Sabah Shark and Ray Catch, Trade and Conservation

SHARK STEWARDS

Image Courtesy Scubazoo

Dedicated in memory of Dr. Steven Oakley, founder of TRACC and longtime Sabah shark and ocean champion. (Image Hazel Oakley)

Prepared with the Sabah Shark Protection Association for the Global Shark Protection Fund

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i. FOREWORD

On behalf of the Sabah Shark Protection Association, a collaborative group of non-profits, businesses, and registered organizations in Malaysia and in Sabah, Shark Stewards has undertaken this report to (1) consolidate existing and unpublished data to better define the quantity and breadth of the catch of chondricthyan fish (sharks, skates and rays) in Malaysia and the trade of their meat and products, and (2) to make recommendations with the goal of increasing management, protection and conservation of these important fish, especially in Sabah waters.

Malaysia is a treasure trove of shark and ray diversity, with many endemic species valuable to the natural heritage and ecology, and with increasing value to the Malaysian economy that extends beyond fishing. As the population increases and more people rely on the oceans for food, managing marine food resource sustainably is increasingly urgent. In this report, we present market data on shark catch and shark fin in Malaysia, Sabah in particular. Additionally, we evaluate the current law on shark and ray catch as well as shark fin trade in Malaysia in general, and in Sabah specifically, and evaluate available market and catch data. We conclude with recommendations for increased management of catch and directed fishing of shark, skates, and rays, and the development of a comprehensive conservation strategy for elasmobranchs in Sabah. A very promising trend is the increasing government focus, NGO support and public attention to marine conservation. A hopeful trend towards marine protection and dive ecotourism can benefit sharks and rays while providing long-term economic benefits, as well as an enduring impact on ecosystem health.

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David McGuire
SHARK STEWARDS

ii. EXECUTIVE SUMMARY

Centered in the heart of the Coral Triangle, Borneo is well known as a region of high biological diversity and endemism. A diverse population of sharks and rays (elasmobranches) are among many species unique to Malaysian Borneo. However, population growth, increased fishing and a growing market demand for fins and ray gill-rakers is placing severe pressure upon many of Malaysia's elasmobranch populations. Evidence provided by dive tourism operators show a decline in large species of sharks and rays such as hammerhead sharks, whale sharks, and reef sharks. (Sharks and Rays Domestic Trade Report, 2015).

Sharks and rays are in peril globally, and Malaysia is no exception. The first systematic analysis of threats for a globally distributed lineage of 1,041 chondrichthyan fishes, sharks, rays, and chimaeras was published in a report by the IUCN Shark Specialist Group (SSG) in 2014, entitled: the *Global Conservation Status of Sharks and Rays*. It estimated that one-quarter are threatened according to IUCN Red List criteria due to overfishing (targeted and incidental). The SSG identified Malaysia, located within the Indo-Pacific Biodiversity Triangle, as among three main global hotspots where the biodiversity of sharks and rays is most seriously threatened. The authors emphasize the need for national and international action to protect sharks and rays from overfishing. Large-bodied, shallow-water and freshwater species are at the greatest risk and five out of the seven most threatened families are rays and sawfish. Many of species in these families are limited to and even endemic to Borneo, including 4 species of sawfish, and are at grave risk.

The state of sharks in Malaysia parallels the state of sharks globally, where a lack of accurate, species-specific harvest data often hampers quantitative stock assessment and sustainable stock management. Moreover, confusion in designation of shark fin in trade data makes shark fin exports and imports more difficult to define and grossly underestimates the quantity of shark fin in the Malaysian market. The findings of the *Global Conservation Status of Sharks and Rays* report, however, indicates a large decline in reef sharks and hammerhead sharks. This report identifies an active shark and ray fishery within Malaysia, including Sabah. As a result, many species of sharks and large rays are on the decline and are traded despite international protections for trade under CITES.

Although the total declared value of world trade in shark products approaches USD 1 billion traded per year, current knowledge of this increasing globalized market remains limited. According to the Food and Agriculture Organization of the United Nations, Malaysia is currently ranked as the world's 9th largest producer of shark products and 3rd largest importer in terms of volume (Food and Agriculture Organization of the United Nations, State of the Global Market for Shark Products report, 2015). Ranked as the third largest importer of shark fin globally, trade and consumption of shark fin in the country is among the highest. Consumption and trade of shark fin in Sabah is high, as observed by the high import to export ratio, market surveys cited herein and the widespread availability of shark fin soup available to both tourists and locals. Import/export codes make tracking of trade difficult, or even absent in the case of gill rakers, and the trade is believed to be largely underreported.

Shark and ray meat consumption in Malaysia is an important source of protein, particularly for subsistence and artisanal fishers. However, these landings are not included in official fisheries statistics leading to management concerns for a sustainable fishery. Malaysia Market and trade surveys of shark catch and shark fin conducted in Malaysia by the author and other investigators

indicate that a more significant shark and ray fishery exists in Malaysia than is reported in statistics under the Department of Fisheries. Much of this catch is underestimated or unaccounted for in official records. Large sharks, and increasingly Manta rays and their cousins in the family Mobulidae are harvested, targeted primarily for their fins and brachial gills respectively, but also for their meat. Although Malaysia appears to be efficient in overall use of shark and ray meat, and shark finning is uncommon (finning is defined as removing the fins at sea from a live or dead shark and often discarding the body), the catch of many species is driven by the lucrative fin value versus the comparatively low value of the meat. Once detached and dried, shark fins are extremely difficult to distinguish the species of shark, or if the shark was legally or illegally harvested.

Shark finning is not illegal in Malaysia and although it is believed to be rare, cases of fins without the associated carcass is common, and allows for the trade of fins from unidentified, unaccounted and threatened species. A legal ban on shark finning has been adopted by over fifty countries and the practice has been condemned by the United Nations. Large sharks are disappearing from landing sites and endangered and protected species are landed in all the Borneo markets observed. Also, shark fin imports and consumption in Malaysia is one of the highest in the world; a market that threatens shark populations globally. While the perception by some may be that shark finning does not exist, and that all sharks and rays are bycatch, the fact remains that Malaysia does catch fish sharks and rays in numbers significant to cause population decline and threatens some species. Additionally, through the large importation and consumption of shark fin domestically, Malaysia is a responsible party in the global shark decline of sharks and contributes to the shark finning problem as a major consumer. To demonstrate that the country is protecting sharks in earnest, a shark finning regulation should be adopted with associated penalties significant enough to deter the practice.

On a positive note, the economic benefits of an expanding dive tourism market targeted at seeing sharks and rays, particularly in Sabah, is providing hope for the economy and a growing population dependent on the ocean for their livelihoods. Additionally, newly gazetted marine protected areas offer hope for healthy ecosystems and communities, providing alternative livelihoods for native people when properly managed and well enforced. Education efforts by the SSPA and their partners is having a positive effect on consumers and shark fin purveyors, and many restaurants and consumers have pledged not to consume shark fin soup in Sabah.

We endorse recommendations made in the Malaysian National Plan of Action for Sharks, by the Sabah government and by external reviewers, and add additional recommendations on how the Sabah can sustainably manage fisheries, protect habitat, and reduce future threats to sharks and rays in Sabah and Malaysia. More rigorous record keeping and trade restriction of protected and targeted species is necessary. The trade and consumption of fin and shark products needs increased monitoring and enforcement. Increased education for tourists purchasing and consuming shark fin, as well as for locals consuming shark fin and meat from protected species will aid in reducing threats to species of concern. Because sharks play such an important role in assuring a well-balanced and healthy ecosystem, prohibiting harvest and exports of listed species will ease pressure on the entire reef system. Supporting and developing the existing dive tourism network and applying science and enforcement to existing marine protected areas will ensure sharks, the marine ecosystem and the Sabah economy will flourish. Detailed recommendations by category are provided and we provide a list of these most important recommendations on the following page.

I. SUMMARY OF RECOMMENDATIONS

1. Amend the Fisheries Act to make shark finning illegal and require that all sharks are landed with fins attached. Require all landings of larger sharks of special interest to occur at public landing centers where these landings can be recorded.
2. Increase training of fisheries inspectors and improve data collection of shark are ray landings by species.
3. Develop a vessel management or automated information system to determine trawler catch and landings, discards and specific regions of catch.
4. Reevaluate Malaysia's classification of 'bycatch' to recognize that sharks and rays and their products are in fact targeted catch and a reconciliation for consistency of language between Federal and State fisheries laws, and recategorize as byproduct.
5. Require all landings of protected and CITES listed species are prohibited and that their products are illegal for trade and consumption.
6. Increasing protection of endangered species and enforcement of landings of listed species.
7. Reduce shark fin import and consumption through a national and state campaign to stop serving shark fin soup. Build on education targeted towards reducing shark fin imports/ exports and internal shark fin consumption.
8. Adopt clear legislation making shark finning illegal and the selling and trade of shark fins illegal from any protected, threatened or listed species. List all CITES species of elasmobranches in appendix I and II in the ESA and enforce regulation of the trade of-listed species.
9. Reconcile Federal and State fisheries definitions and regulations for shark and ray fishing to allow consistent enforcement.
10. Develop consistent trade coding for shark fin and ray gill rakers for imports, exports and re-exports.
11. Support an increased training and enforcement program for staff within established Marine Parks utilizing a community-based conservation model to train and provide skilled jobs for locals who may have previously depended on shark fishing for income.
12. Institute a shark tourism fee across all snorkel and SCUBA resorts that will go directly to enforcement infrastructure such as patrol boats and enforcement officers.
13. Prohibit exports of any undocumented or uncoded seafood product for personal use (e.g. tourist personal exports of fins, seahorses, fish maw, live fish, ray gills etc).
14. Support citizen science and adopt consistent data collection protocols, and endorse well managed shark and ray diving ecotourism at a state and national level.
15. Develop a state and national working group that will support sustainable dive tourism that protects shark populations through shark conservation tourism with direct revenues to local communities with clear deadlines and deliverables.

This report concludes by underscoring that shark ecotourism is currently contributing to the Sabah economy and can provide additional long-term economic benefits to key areas including marine protected areas. Shark ecotourism will benefit all stakeholders and help protect biodiversity hot spots and their abundance of threatened species. This economic sector can develop and support alternative livelihoods to local, indigenous subsistence and artisanal fishers.

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iv. ABBREVIATIONS

ABBREVIATIONS	
ASEAN	**Association of Southeast Asian Nations**
DOFM	**Department of Fisheries Malaysia**
DOFS	**Department of Fisheries Sabah**
FAO	**Food and Agriculture Organization of the United Nations**
IPOA - Shark	**International Plan of Action for Conservation and Management of Shark**
mt	**Metric Tonnes**
NPOA	**National Plan of Action**
SAFMA	**Sabah Fish Marketing Authority - name of landing in Kota Kinabalu**
SEAFDEC	**Southeast Asian Fisheries Development Center**
SEAFEST	**Name of a jetty in Semporna, Sabah**
S.E.A.S.	**Shark, Environment and Awareness & Survival-SEAS is the conservation arm of Scuba Junkie**
SSPA	**Sabah Shark Protection Association**
TRACC	**Tropical Research and Conservation Centre**
WWF	**World Wildlife Fund for Nature**

II. INTRODUCTION TO SHARKS AND RAYS IN MALAYSIA, SABAH

A. Introduction

Since the time of early scientific exploration, it has been well-established that the island of Borneo is a major center of evolution and radiation of endemic terrestrial plants and animals. Approximately 15,000 species of plants, more than 220 species of terrestrial mammals, and some 420 species of endemic birds inhabit the land. This diversity does not stop at the shoreline. The Coral Triangle covers just 2% of the world's oceans but contains 76% of known coral species. [1] The marine biodiversity of Malaysia parallels or surpasses the land in species and endemism, with the island of Borneo high on this list of unique species. Overall, more than 350 coral species are found in Malaysian waters. Sabah contains more than 75 percent of all Malaysian reefs and has high levels of coral diversity.[2]

The region is also known for its large diversity of freshwater flora and fish fauna. Out of 394 species of freshwater fishes, 149 are endemic to the island's rivers and lakes. In a comprehensive biodiversity survey of coral reef fishes of the Indo-Pacific, nearly 1,500 species were recorded in the 100,000 square kilometer grid along the eastern border of Sabah and Kalimantan.[3] Species diversity of sharks and rays is especially rich in Malaysia, with many species living only in the coastal waters and river systems of Borneo. The Malaysian Department of Fisheries Management lists a remarkable 162 species of Chondrichthyans (the group of cartilaginous fish that includes sharks, skates, rays and chimera) comprising 70 sharks, 85 rays, six skates and one chimaera, belonging to 18 families of sharks, 12 of rays, two families of skates and one family in the chimaera[4].

As the Malaysian population and fishing economy grows, increased pressure is occurring on sharks, rays, and the habitat they live in. Many species such as the whale sharks, the manta rays, and the sawfish are threatened globally and have declined in Malaysian waters over the last few decades.[5] Some of these species, like the extremely rare Borneo river shark are bordering on extinction.[6]

In this report we investigate the biodiversity of Malaysian sharks and rays, the estimated magnitude of impact from fishing them based on available data, and the protection mechanisms currently in place. We address threats and benefits of shark and ray protection to ecotourism, and - adding to recommendations made by others included in this summary document - we add recommendations to protect threatened species and marine habitat, and to maintain healthy populations and a balanced fishery.

B. Overview of Sharks and Rays in Malaysia

Sharks, skates, rays, and their sister group the Chimaera are cartilaginous fishes grouped in the taxonomic order Chondricthyii. The focus of this document is sharks, skates and rays (which include the guitarfish) in the sub-class Elasmobranchii. This group is relatively diverse and well represented in the marine and freshwater environments of Borneo. The other sub-class, the Holocephalii includes the ghost fish, or chimaera. This group includes deep sea taxa represented by only one known species in Malaysia and is not generally taken for food.[7]

Although known by indigenous peoples for centuries before European arrival, collections and descriptions of chondricthyan fish began in the early 19th century. In 1849 Cantor compiled the first catalogue of Malaysian fishes that included 28 species of sharks and rays. Basic information, such as collection details, morphological traits, distribution within the region and basic biology, were not

collected at that time. In the next century, Fowler and Herre added new descriptions and data on elasmobranchs from Borneo and Indonesia, especially from Sabah and Sarawak. Since that time the species list of sharks and rays in Malaysia has grown.[1]

In 1996, a project funded by the Darwin Foundation (termed the Darwin Project) provided data on 36 chondrichthyan species from Sabah, and three years later a published checklist from Borneo included 82 species of elasmobranchs in Malaysia. Once the Darwin Project commenced, regular market surveys immediately began to yield new records for Sabah and new records were reported throughout the 18-month survey until 25 new records of sharks and rays had been obtained.[1] The team soon realized that a large number of taxonomic groups (particularly among the rays) were poorly known and that much more research would be necessary before all species can be identified.[6]

New technology using DNA analysis and an increased interest in sharks and rays have lead to the description of more species in the last two decades. Following the Darwin Project, another study of the chondrichthyans of Brunei and Malaysia, including Sabah and Sarawak occurred between 1999 to 2004. This primarily Malaysian-led study collected 760 specimens of 79 species, comprised of 43 sharks, 35 rays and one species of chimaera[8]. A National Science Foundation (NSF) study of Borneo expanded this list to include 118 validated species, including 52 sharks, 65 rays and 1 chimaera. The surveys led to the descriptions of an additional 9 new species, as well as specimens of endangered, rare or little known species, including the rediscovery of the Borneo shark (*Glyphis fowlerae*)[1], known only by an 1850 museum specimen and thought to be extinct[1]. A comprehensive list of species of Malaysian Chondrichtyes has been published by Compagno 2014[9].

Because of its geological isolation, Borneo has a unique assemblage of families and species of sharks and rays. Ground sharks (Carcharhiniformes) and the eagle, manta and devil rays (Mobulidae) are the dominant subgroups in each region comprising more than 20% of the species. The Myliobatid rays, which include devil and manta rays are more dominant in Borneo than any other region. Eagle rays (Myliobatidae) and devil rays (Mobulidae) are more diverse in this region than off Australia. Common elsewhere, the dogsharks (Squaliformes) and the skates (Rajoidei) are relatively absent in Borneo. This may be due to the comparative absence of deepwater habitats near the coast. The richest family in shark species in the region are the whaler sharks (Carcharhinidae) and stingrays (Dasyatidae). Both families represent the highest relative proportions of any marine fauna in Borneo[1].

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[1] Note: *Glyphis fowlerae*

has been reclassified as G. *thurmoni* by et al 2018, and it is believed that the species may be more widely distributed outside the Kinabatangan river basin than previously believed.

Shelf demersal species, otherwise known as bottom living, make up about 70% of the Elasmobranches, and are more dominant in Borneo than in other regions. Of particular interest is the presence of freshwater species, including around the Kinabatangan river where several species of endemic river shark and rays are described from specimens collected from the region. Freshwater and estuarine species of sharks and rays, which includes the guitarfish are among the highest represented, making up almost 7% of the species[1].

Borneo is the type locality for several rare and endangered species including the sawfish (*Pristis zijsron)* and the Borneo shark (*Carcharhinus borneensis)*. Holotype species - that is species serving as the scientific reference for species description - include the Blackspot shark (*Carcharhinus sealei)*, Borneo broadfin shark (*Lamiopsis tephrodes*) and the deepwater Borneo legskate (*Sinobatis borneensis)*. Dr. Sarah Fowler has cited another 10 newly discovered species as holotype species[1]. As the region's biology becomes better studied, new species continue to be described. However, among this rich diversity of elasmobranchs are increasing threats to many species and populations of sharks and rays in Borneo[10].

Scalloped Hammerhead, *Sphyrna lewini* Image: Shark Stewards

C. Global Status of Sharks and Rays

A 2014 report to the IUCN titled *Extinction Risk and Conservation of the World's Sharks and Rays* states that the extinction risk of sharks and rays is substantially higher than most other vertebrates. Population depletion has occurred throughout the oceans, but is particularly prevalent in the Indo-Pacific Biodiversity Triangle that includes Malaysia[10]. The IUCN Shark Specialist Group (SSG) evaluated the status of 1041 species of shark, ray, and chimaera species globally. The work group estimates that one quarter of these species are threatened under the IUCN Red -List of Threatened Species criteria, mainly due to overfishing. The threatened IUCN Red List categories include Critically Endangered, Endangered & Vulnerable rankings. Among these species, the SSG classified 107 ray species and 74 shark species as threatened. The sharks & rays at highest risk for extinction are large-bodied species that live in shallow (heavily fished) coastal waters and/or freshwater. Rays make up 5 out of the 7 most threatened families of cartilaginous fishes globally[10].

A large number of species in Malaysian waters represented on this list include well known, charismatic species such as: whale sharks, manta rays, scalloped hammerhead sharks and sawfish. As a result of their high exposure to coastal shallow-water fisheries and their large body size, sawfishes (Pristidae) are the most threatened chondrichthyan family and arguably the most threatened family of marine fishes. Four of the five known species of sawfish live in Malaysia. All five species are today classified as endangered or critically endangered on the IUCN Red List[11].

The Indo-Pacific Biodiversity Triangle, particularly the Gulf of Thailand and the islands of Sumatra, Java, Borneo, and Sulawesi, is a hotspot of greatest residual threat especially for coastal sharks and rays with 76 threatened species[10]. Malaysia, Borneo in particular, has a unique distribution of freshwater elasmobranchs, many endemic to Borneo. These freshwater sharks and rays suffer multiple threats including limited geographic distribution, and loss of habitat. Local examples include the endangered roughnose stingray (*Pastinachus solocirostris*) that is found only in Malaysian Borneo and Indonesia (Kalimantan, Sumatra and Java), the endangered giant river stingray (*Himantura kittipongi),* the extremely rare Borneo river shark (*Glyphis fowlerae*), a small shark reported only in the Kinabatangan river in eastern Borneo known from only 14 collected specimens in 1996[21,9].

The Borneo River Shark and four other members of the genus Glyphis are listed as either Critically Endangered or Endangered by the IUCN Red List of Threatened Species. The issues facing these coastal sharks are similar to those facing the river sharks, especially given an apparently very restricted range and human impacts on its habitat. The extent of logging and the increasing development of palm-oil plantations within the region increase threats to species with limited range and habitat. Thus, the Borneo river shark is likely to fall into one of the most highly threatened categories and its conservation status urgently requires assessment[8]. Research indicates these rare sharks are the most restricted in range and thus highly vulnerable[11].

Chondrichthyan fish are often caught as incidental catch or bycatch, but retained as valuable catch in fisheries that focus on other species[12]. In many cases, fishing pressure on chondrichthyans is increasing as teleost target species become less accessible (due to depletion or management restrictions) and because of the high, and in some cases rising, value of their meat, fins, livers, and/or gill rakers[1,13]. Shark fins have become one of the most valuable seafood commodities by weight. A

[2] The Borneo River shark, has recently been reexamined and reclassified by Corrigan et al (2015) along with the Irrawaddy river shark (*Glyphis siamensis*) to a single species, *G. gangeticus based on genetic analysis,*

market study in the fin trade in Hong Kong estimated that the fins of between 26 and 73 million individuals are traded annually and are worth US $400-550 million[14]. Although market prices of shark fins have risen steadily, the landings of sharks and rays, reported to the Food and Agriculture Organization of the United Nations (FAO), increased steadily to a peak in 2003 and have declined by 20% since that time[15] (Figure 1).

It is estimated that the true global catch of sharks is likely to be 3–4 times greater than reported due to unregulated and often misidentified, unrecorded, or aggregated catches, or bodies discarded at sea. This results in a lack of species-specific landings information. The reported chondrichthyan catch is increasingly dominated by rays, which have made up greater than half of the reported taxonomically-differentiated landings for the past four decades.[16]

Global Chondrichthyan catch peaked in 2003 were worth US $1 billion; since then the value has dropped to US $800 million as catch has declined[17]. A main driver of shark fishing is the increasing demand for shark fins to supply the demand for shark fin soup, a traditional Chinese dish[14]. This particularly lucrative trade in fins (not only from sharks, but also from shark-like rays such as wedgefishes and sawfishes) remains largely unregulated across the 86 countries and territories that exported over 9,500 mt of fins to Hong Kong (a major fin trade hub) in 2010[10]. The status of these species underscores the need to better understand shark and ray population status in Malaysia. By evaluating catch, trade and consumption of domestic species to better assess risk, this provides data for more knowledgeable management decisions.

D. Uses of Sharks and Their Value in Malaysia

Shark and ray meat is consumed widely in Malaysia and as a traditional food by a small community in the eastern part of Sabah[15]. Small sharks, as well as those that are non-edible or unsuitable for bait are sold to fish mill factories as fertilizers. Rays are mostly consumed fresh (cooked or smoked) and salted[19]. However, the meat of many species of large sharks are rich in urea and unless treated are generally unpalatable[19]. The Malaysian Department of Fisheries (DOFM) has stated in the press that sharks are not specifically targeted by fishers but are caught together with other commercially important species as bycatch. The Department states that sharks are fully utilized in Malaysia and shark meat is both eaten and used in processed food e.g. fish balls and fish meal[4].

A 2005 market survey of shark consumption in Malaysia reported that only five shark species are locally accepted as table food. Both meat and fins from species such as the silky shark (*Carcharhinus falciformes*), blacktip shark (*C. limbatus)*, hardnose shark (*C. macloti*), spottail shark (*C. sorrah*), and spadenose shark (*Scoliodon laticaudus*) are in great demand and the prices of these species were increasing in the 1990s[20]. Markets for shark liver oil, cartilage, skin and teeth are limited but may be under-represented by existing trade statistics, which usually do not distinguish these products as deriving from sharks. Ray skin is exported to Thailand for leathermaking[1].

1. The Value of Shark Fins

Shark fins are the most valuable Chondrichthyes product per unit weight and their use as a luxury food item in Chinese cuisine (most often used in shark fin soup) makes them in high demand. Species

popular locally amongst Malaysian Chinese for their fins and meat include blacktip reef shark (*Carcharhinus melanopterus*), blackspot shark (*C. sealei*), scalloped hammerhead (*Sphyrna lewini*), great hammerhead (*S. mokarran*) and smooth hammerheads (*S. zygaena*)[20].

In 2002, the most well-known and highly priced shark fin sold in Malaysia was the Shovel-nose Ray (*Glaucostegus typus*). The most popular at the time was likely the Blue shark, the largest species of fins traded by volume in Hong Kong and currently the highest priced shark fin traded. Others listed by traders are blacktip reef shark (*Carcharhinus melanopterus*), sandbar shark (*Carcharhinus plumbeus*) and hammerhead shark (*Sphyrna spp*.). **Table 1** below gives prices of shark fin sold in Malaysia in 1999[20]. The price of fins far exceeded the value of shark meat. The most expensive sharks fins were from the white-spotted wedgefish or giant guitarfish (*Rhynchobatus djiddensis*) and white-spotted shovelnose rays (*Rhynchobatus australiae*), bringing up to US $500/kg. Other species of big shark fins brought between US $50.00 - 65.00/kg[20].

Table 1 Prices of Fins by Shark Sold in Malaysia 1999

Name	Product	Size (inches)	Price RM
Basking Shark	4 piece set	pectoral fins 36-60	1000/Kg
Blacktip Shark	4 piece set	pectoral fins 13	310/kg
Blue Shark	4 piece set	pectoral fins 18-30	190-250/kg
Brown Shark	3 piece set	pectoral fins 15	290/kg
Sandbar Shark	4 piece set	dorsal 10, pectoral 13	220/kg
Ryukyu Shark	4 piece set		300/kg
Shovel nose Ray	3 piece set	pectoral fins 4-14	90-360/kg
Whale Shark	4 piece set	pectoral fins 3648	7-800/set

(Source: Vannuccini, UNFAO 2002) [19]

The demand and the prices for shark fins have increased rapidly, in pace with China's economic development[14]. Large fins from basking sharks or whale sharks are generally not eaten but are favored for display, and reported to bring as much as US $57,000[14]. Historical market data for prices per shark at the fin or kilogram level in Malaysia is difficult to find. In the mid-2000s, the reported average retail prices for processed shark fins was USD 218/kg to USD 332/kg in 2005[21].

In the last two decades, the demand and consumption of shark fin has escalated with the increasing affluence of Asian consumers, primarily in China. Between 2000 and 2011, the Food and Agriculture Organization of the United Nations (FAO), reported that an average of 16,815 metric tons of shark fins were traded around the world. Shark fin, and increasingly mobula ray gill rakers, are sold in wet fish markets to traders, prepared and dried in shops and exported[18].

Wet fins sell for much less than dried and treated fins. This study found fresh fins ranging from 25-5995 RM per kg in Semporna and Kota Kinabalu. In two recent market studies, wholesale figures for fresh fins ranged from a low RM 10/kg for small fins to RM 150 (Arshad 2017) in Kota Kinabalu [22, 23]. Street values of treated and packaged fins are much higher than wet or untreated fins. Fins observed for sale in the fishing centres in Sabah ranged from 10-75 RM for fresh fins[24]. Prepared and

packaged fins in Kota Kinabalu shops ranged from RM 595/kg for small shark fins to RM 2995/kg for large fins. The species were not identifiable (pers comm. Aderick Chong, Sabah Shark Protection Association). An independent survey by the author observed processed and packaged shark fins from small shark species ranged from 395 RM to RM 5995 for larger fins. Several packages of the highest priced fins appeared to the author's eye to have the distinctive concavity of hammerhead pectoral fins. The shopkeeper confirmed that all fins were from domestic sources but could not confirm the species of shark.

2. Trends in Malaysian Shark Landings and Prices

Prices of shark meat in Malaysia have risen steadily over time. The NPOA Shark 1 reported the price of shark bodies without fins (all sizes) in Sabah and Sarawak was about RM 0.80-2.80 (US$ 0.20-0.70/kg) in 2006. The prices of all species of elasmobranch in Peninsular Malaysia were consistently higher than that of the Federal Territory of Labuan, Sabah and Sarawak[18].

In 2012, the average prices per kilogram for sharks were RM 4.59 (ex-vessel), RM 5.85 (wholesale) and RM7.90 (retail) respectively. The State of Pulau Pinang registered the highest average ex-vessel and wholesale prices at RM 10.07/kg and RM 12.18/ kg respectively while the State of Kedah showed the highest average retail price of RM 18.92/kg. In the northern States such as Pulau Pinang, Kedah and Perlis, sharks fetched a higher price compared to other States due to the greater demand by the locals. The average ex-vessel price per kilogram of sharks increased from RM 3.74 in 2004 to RM 4.59 in 2012[18].

Trends in prices of shark meat and fins have been rising, attributed to an increase in wealth and lifestyle, and an increasing demand for the delicacy, shark fin soup[15]. Two market surveys in Malaysia indicate shark meat is also increasing in price, ranging from RM 2.0 Kg for small sharks to RM 16/kg for large sharks[23,24]. Sabah maintained its status as a net exporter of fisheries commodities, amounting to 74,973 metric tonnes with the value of RM 851.7 million in 2014[25].

III. EXISTING LAWS, POLICIES AND PROTECTION

A. International Law

1. Convention on the Trade of Endangered Species of Wild Flora and Fauna (CITES)

CITES is an international agreement to which states and regional economic integration organizations adhere to voluntarily. It was drafted as a result of a resolution adopted in 1963 at a meeting members of the International Union for Conservation of Nature (IUCN). States that have agreed to be bound by the Convention ('joined' CITES) are known as Parties. Although CITES is legally binding on the Parties – in other words they have to implement the Convention – it does not take the place of national laws. Rather, it provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES is implemented at the national level. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Malaysia entered as signatory of CITES in August 1, 1978.

2. Convention on Migratory Species

Malaysia is not yet a party to the Convention on Migratory Species. Adopted in 1979 and entered in to force in 1983, the Convention on Migratory Species (CMS) aims to build and strengthen global conservation efforts for migratory species in the air, on land, and in the seas. CMS, also known as the Bonn Convention, is an international and intergovernmental treaty backed by the United Nations Environmental Programme. Its current membership is 116 nations who work to conserve migratory species throughout their range and across national borders. However, Malaysia has signed the Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia in 2011. This MOU satisfies many of the CITES requirements for trade for sea turtles and their products.

B. Federal and Sabah State Regulations

1. Fisheries Act 1985 and Fisheries (Control of Endangered Species of Fish) Regulations 1999

Under the Fisheries Act 1985, the Minister of Agriculture and Agro-Based Industry is empowered to make regulations for the proper management of specific marine fisheries resources. Fisheries in federal waters are regulated by the Malaysian Department of Fisheries. Malaysian Fisheries Waters, as defined under the Fisheries Act (1985), refers to the maritime water under Malaysia's Federal jurisdiction where exclusive fishing rights or fisheries management rights are recognized. The Malaysian Fisheries Waters include the Territorial Sea of Malaysia and the Maritime Waters in the Exclusive Economic Zone of Malaysia. States fisheries management is conducted under state management plans encompassing coastal and inland waters. The definition of Inland Waters and Inland Fisheries may extend to areas that include Sabah's Coastal Zone. Inland waters broadly apply to waters of any river, waterway, lake, reservoir, and watercourse, including the foreshore and subterranean waters. Inland fisheries exclusively apply to fisheries in riverine waters.

Currently the management of Malaysian freshwater sharks and rays in inland fisheries (elasmobranchs) is under the jurisdiction of the states. In order to improve the conservation and management of freshwater elasmobranchs, the Federal Government will propose to the State Governments to establish and include the management of freshwater sharks and rays in their State fisheries rules.

To ensure sustainable exploitation of resources, restrictions on several methods of fishing are imposed under the Fisheries (Prohibition of Method of Fishing) Regulations 1980, and in Section 26 Fisheries Act 1985. These include: the use of explosives, poisons or pollutants, the use of electric shocks, and the use of pair trawls and push nets. The locally known 'pukat pari' is a drift net once used to catch large sized sharks and rays with a mesh size of more than 25.4 cm (10 inches). Nets with large mesh size has been banned since 1990. The Department of Fisheries Malaysia attributes that banning of this gear and fishing methods nationwide helped to reduce the excessive exploitation of sharks and rays and to conserve their breeding stocks, although there is no available data to support this.

Under the Fisheries (Control of Endangered Species of Fish) Regulations 1999, there are 25 species listed as endangered marine animals in Malaysia, including the whale shark. In 2008, seven additional species under the Family Pristidae (sawfishes) were listed as endangered species under the same regulations. The regulations stipulate that no person shall fish or, disturb, harass, catch, kill, take, posses, sell, buy, export or transport any endangered species of fish including their parts except with the written permission from the Director General of Fisheries Malaysia. Any person who contravenes the regulations can be fined up to RM 20,000 (US$ 5229) or a term of imprisonment not exceeding two years or both.

Whale sharks, (*Rhincodon typus*) and all rays from the Pristidae family or sawfish are categorized as 'threatened species' under the Fisheries (Control of Endangered Species of Fish) Regulations 1999, Fisheries Act 1985. It is prohibited to exploit these species and they are not allowed to be caught, sold, exported, consumed or kept as ornamental fish. In Sabah, only whale sharks and sawfish are listed as "threatened" under the Fisheries (Control of Endangered Species of Fish) Regulations 1999, Fisheries Act 1985[25].

2. International Trade in Endangered Species Act 2008 (Act 686) and enforcement of the Convention of International Trade of Endangered Species (CITES)

The Fisheries Act has been enforced since December 2009 with a view to implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Under CITES, Malaysia is required to adopt legislation for implementation and the Department of Fisheries Malaysia (DoFM), Department of Fisheries Sabah (DoFS) and Sarawak Forestry Department have been appointed as Management Authorities for fish. Under the International Trade in Endangered Species Act 2008 (Act 686), trade matters pertaining to hundreds of species, including their parts and derivatives, are being controlled by various authorities. CITES is adopted under the National Plan of Action detailed in the policy section below. However, discrepancies exist for sharks and rays between states and the federal fisheries regulations and work is necessary to harmonize rules between jurisdictions.

