The Scale, Value and Importance of Non-Fin Shark and Ray Commodities in Indonesia

Food and Agriculture Organization of the United Nations
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THE SCALE, VALUE AND IMPORTANCE OF NON-FIN SHARK & RAY COMMODITIES IN INDONESIA

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EXECUTIVE SUMMARY

In recent decades there has been growing international concern regarding overexploitation of sharks, rays (elasmobranchs) and their cartilaginous relatives. Due to their conservative life history strategies relative to most other fish, and susceptibility to capture in a wide-range of fisheries and gear types, many elasmobranch species are vulnerable to overfishing and trade-driven extinction (Dulvy et al. 2014, Dulvy et al. 2015, McClenachan et al. 2016). Fishing pressure for these species comes from both targeted and by-catch fisheries, which is perpetuated by local and global markets for a wide range of shark commodities. It is now estimated that current annual global fishing mortality of elasmobranchs is in the region of 100 million per year (Worm et al. 2013), and that one quarter of elasmobranch species are threatened with extinction (Dulvy et al. 2015).

To date, much international attention to address shark overexploitation has focused on the shark fin trade, and on managing international commercial trade (e.g. under the Convention on the International Trade of Endangered Species of Wild Flora and Fauna, CITES). In contrast, there is a paucity of data and management measures for non-fin commodity markets, both internationally and within shark-producing countries. This in turn hampers the development of comprehensive fisheries and trade management measures for sharks.

Indonesia is the world's largest shark producer (Dent & Clarke 2015), and recognised a global priority for shark fisheries and trade management (Brautigam et al. 2015). Indonesia's fishing industry is also dominated by small-scale vessels (approximately 95%), and people have a high dependency on marine fisheries products for their livelihoods and food security, particularly in coastal regions (FAO 2018). As such, Indonesia represents a priority for understanding the role of non-fin commodities in a) driving fishing pressure and b) supporting food security and local livelihoods. Both of these must be better understood in order to develop effective fisheries management measures that reduce shark fishing mortality, whilst appropriately balancing conservation objectives with the important socioeconomic role of global fisheries, such that shark conservation and management 'does no harm' to marginalised coastal communities.

Recognising this gap, and the global importance of Indonesia as a shark producer, this study was conducted by WCS, MMAF and FAO, during January – November 2018, in order to understand the scale, value and importance of non-fin shark and ray commodities in Indonesia. In particular we sought to understand the current and historic nature of trade in and demand for non-fin shark and ray commodities, and their role in food security and livelihoods, both within Indonesia and in major importing countries. This information will inform policy interventions and/or practical measures to improve management of this largely unknown and unregulated market.

Our study provides one of the first comprehensive assessments of non-fin elasmobranch commodity markets and trade patterns in a producer country, using a mixed-methods approach. We combine a desktop study, to understanding broad scale national-level patterns; with field-based data collection in case study sites, to understand local-level issues. This method also provides a potential template and lessons learned for future studies.

Our results indicate that a wide range of non-fin commodities are produced, traded and processed in to derivative products every year in Indonesia – including meat, liver oil, skin, cartilage and offal. The scale of this non-fin commodities market is significant, and accounts for the vast majority of elasmobranch commodity production, domestic consumption and export ***by volume***, with at least 100,000 tonnes of non-fin commodities produced each year. However, the value of this market – in terms of both exports and domestic consumption, is low relative to that of the fin trade.

At the local-level, shark meat reportedly provides a widely-available source of animal protein in/around shark fishing coastal communities, which is cheaper than almost all other sources of available meat and seafood. This highlights the potentially important role of shark meat in food security, particularly for poorer households, with thousands of households consuming shark meat every day in Aceh and West Nusa Tenggara alone. Local demand for shark products is also linked to traditions and culture, with widely-held preferences relating to taste and perceived health and wellness benefits. Trends in consumption indicate the rapid growth of human populations in coastal communities, particularly in West Nusa Tenggara, which is one of Indonesia's poorest provinces, is leading to greater pressure on marine resources for sustenance and livelihoods. This must also be viewed alongside an understanding of decreasing proportions of under-utilized stocks of other fish species, and overfishing of some staples. Together, these findings indicate that the domestic demand outlook for shark meat products remain high, with increasing pressure/dependency on shark meat for food, as populations decline, and other fish stocks are also being over-utilised.

What is more, post-harvest work within the non-fin commodities supply chain is a significant employer and source of livelihood in shark fishing communities, with thousands of people employed as collectors, first-stage processors, and local retailers. This is also a particularly important form of employment for women.

