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SHARK MOLECULAR IDENTIFICATION, CONSERVATION STATUS AND ISLAMIC LAW REGARDING SHARK CONSUMING

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ABSTRACT

Indonesia is the country with the largest shark production in the world, contributing 16.8% of the total global catch. The decline in shark populations is caused by overfishing, population decline, the characteristics of sharks' slow reproduction and the long time it takes to reproduce. DNA barcoding molecular identification for animals is one way to identify shark species using COI. This method is to obtain shark species identification and phylogeny studies.

Shark tissue sampling was carried out in June at Fish Auctions (TPI), especially TPI Mangkang, TPI Wedung, TPI Moro Demak, TPI Bandungan, as well as Kobong Market and Tambak Lorok Market. The sample used for DNA extraction was shark tissue (white muscle). The results of molecular analysis show that the species identified is Bongo shark (*C. plagiosum*). The conservation status of sharks found is approaching extinction. This study also discusses the halal status of shark for consumption by Muslims.

Keywords:
shark; COI; conservation; DNA barcoding; halal

Introduction

Data on shark fishing in the world is 100 million every year. This data does not include illegal, unreported and unregulated shark catches (Worm et al., 2013). One of the UN agencies dealing with food, the Food and Agriculture Organization of the United Nations (FAO) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are taking immediate conservation action as well as the formation of Regional Fisheries Management Organizations (RFMOs) by countries and entities shark harvester. Global shark fishing is mostly carried out by 20 countries, including Indonesia (13%), India (9%), Spain (7.3%), Taiwan (5.8%), and Argentina (4.3%) which accounts for the most shark landings (Lack and Sant, 2011).

Indonesia has a relatively high diversity of shark species, with at least 117 shark species belonging to 25 families identified in Indonesian waters (Fahmi and Dharmadi, 2013). Apart from overfishing, the population decline is also caused by the reproductive biology of sharks, which generally grow slowly and take a long time to reproduce. In addition, sharks are only able to produce offspring in relatively small numbers compared to other economically valuable fish groups (White et al., 2010). The high level of shark fishing activity has a major impact on local and global populations, thus impacting the balance of the marine ecosystem (Carrier et al., 2010).

Over the past two decades, DNA barcoding systems for animals have offered the opportunity to standardize the identification of wild animal species such as sharks. The Cytochrome C Oxidase subunit I (COI) gene is a standardized gene region, which allows rapid and accurate species identification, making it suitable for routine applications in wildlife forensics (Hebert et al., 2003; Abdullah and Rehbein, 2017). Animal DNA barcoding generally uses the mitochondrial COI gene to identify diversity between species. The COI gene fragment was initially proposed as a universal animal marker or bio-identification system (Hebert et al., 2003). The mitochondrial COI gene is one of the genetic markers commonly used by researchers for research on DNA barcoding and phylogenetic or phylogenetic relationships (Sultana et al., 2018; Ananthan and Murugan, 2018).

The use of COI is of interest as a reliable genetic marker in shark species identification and phylogeny studies (Gkafas et al. 2015; Lissovsky et al. 2016; Vella et al. 2017). DNA barcoding has also been used to determine other high-value processed species such as tuna (Nurilmala et al., 2016) as well as to effectively differentiate regional shark species landed in Indonesia, Australia and Brazil (Ward et al., 2008; Holmes et al., 2009; Sembiring et al., 2015).

Accurate recommendations regarding the types of sharks caught or hunted are needed as a basic reference in determining conservation status. Conventional identification is usually difficult to apply to shark samples because their morphology cannot be detected completely, for example only the fins are found. So the molecular identification method can help the identification process because it only requires a small amount of shark body tissue.

The waters north of Java such as Semarang and its surroundings are coastal areas that have the potential to produce quite large marine fisheries. Research on molecular identification of shark species is needed at fish auctions in Semarang and its surroundings because at these locations there are fish caught from various inland waters. From research on shark catches at TPI Semarang and its surroundings, their conservation status is done using the DNA Barcoding method.

Shark

Sharks are included in the Chondrichthyes, namely cartilaginous fish, with an inner skeleton composed of flexible cartilage and not hard bone. There are two subclasses of Chondrichthyes, namely Elasmobranchii and Holocephali. The difference between these two subclasses is the structure of their gills and the way they develop in the embryo. Sharks, rays, skates, and sawfish are all elasmobranchs. Elasmobranchs have five to seven external gill slits without gill covers, while Holocephali have four gill slits with gill covers. Elasmobranchii are classified into eight shark orders, all of which are distinguished by their unique biological characteristics. In the order Holocephali, Chimaeriformes (ghost sharks) is the only class that is still alive today and all of them have the same biological characteristics.

