Length frequency distribution of skipjack tuna (*Katsuwonus pelamis*) in Indonesia

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Abstract

This preliminary study investigates the length frequency distribution of skipjack tuna (*Katsuwonus pelamis*) in Indonesia. Total of 127,000 samples collected between 2018 and 2021 at various fishing ports along the West of Sumatra and South of Jawa. These ports are Lampulo, Sibolga, Padang, Bengkulu, Binuangeun, Palabuhanratu, Cilacap, Pacitan, Prigi, and Labuhan Lombok. Around three-quarters of the samples were collected from ports along the southern coast of Jawa. Binuangeun contributed the largest share, accounting for over 35% of the total samples. Handlines accounted for about 53% of the sampled fish and purse seines were the second contributing about 27% of the samples. The highest average fork length was recorded in Cilacap using gillnets, at 51.3 cm, indicating that this gear captured larger fish. In Prigi, purse seines yielded an average fork length of 47.3 cm, while trolling lines recorded an average of 46.0 cm. This study highlights the importance of length frequency analysis for understanding stock characteristics and informs sustainable fishery management.

Keywords: skipjack tuna, length frequency, Indian Ocean

Introduction

Skipjack tuna (*Katsuwonus pelamis*) is an important for Indonesia marine fisheries, supporting the national economy and food security. Indonesia contributes significantly to global tuna markets, with capture fisheries yielding more than 500,000 tons annually and skipjack contribute a substantial portion (Suherman et al., 2025). This highly migratory species supports the livelihoods of fishers, processors, and traders across the archipelago, particularly in coastal communities where fishing is a primary economic activity. Moreover, skipjack tuna is a vital protein source for domestic consumption and a key export commodity, creating significant global trade with Asia, Europe, and North America (Guillotreau et al., 2017).

The capture of skipjack tuna in Indonesia is conducted by a diverse fishing gear. The dominant gears include purse seine, which targets large schools of skipjack in open waters, and handline fishing, which is commonly practiced by small-scale fishers in coastal regions (Damora et al., 2021). Other gears, such as pole-and-line, gillnets, and trolling particularly in artisanal fisheries, allowing fishers to catch skipjack from nearshore to offshore waters in the Indian Oceans (Ardill et al., 2011). This diversity in fishing gears need comprehensive data on skipjack populations to ensure that management strategies account for the varying impacts of different gears on stock dynamics. Understanding the size composition of catches from these gears is important for assessing fishing pressure and informing gear-specific regulations (Monroy et al., 2010).

Length frequency distribution is an important tool in fisheries science. By analyzing the size distribution of fish, researchers can estimate key biological parameters such as growth rates, mortality rates, and size-at-maturity, which inform stock assessments and sustainable harvest limits (King, 2010). Furthermore, the length frequency data assist

identifies recruitment patterns and detect potential overfishing, allowing managers to set size-based catch limits or seasonal closures to protect juvenile or spawning populations (Gwinn et al., 2015). In Indonesia, with diverse of fishing gears, the understanding of length frequency distribution of skipjack tuna is important for developing regionally management strategies. The objective of this research is to investigate the length frequency distribution of skipjack tuna (*K. pelamis*) in Indonesia, providing baseline data to support sustainable fisheries management.

Methods

Data collection on skipjack tuna (*K. pelamis*) was collected from 2018 to 2021 at multiple fishing ports located along the southern coast of Jawa and the western coast of Sumatra, two of key regions for tuna fisheries in Indonesia. Sampling was conducted at several ports in West of Sumatra including Lampulo, Sibolga, Padang, and Bengkulu. In the South of Jawa including Binuangeun, Palabuhanratu, Cilacap, Pacitan, Prigi, and Labuhan Lombok (Figure 1). Skipjack tunas are landed by various fishing gears, such as handline, purse seine, trolling lines, and other gears. Trained enumerators recorded data on fish catches directly at the ports, measuring the fork length of individual skipjack tuna to the nearest 0.1 cm using callipers or measuring boards.