3. Convention on Biological Diversity (CBD)

Malaysia ratified the CBD in 1994, promoting biodiversity conservation as an integral part of sustainable development. Part of its obligation in accordance to the decision made at Conference of Parties (CoP) is to adopt the *Strategic Plan for Biodiversity 2011-2020*, with its Aichi Targets conserving Sabah's natural marine and coastal assets. This is achieved by increasing the area designated for conservation purposes (UN SDG 14.5); increasing the level of management and restoration of all marine resources (UN SDG 14.2); and UN Sustainable Development Goal (SDG)
14.5 requires 10% of Sabah's EEZ to be under active conservation management by 2020.

4. Legal Status of Sharks and Rays in Malaysia

A comprehensive review of the Malaysian legal framework for coastal and environmental protection can be found in the document Legal Status of Sharks and Rays in Malaysia, published by the Sabah Shark Protection Alliance.[27]

C. Sabah State Law Pertaining to Sharks

1. Sabah Aquaculture and Inland Fisheries Enactment 2003

First gazetted in year 2003, this enactment was fully implemented in year 2005, stating that all freshwater sharks and rays found in Sabah waters and listed under the IUCN Red List and/or CITES shall be managed in sustainable manner. Results of the studies conducted in Sabah rivers have shown that there are two sharks species found in Sabah rivers: Borneo river shark (*Glyphis fowlerae*) and bull sharks (*Carcharhinus leuca).* Freshwater rays include three batoids: the giant freshwater stingray (*Himantura chaophraya*) and two sawfishes (*Pristis microdon and P. zijsron*). Rules and regulations imposed under the specified section of this enactment eventually will conserve any threatened, protected, control and endangered freshwater sharks and rays.

The related Section applied notably stipulated under Sections:
(V): Fisheries and River Fishing (e.g. Prohibition of destructive/illegal fishing methods, selling and or keeping of its catches by using explosive, poisonous chemical, and electrical shock; Section
(VI): Control of Fish (e.g. any species listed under controlled species are not allowed to catch which include freshwater sharks and rays); Section
(VIII): Protection of Fish Habitat (e.g. Prohibition of destructive activities that threatening, disturbing or destroying fish habitat); and Section
(IX): Fish Sanctuary (e.g. the establishment of Fish Sanctuary mainly for conservation of flora and fauna and its habitat).

2. Control of Endangered Species of Fish

In 2017, the State Fisheries Department added four species of sharks and two species of rays to be included in Fisheries Regulations 1999 and the Fisheries Act 1985. The species of sharks included are the great hammerhead shark (*Sphyrna mokarran*) the smooth hammerhead shark (*Sphyrna zygaena)*,

the winghead shark (*Eusphyra blochii)* and the oceanic whitetip shark (*Carcharhinus longimanus*) while the rays are the oceanic manta (*Manta birostris)* and reef manta (*Manta alfredi*)[3]. Notably absent from this list is the scalloped hammerhead shark (S. Lewinii); a threatened species becoming increasingly rare in Malaysian waters as observed by landings data[22,23,24] and observations by diver survey reported by Scuba Junkie- S.E.A.S. pers comm., and Oakley[24] in Appendix III.

In a public statement April 16. 2017, Dr. Ahemad Sade of the Department of Fisheries, Sabah stated that of the 11 species of sharks and rays listed in the Appendix II of CITES, that four species of sharks and two species of rays be included in Fisheries (Control of Endangered Species of Fish) Regulations 1999, Fisheries Act 1985[4]. Although not yet formally listed under the Fisheries Act, the Federal government however, has decided that none of the 11 species of sharks and rays listed under CITES will be allowed to be exported for the time being. However, the Department of Fisheries has yet to include CITES trade regulations of the scalloped hammerhead (*Sphyrna lewini*) or the other rays in the family Mobulidae under CITES [27]

D. International, National, and Sabah Policy

1. National Plan of Action (NPOA Shark 1) of 2006

In 1999, the United Nations' Food and Agriculture Organization's Committee on Fisheries (COFI) created an International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks). The United Nations Food and Agriculture Organization's National Plan of Action (NPOA) is a non-binding agreement directing that all States should create and implement a National Plan of Action for Sharks (NPOA-Sharks). In accordance with the IPOA agreement, Malaysia developed its first NPOA Shark in 2004[18].

In 2006 Malaysia developed the NPOA-Shark under the requirement of the International Plan of Action for Conservation and Management of Sharks (Department of Fisheries Malaysia, 2006). This plan attempted to comprehensively address the fishing of trade of sharks and rays in Malaysia in accordance with UNFAO guidelines and was among the first in the SAEFDEC to do so.

2. NPOA Shark 2 (NPOA Shark 2) of 2014

The first NPOA-Shark published in 2006 has been revised in 2014 to take into account the suggestions made by the NPOA-Sharks 1, after the document was evaluated on its achievement. According to the NPOA Sharks 2, all the seven items under NPOA-Shark 1 have been addressed but sections on the socio economics profile of the fishers and middlemen requires further empirical evidence as well as on trade issues. Seven major items were considered under the first NPOA including: biology and habitat; socio-economic aspects of fishers and middlemen; trade; consumption of elasmobranch; capacity building and research coordination; increasing awareness through information conservation; and effective management of sharks and rays[29].

One of the major shortcomings recognized during the development of Plan 2 is the insufficient data to generate information pertaining to several aspects of reporting including trade and economic aspects of shark fishery. Specific benchmarks to measure performance not identified in Plan 1 were added into Plan 2. The authors of NPOA Plan 2 recognized both international and national issues surrounding threats to sharks and encompassing concerns from various stakeholders. Plan 2 was developed to

address issues, such as the declining shark landings, the negative perception of catching sharks and the misconception (*sic*) on shark finning.

The NPOA 2 addresses emerging developments and needs, gaps and issues identified from the earlier implementation, as well as emphasizes on education and awareness building among stakeholders. It differs from the initial plan by including prioritized timelines for short, medium and long-term strategies to achieve objectives, is action-oriented, and stresses on balancing the social- economic-ecological aspects in addressing shark conservation and management in Malaysia.

In a meeting discussing the NPOA 2, the requirement for assessment and monitoring were emphasized to ensure its effectiveness, including the need for data collection by species groups, more efforts to address 'bycatch', as well as research and funds required to do so. While emphasizing ecosystem based management, the meeting agreed on identifying feeding and nursery sites to be established as protected areas or fisheries prohibited areas for shark conservation.

NPOA Shark 2 (2014) Objectives

The overall objective of the NPOA-Sharks is to ensure the conservation and effective management of sharks and rays and their long-term sustainable use, as outlined in the FAO IPOA-SHARKS.

These objectives include:

- Ensure that shark and ray catches are sustainable;
- Assess threats to shark and ray populations, determine and protect critical habitats, and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use;
- Identify and provide special attention in particular to vulnerable or threatened shark and ray stocks;
- Develop and improve and the framework for establishing and coordinating effective consultation involving stakeholders in research, management and educational initiatives within and between States;
- Minimize unutilized incidental catches of sharks and rays;
- Contribute to the protection of biodiversity and ecosystem structure and functions;
- Minimize waste and discards from shark and ray catches in accordance with Article 7.2.2 (g) of the Code of Conduct for Responsible Fisheries (for example, requiring the retention of sharks from which fins are removed);
- Encourage full use of dead sharks and rays
- Facilitate improved species-specific catch and landing data and monitoring of shark and ray catches; and
- Facilitate the identification and reporting of species-specific biological and trade data.

A third revision of the NPOA Shark is currently in the process of preparation and is due to be published by 2020.

[3.3] ~~In 2018 the Reef and~~ Pelagic Mantas have been been reclassified with the devil rays into the same genus Mobula by White et a (2017)[34].

Exports of CITES Listed Species and the NPOA

At the time of the NPOA Plan 2 publication, there were three species of sharks- namely basking shark (*Cetorhinus maximus*), great white shark (*Carcharodon carcharias*), whale shark (*Rhincodon typus*), seven species of rays and all sawfishes in the family Pristidae listed under this Act. As of 2017, CITES added five species of shark that are not listed in the Third Schedule of the Act: oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead, great hammerhead (*Sphyrna mokarran)*, smooth hammerhead (*Spyhrna lewini*), the porbeagle (*Lamna nasus*) and all species of manta rays (*Mobula spp*.).
Absent from Malaysian waters listed under CITES include the basking shark (*Cetorhinus maximus)*, great white sharks (*Carcharodon carcharias),* porbeagle shark (*Lamna nasus)* and Smooth hammerhead (*Sphyrna zygaena).* Table 2 lists the CITES listed species present in Malaysian waters. A full list of elasmobranch species listed under CITES is listed in Appendix I.

Under the NPOA 2, any new CITES-listed species is to be added to this existing list. This Act controls any import, export and re-export, and introduction from the sea, possession, transit, breeding or propagation of species are scheduled under this Act [29].

TABLE 2 CITES Protected Species Reported in Malaysian Waters

Common name	Genus Species	Appendix	Year Listed
Whale Shark	*Rhincodon typus*	II	2003
Sawfishes	*Pristidae spp., 7 species)*	II	2007
Oceanic Whitetip	*Carcharhinus longimanus*	II	2014
Great Hammerhead shark	*Sphyrna mokarran*	II	2014
Scalloped Hammerhead shark	*Sphyrna lewini*	II	2014
Great Hammerhead	Sphyrna mokkaran	II	2014
Manta	*Manta spp*	II	2014
Mobulid Rays	*Mobula spp. (7 species)*	II	2017
Silky Shark	*Cahrchar hinus falciformus*	II	2017
Thresher Sharks	*Alopias spp.*	II	2017

3. Coral Triangle Initiative

In 2009, the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), a multilateral partnership initiative, was established between six nations located within or bordering the Coral Triangle region, including: Malaysia, Indonesia, Papua New Guinea, the Philippines, Solomon Islands and Timor-Leste. These nations are also known as the CT6, and have signed onto the initiative to taken a non- binding commitment to address conservation and sustainability concerns within the Coral Triangle.

Regional Plan of Action

The six participating nations signed a declaration to collaboratively take measures to protect the Coral Triangle by implementing a Regional Plan of Action (RPOA).
The RPOA contains five proposed goals that were developed as targeted initiatives to address priority concerns impacting the region:

- Designation of effectively managed seascapes,
- Application of an ecosystem approach to fisheries management,
- Establishment of a fully functional marine protected area system,
- Strengthening climate change adaptation and resilience, and
- Improving the status of threatened marine species

In the interests of shark and ray conservation and management we will feature four of these five, skipping over the long term impacts of climate change.

Malaysia National Plan of Action - Coral Triangle Initiative

Malaysia, along with the other cooperating nations, developed their own Coral Triangle Initiative--CFF National Plans of Action, which was adopted based on the nation's own local, unique conditions. Malaysia's participation under CTI-CFF includes some emphasis on managing practices, which would promote sustainable coral reef ecosystems and water environmental systems. Malaysia's CTI National Plan of Action report provides a list with description of individual targets set out to achieve each of the proposed goals. CTI National Plan of Action contains a set of five broad goals, which are developed in conjunction with list of target objectives and action plans unique to Malaysia[29].

The five overall goals of Malaysia's CTI National Plan of Action include:

1. Designate and effectively manage Priority Seascape areas,
2. Achieve an Ecosystem Approach to Fisheries Management,
3. Establish and manage marine protected areas,
4. Address climate change dangers and concerns, and
5. Improve the status of threatened marine species.

Under Goal 5 in this Plan: Threatened Species Status Improving is Target 1: Improved Status Of Sharks, Sea Turtles, Seabirds, Marine Mammals, Corals, Seagrass, Mangroves And Other Identified Threatened Species. Populations of sharks, turtles, marine mammals, corals, seagrass, mangroves and other threatened marine species on the IUCN Red List of Threatened Species (or listed under CITES) will no longer be declining (2015), followed by a clear trend towards and improved status (2020), as key steps for preventing their extinction and supporting healthier marine

Among the Action Items committed in this Plan relevant to sharks are:

Action 2 Implement the NPOA for Conservation and Management of Sharks. Indicators are:

- By-catch levels in capture fisheries
- Key predator species population status.
- Ecosystem populations balance.
- Data on life history and other aspects of natural history.

Action 10 Complete and implement the NPOA on IUU Fishing with the following indicators:

- Number and frequency of IUU fishing incidences.
- Number of educational programs.
- Populations of threatened species
- Number of cross - border infringements.
- MCS coverage (area and number days/ year).
- Number of vessels implementing responsible fishing practices.
- Level of understanding amongst coastal communities of adverse effects from IUU fishing
- Number of inter-agency operations.

Action 19: Identify cultural and economic uses of endangered species (both consumptive and non-consumptive), and assess the level and impact of traditional harvest, with particular attention to shark fins and turtle eggs.

- Level of cultural acceptance (perception) for sea turtle and shark conservation.
- Number and area of sea turtle protected sites (ha).
- Number of sea turtle eggs traded in markets.
- Population status of shark identified by species.

Additional commitments include Action to increase areas of marine protection, fishing gear restrictions and habitat protection under the CTI.

Priority Seascape Areas

Malaysia proposed to achieve the target of designating a set of priority seascapes for investment planning and action. To implement the planning and management goals of this target, the National Plan of Action lists a commitment to complete a National Coastal Zone Physical Plan for East Malaysia and Peninsular Malaysia by the year 2012. The tasks of conducting regular oceanographic surveys in the Sulu--Suluwesi Marine Ecoregion (SSME) and Malaysian waters area is emphasized as an area of commitment. The second target objective under this goal is to ensure the sustainable management of marine and coastal sources within Priority Seascapes for coastal communities the environment and economies relying on the coastal resources. Some the relevant commitment to actions proposed includes the management and conservation of SSME mangrove forest reserves and the development of a Mangrove Information System.

Ecosystem Approach to Fisheries Management

A target objective provided under this goal is to develop a strong legislative, policy and regulatory framework to achieve an Ecosystem Approach to Fisheries Management (EAFM), which utilizes the input and involvement of multiple stakeholders within different overlapping communities and industries. Some of the policy related action plans under this target objective includes: a commitment to establish a national policy on EAFM, updating of the Fisheries Act 1985 to reflect EAFM principles,

and development of EAFM Strategy for Sabah Fisheries. In the area of monitoring and enforcement, this target objective aims to increase participation of coastal community and fishers in reporting illegal fishing activities and increasing the operational capacity of MMEA and maritime enforcement. Another target objective proposed the development of a new initiative called the Sustainable Coastal Fisheries and Poverty Reduction Initiative (COASTFISH), in order to address measures to improve the income and livelihood opportunities for coastal communities while also protecting food securities.

Marine Protected Areas

In aiming for the establishment of marine protected areas, a target objective of this goal is to establish a region-wide Coral Triangle MPA System (CTMPAS). This would link individual Marine Protected Areas (MPAs) with networks of MPAs to increase income and food security for coastal communities and address marine conservation issues. The ultimate action plan is to establish marine sanctuaries and protection for near-shore habitats, particularly assigning these areas as "No Take Replenishment Zones", which will allow for sustainable management of fisheries resources.

Threatened Marine Species

This targeted objective was developed to protect populations facing a rapid decline. Sharks, sea turtles, seabirds, marine mammals, corals, and mangroves are recognized under this National Plan of Action as facing a rapid decline in numbers. Malaysia has signed onto a commitment to halt the decline rate by the year 2015, to prevent extinction of threatened species and improve the status of the listed species and other species listed under the IUCN Red List of Threatened Species. For sea turtles and sharks, Malaysia has made a commitment to implement a National Plan of Action for Conservation and Management to improve the status of these species. The Action plan to protect threatened species from depletion is based on the objective to promote policies such as the regulation of fishing vessel practices and the by-catch of threatened species in capture fisheries. Appendix I provides a list of threatened shark and ray species in Malaysia listed by the International Union for the Conservation of Nature. Of this list of sixty species listed as Vulnerable, Endangered or Critically Endangered, only a few are listed as threatened species under Malaysian law.

4. Sabah Blue Ocean Initiative

Developed in 2017, the 'Sabah Blue Ocean Initiative' Action Plan, is a sustainable development program aimed at conserving Sabah's natural marine and coastal assets by increasing the area designated for conservation purposes under the United Nations Environmental Programme Sustainability Goal 145. Sabah committed to this goal and also SDG 14.2, increasing the level of management and restoration of all marine resources. At the same time the programme addresses the need for prevention of further damage from IUU and fish bombing (UN SDG 14.4) throughout Sabah's EEZ waters and facilitating sustainable resource use to enable continuing economic growth and social stability for the people of Sabah. In particular, the plan has a focus on tourism that is environmentally sustainable and which increases the benefits arising for local communities. This plan, in progress is in the draft phase under the Sabah Department of Tourism, and Culture[31].

IV. Fisheries, Market and Trade of Sharks in Malaysia

A. Shark Fisheries and Catch by Common Species

In 2004, the South-East Asia Fisheries Development Centre (SEAFDEC) study, jointly undertaken with the Fisheries Department, culminated in the report *Elasmobranch Resources, Utilization, Trade and Management in Malaysia*[30]. During 1990's only five shark species were reported as locally accepted as table food. Both meat and fins from species· such as silky shark (*Carcharhinus falciformes*), blacktip shark (*C. limbatus*), hardnose shark (*C. macloti*), spottail shark (*C. sorrah*), and spadenose shark (*Scoliodon laticaudus*) were in great demand and prices of these species were increasing. Other species also popular locally amongst Malaysian Chinese for their fins and meat, especially blacktip reef shark (*Carcharhinus melanopterus*), blackspot shark (*C. sealei*), scalloped hammerhead (*Sphyrna lewini*), great hammerhead (*S. mokarran*) and smooth hammerhead (*S. zygaena*)[32].

This report is the first to identify the need to manage sharks and rays. It is also recognized in Malaysia, that sharks and rays have a significant value in promoting ecotourism, particularly diving and recreational angling. Much of the data collected in this early report was used in the development of the first NPOA[23].
Since 1982, landings of sharks and rays in Malaysia increased almost exponentially with a minor decline in 1990. Since 1991, landings in sharks grew steadily, peaking at 3,176 metric tons in 1995, and gradually declined to 1,577 metric tons in 2001. The report suggests that this could be due to over-fishing. Based on landing data collected from 2003 to 2004, the most dominant species of sharks captured in Malaysia were from the longtailed carpet sharks (Family *Hemiscyllidae*) and Requiem sharks in the family Carcharhinidae. The most common rays are whiptail stingrays (Family *Dasyatidae*)[27]. Since the first report on shark consumption, the list of shark and ray species in Malaysia common to consumption is growing.

SEAFDEC (2006) reports that the ten most commonly taken shark species in Malaysia (in order of abundance) are:

- Spadenose Shark (*Scoliodon laticaudus)*
- Brownbanded Bamboo Shark *(Chiloscyllium punctatum*)
- Spottail Shark (*Carcharhinus sorrah*)
- Indonesian Bamboo Shark *(Chiloscyllium hasselt*)
- Blackspot Shark (*Carcharhinus seali*)
- Scalloped Hammerhead (*Sphyrna lewinii*)
- Milk Shark (*Rhizaprionodon acutus*)
- Graceful Shark (*Carcharhinus amblyrhnchoides*)
- Sicklefin Weasel Shark (*Hemigaleus microstoma)*
- Grey Bamboo Shark (*Chiloscyllium griseum*)

With the exception of the scalloped hammerhead (*Sphyrna lewini)*, the sharks reported are small species which mature early at a relatively small size. These sharks live in coastal and inshore waters and are easily captured by trawls and nets. With increased fishing, large species and larger sharks

within shark populations are being fished, resulting in an increasing presence of smaller sharks more common in fish landings. The SEAFDEC report also demonstrates the danger of extrapolation from Peninsular Malaysia to Sabah. Some of these "common" species in eastern Malaysia are rare or absent from Sabah. For example, the Indonesian bamboo shark (*Chiloscyllium hasselt)* and the graceful shark (*Carcharhinus amblyrhnchoides)* common in Peninsular Malaysia, were absent or very rare in Sabah[33].

B. Landings of Sharks and Rays in Malaysia 1982-2012

In 2012 the second National Plan of Action Sharks was published, evaluating management measures and Catch records since the first NPOA. From 1982, landings of sharks in Malaysia increased from 4,444 metric tons in 1982 to 6,536 metric tons in 2012 with an average of 6,728 metric tons/year. Landing of rays also increased from 6,348 metric tons in 1982 to 15,612 metric tons in 2012 with an average of 13,396 metric tons/year. The peak landing for sharks was recorded in 2005 at 9,165 metric tons and rays in 2003 at 19,253 metric tons. (Figure 1). The highest landings of sharks and rays combined were in 2003 at 27,948 tonnes while the lowest landings were in 1985 at 10,185 metric tons. NPOA 2 authors conclude this trend is due to the nature of the fisheries and sharks and rays being seasonal in occurrence, in contradiction to the first NPOA where the authors suggest the decline may be due to overfishing[29]. Landings of sharks (blue), rays (red) and total (black) are displayed in Figure 1.

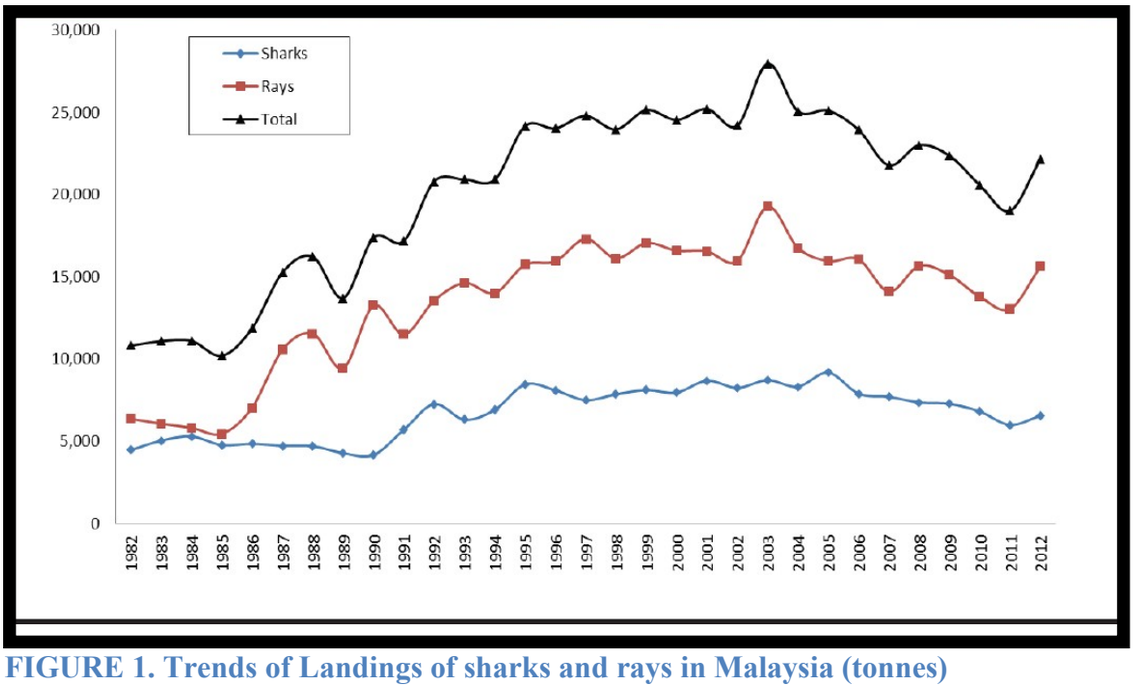


FIGURE 1. Trends of Landings of sharks and rays in Malaysia (tonnes)
Source: Annual Fisheries Statistics (1982-2012), in NPOA 2

Malaysia reports shark catch to FAO in two categories of which 'Rays, stingrays mantas nei' (not elsewhere included) comprise 67% and 'Sharks, rays, skates etc. nei (not otherwise included) at 33%. Annual catch ranked Malaysia eighth highest globally, accounting for 2.9% of the total global reported shark catch during that period[29].

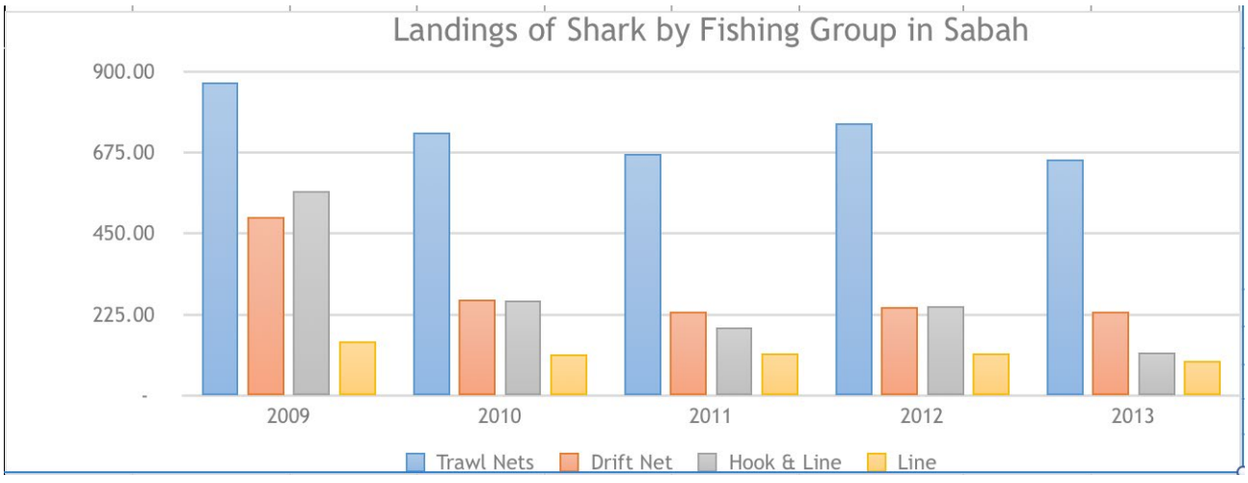


FIGURE 2 Landings of Sharks by Fishing Gear in Sabah 2009-2012 (Source: Department of Fisheries, Sabah)

Data available for Sabah from the Department of Fisheries Sabah, shows a relative decline in catch between 2009 and 2013 from 2087.46 metric tons (mt) in 2009 to 1104.21 mt in 2013 total shark catch. TFigure 2 shows the landings of sharks in Sabah by gear type, with trawlers landing the majority of sharks. More detail on shark landings in Sabah will be discussed in the following sections.

C. Sabah Trade and Market Assessment Sharks and Rays, 2017

An analysis of the shark and ray market has been published in Marketing of Sharks and Rays in Sabah and International by Arshad et al 2017[22], and in a concurrent study titles Data Collection on Sharks and Rays Species in Malaysia by Ahmad[4] et al 2017[23]. [5]In the marketing study contracted by the Malaysian Department of Fisheries, the author's stated goals were to understand the domestic marketing of sharks and rays in Sabah as well as the international trade of Malaysia's shark and ray products. It is intended to complement another study titled "The Socio-economic and dependency of fishers on sharks and rays in Sabah" carried out by the Institute of Agricultural and Food Policy Studies in collaboration with Marine Fishery Resources Development and Management Department, Southeast Asian Fisheries Development Center (SEAFDEC/MFRDMD). The study aims to examine the domestic marketing of sharks and rays in Sabah and the international trade of Malaysia's sharks and rays. As for the trade, the study focuses on the shark trade pattern globally and in ASEAN and the role of Malaysia besides measuring the country's export competitiveness using Marketing Field reports and Relative Trade analyses[22].

The study selected major landing centres in Sabah such as Kota Kinabalu which accounted for 18.6% of sharks landing in Sabah in 2013, Sandakan (29.1%), Tawau (3.2%) and Semporna (35.6%) (Department of Fisheries Sabah, 2014). The investigators also conducted interviews and focus groups with stakeholders.

[4] Dr. Ahmad bin Ali is a Senior Researcher SEAFDEC/MFRDMD and Regional Vice Chair IUCN Sharks Specialist Group Southeast Asian Region. Citations under his name are Ali, and Ahmad used in this report.

The overall objective of the Marketing and Trade study was to examine the domestic marketing of shark and ray products in Sabah and the international trade of Malaysia's sharks and rays.
Sub-objectives included:

- To identify the major actors in the marketing of sharks and rays in selected areas of Sabah;
- To examine the sharks marketing channels and practices in selected areas in Sabah;
- To examine the shark trade pattern in Malaysia and ASEAN countries; and
- To assess the competitiveness of the Malaysian sharks export using shift share analysis, reveal trade advantage and multifactor partitioning method.

For purposes of brevity we will highlight one case study of the four ports examined in Sabah by Arshad et al. 2017.

1. Case Study: Marketing Channels of Sharks in Kota Kinabalu, Sabah September 2015

Case studies of fish markets in three Sabah ports are presented in the Trade and Market study by Arshad et al in 2017. For brevity, we will focus on the marketing practices and channels of sharks at Kota Kinabalu. The authors observed the landing of sharks at the landing complex provided by the Sabah Fish Marketing Authority (SAFMA) in Kota Kinabalu. It is reported (and verified in other studies and by the author) that sharks are also landed and processed at other private jetties nearby. Unlike tuna and marlin where they were traded on contractual basis between the fisher and buyer, sharks are sold openly to traders. Prices were determined by the buyers (who are largely wholesalers) and they varied according to species, size and grade. Transactions were mainly made in cash.

The authors report that the major sharks species caught were hammerhead shark (*Sphyrna lewini*), although landings are rare in other studies outside of juveniles. Bamboo sharks (*Chiloscyllium punctatum and C. plagiosum*) and sport-tail (*aka Spottail*) shark (*Carcharhinus sorrah*). The landing prices for each species were RM4.50/kg, RM4/kg and RM2.50/kg respectively. The whole body of sharks and rays were sold to a single wholesaler (first level) who offered high price irrespective of volume. For instance, hammerhead shark and sport-tail shark were sold at RM5/kg. The separation of the body parts were done either at the landing centre, wet markets, or factories. The body parts were sold at the landing centres (stalls owned by the fishers) as well as to other wholesalers (second level) and local restaurants. Some of the wholesalers (second level) processed the shark body parts at the landing centres to produce fish balls and small cuts.

In a separate survey by Ahmad et al., (2017), the highest sharks species landing by weight at SAFMA Jetty were brownbanded bamboo shark (*Chiloscyllium punctatum*) followed by whitespotted bamboo shark (*C. plagiosum*), sport-tail shark (*Carcharhinus sorrah*), scalloped hammerhead shark (*Sphyrna lewini*), and coral catshark *(Atelomycterus marmoratus*). The landing prices varied by species. For instance, wet fins from relatively large size sharks from family Carcharhinidae such as sport-tail shark, or the scalloped hammerhead shark were sold at RM2.50/kg to RM3.50/kg. Almost all sharks and rays were sold to a single wholesaler. Fins were sold separately. Processing for big size sharks to small cuts was carried out at the jetty by the wholesaler. A whole body of small size shark such as scalloped hammerhead shark and sport-tail shark were sold at RM3.5-RM4.5/kg. The body parts were sold to other retailers at nearby fish markets, traders and local restaurants.Table 3 summarizes the most common sharks landed by species reported by Arshad et al, Ahmad et al In their respective 2017 market surveys.

TABLE 3 Most Common Shark Species Catch by Order of Weight Landed Kota Kinabalu 2017 Studies (Arshad et al, Ahmad et al)

Common name	Genus Species	Price	Source
Brownbanded bamboo shark	*Chiloscyllium punctatum*	2.0-2.5 RM/Kg	*Arshad et al*
Whitespotted bamboo shark	*C. plagiosum*	2.0-2.5 RM/Kg	
Coral catshark	*Atelomycterus marmoratus*	2.0-2.5 RM/Kg	
Spot-tail shark	*Carcharhinus sorrah*	3.0-3.5 RM/Kg	
Scalloped Hammerhead shark	*Sphyrna lewini*	3.0-3.5 RM/Kg	
Whitetip reef shark	*Triaenodon obesus*	*ND*	*Ahmad et al 2017*
Bamboo sharks	*Chiloscyllium spp*	*1.5-2.0 RM/Kg*	
Spot-tail shark	*Carcharhinus sorrah*	*RM 2.5-3.5* RM3.5-RM4.5/ kg. (whole body)	
Scalloped Hammerhead shark	*Sphyrna lewini*	*RM 2.5-3.5* RM3.5-RM4.5/ kg. (whole body	

Sources: Ahmad et al 2017 Data Collection On Sharks and Rays By Species In Malaysia
Arshad, et al, 2017 Marketing of Sharks and Rays in Sabah and International Trade of Malaysia's Sharks and Rays.

Occasionally, the traders outsourced sharks from fishers to produce shark filets and fish balls. The leftover body parts were also processed into animal food (pellet) by a fishmeal factory. The leftover meat was sold at RM0.40/kg and heads and other parts of the body were priced at RM0.15/kg. Almost all parts were fully utilized. The prices doubled or even tripled once it reached the fish market. For example, spot-tail and bamboo sharks were sold at RM2.5 to RM3.5/kg at SAFMA jetty before were sold at RM4.50 to RM5.50/kg at nearby Kota Kinabalu fish market. The shark fin marketing channel differs from the body parts. To further enhance the value added to the fin, the fins are treated by drying and salting for about two to three weeks. They also source fins from other fishers. The dried and salted fins are stored in sacks. Each sack weighs 15 kg and it takes two to three months to fill up one. The price of fins per sack is between RM1,200 to RM1,300 sold to Chinese medicinal shops locally.