Sharks are cartilaginous fish with approximately 500 species divided into eight orders and 30 families. Many sharks are caught for commercial purposes. Overfishing of sharks caused a significant decline in the populations of several shark species in the late 20th and early 21st centuries.

DNA Barcoding

DNA Barcoding is a molecular taxonomy technique for identifying species by using short genetic markers (around 600-700 bp) in the DNA of an organism (Hebert, 2003; Costa and Carvalo, 2007; Jefri et al., 2015). Mitochondrial DNA (mtDNA) is widely used to identify species (Kyle and Wilson, 2007; Saleky et al., 2016). The mitochondrial COI DNA locus can be used to distinguish species based on DNA structure and components, as well as providing information on the phylogenetic relationships of species (Brooks and McLennan, 1991).

The ability of DNA barcoding to identify a species depends on degeneration or variation in the genetic code. Ward and Holmes (2007) proved this by analyzing DNA barcode regions in 388 fish species, including four Holocephali and 61 Elasmobranchs. Based on the results of this research, so far DNA barcoding can differentiate 98-99% of the fish species studied.

The Barcode of Life Data System (BOLD) is a COI barcode DNA sequence data storage that can be accessed online and is growing rapidly. COI DNA barcode data in BOLD has significant advantages compared with universal primer techniques that target other gene regions (Ratnasingham and Hebert, 2007). Pegg et al. (2006) have used DNA barcoding to identify planktonic fish larvae, then Smith et al. (2008) and Wong and Hanner (2008) to identify seafood.

The development of DNA barcoding over recent years has provided an opportunity to standardize the identification of wildlife species. The COI gene is a gene region that meets standards that enable quick and accurate species identification, making it suitable for routine use in identifying wildlife or wildlife forensics (Hebert et al., 2003; Abdullah and Rehbein, 2017). In addition, other high-value processed species, such as mackerel, have also been identified using DNA barcoding (Nurilmala et al., 2016). Previous studies relied on multiplex Polymerase Chain Reaction (PCR) assays and species-specific primers for shark species identification (Shivji et al., 2005; Clarke et al., 2006; Magnussen et al. 2007). Several regional shark species landed in Indonesia, Australia or Brazil have also been successfully identified using DNA barcoding (Holmes et al., 2009; Ward et al., 2008; Sembiring et al., 2015).

Cytochrome C Oxidase Subunit I (COI) Marker

The Cytochrome Oxidase subunit I (COI) gene is one of the genes that can be used for molecular identification and is often used as a molecular marker. One of the advantages of the COI gene as a marker for phylogenetic analysis is that the amino acids in the COI fragment are rarely substituted (conserved). However, the bases in the codon triplet can still change and remain unchanged or undergo silent mutations, that is, changes in bases that do not change the type of amino acid. This change generally occurs due to a substitution in the third nucleotide base of the codon (Lynch and Jarrell, 1993). The COI gene sequence is conserved, so it can be used to reconstruct phylogenetic trees at the species level (Palumbi, 1996). In addition, the COI gene can be used in DNA barcoding techniques because its sequence only has slight variations or deletions and insertions. As a result, sequences that have slight variations (conserved) become species identities (Hebert et al., 2003). Several studies have used the COI gene as a molecular marker, such as in primates (Wu et al., 2000), Cestoda (Gasser et al., 1999), and Hemiptera (Rahayuwati 2009).

The mitochondrial COI gene is one of the genetic markers commonly used for DNA barcoding (Sultana et al., 2018) and phylogenetic studies (Ananthan and Murugan, 2018), both of which require genes capable of identifying species within a particular taxonomic group. According to Lissovsky et al. (2016) showed that COI can differentiate closely related animals. The COI gene has a high rate of sequence changes in most animal groups so it is effectively used as a genetic marker for species identification (Hebert et al., 2003). Several studies have been carried out to identify seafood product species using DNA barcoding (Fernandes et al., 2017; Günther et al., 2017; Nedunoori et al., 2017). In addition, the use of COI as a reliable genetic marker in shark species identification and phylogeny studies has been carried out and supported by several researchers (Gkafas et al., 2015; Vella et al., 2017).

