Volume 1 Issue 1 (2022): 8-17
Tropical Marine Environmental Sciences
e-issn 2962-0759

Endangered Shark Species Identified in Bintan Island Waters, Riau Island Province, Indonesia

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Article Info

Received
31 August 2022

Accepted
25 September 2022

Keywords:
Shark,
Identification,
Trading,
Catch.

Abstract

Shark is one of the fish caught and traded around Bintan Island, Indonesia. There are at least 13 species of shark and of which there are 3 species that are already in endangered status. This research was conducted from January 2 to June 30 at the Padang Coastal Marine Resources Management Center (PCMRMC), Tanjung Pinang Work Unit. The purpose of this study was to identify the species of deep shark whose population is critically endangered and endangered in the waters around Bintan Island, Riau Island Province, Indonesia. Shark identification is done by observing the shark's physical body in whole or in part. Includes color, fin shape, tooth shape, motif. A number of 3 critically endangered and endangered shark species were identified from Bintan Island waters, namely the scalloped hammerhead (*Sphyrna lewini* Griffith & Smith, 1834), zebra shark (*Stegostoma tigrinum*), and sandbar shark (*Carcharhinus plumbeus*). All of these sharks are still caught, consumed and traded in this area. According to the IUCN, the current population conservation status of them is critically endangered (scalloped hammerhead), and endangered (zebra shark and sandbar shark).

1. Introduction

Sharks are found in almost all waters around the world, from the shallows to the deepest parts of the oceans. Some species migrate over great distances, moving between different locations to breed and find food sources. Some of these migrations are fairly easy to track. But there are also sharks that migrate individually or in small numbers, making it very difficult to track their movements. Some shark species also migrate vertically, i.e. between deeper and shallower waters and vice versa every day. This kind of migration is called vertical diel migration. This daily migration distance ranges from 30 to 300 feet (tens to hundreds of meters) depending on the shark species. Sharks have a variety of adaptations that make them very well suited to their environment. No wonder they are called the most accomplished predators on the planet. The skeleton of a shark is made of cartilage. It is strong and durable, yet much more flexible and lighter than ordinary bone. The lighter weight helps the sharks to stay afloat and reduces the amount of energy they need to move. The flexibility of cartilage also allows them to turn quickly. Making it one of the most agile animals in the ocean (Compagno, 2002; Carrier & Musick, 2004).

According to scientists, shark populations have declined globally by about 70% over the past 50 years, which makes it all the more urgent to reform fishing laws and landing restrictions. According to recent research, there is a significant disparity between shark import and export data between Indonesia and its trading partners. There is a complex domestic shark trade network and a

surge in live shark exports (Dharmadi & Satria, 2015). With an average annual landing of 110,737 metric tons between 2007 and 2017, Indonesia, the world's largest shark fishing nation, is home to one-fifth of all known shark species. Interestingly, it was reported by the Wildlife Conservation Society that in 2018 around 86% of Indonesian fisheries caught sharks as bycatch (Einhorn, 2021; Adams *et al.*, 2018).

Shark skin is covered with millions of tiny teeth that grow and point backwards called dermal denticles. The trail behind these denticles reduces surface drag and helps the shark swim faster. As sharks grow, they shed their denticles, replacing them with larger ones. The denticles vary in shape according to the species and where they are located on the body. Some species have denticles so large that sharks use them as spines or defensive shields. Sharks fend for themselves soon after birth, so they are born with complete bodies. They have many rows of teeth that are constantly changing (Carrier & Musick, 2004). Sharks replace their teeth about every 2 weeks. Some species can lose 30,000 teeth in their lifetime. We can tell what sharks eat by the shape of their teeth. The flat crushing teeth are perfect for eating shellfish. Sharp teeth for gripping fish. And sharp serrated teeth for larger prey, such as seals. Shark teeth can change as this fish ages (Compagno, 2002; Compagno, 2003).

Shark fins provide balance and stability in the water. Sharks have a large dorsal fin that provides balance. Usually they also have a smaller dorsal fin further back towards the tail. Their pectoral fins are used to direct and lift themselves in the water. And their tails are used to propel themselves forward. Shark fins and tails can vary in size and shape. Sharks that swim faster tend to have shorter, crescent-shaped tails. The slower moving sharks have longer and thinner tails. Unfortunately, the high demand for shark fin has contributed to the decline of many shark species. In order to breathe, many species of shark have to keep moving forward constantly. As they swim, water is pushed through their mouths and out through their gills. A process known as 'ram-ventilation'. When water passes through the gills, oxygen is absorbed into small blood vessels and transported throughout the body (Carrier & Musick, 2004; Compagno, 2002).

