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Case study of shark fishing which requires more serious attention to the possibility of its sustainability as a top trophic level organism in aquatic ecosystems

Muhammad Zainuri[1*], Irsyad Maulana Azzahir[2], Khaizuran Maziz Dhiyaulhaq[3]
[1,2,3]Program Studi Manajemen Sumberdaya Perairan, Universitas Trunojoyo Madura, Indonesia; zainborn@rocketmail.com (M.Z.)

Abstract: The purpose of this study was to determine the number, species, distribution of body length, and sex ratio. Data were collected from the Fish Production Statistics Report at the Muncar-Banyuwangi Coastal Fishing Port (2008-2022) and the Fish Production Report in Lamongan Regency (2019-2023), as well as sampling data from December 2022 to January 2023 and January to February 2024 at the Brondong Nusantara Fishing Port, Lamongan. The data were analyzed descriptively and quantitatively. The results of the study showed that shark production fluctuated and reached around 1,000 tons per year. The results of data analysis based on sampling showed that there were eight species of sharks caught, four species or 50% of which were protected sharks and listed in the Appendix (CITES II), namely the Hiu Martil (Sphyrna lewini), Hiu Lanjaman (Carcharhinus dusumieri), Hiu Karang Sirip Hitam (Carcharhinus melanopterus), and Hiu Tikus (Alopias pelagicus). Even the Hiu Martil is classified as critically endangered (CR). While other species of sharks are classified as Near Threatened (NTT). Based on their body length, most of the catches are still classified as immature. The sex ratio is known to be close to 1 (male) to 1 (female). Considering the sustainability of sharks and that some of the species caught are classified as protected by law, shark management in Indonesia should be taken more seriously to gain attention.

Keywords: *Body length distribution, Fecundity, Sex ratio, Shark.*

1. Introduction

Sharks are biota that play an important role in the food chain because sharks are top predators in the sea, but shark hunting is still often carried out by fishermen because the selling value of shark fins is quite high, so that they ignore their conservation status [1]. There are also sharks as part of bycatch. So, the rate of shark capture has increased along with the high market demand in recent years [2]. Sharks are widely caught because almost all parts of the shark's body can be used as raw materials of high quality and economic value such as meat as food, skin as accessories and clothing, shark oil as a pharmaceutical ingredient, and teeth and bones can be used [3]. Sharks as part of bycatch from cantrang (like trawl) fishing gear, gillnets and angling.

Shark is a capture fishery commodity that increases every year. The Directorate General of Capture Fisheries of Indonesia [4] showed that shark fishing increased by 6%, especially in the Java Sea fishing area [5]. Sharks landed at PPN Brondong are classified as by-catch with a fairly high catch rate. Sharks at Brondong Nusantara Fisheries Port are utilized by auctioning meat and fins, and certain types are utilized for their skin [6].

Shark utilization and fishing activities are regulated in government policy in PERMEN-KP no. 5 of 2018 and PERMEN No. 61/PERMEN-KP/2018 concerning the utilization of protected fish species and/or fish species listed in the CITES Appendix. The capture of sharks both as targets of fishing and

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* Correspondence: zainborn@rocketmail.com

bycatch is very worrying, namely it can cause a decline in its population, while data collection for shark fishing is not carried out seriously by the relevant parties [5]. As is known, shark fecundity is very low so it is very vulnerable to excessive exploitation. The purpose of this study was to determine the production, species, distribution of body length and sex ratio of sharks.

2. Data and Methodology

This research was conducted in December 2022-January 2023, May 2023, and January 8-February 7, 2024. This research was conducted at the Brondong Nusantara Fishing Port (PPN) and the Muncar-Banyuwangi Coastal Fishing Port.

2.1. Research Methods

1. Shark production data used is secondary data from Muncar-Banyuwangi Coastal Fishing Port, from 2028 to 2022 and from the Lamongan Fishery Office from 2019 to 2023

2. Data on the species, body length, and sex ratio used is primary data collected from December 2022-January 2023, and January 8-February 7, 2024 by means of a direct survey at the Brondong Nusantara Fishing Port (PPN).

2.2. Data Analysis is Carried Out by

1. Production is described quantitatively descriptively in the form of graphs
2. Identifying to find out the species of shark by referring to the Introduction to Shark species in Indonesia [7].
3. Distribution of body length, namely measuring the total body length (TL) from sample samples based on Anjayanti, et al. [8].

Data range (J) = Maximum data – Minimum data

Calculating the interval (K) based on Parluhutan and Imaniar [9]:
K = 1 + 3.32 (log n)
Where: K = Number of classes
n = number of individual sharks per species

Determining the length of the class interval (C):
C = J/K

4. Analyze the sex ratio by comparing the number of male sharks with female sharks based on Chodrijah, et al. [10]. Identification of sex is based on the Shark and Ray Fisheries Data Collection Guidelines [11].

NK = Nbi/Nji
Description,
NK = Sex ratio
Nbi = Number of female fish in group i
Nji = Number of male fish in group i

3. Results and Discussion

3.1. Shark Catches

Figure 1 shows the catch of sharks landed at the Muncar-Banyuwangi Coastal Fishing Port for 15 years.

Sharks caught and landed at Muncar-Banyuwangi Fishing Port are fish that are indeed the target of fishing, while those caught at Lamongan Nusantara Fishing Port are bycatch from trawl-type fishing

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gear or better known as "cantrang". In Muncar-Banyuwangi, it is known that shark catches have fluctuated from 2008 - 2022, the highest reaching around 300 tons per year (Figure 1).