Rays make up a significant portion of the catch of the elasmobranchs in Sabah. The study reported that

in terms of weight, the highest landing by species for rays at SAFMA Jetty were bluespotted stingray (*Neotrygon kuhlii)* followed by whitespotted whipray (*Himantura gerrardi*), sharpnose stingray (*Dasyatis zugei*) and narrow tail stingray (*Pastinachus gracilicaudus*). In the Marketing study, Arshad et al reports that the ray species sold at the landing area were eagle ray (*Aetobatus ocellatus*), leopard whipray (*Himantura leoparda*), honeycomb whipray (*Himantura undulata*), narrow tail stingray (*Pastinachus gracilicaudus*), starrynose stingray (*Pastinachus stellurostris*) and bluespotted stingray (*Neotrygon kuhlii*).

TABLE 4 Ray Species Observed by Order of Highest Landings SAFMA Jetty, Kota Kinabalu 2017

Common name	Genus Species	Price RM/Kg	Source
Eagle ray	*Aetobatus ocellatus*	*1.50-2.50*	*Arshad et al 2017*
Leopard whipray	*Himantura leoparda*	*3.5-4.5*	
Honeycomb whipray	*Himantura undulata*		
Narrow tail stingray	*Pastinachus gracilicaudus*	*3.5-4.5*	
Starrynose stingray	*Pastinachus stellurostris*		
Bluespotted stingray	*Neotrygon kuhlii*	*4.0*	
Bluespotted stingray	*Neotrygon kuhlii*	*2.0-4.0*	*Ahmad et al 2017*
Whitespotted whipray	Himantura gerrardi	2.0-2.5	
Sharpnose stingray	*Dasyatis zugei*	*1.5-3.0*	
Narrow tail stingray	Pastinachus gracilicaudus	2.0-2.5	
Reef Manta	*Mobula japonica*	*2.0-2.5*	

Source: Ahmad et al 2017 Data Collection On Sharks and Rays By Species In Malaysia and
Arshad, et al, 2017 Marketing of Sharks and Rays in Sabah and International Trade of Malaysia's Sharks and Rays.

Table 4 represents species and market prices of most common ray species observed by order of highest landings at SAFMA Jetty, Kota Kinabalu 2017 by Ahmad et al and Arshad et al. The price range for large size eagle ray and leopard whipray (whole body) sold to the first level wholesalers was RM1.50 - RM2.50/kg while small size bluespotted stingray (*Neotrygon kuhlii)* could reach to RM4/kg. The price of small size reticulated whipray (*Himantura uarnak*) was RM5/kg. Processing of big size rays to small pieces (about 10 cm width) such as leopard whipray (*Himantura leoparda)*, reticulated whipray (*H. uarnak)*, eagle ray (*Aetobatus ocellatus)* and narrow tail stingray (*Pastinachus gracilicaudu)* were carried out at the jetty by the wholesaler. The wholesales price at jetty ranged from RM3.5 to RM4.5/kg. The prices were eventually more than doubled once sold at the fish market. Skins for big size rays species such as leopard whipray, reticulated whipray, and narrow tail stingray and starry nose stingray also have commercial value.

Landings of protected species include reef manta (*Mobula japonica)** and 112 individuals of scalloped

hammerhead sharks (*Sphyrna lewini*) were observed in this survey. Average landings size of large species of shark are primarily immature, some as much as half the length to maturity, such as spinner sharks (*Carcharinus brevipinna*), bull sharks (*C. leucas*) and hammerhead sharks (*Sphyrna. spp)*.

In Semporna, the fishermen sold their shark catch to collecting agents of wholesalers at the landing site. The fishers were paid cash upon delivery. The prices varied according to sizes. For instance, the price of fin of 15 inches was RM 80/set, RM 130/set (18 inches) and RM 20/set for fins that were less than 15 inches. Fishers' selling prices for hammerhead sharks were in accordance to its size where RM 10/set was charged for 9 inches hammerhead, RM 20/set (10 inches), RM 30/set (11 inches), RM 40/set (12 inches), RM 50/set (13 inches) and RM 80/set (14 inches). The skin from the head area fetches RM 6/kg (good market in Semporna for this part of the sharks) because of the local demand which used the skin part for local signature cuisine. At the landing site, the hammerhead shark meat was sold at RM 2.00-RM 2.50/slice while the wholesale price reaches RM 3/slice.

These prices observed by Ahmad et. al. are extremely low even at the wholesale level. We have observed small low quality fins from ground sharks selling for RM 75 in Semporna. These authors report market prices significantly less than reported by Arshad et al 2017 where the most expensive shark meat was sold at RM7 - RM40 for bull sharks, RM6 - RM12 for spot tail and tiger shark for RM8-10/kg. Fins of adult bull shark (*Carcharhinus leucas),* spot tatil (*C. sorrah),* spinner *(C. brevipinna)* and blacktip *(C. limbatus)* were sold separately, with the price ranging between RM 70 - RM 150 respectively, based on sizes. Market destinations for sharks and rays were similar as reported by Arshad[23].

The following synthesis of the case study made by Ahmad et al. are summarized herein[22].

2. Marketing channels were highly localised depending on the catch (volume and type) and local demand for example that in Kota Kinabalu, sharks were consumed by local consumers in various forms (including medicinal purposes.

3. Sharks and rays were traded in the world market particularly in the Asian region such as Hong Kong, Singapore and Thailand. China was the final destination for some products particularly shark fin that were exported to Hong Kong.

4. Traders seemed to have a good marketing network within and outside Malaysia. Popular export destinations were: Thailand, Singapore, Hong Kong and China. Major internal market destinations include Sibu, Johor Bharu and Selayang.

5. Sharks and rays product development was active in that fishers and traders were able to add value to their catch by various product transformations through drying, packaging and processing both for food and non-food purposes. The diversity of products and value-added, created indicators of a high degree of utilisation of shark carcasses by the fishers, processors and traders.

6. Traders were able to perform marketing function efficiently despite the location disadvantage and infrastructural defects particularly at the landing centres. This indicates that there is a need for logistical upgrading to minimize transaction costs.

7. Due to the 62 unique properties of the shark and ray products, its marketing system was run by a wide range of intermediaries including: fishers, wholesalers, retailers

(including those specializing in medicinal products), restaurants, exporters/ importers and consumers. In short, the fundamentals for sharks and rays were relatively strong particularly the demand sector. [6]

8. The uniqueness of shark fin which is revered by Chinese consumers at large explains for it very high market value and hence incentives for the supply sector. The supply sector on the other hand may not be able to respond as fast as the demand and in fact it requires monitoring to ensure sustainability.

The market study concludes with a discussion on the world trade of sharks and rays citing a number developments that are impacting the performance of the Malaysian sharks and rays industry.

> "The study observes that the trade volume of sharks and rays has experienced a rapid increase in the last two decades after a slow growth in the 1980s and 1990s. Between 1990 and 2011 the quantum of trade has increased threefold, and the increase driven by fundamental factors, supply and demand.
> On the supply side, improvement in the capture technology has encouraged industrial and artisanal fleets from all over the world to supply shark fin and meat to meet increasing demand. On the other hand, globalisation has brought growth particularly to the Asian region particularly China and Vietnam who are among the world largest consumers of shark fin. The analyses merely confirm that the increase in the Malaysian export is partially attributed to the increase in trade growth in the region and Malaysia appears to have some competitive advantage in the shark fin export respectively".

D. Data Collection on Sharks and Rays by Species Malaysia, 2017

A recent assessment of shark and ray catch in Malaysia titled Data Collection on Sharks and Rays by Species Malaysia August 2015- July 2016, by Ahmad et. al. evaluated landings in four major ports in Malaysia: Larut Matung, Manjung Utara on the west coast of peninsular Malaysia and Sandakan and Kota Kinabalu in Sabah. Between 1 and 3 fishing vessels were selected for sampling each day for 12 days per month at each landing site. The total catch of all sharks and rays by species as well as the total catch of commercial and low-value species were also recorded for each sampling vessel[23].

Kota Kinabalu

In Sabah, Kota Kinabalu recorded the highest number of species with 20 rays from six families and 17 sharks from 11 families compare to Sandakan with 19 species of rays from six families and 14 sharks species from six families. The landings of rays and sharks were minimal in the state compared to total landings, with the contribution of 0.39% and 0.24% at Kota Kinabalu, and 1.81% and 0.53% at Sandakan respectively. The abundance of sharks and rays species varied between the studysites.

[6] Arshad et al[22] cites 62 properties of sharks and rays but does not define them.

The most abundant shark species at Kota Kinabalu were the brownbanded bamboo shark (*Chiloscyllium punctatum)* followed by the whitespotted bamboo shark *(Chiloscyllium plagiosum)* and the cat shark *(Atelomycterus marmoratus).* Other common sharks species were spottail shark (*Carcharhinus sorrah),* scalloped hammerhead (*Sphyrna lewini)* and fossil shark *(Hemipristis elongata)*. Most of the ground sharks were mature, however the scalloped hammerheads landed throughout the year at Kota Kinabalu were all immature, with an average of 74.9 cm total length(TL). Branstetter (1987) estimated that males mature at 10 years, 180 cm total length and females at 15 years, 250 cm total length in the Gulf of Mexico. *Hemigaleus microstoma, Heterodontus zebra* and *Mustelus manazo* were landed in four months; *Alopias pelagicus* and *Loxodon macrohinus* in three
(3) months, while *Carcharhinus brevipinna*, *Carcharhinus sealei, Halaelurus buergeri*, *Orectolobus leptolineatus*, *Squatina tergocellatoides* and *Stegostoma fasciatum* were only landed between 1 - 2 months.

For rays, the bluespotted stingray (*Neotrygon kuhlii)* was most common followed by whitespotted whipray (*Himantura gerrardi)* and *Dasyatis zugei*. As for Sandakan, the most abundant sharks species were brown banded bamboo shark *Chiloscyllium punctatum* followed by spottail shark (*Carcharhinus sorrah)* and the brownbanded bamboo shark (*Chiloscyllium plagiosum)*. For Sandakan, rays landed in order of most common were blue spotted stingray (*Neotrygon kuhlii)* followed by white spotted whipray (*Himantura gerrardi*- now in genus *Maculabatis)* and the bluespotted fantail ray *(Taeniura lymma)*.

There were 224 trawlers observed in Kota Kinabalu compared to purse seines which number ed around 41. The operation duration per trip of trawl nets is up to a week while the purse seine's operations only take up to three days the most. Out of 224 licensed fishing vessels in Kota Kinabalu, over half (124) are boats are in the mid size of 25-39.9 Gross Registered Tons (GRT) fishing along the west coast beyond the 3 nm limit. 13 of these are large vessels greater than 70 GRT and capable of fishing beyond the 200 mile limit. 41 seiners are licensed with 21 in the mid range with 38 less than
69.9 GRT and 3 large vessels over 70 GRT capable of fishing offshore beyond 30 nM.

For rays, the catches are for local consumption as well as for outside markets, especially to Peninsular Malaysia. Grilled rays are special delicacies that highly enjoyed by locals and tourists alike. Dried rays are also commonly sold on the street. At SAFMA landing jetty, wholesale price of rays are between the range of RMI - RM4 depending on the species and size. Mangrove whiprays (*Himantura walga)* and pale edged stingray (*Dasyatis zugei*) were priced RMI - RMl.50 while bluespotted stingray (*Neotrygon kuhlii)* and bottlenose wedgefish (*Rhychobatus australiae)* can fetch up to RM4/ kg. The prices were eventually doubled or even more once the rays sold at the fish markets. Among the favourite species for consumption are honeycomb stingray (*Himantura uarnak), w*hite spotted
Whipray (*Himantura gerrardi*- now in genus *Maculabatis),* Bleeker's variegated whipray (*H. undulata)* , leopard whipray *(H. leoparda)* and the Porcupine Ray *(Urogymnus asperrimu*s).
Ray's skin for some species can fetch a bigger value than the meat. Ray's skin of Bleekers whipray (*Himantura uarnacoides* reclassified as *Pateobatis),* white spotted whipray (*Himantura gerrardi*- now in genus *Maculabatis),* round whipray *(H. pastinacoides),* tubemouth whipray *(H. lobistoma),* Jenkin's whipray *(H. jenkinsii,* now *Paleobatis jenkinsii),* pink whipray *(H. fai* now *Pateobatis fai),* broad cowtail ray *(Pastinachus atrus),* narrowtail stingray *(Pastinachus gracilicaudus)* and roughnose stingray *(P. solocirostris)* is processed before being sent to Kuala Lumpur by plane or container.

For sharks, except for the fins, the meat are mostly used to cater domestic demand and sold mainly at fish wet markets in Kota Kinabalu, though some were brought to the interior part of Sabah. Some of

the fins, however, are exported, mainly to Peninsular Malaysia.

Sandakan

Sandakan has the highest number of trawl net vessels in Sabah, which numbers around 457 compared to 1,069 total of trawl net vessels statewide. In a big contrast, there are only twelve purse seines vessels operating in Sandakan waters. Sandakan is ranked third in all marine fish landings in 2015 with 18,700 mt, behind Kota Kinabalu (61,800 mt) and Kudat (24,600 mt). The total landing of the state during that year was 175,400 mt. There are a number of fish landing jetties in Sandakan but the main landing point in the district is the Sandakan Fish Market Jetty where 45 estimated fishing vessels of various sizes landed their catch daily.

The most common and abundant shark species were the groundsharks *Chiloscyllium punctatum* followed by (*Carcharhinus sorrah*) and brownbanded bamboo shark (*Chiloscyllium plagiosum*). Common species were (*Atelomycterus marmoratus*), Rhizoprionodon acutus, Sphyrna lewini, Carcharhinus sealei, Hemigaleus microstoma and Stegostoma fasciatum. All these species were landed between 8 - 12 months. Other species such as *Hemipristis elongata*, *Carcharhinus limbatus, C. leucas, C. brevipinna* and tiger shark (*Galeocerdo cuvier*), were only landed between 3 - 7 months during the study period.

Also landed during the sample period were 42 of leopard sharks, (*Stegostoma fasciatum)* and 15 scalloped hammerhead (S*phyrna lewini*), also listed as endangered and juvenile tiger shark (*Galeocerdo cuvier*). Trends in maturity follow Kota Kinabalu with the ground and cat sharks primarily in the maturity range, while the Requiem and other more rare sharks were landed as immature and juvenile in size. Rays had a mixture of maturity with a mix of mature and immature rays in the Himantura genus and other species dominated by immature rays.

Use and marketing for sharks and rays in Sandakan is similar to Kota Kinabalu. Ray's skin can fetch a bigger price than the meat. The prices are varied according to species and size of skin. Ray's skin is processed before being sent to Kuala Lumpur by plane or container. The prices are varied according to species and size of skin. Sharks and rays are mainly consumed locally. For rays, the catches are for local consumption as well as to fulfill demand from Peninsular Malaysia. For sharks, shark meat are mostly to cater domestic demand and sold mainly at fish wet markets in Kota Kinabalu. While shark fin soup is still served in some Chinese restaurants in Sandakan, fins are sent mainly to Peninsular Malaysia.

Most species landed are ground sharks and rays, however, among this catch are endangered and threatened species of both rays and sharks, including species listed as protected under the Fisheries Act including the endangered leopard shark, (*Stegostoma fasciatum)* and scalloped hammerhead (S*phyrna lewini*). Rays are an important domestic food source, more than shark meat. Many species of *Haimantura* rays are listed as vulnerable under the IUCN, the smoothnose wedgefish (*Rhynchobatus laevis)* is listed as Vulnerable and decreasing globally. The average size of large Requiem sharks were primarily in the immature range, in some cases less than half the size of maturity such as the spinner shark.

Besides Sandakan and Kota Kinabalu in Sabah, this survey also sampled landings at two sites in Peninsular Malaysia at Larut Mantang and Manjung Utara. In general, more rays are caught than sharks. Markets and prices varied between towns and regions. In general prices for meat are much higher than in east Malaysia. Shark, rays and fins are also exported to Kuala Lumpur from Sabah. In some cases such as the Whiptail ray (Himantura gerradi) sold for RM 6-21 and (H. undulata) at RM 15-20- selling

for 3-8 X more than in Kota Kinabalu. Sharks were also more expensive with Bull sharks bringing in RM 7-40 and C. sorrah at RM 6-12 and tiger shark at RM8-10.

In general, bigger sized rays were more expensive than the smaller ones. Fins from big size Rhynchobatus australiae were sold separately with the price ranging between RMl00 - 300/kg based on sizes. In general, bigger sized rays were more expensive than the smaller ones. The price was almost consistent for the whole year for all species but can fluctuate up to 50% when supply was limited and during festive seasons such as Chinese New Year and Hari Raya especially for species such as Himantura gerarrdi, H. walga, Dasyatis zugei, Neotrygon kuhlii, Dasyatis akajei and Rhynchobatus australiae for rays and, Carcharhinus sorrah and C. leucas for sharks. Fins from larger Rhynchobatus australiae were sold separately with the price ranging between RMl00 - 300/kg based on sizes.

Arshad et al 2017 conducted one of the few available catch per unit analysis in Sabah. The top 10 catch per unit effort (CPUE) rays and sharks species captured by trawl net, combined for Kota Kinabalu and Sandakan in Sabah, were determined in two zones in Sabah. For rays, *Himantura gerrardi* topped the list, followed by *Neotrygon kuhlii* and *Himantura fai* in the east and west coasts of Sabah, *Neotrygon kuhlii* was the main species, followed by *Himantura fai* and *Himantura uarnacoides*. For sharks, the top three species for both zones evaluated, were in the same order, with *Chiloscyllium punctatum* came first, followed by *Chiloscyllium plagiosum and Carcharhinus sorrah*. CPUE is commonly used as a measure of species abundance and population status.

The abundance of sharks and rays species varied between the landing sites but all were dominated by ground sharks and rays commonly taken in the trawl fishery. The catch per unit effort shows highest the common whip rays and bamboo sharks. In general these species are more fecund and reproduce at younger ages than the larger species. Of note are the presence of bull sharks at Sandakan which are a coastal species, and the Requiem sharks such as *C. Sorrah* living further offshore. Many species of Whiprays (*Haimantura spp*.) are listed as vulnerable under the IUCN; the smoothnose wedgefish, (*Rhynchobatus laevis*) popular for fins is listed as Vulnerable and decreasing globally.

The authors make the following recommendations for future activities:

1. Continuing to record landing data up to species level at the existing sites
2. Extending the program to other states in Malaysia.
3. Seeking national funding to:
   a. Continue the sharks data collection program
   b. Conduct trainings/courses at national level
   c. Attend meetings and seminars at national and international level
   d. Conduct public awareness
   e. Publish materials (posters, templates, identification manuals)
4. Using the current program finding to:
   a. Conduct Non-detriment Findings (NDFs) study on sharks.
   b. Rectify various issues concerning sharks management and national and international level.
   c. Provide input for the next Malaysia NPOA-Shark.
5. Conducting training for fisheries staff on sharks data collection (SEAFDEC, Terengganu and on-sites)
6. Continuing public awareness campaigns and practices, such as: the current regulation of listing on endangered species; a government policy of not serving shark fin soup during official events; and rectifying the

misconception of bycatch, 'shark finning' and 'shark fishing' terminology.

7. Enhancing enforcement capacity through relevant training, such as the identification of sharks and rays species and its parts.
8. Expending the ongoing study on the usage and marketing, as well as the socioeconomic value related to living sharks and rays in Sabah, to other states of Malaysia.

E. Sabah Shark and Ray Market Surveys 1996 and 2016

A comparison of shark and ray species representation and abundance is being conducted by Matusmoto and Fowler[7]. The researchers compared species and abundance conducted under the 1996-1997 Sabah Elasmobranch Biodiversity Darwin Project with theSabah Elasmobranch Biodiversity Monitoring and Assessment SOSF Project 2016-2019. Data collected included Fish market surveys by researchers and enumerators; Vouchers (whole and/or tissue samples) in collection; Photographs, video and; identification of taxa to lowest level .e. species; genus –and finned sharks. Market survey data are predominantly from trawl fisheries. Six major taxa were compared for sharks including the Zebra shark, Bamboo sharks, Catsharks, Weasel sharks, Whaler sharks, Hammerheads.

For rays, the data were recorded by ecotype and morphology e.g. demersal shark-like batoids (wedgefishes and guitarfishes), demersal stingrays (flat-bodied stingrays - small to medium-sized species), demersal stingrays (flat-bodied stingrays- large-sized species, inshore bentho-pelagic, offshore pelagic. In 1996 Sharks are dominated by two of the six taxa groups: hammerheads (*Sphyrna leweni*) and whaler sharks (*Carcharhinus* spp). In 2016, Sharks are now dominated by two of six taxa groups: catsharks and bamboosharks. Relative abundance for all species has declined significantly. In 1996, Rays are dominated by three of the five taxa groups with all three are demersal species commonly caught by trawl. In 2016, rays are presently dominated by demersal species (small to medium-sized and flat-bodied batoids);, Their relative abundance has increased. Conversely, the relative abundance of all the other four taxa groups decreased.
This market comparison gives strong evidence that species abundance of sharks- particularly the large species is decreasing and some rays once abundant are seriously declining in Sabah waters.

F. Sabah Shark and Ray Fish Market Survey TRACC 2014-2016

1. Overview

A shark and ray landings study conducted by the Malaysian Registered Organization, the Tropical Research and Conservation Centre (TRACC), collected data on all Sabah fish markets between May 2014 and August 2014. Assisted by the author, additional data was collected by TRACC for two key landing points (Kudat and Kota Kinabalu) up to May 2015 published herein. The author accompanied surveys in Sandakan, Kota Kinabalu and Semporna in July and August 2015 and again in 2016. During the Statewide data collection period, a total of 18 fish markets and landing sites were visited on 65 days. On some days, several different fish markets were visited to make a total of 142 separate fish market surveys. For large fish markets, the visits were for a period of 2h in the early morning, with repeated observations around the market to ensure that all catches were recorded. Kota Kinabalu

[7] Data presented by Dr. Matsumoto at the Sabah Sharks and Rays Forum June 2017. In Elasmobranch Diversity, Conservation and Management Proceedings of the International Seminar and Workshop Sabah, Malaysia 1997. S.L. Fowler, T. Reed, and Frances Deeper Editors. IUCN Species Survival Commission No.25

fish market was visited 43 times during the survey period while Kudat fish market was visited 36 times. Kunak, Sipitang and Menumbuk were only visited once each while all other markets surveyed were visited at least twice[24].

The investigators made 142 fish market visits around Sabah in an attempt to document and enumerate which shark and ray species were caught by the various fisheries in Sabah. From the scientific evidence collected by TRACC during this study and in conjunction with unpublished data from ACT/ WWF and anecdotal evidence from dive operators, TRACC concludes that most species of large sharks are being fished out, and smaller sharks are entering the market primarily for their fins. Oakley reports observing species of large sharks in the wild is becoming a rarity in unprotected areas in Sabah and that on average size is declining for most species.

Data collected by TRACC from the Sabah fish markets over the survey shows an ecosystem with few large elasmobranchs but a significant fishery for ground sharks and rays. On the west coast, individuals caught are primarily smaller species of shark and ray and also small for the species. This is due to the fact that older and larger fish in a population become rare in a heavily fished area. Each year group accumulates the effects of fishing mortality through time and large sized individuals of every species have become very rare. Large sized species (e.g. Manta & Himantura rays; hammerhead and tiger sharks) are more vulnerable because they reproduce later in life at larger sizes and in the case of Sabah have mostly disappeared from the ecosystem because they are caught before reproductive sizes.

On the east coast of Sabah, both trawl and purse seine fisheries have removed not just the large sharks but the small sharks and rays from the next level of the food web. The analysis of the bycatch shows high incidence of juveniles and almost no reproduction of bottom living soft sediment species. In Sandakan, small sharks were common in purse seine catches but there were very few sharks and rays in the trawl catches. The observed landings of sharks by TRACC between 2009 and 2013 for Sabah by port indicate that Sandakan, followed by Kota Kinabalu, Semporna and Kanak rank highest in Sabah for shark landings during the period, with 80.3 % of the overall catch. Over four years a total of 1576.86 metric Tons were observed with an average of 394.21 mT per year in Sabah.

Data collected by TRACC between 2009- 2013 on total shark catch for Sabah approximates 394.21 mT/ year on average across Sabah by Landing Sites. Landings by district recorded by Oakley are summarized in Table 5.

TABLE 5 Landing of all Sharks by Sabah District (2009-2013) Average Metric Tons (Oakley)

Tawau	**Semporna**	**Kunak**	**Lahad Datu**	**Sandakan**	**Belurun**	**Kudat**	**Kota Marudu**
43.91	178.39	178.39	600.64	10.86	88.57	88.57	0
Pitas	Kota Belud	Tuaran	Kota Kinabalu	Papar	Beaufort	Kuala Penyu	Sipitang
0	25.12	0	306.33	89.72	0	11.09	8.12

TOTAL	1576.86 mT

Like the 2017 studies conducted by Arshad et. al.[22] and Ahmad et. al.[23] in 2017 on shark landings, these findings do not include sharks and rays landed on private docks, although small boats are observed landing reef sharks and large rays in Semporna and at Mabul. Given the relative dearth of reef sharks observed by divers and at landing sites in the Semporna islands Oakley concludes these boats are leaving Sabah waters to fish for sharks.

An assessment of the pelagic longline fishery was conducted by TRACC between 2011 and 2015 in the Semporna region. Interviews with longline fishermen were conducted by volunteers in Malay. Oakley estimates that sharks were caught at an average of 20 per day or 62 sharks per trip. The most common pelagic species were blue sharks (*Prionace glauca*) at 5.07/day, blacktip (*Carcharhinus limbatus*) at 4.6/day, hammerhead species (*Sphyrna spp*)(4.1/day) an unidentified whaler sharks (*Carcharhinus*) (3.26/day). The silky shark (*Carcharhinus albimarginatus)* at 1.62/day and silvertip (*(Carcharhinus albimarginatus)* at 1.17/day were less commonly caught, while the remaining species were caught at less than one per day. Bull sharks (*Carcharhinus leucas*), tiger sharks (*Galeocerdo cuvier*) and mako sharks (*Isurius oxyrhinchus*) were uncommon in catches, occurring at less than 1 per 3 day trips made.

Although tuna are also caught, the longline fishery is a targeted shark fishery and should not be considered bycatch. Many of the larger sharks caught in the longline fishery were rare or completely absent from all other fish markets sampled. The silvertip shark, graceful shark, silky shark, mako shark and blue shark were all absent from the other survey locations. Over 70% of all thresher sharks

and 60% of tiger sharks were also caught by the longline fishery. All these sharks (except the tiger shark) are pelagic or in the case of the graceful shark, live along the continental shelf, and are completely absent from the nearshore waters where the purse seine boats operate. Oakley believed that pelagic seine, longline and gill net fishery are over-pressuring these species from Sabah waters and that the pelagic longliners are specifically targeting reef, tiger and hammerhead sharks for their fins, although the meat is also sold. Oakley believed that these species had suffered a decline by as much as 90% in Sabah waters. Observations of sharks by the dive operator Scuba Junkie 's SEAS Program bears this out anecdotally, although additional data collected in a standardized with a comparable methodology is needed to confirm this. Appendix plots dive observations of Hammerheads at Sipadan Island.

2. Landings Kota Kinabalu

Fish in the Kota Kinabalu market, which is mostly trawl caught, are dominated by guitarfish and rays, primarily bluespotted and whiptail rays. In Kota Kinabalu, the two most common bamboo sharks dominated the daily catch of shark species with an average of 65.8% of the total shark catch (98 individuals landed per day). Coral catsharks (*Atelomycterus marmoratus*) are typically restricted to reefs, there were few seen in the trawl fishery in KK or in Kudat. The two guitarsharks, (*Glaucostegus typus*) giant guitar shark and (*Rhynchobatus australiae*), were second most common shark family landed in Kota Kinabalu with 14.4% (21.5 individuals landed per day equal or exceeding 7000/yr). Oakley notes that more immature than mature guitarfish are landed here, suggesting a geographic feature e.g. a rock bank or reef that excludes trawlers. The Mangalum and Saracen banks offshore from KK are probably the refuge area. The banks are too shallow for trawling with complex topography and numerous coral outcrops, causing gear entanglement. We recommend these key areas to be considered for marine protection, established as a protected nursery site with no fishing. Both species are coveted for their fins and meat, and the IUCN reports their populations as vulnerable and declining. This area is also a select location for divers to see sharks coming out if Kota Kinabalu and includes bamboo sharks, coral cat sharks and blue spotted stingrays.

The Hammerheads, mostly scalloped (*Sphyrna lewini)* were less abundant than guitar sharks and caught

at an average of 7.0 individuals landed per day (4.7% of total catch). Small individuals of less than 50 cm or the "0" year age group dominates the landings again suggesting a nursery site. Mature hammerhead sharks are rare. All sharks are immature, 88% of landings of all species are small specimens. The trawl fishery is clearly catching most of the annual recruitment of hammerhead sharks. A landing rate of 7 individuals each day projects to an annual fishing mortality of over 2,500 baby hammerhead sharks from Kota Kinabalu alone.

Requiem sharks (*Carcharhinus spp*) were the third most abundant group; caught at an average of 14.5 individuals landed per day (9.7% of total catch). Identification of the Requiem sharks was hampered by the almost universal removal of the fins. Hammerhead, thresher and guitar sharks were also almost always seen with fins removed but could be identified to species from body shape. The shallow water reef related species, e.g. blacktip reef shark, white tip reef shark and leopard sharks, were mostly absent. Only the small species of offshore pelagic Carcharhinid sharks were occasionally landed. The most common species were spottail shark (*Carcharhinus soorah)* and blacktail reef shark (*Carcharhinus* limbatus) likely due to the extensive shallow regions to the north and west of Sabah, and limited range by most vessels. The larger species such as tiger shark (*Galeocordo cuvier)* were extremely rare at <1.0% observed landings.

3. Landings – Semporna

The Semporna fish market was visited for a total of 21 days during the 2015 survey and 14 days in 2014 for a survey conducted by Green (Alam Sekitar Tanggungjawabku or AST) for WWF. The AST survey did not record rays although mobula rays can be seen in the photographs taken. A variety of shark species were seen in the Semporna market from thresher sharks (*Alopias spp*) and the whitecheek shark (*Carcharhinus dussumieri*) are generally caught as bycatch from the purse seine fishery to small hammerheads, leopard, & guitar sharks[2] more commonly associated with benthic sediments and caught by trawlers. Reef related benthic sharks such as bamboo and coral cat sharks were the most commonly seen but a few reef related pelagic sharks such as grey reefs and black tip were occasionally caught. From the observations of cut mouths indicating the removal of a hook most of the reef related sharks in Semporna were caught on hook and line. The white cheek shark was the dominant shark in the purse seine landings with an average catch rate of 1.85 individuals per day from a fishery of 28 large boats and over 50 smaller seiners. This catch rate is very low compared to other purse seine fisheries which reiterates the heavy fishing pressure and serious population declines.

The observations of fresh bamboo sharks and rays in the Semporna fish market was a biased sample and a serious underestimate of actual catches. These small sharks and rays are caught away from the landing centre dried and sold by street vendors walking the streets. On one sampling day, all the dried bamboo sharks seen carried by vendors were counted. On 22nd May 2014, there were no fresh sharks in the market but 4 dried bamboo sharks were for sale and 23 dried bamboo sharks were being carried around town by vendors. On the 23rd May, a total of 28 dried bamboo sharks were seen on sale. However, it was not possible to determine when the dried sharks or where caught, and do not add into the wet landings leading to an underestimate of catch,

Small sharks sell for a cheap price RM1-1.5/Kg in the Semporna market and are frequently eaten by the fisher or sold direct from the boat to other villagers, and do not get transported to market. Sales before market was observed in most rural villages leading to another factor underestimating catch.

Guitarfish landed at Semporna Fish Market (Photo S. Oakley)

Ray Diversity in the KK fish market, (note the missing tail) Photo S. Oakley

Rays make up a large part of the Semporna catch, particularly by trawlers. The larger easily identifiable rays (*H. undulata & H. uarnak*) were considered common, possibly because they could be recognized while the other large rays showed no clear pattern of abundance. The eagle ray, cow nose rays, manta and mobula rays were considered common on the East coast in the survey of the market traders. The fish market landings from the Trawl fishery are typically pre-sorted on the boat and the landings of each species is in size/price categories. Very small sharks and rays of many species were discarded as part of the bycatch. Some species such as the torpedo rays (*Narcine spp*) were not seen in the market but were common in the bycatch. Both groups of common small rays (whip tail and Blue spotted) were sorted by the fishermen into groups larger than 24cm (medium) or smaller than 24cm (small). The blue

spotted mask ray was found in the small size category from a width of 14cm while the smallest whip tail rays were 17cm. Smaller specimens were present in the discards. This retention of smaller blue spot rays is presumably because they are thicker dorso ventrally and weigh more than similar width whip tail rays. The three common whip tail ray species *Himantura imbricata*, *Himantura walga* and *Dasyatis zugei* were not separated by the fishery and were sold in all fish markets as the same species.

In 2016 the market location changed from near the old jetty to a new concrete landing site more accessible to deeper draft vessels. Although fresh fish were still sold at the street market, landed by small boat fishers, the large seiners and trawlers unloaded into fish boxes at the new jetty. Five market surveys conducted at semporna market in 2016 and 2017 did not observe any pelagic or Carcharhinid sharks, although small mobula rays (*mobula japonica*) were observed in the street market. Mantas and mobulas are occasionally seen in the market, absent the brachial plates or gill rakers. One survey by Manta Trust reported Manta rays and mobula rays in the Semporna market. An opportunistic small scale fish market of fish by artisanal fishers still occurs at the old jetty and mobula rays and mantas were observed for sale on three visits, Small markets like this are not considered in fish catch statistics, and catch rates of mobula rays are underestimated in fisheries statstics due to their focus on major centres. These and their close cousins the eagle rays are popular among dive tourists, and are discussed in Appendix III.