At the national-level, results also suggest that considerable volumes of non-fin commodities are traded from coastal communities to big cities, and internationally, in the form of 'raw' commodities (i.e. meat, oil, cartilage, gill plates) and derivative products such as fashion items (bags and belts derived from skin) and health and beauty supplements (derived from oil and cartilage). This represents a significant challenge for seafood transparency and CITES implementation, since much of Indonesia's shark production consists of threatened and CITES-listed species (in particular silky sharks, hammerhead sharks and thresher sharks) and these non-fin commodities are largely unidentifiable to the species level using visual techniques alone. As such, many people may be unknowingly consuming unsustainable shark products in Indonesia, while large volumes of CITES-listed species may be leaving the country undetected. This is exacerbated by end-consumers being largely ambivalent to or unaware of the species within the final consumer product.

In the future, there is a need to expand understanding of the important local- and international-level roles of non-fin elasmobranch commodities, both in driving global fishing mortality, and for livelihoods, nutrition and food security, particularly in marginalised coastal communities with limited adaptive capacity. This is essential for developing practical and ethical management measures across producer, trader and consumer countries, that can reduce shark fishing mortality without exacerbating poverty. In terms of management interventions, there is a need to improve data collection, from fisheries to export, in order to better understand the species and stocks

of origin for traded shark products. This data needs to be coupled with improved traceability and labelling of seafood products in trade, and improved verification and forensics systems for shipments and exports. Such systems could incorporate risk-based protocols with visual and genetic identification tools, to increase detection of and enforcement against illegal, unreported and unregulated trade. At the fisher level, trade regulations should be coupled with practical fisheries management interventions that result in changes in fisher behaviour and measurable reductions in fishing mortality of threatened and protected species at 'the point of kill'. Trade regulations alone may result in unintended and perverse consequences for sharks and people. Finally, at the consumer level, there is a need to broaden knowledge of and demand for responsibly-sourced seafood products. This includes promoting sustainable alternatives to shark products, and increasing demand for other seafood products derived from by-catch free/by-catch minimising fisheries.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