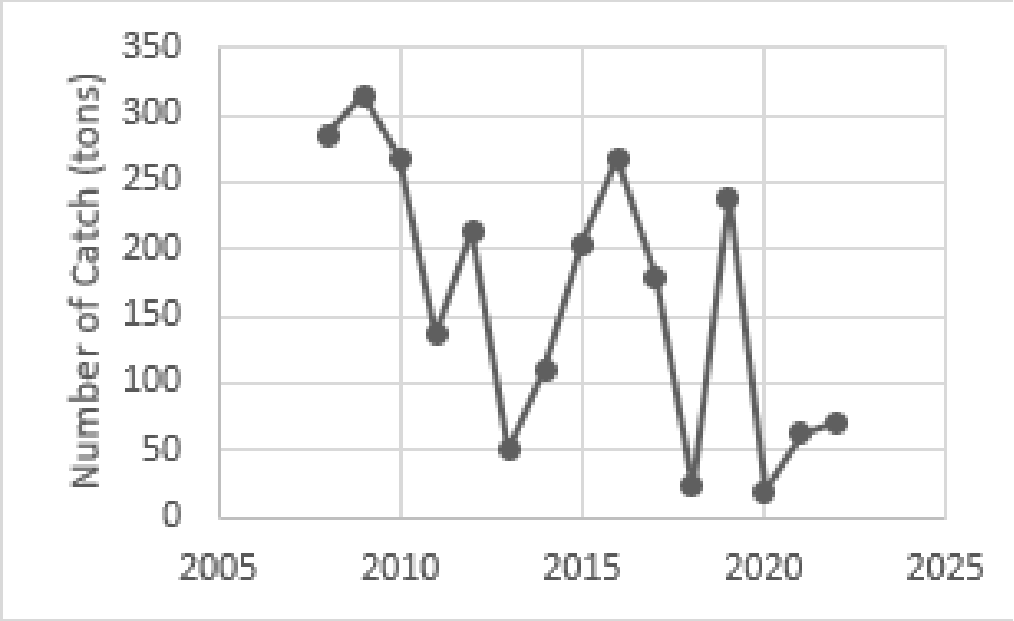

Figure 1.
Shark catches at Muncar Coastal Fishing Port (2008-2022).
Source: Muncar Coastal Fishing Port (2023)

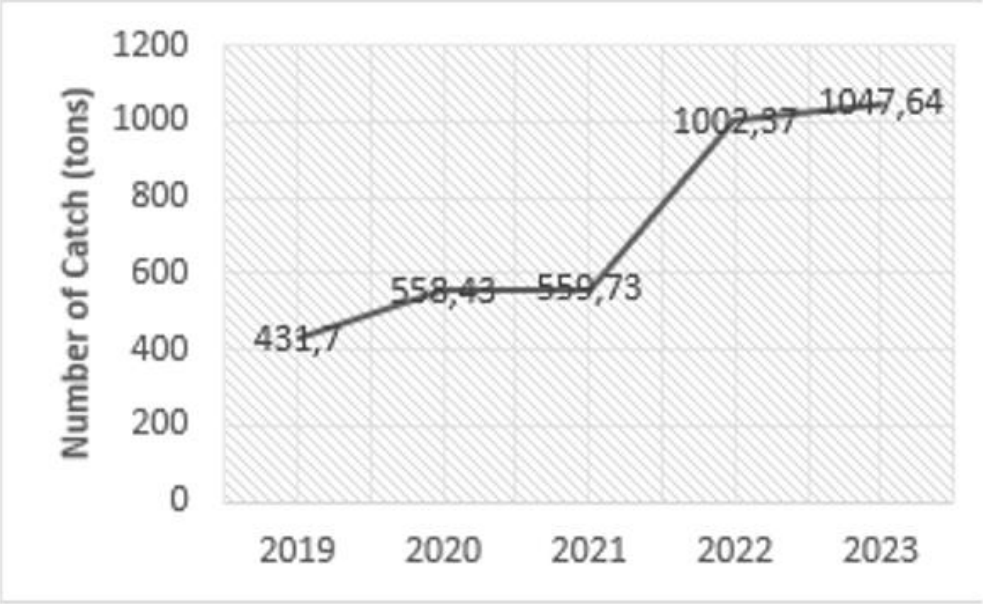

Figure 2.
Shark catches at Samudera Lamongan Fisheries Port (2019-2023).
Source: Lamongan Fisheries Service (2024)

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However, statistically it can be said that the trend of catch results shows a decline. The condition of the results can be suspected to be caused by the decreasing population of sharks in the fishing area, or the decreasing effectiveness of fishing. Meanwhile, in Lamongan, shark shows catches has increased from 2019 - 2023 with the highest production reaching around 1,000 tons per year (Figure 2). The high catches of sharks is thought to be due to the fact that the "cantrang" fishing gear is very effective in caught bycatch in the form of sharks. The "cantrang" fishing gear based on the Ministerial Decree No. 6: 2010 concerning types of fishing gear in the Territory of the Republic of Indonesia number II is included in the group of seine nets fishing gear.

3.2. Species of Shark

The number of samples used in this study was 561. The identification results showed that the species of sharks caught consisted of 8 species, namely Hiu Martil (Sphyrna lewini), Hiu Lanjaman (Carcharhinus dusumieri), Hiu Bambu Coklat (Chiloscillium punctatum), Hiu Bambu (Chiloscillium plagiosum), Hiu Tokek (Atelomicterus marmoratus), Hiu Karang Sirip Hitam (Carcharhinus melanopterus), Hiu Macan (Galeocerdo cuvier) dan Hiu Tikus (Alopias pelagicus) (Figure 3).

iu Martil (Sphyrna lewini)

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Hiu Lanjaman (Carcharhinus dusumieri).

Hiu Bambu Coklat (Chiloscillium punctatum)

Hiu Bambu (Chiloscillium plagiosum)

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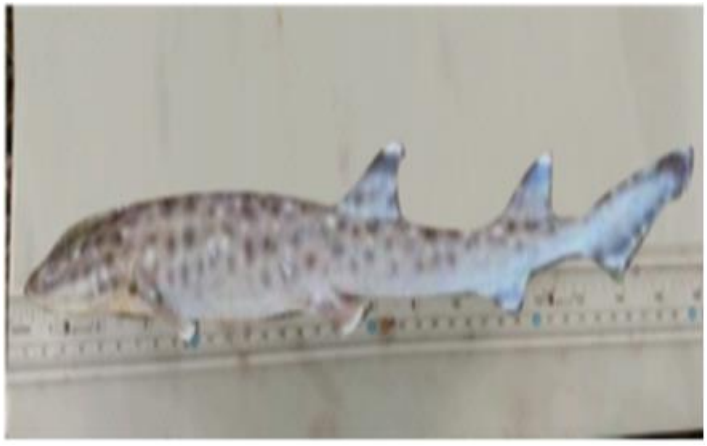

Hiu Tokek (Atelomicterus marmoratus)

Hiu Karang Sirip Hitam (Carcharhinus melanopterus)

Hiu Macan (Galeocerdo cuvier)

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Hiu Tikus (Alopias pelagicus)

Figure 3.

Species of sharks landed at Samudera Lamongan Fishing Port (January-February 2024).