Sharks grow and mature slowly and only reproduce in small numbers during their lifetime. Unlike most true bony fish, they strive to produce a small number of highly developed chicks at birth rather than releasing large numbers of eggs which have a high probability of not surviving. Due to the conservative character of their life cycles and ecological sensitivity to fishing pressures, sharks are particularly susceptible to overexploitation (Stevens, 2000; Stobutzki *et al.*, 2002).

Sharks have been exploited and traded in recent years to meet the growing demand for a variety of consumer products, including fins, meat and cartilage (Muttaqin *et al.*, 2019; Clarke *et al.*, 2006). Because of overfishing, the shark population has dropped by 71% since 1970 (Einhorn, 2021). As a result, several species have experienced dramatic population declines, and it is currently estimated that one in four Chondrichthyan species is facing extinction. Therefore, sharks are one of the most endangered vertebrate species in the world (Dulvy *et al.*, 2014). There is a trade-off between the goals of shark conservation and the economic and social importance of shark fishing in Indonesia. This study aims to identify, evaluate the status and efforts of trade in critical and endangered sharks in the waters of Bintan Island, Riau Archipelago Province, Indonesia.

2. Methodology

2.1. Time, Place and Materials

This research was conducted from February to May 2022 in the waters of Bintan Island, Indonesia (Figure 1). The sharks were caught by fishermen from around the marine waters of Bintan Island and then landed at Tangseng Harbor, Bintan Island, Riau Islands Province, Indonesia. Identification of the sharks were carried out at this port and at the Padang Coastal and Marine Resources Management Center (PCMRMC), Tanjung Pinang Work Unit, Indonesia. In addition, observations and identification were also carried out at several places selling processed shark fins on this island as well.

2.2. Research Design

The shark caught by fishermen in the waters surrounding Bintan Island landed at Tangseng Harbor. Then observed and identified at the port and at PCMRMC, Tanjung Pinang Satker. In addition, observations and identification were also carried out at several places selling processed shark fins in this area.

The tools used to identify the type of shark are: identification book, camera, laptop, ruler and meter. The material used is fresh shark caught in the waters of the Bintan Islands and its surroundings and also processed shark fins. Identification is done by observing the overall physical characteristics, certain parts of the body or fins of the shark. Documentation was carried out by photographing objects using a camera with reference to Clarke *et al.* (2006); Compagno (2002); Compagno (2003); CITES (2021); and Compagno *et al.* (2014).

2.3. Data Collection

Data collection was carried out by direct observation of the species of sharks that were trafficked at the port location as well as to the commodity trading business. Secondary data was obtained from the PCMRMC, Tanjung Pinang Work Unit and added with reports, journals, theses, dissertations and books.

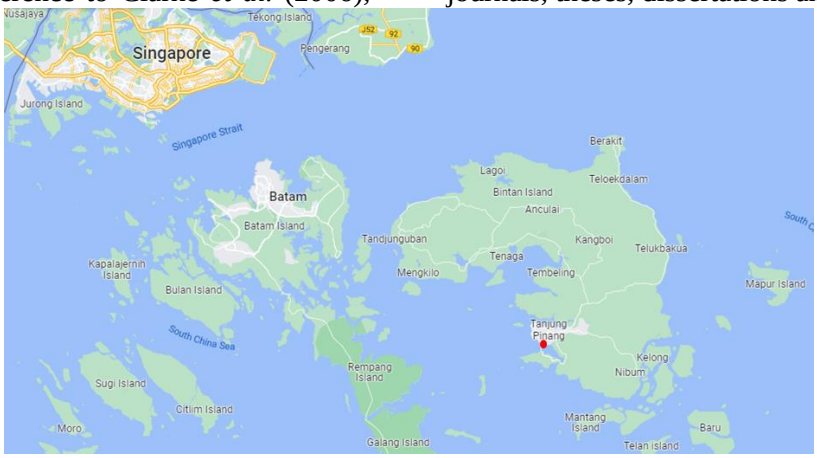

Figure 1. Location of the research area on Bintan Island, Riau Islands Province, Indonesia

3. Result and Discussion

In this study 1 species critically endangered shark (scalloped hammerhead) and 2 species of endangered shark (zebra shark and sandbar shark) were identified from Bintan Island waters, Riau Island Province, Indonesia.