Conservation Status

Conservation status is an indicator that is commonly used to show the level of extinction of living things (the possibility of a species surviving now or in the future) due to conservation. Determination of conservation status aims to provide protection and preservation of living creatures. Conservation status is issued by the government or non-governmental organizations that are concerned with biodiversity. The conservation status that is usually used as a global reference is The IUCN Red List of Threatened Species and CITES Appendices.

IUCN Red List

One of the most well-known objective assessment systems for evaluating the condition of endangered plants, animals and other species is the IUCN Red List of Threatened Species, commonly known as the IUCN Red List. . This assessment approach was introduced by the International Union for Conservation of Nature (IUCN) in 1994. This approach includes appropriate criteria and categories to categorize the conservation status of a species based on its probability of extinction.

The IUCN Red List is an important indicator of the health of the world's biodiversity and can provide information and related actions for biodiversity conservation and policy changes that are critical to protecting our natural resources. Such lists can provide information about range, population size, habitat and ecology, use and/or trade, threats, and conservation measures that will assist in making necessary conservation decisions. The IUCN Red List of Threatened Species is categorized into nine categories of conservation status of living things (IUCN, 2012).

Extinct (EX)

If a taxon is declared extinct, there is no doubt that the last individual has died and if continuous surveys of the habitat at appropriate times throughout a certain time span fail to record or locate a single individual.

Extinct in the Wild (EW)

A taxon is said to be extinct in the wild if the taxon can only survive in cultivation, captivity, or as a population integrated into a particular ecosystem (naturalization) that is far outside its previous distribution.

Critically Endangered (CR)

A taxon is considered critically endangered if the best available data indicate that the taxon meets one of criteria A through E for critically endangered (see section V).

Endangered (EN)

A taxon said to be endangered is considered to face a very high risk of extinction in the wild.

Vulnerable (VU)

A taxon is considered vulnerable if available data indicates it faces a high risk of extinction in the wild.

Near Threatened (NT)

A taxon is said to be near threatened if an evaluation has been carried out based on criteria but currently does not meet the requirements for critical, endangered or vulnerable, but almost meets or is likely to meet the requirements for the endangered category in the near future.

Least Concern (LC)

A taxon is considered low risk when it has been evaluated based on criteria and does not qualify as critical, endangered, vulnerable, or near threatened.

Data Deficient (DD)

A taxon experiences a data deficiency or lack of information when there is not enough information to make a direct or indirect assessment of the risk of extinction based on its distribution and/or population status.

Not Evaluated (NE)

A taxon is said to be not evaluated if it has not been evaluated based on the criteria above.

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)

1) Appendix I

A species list that lists the most endangered species among the animals and plants listed in CITES. International trade in specimens of this species is prohibited by CITES unless the purpose is not commercial, but rather scientific research. In certain cases, trade can be carried out provided that permits are obtained through the granting of import permits and export permits (or re-export certificates).

2) Appendix II

A species list that includes species that are not necessarily currently endangered, but will be unless trade is strictly controlled. It also includes so-called "similar species", i.e. species whose specimens in trade are similar to species listed for conservation reasons. International trade in specimens of Appendix-II species can be authorized by granting an export permit or re-export certificate. No import permit is required for this species under CITES (although permits are required in some countries that have taken more stringent measures than CITES requires).

3) Appendix III

International trade in specimens of the species listed in this appendix is permitted only upon presentation of appropriate permits or certificates.

Islamic Law Consuming Sharks

Based on what has been explained in the verses of the Qur'an and Hadith, marine animals are animals that are halal for consumption. Except for animals that will cause harm if consumed. Based on this, sharks are one of the animals that is halal for consumption. The basis for this opinion is the following arguments (Nadha, 2022):

"Permitted to you are sea game and food (originating) from the sea."
(Q.S. Al-Maidah: 96)

"Someone once asked the Messenger of Allah, "O Messenger of Allah, we once boarded a ship and only brought a little water. If we perform ablution with it, we will get thirsty. Can we perform ablution with sea water?" The Prophet then answered, "Sea water is holy and its carcass is halal." (H.R. Abu Dawud, An-Nasa'i, and At-Tirmidhi. Shaykh Al-Albani said that this hadith is authentic).

In Arabic literature sharks are called al-qirsyu. (https://www.almaany.com/). According to Islamic law, scholars have different opinions regarding the law of consuming shark. Some think it is haram. For example, some Shafi'iyah scholars are of the opinion that sharks are haram, because sharks are considered wild animals that attack with their fangs (ya'duw bi-naabihi). (Abul 'Ala` al-Mubarakfuri, Tuhfatul-Ahwadzi, 1/189; Ibnu Hajar al-Asqalani, Fathul Bari, 9/169; Ibrahim bin Muhammad, Manarus-Sabiil, 2/368) (Fitria 2022).