4. Semporna Longline Survey

The shark longline fishery used to be based in Mabul with one operation next door to Big John Scuba but with pressure from dive operators some, if not all, shark fin operators have moved to other water villages closer to Semporna. In 2014, an employee of a longline boat was hired to help collect data on the shark landings at one of the shark houses located in Kampung. Air, Semporna. The employee was contracted by TRACC and interviewed for the study. The shark long line boats go out for 2-3 nights usually traveling in and out of Semporna at high tide in the middle of the night so they can travel across the reef flat and avoid the police boats in the channel. the report states that the shark fishery operators do not think the fishery is illegal but many of the fishers have no Malaysian identity documents so automatically avoid Malaysian authorities. Two or three boats usually travel in groups to the fishing grounds.

According to the interviewee, these boats travel approximately 200km to the south and south east. The basket of long line has about 300 hooks and they set one basket per boat usually with a second line a few kilometers away. The lines are baited with squid or tuna heads in late afternoon and set before sunset. The lines are hauled shortly after dawn. The boats normally move location during the day (about 25-30km, equivalent to 1 hour travel). The hooks are baited again in the late afternoon.

The sharks are clubbed to death and then normally stored whole in the ice holds. Occasionally the catch is too large for the holds and sharks are stored anywhere available in the boat. If the catches are very good, the fins are removed and the carcasses dumped in the sea, however, the owner does not like this practice, apparently it is possible for all the fins from one or more sharks to disappear between catch and landings. The shark identification was verified by photographs. Although the fishers use the Malay or Bajau names but all the easily identified large shark species were accurately identified by the employee. We gave copies of Malay language books on sharks to the observer however it was clear that while he could recognize the species he could not read.

Interviews with shark fishers indicated that although most were aware that shark finning was prohibited, they were not aware what species were protected, and still landed any large shark with the exception of

the whale shark. After landing, the shark meat is cut into fish box sized chunks and loaded onto a lorry. The understanding of the Semporna Shark slaughterhouse workers is that the meat goes to rural palm oil plantations to feed the workers. The shark fins are collected and taken away by the owner who usually supervises the landing/slaughter operations.

During the survey period, 14 trips were made and a total of 947 sharks & rays were landed, representing an average catch per trip of 67 sharks & rays per trip or 23 individuals per boat per trip. Assuming 500 hooks per boat the catch rate was 0.04 sharks & rays per hook. The sharks were caught at an average of 20 sharks per day or 62 sharks per trip. The most common species caught were Blue sharks (*Prionace glauca*) at 5.07/day, Blacktip reef sharks at 4.6/day, Hammerhead species at 4.1/day and unidentified Carcharhinus species (species of Requiem or whaler sharks) at 3.26/day. The silky (1.62/day) and Silver tip *(Carcharhinus albimarginatus)* at 1.17/day were less commonly caught, while the remaining species were caught at less than one per day. Bull, tiger and mako sharks were rare in catches occurring at less than 1 per 3 day trip.

Many of the larger sharks caught in the longline fishery were rare or completely absent from all other fish markets sampled. The silver tip, graceful shark, silky shark, mako and blue sharks were completely absent from the other markets. Over 70% of all thresher sharks and 60% of all tiger sharks were also caught by the longline fishery. All of these sharks (except the tiger shark) are pelagic and are clearly completely absent from the nearshore waters where the purse seine boats operate. The pelagic seine, longline and gill net fishery has completely fished out all these species from all Sabah waters Oakley concludes. The Semporna longline fishery caught an average of 4.1 hammerheads per day from 1 fishing operation (4.1 x 6 days = catch of 24.6 hammerheads per week). At least 6 longline fishery operations were working from Semporna and catching sharks from the offshore waters beyond Sipadan island, most likely illegally in Indonesian waters. While large fins were observed in the market, the bodies of pelagic species were not observed, and are believed to be filleted and transported in fish boxes. This fishery is largely unregulated, is targeting large sharks and the vessels operate out of private docks without proper recording of landings. This longline fishery is also responsible for the series of negative public, press and social media interactions that has a ripple effect with potentially negative impacts on dive tourism so valuable to the region.

Reef Manta Ray (*M. alfredi)* dismembered at private dock, Semporna (note gill rakers foreground and on wing, left). Photo S. Oakley

Dried Mobula Gills for sale, Kota Kinabalu Street Market (Photo D. McGuire)

Mobulid and manta rays were not quantified in the AST survey but were evident in the market and identified in photographs as reef mantas (*Manta alfredi*) (Image) and devil rays (*Mobula japonica*). Mobulid rays (*Myliobatiformes*) are under heavy fishing pressure from the Semporna fishery with an average annual catch of 2300 individuals within the study period. The large pelagic manta (M. birostris are landed on occasion.* As of 2017 all Mobulid rays are protected by CITES but are not yet protected in Malaysia, and were commonly observed being butchered after landing on the public fish market jetty by the Semporna Artisanal fishery. The gills are carefully separated for the Traditional Chinese Medicine trade and bring a high price[84].

The manta and mobula rays are filter feeders and do not take a hook so it is speculated that they were caught in a surface gill net set around a shoal of rays on the surface or by harpoon and spear. The very low fecundity (i.e. low reproduction rate) of the large and long-lived mobulid rays make the stocks of their species particularly susceptible to fishing mortality[36].

5. Shark Fin Survey Kota Kinabalu

A continuation of the TRACC study by McGuire and Oakley in 2016 revisited the SFMA jetty and dried fish shops in Kota Kinabalu. Inspection revealed numerous shops selling dried and packaged shark fin in Kota Kinabalu, Sandakan and Tawau. In Kota Kinabalu, two large shark fin sellers displayed well over 1,000 dried and packaged fins in sets or individually to sell. Wet fins detached from the shark bodies were present in all 12 of the surveys in Kota Kinabalu with a range from 25 to 300 wet fins. In the Kota Kinabalu fish market one vendor serves as the primary shark and ray vendor. Interviews with the vendor, documented on camera indicates that the shark fins are generally

bought by a wholesaler on the same day, and the meat is sold to restaurants or the public. After a few days, unsold shark meat is sent to the rendering plant to make fishmeal. On three visits we observed ground sharks that had been on sale go unsold after several days, but the fins were sold the day of landing. Fins from ground sharks sell for approximately ten times the value of the meat the vendor explained, primarily from sharks including bamboo and coral cat sharks. Trade data indicates that Malaysia has increased exports in low value shark fins, and it is reasonable to assume that the trawl fishery is one of the major fisheries supplying the shark fin exports throughout Sabah given large catch of ground sharks including bamboo sharks and cat sharks. Fins from guitarfish and Requiem sharks (*Carcharhinide*) sold for 5-10 X higher than the fins from the small ground shark species. The vendor explained small fins of low value are used for shark fin dumplings.

Shark carcasses landed with fins detached, although illegal, is commonly observed. White spotted guitarfish with fins removed were observed on several occasions, and the bodies of a Carcharhinid shark, likely a sandbar shark (*Carcharhinus plumbeus*) or blackspot shark (*Carcharhinus sealei*) were common, but difficult to identify species without the fins attached. Information provided by the vendor who sells them directly to a wholesaler vendor indicates that guitarfish fins bring a high price, as much as RM 300. Fresh fins from smaller Carcharhinid species sell for over 100 RM. On three occasions fins from scalloped hammerhead sharks, blacktip reef and pelagic thresher sharks were observed in the Kota Kinabalu market in the early morning before 5 AM. Meat from large hammerhead sharks was absent, although large fins were observed in bins and finned scalloped baby hammerhead sharks were on sale on five visits in 2017. As noted in the 2015 survey byTRACC, most of the hammerhead sharks are juvenile fins from these sharks bring far more value are bought by a wholesaler. Market value of dried fins, including fins from what appeared to be hammerhead sharks sold for RM 2995/kg ($760 US).

An unpublished study at the time of this writing by Dr. Amran Hazmah looked the socioeconomic value of sharks and rays fisheries in Sabah[9]. Presented at the Sabah Shark and Rays Forum in June 2018, the study visited Sabah shark markets, but also went underground and examined the fin market and fin fishery. The investigators found it easy to get large quantity of shark fins through middle men based in Tawau, near Semporna and a black market exists in Semporna using Pulau Mabul as a transit point. Sharks and rays mostly caught in Indonesian waters and fins are sourced sourced from neighboring Indonesia.

Other findings by Hazmah include:

- Local fishers target tuna but include sharks and rays as bybcatch especially during the ‘sharks season’ (April to June);
- Around 6 local fishers employed by agency based in Semporna to process/butcher sharks and rays at P. Mabul;
- Shark fins be sold for RM 300 to RM 400;
- Currently a 20in. shark fin could fetch up to RM600.

A similar phenomenon as shark fin, the high Asian demand for dried gill rakers (also known as brachial plates).The dried gills, are used in Traditional Chinese Medicine is driving a fishery that is

[9] Dr. Amran Hamzah Centre for Innovative Planning and Development (CIPD) Universiti Teknologi Malaysia, Socio-Economic Study of Sharks and Rays Fisheries in Sabah. Socioeconomic study conducted in 2017 analyzing social and market value of sharks and rays in Sabah

causing a decline in Mobula ray populations globally. Dried manta gills were also observed for sale in the dried fish market alongside shark fins selling for RM595/package of two ($150). On all occasions we observed the bodies of dismembered rays stored in fish boxes, with the brachial plates absent. Shark fin and increasingly manta and mobula ray gill rakers are sold in wet fish markets to traders, prepared and dried in shops and exported to China[10]. The Guangzhou trade is as much as 99% of the global market. Market analysis yields total annual gill raker trade volume in excess of 61,000 kg with an estimated value of US$11.3 million per year. Gills from Mobula rays sell in Malaysia and as much as $251 US/ kilogram in China[35].

Additionally, at all the major centres in Sabah, tourists have been observed filling small Styrofoam coolers at fish markets for personal export. We were informed that tourists are allowed to take 10 kilograms of fresh fish and fish products outside the country. The level of species and the number of tourists taking shark fin, manta ray gill, sea horses and fresh fish is unrecorded but is certainly significant. Mobulid rays are live bearing species with relatively few young and late onset of reproduction. Combined with their tendency to aggregate, Catch of large numbers by net is relatively easy, and populations are at high risk of being fished out[36]. There is no evidence of manta ray gills in trade records and the trade commodity code does not appear to be in use for exports and imports. Since 2015 we have routinely observed dried gill rakers on sale in Kota Kinabalu.
Collecting catch and landings data on Mobulid ray by species and volume, regulating the gill raker trade and creating export codes is increasingly urgent.

Dried Brachial Gill Plates (gill rakers) Street Market, Kpta Kinabalu Photo D. McGuire

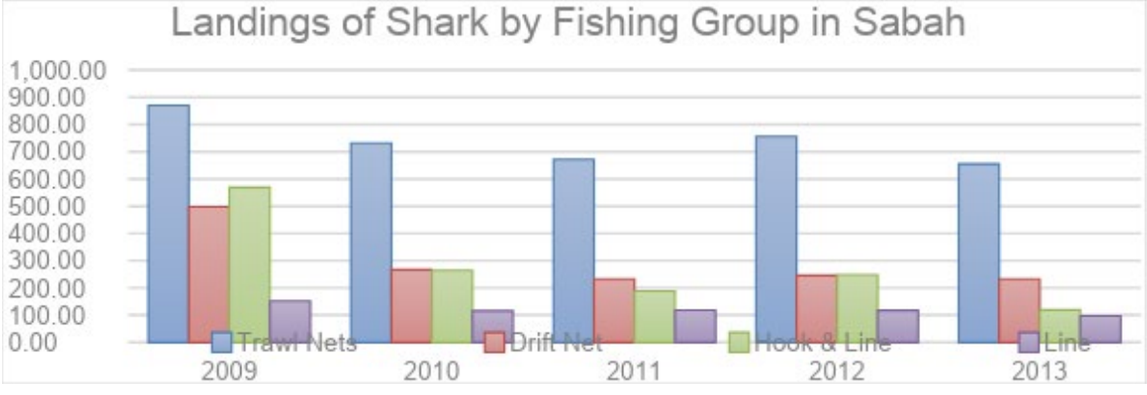
[10] As noted previously, the Reef and Pelagic Mantas have been been reclassified with the devil rays into the same genus Mobula[34].

Finned juvenile hammerhead, bamboo and carcharhinid sharks Kota Kinabalu Fish Market. Photo D. McGuire

G. Shark Landings by Gear

The Department of Fisheries has stated that all sharks and rays landed are bycatch of fishing boats, where 49 percent are by-catch of trawlers. Sharks and rays are also caught using other gear types such as 'rawai' (long liner), fishing lines, pukat tangsi (gill net) and fish traps. Data provided by TRACC agree with this gear assessment, and that trawlers are the most prevalent gear type used in Sabah[24]
Sandakan: Fish trawl is the major fishing gear landing sharks in Sandakan, Sabah. A total of 7,258 kg of sharks were landed from 133 fish trawlers landings sampled during the study duration. This amount contributed 94.63% of the total shark landings followed by longline (3.91%) and gillnet (1.46%). The shark landings from these three fishing gears contributed 3.64% of the total landings (shark and non-shark). An average of 1.27 fish trawlers/day, 1.0 longliners/day and 1.0 gillnetters/day were found to have sharks in their catches.

Kota Kinabalu: Fish trawl is the only fishing gear landing sharks in Kota Kinabalu during the study duration. A total of 9,293 kg of sharks were landed from 138 trawler landings sampled. Sharks constituted 1.30% of the total landing (shark and non-shark). An average of 1.2 trawlers/day have sharks in their catches. Fish trawl contributed almost 100% of sharks landed in Hutan Melintang, Kuantan, Sandakan and Kota Kinabalu.



Source: TRACC

Figure 3 Landings of Shark by fishing Groups, Sabah 2009-2013

Prior to the introduction of trawls in 1960s, sharks were caught by gill nets and hooks and lines throughout Malaysia. In 1965, when the use of trawls was still in its infancy stage, sharks caught by this gear constituted 4.0% of the total shark landings. In 1970, the relative amount of sharks caught by trawlers increased to 35.0%. By 1975, trawls became the main fishing gear catching sharks in the country. Sharks caught by trawls in 2001 contributed 60.0% of the total sharks landings, followed by drift nets (26.0%) and hooks and lines (13.0%). Other fishing gears include portable traps, stationary gears, barrier nets, purse seines and other seines.

An evaluation of gear type by region has been reported by SEAFDEC in *Sharks Fisheries in Southeast Asia*[31]. As catch rates and profits have declined, ecosystems have been altered, and conflicts between trawl-fishers and other users of the resources, especially small-scale artisanal fishers, are a common occurrence.

These issues have resulted in various management responses such as:

- complete bans on trawling (mostly at the subnational level);
- the introduction of fishery zonation and trawl exclusion areas in many countries in the region;
- efforts to improve the post-harvest utilization of low value catch (e.g. surimi); and;
- subsidies to sustain production, despite declining catches and profitability.

In some examples, the introduction of trawl bans resulted in the rapid recovery of both shrimp and fish stocks (e.g. following a trawl ban, the density of demersal fish in the Straits of Malacca more than doubled from 1.2 tonnes/km2 to 3 tonnes/km2 between 1983 and 1985). This has led to onward benefits to small-scale fishers. However, zonation regulations are enforced with various degrees of success and it is a common complaint that trawlers break zoning regulations and fish in reserved areas and during closed seasons.

The NPOA evaluation of the two fishing centres evaluated by TRACC corroborate that trawl landings is the most significant source of shark and ray catch. This method of fishing is indiscriminate and responsible for significant amounts of untargeted catch also known as bycatch which includes sea turtles, rays and small or unpalatable fish known as trash, or garbage fish. Trawls are also known to damage benthic habitat via the lead chain and the nets entangle on coral and reefs. Additionally, these nets are dangerous to air breathing animals such as sea turtles, seabirds and marine mammals. Gear restrictions and modifications such as cod end, tow length and type exist elsewhere in the world that potentially could benefit sharks[37].

The DoFM has prohibited the use of explosive, poison or pollutant, the use of electric shock, pair trawling and push nets. The locally known 'pukat pari', a drift net with a mesh size of more than 25.4 cm (10 inches), once used to catch large sized sharks and rays has been banned since 1990. Commercial gears such as trawlers and purse seine are prohibited to operate within 8 nm from coastline. This reduces conflict between large-scale fishers and artisanal or subsistence fishers.

More recently, the Department of Fisheries in Sabah recorded the landing by gear for sharks (shark group) between 2009-2015, displayed in Figure 4. These data provided by the Department of Fisheries Sabah, mirror the national decline in shark landings across all gear types. Like to the national trend, trawlers dominate the shark landings[11].

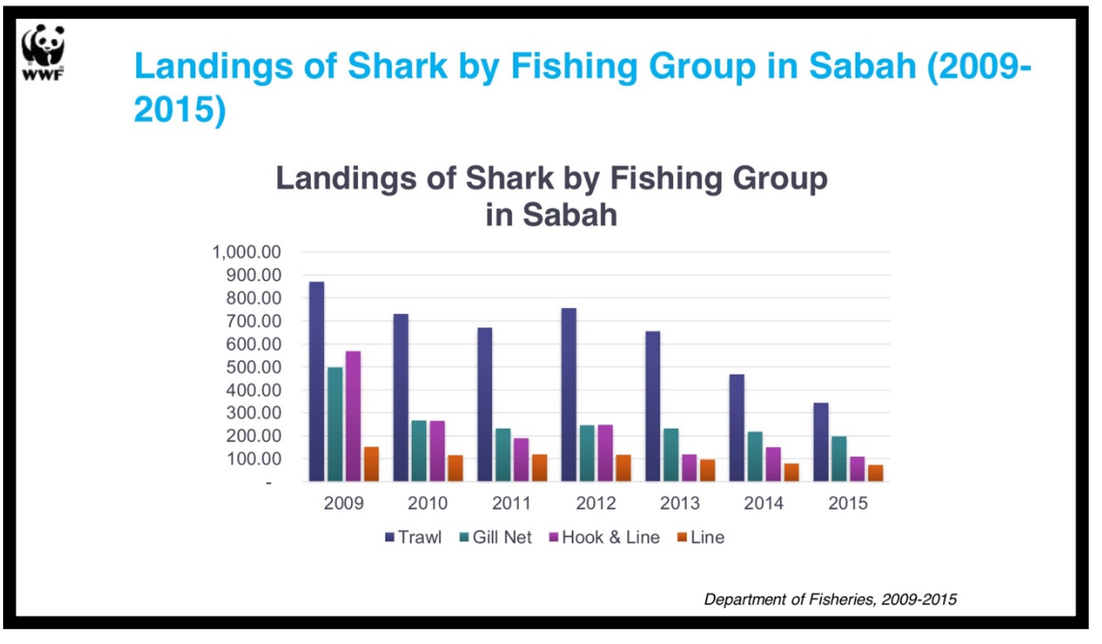


FIGURE 4 Image Courtesy WWF-Malaysia

As shown in Table 6, Sandakan is the largest landing site for sharks and rays, followed by Kota Kinabalu, Semporna and Kudat. (Source WWF-Malaysia) This data supports earlier NPOA findings defining trawler and drift gill nets are the majority of fishing gear used in Sabah, and is consistent with our observations.[12] Although gill nets and longlines target sharks, the former is illegal (large mesh size) and the latter is less common and used in the tuna fishery. However, trawlers are an indiscriminate method of fishing and frequently land sharks and rays and other non-targeted species

[11] Source Dr. Robecca Jumin, WWF-Malaysia

as bycatch. Artisinal and subsistence catch for sharks and rays are not reflected in the DOFS statistics. The subject of sharks and rays as bycaych in the trawler fishery will be investigated in depth in section IV E of this document.

TABLE 6 Ranked Main Fishing Gear by Most Common and Main Landing Sites Sharks Sabah

Main types of fishing gear by Use	Main landing districts in Sabah
1. Trawl net (Main gear)	1. Sandakan
2. Drift net (pukat hanyut)	2. Kota Kinabalu
3. Hook & Line (pancing)	3. Semporna
4. Line (Rawai)	4. Kunak

Source: Department of Fisheries, Sabah 2015

Trawler sorting catch. Kota Kinabalu market (photo D. McGuire)

V. FISHING, FINNING AND THE SHARK FIN TRADE

Fresh Fins from Scalloped Hammerhead Shark. (Image Courtesy crema.org)

A. Overfishing Shark Globally and Threats From the Shark Fin Trade

In a discussion of shark fishing and the shark fin trade, the practice of shark finning must be clearly defined. The practice of shark finning, is generally described as the practice of killing or capturing sharks and cutting and maintaining the fins and discarding the body dead or alive while retaining the valuable fin. Shark finning is generally deplored as cruel and wasteful and is condemned by the United Nations and international community. Internationally, approximately one quarter of nations - at this point approximately 50 - have national laws banning the practice of shark finning. However, the high value of shark fin relative to the low value meat and the additional handling and treatment of shark carcasses leads to more sharks killed for their fins than is reported[15].

Linking fins to a specific fishery, illegal or legal is a challenge and difficult without trading or sophisticated technology once the treated fin has entered the marketplace. Fishermen can easily hide fins among the regular catch and sell them once ashore with no questions asked. The UN Convention (2007) has required all signatories to land sharks with their fins attached, however this is managed by regional fisheries management authorities (e.g SEAFDEC) by country and locality, and some countries, like Malaysia allow the landings of sharks with fins detached from the body[13].

Under the 2006 Southeast Asia Fisheries Commission (SEAFC) of which Malaysia is included, the full utilization (defined as retention by the fishing vessel of all parts of the shark except head, guts and skins, to the point of first landing) of entire shark catches. Shark bodies are allowed to be landed without fins in this fishery, but the accompanying fins should not total more than 5% of the weight of sharks

onboard. Malaysia, like many nations is largely dependent on sharks to support its economy. As observed in other countries where landings of shark body to fin ratios by weight are allowed, notably Spain, the weight ratio has lead to killing of protected species and more sharks are killed than are accounted for[13]. Thus, allowing sharks to be landed with fins detached undermines accurate data collection at landing sites and recording, and also leads to an underestimate of shark catch.

The Malaysian NPOA-2 aspires to "Minimise waste and discards from shark and ray catches in accordance with Article 7.2.2 (g) of the Code of Conduct for Responsible Fisheries (for example, requiring the retention of sharks from which fins are removed)"[29]. A main driver of shark fishing is the globalized trade to meet Asian demand for shark fin soup, a traditional and usually expensive Chinese dish. This particularly lucrative trade in fins (not only from sharks, but also of shark-like rays such as wedgefishes and sawfishes) remains largely unregulated across the 86 countries and territories that exported over 9,500 mt of fins to Hong Kong in 2010[15].

Between 2001 and 2005, Clarke et al. examined market data from shark fin auctions in Hong Kong, at the time the largest point of shark fin trade globally. From the data on fin numbers, types, sizes, and source species in the market, she and her colleagues have estimated the magnitude of the international trade in fins. Clarke estimates that finning claims between 26 million and 73 million sharks annually with a median of 38 million[14]. During that period Hong Kong represented as much as 90% of the global shark fin trade. Changes in global trade policy and opening markets within mainland China, with possibly increased exposure on the lack of sustainability and absence of health benefits of shark fin soup lead to a decrease in shark fin trade in Hong Kong in the early 2000s. Historically, Hong Kong has served as the major transit point for shark fin passing between Mainland China and the rest of the world. However, as the proportion of the Hong Kong shark fin trade exports decreased, the trade in shark fins between key Southeast Asian trading centers (e.g. Singapore, Malaysia and Thailand) and mainland China has significantly expanded[15].

A shift in global economics, social dynamics have altered patterns of shark fin trade, and Hong Kong SAR once the world's largest exporter has shifted to other countries in Southeast Asia. As of 2015, Thailand surpassed China, and estimates suggest that its main trading partners Japan and Malaysia may be among the world's top four export markets for shark fins. All three countries are among the top 15 shark and ray capture production countries globally. The vast majority of shark fins are destined for consumption in a relatively small selection of countries and territories in East and Southeast Asia such as China, Hong Kong SAR, Taiwan Province of China, Singapore, Malaysia and Vietnam[15].

A follow up to the Hong Kong fin survey by Clarke published by Fields et. al. in 2016 conducted the genetic identification of 4800 fins offered for sale in Hong Kong seafood districts during 2014-2015. They found 76 different species of sharks, rays and chimeras represented, with 1/3 of these species listed as Vulnerable or Endangered by IUCN. Most prominent were blue sharks, comprising one third of the samples, followed by silky sharks, which represented 10% of the fins. The two species of rays were both guitarfish, a batoid with large dorsal fins. They found equal numbers of small and large sharks, and many of the species were coastal. Half of the trade was in oceanic sharks[37].

A comprehensive study on global commercial shark catch that combines illegal shark killing including shark finning estimates that 100 million sharks and rays on average are killed every year around the world[16]. Worm et al. analyzed data on shark catches globally to estimate the number of unreported shark deaths every year and estimate a statistical range between 63 million sharks and 273 million sharks are killed a year. Hammerhead sharks are particularly at risk, the authors note. The researchers estimated that global reported catches, unreported landings, discards exceed legal catch for elasmobranchs. The

study estimates that globally, sharks caught and finned were as high as 97 million fish caught, in 2010, slightly down from the estimated 100m caught in 2000. The authors conclude that results provide the first fishery-independent estimate of the scale of shark catches worldwide and indicate that shark biomass in the fin trade is three to four times higher than shark catch figures reported in the only global database[16].

Accurate record keeping of sharks and rays is exacerbated by large amounts of by catch, particularly in the trawl industry. The shrimp trawl fishery is responsible for unselected catch and habitat damage throughout Southeast Asia, including Malaysia, and bottom sharks and rays are highly represented[38].

B. Domestic Shark Fin Consumption

Shark fin consumption in Malaysia is high, particularly in Kota Kinabalu and Kuala Lumpur. A study conducted in 2003–04 in six major Malaysian shark landing ports found that most fin products are consumed locally with only the largest and most valuable fins exported (SEAFDEC, 2006). In Sabah, seafood tourism is a developing industry attracting Asian visitors. Through its research, WWF Malaysia found that shark fin consumption between 2004 and 2011 has increased by an average of 54 per cent per year. In a survey conducted in 2016, WWF-Malaysia reports that 84% of these imported shark fins are consumed domestically. Shark fin and shark fin soup are widely available[39].

State and FAO trade records indicates that more shark fin is consumed in country than re-exported. Singapore and Indonesia are the main suppliers to the Malaysian market followed by Australia, Hong Kong, Fiji, Philippines and Maldives. Malaysia exports limited volumes of shark fins, with Thailand as its major market. In 1997 Malaysia exported 31 metric tons, worth US$173,000 and imported 122 metric tons, valued at US $652,000. However, fins from high value sharks such as hammerhead sharks and the white spotted guitarfish are exported, primarily to China[37].

An accurate analysis of Malaysia's shark fin trade records is difficult given the unclear descriptions in commodity categories with several code changes over time, and overlap in categories. Between 2000 and 2011, Malaysia recorded average annual shark fin imports of 1,172 tons, worth US$3.2 million (approximately RM14 million) and average annual shark fin exports of 238 tons, worth US$902,000 (approximately RM3.9 million)[29].

Among the seafood categories in Malaysia, Arshad et al. (2017) reports the shark fin trade registered rapid growth compared to shark meat in terms of value in the past ten years. The unit trade value of shark fin is much higher than the shark meat, as much as 10-100x more in value depending on the shark.[22] This difference in value between shark fin and shark meat is confirmed by the author's market observations in Sabah with Oakley between 2012 and 2016 and the recent market analysis by Ahmad et al in 2017[23,24].

These data and those reported by the FAO Shark 2 suggests that shark fin consumption rates in Malaysia is among the world's highest. The large quantity of processed shark fins imported by Malaysia in recent years suggests that domestic consumption is growing. Malaysia's ranking among the top ten domestic chondrichthyian capture production nations provides it with additional supplies that are processed and consumed locally and supply an increasing tourist trade[13]. Prices and sales are reported to increase during the Chinese New Year[39].

C. Imports and Exports of Shark Fin, Malaysia

The UNFAO cited a total of 1,341.8 metric tons of shark's fins prepared and ready for use and in airtight containers were exported from Malaysia between 2004-2012 with an average of 149.1 metric tons/year. For the same product, Malaysia imported 9,756 metric tons with an average of 1,084.1 metric tons/year during the same period. Overall, there is a steady increase in the trends of the quantities of exports and imports of shark fins prepared and ready for use and in airtight containers from 2006 to 2009. These quantities fluctuate slightly from 2010 to 2012 but with an overall increasing trend[18].

Despite some uncertainties as to the accuracy of the volume reported before 2004, Malaysia's imports of shark fins increased considerably from 2004 to 2012. In the State of the Global Shark Fin Market, analysis, the import volume of 850 metric tons an increased 813 metric tons from the previous year in Malaysia. The 2012 value of 1,433 metric tons reflects a further increase of 123 percent compared with 2004. In monetary terms, the shark fin import total was USD 237,000 in 2003, USD 1.8 million in 2004 and USD 6.3 million in 2012. This represents a 251 percent increase in eight years between 2004 and 2012. The proportionally larger increase in value is mainly due to the increasing value per kilogram of "prepared or preserved" shark fins, which from 2004 to 2012 accounted for an average of 92 percent of total shark fin import volume with an 85 percent of value [13,15].

TABLE 7 Malaysia's Import of Sharks and Rays by Product (Mt), 2004-2014

Commodity	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Dogfish and other Sharks, excluding Livers and Roes, Fresh or Chilled	-	-	-	1	o	-	-	-	-	41	3
Dogfish and other Sharks,excluding Livers and Roes, Frozen	36	33	52	130	29	94	52	19	67	-	54
Shark fins	164	82	121	142	43	49	44	161	71	67	57
Sharks'Fins, Prepared & Ready for Use, other than in Airtight Containers	99	82	121	142	43	49	44	161	71	67	57
Shark's Fins,Prepredor preserved, in Airtight Containers	-	-	0	1	3	9	31	2	21	237	0
Sharks'Fins, Prepared & Ready for Use, in Airtight Containers	586	593	760	1054	1150	1273	1270	1270	1802	1540	1444
Total	984	876	1053	1328	1226	1425	1397	1453	1962	1952	1634

Source: DOFM (2015)

Table 7 details the countrywide import of sharks and rays by product between 2004 and 2014. Shark

fins are categorized as: Shark Fins; Shark Fins Prepared and Ready to Use other than in Airtight containers; Shark Fins Prepared or Preserved in Airtight Containers and; Shark Fins Prepared and Ready for Use, in Airtight Containers. The latter category is the highest, trending up until 2012, and then declining like all categories.

Dried fins are the second most imported product form, with an average quantity of 71 metric tons (USD $283,000) imported annually from 2000 to 2012, while the average yearly volume for frozen fins for the same period was only 13 metric tons (USD $167,000). For exports from 2004 to 2012, the relative proportions of the different product forms are similar, with "prepared or preserved" fins accounting for 89 percent of volume and 72 percent of value. Exports of "salted and in brine" and dried fins are minimal, although generally somewhat higher valued. Once fins have been detached from the body of a shark, it is difficult to know whether they came from sharks legally caught for their meat in a sustainably managed fishery or from illegal, unmanaged and unsustainable fisheries such as shark finning[15,33]. From 2000 to 2011, trade statistics for shark fins were recorded by Malaysian customs under nine different commodity codes, only two of which were not discontinued at some point in this period. Although there is a distinction between "prepared or preserved", "dried" and "frozen" shark fins, a large discrepancy between reported statistics for "prepared or preserved" fins before and after 2004 suggests that this product form may have previously been included under a more aggregated category[29].

Except for the customs statistics, government departments do not have specific information on shark fins or shark fin traders, even though imports must be licensed. Starting in 1988, the item previously under the group "Shark fin prepared not in airtight containers" was simply renamed "Shark fin". This simplification no longer describes the product and may cause confusion when comparing trade. The early statistics for shark fin products, previously reported as shark fin dried, salted or in brine, was subdivided in 1989 into two separate groups. One "Dried whether or not salted but not smoked" and the other "Salted but not dried or smoked and in brine". As only dried fins are traded in the region, the first group is in fact dried shark fin and the second group is salted and dried shark fin creating difficulty in tracking. There are five shark's fin products and two other shark products which are traded in Malaysia. The Annual Fisheries Statistics and Customs Code do not differentiate the various species of sharks that are being traded[18]. Although evidence exists, as recently as 2017 that fins are treated and re- exported. However, this may not be well reflected in the records[33].