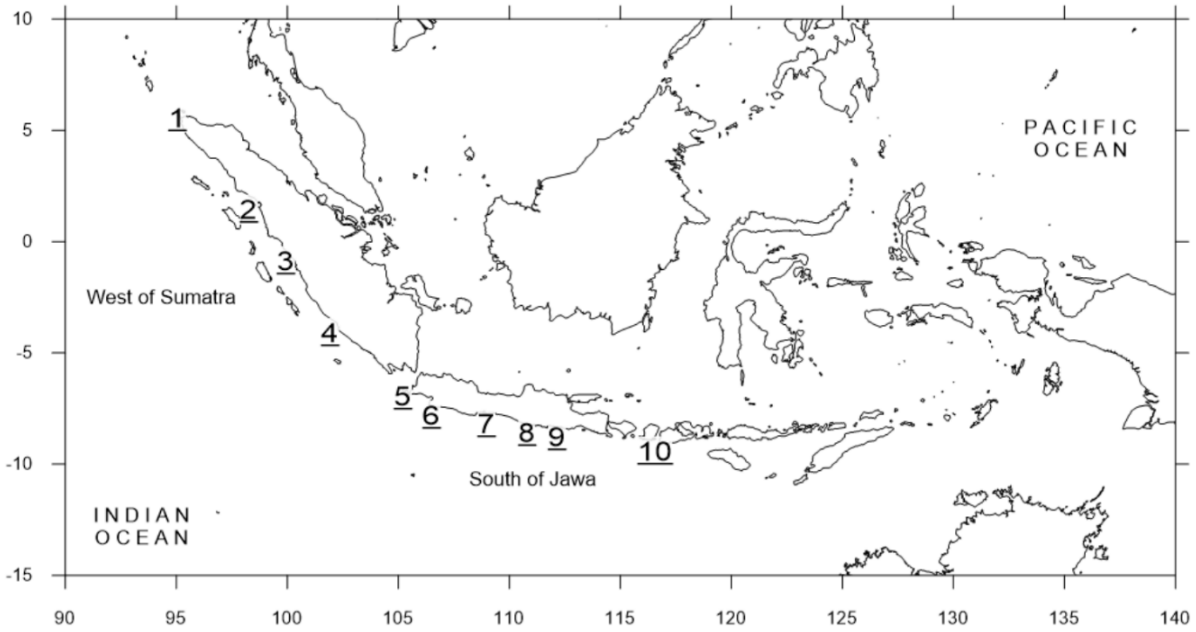

Figure 1. Sampling locations of skipjack tuna (*K. pelamis*) in Lampulo (1), Sibolga (2), Padang (3), Bengkulu (4), Binuangeun (5), Palabuhanratu (6), Cilacap (7), Pacitan (8), Prigi (9) and Labuhan Lombok (10).

Length frequency distributions were analyzed to characterize the size structure of skipjack tuna populations in the sampled regions. Fork length measurements were grouped into 3 cm bins, ranging from the minimum to the maximum observed length, using the R statistical software (Tierney, 2012). The data were processed to remove any missing or invalid entries, and length frequency histograms were generated to visualize the distribution of fork lengths across the entire dataset the stratify by year and location. The analysis was performed using the ggplot2 and dplyr packages in R to create histograms with consistent bin widths and to calculate frequencies for each size class (Kassambara, 2013).

Results

The length frequency analysis of 127,000 skipjack tuna (*Katsuwonus pelamis*) measured across fishing ports in South Jawa and West Sumatra from 2018 to 2021 showed a different size distribution, with fork lengths grouped into 3 cm bins. The mode of the length frequency distribution was 39 cm (Figure 2). The highest sample sizes were recorded in Binuangeun, with approximately 20,000 individuals measured in 2020 and 25,000 in 2021, contributing significantly to the overall dataset (Figure 3).