3.1. Scalloped hammerhead (*Sphyrna lewini*)

This shark can be identified by looking at some of the characteristics that exist in this shark, including: 1). The shape of the head widens sideways so that at first glance it can look like a hammer, the width is less than a third of the body length. 2) The front edge of the head is very curved, there is a shallow indentation in the middle. 3) The first dorsal fin is high, slightly curved while the second dorsal fin is short. 4) The underside of the body is white and 5) the mouth looks like a semi-circle (Figure 2).

This type of shark is found throughout warm tropical and subtropical waters. It is the most common species in the tropics, found in archipelagic waters and continental shelves from the surface layer to a depth of 275 m. Scalloped hammerhead belonging to the Sphyrnidae family is a type of shark that is often caught in Indonesian waters (White *et al.*, 2008), especially in the Indian Ocean region south of Java and Nusa Tenggara (Chodrijah, 2013; Fahmi & Dharmadi, 2015). This is in accordance with the condition of the waters around Bintan Island which has a tropical climate, dominated by shallow, clear waters and overgrown with coral reefs. The hammerhead shark was originally a bycatch in tuna fisheries but in artisanal fisheries in some areas it is sometimes a catch target (Drew *et al.*, 2015; Fahmi & Dharmadi, 2013). Furthermore, Fahmi & Dharmadi (2015) reported that the catch of *S. lewini* from longline fisheries based in Tanjung Luar was 18% of the total catch.

The population of S. lewini is thought to have been under pressure due to intensive fishing and trade, especially for its fins (Ferretti *et al.*, 2008; Hayes *et al.*, 2009). Although the status of the population is not known with certainty, it is suspected that there has been a decline in the population of *S.lewini.* throughout the world, one of which is in the waters of the Indian Ocean. In general, sharks are very susceptible to overfishing pressure (Galluccci *et al.*, 2006; Musick *et al.*, 2000) because they exhibit a K-strategy pattern of long life cycles, slow growth and sexual maturity and low fecundity (Castro *et al.*, 1999; Last & Stevens, 2010; Stobutzki *et al.*,

2002). Therefore, it is necessary to monitor the population status of hammerhead sharks and other elasmobranchii in order to implement a sustainable fisheries management effort.

The need for data and information related to *S. lewini* is currently quite important considering its conservation status which according to the Red List of the International Union for the Conservation of Nature and Natural Resources (IUCN Red List) is Endangered and according to the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora has been included in Appendix II (Dulvy *et al.*, 2014; Fahmi & Dharmadi, 2013; White *et al.*, 2006). Fisheries Number: 59/PERMEN-KP/2014 and Number: 34/PERMEN-KP/2015. Information related to the biology and population of S. lewini in Indonesia is still relatively limited, such as studies on the composition of the size caught, sex ratio, age, growth and sexual maturity at certain fishing grounds (White *et al.*, 2008; Chodrijah, 2013; Drew *et al.*, 2015; Chodrijah & Setyadji, 2015).

The scalloped hammerhead (*S.lewini*) is part of the Sphyrnidae family. Originally known as *Zygaena lewini*, the genus name was later changed to its current name. The Greek word sphyrna translates to hammerhead, which refers to the shape of this shark's head like a hammerhead. The most distinguishing characteristic of this shark, as with all hammers, is the 'hammer' on its head. The shark's eyes and nostrils are at the ends of the extensions. This is a fairly large hammer, but still smaller than a large and fine hammer (Rigby *et al.*, 2021)