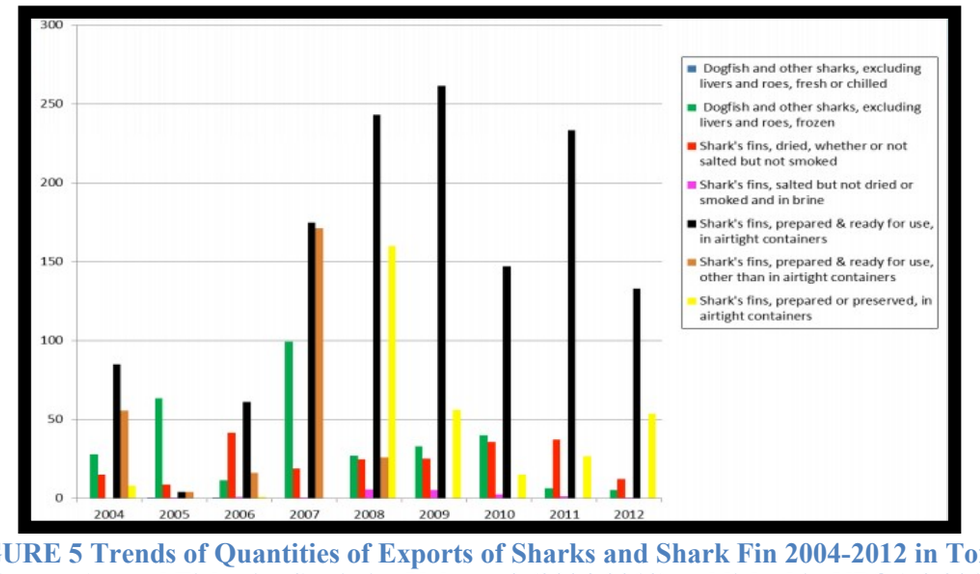


FIGURE 5 Trends of Quantities of Exports of Sharks and Shark Fin 2004-2012 in Tonnes
Source Annual Fisheries Statistics Volume 2 (2004-2012) published in NPOA 2 2014

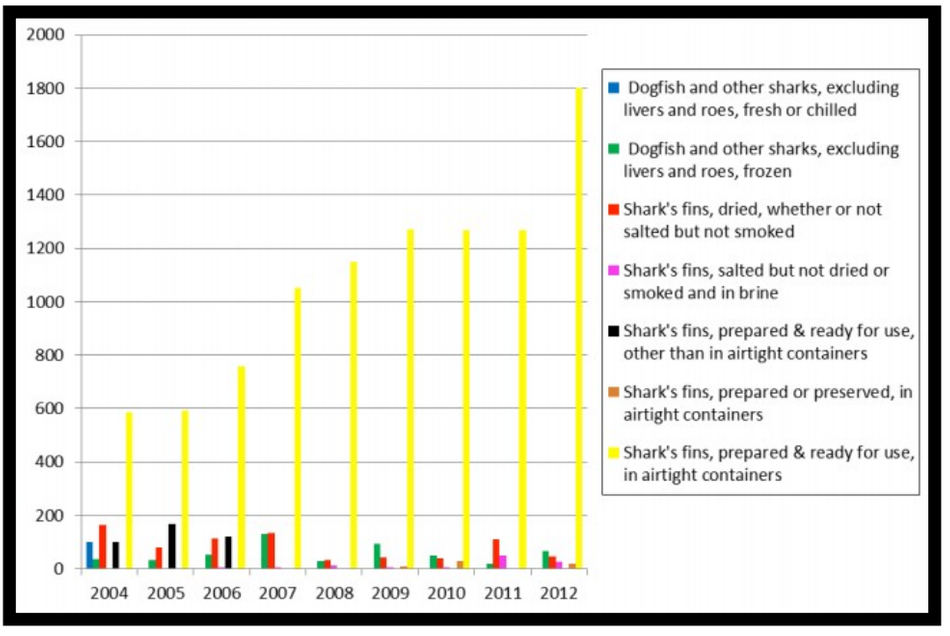


FIGURE 6 Trends of Quantities of Imports of Sharks and Shark Fio 2004-2012 in Tonnes
Source Annual Fisheries Statistics Volume 2 (2004-2012) published in NPOA 2 2014

Figures 5 and 6 feature the trends in the Malaysian imports and exports published by the UNFAO between 2000 and 2012. While exports increased rapidly between 2005 and 2007, they declined significantly after 2007 (Figure 5). Although coding modifications after 2011 may have some bearing on the decline in 2012, and economic factors can influence trends, it is also likely the decline of exports is a reflection of shark landings in Malaysia which peaked in 2003 reported in NPOA 2. At the same time, imports increased precipitously up, reflecting the increase in demand for shark fin consumption domestically (Figure 6). These trends suggest that Malaysia is both overtaxing the domestic supply of shark fins, especially large sharks, and the increase in imports is attributed to a large increase in market demand.

Malaysian statistics show steady growth in shark fin import volumes in the last decade but large discrepancies between volumes recorded before and after 2004 suggest that this may be a case of increased identification of shark fins in trade records rather than a real increase in trade quantities.
Malaysia is a major shark producer with a large consumer market for shark fins, posting large import volumes of low value fins.
From 2000-2011, Malaysia recorded average shark fin imports of 1,172 metric tons, worth USD 32 Million
Thailand is the major origin of Malaysian imports, supplying primarily low valued processed fins
Malaysian authorities have consistently distinguished between prepared of preserved, dried and frozen shark fins, but revisions of commodity codes, whose descriptions may or may not identify shark fins explicitly , have been frequent.
Malaysia ranks as the world's ninth-largest shark producer and third largest importer in volume terms.

Table 8 Summary Shark Fin Imports and Exports Malaysia, 2000-2011

(Source Lack and Dent 2015)

Of concern is species that are CITES listed or endangered entering the market, whether through reporting discrepancies inaccurate import or export codes, or a lack of identification by species, thereby allowing the traffic of threatened species. Inconsistencies in reporting categories confuse statistics making comparisons difficult and allow for a greater quantity of fins traded than reported. Data from the most

recent summary by Lack and Sant suggest the shark fin markets in Thailand, Malaysia and Japan, although focused on small low-value fins, may be among the world's largest[13]. These fins typically come from smaller sharks that do not have high density of collagen fibers that give the fin rigidity and make up the desired texture, making up the needles in shark fin soup. Although requested, statistics for imports and exports more recent than 2014 were not available at the time of this writing.

D. CITES Restrictions and the Fin Trade

Malaysia is a signatory to CITES, and as such adheres to permitting and reporting required under the agreement. A summary document on shark catch and fisheries by the UNFAO on Malaysia states that the country has never allowed exportation of any CITES listed sharks, manta rays and sawfishes originated from Malaysia. Zero quotas were applied for export and import of CITES species. However, discrepancies in data from importing and (re)exporting countries and territories are not uncommon in the UNEP-WCMC's CITES trade database.

Inspection challenges during transshipment, confusion among product codes and mislabeling allow for avenues of CITES listed products to bypass inspectors and permitting agents and cross borders in violation of CITES. For example, in 2014 the CITES exports for listed sharks shows that only Hong Kong (of the three study areas) had imported and (re)exported shark fins of CITES listed species (Basking Shark), while both mainland China and Hong Kong had imported shark meat. Only Hong Kong reported imports of the fins (6,933.4 kg) of Basking Shark fins (*Cetorhinus maximus*) from Norway, and reported the (re)exportation (9 kg) of fins from this same shipment to Malaysia. These imported fins however were not reported by Malaysia as required under CITES[15]. Either by accident or design, shipment of CITES protected species under vague or inaccurate coding allows for the transshipment and trade of threatened species.

CITES is a tool to permit and regulate threatened and endangered species that are listed, but does not directly protect species from over-harvesting in country unless specifically listed under the law of the country or state. CITES does not apply directly to domestic harvest of listed species, of which Malaysia is host to many (Appendix I). All Sawfish (Pristiformes) are listed under Appendix I of CITES and as such are prohibited from international trade with a few minor scientific exceptions. Of particular concern is the frequently observed trade in scalloped hammerhead, a shark listed under Appendix II, but not included under the Malaysian Endangered Species Act. This shark has been observed to be declining in Malaysia and the fins are traded in wet fish and dried fish markets[24]. Once removed species identification is very difficult and inaccurate labeling, or an absence of trade codes such as the case of Manta rays exacerbates a growing decline in these species.

E. Shark Fin Soup Consumption, Malaysia

The trade in shark fin is primarily associated with the preparation of the delicacy shark fin soup. This dish is reported to date back to the emperor in the Song Dynasty in the 10th century AD. Served at banquets, business functions and celebratory occasions, the dish represents wealth, power and generosity. The increasing wealth of the middle class in China at the end of the last century increased demand for luxuries like shark fin soup. The shark fin trade more than doubled between 1985 and 2001, and was calculated to increase approximately 5% each year after 2004[33]. As detailed in the previous section, shark fin brings high prices to fishers and middlemen. This large demand has increased shark catch and targeting species for their fins to supply the lucrative shark fin trade[21].

Malaysia, with a large ethnic Chinese population, is an important secondary market for shark fins, taking an average share of 7 percent of world import volume (1,172 metric tons) from 2000 to 2011[21]. Although comprehensive market data for shark fin consumption in country is absent, scores of hotels and restaurants serve shark fin soup in Malaysia. Shark fin exports have declined since 2007 while shark fin imports have risen steadily. Consumption at home during celebrations and holidays such as the Lunar New Year are unaccounted for in trade records, but thought to surge[39]. In 2017 a market survey in Singapore estimates that Malaysia's trade in shark fin is on the increase just behind Singapore and Hong Kong[41].

Shark Fins from Large Shark on sale in Kota Kinabalu. (Photo Aderick Chong, Sabah Shark Protection Association)

A shark fin consumer survey conducted by WWF-Malaysia in 2015 revealed that consumption of shark fin soup is strongly tied to celebrations such as weddings (85%). A key finding of the survey is that shark fin soup consumers are mostly of Chinese ethnicity (76%), living in Kuala Lumpur or Petaling Jaya (91%). The market survey conducted by the WWF identified 176 restaurants serving shark fin in Kuala Lumpur and 16 in Kota Kinabalu. The investigators note the challenges of surveying when shark fin is often served off the menu, or by special request and is likely much higher. A positive finding suggests the over half of consumers polled (57%) said it was acceptable to replace shark fin soup with alternatives at weddings. As a result of an intensive Malaysian public campaign called My Fin My Life by WWF-Malaysia and supported by the Sabah Shark Protection Association, the group obtained 86 Corporate Pledges, 31 Hotels/Restaurants and 55 Corporations to voluntarily opted out of selling shark fin as of 2017. It is clear that public opinion can be swayed by these education campaigns, and that strong statements or actions by

government can have similarly profound effects in awareness and reducing shark fin consumption[39].
In this survey, the author observed packaged, dried and treated shark fins are readily available in the dried seafood shops throughout Malaysia, but especially focused in Kuala Lumpur and Kota Kinabalu. A survey of shops selling fins in Kota Kinabalu revealed prices of packaged fins ranging from RM 595 ($150 US) - RM 2995 ($756 US) for a set of fins. Packaged manta ray gills were sold for RM 595/ kg ($150 US). More highly priced shark fins were large fins of undetermined species, possibly hammerhead. Shark fin soup does not only include shark fin. We observed the fins of guitarfish sold with shark fins in Kota Kinabalu and were informed that parts of ray wings also enter the fin market. The trader in Kota Kinabalu informed us that the fins from the guitarfish are among the most prized. In Hong Kong fins from rays and sawfish have been reported to be utilized in the production of shark fin soup[41]. Thus, consideration to these species of rays (e.g. the giant guitarfish (*Rhynchobatus djiddensis*) and wedgefishes, should also be considered in fisheries and conservation plans.

On a promising note that may be trend setting throughout the shark fin consumer market, Sabah State Tourism, Culture and Environment Minister, YB Datuk Seri Panglima Masidi Manjun urged the state government to remove shark fin soup from the menu at all its official functions. In 2007, Malaysia's Natural Resources and Environment Ministry, banned shark's fin soup from official functions[42]. Although it is not known how much consumption has been reduced as a result of this measure, it sends a clear signal from top government ministers that shark fin is not a sustainable dish. In 2012 the Central Chinese government issued a decree that shark fin soup would be forbidden at any government function, and went fully into effect in 2015. A trickle-down effect from government functions avoiding shark fin may be resulting in an overall decline in shark fin soup consumption. A survey of shark fin soup consumption by WildAid estimates consumption of shark fin soup in China has declined significantly since the government proclamation. The study also cites the rise in consumption outside of China in adjacent Southeast Asian nations[43].
By going shark fin free, Sabah has the opportunity to demonstrate an ocean conservation ethos that could be trend setting for the rest of Malaysia, and have a significant overall effect in the decline of shark populations both domestically and internationally.

F. Bycatch of Sharks and Rays and Fish Market Observations, Sabah

Bycatch includes all non-target animals and non-living material (debris such as rock) caught while fishing. In shrimp-trawl fisheries, bycatch is defined as anything the fisherman does not intend to catch and may include turtles, fish, crabs, sharks, stingrays, pieces of coral, weed and seabed debris. Sometimes this is called incidental or accidental catch. Bycatch also includes animals and non-living material that interact with the fishing gear but do not reach the deck of the fishing boat. This includes coral and seagrass that are entangled by the ground gear, undesirable species and small fish that are selected out of the net and discarded at sea[38].

Many species of sharks and rays are commonly caught as bycatch in commercial fisheries, especially in the trawl fishery, a gear known for notorious amounts of bycatch. Many species are often retained as valuable catch in fisheries that focus on more marketable fish species, such as tunas or groundfishes[12]. In many cases, fishing pressure on sharks and rays is increasing as other target species become less accessible due to depletion. This decline in the primary catch has lead to a market shift focusing on the meat of other species, including rays and some sharks. Additionally, the increasing value of meat, fins, livers, and/or gill rakers leads to increased capture of sharks and rays [5,13,35].

Globally, the reported shark and ray catch has been increasingly dominated by rays, which have made up greater than half of reported taxonomically-differentiated landings for the past four decades. Most chondrichthyan catches are unregulated and often misidentified, unrecorded, aggregated, or discarded at sea, resulting in a lack of species-specific landings information[12].

Evidence from the TRACC fish market and trawler survey indicates elasmobranch bycatch by trawler is high, especially rays in the Dasayatidae and Himanaptura families. Rays are frequently lumped in under the category stingray, and species recordings have been few. The absence of small skates and rays in the main market initiated a survey of the bycatch at the four major landing points in the TRACC study. This bycatch is small species of fish or invertebrates typically caught by trawlers which have little market value. The trawl fishery bycatch and market discards – skins, heads, guts and decomposing fish - were sold to the fish meal processing factories for producing fish meal[24].

The small pelagic fish species observed from the purse seine fishery were and were typically sold direct to fish processing factories for making processed fish (fish balls or cakes) or to fish farms for fresh wet feed. Oakley reports that many species of groundshark (Family Carchirhinidae, which includes sandbar sharks and spottail sharks) and bamboo sharks (*Chiloscylium spp*.) are sought for the fins and the bodies ultimately rendered and not used for food. While aiding the TRACC study, the author documented whole carcasses of over 100 coral cat-sharks, bamboo reef sharks, and brown sharks in the Kota Kinabalu fish market in a single survey over 3 days. The shark bodies eventually decayed, and were sent to be rendered into fish balls. When interviewed, the shark vendor expressed that the fins are the first to sell each morning, picked up by a wholesaler and the bodies of low value were poor selling items next to thresher, hammerhead and reef sharks we observed on rare occasion. The meat from these pelagic species, in addition to leopard rays and the occasional mobula ray all sold over the counter and were not rendered. Rays appeared to be preferred by patrons of the wet fish markets over the small sharks. Spotted leopard ray and the Blue spotted stingrays (*Taeniura lymma*) from the trawl fishery the Semporna and Sandakan market surveys were commonly observed and sold for local consumption[24].

The TRACC study documented bycatch at each location where bycatch sampling was possible. A total of 50 boxes/baskets of trawl bycatch were sampled for small sharks and rays kept in the rear of the market. All elasmobranchs seen were identified to species, counted and measured. Each box weighed 45-55kg; thus a total of 2,000-2,500 kg of trash fish were sorted at Kota Kinabalu, Sandakan, Semporna and Tawau. In Kudat, trash fish remains on the fishing vessels and is then transferred directly to trash fish boats that sell direct to rendering or fishmeal operators. This catch is not reported or recorded by species and thus any catch of rays and other fish is vastly underreported.

A fundamental problem in fisheries management is accurate reporting. Part of this problem is that bycatch is not differentiated from “catch”, so it is difficult to draw conclusions on incidental as opposed to targeted shark fishing. Semporna longliners are targeting reef sharks, and many artisanal scale fishermen in Sabah focus on the ray trade. Management of populations becomes more challenging when a fishery is discounted or otherwise ignored because the catch of sharks and rays are dismissed as bycatch. The observations in the fish market by TRACC corroborated in the 2017 Sabah Data[23] and Market[24] studies strongly suggest that in many cases, shark and ray catch are not sweepingly bycatch, and should be considered a fishery category and managed separately. To increase data on shark and ray catch, especially large sharks and mobula rays, inspections need to occur during landing times at night and in the early morning.

Table 9 Shark Catch by Gear Type Sabah Observed in TRACC Survey 2009-2013

Year	-Pukat Tunda Trawl Nets	Pukat Hanyut Drift/Gill Nets	-Mengail Pancing Hook & Line	Rawai - Line	-Hook and Line (Tuna)
2009	870.05	497.3	568.56	151.55	0
2010	730.92	266.69	264.37	115.52	0
2011	671.28	232.65	188.92	118.19	0
2012	755.86	245.69	248.14	117.19	0
2013	654.88	232.63	119.42	97.28	0
Total	3682.99	1474.97	1389.41	599.74	0

Table 9 displays the volume of shark catch by gear type collected by TRACC between 2009 and 2013 in Kota Kinabalu. Catch for all types of gear show a decline in catch over the four years of the study. Trawl catch is far higher than gill nets, and hook and line by nearly double. Consistent with data in the 2017 market and trade surveys[23,24], In their surveys, TRACC reports that trawlers are the most common licensed fisher in Malaysia and in Sabah. Trawl catches the highest volume of non-targeted catch, or bycatch. Along with most valued fish, non-targeted invertebrates and fish are captured. Some are discarded at sea, and others sorted at the landing site. Following the sort, fish of no or lesser value are sent from the major centers to fish processing plants. These so called trash fish are rendered for animal feed, fish-meal and fertilizer. However, transportation challenges and distance from docks outside major centers lead to an unaccounted waste. The trawl fishery in general is extremely harmful to habitat and is extremely high in bycatch. In some fisheries, such as the US shrimp fishery where accurate records of catch vs bycatch are collected, as much as 97% of the catch is wasted or unwanted[44].The shrimp trawl fishery is responsible for unselected catch and habitat damage throughout Southeast Asia, including Malaysia[38]. A 2018 analysis of Industrial fisheries that rely on bottom trawling to catch fish, estimates 437 million tonnes of fish and $560 billion were discarded overboard over the past 65 years[465].

Matusmoto and Fowler also address bycatch in their comparison of shark and ray catch between 1996 and 2016 in Sabah. In a mixed-species fishery where all species are subject to the same fishing effort and similar fishing mortality rates, less abundant species subjected to fishing activity throughout their range could be driven to extinction, while numerically dominant species continue to support the fishery. Species caught extensively as bycatch may be, indirectly, even more vulnerable than target species taken in a mixed fishery, because discards and landings are generally poorly monitored and signs of declining catches and collapsing stocks may thus be overlooked. They define ‘unsustainable by- catches’ as species that are not currently at risk but if they persist being by-catches, the population would decline. Critical by-catches’ are defined by-catches of species that are in danger of extinction which would refer to the Scalloped Hammerhead and Zebra Shark[13].

In Sabah, rays are caught in Terengganu and Kelantan rays are caught legally with trawlers, but also are caught illegally with 10 inch gill nets, and with bottom long-lines (Dr. Nicholas Pilcher, pers. comm). Bottom longlines are not reported to be used in Sabah, but rays and some sharks are taken in trawls, while others are caught with hook and line. No commercial catches (or at least negligible numbers) are

taken by hook and line. This method is more artisanal and targets deepwater sharks and takes the whole animal and uses the whole animal.[14] Instead of terming the shark and ray capture as bycatch - Pilcher recommends it be termed *byproduct* because all catch is landed. While not solving the issue of overfishing, it would help with statistical analysis and comparison of catch.

Fishing licenses for Malaysian vessels do not restrict the species that can be caught. The license usually only restricts the location where fishing can be done (the fishing zone and class of vessel) and the gear type used[28]. This system allows for catch of threatened and endangered species along with targeted catch. Since fishing codes are general or even absent, even at landing sites there is little available data that is accurate on the volume of fish wasted or unaccounted for in this fishery, including sharks and rays. Discards at sea, generally considered rare in Malaysia, are undocumented and large quantities of invertebrates, unmarketable fish and other marine life are shoveled off the landings at the dock (personal observation, author). Small scale fishers are more selective and have far less waste than commercial scale fisheries, however an unaccounted volume of inedible or unpalatable species is entrained and wasted in trawl fisheries. As a major source of protein for Sabahans it would behoove fisheries managers to more closely scrutinize areas of catch and species of rays landed with the zones fished. Nursery areas as indicated by high volumes of small disc size, or juvenile sharks should be protected from trawlers to help maintain this valuable resource. A Vessel Management System such as Global Fish Watch would allow for better data collection matching species catch with geographical location, and allow managers to better enforce vessels fishing outside of their designated fishing zones.

G. Artisanal and Small Scale Fisheries

A decade ago, the 1998 Malaysian Annual Fisheries Statistics estimated that 81,548 fisherfolk earned their livelihood by catching fish. Out of these, 51.6 percent (42,111) operated traditional fishing gear in small-scale fisheries throughout Malaysia, An estimated 289,275 tonnes of fish (23.63 percent of total fish landing) were caught by these small-scale fishermen in 1998[46]. Since then, the domestic fisheries sector has increased by 60%. Fisheries in general provided employment to 136,514 fishers in 2017[47]. The Malaysian capture fisheries is divided into coastal and deep-sea; which contributed 1,136,182 mT (77.2%) and 336,057 mT (22.8%) respectively to the total marine landings in 2014[47].

A challenge to accuracy in fisheries statistics is that like in many countries, Malaysian data are collected for licensed commercial fishers and reported landings, but do not account for unlicensed, artisanal or small-scale fisheries. Licensing of small fisheries is challenging due to the decentralized nature of the fishery. A 2011 study by Teh and Teh focused on the small-scale and artisanal fishing sector in Sabah, Malaysia, and uses a previously reconstructed time series of Sabah's small-scale catches as the basis for estimating the economic value of these fisheries. Their findings suggest that since the early 1990s, small-scale fish catches in Sabah may have been undervalued by up to 225%. Presently, small-scale fisheries may be supporting up to an additional 3.5% of Sabah's population. Further, accounting for the economic impact of unaccounted small-scale fisheries value could have potentially tripled the reported contribution that commercial and small-scale fisheries combined made to GDP in 2009[98].

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[13] Literature cited FAO Fisheries Technical Paper 474
Management techniques for elasmobranch fisheries.J.A. Musik and R.Bonfil editors.
United States of America Food and Agriculture Organization OF THE UNITED NATIONS
Rome © FAO 2005; Martin A.Hall, Dayton L., Alverson, Kaija I.Metuzals, By-Catch: Problems and Solutions
Marine Pollution Bulletin Volume 41, Issues 1–6, 2000, Pages 204-219

[14] Dr. Nicolas J. Pilcher, Founder & Executive Director of the Sabah Based Marine Research Foundation, and works in marine conservation, especially turtle catch and conservation in Malaysia.

Overall, the results show that the socio-economic contribution of small-scale fisheries to Sabah society have been substantially undervalued or even unaccounted for historically and in present fisheries statistics. This undervaluation also implies that fishing pressure on Sabah's inshore marine resources is likely much higher than reported. This raises concerns about the long-term sustainability of these fisheries resources, and the capacity for Sabah's inshore fisheries to support coastal livelihoods into the future the authors argue. This study strongly suggests the need for more encompassing fisheries monitoring and data collection methods that target the large population of small-scale fishers whose catch is largely unreported.

A 2017 report by the FAO, details the issues concerning small-scale fisheries management based on experiences at both national and regional levels in Southeast Asia. To overcome various constraints encountered between small artisanal fisheries and licensed commercial scale operations, the consultation developed an interactive plan to implement decentralized small-scale fisheries management. The plan which offers solutions to some of the challenges of an unregulated and small scale fishery is divided into three phases[49]. The plan describes in a matrix constraints and identified solutions in implementing small-scale fisheries management for six identified areas:

1. Organization,
2. Content/substance,
3. Legal,
4. Support,
5. Training and,
6. Process.

This interactive plan is designed for the needs of fisheries managers at different political levels, non-governmental organizations and others working in the field of small-scale fisheries management. “Regional consultation on interactive mechanisms for small-scale fisheries management” was initiated by the FAO and co-organized by the Coastal Development Centre, Kasetsart University, Bangkok, Thailand). Small scale fisheries, particularly subsistence fisheries are unreported in fisheries, and likely have a significant contribution to fishing freshwater and coastal ray species, including small sharks and guitarfish.

H. Illegal, Unreported and Unregulated (IUU) fishing.

IUU is estimated globally to represent 25 percent of all fish landed, possibly as high as 30-40% of global catch at a cost between $4 - $9 billion a year[51]. Not included in this assessment is the high price of species extinction, lost fisheries and long term livelihoods and ecosystem destruction.

Sharks rank high in IUU fishing globally. In their estimate of 100 million sharks killed annually, Worm et al. (2010) combined landed catch data reported to the UNFAO estimated unreported landings, finned sharks, and other discards of dead sharks arriving at numbers far in excess of standard reported landing data[16]. Worm et al. predicted that that between 6.4% and 7.9% of sharks of *all* species are killed annually, many of them illegally. The number exceeds what many shark populations need to recover. To put that range in perspective, researchers analyzed life data from 62 shark species and found that only 4.9% of sharks can be killed each year to maintain population stability[16].

A report prepared by the Government of Australia and TRAFFIC confirmed that IUU fishing for sharks is occurring globally, and that most of the identified illegal fishing involves the retention of fins. The

report emphasizes that the high value of fins relative to meat is a clear driver for both legal and IUU fishing. The report also concluded that the most frequently cited species taken in illegal shark fishing are hammerhead sharks (*Sphyrna spp*.) and silky sharks (*Carcharhinus falciformis)*[13,50].

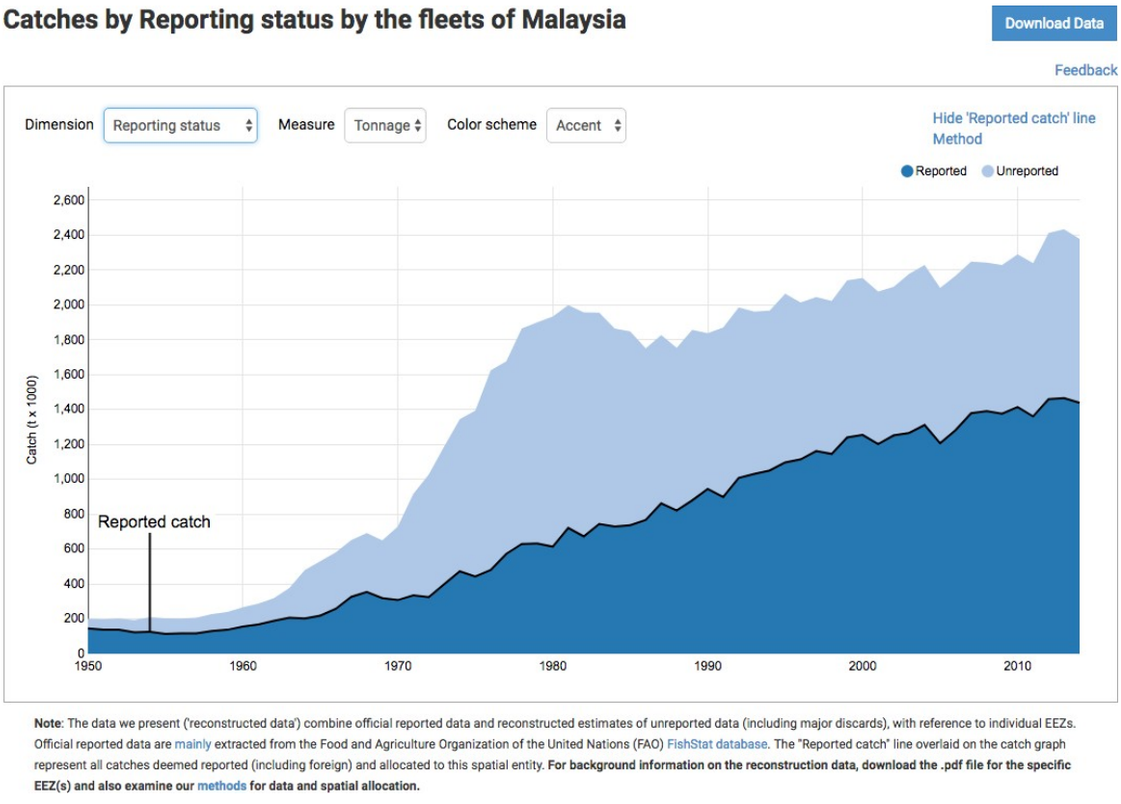
Poaching by non-national fishers in Malaysian waters is a major area of concern by the Department of Fisheries. Each year hundreds of foreign vessels fishing in Malaysian waters are observed or confiscated and many are burned. In early 2016, more than 100 Chinese fishing vessels were detected off the Borneo state of Sarawak[51]. In June 2017, the Fisheries Department said the country lost 980,000 tonnes of seafood worth up to RM6 billion (S$1.9 billion) each year because of illegal fishing. Datuk Ismail Abu Hassan, director-general of Malaysia's Fisheries Department, was quoted as saying in June 2017 that it was estimated that only about half of all seafood caught in local waters reaches Malaysian consumers[52]. It is reasonable to assume that sharks are an important part of this resource, especially offshore species captured by longline.

Additionally, illegal fishing from domestic fishers in Malaysia is widespread, particularly fish bombing or dynamite fishing. Blast fishing or fish bombing is composed of homemade bombs of fertilizer, kerosene in a bottle and activated by an igniter and thrown onto the reef. The fishermen collect the stunned and dead fish, and other sea life including sea turtles and sharks, leaving behind a path of ecological destruction. This widespread problem is reported throughout Southeast Asia and in Sabah, both anecdotally by divers and through direct observation of damaged reefs[53]. This practice is illegal under the Fisheries Act and condemned internationally, yet remains a problem in Malaysian waters[31]. Blast fishing and other destructive fishing techniques and overfishing are reported to be a medium to severe threat to nearly 60% of reefs globally, with the greatest prevalence occurring in countries in the coral triangle in Southeast Asia[54] and in Tanzania[54].

Fish bombing is a major threat to coral reef ecosystem biodiversity and resilience as a result of its indiscriminate and cumulative destruction of fish, other species and the biophysical habitat i.e. their life support system. As a result, its destructive nature directly threatens the long-term sustainable harvest of the principal source of protein for subsistence fishermen, their families and coastal communities worldwide and in Malaysia. Mostly directed at the live and reef fish trade, ground sharks and rays are also vulnerable to this form of IUU fishing. Given the illegal nature and black market for these fish, data is almost completely absent[31].

Illegal techniques including blast fishing is known to occur along Sabah reefs and even within the parks. In Malaysia, blast fishing is still practiced, especially in Sabah, where up to 15 blasts can be heard per hour. One study has shown that many reefs in Sabah have less than 25% of their reef structure intact and some have interconnecting series of bomb blast craters. On bombed reefs, fish diversity was reduced to less than half and actual numbers of benthic living fish species were reduced to less than 10% of original numbers[55].

Figure 7



In addition to illegal fishing unreported catch of sharks by offshore fisheries, both foreign and national sources, in addition to small scale fisheries, places additional pressure on shark populations[56]. This unreported catch may exceed reported catch by as much as two to three times. The Sea Around Us (SAU), a project of the University of British Columbia has developed interactive charts and fishing maps based on a database of catch by country, zone and taxa for global fisheries[57]. The data presented by the Sea Around Us project ('reconstructed data') combine official reported data and reconstructed estimates of unreported data (including major discards), with reference to individual EEZs. Official reported data are mainly extracted from the Food and Agriculture Organization of the United Nations (FAO) FishStat database. The "Reported catch" line overlaid on the catch graph represent all catches deemed reported (including foreign) and allocated to this spatial entity[57]. Figure 7 uses data reconstructed using estimates by Pauly and Zeller (2014) and other sources to compare total catch with official reported catch in the Malaysian EEZ extracted from the UNFAO Data (dark blue). The light blue considers foreign catch, estimates unreported discards and adjusts for unreported catch across fisheries based on the calculations used by Pauley and Zeller. This formula accounts for unaccounted industrial sectors including illegal, unregulated fisheries, artisanal catch, subsistence catch, recreational catch and discards.

The trends show a steady increase in reported catch using the data reported by the DoFM and to the FAO (dark blue), as well as a significant volume of catch that is unreported (light blue). Using this data for shark and ray catch combined, the trends follow the FAO data, increasing steadily from 1950, until a peak of 60,260 tonnes is realized in 2004, and then declining to 47,430 mT in 2014. The FAO reported peak catch combined for sharks and rays occurred in 2003 at 27,148 mT. The reconstructed data for combined shark and ray catch in 2003 at 59,390 mT, a difference of 32,242 mt of catch that was not reported and unconsidered in management decisions such as quotas.

To compare reported versus reconstructed data for 2012 where the data is available: the FAO data recorded the combined landing for sharks and rays in Malaysia at 22,148 mT for sharks and 15,162 mT for rays for a combined weight of 37,310 mT reported catch. Compared to the reconstructed data, the additional catch would weigh 51,740 mT, a difference of 14,610 metric tons for that year. The results demonstrate a significant increase in overall catch of sharks and rays in Malaysia, and would mislead fisheries managers in their perception of catch volume and the associated impacts on domestic stocks.

Reducing IUU fishing on a global scale is an international concern. One of the United Nation's key Sustainable Development Goals since September 2015 is to stop IUU fishing by 2020 (Targets 14.4 and 14.6)[58]. In 2017, the State Government of Sabah registered a Voluntary Commitment to apply fish bomb detection technology in the Tun Mustapha Marine Park (around 900 square kilometers in area) as an example of best practice in tackling the issue, and lessons learned will be valuable for implementation in other territories (Sabah Blue Ocean Initiative)[31]. With Project Tseng Hoi, the Stop Fish Bombing coalition and Malaysian conservation partners, the author appeared at the 2017 United Nations Oceans Conference on IUU fishing and shark finning and presented the positive commitments Sabah is taking to reduce these harmful practices.