Of the 8 types of sharks caught, it is known that 4 types or 50% are protected shark types and are listed in Appendix (CITES II), namely Hiu Martil (Sphyrna lewini), Hiu Lanjaman (Carcharhinus dusumieri), Hiu Karang Sirip Hitam (Carcharhinus melanopterus), dan Hiu Tikus (Alopias pelagicus) (Gambar 3), even Hiu Martil are classified as critically endangered (CR). While other species of Sharks are classified as Near Threatened (NTT). These results indicate that prevention of the possibility of preserving Shark resources is very weak and worrying or even less noticed as shown in the production report both in Muncar and in Brondong, no mention of the species of Sharks recorded. Therefore, it should be a concern because the loss of sharks in the marine ecosystem can affect the balance of the ecosystem itself. Specifically, for Hiu Martil (Sphyrna lewini) the Indonesian government issued a link, namely PERMEN-KP no. 5 of 2018 article 2 paragraph 1 concerning the prohibition of exporting Hiu Martil and their processed products outside the territory of the Republic of Indonesia and PERMEN-KP No. 61.

3.3. Distribution of Shark Body Length

3.3.1. Hiu Martil (Sphyrna lewini)

The distribution of the length of the Hiu Martil in Figure 4 is in the range of 42-140 cm, the largest is in the range of 53-63 cm with 68 males and 70 females and the smallest number is in the range of 119-129 cm with 1 male. The average body length of the Hiu Martil (Sphyrna lewini) is relatively smaller when compared to the results of the study by Sentosa, et al. [12] in the Indian Ocean waters, which is in the range of 39 - 316.8 cm.

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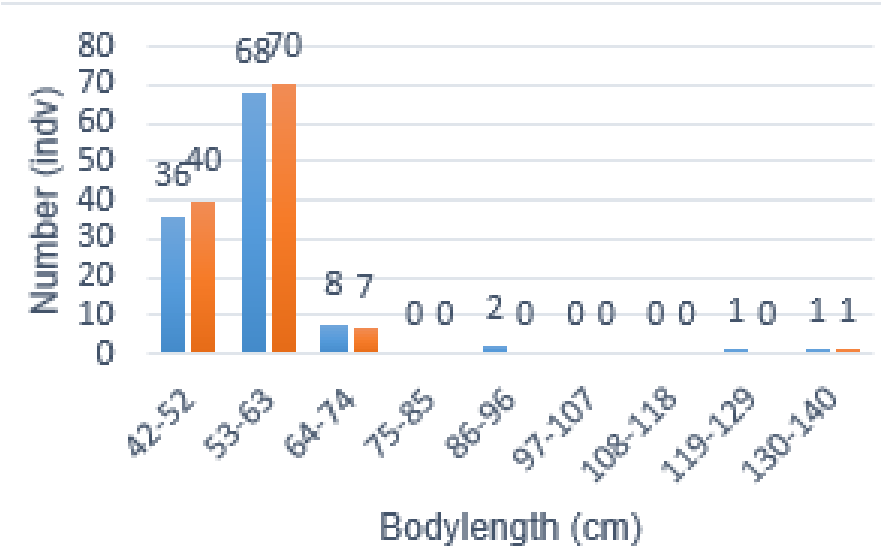

Figure 4.
Distribution of Body Length of the Hiu Martil (Sphyrna lewini) (Male; Female).

The small size of the Hiu Martil landed in Brondong-Lamongan are classified as not having reached maturity or not being ready for the recruitment process. Based on Fahmi and Dharmadi [7] in Alaudin, et al. [13] male Hiu Martil are said to be mature or ready to reproduce with a body length of around 165-175 cm, while for females the body length is around 220-230 cm. Sharks will spawn and carry out the recruitment process when the biota is ready for reproduction, indicated by the clasper level which is in the full clacification category. Male fish that are ready to fertilize female egg cells are indicated by calcification on the male genitals (Andrian et al 2019). The condition of the Hiu Martil of this result is that the gonads are still immature and not ready to spawn. If many are caught, it is feared that this could reduce their sustainability and increase the occurrence of overfishing because the growth and maturation of the gonads of these sharks takes a long time and the fecundity is quite long [12].

3.3.2. Hiu Lanjaman (Carcharhinus Dusumieri)

Lanjaman sharks (Carcharhinus dusumieri) are known to have a body length distribution of 35-90 cm, the most ranging from 56-62 cm, numbering 17 males and 17 females, while the least ranges from 84-90 cm and 1 male and 2 females were found (Figure 5).

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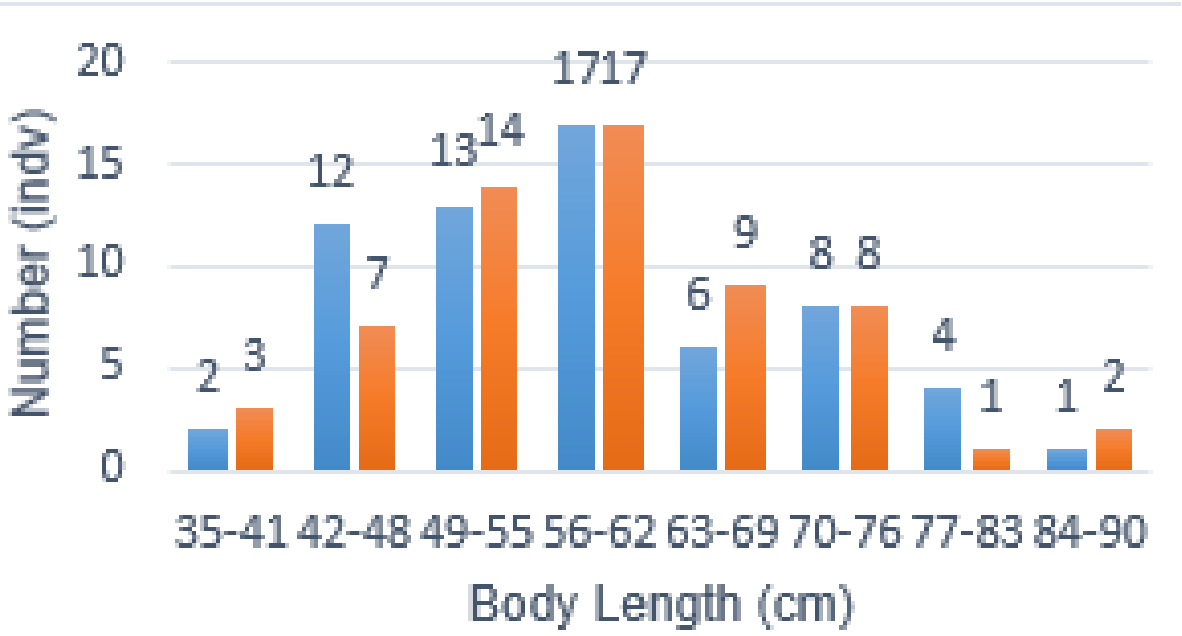