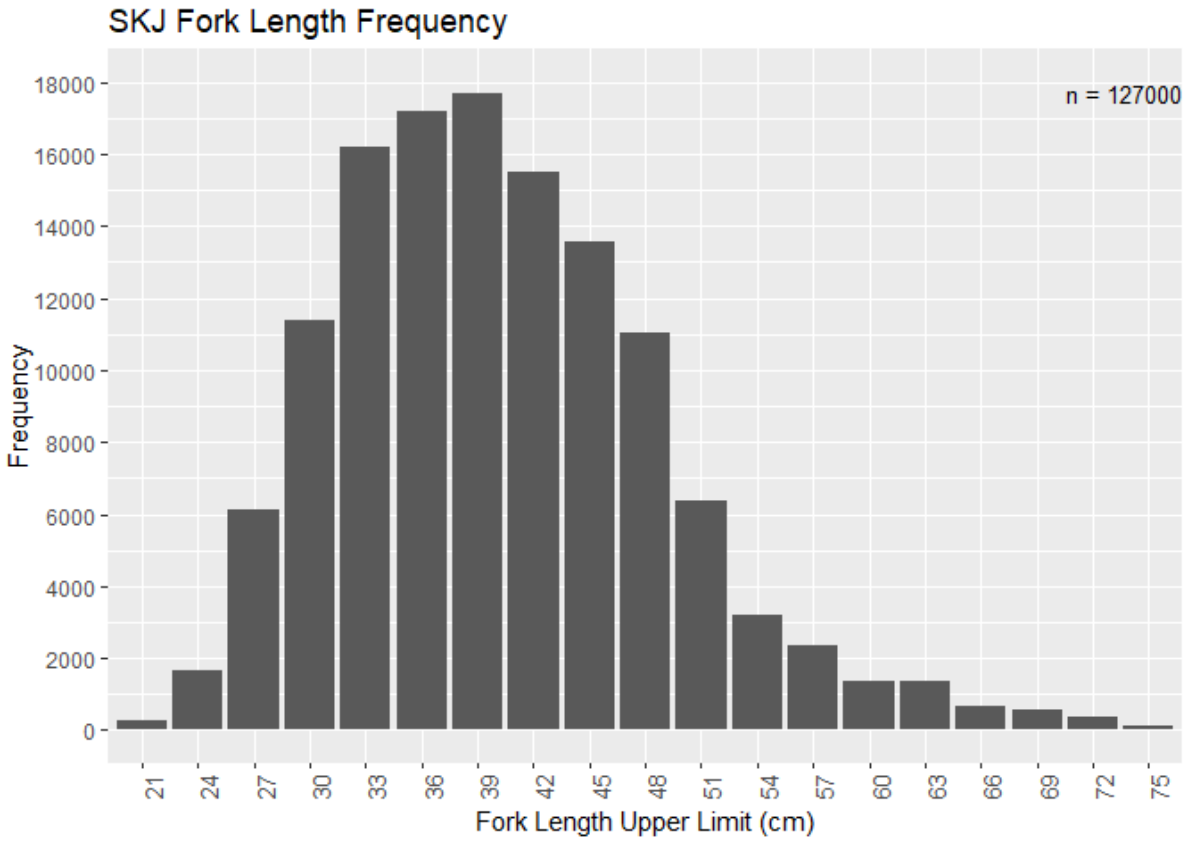

Figure 2. Length frequency of skipjack tuna (*K. pelamis*) in Indonesia.