However, the majority of scholars are of the opinion that sharks are halal. This opinion was expressed by Muhibbuddin at-Thabari in the book Syarh at-Tanbih. He believes that sharks are halal animals for consumption. In Indonesia, the Indonesian Ulema Council (MUI) believes that consuming shark is halal. This is based on the general arguments of the Qur'an and hadith which state that all marine animals are halal. (https://halalmui.org/ Hukum-mengkonsumsi-daging-hiu/).

The scholars hold this opinion based on the word of Allah in Surah Al-Maidah verse 96 which states that it is permissible for you to hunt sea animals and food (which comes from) the sea. The Prophet's hadith also explains that sea water is holy and its carcass is halal. (HR. Abu Daud no. 83, An Nasai no. 59, At Tirmidhi No. 69). It is on this basis that the majority of scholars are of the opinion that shark meat is halal. (Ahmad bin Abdurrazak al-Duwaisi. Fatawa Al-Lajnah Al-Daimah Li Al-Buhus Al-Ilmiyah Wa Al-Ifta.). What are the laws regarding consuming sharks that are approaching/almost extinct? be interesting to discuss.

Methods

Shark tissue sampling was carried out in June at Fish Auction Places (TPI), especially TPI Mangkang, TPI Wedung, TPI Moro Demak, TPI Bandungan, as well as Kobong Market and Tambak Lorok Market. The samples used for DNA extraction were shark tissue (white muscle), dissected directly with surgical scissors, stored in 1.5 ml Eppendorf tubes containing 96% ethanol or put in plastic clips and stored in the freezer at the Integrated Laboratory, Faculty of Science and UIN Walisongo Semarang Technology before being used for molecular analysis.

DNA Extraction, Amplification and Sequencing

PCR visualization stage on a 0.8% agarose gel using 1X TBE and the target DNA size compared with a 1 Kb DNA ladder. DNA sequencing was carried out in two directions, namely, forward and reverse at 1st BASE Laboratories (Malaysia).

Sequence Data Analysis

The sequence results obtained were in AB1 file format and the chromatograms were edited using BioEdit 7.2.5 (Hall, 1999). Sequence data that is not good is edited and cut and then combined into one sequence or called a contig. The nucleotide sequence data obtained will then be compared with sequence data available in GenBank NCBI (National Center for Biotechnology Information) for species identification using BLAST (Basic Local Alignment Search Tool) which can be accessed online at http://blast.ncbi. nlm.nih.gov/Blast.cgi (Altschul et al., 1990). The type or hit with the highest query cover and percent identity values is selected as the reference sequence (Barbuto et al., 2010; Armani et al., 2015). The sample sequence was then aligned with the sequence obtained from the BLAST results downloaded from GenBank. Then, the alignment process was carried out for further phylogenetic analysis.

Determination of Conservation Status

An overview of the conservation status of sharks that have been molecularly identified is determined using the IUCN Red List of Threatened Species (http://www.iucnredlist.org/) and the trade status of identified species is determined using CITES which can be accessed online at https://cites .org/eng.

From the description above, researchers want to identify the conservation status of sharks based on molecular identification and Islamic law regarding consuming sharks whose conservation status is almost extinct.

Results and Discussions

Shark Sampling Locations

Sampling was carried out at seven locations. Shark samples were collected from only three locations, namely TPI Pasar Kobong Semarang and TPI Wedung and Pasar Pagi Wedung Demak. A total of 12 shark samples were collected from the seven sampling locations (Table 1). Not all sampling locations found sharks. Based on the results of interviews with several fishermen, this is likely because the number of sharks caught each day in each location is uncertain, so that in locations where no shark samples were found, no sharks were landed at the TPI or market at the time the samples were taken.

Table 1. Number of shark samples

No	Location	Quantity	
		Sample Collection	Sample Isolation
1	TPI Mangkang (Semarang)	-	-
2	Tambak Lorok Market (Semarang)	-	-
3	Pasar Kobong (Semarang)	4	4
4	TPI Wedung (Demak)	6	2
5	TPI Bandengan (Kendal)	-	-
6	TPI Morodemak (Demak)	-	-
7	Pagi Wedung Market (Demak)	2	2

Figure 1. Sampling locations (Personal Documentation, 2023)

Figure 2. Shark samples found at Kobong Market, Semarang. (Personal Documentation, 2023)

Figure 3. Shark found at TPI Mangkang Semarang (Personal Documentation, 2023)

Shark DNA isolation

Shark DNA was isolated from muscle tissue close to the shark's fin. Next, 50 µL of the isolated DNA was added to elution buffer and then stored in the freezer until used in the next stage (Figure 4).