Figure 5.
Distribution of Body Length of the Hiu Lanjaman (Carcharhinus dusumieri).
(Male; Female

If we are guided by the research results of Dewi, et al. [14], the Hiu Lanjaman is declared adult at a size of 191-280 cm and according to Chodrijah, et al. [10] which groups into young and adult sharks each with a body length of less than 185 cm and 242 cm, so the sharks landed in Brondong were all classified as immature or still young

3.3.3. Hiu Bambu Coklat (Chiloscyllium Punctatum)

In Figure 6, it is known that the Hiu Bambu Coklat caught had body lengths ranging from 40-151 cm, the largest number ranged from 54-67 cm, namely 22 males and 27 females. Meanwhile, the smallest number is 1 individual with a body length ranging from 96-151 cm. If we are guided by the results of research by White, et al. [15] which is categorized as adult and ready to reproduce at a size of 67-70 cm and can grow to a length of more than 120 cm, then the body length distribution of Hiu Bambu Coklat landed in Brondong is categorized as adult as many as 22 individu consisting of 10 males and 12 females. There are more immature Hiu Bambu Coklat compared to the adult category.

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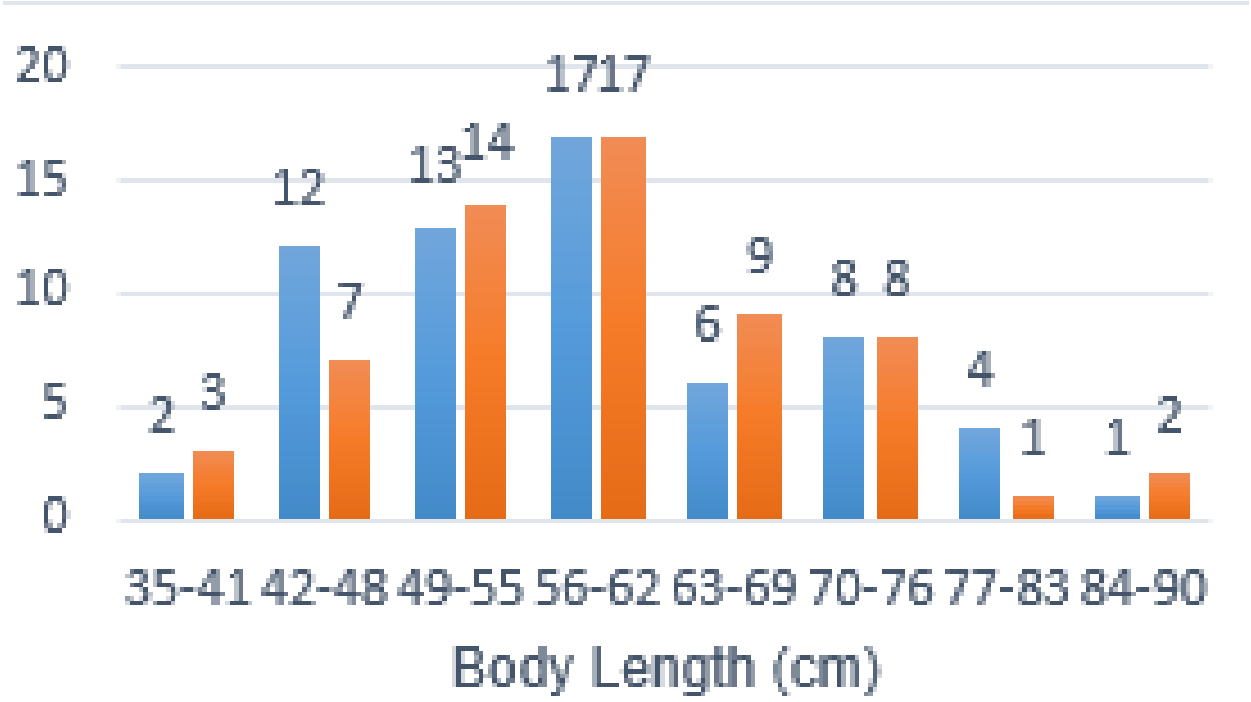

Figure 6.
Distribution of Body Length of the Hiu Bambu Coklat (Chiloscyllium punctatum).
Male; Female

3.3.4. Hiu Bambu (Chiloscyllium Plagiosum)

In Figure 7 it can be seen that the distribution of Hiu Bambu body length ranges from 34-68 cm from 70 samples. The largest number is in the body length range of 54-58 cm, namely 9 males and 10 females. Most male Hiu Bambu were caught in the 59-63 cm length range, with 12 males, while the most females were caught in the body length range of 54-58 cm. These results also show that sharks with a body length greater than 49 cm are caught more often than those with a smaller size.

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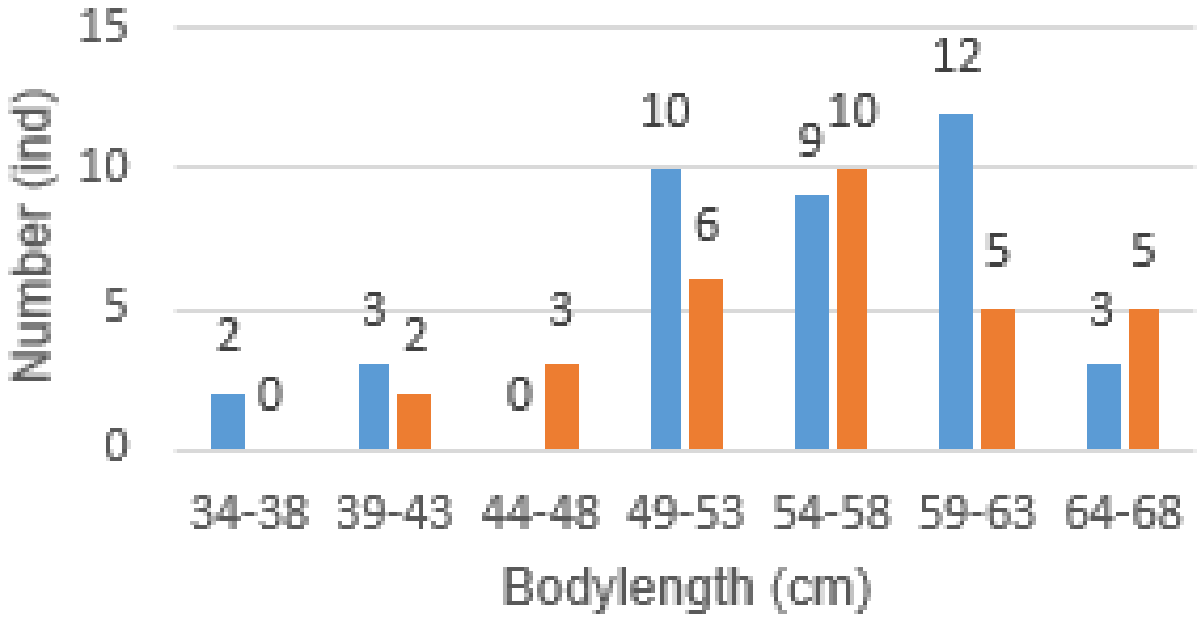

