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COMPOSITION, LENGTH-WEIGHT RELATIONSHIP, AND FISHING GROUND OF SHARKS LANDED AT PPS CILACAP, CENTRAL JAVA

Komposisi Jenis, Hubungan Panjang-Berat, dan Daerah Penangkapan Hiu yang Didaratkan di PPS Cilacap

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ABSTRACT

This study was conducted to analyze the catches of sharks, such as composition, length-weight relationship, and to determine the distribution of shark fishing areas. Every fishing activity has by-catch issues. Fishers commonly catch sharks as by-catch. These fishing activities will harm the shark ecosystem in the waters. This research was conducted in March – May 2021 at PPS Cilacap. The results of this study showed that A. superciliosus (paitan shark) was a common catches and its total catch was 1,820 kg. The next common catch was Carcharhinus falciformis and the total catch was 723 kg. The lowest catch was the Carcharhinus sorrah shark (sorrah shark) and its total catch was 16 kg. The growth of Carcharhinus falciformis was negative allometric because b-value <3. Meanwhile, the growth of A. superciliosus is positive allometric because b-value was > 3. Length-weight relationship of Carcharhinus falciformis and A. superciliosus was isometric, which means that the growth between length and weight is balanced. Shark fishing areas are located at coordinates 8º - 15º South and 100º - 111º East. The area of shark fishing is at coordinates 8º - 10º South and 108º - 110º East.

Keywords: *Composition, Length-Weight Relationship*

ABSTRAK

Penelitian ini dilakukan untuk menganalisis hasil tangkapan hiu yaitu komposisi, hubungan panjang-berat, dan mengetahui sebaran daerah penangkapan ikan hiu. Setiap aktivitas penangkapan pasti memperoleh hasil tangkapan sampingan. Salah satu jenis ikan hasil tangkapan sampingan yang tertangkap oleh nelayan di PPS Cilacap adalah ikan hiu. Kondisi ini akan berdampak buruk pada ekosistem hiu di perairan. Penelitian ini dilakukan pada bulan Maret-Mei tahun 2021 di PPS Cilacap. Hasil yang diperoleh dari penelitian ini adalah bahwa komposisi hasil tangkapan yang paling dominan adalah jenis hiu A. superciliosus (hiu paitan), total tangkapannya adalah sebesar 1.820 kg kemudian disusul oleh jenis hiu Carcharhinus falciformis sebanyak 723 kg. Hasil tangkapan terendah adalah hiu Carcharhinus sorrah (hiu sorrah) dengan total tangkapan 16 kg. Pola pertumbuhan ikan hiu Carcharhinus falciformis bersifat allometrik negatif karena terima thitung < ttabel (terima H0) dan nilai b < 3. Sedangkan pola pertumbuhan ikan hiu A. superciliosus bersifat allometrik positif karena thitung < ttabel (Terima H0) dan nilai b > 3. Hubungan panjang berat pada ikan hiu Carcharhinus falciformis dan hiu A. superciliosus memiliki pola pertumbuhan isometrik, artinya pertumbuhan Panjang dan berat ikan seimbang. Daerah penangkapan ikan hiu terdapat pada koordinat 8º − 15º LS dan 100º − 111º BT. Penangkapan ikan hiu paling dominan berada pada koordinat 8º − 10º LS dan 108º − 110º BT.

Kata kunci: Komposisi hasil tangkapan, hubungan panjang berat

INTRODUCTION

Sharks are top predators that have a major impact on the ecology and dynamics of the food chain in coral reefs and epipelagic marine ecosystems. Sharks is one of the major contributors to the rich biodiversity in Southeast Asian Region (Weigmann 2016). Sharks are now overfished, endangering the health of coral reefs and the world's pelagic environment (Sembiring *et al.* 2015). The Oceanic Fishing Port of Cilacap or PPS Cilacap is located at coordinates 109º 01' 18.4" E and 07º 43' 31.2" S. One of the notable catches landed at PPS Cilacap is shark. Sharks are primarily caught by using various fishing gear, including longline, multifilament drift gill nets, bottom set gill nets, bottom longline, drift longline, and tuna longline (Hanifa *et al*. 2018). Shark production from Cilacap contributes 4.7% to the total shark production in Indonesia (Fahmi & Dharmadi 2015).

Initially, sharks were not targeted as main catch, but over time, shark fishing has increased significantly year by year due to the highly market demand for sharks (Novianto *et al*. 2010; Arrum *et al*. 2017). In the early 21st century, Indonesia became the world's largest producer of sharks. Many small-scale traditional fishermen utilize sharks as food source and for high value product materials such as shark skin. However, most of number of sharks are caught as bycatch, particularly for their fins. The distribution of sharks in Indonesian waters includes both deep waters and territorial seas, with around 75 species of sharks present (Alaydrus *et al*. 2014)

Sharks are key predators to control food chain and for maintaining the balance of marine ecosystems. They are also classified as one of the oldest fish species in the world. Sharks have long life cycle to reach adult and their capability to reproduce is very low. They become factors of sharks fishing. Many sharks are also caught accidentally and thrown back into the ocean (Hidawati *et al*. 2020).