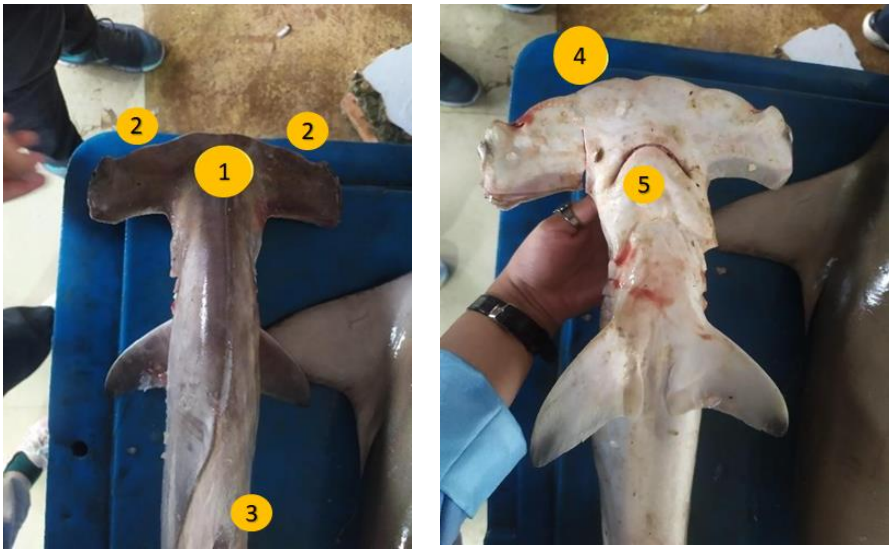

Figure 2. Scalloped hammerhead (*Sphyrina lewini* Griffith & Smith, 1834).

3.2. Zebra shark (*Stegostoma tigrinum*)

Local people usually call the zebra shark as “hiu belimbing” or starfruit shark. It is relatively easy to recognize from its slightly brownish orange color. Plus there are black spots on the surface of the skin. Characterized by the following characteristics: 1) The color of the body and skin is slightly brown and sprinkled with dark brown round spots 2) The tail is relatively long 3) The head is flat and 4) The outer layer of the fins is also sprinkled with dark brown round spots (Fig. 3).

A very distinctive and easily identified shark with a very long tail. During the day, divers usually zebra sharks resting motionless on the bottom. At night, they actively hunt, wriggling into caves and crevices in search of prey. Adults are yellowish to tan or brown with dark leopard-like spots. Juveniles are brownish to blackish with vivid white bands and large blotches. As the shark grows, the stripes gradually break up into spots (Bray, 2020).

Taxonomically, the zebra shark is a valid name for this shark species based on the results of a recent study described by Dahl *et al.*, (2019). Previously, the zebra shark was better known by the scientific name *Stegostoma fasciatum* or *Stegostoma varium*, now both names are synonymous names of *S. tigrinum*. Zebra sharks have distinctive morphological characteristics so they are very easy to recognize. In general, the body resembles a cigar with a tail that extends like a blade; the length of the tail is almost half of its total

length. On the back and sides of the body there are prominent streaks that extend from the back of the head to the base of the tail (Compagno, 2001; Compagno *et al.*, 2005).

Adult individuals are generally yellowish in color with brown spots, so it is not surprising that in Indonesia this species is called the starfruit shark because it is analogous to a star fruit. Meanwhile, in some locations, it is also called the spotted shark because of its spotted pattern that resembles a leopard (White *et al.*, 2006). Meanwhile, zebra shark chicks (juvenile) have a more diverse pattern but are generally brown with a pattern of stripes and white spots, so sometimes this shark is also known as the zebra shark (Compagno, 2001; Michael, 2001). Dahl *et al.*, (2019) states that leatherback sharks have a variety of body patterns but can be grouped into two groups of pattern variations, namely stripe morphs (zebra stripe morphs) and sandy morphs (sandymorphs).

The zebra shark or previously known as *Stegostoma fasciatum*, is an oviparous shark that usually inhabit in inshore and shallow coastal areas throughout the Indo West Pacific region, from South Africa to Solomon Islands. This species is found mostly on sandy substrates, around coral and rocky reefs, to at least 65 m depth. In 2019, the IUCN changed the vulnerable status of this species to be endangered due to the global population declined by 50% within the last 51 years. In contrast, the zebra shark was not classified as a threatened species in any regulations and conventions related to conservation acts both nationally and regionally. In Indonesia, this species has been caught and utilized for its fins, meat, skin, and cartilages for a long time and is often being traded as a live shark for aquaria. The ongoing exploitation of this species in this country has indicated local extinction in several locations (Dahl *et al.*, 2019; Dudgeon *et al.*, 2019).