Figure 7.
Distribution of Body Length of Hiu Bambu (Chiloscyllium plagiosum).
Male; Female

However, if we are guided by the research results of White, et al. [15] and Kurniawan, et al. [16] that Hiu Bambu are classified as adults when their body length is around 67-70 cm, then almost all of the Hiu Bambu landed in Brondong are classified as immature.

3.3.5. Hiu Tokek (Atelomycterus Marmoratus)

In Figure 8 it can be seen that the distribution of body lengths of Hiu Tokek landed in Brondong ranges from 39-62 cm. The largest number was in the range of 47-50 cm, while fewer other sizes were caught.

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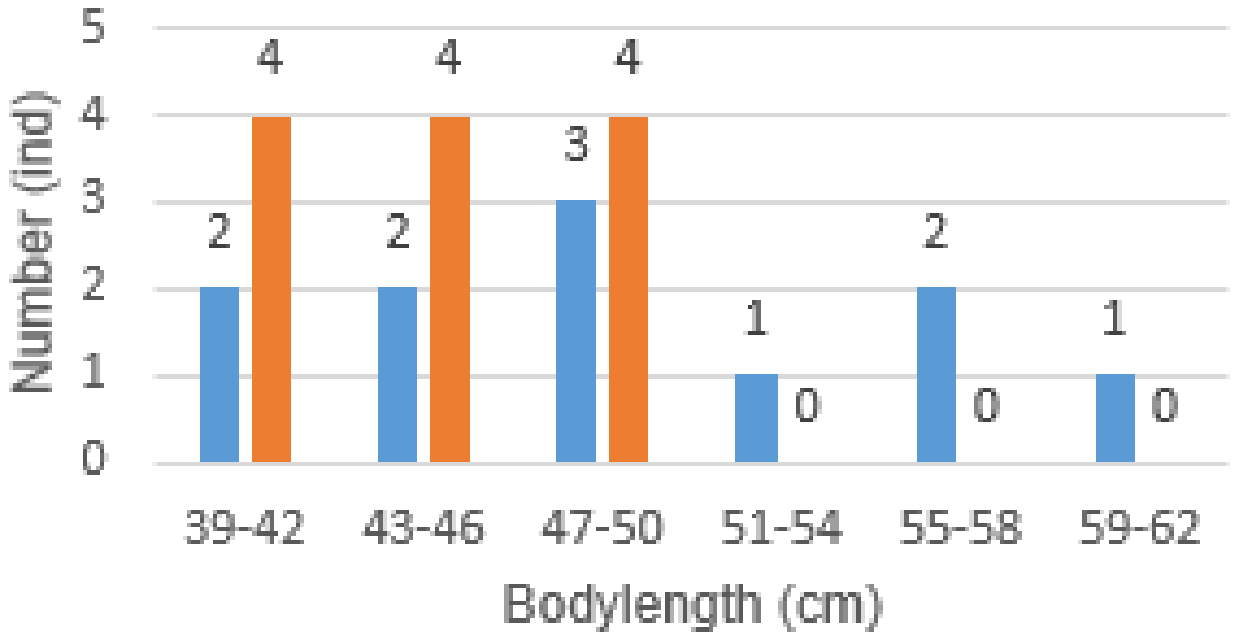

Figure 8.
Distribution of Body Length of Hiu Tokek.
(Atelomycterus marmoratus) (■Male; ■Female)

Hiu Tokek are categorized as adults at a size of 47 cm for males and 49 cm for females and can grow up to 70 cm in length [15]. There were 11 Hiu Tokek from the sampling results that were mature and ready to spawn or reproduce with body lengths ranging from 47-50 cm, consisting of 3 males and 4 females, with body lengths ranging from 51-54 cm; 55-58cm; and 59-62 only males, respectively 1 male; 2 males; and 1 male.

3.3.6. Hiu Karang Sirip Hitam (Carcharhinus Melanopterus)

The body length distribution of Hiu Karang Sirip Hitam ranges from 46-54 cm (Figure 9), 4 individuals were caught consisting of 3 females with a body length ranging from 44-51 cm and 1 male with a body length ranging from 52 cm. -54 cm. If we are guided by the results of research by Arisandi, et al. [17] which states that Hiu Karang Sirip Hitam are said to be adults at a size of 180 cm, then those landed in Brondong are classified as immature.

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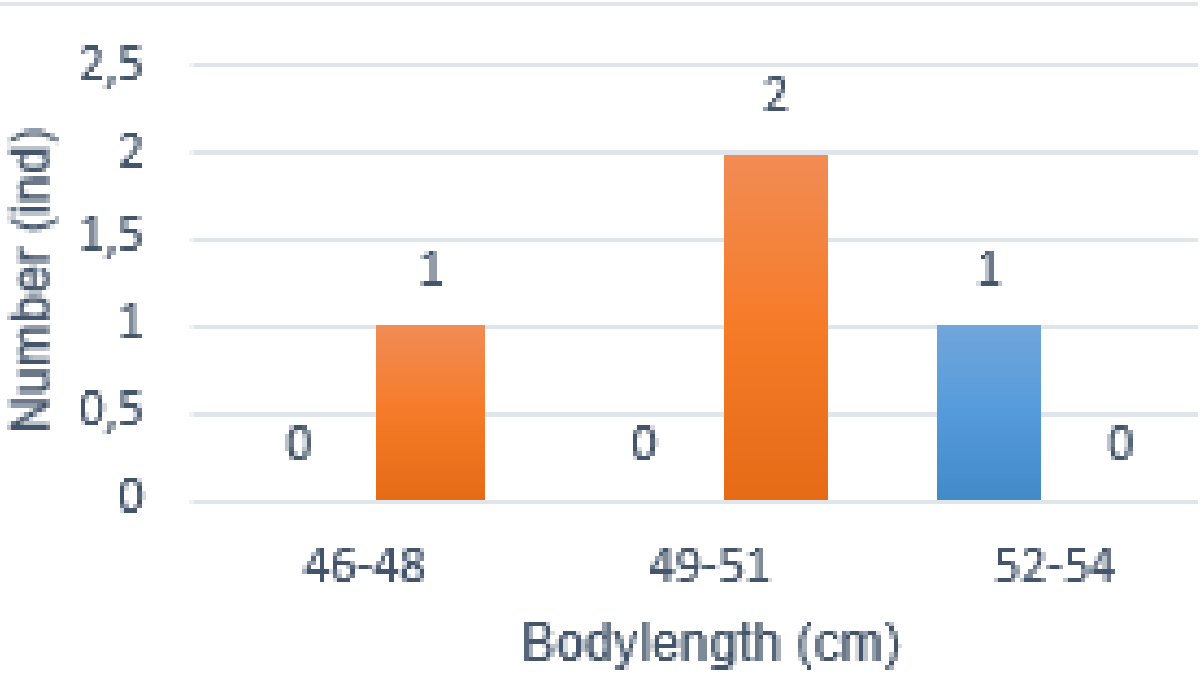