The official FAO statistics conservatively estimate the average annual value of global shark fin imports at $377.9 millions from 2000 to 2011, with average annual imports volume of 16.815 tons (Dent & Clarke 2015). In Indonesia, approximately 72% of sharks are caught as bycatch, and with only 28% being the primary fishing target (Emiliya *et al*. 2016). Currently, shark population in Indonesia are declining. Many sharks species are critically endangered, primarily because they are heavily hunted for their fins, which fetch high market prices (Sukmaningrum *et al*. 2022). Life history traits of shark species can differ between conspecific populations, reflecting varying population dynamics and resilie (Rigby & Simpfendorfer 2015).

The dominant shark species frequently caught in the Indian Ocean waters from the south of Java are *Alopias superciliosus* and *Alopias pelagicus* (Hanifa *et al*. 2018). Whereas there are 14 species of sharks that landed in PPS Cilacap (Bhagawati *et al*. 2017). The shark fishing ground based on the type of the vessel fishing gear are as follows, tuna longline vessels operate at coordinates 7°–14° S and 103°–109° E, shark longline vessels at 7°–14° S and 108° E, bottom gillnet vessels at 7°–10° S and 106°–109° E, and drift gillnet vessels at 7°–12° S and 107°–104° E (Prihatiningsih *et al*. 2018). One of region with high shark diversity is PPS Cilacap, where 32 sharks species have been recorded in this area (Dharmadi *et al*. 2009). A study by Setiawan and Nugroho (2015) noted that the dominant shark species caught at PPS Cilacap are *A. superciliosus* (17.45%), *A. pelagicus* (20.33%), and *Carcharinus sorrah* (20.19%). Landed sharks at PPS Cilacap are generally caught from the Indian Ocean using tuna gillnets (Widodo & Mahulette 2012). Shark fishing activities in this area are quite intense, with *Alopias pelagicus* and *A. superciliosus* constituting approximately 59.4-70.2% and 9.7-21.7% respectively of the total shark catch by gillnet. This activity gradually impacts shark resources and availability in these waters.

A study conducted in 2018 by Muslim *et al*. (2019) revealed that a significant portion of the shark catch in Cilacap consists of immature individuals, as most of the sharks found had not yet reached gonadal maturity. This is because the fishing ground for *Alopias pelagicus* and *A. superciliosus* are located near nursery ground, making them easily caught with nets in relatively shallow waters. Recent studies specifically addressing species composition, length-weight relationship, and fishing ground of sharks landed at PPS Cilacap are still not available.

Further research is needed by monitoring shark catches continuously to ensure they are systematically recorded in shark catch statistics. The aim of this study is to assess the species of sharks caught, as well as the development and growth patterns of sharks landed at PPS Cilacap, in order to obtain up-to-date information on shark resources. The output of this analysis is to support shark fishery management policies, helping to prevent overfishing activities.

METHODS

This research was conducted from 1st March to 31st May 2021, at the Oceanic Fishing Port of Cilacap. Sampling of fishing vessels were conducted at this period. The fishing ground were determined through interviews with ship captains based on Global Positioning System (GPS) data. Shark data were collected using three types of fishing gear: longline, hand line, and gillnet. The gillnet fishing ground were located at coordinates 8º - 10º S and 108º - 110º E. The hand line fishing ground were at coordinates 8º - 12º S and 107º - 110º E. The longline fishing ground were at coordinates 8º - 10º S and 107º - 109º E.

Shark identification was carried out through direct field observation. The sharks measured were all caught from 23 fishing vessels, including 3 gillnet vessels, 11 handline vessels, and 9 longline vessels. These fishing vessels landed during data sampling period. The numbers of each gillnet, handline, and longline fishing vessels were 36 units, 83 units, and 122 units. The numbers of each individual sharks of Gillnet, handline, and longline were 11 ind, 73 ind, and 33 ind. Total individual of sharks were 117 ind. These Individual sharks were all obtained from bycatch that caught on fishing vessel. Afterward, the sharks were measured and weighed to obtain data on their length and weight. The sharks were then photographed and compared with a shark identification guidebook. Shark length was measured using a measuring tape in centimeters (cm), employing the technique of measuring the total length from the tip of the snout to the tip of the edgest tail fin. The weight of the sharks was measured in kilograms (kg).