In 2017, Sabah Minister YB Datuk Seri Panglima Masidi Manjun supported a more holistic approach to managing the marine and coastal resources of Sabah to meet sustainable development goals that cover both economic growth targets and conservation needs, whilst engaging and involving communities at the same time. The 'Sabah Blue Ocean Initiative' Action Plan, is a sustainable development program developed to conserve Sabah's natural marine and coastal assets by increasing the area designated for conservation purposes (UN SDG 14.5) and the level of management and restoration of all marine resources (UN SDG 14.2) [31].

I. Habitat Loss and Environmental Impacts

Coral reefs provide habitat for critical fisheries, coastal defense and tourism. Approximately 120 million people's livelihoods depend directly on fishing, live along the coasts and islands of the Coral Triangle. This large population is placing huge pressures on the marine environment through a range of fishing activities among local fishers, many of which are unreported, unregulated or unenforced[55]. Harmful fishing practices, often illegal, cause long-lasting and even irreparable harm to coral reefs and fisheries.

The live fish trade, supplying dominant markets in Hong Kong and China, takes some 30,000 tons/year of reef fish worth more than US$150/kg out of the Coral Triangle, with Kota Kinabalu the main base in Malaysia. Due to the illegal nature, this trade frequently employs practices that damage coral reefs and habitat. In addition to supplying restaurants, live reef fish are exported for the ornamental fish trade and many are caught by illegal cyanide fishing. Due to dynamite fishing, or in the case of Malaysia, homemade fish bombs made from fertilizer and kerosene, widespread and long lasting reef damage occurs. Through illegal, unreported and unregulated (IUU) fishing by other South east Asian countries, and over-harvesting of invertebrates such as triton, sea cucumber and giant clam, the region's coral reefs and associated ecosystems are being increasingly threatened[59].

Besides destructive fishing, local threats to coral reefs in Malaysia include trawl damage, coastal development, pollution, sedimentation as well as direct physical impacts from tourism activities such as diving and boating. A general review of Malaysian coral reefs indicates poor to fair conditions of coral reefs in Peninsular Malaysia due to increases of sedimentation and tourism impacts. Overfishing and fish blasting were the main threats of coral reefs damage in Sabah. In Sarawak, coral reefs are threatened by

high sedimentation and sand mining[56]. Mass coral reef bleaching has emerged over recent years as a global threat with potentially devastating effects in Malaysia. In 1998 the first significant mass coral reef bleaching event reported in Malaysia caused 5-10% of coral death in Peninsular Malaysia[59].

Plastic pollution is an emerging threat to coral reefs. In a survey of 159 coral reefs in the Asia-Pacific region, billions of plastic items were entangled in the reefs. The more branching or complex the structure of the coral species, the more likely they are to snag plastic. Disease likelihood increased 20 times once plastic draped a coral. Plastic debris stresses coral through light deprivation, toxin release, and anoxia, giving pathogens a foothold for invasion[60].

Habitat loss along freshwater and estuarine habitat is an important impact affecting elasmobranch survival, particularly rare and endemic species with limited range. Upstream deforestation, and especially loss of mangrove and eelgrass habitat remain current threats to freshwater and brackish species of elasmobranchs.

VI. TOURISM AND MARINE MANAGEMENT SOLUTIONS

A. Shark Sanctuaries: Tourism and the Value of Living Sharks

Economic information is valuable for governments with limited institutional powers, especially in regards to environmental protection, in order to prioritize conservation of habitat and develop effective management plans. The value of diving, specifically shark diving tourism is a relatively new phenomenon and has generated a new level of protection for sharks called “the shark sanctuary.” Attracting dive tourism, shark sanctuaries have mixed results but are generally positive when large enough to protect migratory species, and includes a multi species and habitat management approach and include local education, employment and enforcement. These shark sanctuaries also attract dive tourism, and provide significant economic benefit, to the point that no shark fishing is allowed in these waters.

In a 2011 study of the value of sharks to the economy of the island nation of Palau, the Australian Institute of Marine Science (AIMS) estimated that a reef shark generates around $179,000 per year in tourism revenue. This equates to $1.9 million during its lifetime. In comparison, a single shark's fin, and by implication the value of a shark - brings around $108 when sold for shark fin soup[61]. The benefits of shark tourism to the Palau economy are summarized in Table 10.

Table 10 Summary of Economic Benefits of Sharks to Palau Economy

The shark-diving industry attracts 8,600 divers each year or approximately 21% of the divers visiting Palau.
The value of sharks to the Palauan economy was estimated to be US$18 million per year, accounting for approximately 8% of the gross domestic product of Palau.
An individual reef shark in Palau was estimated to have an annual value of US$179,000 and a life-time value of US$1.9 million to the tourism industry.
The annual income in salaries paid by the shark-diving industry to the local community was estimated to be US$1.2 million.
The annual tax income to the Government of Palau generated by shark diving was estimated to be US$1.5 million or 14% of the business tax revenue.
industry in Palau would obtain a maximum of US$10,800, or 0.00006% of the life-time value of these animals as a non-consumptive resource.
A fishery targeting the same 100 sharks that are interacting with the tourism the maximum revenues that they could obtain for the once-off capture and sale of the sharks interacting with the tourism industry would be around US$196.
The shark-diving industry attracts 8,600 divers each year or approximately 21% of the divers visiting Palau.
The value of sharks to the Palauan economy was estimated to be US$18 million per year, accounting for approximately 8% of the gross domestic product of Palau.

Source (Vianna et. al 2010).

A 2012 Shark Tourism Economic Valuation Study of the Semporna Region of Sabah revealed that shark-diving had brought direct revenues of over USD9.8 million (RM37.9 million) to Malaysia's most popular diving destination, generating over USD2 million (RM7.7 million) in direct taxes to the government and USD1.4 million (RM5.4 million) in salaries to the local community[62]. Interviews with divers showed that the principal motivation to visit the area was to engage in general diving activities (37%), but 25% of divers came to the Semporna region specifically to dive Pulau Sipadan famous for its sharks, Six percent of the total came to the region principally to dive with sharks. Although not the sole motivation for diving in the region, the survey concludes that 73% of divers stated that they were interested or very interested in diving with sharks. Business revenues from shark diving in the region in 2011 were $7.8 million USD. Tax revenue to the government from shark diving totaled $1.5 million USD with the estimated community income from shark diving placed at $1.4 million USD. The authors conclude that protection of sharks in the Semporna region would result in loss of approximately USD
$122,000 from shark fishing on an annual basis, a small fraction (2%) of the annual revenues generated by shark-diving tourism[62].

A research team from the University of British Columbia, the University of Hawaii and Universidad Autónoma de Baja California Sur in Mexico examined shark fisheries and shark ecotourism data from 70 sites in 45 countries. Almost $124 million in tourism dollars were generated annually in the Caribbean from shark tourism, supporting more than 5,000 jobs. In Australia and New Zealand, 29,000 shark watchers

help generate almost $40 million in tourism a year[63]. A study on whale shark tourism in the Maldives estimated that direct expenditures for whale shark focused tourism in the South Ari Marine Protected Area for 2012 and 2013 accounted for US$7.6 and $9.4 million respectively. These expenditures are based on an estimate of 72,000–78,000 tourists who are involved in whale shark excursions annually[64].

A global evaluation of "shark sanctuaries" funded by the Pew Trust in 2013 documented that while global shark fisheries earn around $630 million annually, shark populations have been in decline for the past decade. Shark tourism, on the other hand, earns $314 million annually with a predicted growth, generating a potential $780 million annually worldwide over the next 20 years [65].

In 2015, nations and territories in the western Pacific Ocean linked their efforts to create the first regional sanctuary in Micronesia. Collectively, these protected areas spread across more than 19.4 million square kilometers (7.5 million square miles), an area twice the size of Europe. Today, a total of 17 shark sanctuaries have been created around the world[65].

A 2017 study surveyed dive tourists in Australia estimated conservatively that the total annual direct expenditure by shark divers was $25.5 M. Additional expenditures provided by the white-shark and whale-shark-diving industries totaled $8.1 and $12.5 M for two popular shark diving destinations at Port Lincoln and Ningaloo Reef respectively. International tourists diving with white sharks also spent another $0.9 million in airfares and other activities while in Australia. These additional revenues show that the economic value of this type of tourism do not flow just to the industry, but are also spread to other services where the tourism occurs[66].

An additional economic analysis of the value of shark tourism to Sabah has been conducted by in 2017, and the results are much higher than the 2012 study. This study, undertaken by the Australian Institute for Marine Science for the Sabah Shark Protection Alliance polled the opinion of tourists diving Sabah. The results indicated that an enormous monetary value of live sharks was demonstrated by the expressed willingness of tourists to pay. Unfortunately, it is clear that the numbers are declining due to fishing. It is noteworthy that much of the financial gain from this fishery is made outside of Sabah, hence Sabah is foregoing long-term sustainable tourist income for very little gain (in addition to the fishery itself being highly unsustainable). In summary, sharks are worth more alive than dead[67].

B. Semporna Shark Sanctuary and the Shark Finning Conundrum

While tourism can have positive economic and protective effects. The juxtaposition between fishers and dive tourists combined with social media can lead to misunderstandings and can even have a negative impact on the image of Malaysia and even tourism. A recent example where several incidents of shark and ray dismemberment at the dive tourist enclave Pulau Mabul in Semporna have shocked tourists, and the shared images on social media have rippled across press and the international consciousness. The most recent event in February 2018 has drawn considerable negative attention and censure[68].

As early as 2009 incidents of shark slaughter on private jetties on Mabul Island (gateway to Sipadan Island) catalyzed dive operators and conservation organizations to call for increased shark protection in Semporna. On Mabul the dive resort Scuba Junkie and their associated conservation group Shark, Environment and Awareness & Survival (S.E.A.S.) reported observing several shark 'stations' where a

catch of 50-60 sharks could be seen with their fins being removed as often as three or four times a week[69]. Concerned about the declining numbers of sharks observed and the negative effect on dive tourism by witnessing shark harvesting, SEAs with other conservation groups and prohibit shark fishing and the fin trade[70]. In 2015 Sabah Department of Tourism, Culture and Environment Minister YB Datuk Seri Panglima Masidi Manjun responded to this appeal with statements supporting shark protection and a proposed ban on shark hunting in Sabah[71].

Sharks regulated under the Fisheries Act fall under the jurisdiction of Agriculture and Agro-based Industry Ministry and any regulation change would fall under their purview. Malaysian Agriculture and Agro-Based Industry Minister Datuk Seri Ahmad Shabery Cheek rejected the appeal that shark hunting and finning industry did not exist in Malaysia, and that a shark fin ban was deemed unnecessary. The Minister added that sharks are normally caught by accident and not for their fins, and that a law is unnecessary[71]. However, repeated documentation by tourists of shark and manta ray slaughter have catalyzed public outcry and calls for the ministry to protect sharks from overfishing[73]. Minister Masidi has continued his appeal, and the introduction of new Marine Protected Areas (MPAs) in the form of Sabah marine Parks has stated he will continue the appeal to ban shark fishing in the 6 MPAs in Sabah[74]. Marine Protected Areas in Peninsular Malaysia are managed by national government, whereas the MPAs in Sabah and Sarawak are managed by their state government. Fishing is regulated by the Minister of Agriculture however, and this protecting sharks at a state level has legal adjustment to overcome. It is a challenge to secure consensus between all levels of government in the development of an MPA system, but Sabah is in the process of pursuing these adjustments.

Shark fishing and shark finning have often been confused in the public eye, and even at times by government officials. While these events are inflammatory, the dismemberment of rays and sharks are sensationalized and are not acts of shark finning since the animals are landed and the meat sold with the fins. However, the incidents have brought unfavorable international attention to the issue of shark finning, and perhaps more importantly in Sabah, to the overfishing of reef and hammerhead sharks and species nominally protected such as manta rays.

Despite public statements by Government ministers that shark finning laws are unnecessary, evidence of finning, albeit rare are reported, and regulations addressing shark finning do not exist. A summary document on shark catch and fisheries by the UNFAO on Malaysia states that finning is prohibited according to Section 8(b) Fisheries Act of 1985. Measure enforced in 2014 (fin-attached regulation. In a 2013-2014 report to CITES by the Ministry of Natural Resources and Environment, Malaysia cites a ban on finning on board as a measure taken. (The citation is Section D Administrative Measures D1 Management Authority 10 Provide Additional Measures Taken: Banned Finning on board. (CITES Notification No. 2005/035)[75]. However, no stark finning regulation exists in the Fisheries Law.[15]

The statements by government officials regarding a shark finning law and the absence of finning exacerbates the confusion and concern among the public, conservationists and media. A clear policy on shark finning that is universally consistent between Malaysian state and federal fisheries management will reduce the public outcry and condemnation in the press and social media. Amending the Fisheries Act to ban shark finning would likely have relatively little effort or resistance and would buy significant

[15] This has been verified by personal conversation with Lawrence Kissol, Sabah Fisheries Department assistant director (marine resource management) Lawrence Kissol July 8, 2018, and that the Fisheries Act 1985 does require sharks to be landed with fins attached. Speaking at the Sabah Sharks and Rays Forum 2018, he said the state's Park Enactment 1984 and Wildlife Conservation Enactment 1997 did not specifically provide protection for sharks and stingrays, which were in decline.

international good will. More importantly, an enforced fins-attached policy with fishing and trade prohibitions for signature species (endangered, threatened, legally protected and we propose a new category, high value for tourism) will take an immediate step towards shark and ray conservation. Finally, requiring the landing of any protected, listed or species of rays and sharks economically important for ecotourism should be prohibited.

There is an ongoing effort in Sabah preparing amendments to the Parks Enactment 1984 in Sabah in a move to turn all six marine parks in the state into shark sanctuaries and banning shark fishing in these sanctuaries. Former, State Tourism, Culture and Environment Minister Datuk Seri Masidi Manjun said that the proposed shark fishing ban within marine parks, which covers about 8% of Sabah waters, would help in taking action against those caught shark hunting within the states marine parks[75]. Additional commitment to developing sustainable dive tourism by protecting sharks and rays has been made by the Sabah Government in 2017 under the Sabah Blue Ocean Initiative[31]. Dive tourism, especially in Sabah and select islands in other states has provided a growing and reliable source of income to the local economy[62,65]. The recent change in government has introduced a reassessment phase but it is hoped that additional protection in Sabah will continue.

The socioeconomic studies in Sabah indicate that tourists will pay more to see sharks, and destinations like Layang Layang and Sipadan that are go-to dive destinations for sharks could serve as economic models that benefit sharks and rays elsewhere in Malaysia. In Sabah, four locations: Layang-Layang Island, Sipadan Island, Lankayan Island and Roach Reef are notable for sharks, sea turtle and marine megafauna. These areas are centers of dive tourism, generating a large international presence with economic benefit to the local economy, especially Sipadan Island. Identification of other locations of frequent observance of sharks and rays, or species of interest e.g. hammerhead and whale sharks could provide a potentially new market for tourism and the associated protection afforded. A list of areas with frequent observations of sharks provided by the media production company Scubazoo listed in Appendix III. could be potential sites for future dive tourism development and conservation efforts.

C. Sabah Parks and Marine Protected Areas

1. Overview

An important conservation tool to maintain and protect biodiversity is the establishment of marine protected areas. Marine protected areas in Malaysia consists of four different types of protected areas; marine park, fisheries prohibited area, wildlife reserve and turtle sanctuary. Malaysia has 9,323 km of coastline and 3,600km2 of coral reef area. The coral reefs in Peninsular Malaysia are mostly protected as Marine Parks under the Fisheries Act (1985) and managed by the Department of Fisheries. Fishing is not allowed on the reefs within the Parks, except for non-extractive activities. Reef fisheries are reported as nonexistent but unmonitored76. A 1993 assessment of MPAs in Malaysia quantified 83 MPAs. 51.8% of the MPA sites are coral reef MPAs. The coral reef MPAs in Malaysia are established primarily through its Department of Marine Park (37 MPAs), through the Sabah Wildlife Department (5 MPAs) and through the Forest Department (1 MPA) with the total area of 14,167.634 km2. Malaysia's MPAs are managed by different levels of government. The no-take area of MPAs in Malaysia was reported as only 2309.52 km2 at that time76.

The global database MPA Atlas developed by the Marine Conservation Institute estimates that as of 2017, 102 MPAs exist in Malaysian waters. Of the total marine area of 448,835.1 km² in the Exclusive Economic Zone including territories the area of protected coverage is estimated at 406.0 km². The database estimates 0.09% in area for no-take zones. This data is derived from the UN World Database for Protected Areas[77].

Today, only 3.7% of the world's oceans are protected in implemented and actively managed marine protected areas. Approximately half of that, or 2.0%, of the ocean is strongly protected in no-take marine reserves[77]. To address the need for increased marine protection, Parties to the Convention on Biological Diversity in 2010, targeted global marine protected area target of 10% to be achieved by 2020. This goal was adopted by member States of the United Nations as part of Sustainable Development Goal 14. Under SDG 14 (Life Below Water), Goal 14.5 is to Conserve and sustainably use the oceans, seas and marine resources for sustainable development[78].

The goal is to protected areas of particular importance for biodiversity and ecosystem services, that are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas. The following marine protected areas in Sabah fulfill part of this goal. As part of the Convention, Malaysia has committed to UN Sustainable Development Goal 14 to meet the 10% target[31].

The Sabah MPAs listed below, including the most recent commitment at the Tun Mustapha Marine Park are a major part of Sabah's commitment to meeting SDG 14.

Tuanku Abdul Rahman Park, Tun Sakaran Marine Park

In Sabah, the first marine protected area in Malaysia was Tuanku Abdul Rahman Park. Declared in 1974, it established a 49.29km2 area by Sabah state government. Most of the MPAs are of mixed use with some fishing allowed. Other islands administered as marine protected areas under Sabah Parks includes 350 km2 within the Tun Sakaran Marine Park. Tun Sakaran Marine Park (TSMP), also known as Semporna Islands Park, is situated in an area of 35,000 hectares in Darvel Bay of the Celebes Sea. TSMP was formed in July 2004 and is currently managed by Sabah Parks. This marine park contains 8 islands and is the first marine protected area in Malaysia to include local communities living within its boundaries[76]. As of 2016, Malaysia's Marine Protected Areas (MPAs) covered only a small fraction of the country's Maritime Waters at an estimated area of 1.4%. It is estimated that only 0.01% of those are in no take reserves.[77].

Sipdan Islan

Famous for its exceptional diving and large populations of sharks, Sipadan is a international major dive destination within the Semporna region of Sabah, Sipadan is the only island completely prohibiting fishing in the Celebes sea in Malaysian waters. Fish abundant and rare are all but absent outside this protected area. Known as a famous destination worldwide for divers to see sharks and sea turtles, and large schools of bumpheaded wrasse (*Cheilinus undulatus)*, chevron barracuda *(Sphyraena barracuda)* and bigeye jacks (*Caranax sexfasciatus*); this island is so frequented by divers that Sabah Parks limits daily permits to dive operators visiting the island. Sharks are also abundant at Sipadan, including grey reefs, blacktip reef, white tip reef sharks and rare zebra sharks as well as pelagic migrants like tiger sharks [24, 69].

Located near the international border and a deep water channel, Pulau Sipadan experiences pelagic species such as hammerheads and whale sharks. The island has also been a source of international tension between poachers and potential terrorists from the Philippines and is a military outpost with routine sea patrols protecting the wildlife and the visitors. Scuba Junkies SEAS program has monitored sharks, rays and other fish during their dives since 2011[69]. During that period their divers have documented larger schools of predators than any other location monitored in Malaysian waters. The removal of dive resorts on the island combined with a well enforced no take policy has benefitted reefs to the extent the coral reefs at Sipadan have some of the highest coral cover and reef health in Semporna, and some of the largest fish populations[80].

Tun Mustapha Park

The TMP represents almost one million hectares of marine protected area off the north coast of Sabah. The park encompasses 50 islands and will protect one of the world's most biodiverse marine ecosystems. The declaration of the Tun Mustapha Park (TMP) in 2016 resulted in a total of 7.1% of marine and coastal resources being included in the protected and managed category in Sabah. An additional 966.5 hectares of mangroves as key species habitat is included in Class 1 forest reserve, RAMSAR sites and other forms of conservation management. However effective conservation management will require the creation of additional marine protected areas, more effective marine resource use and control over the impacts of tourism, fisheries productivity in order to provide the underlying need for domestic food security.

2. Sugud Islands Marine Conservation Area, SIMCA

Sugud Islands Marine Conservation Area, or SIMCA, is located near the Philippines border 50 Km north of Sandakan, in western Sabah. SIMCA is the first privately managed marine conservation area in Sabah, Malaysia. Measuring at 46,317 hectares, the area includes three islands of Lankayan, Billean and Tegapil, and surrounding water, shallow coastal reefs, seagrass beds and sandy bottom. SIMCA had been gazetted on 3rd December 2001 as a Category II Conservation Area under The World Conservation Union (IUCN) Protected Area Management Category, which specifies that it is to be protected and managed to preserve natural condition and to provide recreational opportunities[82].

SIMCA is home to at least 500 species of fishes, 2 species of sea turtles, 26 species of seagrasses and algae, 7 species of giant clams, and countless other marine life including species of sharks once common in Sabah but increasingly rare. These islands host one of the few areas with remaining large sharks, including a population of blacktip reef sharks. Hammerhead sharks and whale sharks have been observed in SIMCA waters presumed during their seasonal migration, although little tracking research has been performed to establish range or residency. Apart from Sipadan and Lankayan the white tip & grey reef sharks are sufficiently rare that they are functionally extinct in most Sabah waters. Reef sharks in general do not range far from their home territories and are thus relatively isolated from other island populations by distance and also vulnerable to overfishing[83]. The local Sabah population of reef sharks are so dispersed and rare that encounters between individuals is extremely unlikely and breeding is presumed improbable between island groups[24].

3. MPA Discussion

Marine protected areas (MPAs) are used increasingly as conservation tools around the world, but how they benefit mobile and wide-ranging species sharks is not definitive. The results of tracking experiments demonstrate that MPAs have conservation benefits for shark populations by providing protection across different species and life stages. Additionally, tagging and tracking studies can be used to help tailor MPA design to maximize effectiveness[83]. Some elasmobranchs are highly migratory and can easily move beyond the distances covered by even the largest sanctuaries leaving them vulnerable to exploitation. In these cases, the effectiveness of a sanctuary probably depends on what is and is not protected (portion of the population, critical life stages and duration) and the level of risk when outside the sanctuary (fishing pressure, habitat use and time of year)[84].

Reef shark populations have declined even within some of the largest MPAs outside Malaysia, yet well managed and enforced large MPAs have been demonstrated to be effective protecting sharks. A shark tagging study in Australia off Osprey Reef tracked whitetip reef sharks *triaenodon obesus,* grey reef sharks *carcharhinus amblyrhynchos* and silvertip sharks *carcharhinus albimarginatus*. The results were that most individuals showed year round residency at Osprey Reef with a few individuals leaving the protected

zone to another reef at Shark Reef. The high residency and limited spatial use of Osprey Reef suggests that reef sharks would be highly vulnerable to targeted fishing pressure and that MPAs incorporating no-take of sharks would be effective in protecting reef shark populations at Osprey and Shark Reef the authors conclude[85].

Another study on tagged grey reef sharks at a central Pacific atoll revealed that two-thirds of satellite-tracked sharks showed some site fidelity within the protected no fishing area. However, one individual swam as far as 1000km before returning to the atoll. Most sharks remained within the MPA boundaries of the Palmyra Pacific Remote Islands Monument protected area for the entire study duration of 1 year. The large protected area extending from the atoll out to a distance of 50-200 nM affords wide-ranging species substantial protection for reef sharks, and even wider ranging pelagic species such as tiger sharks that leave the reef crest but stay within the no take zone[86].

These Investigators also examined fishing vessel movements using data from Global Fish Watch and the Automated Information System (AIS) required by the international fisheries management organization Western Pacific Fishery Council (a Regional Fishery Management Organization that sets quotas, gear and other management under UN agreement) for all commercial tuna vessels fishing in the region. Positions from commercial tuna boats with AIS transponders shows high densities of vessels fishing along the edges of the protected area, but no- or occasional illegal fishing effort within the refuge. The significant fishing effort beyond the MPA perimeter suggests that large MPAs can effectively benefit reef sharks and other mobile species if properly enforced[87].

Implementing MPAs for shark and ray species that show some site fidelity, such as reef-inhabiting sharks, may be the most useful approach to achieve some shark management success in Malaysia. The most successful management plan for sharks in Sabah is the Sugud Islands Marine Conservation area (SIMCA). There are regular sightings of white tip, black tip reef shark, grey reef and leopard shark – sharks rare or absent in Sabah outside of protected areas (ScubaZoo pers. comm)[24].

The prohibitions in a Park or Nature Reserve, activities such as fishing, hunting or gathering of food sources are restricted without express permission. (Sabah Parks Enactment 1984, Section 48(1)). Protection has its challenges however. Overfishing and destructive fishing practices has been a high concern even in Parks, as it has implicated the health of the reef ecosystems and limited fishing catches for local communities. Fishermen are routinely observed fishing outside the reef near the marine park in Palau Gaya off Tunku Abdul Rahman Marine Park (TARP). This park is located off the coast of the island of Kota Kinabalu includes five islands: Gaya, Manukan, Sapi, Sulug and Mamutik. Due to the close proximity to the city and the port of Kota Kinabalu, these islands are popular among tourists. Despites its proximity to a major centre, fishing occurs within the Park. On several occasions we have observed fishing lines, gill nets entangled in the coral and the absence of sharks and large fish: all signs of illegal fishing. The absence of sharks and large fish are symptoms illegal fishing is occurring[24,31]. Additionally, while diving within the TARP and TMP we have often experienced the percussions of explosions and observed areas of severely damaged coral, evidence of fish bombing within the boundaries of the Parks.

Any consideration of marine protection, especially no fishing MPAs must consider the human factor. Excluding communities dependent upon marine resources must be considered as part of the conservation and management equation[88]. The largest island in TARP, Palau Gaya, hosts a village of Bajau Laut of approximately 3000 persons, many who are subsistence fishers with vessels of limited range. This indigenous population represents one of the last remaining ethnic groups associated with sea living. These water people, sometimes called Sea Gypsies are living on boats or on houses above the water and subsist

on fish and other marine life they catch. The need for alternative livelihoods, community education and engagement combined with increased enforcement is necessary or this degradation will continue. Additionally, the lack of citizenship and official identification for the Bajau exacerbate the problem of education, social services and building sustainable livelihoods. As fishing pressure on a local reef (or if excluded by a protected area) the fishermen must travel further for their catch, or over extract the local reef, as is the case in several areas in Sabah. Subsistence, and small-scale artisanal fishermen such as the Semporna longline fleet sell their catch to a wholesaler or directly to consumers. This catch is generally unaccounted for in fisheries records.

One of the primary roles of small-scale fisheries is supporting the welfare of coastal communities, however, this welfare dimension is under-represented by official statistics in Sabah. For example, in 2009 Teh et al. calculated that the number of traditional fishers was 370% higher than reported numbers from 1991 to 2006. This arose from the inclusion of illegal migrant fishers, who are not documented in official statistics. These unaccounted small-scale fisheries can and significantly add to the decline of sharks and rays. For Sabah, this study strongly suggests the need for more encompassing fisheries monitoring and data collection methods which include the large undocumented population of small scale fishers[88].

Marine Protected Areas come with a range of protection levels, from fully protected no-take reserves to restriction some activities, gear types, access, target species, or periods of extraction. A growing body of scientific evidence supports the ecological benefits of full reserve protection on species recovery or even benefit to fisheries outside the MPA in a spill over effect[90]. However, it is more difficult to generalize about the benefit of other types of MPAs with mixed extraction, or absent of enforcement, in part because they range in levels of protection. While partially protected areas may provide some benefits over open access areas, no-take reserves generally show greater benefits and yield significantly higher densities of organisms within their boundaries relative to partially protected sites nearby. When designing and subsequently managing and enforcing the life history of the animals, in this case sharks and rays must be considered [91].

The benefits of well-managed marine reserves are overwhelmingly positive. A 2006 global review of 150 MPA worldwide revealed that marine fishes, invertebrates, and seaweeds show significant average increases in biomass, density, size, and diversity inside fully protected areas compared to unprotected areas. This analysis showed biomass, or the total weight of animals and plants, increased an average of 446%, density, or the number of plants or animals in a given area, increased an average of 166%, body size of animals increased an average of 28%, and species diversity, or the number of species, increased an average of 21% [92].

No fishing areas still experience impacts such as pollution, warming sea temperatures, habitat loss, siltation etc.. However, fully protected and well-enforced reserves nearly always achieve their primary goal of significant ecological gains, including more species in greater numbers and larger sizes. Fully protected areas provide ecological benefits as much as ten times greater than partially protected areas. Strong potential also exists to help recover some depleted fisheries outside the reserve. They also provide a control to evaluate the impact of fishing and thus improve fishery management[93].

When developing management plans in Marine Parks, managers must consider artisanal and fishing for livelihoods while delineating some areas as no take. Large populations of indigenous people live within the boundaries of the two large Sabah MPAs, with populations largely reliant on the sea for their livelihoods[93]. For example, the Darwin Project in the Tun Mustapha Marine Park (TMSP) is exploring alternative incomes for indigenous fishers while assessing fisheries and proposed marine protection within the Park. Within the TMP, the Semporna Islands Darwin Project led a project to explore alternative

livelihood opportunities for the residential communities who have historically been reliant on the fisheries resources[94].

The alternative livelihoods project was implemented to explore the options in balancing sustainable access to natural marine resources, developing long- term income opportunities for the communities and ensuring environmental conservation of marine ecosystems. Some alternative livelihood projects that have been explored include the promotion of tourism and craftwork created from recyclable materials. With the involvement and input of the local community, homestays have been one of the options proposed under the Semporna Island Darwin Project. However, this option has been met with challenges due to infrastructure concerns relating to sewage treatment and the need for a garbage disposal system in communities. Other potential alternative livelihood opportunities explored for the TMSP communities include the farming and culture of marine resources such as seaweed abalones and sea cucumbers[95].

The *Global Priorities for Conserving Shark and Rays* report observes that MPAs may not be the entire solution to protect sharks and rays. Only a few threatened shark and ray species have a significant portion of their range protected within the existing global MPA network. Ensuring new MPAs are implemented in a manner that deliver concrete benefits for sharks and rays requires marine spatial planning focused on species as well as habitat conservation. Local targets such as protecting critical habitat like nurseries and aggregation areas need to be identified through expanded field research and data analysis. Appropriate data management tools also need to be developed to guide the planning and management of MPAs, including fisheries closures[96].

D. Integrating a Sound Eco-Tourism Model with Shark and Marine Protection

While the six-year-old findings in the first Semporna study illustrate the economic importance of shark-diving to the district's economy[62], stories on shark finning and ray hunting continue to emerge, the latest being the slaughter of oceanic manta rays, devil rays and a shark in Pulau Mabul in February 2018 and manta rays in Mabul in April 2018[68]. Although these fish were legally harvested, the high impact of shark tourism and tourist's use of social media can generate misconceptions and can have a resultant negative effect on tourism. In the incident on Mabul Island, tourists recorded the landings and processing of at least seven mobulid rays (Manta spp), including both reef and oceanic mantas. Although the meat is processed, gills are processed for export[24]. Mobulid rays are all currently protected under all protected under CITES. This event was shared on social media and also received widespread attention by the Malaysian press. A repeat of earlier documentation, numerous press and viral social media brought widespread international condemnation of the harvest, with unknown but potentially unfavorably negative impacts on future dive tourism.

This incident is not unique however. The removal of dive resorts from Sipadan Island in 2004 has brought dive tourists into direct contact with fishermen in the water village. Both growing tourism, increase in the fishing community and social media provide the ingredients for conflict. Several incidents of tourists objecting to shark dismemberment have occurred at Mabul and reported in the press as early as 2009. Responding to images of dismembered sharks and rays off the resort island of Mabul, dive operators, nonprofits and public concern in the news press and on social media drew attention to harvesting sharks in 2013[69]. Meetings and letters sent to Ministers in Sabah lead to a proposal of a Semporna Shark Sanctuary. This so-called Sanctuary would be a *de facto* no shark fishing and no landing of sharks within the confines of the Sanctuary. This proposal was overruled as superseding State law and unnecessary since, according to the former Minister of Agriculture and Agroindustry, shark fishing and finning are a nonexistent problem[72]. Prohibiting sharks caught in federal waters and landed in state centres presents a

conflict between state and federal agency jurisdictions. To ameliorate tourist concerns, build shark conservation support among the dive community and pursue marine protection a reconciliation between these two regulatory systems is needed. Additionally, the complex social factors of indigenous peoples residing inside a marine park, a changing political dynamic altering movements of people and size of no take zones or reserves all must be considered for the success of a shark sanctuary.