Figure 9.
Distribution of Body Length of the Hiu Karang Sirip.
Hitam (Carcharhinus melanopterus) (Male; ■ Female) ■

Hiu Karang Sirip Hitam in juvenile or immature groups tend to be caught more easily by fishermen because they are more active in looking for food than adult sharks.

3.3.7. Hiu Macan (Galeocerdo Cuvier)

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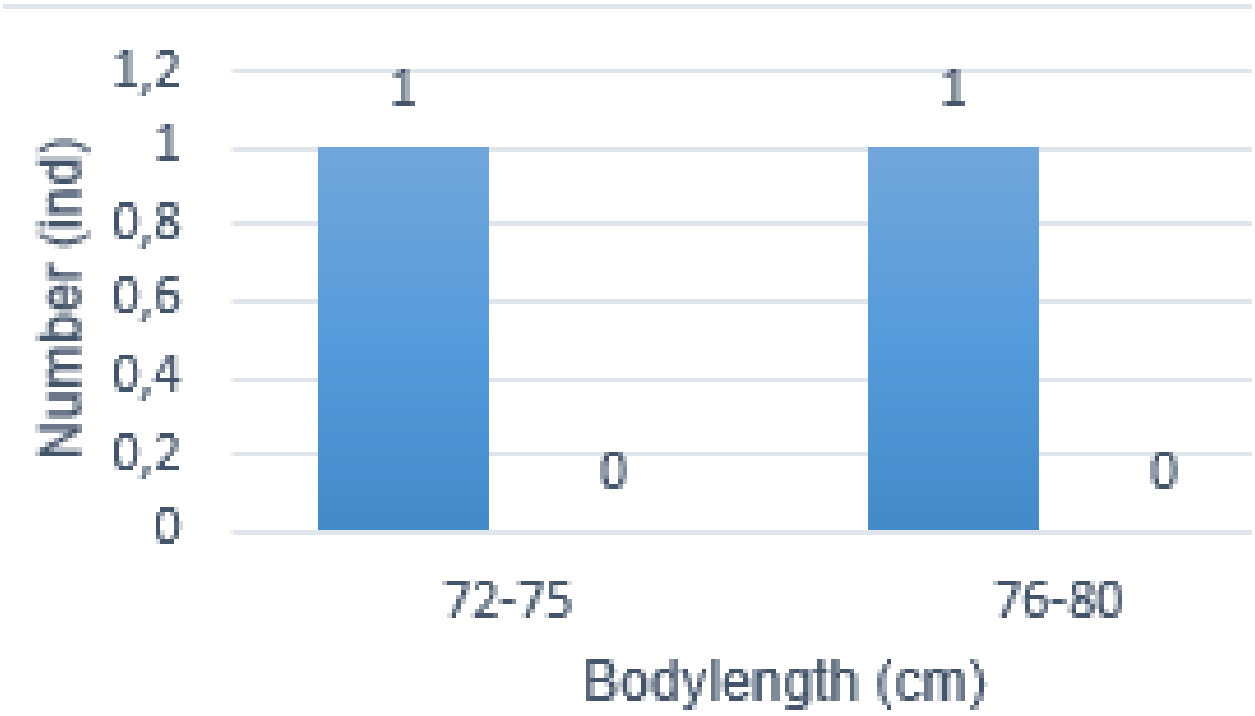

Figure 10.
Distribution of Body Length of Hiu Macan (Galeocerdo cuvier).
(Male; Female)

In this study, only 2 Hiu Macan could be recorded. Body length ranges from 72-80 cm, all of them are male. Referring to White, et al. [15] which states that Hiu Macan can grow up to 760 cm with an adult size of 300-305 cm for males and 250-350 cm for females, and newborn Hiu Macan measuring 51-76 cm, the shark The tiger landed in Brondong (Figure 10) is included in the immature group.

3.3.8. Hiu Tikus (Alopias Pelagicus)

The body length distribution of the Hiu Tikus (Alopias pelagicus) in Figure 11 ranges from 102-110 cm.

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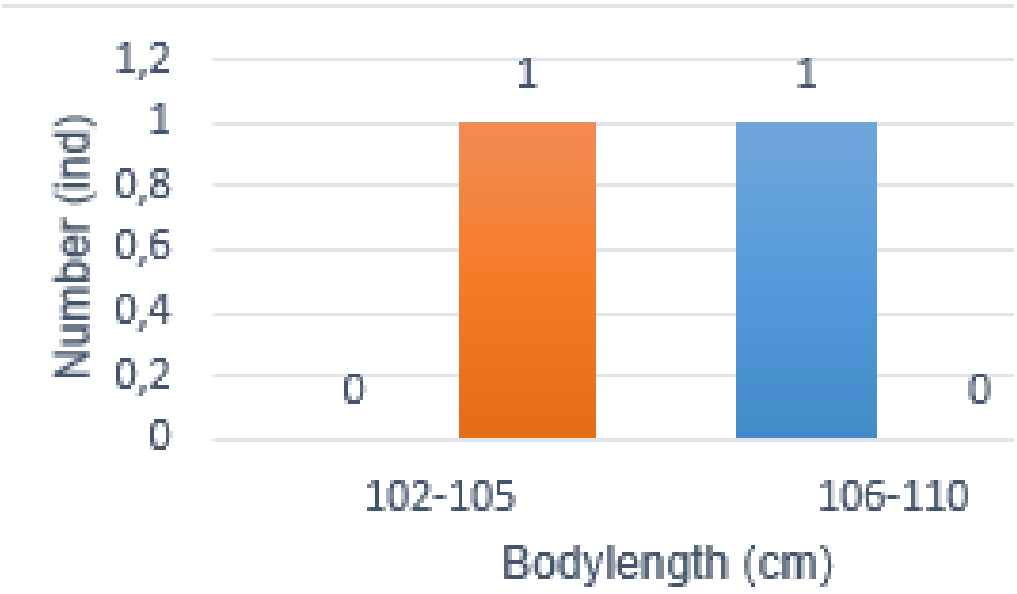