Species Composition

The species composition of the catch was analyzed using the formula provided by Krebs (1989), as follows:

Species composition $= \frac{ni}{Ni}\ x\ 100\%$..............(1)

With:
n_i is the number of a specific fish species
N_i is the total number of all catches

Fish Length Frequency

This analysis is conducted to determine the distribution/frequency of the lengths of the captured sharks. The fish length measurement data are tabulated and analyzed descriptively. The frequency of fish length class intervals is calculated using the frequency distribution formula as follows:

K = 1 + 3,33 Log n..(2)

i = $\frac{N\max - N\,min}{K}$..(3)

with:
K = Total of classes
n = Amount of classes
i = Class interval
N max = Highest score
N min = Lowest score

Length-Weight Relationship

According to aquatic biology, the length-weight relationship of fish provides additional information for the management of aquatic resources (Nurhayati *et al*. 2016). The analysis of the length-weight relationship, through the measurement of length and weight, follows the formula given by Derobert & William (2008):

$W = aL^b$..(4)

with:
W = Weight (kg)
a = Constant
L = Lenght (cm)
B = Regression coefficient

The above formula determines the growth pattern or the length-weight b value of sharks, with the following interpretations for the b b value :

1. If b = 3, the growth is isometric, meaning the length growth is propotional to the weigth growth
2. If b > 3, the growth is positively allometric, meaning the weight growth is faster than the length growth
3. If b < 3, the growth is negatively allometric, meaning the length growth is faster than the weigth growth

The determination of wheter b = 3 or b ≠ 3 is conducted using a t-test (partial test) according to (Steell & Torrie 1989) with the foolowing equation below :

$$t = \frac{3-b}{\mathrm{Se}} \quad (5)$$

with:

t : Score of calculated t
b : Constant from the length-weight relationship
SE : Standar of error from the pameter estimation
3 : Hypothesized parameter score of 3

The decision making for the t-test result on the b score of the length-weight relationship with 95% confidence interval (α=0.05) is as follows:

If $t_{calculated} < t_{table}$, Accept the null hypothesis (H_0)

If $t_{calculated} > t_{table}$, Reject the null hypothesis (H_0)

RESULT

Cath Composition

Based on the shark catch data collected over two months, from 1st March to 30th April 2021, total of 117 sharks were caught, consisting of 7 species. The production of shark catches during the data collection period is presented in Table 1.

The species of sharks listed in Table 1 show similar behavior, living habits, and distribution areas, facilitating the fishermen in selecting the appropriate fishing gear and methods. The differences in body structure among the seven shark species in this study are illustrated in Figure 1.

The dominant catch composition by species and weight was the bigeye thresher shark (*Alopias superciliosus*), with a total catch weight of 1.820 kg (61.31%). However, the species with the highest number of individuals caught was the silky shark (*Carcharhinus falciformis*), with 66 individuals (56,41%). The lowest catch composition was the spottail shark (*Carcharhinus sorrah*), with a total catch weight of 16 kg (0.54%). The composition of the shark catch is detailed in Figure 2.

Length Distribution

Observations conducted from March to April 2021 showed that the most frequently caught sharks were the silky shark (*Carcharhinus falciformis*) and the bigeye thresher shark (*Alopias superciliosus*). The silky shark (*Carcharhinus falciformis*) had a total catch of 66 individuals, with a total range of length (TL) from 60 to 212 cm TL. The shortest *Carcharhinus falciformis* individual measured 60 cm, while the largest was 212 cm.

The bigeye thresher shark (*A. superciliosus*) was caught in a total of 41 individuals, with range of total length (TL) from 166 to 315 cmTL. The length distribution was dominated by individuals measuring 266 to 290 cmTL. The smallest individual measured 166 cmTL, while the largest was 311 cmTL.

Table 1 Shark catch production

NO	Local Name	English Name	Scientific Name	Weight (kg)	FAO Code	Σ amount
1	Sorah Shark	Spot-Tail Shark	*Carcharhinus sorrah*	16	CCQ	2
2	Moro Shark	Shortfin Mako	*Isurus oxyrinchus*	55	SMA	1
3	Buas Shark	Bull Shark	*Carcharhinus leucas*	81	CCE	1
4	Tikusan Shark	Pelagic Thresher	*Alopias pelagicus*	120	PTH	2
5	Selendang Shark	Blue Shark	*Prionace glauca*	154	BSH	4
6	Lanjaman Shark	Silky Shark	*Carcharhinus falciformis*	723	FAL	66
7	Paitan Shark	Bigeye Thresher	*Alopias superciliosus*	1820	BTH	41