TRACC interviews reveal that large sharks and rays are landed and divided offshore and landed in fish boxes leading to underreporting of catch of threatened species of manta and in one case, a whale shark[24]. Mobulid rays landings were common in the 2012-2015 surveys, although the numbers were not documented. Since mantas are filter feeders and don not take a hook they are not caught on longlines. Landing of these large rays by longliners is opportunistic and generally caught by nets[24]. In 2016 we observed reef sharks dismembered at private landings on Mabul Island with a negative backlash among the dive tourists and operators. The fishermen, who were dismembering grey reef sharks became hostile and hid the sharks, although they were (presumably) legally caught and not finned. Public pressure from well-meaning conservationists can have a back lash however. Hiding landings will not solve the problem of overfishing and may only exacerbate the problem by creating an antagonistic situation and motivating dismemberment at sea, or through concealment. In other countries, this negative attention has lead to moving shark landings away from areas of high visibility to private, walled landing sites e.g. public landings of hammerhead sharks at Punta Arenas in Costa Rica (Pers. Comm. Randall Arauz, CREMA.org). In 2017, the Costa Rican government's proposal to export stockpiled hammerhead shark has lead to international protests and tourist s boycotting the country. Instead, large sharks and rays should be required to be landed whole, if allowed at all, in a centralized fish market open to scrutiny and data collection but not directly adjacent to dive tourism resorts.

Shark and ray diving tourism can create considerable benefits for local economies. The 2012 study conducted by AIMs in 2012 has been revised in 2017 by Huveneers et al of the Australian Institute of Marine Sciences (in press)[64]. This study used surveys with dive operators and dive tourists in the Semporna region to estimate the economic value of the shark and ray diving industry as well as the willingness to pay from dive tourists for a daily park fee that would be used for shark and ray conservation measures. The change in demand for dive holidays under the scenario that a shark and ray fishing ban was implemented in the Sabah. The authors found the annual business revenue from shark and ray diving for the dive tourism industry to be USD6.4 million and a tax income of USD3.6 million per year. Shark divers also spent money in a variety of local businesses which yield an estimated USD16.6 million per year. Moreover, shark and ray diving was associated with the generation of 796 jobs that yielded USD2.8 million per year in salaries for employees[66].

All dive tourists generate a total of USD55.3 million annually. If a shark and ray sanctuary was implemented, the demand for dive holidays in Semporna would increase by 20% raising the economic revenues for the local tourism industry to USD66.4 million per year. To the c0ntrary, demand for dive holidays under current conditions would decrease by 20% causing economic losses to the local tourism industry and all associated benefits. This would result in revenues of USD44.2 million for local businesses per year. The willingness to pay for a potential daily tourist fee was on average USD9.5 which could generate a total of USD2.7 million per year that would be available for the management and enforcement of a shark and ray sanctuary[66].

Although the proposed shark sanctuaries within the gazetted Sabah Parks received strong public support, the proposed Semporna Shark Sanctuary - which is presumably be a no shark fishing zone-remains unrealized in Sabah waters. However, interests by the Sabah government to protect shark populations and

build the economic benefit of sharks is in discussion, and the outcome hopeful[73]. The economic value of the shark and ray dive tourism industry in Semporna is substantial. The implementation of a shark and ray sanctuary in all waters of Semporna can increase economic revenues for the dive tourism industry due to a higher demand as well as potentially by collecting a daily tourist fee. These benefits can be used as a finance mechanism to help to manage and enforce the sanctuary in order to maintain and recover shark and ray populations and therefore maintain the shark and ray dive tourism industry in Semporna.

Some criticism challenging the efficacy of Shark Sanctuaries has been made**.** Failures are associated primarily to a focus on only protecting sharks and not the other fisheries in a region, and the lack of enforcement within a Shark Sanctuary. These studies and others note that shark sanctuaries are not the panacea for recovering or protecting shark populations, and other factors must also be considered[97]. In addition to the economic benefits, maintaining healthy shark populations benefits the whole marine ecosystem. Without sharks, other species populations become imbalanced creating a trophic cascade that has deleterious impacts on vulnerable coral reef and seagrass habitats[98]. Apex predators, sharks help maintain the health and balance of marine ecosystems, in turn attracting divers and tourists[98]. A combination of fishing restrictions, habitat and ecosystem protection that include no take reserves and product prohibitions (fins and gills) are the best hope for protecting large sharks and rays valuable to the ecosystem and a Blue economy.

The creation of no fishing zones with concentrations of e.g. a “Shark Sanctuary” makes economic sense in several key areas but not everywhere. Rather than focusing on a shark sanctuary *per se,* management efforts would be more effective using an ecosystem-managed approach combined with no fishing zones and species exclusions (including habitat protection, invertebrates, fish and sharks) into the existing MPA system. Additionally, a combination of prohibiting landings of select species under federal and state law would benefit the recovery of large sharks like reef sharks, satisfy tourists and feed the demand for increased dive tourism, and resolve the issue of landings in full view of tourists or driving shark harvests underground.

A list of islands and areas within Sabah noted for observations of sharks and rays by divers from the Sabah film production company Scubazoo in Appendix III could serve as areas of additional shark tourism and protection.

VI. DISCUSSION

Although far less than agriculture in terms of gross output, fishing is an important industry in Malaysia, and Malaysians have a large appetite for fish. The Malaysia fishing industry was estimated to employ 134,000 fishermen in 2014[99]. In 2012, the fisheries sector produced 1.7 million tons of fish valued at

RM10.8 billion and generated trade worth RM6 billion. The landings from capture fisheries are expected to increase from 1.32 million tons in 2010 to 1.76 million tons in 2020 at an annual growth rate of 2.9%[28].

Consumption of fish among Malaysians is high. Malaysians are among the world's largest consumers of fish, eating at least 56.5 kilograms of fish per person each year. Malaysia's first comprehensive "Fish Supply-Demand Study", found that Malaysians were increasingly buying imported and more expensive high-value fishery products[100]. Although there is an absence in data, shark fin consumption seems to parallel this increase as evidenced by increasing shark fin imports and the large numbers of restaurants selling shark fin soup[48].

Due to improvement in income and changing lifestyle, Malaysia is a net importer of sharks and product and the deficit is growing as demand for shark meat and fin is rising. Malaysia is the largest importer of shark fin in the ASEAN region. Malaysia accounted for about 71.5% of the ASEAN market and 20% of the world import during the period of the Fish Supply-Demand study. This study indicates that Malaysia importation of sharks and rays has increased seventeen-fold between 2004 to 2013 from 984 mt in 1990 to 16,982 mt in 2013[32].

At the same time, shark and ray catch globally is on the decline, including in Malaysia. Global chondrichthyan (shark, ray, skate and chimaera) landings, reported to the United Nations Food and Agriculture Organization (FAO), peaked in 2003 and in the decade since have declined by almost 20%[10]. Shark populations are clearly on the decline in Malaysia and in some cases large sharks are absent from many regions such as Semporna. According to the NPOA, the peak landing for sharks was recorded in 2005 at 9,165 metric tons and rays in 2003 at 19,253 metric tons[29].

Although little new data on state or national catch trends are presented in the market studies in 2017, the studies provide insight on catch of species by region and trade of shark meat and fins including those from hammerhead sharks[22,23]. The reports confirm that Malaysia is a major consumer for shark fins, with large import volumes of shark fins. The demand for shark fin and meat likely leads to the higher volumes of sharks caught in the country both for local consumption, fish meal and for export. While providing useful information on market that has been previously unavailable, the study gives the impression that the trade can be continued or exploited beyond the current rate, despite evidence of a decline in overall yield. Shark and especially ray consumption in Malaysia is high and an important source of local protein.

It has been stated that Malaysia's official position on shark finning and the presence of a targeted shark fishery does not exist in Malaysia[68]. However, given the decline of populations as reported by NPOA 2, and a declining catch per unit effort, it would suggest that these fish are indeed a target species and are being targeted with increasing effort. Thus, the conclusion would be that sharks and ray are an important fishery deserving attention and designated as a catch resource and should not be discounted simply as bycatch. Since domestic shark and ray populations are an important food source, it is advisable to make a closer evaluation of catch rates of sharks and rays by species and area countrywide and in Sabah.
In their 2017 domestic studies, both Arshad[22] and Ahmad [23] conclude their results confirm earlier data as published in Malaysian National Statistics that rays and sharks are only by-catch and not targeted, and contributed less than 2% of the total annual marine landings. However, the trawl fishery is indiscriminate in catch and it is only natural that nearly anything cold be considered bycatch outside of targeted catch (shrimp, species of bony fish such as bream, shad) and in one analysis of Malaysian trawlers about 40% of catch is considered trash fish[101].

Small-scale fishers are also generally unaccounted for in a fishery, leading to underreporting and potential

overfishing. Indeed, with a growing population in Malaysia was 28,688,703 growing to 31, 953,158 in 2018. With a national growth rate of 1.32% it is unlikely that the number of unlicensed fishers and fishing effort has declined[99]. A more thorough analysis of catch per unit effort in this fishery is required to define this trend in the licensed fishery, and greater examination to landings by small scale and unreported landings is necessary to approximate true shark and ray landings[101].

Sharks and rays, including examples of threatened or protected species, are evident in every landing site visited in nearly every study evaluation. In all the fishing ports evaluated in the 2017 market and trade survey by Arshad et al, reported shark and ray products are consumed widely at a local level, as well as for export, mainly to Mainland Malaysia[22]. Major domestic market destinations include Sibu, Johor Bahru and Kuala Lumpur. Shark and ray products were also traded in the world market particularly in the Asian market such as Hong Kong, Singapore. Thailand is a large export market of ray skin. The authors observe that the traders seem to have its own unique of marketing network within and outside Malaysia although there is no record of how this is transacted. Malaysia is a significant importer of shark fin, with 20% of ASEAN market, and has experienced significant growth in market share[32]. Some products appear to be imported for treatment and eventual export. Exports in general have declined, although imports of shark fins have increased significantly. Many sharks, such as the small ground sharks appear to be caught primarily for their fins and the meat is often rendered and not consumed directly by humans[24].

The domestic shark fin trade data demonstrates a trend of declining exports after 2008 along with a steady increase of imports that continues today[29]. Although consumption of shark fin in Malaysia is high, it is difficult to correlate the decline in fin exports solely to increased appetite for shark fin soup. The peak shark catch precedes the export decline and may be as symptom of overfishing, or that fins previously exported are saved for domestic sales and consumption. Whether peak catch and export decline are correlated, it remains that shark fin consumption in Malaysia is very high as evidenced by ranking as third largest importer globally by the FAO. We would suggest that the trade and market studies[22] encouraging domestic shark fin trade and increasing market sources to supply the domestic appetite for shark meat and shark fin soup is irresponsible with regards to managing domestic shark populations.

The overall increase in shark fin imports, and by association shark fin consumption is independent of the domestic shark fishery or targeted shark fin trade, officially recognized or not. The increase in appetite for this luxury dish is contributing not only to local populations but also to a global decline in sharks driven by the demand for shark fin soup. Shark declines can mainly be attributable to two sources of mortality: shark bycatch and the shark finning industry[17]. These two are however not mutually exclusive; the fins are of substantial value which provides incentive for the capture and retention of sharks that would normally be discarded, especially in pelagic longline fisheries[86].

Most of the discussion and analysis has been on domestic landings primarily from trawler catch. Data on the fin trade in longline and offshore fisheries is scant. For offshore fisheries the International Offshore Tuna Commission Scientific Committee (IOTC) identified the need for Malaysia to collect catch and effort information for shark species from its longline tuna fleet and to report this information to the Commission. The evaluation report is that Malaysia partially meets the data requirement for nominal catch and catch and effort for sharks taken in its longline fleet and for nominal catch in its purse seine fleet[87]. However it does not provide data on catch and effort for sharks taken in its purse seine fleet, nor are landings by species given. No catch per unit effort is available in the most ubiquitous trawler fleet.

Although increased fisheries management policies are desirable, and in some cases outright no take is necessary, agreement between state and federal Malaysian fisheries management policy will require

consistency for management and enforcement. The Malaysian fishery consists of large commercial fisheries overlapping range with traditional, small scale artisanal fisheries, with large socioeconomic inequalities between the two. The majority of commercial fishing companies are owned by Chinese Malaysians, whereas the traditional fishermen are predominantly Malay[33]. Large vessels can exert heavy pressure on local stocks, and some licensed vessels have also been reported fishing in areas outside of their licensed range such as occurred by a Chinese vessels fishing in east Sabah waters in spring of 2018 [102].

Fishing often occurs out of sight of land and without long range enforcement vessels current monitoring and surveillance schemes are not sufficient or effective. Data on fishing vessels including fishing locations is limited, inconsistent, and not independently verifiable. Vessel Monitoring systems such as AIS for commercial traffic, or new Vessel Monitoring Systems with Global Fishing Watch provides transparent tracking and a footprint for commercial fishing vessel[45]. In 2018 Indonesian regulations required VMS on fishing vessels exceeding 30 Gross Tons (averaging about 16 meters or more) that are licensed to fish in their waters. In 2017 Indonesia became the first country that will provide detailed, VMS information on their fishing vessels for display on the Global Fish Watch fishing activity map. The addition of their VMS data adds an important new layer to monitoring capacity, and makes nearly 5,000 previously invisible fishing vessels viewable on the Global Fishing Watch heat map. This transparent system will provide data to license transgressions and provides a platform for better monitoring control and enforcement of offshore fisheries[103].

To guide management more comprehensive catch and landing data needs to be collected to ensure appropriate action is taken for the ecological survival of these charismatic predators that are important to the ecosystem. The trawl fishery in particular has a latrge quantity of unspecified catch, and what is considered bycatch is actually a significant portion of capture volume[104]. Applying standards and training such as those developed by Ahmad et al 2017 and applied to a centralized accessible online database will provide scientists and fisheries managers better tools to understand species and populations at risk. At all levels of governance, monitoring and enforcement of shark regulations are significant issues, and pose similar problems to other commercial fisheries. However without regulations there can be no management. The lack of scientific information in relation to specific shark species hampers both sustainable fisheries and conservation efforts. The IUCN Red List cites there is little or no data for many species of shark, and approximately 40% of sharks and rays are data deficient[10]. The FAO collects and reports data, which is available on the FAO Fishstat Capture Production Database. However data is compounded for sharks by the lack of specificity in the current reporting system of bycatch or indefinite species identification[105]. Thus, shark catch is significantly unreported and catch underestimated in the absence of specific and accurate catch data.

The two 2017 market and shark fishing surveys conducted by Arshad[22] and Ahmad[23] emphasized the need for better species data and increased training by inspectors and provided trained inspectors to their field studies. Trained inspectors and surveyors using the guidelines developed and used by Ahmad 2017 for sharks, skates and rays in the trawler fleet will provide better management information on catch rates and species[106]. However, as has been observed, most of the data is collected at the main landings favoring the large, licensed commercial vessels, and not the small fish docks favored by unlicensed and unaccounted fishers. This makes accurate catch data a challenge and underreporting of catch by fisheries managers understandable[89]. The recommendation to increase inspections and data collection at landing sites, and to provide additional training to inspectors is imperative for better species and population management.

Additionally, building on the efforts of NGOs and operators to collect observations will provide a more comprehensive database on shark and ray species occurrences, frequencies and even population trends.

Applying a standardized data collection approach opens new potential for shark and ray species observations (in the wild and at the market) collection and reporting. Citizen science is a growing field engaging trained public in data collection and has an increasing role in conservation and ecology. Scientists across the globe are now using networks of observers to obtain more researchers are recognizing the benefits and are working with citizen scientists. Employing an online centralized and scientist-vetted database such as iNaturalist, observations are comparable and reproducible[107]. For example, programs like Manta Trust are engaging resort divers to develop a database of individual manta rays by location using photographs provided by volunteers and applying pattern recognition software[108].

Sharks and ray consumption is important to the Malaysian population as a source of protein. Many species of ground sharks such as the bamboo sharks are egg layers able to reproduce year round, and can serve as a dependable source of food if managed properly. The popular Himantura or whiptail rays dominate most catch. These are live-bearers with 1-4 young but landings data suggest that these rays reproduce year round and could sustain a managed fishing effort[24]. However, habitat damage will impact all species, and non-selective and damaging gear such as bottom trawls will ultimately cause decline in even these more robust sharks[37]. Although a near shore prohibition exists for trawlers, the large-scale impact on this most common industrial fishing technique is having large-scale impacts on habitat and fisheries, and argues for seasonal or area based closures to allow for recovery[108]. In 2017 Malaysia had

6,074 licensed trawl vessels catching activity landed about 659,308 tonnes of seafood, with more than 33% of it's landing consisting of trash fish and juvenile fish. Average size of fish landed have been smaller and fish younger. Additionally, unpublished data by Matsumoto et al indicates a decline of large sharks and some ray populations in Sabah waters based on catch rates, and a shift of fishing pressure to other elasmobranch species[109].

Large species such as the reef sharks, tiger sharks and the hammerhead sharks are extremely vulnerable to overfishing. Some have argued that the global decline in shark and ray catch is a sign of increased protection. However, global trends of declining populations by the FAO reporting and national landings argue otherwise[110.] In Malaysia, landings data suggests that these species are in dramatic decline, reflecting global trends, by as much as 90% of some large species of shark[16,24, 110]. However, better accounting of landings by species is necessary to verify these trends. To counter this decline, more rigorous control of landings and management in the NPOA and Elasmobranch Action Plan for Sabah in particular should be followed to protect threatened species[111].

The authors of the Fish 2020 model predicts that changes in the international fisheries sector is shifting from large scale industrialized fisheries to localized extraction. As prices for most food commodities fall, fish prices are expected to rise, reflecting demand for fish that outpaces the ability of the world to supply it. The model shows that developing countries will consume and produce a much greater share of the world's fish in the future, and trade in fisheries commodities will also increase. The study shows the causes and implications of these and other changes, and argue for specific actions and policies that can improve outcomes for the poor and for the environment[112]. However, IUU fishing and underreported landings by these small scale fisheries will undermine fisheries management, and it is imperative to increase licensing, landings and reporting of fish by these small scale fishers.

Aquaculture is a growing industry and is being promoted in Malaysia as an important engine of growth and source of food. However, given their biology (slow growth, low reproductive capacity, late onset of reproduction and the need for relatively large areas and food) sharks do not lend themselves well to aquaculture[17]. Thus, to recover overfished populations, or further compromise stocks under pressure, Malaysia must rely on sound fisheries management policy combined with increased population and range

information, catch data and enforcement to protect sharks.

With an observable decline in national landings of sharks and rays since 2003 for sharks and 2005 for rays, and a growing list of threatened and endangered species, the risk to Malaysian shark populations from overfishing and the body parts trade is great. Fishing gear, especially trawl and longline are having widespread impact on shark and rays in addition to other organisms not well quantified and identified as bycatch, and as such do not appear to be seriously considered in fisheries management plans.

Despite statements to the alternative, shark finning is not illegal under the Malaysia Fisheries Act. However, shark carcasses are allowed to be landed with fins detached which is an impediment to the fisheries conservation program under the NPOA. Shark fin trade and tracking is difficult to associate with a fishing area, vessel or species once detached. Adopting a clear and understandable federal law banning shark finning under the Fisheries Act costs nothing and demonstrates Malaysia's commitment to shark and marine conservation.

Threats to these charismatic species will have long-term impacts on the health of Malaysia's marine ecosystems, but will also impact a sustainable tourism economy. Clear definitions of bycatch and shark finning need to be entered into the Fisheries Act and the language should be consistent across states fisheries regulations. A similar prohibition on the importation of shark fin from countries that do not prohibit finning, or are not sourced to fisheries from countries that do not have an NPOA and are known to overfish sharks will similarly demonstrate a commitment to conservation.

On a positive note, the commitment to conservation as evidenced by Sabah's increase in marine protected areas and the voluntary commitment to the United Nations to meet goals set under SDG 14 are highly promising[31]. However the percentage of no take reserves in Malaysian waters is low,. Additionally, the rush to protect large areas to meet these goals have the potential to fail in conservation without a management plan, structure and enforcement. Hopeful for Sabah has embraced sustainable ocean tourism and is increasingly recognizing that sharks are more valuable alive than dead.

VII. RECOMMENDATIONS

The data suggest that in some regions of Malaysia shark and ray populations are being fished more significantly than accounted for by Fisheries statistics. Some areas have been compromised by overfishing, exacerbated by a lack of accurate fisheries catch and landings data. Large-scale imports of shark fin combined with a significant in country consumption by residents and tourists make Malaysia a major contributor to the global decline in sharks. The harvesting of Mobulid rays for their gills is an alarming new trend and is having negative impacts on observed ray occurrences in the wild, and in the public eye, the threat to loss of long term sustainable tourism.

The domestic shark fishery is more significant than recognized by the Department of Fisheries

management. Dismissed as a small percentage of total catch, that sharks are untargeted and caught as bycatch, and that finning does not occur, disregards a class of fish that are important ecologically, for local consumption and economically through ecotourism services. A clearer definition of bycatch and what the definition means to sharks and rays is necessary. Although shark finning appears to be a rare phenomenon in Malaysia, sharks with little or no value as food are being targeted for fins and the meat is rendered as a byproduct. Rare, protected and threatened sharks are caught in this dragnet, and the demand for fins and gill rakers is increasing pressure on already threatened species.

Underreporting of shark and ray catch is significantly higher than accounted for by recorded landings, possibly by as much as 0.5-3x the value reported. Thus, the 2-3 % of sharks and rays as a component of all catch in Malaysia could actually be as high as 6-9% of total catch, making this resource significantly more important than currently considered. At an estimated 20% of total catch or 20 billion to Malaysia lost, IUU fishing is a persistent and urgent threat to food security and management of domestic stocks of sharks, rays and reef ecosystems. Fish bombing is an egregious example that is poaching reefs and destroying critical coral habitat and long term ecological and economic health An integrated enforcement approach combining technology with on the water enforcement is critical to limit this extremely damaging fishery. A fins attached requirement in all Malaysian waters would facilitate enforcement. Longliners in Semporna are either fishing the last remaining domestic reef sharks or highly likely, poaching sharks from Indonesian waters and landing on private jetties. This shark fishery is illegal, harmful to the dive tourism industry and to the pride of Sabah.

Increasing marine protected areas to meet Sustainable Development Goals is admirable, however a well thought out management plan that considers local peoples living within the marine parks is critical for success. Currently no take reserve status is low at an estimated at 0.1 %. These no take reserves when enforced have the best results for recovery of habitat and species, or protecting existing healthy ecosystems. Providing more training and enforcement ability for Sabah parks e.g. patrol vessels and the ability to cite is necessary for protection. However a diver- citizen science network that collects data on protected areas can also serve as eyes and ears to facilitate enforcement and deter poachers. Supporting a system of data collection and management using dive tourists can attract more tourism and increase the support base for enforcement, as well as increasing scientific knowledge. Providing a mechanism for tourists, both above and below water, to participate and contribute through data collection and contribution of a user fee in Marine Parks will provide additional support.

The evidence in this summary indicates that the demand for sharks and shark products remains high as populations continue to face mounting pressure. Similar to the international moratorium on whales, and the positive success in protecting sea turtles in Malaysia, we recommend increased shark management plans for effective, long-term change to make a difference in rebuilding shark populations. Since a moratorium is highly unlikely, regulations, measurement of exploitation rates, protection of critical habitats, and education are vital, and should be used in conjunction with one another, not as stand alone methods. While it is critical to protect endangered species, we recommend identifying and listing species of merit in areas important to or with potential to expand dive tourism (e.g. hammerheads, mobulid rays, zebra shark and reef sharks) and introduce complete protection.

Shark and ray tourism offer an opportunity for local long-term economic benefits with sustainable livelihoods, in addition to developing a positive international image. We offer a series of recommendations by order of feasibility. Some are relatively simple, whereas others will take significant effort in adopting or changing new regulation, trade policies and management. Education is important both for local consumers but also tourists consuming shark and ray products. We applaud in- country

groups such as SSPA, WWF, Scuba Junkies, Green Semporna, Forever Sabah and Scubazoo in their efforts to partner with Sabah and Malaysian Minister of Education, that has broadened appreciation for sharks. Public events, campaigns and videos are helping broaden the understanding on the plight of sharks. However, consumption of shark fin soup is widespread and many consumers and tourists require awareness.

In general, our recommendations reinforce those of the Malaysia in NPOA 2014 and those for Sabah detailed in the 2016 Elasmobranch Action Plan for Sabah 2016 University Malaysia Sabah, Save Our Seas Foundation but with increased urgency and additional recommendations. Many of the goals committed to in the Coral Triangle Initiative NPOA have yet to be implemented. The target to establish marine sanctuaries and protection for near-shore habitats, particularly assigning these areas as No Take Replenishment Zones, will allow for sustainable management of fisheries resources. We observe that Malaysia has signed onto a commitment to halt the rate of declining shark population by the year 2015, to prevent extinction of threatened species and improve the status of the listed species and other species listed under the IUCN Red List of Threatened Species.

Additionally, we restate the 2020 goals of the SSPA in Appendix I for Sabah sharks and rays and proposed legal amendments in Appendix II and published in Future Law and Forever Sabah, 2018. 'Sharks and Rays: Environmental Law and Policy in Sabah (Volume 12). Kota Kinabalu, Malaysia.

Appendix III to reduce shark fin consumption, imports and trade in Malaysia. This must be done through increased education in schools, in public campaigns and through increased enforcement.

With respect to the Department of Fisheries Malaysia, the Department of Fisheries Sabah, their staff and scientists, we make the following recommendations to help manage domestic shark and ray populations for the people of Malaysia, visitors and the health of the marine environment:

A. Enforcement of Existing Fishing Regulations and Increased Regulation

1. Clearly define Finning under Federal Fisheries Act. Institute or clarify a national ban on shark finning under the Federal Fisheries Act requiring sharks to be landed with fins attached. Adopt language across state fisheries regulations.
2. Redefine bycatch status of sharks and ray under Federal Fisheries Act to identify fisheries with landings over 5% total catch as a targeted category.
3. Prohibit the sale of gill rakers of listed species such as manta rays, devil rays, eagle rays and fins from hammerhead sharks and other endangered and protected species.
4. Enforce existing regulations (Wildlife act, Fisheries act and Endangered species act)
5. Implement recommendations in the NPOA-2 recognizing the need to impose new conditions for fishing licenses to ensure no undocumented discards of sharks and rays.
6. Require Vessel Monitoring using the VMS system applied by Fish Watch for vessels > 30 Gross Tons to monitor license violations, poaching from outside nations and other IUU fishing,
7. All IUCN threatened species should be included in ecosystem approach to fisheries management plan (EAFM) that control shark mortality as recommended under the NPOA and in the Coral Triangle Initiative.
8. Include endangered, threatened and nearshore marine species into State fisheries law adding to current management of freshwater sharks and rays.
9. Protect all locally threatened endemic shark and ray species e.g. pale whipray (*Himantura signifer*)

found in Pahang, and river sharks (*Glyphis spp.*) and giant stingray (*Himantura chaophraya*) in Sabah and in Malaysia under the Fisheries act and Endangered species and receive full protection.
10. Prohibit landings of recognized eeconomically valuable species for the dive tourism industry (e.g. black tip sharks, grey reef sharks, white tip sharks, leopard sharks, hammerhead sharks from all fisheries in areas of high impact/high tourism such as Semporna.
11. The guitar shark fishery in Kota Kinabalu requires minimum landing size regulations. Elsewhere guitar sharks need to be totally protected to allow population recovery.
12. Implement seasonal closures for fishing including artisinal gill nets for areas such as mangroves and estuaries where nurseries are located. For example, Black tip reef sharks exit mangroves and lagoons at predictable times and temporal closures will reduce bycatch.
13. Prohibit small scale or unlicensed longliners from landing any pelagic species of shark, reef shark or Mobulid rays.

B. CITES Adoption and Enforcement

1. Fully adopt CITES for all elasmobranchs. All CITES species should be protected in Malaysia under the Endangered Species Act. This includes scalloped hammerhead sharks and Mobulid rays, and CITES Appendix I and II species. If these species are caught accidentally they should be released alive as is required in other countries, or reported when captured and any products restricted from sale or export consistent with CITES II requirements.
2. Implement a coding category for shark fin and gill rakers by species for sale and trade. Make consistent with Standardized code categories for exports.
3. Apply the latest technology using genetic barcoding to identify products and derivatives as listed under the CITES Appendices could be implemented order to strengthen the enforcement of Act 686.
4. Include all CITES species of elasmobranchs in import/export trade of meat and fins, including the Scalloped Hammerhead sharks (*Sphyrna lewini*).
5. Include all products of endangered and threatened species listed under the ban exports consistent with other CITES protected species adopted in 2017.
6. Adopt the Federal Minister of Natural Resources and Environment proposal to remove CITES-listed sharks from the Agriculture and Agro-based Industries Ministry and recognize them as protected species under a planned Protected Marine Species Act (26 July 2016).
7. Increase education among fishers to release protected species.
8. Add observer coverage to licensed longline and trawl fisheries to quantify bycatch and capture of compromised species.

C. Data Collection and Monitoring

1. Refine data collection by inspectors and reporting by taxonomic group down to the genus, or at minimum family will more accurately identify species most threatened and increase accuracy of catch rates.
2. Increase training of fisheries inspectors such as those provide by SAEFDEC in the 2017 Marketing and Trade Reports.
3. Eliminate grouping trade under the simple identifier “sharks or Yu” and adding more accurate reporting including location caught to aid in avoiding overfishing threatened species already at risk.
4. Increase knowledge of migratory species at high risk and high value to tourism e.g. mantas, hammerheads, whale sharks though citizen science, BRUV and tagging tracking.

5. Support a standardized national citizen science shark and ray observation program. Promote and develop with volunteer organizations like the SEAS model with dive operators. Institute through Department of Tourism a State and national program developing dive tourism, and broadening dive and tourist based data collection for sharks and rays.
6. Expand information on market catch as well as wild animals in the environment, providing DoF data on what areas needing increased enforcement, management or closure.
7. Develop a national database on the catch and observations and activities of sharks and rays.
8. Host a statewide Sabah annual shark dive for divers to record and report observations of sharks and rays.
9. Provide vessel observer or vessel tracking using GPS-integrated cameras or vessel management systems e.g. Global Fish Watch and correlate catch through inspection with region.

D. Fishing Gear

1. Substitute harmful trammel netting responsible for high bycatch for other less harmful methods, particularly in regions of sensitive habitat.
2. Eliminate trawlers and create restricted no fishing zones in nursery regions identified as critical for habitat, or pupping of sharks and rays.
3. Mesh size reductions made in gill nets in 2010 are attributed with a measurable decline in catch of large sharks in that fishery. The NPOA-SHARKS (2006) recommendations for shark gill net size should be enforced. Similarly, adding TED type modification to all trawl nets will reduce shark and ray bycatch, benefit sea turtles and have the added benefit of reducing clogging of nets by debris.
4. Conduct a biannual survey of trawler catch similar to that of Arshad 2017, focusing on gear, catch per unit effort and region fished to better estimate species or area declines.
5. Requiring trawler gear to be retrofitted with chain modifications and TED devices to reduce benthic damage, reduce sea turtle mortality and allow other non target species to escape.
6. Replace the Semporna offshore long line shark fishery with hook and line or other alternative due to the catch of protected species, lack of licensing, high potential of international poaching and conflict with the dive tourism industry.
7. Instituting emergency measures banning landings and the sale of fins from protected species e.g. a mandatory reporting catch of targeted species such as hammerheads.
8. Until prohibited to catch, require landings and processing of charismatic species such as Mantas and sharks at the centralized fish markets, catalogue area of catch and fisherman.

E. Fin Trade and Consumption

1. Institute a ban on import and export of all fins and gill rakers of CITES listed and protected species under Malaysian law.
2. Introduce a list of species of sharks where the fin trade is illegal inside Malaysia.
3. Increase penalties on undocumented, unlicensed shark catch and fin trade, or fins from protected species.
4. Create a fin registration system for traders with a mandatory data reporting system.
5. Ban any handling and trade of shark fin outside of formal landing places and traded by registered traders.

6. Implement a complete ban on manta and mobulid ray gill rakers for export and for in-country sale.
7. Prohibit the importation of any shark fin from countries that do not prohibit finning, or are not sourced to fisheries from countries that do not have an NPOA and are known to overfish sharks.
8. Follow the guidelines in NPOA 2 to reduce national fin trade and consumption. And strengthen in NPOA 3.
9. Implement shark fin import guidelines with traceability by source and species.
10. Require all sharks to be landed whole and at centers where recordkeeping occurs.
11. Provide customs officials and inspectors with training on recognition of shark fin and spot analysis using iSharkFin photo ID technology to help inspectors identify CITES or protected species in the market.
12. Utilise a Harmonized Systems Code to classify mobulid gill plates, and consistent coding for shark fin for import/export and re-export.

F. Ecotourism

1. Develop a prototype model to develop shark and ray tourism supporting an opportunity for local long-term economic benefits with sustainable livelihoods, in addition to developing a positive international image.
2. Develop a shark ecotourism sub committee to investigate and recommend additional sites to protect, and promote well managed dive tourism - especially for guitarfish, zebra sharks, hammerheads, whale sharks and manta rays.
3. Develop a public Dive Malaysia tourism campaign to promote increased dive tourism with the department of Tourism, commerce and tourist businesses. Promoting shark and ray tourism while ensuring protection for these fish will pay off in dividends.
4. Develop a dive visa program charging divers a nominal fee that will go into a marine protection fund to support a shark conservation science and enforcement program.
5. Avoid public misunderstanding and censure by tourists and negative international attention by requiring the landing of all sharks and rays at centralized fish markets not intended for immediate local consumption. Landing sharks and large fish catch in centralized fish markets will provide better available data for fisheries managers, regulate unlicensed shark fishing and avoid public backlash which in turn harms tourism.
6. Embrace a statewide or national program to engage with tourist businesses and dive resorts and operators to promote increased shark and ray education, and data collection through a standardized citizen science program with a centralized web site. Observations can be added and maintained on sightings and participants can add additional data such as vessels fishing, protected species or poaching. This community engagement will promote a sense of ownership, potentially increasing protection through reporting and provide information that can aid enforcement.
7. Prohibit tourists from individual export of live or dead fish, including dried seafood products such as shark fin, manta gills, fish maw, seahorses and sea cucumbers.