Figure 11.
Distribution of Body Length of Hiu Tikus (Alopias pelagicus).
(Male; Female)

In this study, only 2 Hiu Tikus were recorded, consisting of 1 male (body length 106-110 cm) and 1 female (body length 102-105 cm). Based on the research results of White, et al. [15] it is stated that adult Hiu Tikus are 240 cm in size in males and 260 cm in females so that the Hiu Tikus landed in Brondong are included in the immature category.

Overall research results for all species of sharks can be said that more immature sharks are caught than adults. On the one hand, this can show that the regeneration of sharks in the waters where they are caught is still going well, but on the other hand, that if fishing is carried out in the same conditions continuously, it will cause extinction considering that because the sharks caught are not yet mature, it means they have not had the opportunity to produce offspring.

4. Sex Ratio

In Table 1, the sex ratio of all species of shark samples landed in Brondong is presented. The results of the research show that except for Hiu Karang Sirip Hitam and Hiu Tikus, the sex ratio for other types of sharks is close to 1 male: 1 female.

The sex ratio of Hiu Martil is 49%:51% (1 male: 1.04 females). There are more female Hiu Martil than males. According to Muslih, et al. [18] in the Java Sea the composition of Hiu Martil catches is mostly males. The sex ratio of the Hiu Martil, S. lewini in the good category is male: female, which is 1:1 or close to it. If the male and female population stocks are balanced or there are more female shark stocks in nature, it can be assumed that conditions are still ideal for the sustainability of the Hiu Martil species. According to Sentosa, et al. [12] Hiu Martil have 14-41 young in their uterine sac with an average of only 25 with a gestation period of 9-10 months.

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Table 1.
Sex Ratio of Sharks Landed at Brondong-Lamongan Nusantara Fishing Port

Spesies	Male (%)	Female (%)
Hiu Martil (Sphyrna lewini)	49	51
Hiu Lanjaman (Carcharhinus dusumieri)	51	49
Hiu Bambu Coklat (Chiloscyllium punctatum)	41	59
Hiu Bambu (Chiloscyllium plagiosum)	56	44
Hiu Tokek (Atelomycterus marmoratus)	50	50
Hiu Karang Sirip Hitam (Carcharhinus melanopterus)	25	75
Hiu Macan (Galeocerdo cuvier)	100	0
Hiu Tikus (Alopias pelagicus)	50	50

The Hiu Lanjaman in Table 1 shows that the sex ratio between males and females is 51%: 49% (1.04 males : 1 female). According to Arisandi, et al. [17] if more female sharks are caught, it will increase competition between males for reproductive purposes. According to White, et al. [15] the Hiu Lanjaman has low fecundity with the number of children born being 1 to 4 with an average of 2 and the length of pregnancy is unknown, but the reproductive cycle is not seasonal.

The sex ratio of the Hiu Bambu Coklat is 41%: 59% (1 male: 1.44 females). Considering that in general the sex ratio for sharks spawning in nature is 1:1, the research results for Hiu Bambu Coklat can still be said to be balanced. Conrath [19] states that sharks of the order Orectolobiformes are oviparity sharks with a hatching period of more than 15 months with the number of sharks born being 1-15. Bernal et al 2015 stated that C. punctatum sharks' mate once per year, with the spawning period between July and September.

For Hiu Bambu, it is known that the male sex ratio is; females are 56%: 44% (1.3 males: 1 female). Like the Hiu Bambu Coklat, although the results are not ideal 1:1 between males and females, this condition can be categorized as better than the other way around. If more females are caught which also reflect conditions in nature, then the chances of the reproductive process will tend to be higher. Chandramila and Junardi [20], if the composition of the shark sex ratio with a greater number of females caught will disrupt the reproductive process with the assumption that male sharks have the opportunity to compete and the opportunity for males to mate and produce offspring is lower. White, et al. [15] in Taiwan waters, Bamboo Sharks give birth from June to August. Meanwhile, Conrath [19] stated that sharks from this order are oviparous with only 1-15 hatchings in a hatching period of 8-15 months.

The Hiu Tokek is the only one from this study that shows the ideal sex ratio, namely 50%: 50% (1 male: 1 female). Bhagawati, et al. [21] stated that the ideal shark sex ratio value is balanced or close to that shown by the results of the analysis of Hiu Tokek.

For Hiu Karang Sirip Hitam, the sex ratio shows quite significant different results, namely 25% : 75% (1 male : 3 females). Based on the results obtained, the composition of female sharks is greater than that of male sharks, the tendency can influence the recruitment process of the population because there will tend to be increased competition from male sharks to obtain mates and in turn the chances of being able to reproduce will decrease. Arisandi, et al. [17] stated that the Hiu Karang Sirip Hitam's reproductive process is carried out internally and is viviparous and the gestation period is quite long, namely 8 to 16 months, which can only give birth to 2 to 4 young. Considering that not all fertilized female sharks can give birth successfully, attention needs to be paid to the possibility of a decline in their

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population. According to Amir [22] the sex ratio of C.melanopterus sharks is said to be ideal if the value of the sex ratio is balanced so that the reproductive process to produce new individuals increases more

Hiu Macan can be a very serious concern considering that the results of this research did not show any females landed in Brondong. All Hiu Macan recorded are male. However, this result may not reflect conditions in nature because the data obtained was only 2 individuals, or it could actually indicate real conditions in nature, namely that the number of female Hiu Macan has greatly decreased. According to White, et al. [15] Hiu Macan can give birth to 10-82 individuals with a gestation period of 12 months or a year.

Just like Hiu Tokek, the sex ratio of Hiu Tikus is recorded as 50%: 50% (1 male: 1 female). The results are ideal to show the possibility that the mating process will take place in good conditions. Bhagawati, et al. [21] stated that the sex ratio of sharks in nature should be close to 1:1 or balanced. However, in the case of Hiu Tikus, the presence of male sharks greatly influences the reproductive process because according to Parson, et al. [23] male Hiu Tikus can fertilize twice in close proximity and female sharks can give birth twice in an unknown period of time, but the maximum can be gives birth to two in a year.