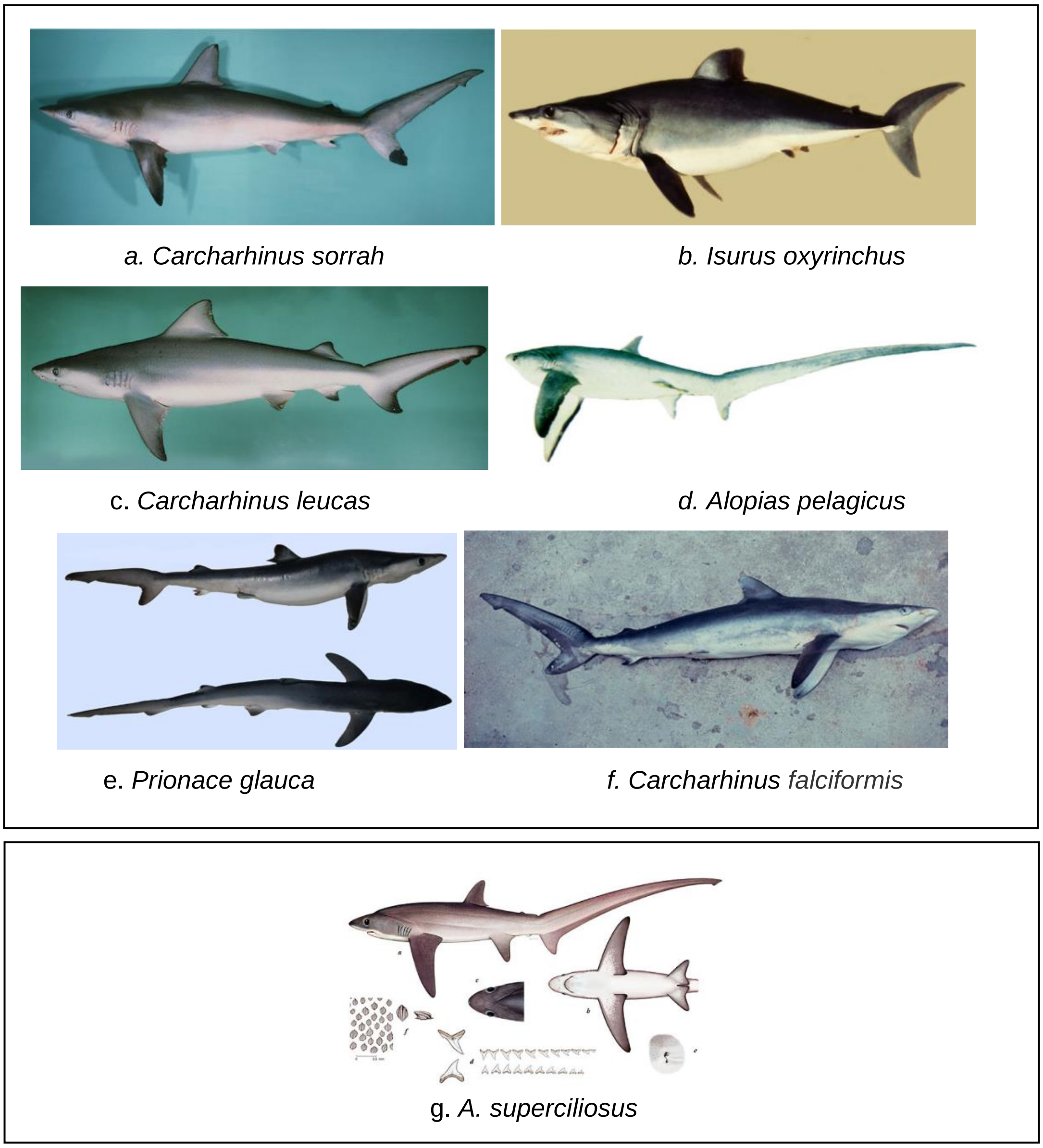

Figure 1 Shark Species Landed at PPS Cilacap

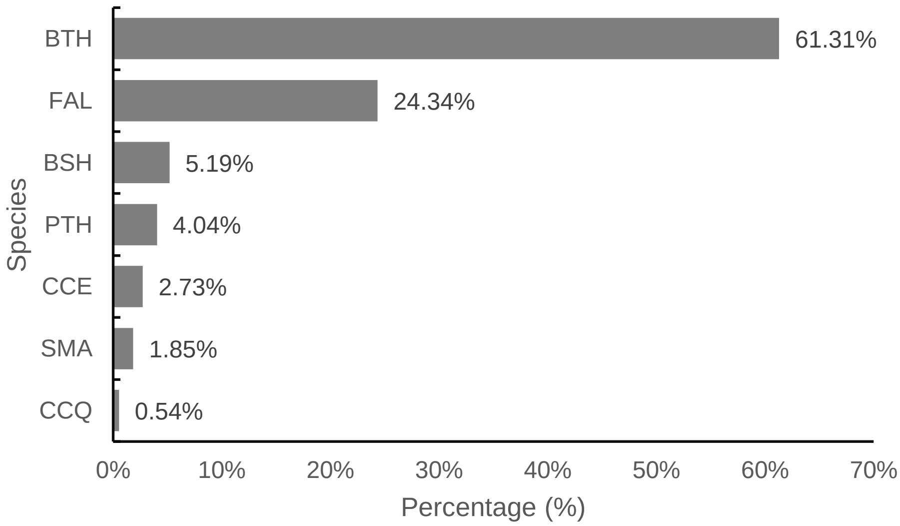

Figure 2 Catch Composition (1st March to 30th April 2021)