Figure 4. Shark DNA isolation result (Personal Documentation, 2024)

Amplification of shark DNA

Amplification of the mitochondrial COI region in shark samples using the primer pair FISH-F1 and FISH-R1 produced a single band measuring approximately 655 bp. In the first amplification, samples W1 and PK4 did not produce a single band. This shows that the DNA has not been successfully amplified, so a second amplification is carried out. In the second amplification, the PK1 sample still showed a thin band even though the volume of template DNA had been added, while the PK3 sample showed a double band. Visualization of amplicon DNA was carried out on a 0.8% agarose gel.

Shark morphology identification results and conservation status based on IUCN

Table 2. Shark morphology identification results and conservation status based on IUCN

No	Sample Code	Shark Species (in Indonesian)	Conservation Status (IUCN)
1	PK1	Cucut lanjaman (*Carcharhinus sealei*)	Near Threatened; NT
2	PK2	Hiu pilus (*Rhizoprionodon oligolinx*)	Least Concern; LC
3	PK3	Cucut lanjaman (*Carcharhinus dussumieri*)	Near Threatened; NT
4	PK4	Hiu mungsing (*Carcharhinus falciformis*)	Near Threatened; NT
5	W1	Cucut lanjaman (*Carcharhinus dussumieri*)	Near Threatened; NT
6	W2	Hiu Bongo (*Chiloscyllium plagiosum*)	Near Threatened; NT
7	PW1	Cucut lanjaman (*Carcharhinus sealei*)	Near Threatened; NT
8	PW2	Cucut lanjaman (*Carcharhinus dussumieri*)	Near Threatened; NT

Table 3. Results of identification of shark morphology and conservation status based on CITES

No	Sample Code	Shark Species (in Indonesian)	CITES
1	PK1	Cucut lanjaman (*Carcharhinus sealei*)	Appendix II
2	PK2	Hiu pilus (*Rhizoprionodon oligolinx*)	
3	PK3	Cucut lanjaman (*Carcharhinus dussumieri*)	
4	PK4	Hiu mungsing (*Carcharhinus falciformis*)	
5	W1	Cucut lanjaman (*Carcharhinus dussumieri*)	
6	W2	Hiu Bongo (*Chiloscyllium plagiosum*)	
7	PW1	Cucut lanjaman (*Carcharhinus sealei*)	
8	PW2	Cucut lanjaman (*Carcharhinus dussumieri*)	

Sharks are predators that occupy the top position (apex predator) in the marine food chain. Sharks indirectly help maintain and regulate the balance of marine ecosystems by regulating the number of animal populations at lower trophic levels. Reducing the number of apex predators in a population can increase the number of certain animal populations that become their prey, giving rise to the dominance of certain species that monopolize resources in a community. The decline in sharks can result in a reduction in vegetation in the sea, causing juvenile fish and other benthic biota to lose food and shelter. This results in the death of coral reef ecosystems (Bascompte et al., 2005). Ultimately, declining shark populations can disrupt the balance of the ecosystem (Ferretti et al., 2010).

Molecular identification needs to be carried out first to determine the conservation status of sharks at TPI Semarang. The advantage of molecular identification is that it only requires a small number of samples, samples can be taken at any stage of life, both adolescents and adults. Apart from that, molecular techniques have the advantages of being faster, more sensitive, specific and efficient compared to conventional methods (Keramas et al., 2004). Sharks from TPI were identified and classified based on IUCN population status based on molecular data collected using DNA barcoding. It is hoped that this data can increase awareness and understanding of the important ecological role of sharks, as well as the need for shark conservation among fishing communities in particular and Indonesian society in general.

The collected sharks were successfully identified and the next step is to determine the conservation status of sharks based on the IUCN Red List of Threatened Species (http://www.iucnredlist.org/) and the trade status of identified species is determined using CITES which can be accessed online at https:/ /cites.org/eng. Table 2 shows search results from the web and other references, showing that of the eight samples, only one is included in the least concern (LC), while the others are included in the near threatened (NT).