The zebra shark is a species of shark that is commonly found in shallow waters in the tropics and subtropics. They are often found at depths of less than 65 meters, around coral reefs or in waters with sandy substrates on continental shelves (Compagno, 2001). The distribution of this shark covers the Indo-West Pacific region, from South Africa and the Arabian Peninsula in the west to the waters of Palau and the Solomon Islands in the east; while in the northern region it spreads from the waters of Japan and China to the south to the western and eastern regions of Australia (Dudgeon *et al.*, 2019). In Indonesia, this shark can be found in almost all shallow waters with sandy substrates from Aceh to Papua (Fahmi, 2021; White *et al.*, 2006; Fahmi & Dharmadi, 2013).

The zebra shark population in nature is gradually decreasing, even in some areas in Southeast Asia this species is believed to have experienced extinction locally due to overexploitation. Indications of the high level of exploitation of the leatherback shark have caused its conservation status in the IUCN (International Union for Conservation of Nature) red list to change, from previously being vulnerable to extinction to being categorized as endangered (Dudgeon *et al.*, 2019).

Figure 3. *Stegostoma tigrinum* and fin cut

3.3. Sandbar shark

The sandbar shark (*Carcharhinus plumbeus*) also known as the brown shark or thickskin shark, is a species of requiem shark, and part of the family Carcharhinidae, native to the Atlantic and Indo-Pacific Oceans. It can be distinguished by its very high first dorsal fin and interdorsal ridge (Rigby *et al.*, 2021). This shark can be identified from various characteristics including: 1) Body color and

fins are somewhat the same, namely grayish with a slightly rough texture with salt-like denticles. 2) The body is slightly oval, all the fins are slightly oval towards the back. 3) The ventral surface is slightly blackish at the apex and along the edges and in a backward direction. 4) The upper caudal fin is dominantly long and large compared to the lower caudal fin.

The sandbar shark is one of the largest beach sharks in the world, and is closely related to the black shark, the great nose shark, and the bull shark. The dorsal fin is triangular and very tall, and has a very long pectoral fin. The scallop shark usually has a heavy body and a rounded snout that is shorter than the average shark's snout. The upper teeth have broad, uneven protrusions with sharp edges. The second dorsal and anal fins are almost the same height. Females reach sexual maturity around age 13 with an average fork length (tip of nose to fork on tail) of 154.9 cm, while males tend to reach maturity around age 12 with an average fork length of 151.6 cm. Females can grow to 2–2.5 m (6.6–8.2 ft), males to 1.8 m (5.9 ft). Body color can vary from bluish to brownish gray to bronze, with white or pale underparts. The scallop shark swims alone or in groups separated by sex of varying sizes (Baremore and Loraine, 2012; Rigbya *et al.*, 2021).

Figure 3. *Carcharhinus plumbeus* and fin cut

The sandbar shark, as its nickname, is generally found on muddy or sandy bottoms in shallow coastal waters such as bays, estuaries, harbors, or river mouths, but also swims in deeper waters (200 m or more) as well. as the intertidal zone. The scorched shark is found in tropical to temperate waters around the world; in the western Atlantic they range from Massachusetts to Brazil. Juveniles are common in the lower Chesapeake Bay, and nurseries are found from Delaware Bay to South Carolina. Other nurseries include Boncuk Bay in Marmaris, Muğla/Turkey (Baremore & Loraine, 2012) and the Florida Keys (Ferrari & Ferrari, 2002). Natural predators of these sharks include the tiger shark, and rarely the great white. They themselves prey on fish, rays, and crabs.

3.4. Trade of Endangered Shark

In Tanjung Pinang City, Bintan Island, the fin is the most valuable part of the shark. This body part is usually used as shark fin soup. However, on the island of Bintan shark meat is also consumed by the community. Usually fried and covered in flour so it tastes so delicious. These two conditions have allowed the shark trade in this area to continue. This trade will of course result in suppression of the shark population due to shark fishing in the sea. Sharks in their whole form or dried fins appear to be commercially available in this area (Figure 4). The author himself at the time this research was carried out did not experience significant difficulties in finding shark landing sites and also stalls selling shark fins. Likewise, restaurants selling shark soup were also not difficult to find.

Located in Senggarang, precisely on Pasar Kota Tanjungpinang street, Swi Kim has been selling various fried foods for more than 15 years, from otak-otak to sausages. But the most famous menu is fried shark, which is made from sliced fish meat that is often found there. Swi Kim admitted that he got the shark he used at the seaside market. People call it sua he pia, a type of shark that doesn't attack humans. He continued, for the price range, Swi Kim set a price of 5 thousand rupiah for one piece of fried shark. It tastes good, like chicken, only a little fishy, if you eat it with rice, it might be more appropriate.