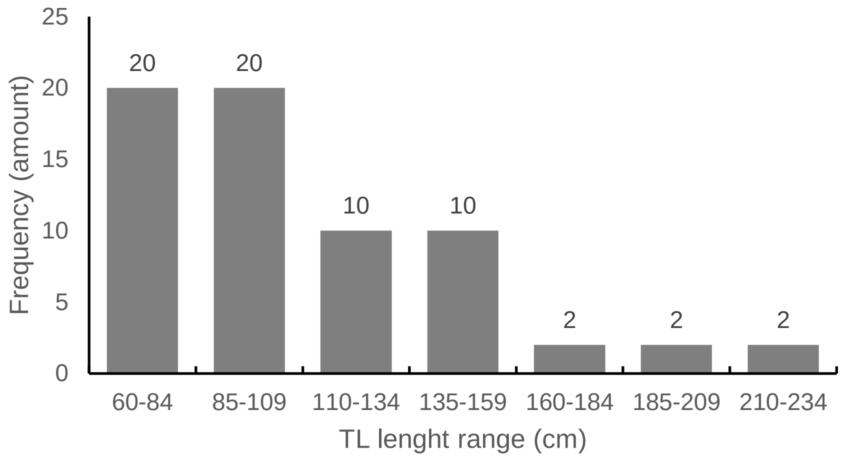

Figure 3 Length Distribution Chart of Carcharhinus falciformis

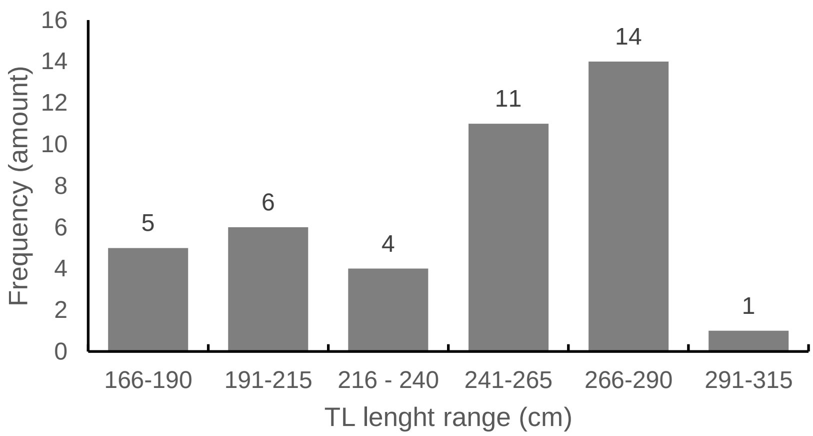

Figure 4 Length Distribution of A. superciliosus

Length-Weight Relationship

The length-weight relationship of sharks provides valuable information regarding their growth patterns. This analysis was conducted on the silky shark (*Carcharhinus falciformis*) and the bigeye thresher shark (*Alopias superciliosus*) landed at the Cilacap Oceanic Fishing Port. A total of 66 silky sharks (*Carcharhinus falciformis*) were measured during the period of March – April 2021, with length ranges of 50–178 cmTL and weight ranges of 1.5 – 55 kg. The analysis yielded the length-weight relationship equation for silky sharks (*Carcharhinus falciformis*) as $W = 0.0192L^{2.7639}$, with a b = 2,7639 and an R^2 = 0,9864. The R^2 value of 0,9864 indicates a very high correlation in the length-weight relationship. Based on the t-test results with a 95% confidence interval, the score of $t_{calculated}$ = -0.55, and the t_{table} = 2.0 The data analysis results show that the $t_{calculated} < t_{table}$ and b < 3. Therefore, the decision is to accept H0, indicating that the growth pattern of the silky shark (*Carcharhinus falciformis*) is negative allometric. This shark species is listed in Appendix II of the CITES Red List (Sentosa & Hedianto 2017). However, the management of this species is not yet regulated by official regulations in Indonesia but is listed as "near threatened" (Nurastri & Marasabessy 2021). The draft recommendation for the wild capture quota is still not finalized, waiting for the final results of the Non-Detriment Findings (NDF) document preparation.

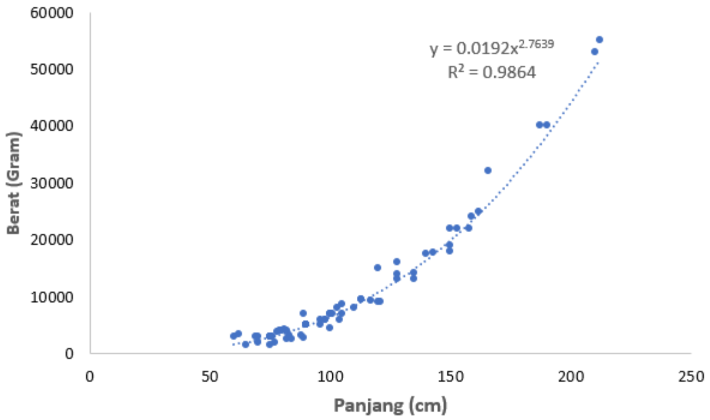

Figure 5 Length-Weight Relationship Curve of Carcharhinus falciformis

A total of 41 pelagic thresher sharks (*Alopias superciliosus*) were measured during the period from March to April 2021, with length range of 98 to 191 cmFL and weight range of 12 to 114 kg. The results of the analysis obtained through the length-weight relationship equation for pelagic thresher sharks (*Alopias superciliosus*) is W = $0.00104L^{3.176}$, with b = 3.175971 and R^2 = 0,90525. The R^2 = 0,90525 indicates a very strong correlation in the length-weight relationship. Based on the t-test results with a 95% confidence interval, the score of $t_{calculated}$ = 0.198568 and score of t_{tablel} = 2.022691. Since tcalculated < ttable and value of b > 3, the conclusion from the data analysis is to accept H0, indicating that the growth pattern of the pelagic thresher shark (Alopias superciliosus) exhibits positive allometric growth.