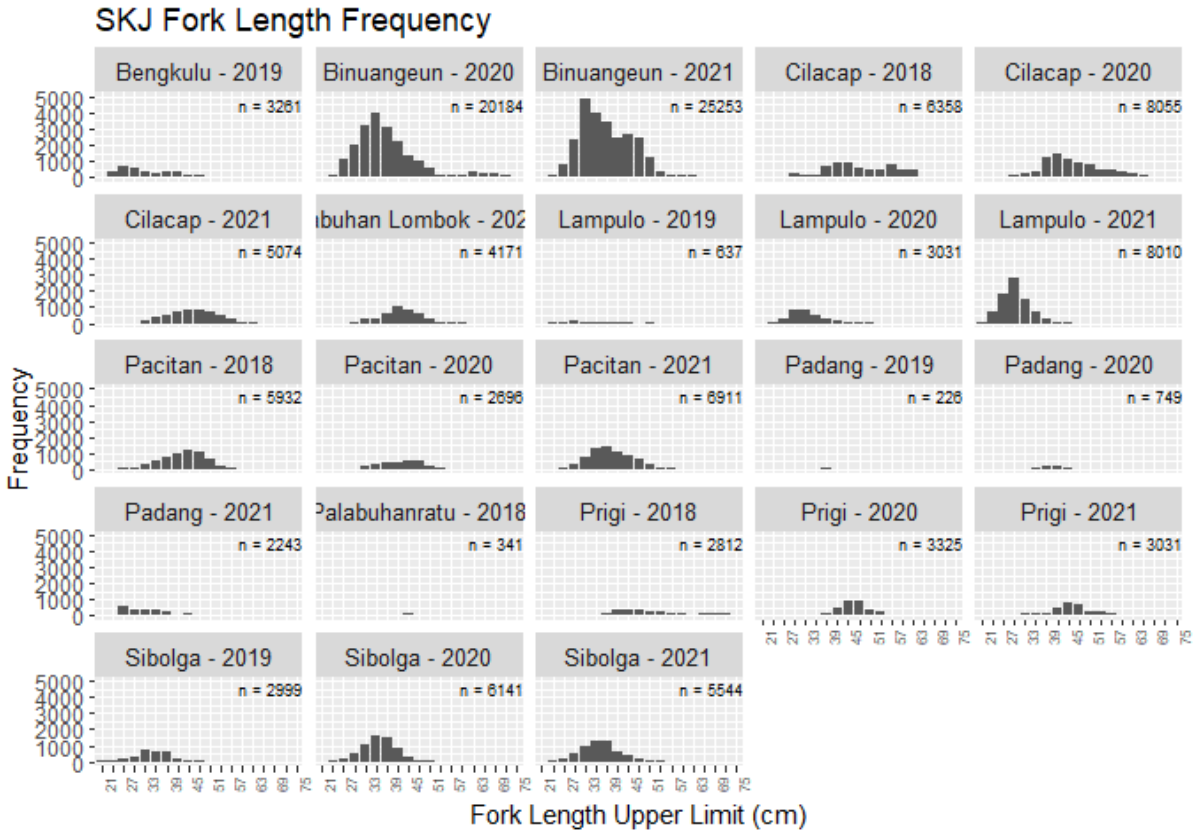

Figure 3. Length frequency of skipjack tuna (*K. pelamis*) in Indonesia per year per locations.

Around three-quarters of the samples were collected from ports along the southern coast of Jawa. Binuangeun contributed the largest share, accounting for over 35% of the total samples (around 45,000 fish), followed by Cilacap with around 15% (around 19,000 fish). The remaining samples were primarily collected from ports in West Sumatra, such as Bungus and Muara Padang, and other South Jawa ports, including Prigi. This distribution highlights the significant contribution of South Jawa, particularly Binuangeun.

The utilization of fishing gears for skipjack tuna captures varied across the sampled regions, with handlines being the most dominant gear type. Handlines accounted for about 53% of the sampled fish (around 67,000 fish), highlighting their dominance in small-scale and artisanal fisheries targeting skipjack tuna in Indonesia. Purse seines were the second most common gear, contributing about 27% of the samples (around 34,000 fish), mainly used in medium and large-scale operations targeting schooling fish. Other gears, including trolling lines, lift nets, and gillnets, made up around 14%, 4%, and 1%, respectively. This gear distribution shows the diverse fishing practices across the regions, with handlines and purse seines being the primary methods for capturing skipjack tuna in both South Jawa and West Sumatra.

Analysis of fork length data showed variations in average sizes across ports and gear types, with measurements grouped into 3 cm bins for the length frequency distribution. The highest average fork length was recorded in Cilacap using gillnets, at 51.3 cm, indicating that this gear captured larger fish. In Prigi, purse seines yielded an average fork length of 47.3 cm, while trolling lines recorded an average of 46.0 cm, suggesting moderate size selectivity for these gears (Table 1).

Table 1. The average length of skipjack tuna (*K. pelamis*) in Indonesia by locations.

Fishing grounds	Locations	Gears	Fork length (cm)				
			N	Min	Max	Average	SE
South of Jawa	Binuangeun	Handlines	37,301	20	75	37.16	0.04
		Trolling lines	8,136	20	75	36.85	0.07
	Palabuhanratu	Trolling lines	341	26	50	41.79	0.27
	Cilacap	Gillnets	1,714	24	67	51.30	0.18
		Handlines	16,981	21	75	44.24	0.06
		Longlines	792	30	66	43.79	0.22
	Pacitan	Handlines	6,183	20	66	41.79	0.08
		Lift nets	1,800	20	55	39.57	0.16
		Purse seines	7,556	20	67	38.54	0.07
	Prigi	Purse seines	481	27	74	47.27	0.37
		Trolling lines	8,687	26	75	46.00	0.09
	Labuhan Lombok	Handlines	3,781	18	63	40.68	0.09
		Pole-and-lines	405	33	60	43.78	0.23
West of Sumatra	Lampulo	Handlines	781	19.5	45	31.27	0.14
		Purse seines	10,898	18	63	29.50	0.05
	Sibolga	Lift nets	40	27	47	34.00	0.75
		Purse seines	14,644	18	60	34.66	0.04
	Padang	Lift nets	3,140	18.7	71.9	33.84	0.13
		Trolling lines	78	31	46	35.83	0.41
	Bengkulu	Handlines	2,063	20	64	31.63	0.16
		Lift nets	273	18	46	27.02	0.31
		Longlines	45	23	40	36.49	0.42
		Purse seines	258	19	54	30.25	0.40
		Trolling lines	622	19	54	32.21	0.29
		Total:	**127,000**				

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Appendix 1. Length frequency of skipjack tuna (*K. pelamis*) with free y-axis.