Not all sharks have CITES data. After searching eight samples, only one sample had CITES data, namely the mungsing shark (*Carcharhinus falciformis*) and was classified in appendix II. Appendix II is a species list that includes species that are not necessarily threatened with extinction at this time, but will become endangered unless trade is strictly controlled. International trade in specimens of Appendix-II species can be authorized by granting an export permit or re-export certificate. No import permit is required for this species under CITES (although permits are required in some countries that have taken more stringent measures than CITES requires). A permit or certificate should only be granted if the relevant authorities are satisfied that certain conditions have been met, especially that trade will not harm the survival of the species in the wild.

Shark fishing is increasing from year to year, causing the current shark population in Indonesia to decline. Data from the Ministry of Maritime Affairs and Fisheries (2016), Indonesia is the country with the largest shark production in the world, contributing 16.8% of the total global catch. Apart from that, the decline in shark populations is also caused by overexploitation which is driven by the high demand for these products, such as fins and meat to be processed into food or food products. In 2014-2016, WWF-Indonesia found that several restaurants and hotels in Jakarta were able to serve around 12,622 kg of shark fins a year (WWF, 2018). Shark fin soup is a prestigious dish at seafood restaurants in several big cities in Indonesia, including Jakarta, Semarang and Surabaya. Shark meat in dried form such as salted fish is sent to several other big cities, including Jakarta, Bandung, Surabaya and Semarang, and some is even exported to neighboring countries such as Bangladesh and Sri Lanka (Fahmi and Dharmadi, 2013).

Shark Conservation Status

Not all sampling locations found sharks. Based on the results of interviews with several fishermen, this is probably because the number of sharks caught every day in each location is uncertain, in some locations they were found in large numbers, but in other locations no sharks were landed at TPI or the market at the time of sampling was carried out.

Zainudin (2011), found that shark fishing in Indonesia was mostly obtained from bycatch (72%), and only 28% was the main catch. The number of sharks caught by fishermen depends on the type of fishing gear and fishing methods used. In Indonesia, sharks can be caught with various types of fishing gear, including nets, fishing rods and spears.

Based on the percentage of shark catches as by catch, the following is one of the fishing gears that is included in the high risk category in shark fishing, namely gillnets and longlines. The risk categories for various fishing gear that catch sharks based on variations in the percentage of catches according to Zainudin (2011), are described as follows:

a. High category: 0-50% for gill net and 1-30% for longline
b. Medium category: trawl fishing gear (0-20%); ring net or purse seine (0-20%); and hand fishing (handline) with FAD aids (1-10%)
c. Low category: fish trap fishing gear (5%), lift net for squid fishing gear (0-1%) and Danish seine (0-1%).

Based on the results of interviews with fishermen at the time of sampling. The fishing gear commonly used by fishermen is longlines which are included in the high category and trawls and circle nets which are included in the medium category. The sharks caught in this study were generally by-catch or not the target catch of fishermen. Most of the sharks caught were young and small.

The use of fishing gear can affect the size of the catch. Fishing gear that tends to be selective, such as gill nets with a certain mesh size and longline fishing with a certain type of bait, will only catch fish of a certain size and type according to the expected target. On the other hand, non-selective fishing gear, such as trawls and other types of trawls, tend to catch all types and sizes of fish that enter their catch area, so that many young or immature fish are caught. The use of non-selective fishing gear can disrupt the balance of fish populations in nature because it will result in growth over fishing, namely a level of fishing where many young fish are caught before reaching optimum growth (Pitcher and Hart, 1982; Pitcher et al., 2008).

There is a reduction in the population of adult fish, possibly due to growth over fishing, which can then result in recruitment over fishing or a level of fishing where the availability of adult fish decreases because the additional individuals produced are not sufficient to maintain the population. In other words, the growth and recruitment process of a type of fish cannot proceed well if fishing is carried out continuously without supervision. The negative impacts resulting from this non-selective fishing method will be more clearly seen in shark species which have biological characteristics such as being slow to reach sexual maturity and growth, producing few offspring, and having a long life span.

Thus, the use of non-selective fishing gear should not be operated in coastal waters and shallow waters where young sharks are found, because it will gradually affect the adult fish population in the future and hamper the recruitment process in nature. The success of the recruitment process for a species is influenced by several factors such as the fishing area, the fishing gear used and the size of the fish caught (Sparre et al., 1989; Sparre & Venema, 1992). Apart from that, the recruitment process can also be influenced by the quality of the aquatic environment and the density of available brood stock.