Fishing Ground

Based on primary and secondary data on the distribution of shark fishing ground during March - April 2021, the distribution of shark fishing ground was found to be at coordinates 8º - 15º S and 100º - 111º E, with the highest concentration of shark catches at coordinates 8º - 10º S and 108º - 110º E (Figure 6). The shark catch distribution map presented in Figure 6 shows that the waters that serve as the shark fishing locations in this study are the southern Java waters of Indian Ocean. As it can be seen in map, the fishing locations at that areas have many fishing activities and also near to land area. It can cause heavily exploitation. Areas closer to human settlements, where fishing activity is more intense, often experience higher rates of shark mortality. Marine reserves, on the other hand, provide safe havens for sharks, allowing their populations to recover (Clementi *et al*. 2021). The exploitation of juvenile sharks is a widespread problem in Southeast Asia region. These young sharks are often caught unintentionally as bycatch in trawl fisheries, which use large nets to sweep the ocean floor for fish (Ali *et al.* 2018).

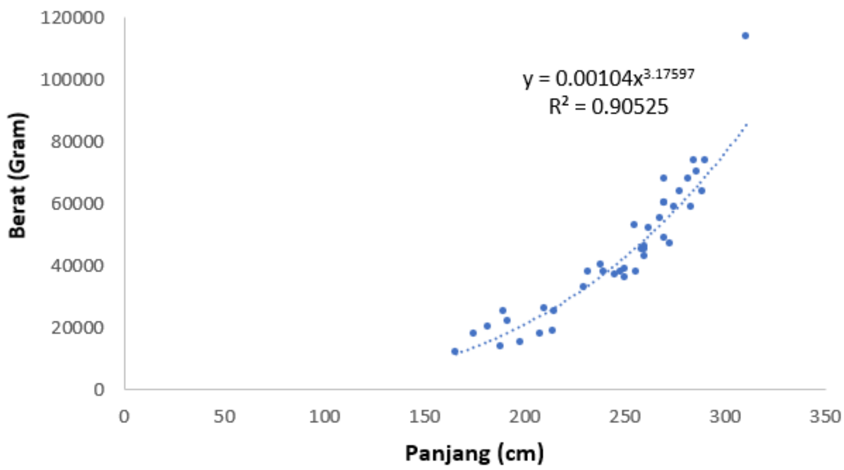

Figure 6 Length-Weight Relationship Curve of A. superciliosus

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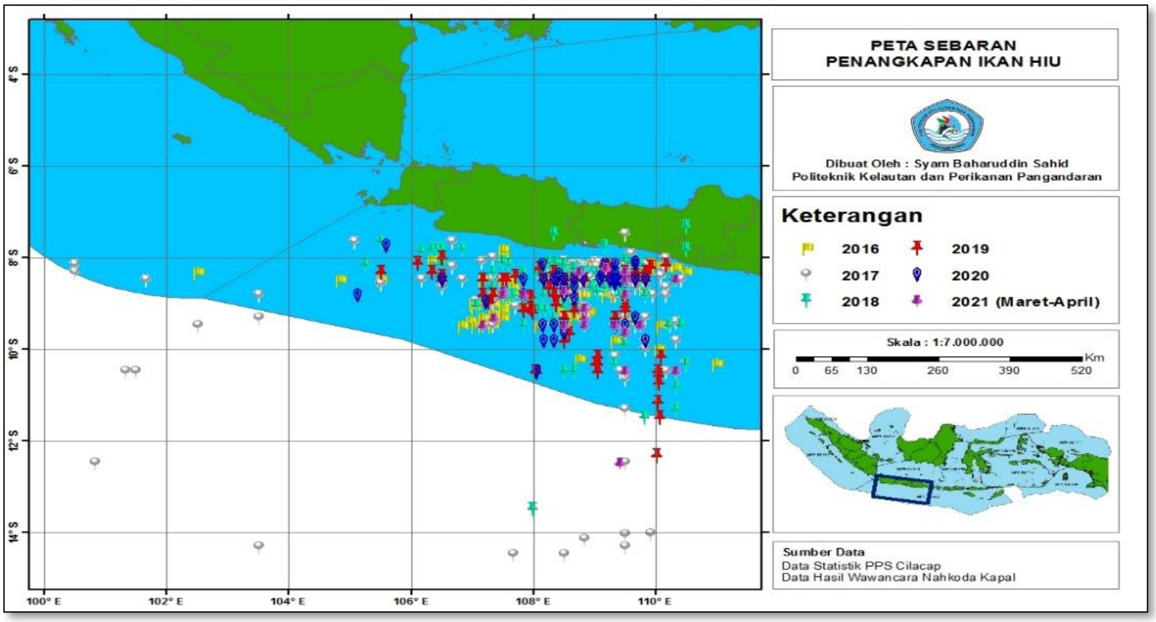