5. Conclusion

1. Shark catches in Muncar-Banyuwangi fluctuates, tends to decrease, while in Brondong it continues to increase.
2. There are 8 species of sharks caught and landed at the Brondong-Lamongan Nusantara Fishing Port, namely Hiu Martil (Sphyrna lewini), Hiu Lanjaman (Carcharhinus dusumieri), Hiu Bambu Coklat (Chiloscillium punctatum), Hiu Bambu (Chiloscillium plagiosum), Hiu Tokek (Atelomicterus marmoratus), Hiu Karang Sirip Hitam (Carcharhinus melanopterus), Hiu Macan (Galeocerdo cuvier) and Hiu Tikus (Alopias pelagicus).
3. Based on body length, most sharks are classified as immature
4. Shark sex ratio, namely the ratio between male : female is 1 (male) : 1 (female) or close to 1 : 1 except for Hiu Kaang Sirip Hitam and Hiu Macan.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

References

[1] M. F. Isma, E. Imamshadiqin, L. O. A. F. Hasidu, F. W. Hadinata, and Syahrial, "Biodiversity and conservation status of sharks and rays in Lampulo fishing port, Banda Aceh," *Indonesian Journal of Biology*, vol. 17, no. 2, pp. 155-126, 2021.

[2] Prihatiningsih, E. Nurdin, and U. Chodrijah, "Species composition, catch results per effort, season and shark fishing area in the South Indian Ocean Waters of Java," *Indonesian Fisheries Research Journal*, vol. 24, no. 4, pp. 283-297, 2018.

[3] I. S. Alaydrus, N. Fitriana, and Y. Jamu, "Types and conservation status of sharks caught at the Labuan Bajo Fish auction place (TPI), West Manggarai, Flores," *Journal of Biology*, vol. 7, no. 2, pp. 83-88, 2014.

[4] The Directorate General of Capture Fisheries of Indonesia, *Guidelines for the management of capture fisheries resources techniques (Guidelines for the Management of Capture Fisheries Resources)*. Indonesia: Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries, 1994.

[5] S. Suryagalih and Darmawan, "Study of shark fisheries management on the North Coast of Java Island," *Marine Fisheries*, vol. 3, no. 2, pp. 149-159, 2012.

[6] Fuad, D. Y. Gautama, Sunardi, and C. S. U. Dewi, *Proceedings of the Symposium on Sharks and Rays in Indonesia*. Jakarta: Ministry of Marine Affairs and Fisheries, 2016.
[7] Fahmi and Dharmadi, "Introduction to shark species in Indonesia," *Staff of Fish Species Conservation Sub-Directorate*, pp. 1-63, 2013.
[8] L. Anjayanti, A. Ghofar, and A. Solichin, "Some aspects of biology and production of bittern shark (Alopias superciliosus) in the Southern Waters of Central Java," *Journal odf Maquares*, vol. 6, no. 2, pp. 137-146, 2017.
[9] R. Parluhutan and R. Imaniar, "The influence of human resource management implementation on employee performance in company X," *Journal of Management and Business*, vol. 12, no. 1, pp. 1-11, 2015.
[10] M. Chodrijah, D. Lestari, and M. Susanti, "The influence of environmental education on environmental awareness of junior high school students in City X," *Journal of Education and Learning*, vol. 6, no. 2, pp. 87-96, 2017.
[11] A. Dharmadi, M. Fahmi, and R. Setiadi, *Introduction to shark species in Indonesia*. Indonesia: Ministry of Marine Affairs and Fisheries, 2020.
[12] A. A. Sentosa, W. Nanang, N. W. Ngurah, and S. Fayakun, "Differences in shark catches from drift and bottom longlines based in Tanjung Luar, Lombok," *Indonesian Journal of Fisheries Research*, vol. 22, no. 2, pp. 105-114, 2016.
[13] M. Alaudin, H. Siregar, and F. Rahman, "The impact of climate change on fisheries resources in Indonesian waters," *Journal of Marine Science*, vol. 21, no. 1, pp. 45-58, 2021.
[14] R. M. Dewi, H. B. Santoso, and D. S. Pratama, "The influence of coastal resource management on the sustainability of marine ecosystems in Indonesia," *Journal of Marine and Fisheries*, vol. 21, no. 2, pp. 120-132, 2018.
[15] W. T. White, P. Last, J. Stevens, G. Yearsley, D. Fahmi, and D. Dan Dharmadi, *Economically important sharks and rays of Indonesia*. Canberra, Australia: Australian International Agricultural Research, 2006.
[16] R. Kurniawan, M. Syamsudin, and S. Harahap, "Analysis of sustainable fisheries management in the coastal areas of Indonesia," *Jurnal Sumber Daya Alam dan Lingkungan*, vol. 12, no. 1, pp. 78-87, 2014.
[17] D. Arisandi, B. Wibowo, and T. Supriyadi, "Sustainable fisheries resources management in Indonesian waters," *Journal of Fisheries and Marine Affairs*, vol. 19, no. 1, pp. 45-58, 2020.
[18] M. Muslih, H. Siregar, and R. Hidayat, "Study on sustainable marine resources management in Indonesia," *Journal of Natural Resources*, vol. 13, no. 2, pp. 87-98, 2016.
[19] J. Conrath, "The role of technology in the development of sustainable fisheries management practices," *Journal of Fisheries Science*, vol. 12, no. 3, pp. 234-245, 2005.
[20] S. Chandramila and J. Junardi, "Study on the sustainable management of fishery resources in coastal areas of Indonesia," *Journal of Fisheries Science*, vol. 17, no. 2, pp. 115-125, 2008.
[21] D. Bhagawati, T. Nurani, and M. N. Abulias, "Types, performance, and sex ratio of sharks landed at the cilacap Ocean Fishing Port," *Indonesian Journal of Ichthyology*, vol. 17, no. 2, pp. 185-200, 2017.
[22] F. Amir, Mallawa. A., Tresnanti. J., "Size structure and sex ratio of blackfin reef shark (Carcharhinus melanopterus) Landed at Paotere TPI, Makassar City and Beba TPI, Takalar Regency, South Sulawesi Province," *Journal of Fisheries Agribusiness*, vol. 13, no. 2, pp. 232-237, 2020.
[23] R. Parson, A. Smith, and T. Johnson, "Environmental sustainability and management practices in coastal fisheries: A global perspective," *Marine Policy*, vol. 32, no. 3, pp. 245-258, 2008.

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