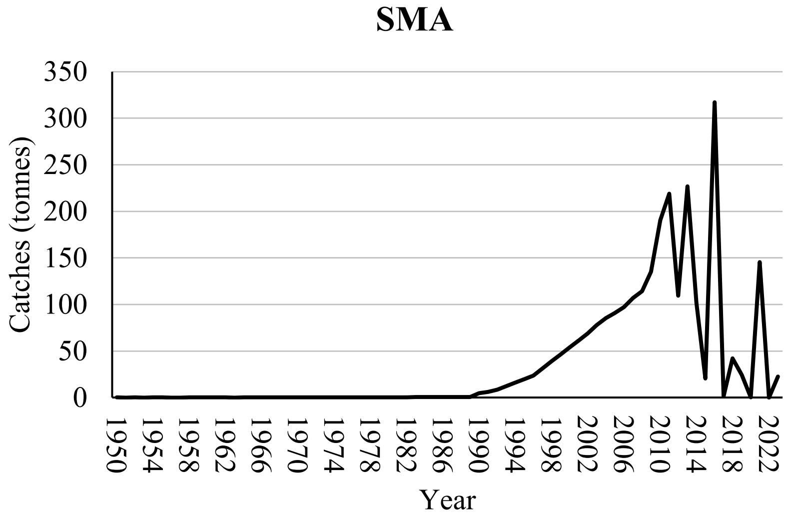

Figure 5. The production of shortfin mako (*I. oxyrinchus*) in Indonesia from 1950-2023.

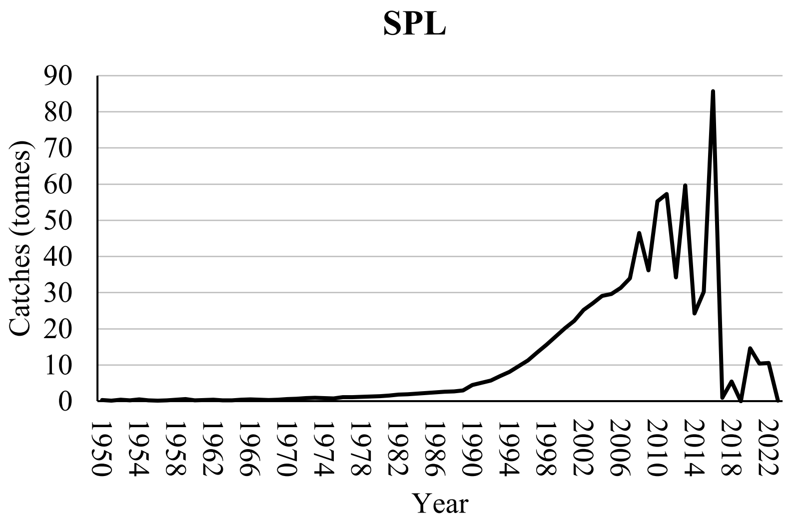

Figure 6. The production of scalloped hammerhead (*S. lewini*) in Indonesia from 1950-2023.

Conclusion

Shark production trends in Indonesia from 1950 to 2023 showed variability and differences among species. Blue shark production increased from the 1990s and reached its highest level in 2018 before declining in recent years. In contrast, silky shark catches peaked earlier, in 2006, and have since shown a generally decreasing trend. Oceanic whitetip shark production remained consistently low for most of the time series, except for a pronounced spike in 2011. Other species such as porbeagle, shortfin mako, and scalloped hammerhead exhibited relatively low or sporadic catches, although shortfin mako and scalloped hammerhead reached temporary peaks around 2016 before declining sharply.

References

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