Figure 7 Map of Shark Catch Distribution

DISCUSSION

The research conducted from March to April 2023, 7 species of sharks were captured at the PPS Cilacap (Table 1). The fishing ground were in the southern Java waters of Indian Ocean. Thresher sharks (*Alopias superciliosus*) and silky sharks (*Carcharhinus falciformis*) were the most frequently caught species during this study. It's diffrent from Prihatiningsih *et al*. (2018) reported that 16 species of sharks were caught in the southern Indian Ocean waters off Java and landed at PPS Cilacap between 2006 and 2016, while 18 species were caught in the same area and landed at Tanjung Luar, Lombok (Sentosa *et al*. 2016).

Dharmadi *et al*. (2009) reported the presence of 27 species of sharks in the southern Indonesian waters which landed at various locations such as Palabuhanratu, Cilacap, Kedonganan, Tanjung Luar, Kupang, and Merauke. Furthermore Dharmadi *et al*. (2015) also documented that a total of 25 families and 118 species of sharks have been identified in Indonesian waters. This highlights the Indonesia vast marine area and its rich marine natural resources, making it one of the countries with a high diversity of shark populations (White *et al*. 2006). Arrum *et al*. (2017) observed that nine species of sharks landed at the PPS Cilacap, including *Galeocerdo cuvier, Isurus oxyrinchus, Isurus paucus, Prionace glauca, Carcharhinus plumbeus, Carcharhinus falciformis, Sphyrna lewini, Alopias superciliosus, and Alopias pelagicus*.

Based on several studies, the evident clearly tell that the majority of shark species landed at PPS Cilacap, particularly from the Indian Ocean fishing grounds, are the silky shark (*Carcharhinus falciformis*) and the bigeye thresher shark (*Alopias superciliosus*). This is further supported by research findings from several researchers. Arrum *et al.* (2017), and Widodo & Mahulette (2012) reported that the species composition of sharks in the Indian Ocean mainly includes the pelagic thresher shark (*Alopias pelagicus*) and the bigeye thresher shark (*Alopias superciliosus*). Sentosa *et al*. (2016) and Dharmadi & Kasim (2010) stated that the silky shark and the pelagic thresher shark are more dominant in the surrounding waters (WPP 573), and consequently, the bigeye thresher shark and the silky shark are predominantly landed at TPI PPS Cilacap.

The most frequently caught sharks in this study were the silky shark (*Carcharhinus falciformis*) and the bigeye thresher shark (*Alopias superciliosus*). These species are large pelagic fish that are distributed in tropical to subtropical waters. The shark fishing occurred from March to April, which marks the end of the western monsoon season and the beginning of the transitional season. During this period, high rainfall and strong winds create abundant food sources, which are utilized by fish, including sharks. The bigeye thresher shark (*A. superciliosus*) is commonly found because it inhabits depths from the surface down to 152 meters (Compagno 2002). The silky shark (*Carcharhinus falciformis*) is generally found in offshore waters near the coast and at the surface, although it can occasionally be found at depths up to 500 meters (White *et al*. 2006).

The length distribution graph for the silky shark (Carcharhinus falciformis) indicates that this species is predominantly captured in the size ranges of 60-84 cmTL and 85-109 cmTL, with 20 individuals caught in each range. The least captured sizes were in the ranges of 160-184 cmTL, 185-209 cmTL, and 210-234 cmTL, with only 2 individuals each. The silky shark reaches maturity at a length of 183-204 cmTL for males and 216-223 cmTL for females (White *et al*. 2006). However, according to www.fishbase.se, the length at maturity for this species caught in Indonesian waters is above 219.5 cm TL. Therefore, many of the silky sharks caught are below the length of maturity.

The bigeye thresher shark (*Alopias superciliosus*) reaches maturity at a length of 276 cm for males and 341 cm for females (Sentosa and Hedianto 2017). According to www.fishbase.se, this species reaches maturity at 154,5 cmTL for males and 169,5 cmTL for females found in China waters. Based on the graph shown in Figure 3, many of the bigeye thresher sharks that caught in Cilacap Waters were at unmature size.