8. Adopt a national system that ranks seafood by source and sustainability based on the Seafood Watch model of the Monterey Bay Aquarium. Adopt a state and national policy with voluntary guidelines for ranking and red listing the most unsustainable products or fish from sources known to be questionable or irreputable.

G. Marine Protected Areas/Shark Sanctuaries

1. Develop a strong legislative, policy and regulatory framework to achieve an Ecosystem Approach to Fisheries Management ("EAFM"), which utilizes the input and involvement of multiple stakeholders within different overlapping communities and industries including:

    i. A commitment to establish a national policy on Ecosystems Approach to Fisheries Management, the Fisheries Act 1985 to reflect EAFM principles, development of EAFM Strategy for Sabah Fisheries.
    ii. increase participation of coastal community and fishers in reporting illegal fishing activities and increasing the operational capacity of MMEA and maritime enforcement.
    iii. development of a new initiative called the Sustainable Coastal Fisheries and Poverty Reduction Initiative (COASTFISH), to address measures to improve the income and livelihood opportunities for coastal communities while protecting food securities.

2. Establish marine sanctuaries and protection for near-shore habitats, particularly assigning these areas as No Take Replenishment Zones, which will allow for sustainable management of fisheries resources.
3. Provide resources to parks Managers to increase enforcement.
4. Delegate discrete marine reserves with no fishing for all species with no vessel access to aid enforcement of no shark fishing areas.
5. Develop an MPA and Area Management Plan which would link individual Marine Protected Areas (MPAs) and networks of MPAs to increase income and food security for coastal communities while addressing marine conservation.
6. Include fisheries no-take restrictions, particularly for large migrating species like whale sharks, hammerhead sharks and large rays in MPA management plan..
7. Develop a monitoring plan that includes a reporting system for enforcement of IUU fishing e.g fish bombing and shark fishing.
8. Include tourists and volunteers in monitoring, data collection and reporting observations inside and outside MPAS.
9. Provide mechanisms for shared economic benefits to local communities to offset potential loss from fishing through a diver-shark fee.

H. Protection of Threatened, Rare or Endangered species

1. Adopt and formally regulate all listed species of sharks and rays under CITES Appendix I and II.

2. Ban the trade or possession of rare species such as Pale Whipray (*Himantura signifer*), the Borneo and Kinabatangan river sharks (*Glyphis spp.*) and Giant Stingray *(Himantura chaophraya*) and all sawfish species in Sabah. Develop a list of species of concern by State and a system to flag fins or gill rakers for protected species or species of concern e.g. Manta rays.

3. Prohibit all landings of whale sharks, hammerhead, giant ray and hammerheads and increase penalties for landings or product sales.

4. Ban the capture and sale of Manta and gills from all Mobulid rays.

5. Develop a shark and ray specialist group to help define regions of high abundance for threatened sharks and rays and critical habitat and develop recommendations to identify species and area-based protection.

J. Reporting and Research

1. Include a clear definition of bycatch into the Fisheries Act. as opposed to secondary market catch for sharks and rays.
2. Report species catch by genus when possible, at least the level of Family
3. Increase training for inspectors and develop universal codes and reporting species and fin categories.
4. Support increased population and species research for sharks and rays. Comprehensive knowledge on biology, taxonomy, socio-economy and trade is critical for the successful management of sharks and rays.
5. Develop tools for inspectors e.g. Apps or ID cards to easily identify sharks and rays by genus level.
6. Support additional scientific research for tagging and tracking migratory species e.g whale sharks, scalloped hammerheads, reef sharks, including overlap of fishing efforts to develop areas needing protection.

K. Education

1. Build on efforts by WWF, Green Semporna, SEAs and others reaching over 15,000 thousand school children and a country wide audience through campaigns such as My Fin My Life. Develop a national targeted campaign on the importance of sharks and rays into science lesson plans that will reach middle and high school youth.
2. Target visitors at airports providing information on endangered marine wildlife, best practices including avoiding eating shark fin, sea turtle eggs and other threatened wildlife.
3. Develop messaging and content for government and private tour agencies websites not to eat endangered sea life or remove them from the country. This could include developing a short video for incoming and internal airlines on sharks and diving Malaysia, with the added message of enjoying ecotourism.
4. Develop standardized shark and ray conservation education materials and encourage all dive or ocean resorts to post, or present to their guests.
5. Strengthen partnerships with businesses, non-profits and local organizations to developed increased awareness through social media or other web portals.

VIII. APPENDICES

APPENDIX I CITES LISTED SPECIES, ELASMOBRANCHS

Apppendix	Common Name	Scientific Name	Year listed in CITES
Appendix I	Dwarf Sawfish	Pristis clavata	2007
	Small-tooth Sawfish	P. pectinata	2007
	Southern Sawfish	P. perottet	2007
	Common Sawfish	P. pristis	2007
	Green Sawfish	P. zijsron	2007
	Knifetooth Sawfish	Anoxypristis cuspidata	2007
	Freshwater Sawfish	Pristis microdon	2014
Appendix II	Whale Shark	Rhincodon typus	2001
	Basking Shark	Cetorhinus maximus	2001
	White Shark	Carcharodon carcharias	2004
	Oceanic Whitetip	Carcharhinus longimanus	2013
	Silky Shark	Carcharhinus falciformis	2016
	Scalloped Hammerhead	Sphyrna lewini	2013
	Smooth Hammerhead	S. zygaena	2013
	Great hammerhead	S. mokarran	2013
	Porbeagle	Lamna nasus	2013
	Bigeye Thresher Shark	Alopias superciliosus	2016
	Pelagic Thresher Shark	A. pelagicus	2016
	Common Thresher Shark	A. vulpinus	2016
	Reef Manta Ray	Manta alfredi	2013

	Giant Manta Ray	Manta birostris	2013
	Giant Devil Ray	Mobula mobular	2016
	Spinetail Devil Ray	Mobula japanica	2016
	Bentfin Devil Ray	Mobula thurstoni	2016
	Box Ray	Mobula tarapacana	2016
	Pygmy Devil Ray	Mobula eregoodootenkee	2016
	Shortfin Pygmy Devil Ray	Mobula kuhlii	2016
	Atlantic Pygmy Devil Ray	Mobula hypostoma	2016
	Lesser Guinean Devil Ray	Mobula rochebrunei	2016
	Munk's Pygmy Devil Ray	Mobula munkiana	2016

APPENDIX II SPECIES OF CONCERN & CITIZEN SCIENCE in MALAYSIA-CASE STUDIES

Shark biology in general makes them more sensitive to overfishing than most fish species. Sharks and rays include some of the latest maturing and slowest reproducing of all vertebrates. Sharks have the longest gestation periods of any vertebrate, and some of the highest levels of maternal investment. With low reproductive rates, slow growth and late onset of reproduction, the biology of many chondrichthyans result in very low population size, growth rates and weak density-dependent compensation in juvenile survival, making them highly vulnerable to overfishing (Musick, 1999b). Besides endangered species endemic to the region, globally threatened and endangered species are becoming increasingly rare in Borneo, including species that provide economic benefit through dive tourism. The section below gives a case study of four vulnerable and economically valuable species from anon-extractive perspective.

Whale Sharks

The Whale shark (*Rhincodon typhus*) is listed by the IUCN as endangered and protected in Malaysian waters. Whale Sharks are subject to large- and small-scale bycatch in fisheries, with some national and international trade in products. IUCN. Fins are sold as display or trophy fins for shark-fin soup restaurants (Chen and Phipps 2002), with displays in restaurants in Kota Kinabalu and Kuala Lumpur. Surveys have reported that Whale Shark fins are now demanding high prices, which is likely to result in increased targeting (Li *et al*. 2012). Taiwan's commercial whale shark commercial fishery catching

around 100/year closed in 2009. However, a January 2018 undercover story revealed China's clandestine fishery killing around 600 whale and basking sharks/year. (WildLife Risk) Whale shark fins have been reported to sell for as much $30,000 US. (SharkTrust) Generally not savored for soup due to the low concentration of ceratotrachiae or fin rays, the fins of these large sharks are decorative gracing the fronts of restaurants or as personal trophies.

Sightings of whale sharks in Malaysia are now relatively rare, but the sharks are known to migrate through Malaysian waters in the winter months. Sightings have occurred off Lankayan, Pedang Island, and Layang Layang. Whale sharks are seen occasionally at various places migrating North from Miri to Kudat from Jan to April each year, with some of Lahad Datu. One or more individuals is seen off KK by divers each season (SEAS, Scubazoo, TRACC Pers. comm.). Whale sharks are an important attraction to divers and receive a defacto protection when around resort waters such as Layang Layang and Lankayan. No whale shark meat was observed seen in the fish markets during the TRACC survey but many dried fin shops had whale shark fins as a display in Kuala Lumpur and Kota Kinabalu.

Reports of whale shark catch is still reported with no enforcement of the laws protecting them. TRACC reports in their survey that the Semporna shark long line fishery actively targeted whale sharks, and one was observed killed in Sarawak in 2014[24]. The whale shark is the most iconic and prestigious cartilaginous fish found in Sabah. Individuals of this slow-moving filter feeding shark species are also well known to visit TARP between January and April, in conjunction with the krill (bubuk) season.

A study of whale shark movements was undertaken on the west coast of Sabah. Satellite tags were deployed near Usukan Island and the study showed that individual whale sharks travel as far as Spratly Islands. Two other whale sharks were found to move between Pulau Tiga Park, Dinawan Island and TARP before the tags fell off. It is clear that whale sharks actively migrate within local waters especially to forage. Other than on the west coast, whale sharks can occasionally be seen in north and southeast waters where they remain as one of the tourist attractions. These charismatic sharks are piquing tourists interests and sightings are making news, such as the recent sighting of a whale shark off Lahad Datu in March of 2018 (Borneo Press) Whale shark tourism is a growing industry worldwide garnering significant economic benefits to the local economy.

A 2006 study revealed whale shark tourists spent $6.0 million in the Ningaloo Coast region of Western Australia and added between $2.4 million and $4.6 million to the regional economy in direct expenditure (Jones et al. 2009). Cagua (2014) estimated that direct expenditures for whale shark focused tourism in the South Ari Marine Protected Area for 2012 and 2013 accounted for US$7.6 and $9.4 million respectively. These expenditures are based on an estimate of 72,000–78,000 tourists who are involved in whale shark excursions annually.

Manta and Mobula Rays

There is an increasing demand for branchial filter plates or gill rakers of Mobulids. A 2017 study assessing the use of rays reports the increasing use of the rakers also known as brachial plates from Mobulid Rays which includes Manta, Devil and Eagle Rays. Branchial filter plates, which are used for traditional Chinese medicines, are among the most valuable seafood product by weight, fetching as much as 150 $US a kilo (dry weight)[35]. This alarming global trend is driving overfishing of mobulid rays globally and the situation in Sabah mirrors that global trend. The very low fecundity of the large and long-lived Mobulid Rays make the stocks of their species particularly susceptible to further increases in fishing[36].

Beginning in 2005, Scuba Junkie's S.E.A.S. program has conducted ray and shark observations and recording at the Semporna island of Si Amil where large aggregations of eagle and devil rays were known to occur. In 2014 dive masters from Scuba Junkie reported 135 eagle ray and 896 devil ray sightings over 30 trips in 2014. A total of only 3 Manta Ray sightings were reported in the same period. They continued these observations of 447 cumulative devil ray sightings, 70 eagle rays and no Manta rays were observed in 2015 over 26 trips.

It should be observed that these numbers do not represent total species but totals observed over each dive, and the same individuals are observed on a daily basis. Hence, individuals frequenting dive sites that are targeted to take tourists to see these animals are biased by location and the actual numbers of individual animals are lower than observations, by as much as a factor of ten. The sightings data does confirm presence/ absence, and seasonality for migratory species. Tagging or photo identification data are absent, however the non profit group Manta Trust collected ray data for catch in the Semporna market, and some photo ID that would be useful for evaluating ray fisheries. (Scuba Junkie- S.E.A.S. pers comm.) However, when contacted this data was not made available for this report.

Citing national security, dive trips to Si Amil were prohibited by National Police in July 2015, raising concern among operators that the rays might be fished without diver presence. A few specially permitted dives following the closure did not record significant numbers of rays at Si Amil (S.E.A.S. pers comm). However, trends in the wild reflect those reported by market survey suggest that Mobulid rays are declining in the region.

Scientists assessed the extent and economic value of manta ray watching in the Maldives, by surveys of tourist numbers at manta diving sites, and from interviews with divers. This was estimated to be worth about US$ 8.1 million per year in direct revenue (Anderson et al. 2011). The burgeoning industry has made a strong economic case for conservation in that the sharks are worth more alive for tourism purposes than dead (Cisneros-Montemayor et al., 2013). Economic information is important for localities with limited institutional powers—particularly in regards to environmental protection—to prioritize conservation of natural areas and implement effective management plans.

These "Citizen Science" programs lead by ecodive operators serve as a frontline for baseline data collection and in some cases are the only tangible data available. Standardizing these observations and rewarding operators for providing consistent monitoring of elasmobranchs (such as the Model used by Reef Check) can serve as reliable data sources, providing critical management tools. In some cases such as Si Amil where once abundant rays are now reported absent, dive tourism combined with photo ID and market catch data may serve as an effective guard, and perhaps the only protection available to these vulnerable species.

Data collected by the NGO Manta Trust in 2013 at or near Si Amil Island in Semporna observed Devil Rays including the Japanese Devil Ray (*Mobula japonica*) and Smooth Devil Ray (Mobula thurstoni) in the Semporna market. Most rays observed were immature based on disc size. The rays were reported to be caught by nets near Si-Amil and Denawan Islands. (Data Ali Hochstetter, Malaysian Manta Project, Manta Trust)

Mobula japanica is highly susceptible to gillnets and is taken, either as bycatch or as a target species in Indonesia, and in Malaysia. Juveniles could also be incidentally captured in trawl fisheries. While information is available on these areas it is likely to be landed in other countries also, particularly in Southeast Asia where pressure on the marine environment is considerable and where mobulid gill rakers

are a high value product. (IUCN)

In the Philippines, fishing for mobulids was banned in 1998, however it was lifted in 1999 to study the fishery. The ban was put back in place in 2002, and currently it is illegal to fish for any *Manta* or *Mobula* in Philippine waters. However, enforcement is insufficient and mobulids are still being taken illegally. (IUCN)

Additional research is needed to quantify the extent of target and non-target fisheries take for this species throughout its range. Observations by divers and citizen scientists like these two examples can be an invaluable tool in observing population trends and presence/absence. Because of its large size, migratory behavior, extremely low fecundity and large size at maturity, these rays are likely highly vulnerable to fishing pressure. However, available life history information is limited and more research is required to make a more accurate assessment of the threat posed by fisheries. (White 2006)
Although listed as Near Threatened under the IUCN Red List, the population is declining world wide. White, et al (2016)

Hammerhead Sharks in Sabah

Scalloped hammerhead sharks are charismatic and rank high on the bucket list of any diver to see in the wild. Global trends in hammerhead sharks show a decline of the three species of *Spyhrna* by as much as 90%, and in some regions they are extirpated (locally extinct)[10, 24]. Malaysia populations of hammerheads These global trends appear to be similar to those experienced in Malaysia. (Oakley). Fins from Hammerhead sharks are among the most highly valued, selling for $800/kg in the Hong Kong Market. Fresh hammerhead fins sell for RM 75-125 in the Semporna market. These sharks are also commonly consumed. Market studies cited in Ahmad, Ali and Oakley indicate the scalloped hammerheads are rare, and giant hammerheads are extremely rare in the fresh market. As reported here, most scalloped hammerhead sharks landed in Sabah are juvenile.

Trained dive masters with Scuba Junkie's SEAS program recorded observed events of Hammerheads and other key species over several years of diving at Sipadan. Since these events are of unequal observation events (SCUBA dives) throughout the year, the dives are at the same locations one cannot take the observations as empirical. However, a ratio can give us some weight to observations. Peak recorded observations of 364 occurred in 2014, over 52 dives. The following year 291 observations were recorded with 11 dive events, and in 2016- 166 were observed over 9 dives.

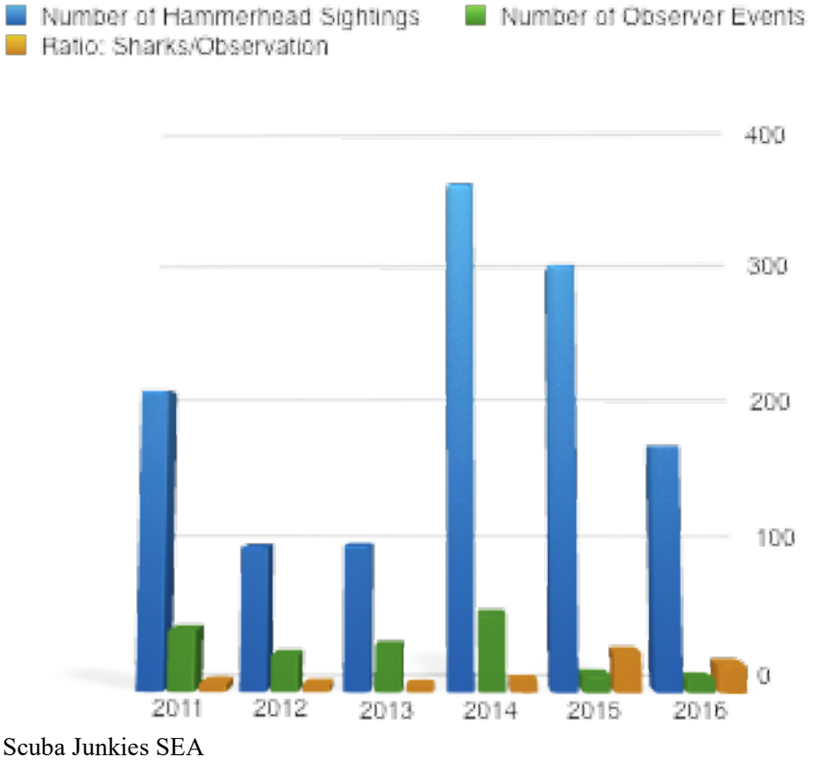
Although many of the sharks observed were the same sharks day after day, some seasonality and group size can be gleaned from this observer data. These sharks visit seasonally in the summer and early fall. Peak numbers sighted were in 2014 with groups of 60, sighted several times weighting the overall number. Identification of individuals over time through photo ID or more accurately, acoustic tagging will help resolve where the sharks go and location preferences. Trends in the last two years are down, with maximum numbers of scalloped hammerheads sighted in 2017 were 9 in any one month. Hammerhead and Manta Rays are extremely rare with individuals sighted. On a positive note, green and hawksbill sea turtles are common and whitetip reef sharks that are reef residents are also abundant at Sipdan demonstrating the efficacy of protection. Scalloped hammerhead sharks are migratory, and without accurate tracking data it is difficult to predict their residence in Malaysian waters and overlap with domestic and international fisheries. Increased research and measures to implement no fishing regulations are urgent to save this species.

Although not statistically valid for comparison, these surveys are an example of a citizen science approach to shark research that provides wide scale observations of presence/absence, individual

identification, species and population trends. If standardized, a system could be developed and shared across the dive tourism industry that would incorporate an education program that could extend beyond the dive community to consumers of shark and shark products and might lead to a reduction in that sector. The table below records total sightings of scalloped hammerhead sharks by SEAS divers per year at Sipadan Island.

Diver Observed Sightings Scalloped hammerheads, Sipadan Island

Year	Number of Hammerhead Sightings	Number of Observer Events	Ratio: Sharks/ Observation
2011	204	41	4.98
2012	97	24	4.04
2013	98	30	3.27
2014	348	52	6.69
2015	291	11	26.45
2016	166	9	18.45
TOTAL	1204	167	63.68
Source Scuba Junkies SEAS			



Source Scuba Junkies SEA

Additional data presented by Dave McCann of Scuba Junkie SEAS program at the Sabah Shark and Ray Forum charts diver sightings for large rays at Si Amil Island over 2014 and 2015. The sightings show a decline in Eagle and Devil rays, although the two years cannot be accurately compared she observations do not occur over all months of each year due to Maritime security excluding divers at the island. Manta

Rays sightings are extremely rare and the sightings of mobile rays are episodic. Divers presence and consistent recording can provide trends in populations and can also serve as protective eyes against illegal fishing.

Sighting data

Date	Eagle	Devil	Manta		Date	Eagle	Devil	Manta
January	-	-	-		January	8	90	0
February	-	-	-		February	25	60	0
March	-	-	-		March	7	122	0
April	-	-	-		April	14	88	0
May	23	167	0		May	0	2	0
June	9	201	0		June	10	66	0
July	15	184	0		July	6	19	0
August	20	363	1		August	0	0	0
September	45	272	0		September	-	-	-
October	17	45	0		October	-	-	-
November	40	89	0		November	-	-	-
December	13	127	1		December	-	-	-
Year 2014	**182**	**1448**	**2**		**Year 2015**	**70**	**447**	**0**

APPENDIX III Sharks Observed by Divers, Sabah (Scubazoo)

Long time Sabah professional divers and photographers with conservation partners SSPA have compiled a list of known locations with a history of shark and ray sightings.
The list of observations compiled include the list below

Pulau Tiga
Reef Sharks
Bamboo sharks
Catsharks
bluespotted stingrays
whip rays
marble stingrays

Tunku Abdul Rahman Park (TARP)

White tip reef sharks
Grey reef sharks
Black tip reef sharks
Marbled Stingrays
BlueSpotted stingrays
Catsharks
Bamboo sharks

possibly also for transitory
Whalesharks

Pulau Layang-Layang -

Schooling scalloped Hammerheads
Leopard sharks
White tip reef sharks
Grey reef sharks
Black tip reef sharks
Marbled Stingrays
BlueSpotted stingrays

Possibly also transitory
Thresher sharks
Silver tips
Manta Rays
Mobula Rays
Whalesharks

Pulau Mengalum

Black tip reef sharks
Bowmouth Shark
Guitarsharks
Shovelnose rays
Bluespotted stingrays
Marble rays
whip rays

Pulau Mantanani

Reef sharks
Catsharks
Bamboo sharks
small stingrays

Marble ray

Kudat - Tun Mustapha Marine Park

Reef sharks
Catsharks
Bamboo sharks
small stingrays
Marble ray

Sugud Islands Marine Conservation Area - SIMCA

Leopard sharks
White tip reef sharks
Grey reef sharks
Black tip reef sharks
Marbled Stingrays
BlueSpotted stingrays
whip rays
Possibly also transitory
Whalesharks

Sipadan Barrier Reef
White tip reef sharks
Grey reef sharks
Black tip reef sharks
Marbled Stingrays
BlueSpotted stingrays
whip rays

possibly also for transitory
Manta Rays
Mobula Rays
Whalesharks

Sipadan Reef

Schooling scalloped Hammerheads
Leopard sharks
White tip reef sharks
Grey reef sharks
Black tip reef sharks
Marbled Stingrays

possibly also for transitory
Thresher sharks
Manta Rays
Mobula Rays
Whalesharks

Mabul/Kapalai
small reef sharks
catsharks
bamboo sharks
saw shark
bluespotted stingray
whiprays
marble stingray

possibly also for transitory

Manta Rays

Mobula Rays
Whalesharks

APPENDIX IV THREATENED AND ENDANGERED SPECIES MALAYSIA

Family	Species	Common name	Threat Category	Occurrence
Myliobatidae	Aetobatus ocellatus	Ocellated eagle ray	Vulnerable (VU)	native
Myliobatidae	Aetomylaeus maculatus	Mottled eagle ray	Endangered (EN)	native
Myliobatidae	Aetomylaeus nichofii	Banded eagle ray	Vulnerable (VU)	native
Myliobatidae	Aetomylaeus vespertilio	Ornate eagle ray	Endangered (EN)	native
Alopiidae	Alopias pelagicus	Pelagic thresher	Vulnerable (VU)	native
Pristidae	Anoxypristis cuspidata	Pointed sawfish	Endangered (EN)	native
Carcharhinidae	Carcharhinus albimarginatus	Silvertip shark	Vulnerable (VU)	native
Carcharhinidae	Carcharhinus borneensis	Borneo shark	Endangered (EN)	native
Carcharhinidae	Carcharhinus hemiodon	Pondicherry shark	Critically Endangered (CR)	native
Carcharhinidae	Carcharhinus longimanus	Oceanic whitetip shark	Vulnerable (VU)	native
Carcharhinidae	Carcharhinus plumbeus	Sandbar shark	Vulnerable (VU)	native
Sphyrnidae	Eusphyra blochii	Winghead shark	Endangered (EN)	native
Glaucostegidae	Glaucostegus thouin	Thouin ray	Vulnerable (VU)	native
Glaucostegidae	Glaucostegus typus	Giant shovelnose ray	Vulnerable (VU)	native
Gymnuridae	Gymnura zonura	Zonetail butterfly ray	Vulnerable (VU)	native
Hemigaleidae	Hemigaleus microstoma	Sicklefin weasel shark	Vulnerable (VU)	native
Hemigaleidae	Hemipristis elongata	Snaggletooth shark	Vulnerable (VU)	native
Dasyatidae	Himantura leoparda	Leopard Whipray	Vulnerable (VU)	native
Dasyatidae	Himantura uarnak	Honeycomb stingray	Vulnerable (VU)	native

Dasyatidae	Himantura undulata	Oceallate whipray	Vulnerable (VU)	native
Ginglymostomatidae	Nebrius ferrugineus	Tawny nurse shark	Vulnerable (VU)	native
Carcharhinidae	Negaprion acutidens	Sicklefin lemon shark	Vulnerable (VU)	native
Dasyatidae	Pastinachus solocirostris	Roughnose stingray	Endangered (EN)	native
Rhinidae	Rhina ancylostoma	Bowmouth guitarfish	Vulnerable (VU)	native
Rhincodontidae	Rhincodon typus	Whale shark	Endangered (EN)	native
Sphyrnidae	Sphyrna lewini	Scalloped Hammerhead	Endangered (EN)	native
Sphyrnidae	Sphyrna mokarran	Great hammerhead	Endangered (EN)	native
Stegostomatidae	Stegostoma fasciatum	Zebra shark	Endangered (EN)	native
asyatidae	Taeniurops meyeni	Round ribbontail ray	Vulnerable (VU)	native
Narkidae	Temera hardwickii	Finless sleeper ray	Vulnerable (VU)	native
Dasyatidae	Urogymnus asperrimus	Porcupine whipray	Vulnerable (VU)	native

Source: FishBase

APPENDIX V Rays and Shark Species Observed in TRACC Market Surveys

Oakley reported black tip reef sharks (C. melanopterous) occurring at a small isolated population on the Samarang bank and Pulau Mangalum reefs where they are fished from the market towns of Papar and Kuala Penyu. There is a small population of approximately 12 individuals reported at a reef near Kota Kinabalu (dive down below pers comm- 2014). The black tip reef shark has been rarely seen by divers and in fishery landings in Kudat and Banggi islands.

SIMCA has a significant population which are apparently breeding. They are also very rarely seen in TARP (one observation in over 2500 hours underwater- Oakley) & Sipadan (1.5 sightings per month – S.E.A.S. unpublished). Oakley concludes these sharks are so rare as to be functionally extinct from the East coast of Sabah with exception of the two totally protected areas (SIMCA and Sipadan). Wider ranging species require protected areas large enough to protect them from fishing. The Sabah Parks totally protected (no take) areas within TARP & TSMP appear to be too small to contain a breeding population for black tip reef shark. No information is available on the shark population of the Turtle islands Park off Sandakan where fishing has been prohibited for many years. Reporting of reef shark landings is declining with one Black tip reef shark observed in Sandakan market in March 2015[24].

The leopard shark (*Stegostoma fasciatum*) occurs as a small isolated population in SIMCA and as very rare individuals seen a few times each year on Sipadan. One individual was seen in the Semporna fish market during this survey. One individual was caught in 2005 off Kudat. Small specimens – presumably breeding in SIMCA or Turtle islands Park and caught either in the Park or at the edges- are occasionally caught in Sandakan. Per Oakley, this species is endangered globally, and sufficiently rare to be functionally extinct in Sabah[24].

Sharks

Heterodontus zebra zebra - horn shark (R)
Chiloscyllium indicum slender - bamboo shark (R)
Chiloscyllium plagiosum whitespotted - bamboo shark (C)
Chiloscyllium punctatum brown banded- bamboo shark (C)
Cephaloscyllium sarawakensis - swell shark (R)
Atelomycterus marmoratus - coral cat shark (C)
Stegostoma fasciatium - leopard shark (ER)
Alopias pelagicus - thresher shark:(UC)
Isurus oxyrinchus - mako shark (IC) semporna longline (C)
Mustelus spp - smoothhound shark (R)
Hemipristris elongata - hook tooth shark (R)
Carcharhinus albimarginatus - silvertip Reef Shark (R)
Carcharhinus amblyrhynchoides - graceful shark (UC-semporna longline (C)
Carcharhinus amblyrhynchos - grey reef shark (UC)
Carcharhinus brevipinna spinner shark (R- emporna longline(C))
Carcharhinus dussumieri white cheek shark (R)
Carcharhinus leucas bull shark (R)
Carcharhinus limbatus black tip shark (R)

Carcharhinus melanopterus black tip reef shark (R) Seen in W coast markets
Carcharhinus sealei black spot shark (R)
Carcharhinus sorrah spot tail shark (C in seiners)
Galeocerdo cuvier tiger shark (R)
Triaenodon obesus- white tip reef shark (R)
Eusphyra blochii - winghead shark (R)
Sphyrna mokarram - Great hammerhead (R)
Glaucostegus thouin Clubnose guitar shark (ER)
Rhynchobatus springeri Broadnose guitar shark (ER)
Rhinobatos formosensis Taiwan guitar shark (ER)
Rhizoprionodon acutus milk shark (UC)
Rhizoprionodon oligolinx grey sharpnose (UC)
Loxodon macrorhinus Sliteye shark (UC)
Mustelus spp smoothhound shark(R)

Rays

Aetomylaeus spp eagle ray (C-Semporna)
Dasyatis ushiei cow stingray
Dasyatis zugei sharpnose stingray
Gymnura spp butterfly ray
Himantura fai pink whipray
Himantura gerrardi whitespotted whipray
Rhynchobatus laevis Smoothnose Wedgfish(ER)
Glaucostegus typus- giant guitar shark (UC)
Rhynchobatus laevis - smoothnose wedgefish (UC)
Rhynchobatus australiae southern guitar shark (UC)

II Species Observed 2017 Studies

Species landed Kota Kinabalu (SAFMA Jetty)

Ahmad et al., (2017), the highest sharks species landing by weight at SAFMA Jetty were brownbanded
Common
Bamboo shark (Chiloscyllium punctatum)
whitespotted bamboo shark (C. plagiosum),
spot-tail shark (Carcharhinus sorrah),
scalloped hammerhead shark (Sphyrna lewini),
Coral catshark (Atelomycterus marmoratus)
Uncommon
Scalloped hammerhead (Sphyrna lewini)
Fossil shark (Hemipristis elongata).
Other sharks included:
Hemigaleus microstoma,
Heterodontus zebra
Mustelus manazo
Alopias pelagicus
Loxodon macrohinus i

Carcharhinus brevipinna,
Carcharhinus sealei,
Halaelurus buergeri,
Orectolobus leptolineatus,
Squatina tergocellatoides
Stegostoma fasciatum

RAYS

The highest landing by species for rays at SAFMA Jetty
Bluespotted stingray (Neotrygon kuhlii) f
Whitespotted whipray (Himantura gerrardi),
Sharpnose stingray (Dasyatis zugei)
Narrow tail stingray (Pastinachus gracilicaudus)
Himantura walga and Dasyatis zugei
Rhychobatus australiae

Whiptail Rays
Himantura uarnak,
H. gerarrdi,
H. undulata
H. leoparda
H. uarnacoides
H. pastinacoides
H. lobistoma
H. jenkinsii
H. fai
Urogymnus asperrimus
Pastinachus atrus,
P gracilicaudus
P solocirostris

Kota Kinabalu (Arshad 2017)

The major sharks species caught were hammerhead shark (Sphyrna lewini), bamboo shark (Chilloscyllium punctatum and C. plagiosum) and sport-tail shark (Carcharhinus sorrah)

RAYS

Eagle ray (Aetobatus ocellatus)
leopard whipray (Himantura leoparda),
honeycomb whipray (Himantura undulata),
narrow tail stingray (Pastinachus gracilicaudus),
starrynose stingray (Pastinachus stellurostris)
bluespotted stingray (Neotrygon kuhlii).
Bluespotted stingray (Neotrygon kuhlii)
White spotted Whipray (Himantura gerrardi- now in genus Maculabatis)
Bluespotted Fantail ray (Taeniura lymma).
eagle ray (Aetobatus ocellatus), leopard whipray (Himantura leoparda), reticulated whipray (Himantura uarnak), honeycomb whipray (Himantura undulata), narrow tail stingray (Pastinachus gracilicaudus),

starrynose stingray (Pastinachus stellurostris) and bluespotted stingray (Neotrygon kuhlii).

Sandakan Arshad et al., (2017)

The highest landing of shark species was brownbanded bambooshark (Chiloscyllium punctatum) followed by spot-tail shark (Carcharhinus sorrah), zebra shark (Stegostoma fasciatum), bull shark (Carcharhinus leucas), and whitespotted bambooshark (Chiloscyllium plagiosum).

Rays

The highest landing of rays by weight was from pink whipray (Himantura fai) followed by whitenose whipray (H. uarnacoides), leopard whipray (H. leoparda), whitespotted whipray (H. gerrardi), Jenkin's whipray (H. jenkinsii), reticulated whipray (H. uarnak) and bluespotted stingray (Neotrygon kuhlii). Sandakan was found to be the major landing site for rays in Sabah.

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