Almost all parts of the shark's body have economic value and can help the lives of fishermen, traders and exporters. Apart from being sold locally, dried shark meat (salted fish) is also sent to several other big cities such as Jakarta, Bandung, Surabaya, Semarang and some is even exported to neighboring countries such as Bangladesh and Sri Lanka. Based on the results of interviews with fishermen at TPI Mangkang, the sharks they catch are generally already housed. Among the people, there is still a belief that sharks have medicinal or health benefits. Apart from that, from interviews with fishermen at TPI Wedung, the sharks that were caught were less popular, so they were usually used as salted fish (Figure 5).

Figure 5. The process of making salted fish
(Personal documentation, 2024)

Another factor that influences the number of catches is the time of catch. The time it takes for fishermen to get to the fishing area varies greatly, from just a few hours to months. However, in general, small-scale fishermen (artisanal fisheries) only need a few hours to get to their fishing place. Meanwhile, large-scale or industrial fisheries (for example longline tuna fisheries) require a longer time, which can reach 30-40 days or even more than that, depending on the catch obtained and the fishing area. Some fishermen who catch sharks say that every year the fishing area becomes farther away and the catch decreases from year to year. This is an indication of a population decline.

Shark fishing is carried out in almost all Indonesian waters, but the vastness of Indonesian waters is one of the obstacles in managing shark fisheries. To make it easier to manage its fisheries, the Indonesian Government through Minister of Maritime Affairs and Fisheries Regulation Number PER.01/MEN/2009 concerning Fisheries Management Areas of the Republic of Indonesia has established fisheries management area units in Indonesia.

Indonesia, with its vast territorial waters, has potential areas for shark fisheries management. Determining potential fishing areas is usually based on the abundance of fish species that have important economic value or that are targets for fishermen's catches. In general, fishermen rely on their experience in fishing for sharks, so that they know the conditions of the water environment and the fishing area well. With the development of technology, most shark fishermen already use tools such as GPS (Global Positioning System), which can help to find the geographical position of their catch area. When fishermen catch a lot of sharks, the coordinates will be saved on the GPS and for the next fishing activity they will return to the coordinates of the fishing location.

Identification of the Chiloscyllium plagiosum shark (Bennett, 1830)

The shark that was successfully identified molecularly was the Whitespotted bamboo shark (*Chiloscyllium plagiosum* (Bennett, 1830)). This shark has the local name bongo shark or shark dolok (Javanese). Bongo sharks are characterized by the morphology of a slender body and tail, there are less obvious skin stripes along the body, the body is covered in dark and white stripes, as well as thin and thick dark stripes on a light colored background and both fins the backs are small and separated from each other. Body size can reach 95 cm. Adult males can reach sizes between 50-63 cm, hatch at sizes between 10-13 cm. The whitespotted bamboo shark is widespread in the waters of the Indo-West Pacific, from Madagascar to Japan and the Philippines. Commonly found at the bottom of coral waters, tidal areas and rocks. This shark is an oviparous animal and its diet consists of invertebrates and small fish (White et al., 2006).

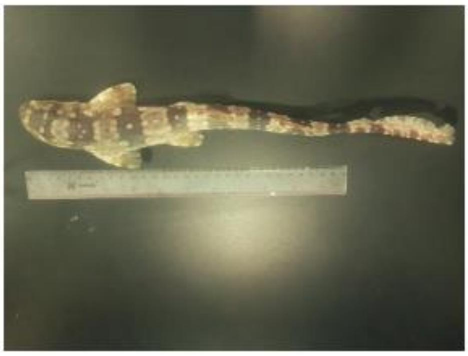

Figure 6. Sample of whitespotted bamboo shark (*Chiloscyllium plagiosum*)
(Personal documentation, 2024)

The existence of groups of rays that have shark-like morphology and which lay people categorize as a type of shark, has led to misunderstandings regarding the term shark in general. For example, the Rhynchobatidae group is better known as palm sharks or bandrong sharks, the Rhinidae tribe is known as stingray sharks, barong sharks or butterfly sharks, while the Pristidae tribe is better known as saw sharks compared to its original name, saw rays or sawfish. One of the distinguishing characteristics between sharks and rays is the location of their gills. Even though some types of stingrays have a body shape like a shark, the location of their gills is always at the bottom (ventral), in contrast to the location of the gills of sharks which are always on the left and right (lateral) sides of their body. Information regarding species diversity, biological aspects and stingray fisheries will not be discussed further in this book which will only focus on shark resources in Indonesia (Fahmi and Dharmadi, 2013).