The length-weight relationship in the silky shark (*Carcharhinus falciformis*) and the bigeye thresher shark (*Alopias superciliosus*) follows an isometric growth pattern. Isometric growth indicates a balance between fish weight and length increase (Nurhayati *et al*. 2016). This is evidenced by the R^2 values of 0,9864 for the silky shark (*Carcharhinus falciformis*) and 0,90525 for the bigeye thresher shark (*Alopias superciliosus*), demonstrating a strong correlation between length and weight in these sharks (Nurhayati *et al*. 2016). Generally, changes in body weight and shape during fish growth result in non-isometric growth patterns (Nair *et al*. 2015). In this context, the growth pattern of fish is determined by the value of 'b.' Variations in the 'b' value largely reflect changes in body shape influenced by environmental factors such as temperature, food supply, spawning conditions, and other factors like sex, age, capture time and location, and fishing vessel (Ricker 1973).

Research by Chodrijah *et al*. (2021) in the southern Indian Ocean off Java found that the bigeye thresher shark (*Alopias superciliosus*) exhibited positive allometric growth in females, where weight increase was greater than length growth, and isometric growth in males, where length and weight growth were proportional. Conversely, Caesar *et al*. (2018) found negative allometric growth in the silky shark (*Carcharhinus falciformis*) at Muncar Fisheries Port, Banyuwangi. In contrast, Sentosa (2017) reported negative allometric growth for bigeye thresher sharks (*A. superciliosus*) landed at Tanjung Luar, East Lombok. These discrepancies in growth patterns can be attributed to various internal and external factors, such as physiological condition, genetics, sex, age, parasites, or disease (Jennings *et al*. 2001). Froese (2006) further added that external factors, including environmental conditions like temperature, pH, salinity, geographic location, and biological conditions like gonad development and food availability, also play significant roles.

The map presented in Figure 6 illustrates shark fishing ground in WPP RI 573 (southern Indian Ocean of Java). The map shows shark catch points located south of Java, with catches landed at PPS Cilacap. The dominant shark species caught are *Carcharhinus falciformis and A. superciliosus.* Most *Carcharhinidae,* specifically *Carcharhinus falciformis*, are long-distance migratory species that live individually. They inhabit continental and island slopes, reefs, and open seas (Dharmadi *et al*. 2009). These species are often found in offshore waters near the coast and the surface (White *et al*. 2006). Shark fishing areas for *Alopias spp*. in this study are located on 8°-10°S and 107°-112°E. Other studies indicate that sharks caught by Cilacap fishermen generally use tuna longlines and gillnets at coordinates 8°-13°S and 106°-111.3°E (Fahmi & Dharmadi 2015).

The type of fishing gear used significantly affects the size composition of the catch. More selective gear, like gillnets with specific mesh sizes, can only catch fish of certain types and sizes depending on the target species (Sentosa & Haryadi 2018). However, Zainudin *et al.* (2017) noted that sharks were the most species that frequently captured in Indonesian Longline tuna fishery incidentally.

In several regions of Indonesia, sharks are targeted as main catch, using drift longlines and bottom longlines (Triyono *et al*.

2020). Shark species like *Carcharhinus falciformis, Alopias pelagicus, Carcharhinus amblyrhynchos, Prionace glauca*, and Sphyrna lewini are predominantly caught using longlines, accounting for 62% of pelagic fisheries catches (Dharmadi *et al*. 2009).

Based on the results of this analysis and research, a large number of sharks caught are sharks that have not reached mature size, while sharks are a species that takes a long time to mature. For example, *Carcharinus* sp were aged to a maximum of 18 years for females and 17 years for males through vertebral band counts, providing the oldest age estimation to date (D'Alberto *et al* 2017). In general, sharks can reproduce after 2 years of becoming adults with a number of jouvenil around 1 to 40 individuals, meaning that the fertility rate of sharks is still relatively low. If many jouvenil sharks are still caught by fishers and reproduction rate are low, these population will be increasingly difficult to develop. The decline in the shark population will result in changes in the food chain. Therefore, sharks that become bycatch should be released back into the waters so that the sustainability ecosystem can be maintained. This can be a reference for policy makers to re-formulate regulations related to shark fishing activities, regulating the number of shark catches, and important habitats for sharks. This includes managing the challenges that arise through strategies, population recovery, and human integration. Activities for shark protection must be carried out massively by providing education related to regulations to fishers in carrying out fishing activities.

CONCLUSION

The dominant species in the catch composition was *Alopias superciliosus* (Bigeye Thresher Shark) with a total shark catch weight of 1.820 kg. The least abundant species was *Carcharhinus sorrah* (Spot-tail Shark) with total shark catch weight of 16 kg.

The length-weight relationship for *Carcharhinus falciformis* (Silky Shark) was negative allometric, with the T-test accepting H0, while for *Alopias superciliosus*, it was positive allometric, with the T-test also accepting H0.

The distribution of shark fishing areas ranged from 8º S to 15º S and 100º E to 111º E, with the most dominant shark fishing occurring between 8º S to 10º S and 108º to 110º E.

RECOMMENDATION

There is a need to enhance the prohibition of fishing endangered sharks by regulating shark protection through regulation. The endangerment of sharks is mainly due to high fishing activity from fishers and the highly lucrative market for shark fins. Further studies are required on migration areas, feeding patterns, nursery habitats, and a reassessment of the shark fishery status in Indonesia.

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