Shark items are typically distributed in Indonesia as partially processed (i.e., dissected and dried or frozen), frequently with a significant degree of morphological similarity amongst the various species. There isn't much species-specific desire for shark items among Indonesian consumers, which restricts the market's demand for products with verifiable and sustainable sourcing. This makes it more difficult for dealers, customers, and law enforcement officials to confirm that shark goods come from ethical and sustainable sources, which can result in fraud such as intentional species substitution and mislabeling. As a result, intentional species substitution and/or fraudulent labeling are made easier. Inaccurate seafood labeling poses a hazard to consumers' health and safety, endangered and protected species, sustainable fisheries management, and IUU (illegal, unreported, and unregulated) fishing (Muttaqin *et al.*, 2019; Hebert *et al.*, 2003; White *et al.*, 2006).

Authorities have difficulty tracing the origins of a wide range of processed shark and ray items, including shark meat and oil as well as fins and cartilage. Authorities can now utilize a new method known as DNA barcodes to identify the names and origins of species, including protected and endangered species (Hebert *et al.*, 2003). It can be difficult to strike the right balance between a good catch and long-term sustainability. The vast Indonesian Island makes it difficult for fisheries authorities to keep track of where fish are collected and how they are traded in home and foreign markets. A fascinating challenge is the intricacy of shark fisheries and how they affect population dynamics.

Figure 4. A view of a shark market on Bintan Island, Riau Island Province, Indonesia

3.5. Conservation status

Sharks and their relatives are one of the most threatened species groups in the world, with an estimated one in four species threatened with extinction. Every shark product will have its traffic recorded in the international trade in shark fin and shark meat. According to data taken from FAO and analyzed by Dent & Clarke (2015), the market for shark fin and shark meat has a distinct market. The majority of shark fin is for consumption in several countries, especially in East and Southeast Asia such as China, Hong Kong, Taiwan, Singapore, Malaysia and Vietnam. Even from 2000 to 2011, China and Hong Kong became the most important centers of the shark fin trade, followed by Thailand from 2007 to 2011 as the world's largest exporter of shark fin (Dharmadi & Satria, 2015; Dent & Clarke, 2015; FAO, 2015).

The sandbar shark (*C. plumbeus*) is an endangered species from the IUCN. The decline in the number of this shark populations is already very worrying. So far, a detailed survey of population size has not been carried out, but the population is believed to be declining. Shallow waters where fish live are fished intensively with longlines and gillnets, and blackspot sharks can be overexploited through overfishing. It is sold in local markets and the meat is used for human consumption (Dulvy *et al.*, 2021).

Marine sientists are urging the government to enact regulations to protect the sharks, which have experienced a declining population, according to Ministry of Maritime Affairs and Fisheries data. Sharks have biological characteristics that make them grow more slowly, which makes them vulnerable to fishing. In addition to their slow growth, sharks also reproduce slowly and only give birth to a

few young sharks. This causes several species of sharks to be included in endangered groups, such as freshwater sharks. It is therefore important to issue fisheries regulations to protect sharks from extinction.

To promote sustainable shark fisheries the trade in shark fins should be prohibited, gear sizes should be limited and regulated and there should be quotas and catch management, as well as protection for endangered sharks. Fishing gear must be selected properly, and limited to large-scale fishing gear, nets and nets. Many pregnant sharks are caught. Sharks only start the mating process after reaching the age of 30 years. Sharks also play an important role in marine ecosystems by maintaining the balance of the food chain. Data from the IUCN shows that sharks are under threat of extinction. It is estimated that the current population of sharks is only around 31%. Two hundred and fifty of the 1,250 vertebrate fish species live in Indonesia. In Indonesia shark fishing began in around 1980s and the demand for sharks in the international market increased (Fahmi & Dharmadi, 2015; White, 2006; White *et al.*, 2006).

4. Conclusion

In this study, 3 critically endangered and endangered shark species were identified from Bintan Island waters, namely scalloped hammerhead (*S. lewini* Griffith & Smith, 1834), zebra shark (*S. tigrinum*), and sandbar shark (*C.plumbeus*). All of these sharks are still caught, consumed and traded in this area. According to the IUCN, the current population conservation status is critically endangered (scalloped hammerhead), and endangered (zebra shark and sandbar shark)

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