This was also found during sampling at TPI, several fishermen still could not differentiate between rays and sharks, as well as sharks and other fish. For example, the whitespotted bamboo shark sample has a pattern similar to that of a grouper (*Epinephelus fuscoguttatus*), so there are people who still don't know that it is a shark, not a grouper.

Because of this, researchers created a module for fishermen and society in general. The module contains general information regarding sharks. Apart from that, the description and morphology of sharks is a guide to getting to know the types of sharks. It is hoped that this module can help the public to know sharks more specifically and be able to distinguish sharks from other fish, especially shark species which are protected as a form of conservation and to keep shark populations in nature from declining.

Socialization needs to be done to fishermen not to catch sharks, especially juvenile ones. So that the shark population is maintained and the marine ecosystem is balanced. If sharks as top predators experience a decline in numbers, it is feared that this will disrupt the balance of the natural ecosystem.

Shark consumption in Islamic law

The opinion of the ulama was conveyed by Muhibbuddin at-Thabari in the book Syarh at-Tanbih. He believes that sharks are halal animals for consumption. In Indonesia, the Indonesian Ulema Council (MUI) believes that consuming shark is halal (https://halalmui.org/ Hukum-mengkonsumsi-daging-hiu/). The scholars agree that all types of sea fish are halal for consumption, except for those that cause harm or are dangerous to human health, including consuming shark.

Islam teaches that it has actually provided a view for its followers to preserve the environment. Where the Earth and Heaven are gifts and favors from Allah SWT for humans (Al-Baqarah: 29); (Al-Mulk: 15) and (QS. Lukman: 20) to always be preserved and maintained so that they can be beneficial for human welfare. The role of humans as caliphs (Al-Baqarah: 30) is actually as creatures of Allah SWT, not only as rulers on earth but also in their role to prosper the entire earth. The Islamic religion has strictly prohibited behavior that can cause damage to the Earth, according to the Word of Allah SWT.

وَلَا تُفْسِدُوْا فِى الْاَرْضِ بَعْدَ اِصْلَاحِهَا وَادْعُوْهُ خَوْفًا وَّطَمَعًاۗ

"And do not cause damage to the earth, after (Allah) has repaired it" (QS. Al-A'raf: 56).

The government has issued regulations on the capture and trade of protected animals in the form of laws giving serious attention to the protection of protected and endangered animals, including the protection of sharks. In PP number 7 of 1999 concerning Preservation of Plants and Animals, saw sharks receive full protection so they cannot be exploited for individual or commercial interests. Decree of the Ministry of Maritime Affairs and Fisheries Number 18 of 2013 which stipulates the protection status of sharks and whales, followed by the determination of the protection of whitehead sharks and hammerhead sharks as in Decree of the Minister of Maritime Affairs and Fisheries Number 57 of 2014 (Zaka Firma & Sholahuddin, 2017).

Shark populations are still heavily exploited, with a decline of more than 70% in the last 50 years. As an apex predator, this animal is very important for the balance of the marine food chain. The loss of sharks will have a negative impact on the food chain in the sea and coral reefs. The Indonesian Ulema Council (MUI) has established Fatwa of the Indonesian Ulema Council (MUI Fatwa) No. 14 of 2014 concerning Preserving Endangered Animals for Ecosystem Balance. Based on Islamic teachings, in this fatwa the MUI decided, among other things, that every living creature has the right to live its life and be utilized for the benefit of humanity. Islamic teachings emphasize that animals have the right to shelter and be protected. Islam teaches to do good to every creature, including animals. It is hoped that the MUI fatwa will effectively be able to provide changes in perception and awareness in society (Clement et al, 2010; McKay et al, 2014).

Islamic teachings about preserving animals and the MUI Fatwa can be socialized more intensively through informal community leaders who are respected at the grassroots level, such as religious leaders and regional leaders in local communities. The hope is to raise public awareness and participation in preserving protected and unprotected animals.

Conclusion

The total shark that was identified from this research using COI markers was Bongo shark (*C. plagiosum*). Of the 8 samples, only one shark was identified molecularly. This is possibly caused by the COI marker used being less specific.

Sharks that have been identified molecularly have conservation status based on the IUCN Red List of Threatened Species, namely near threatened (NT), whereas not all sharks have conservation status based on CITES. The *C. plagiosum* samples have not been found to have conservation status based on CITES.

The basic law of consuming shark is halal, unless it causes harm. However, in the context of positive law in Indonesia, sharks are protected animals, therefore, sharks are prohibited for consumption.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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