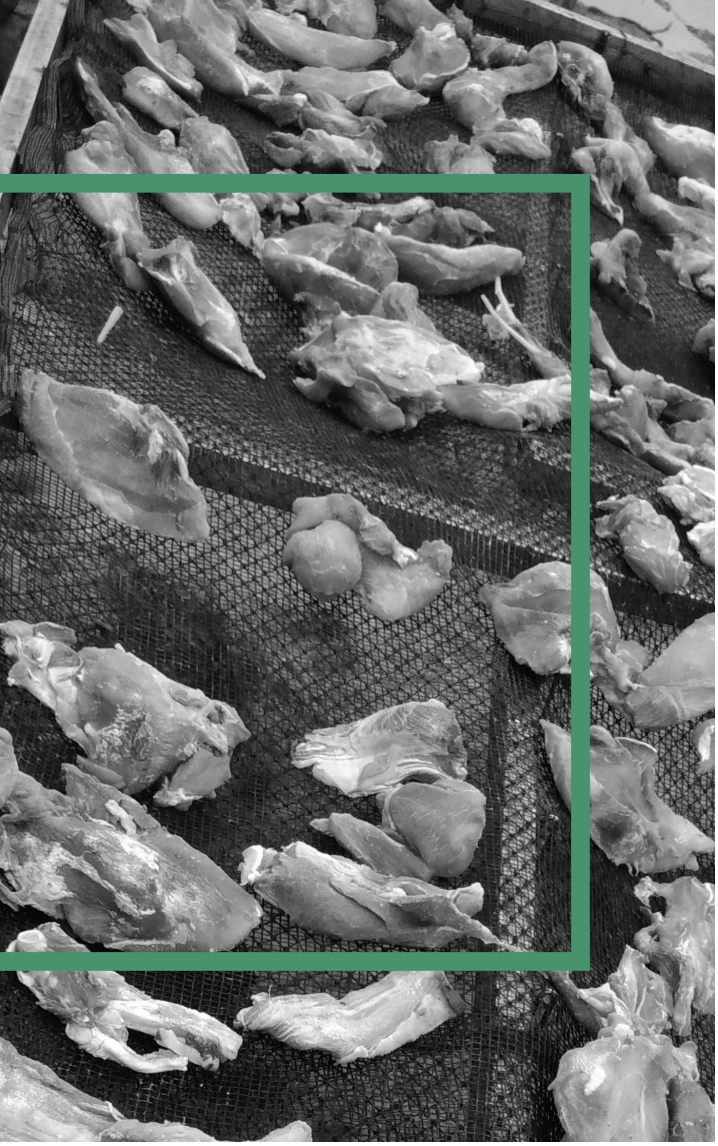
INTRODUCTION

Background

Many species of sharks, rays (elasmobranchs) and their cartilaginous relatives are recognised as vulnerable to overfishing and trade-driven extinction. This is primarily due to their conservative life history strategies relative to most fish species, their susceptibility to capture in a wide range of fisheries and gear types, and their high value (Dulvy et al. 2008, Dulvy et al. 2014, McClenachan et al. 2016). Elasmobranchs are now recognised as being one of the world's most threatened species groups, with one quarter of species threated with extinction according to the IUCN Red List of Threatened Species (Dulvy et al. 2014). This is primarily due to overfishing through capture in both targeted and by-catch fisheries, with an estimated annual global fishing mortality of 100 million per year (Worm et al. 2013). In turn, this fishing pressure is perpetuated by local and global markets for a wide range of elasmobranch commodities (Dent and Clarke 2015). Comprehensive fisheries and trade management measures are urgently needed to address unsustainable utilisation, sustain healthy elasmobranch stocks and conserve threatened species.

Within this global context, Indonesia is the world's largest elasmobranch fishing nation (Dent and Clarke 2015), and a global priority for elasmobranch fisheries and trade management (Brautigam et al 2015). However, in order to develop effective management measures, in Indonesia and worldwide, a comprehensive understanding of the drivers of fishing pressure – in particular, trade and consumption of elasmobranch commodities – is needed.

To date, most efforts to understand and influence trade in elasmobranch commodities have focused on the shark fin export trade, with international regulation



of shark trade primarily effected through CITES listings, and even that regulation only commencing in 2013. Although there is a young and growing focus on regulating the fun trade, there is little to no management in the trade in shark meat or other products. But CITES doesn't mandate enforcement of non-readily identifiable products. This gap in knowledge, especially for trade in shark meat, was highlighted in a recent review of trade in elasmobranchs (Dent & Clarke 2015, Dulvy et al. 2017), and hampers the development of practical and ethical management interventions for shark fishing and trade.

Understanding the complex interactions between trade in fin and non-fin commodities, and the impacts that policy measures have on elasmobranchs and people, is crucial for ensuring management measures are appropriate, effective and balance trade-offs between conservation objectives and the important socio-economic role of global fisheries.

Aims & Objectives

Recognising this context and needs, this study aims to understand the scale, value and importance of trade in non-fin elasmobranch commodities in the world's largest shark fishing nation: Indonesia (FAO 2018). In particular, the study aims to answer to the following questions:

1. What is the current and historic nature of trade in non-fin shark and ray commodities (volume, species composition, commodity type, sources and market destination)?
2. How much of the trade (volume and value) comprises export trade regulated (CITES listed) species?
3. What is the current and historic demand (domestic and import/export) for non-fin shark and ray commodities?
4. What is the historic and current importance of shark and ray non-fin commodities for food security, nutrition and livelihoods [domestic and import/export] for local people?
5. What are the key policy interventions and/or practical management and conservation measures that are, or potentially could be, put in place to manage and conserve shark and ray resources impacted by the trade in non-fin commodities?

In turn, we anticipate these findings will to inform both the fisheries and conservation sectors on how to better manage and protect elasmobranch stocks and species in the long-term, through approaches that recognises the full range of uses and values of elasmobranch commodities.

METHODS

To achieve these aims and objectives, we established a mixed-methods process to capture key quantitative and qualitative information on trade in non-fin commodities in Indonesia. In particular, we sought to obtain broad-scale information on national-level patterns of production and trade, through desktop research, followed by more detailed data collection on local-level trade patterns and utilisation, with a consideration of food security and livelihood issues, through field-based research in two case study provinces.

Desktop research focused on compiling existing information on shark and ray production, domestic trade, international exports and supply chains from readily available sources (Table 1), and identifying key stakeholders (including traders, NGOs and government officials; Table 2) that could be approached for field-based data collection. The desktop study identified and reviewed all relevant peer-reviewed articles, published reports and grey literature, as well as drawing on personal communications with experts, management practitioners and stakeholders. Secondary data was also obtained from Customs, ComTrade and the Ministry of Maritime Affairs and Fisheries (MMAF) of the Republic of Indonesia, and their subsidiary offices and local governments (Table 1).

Field-based research focused on two case study provinces: Aceh and West Nusa Tenggara (Figure 1), which were selected as indicative of higher use areas for elasmobranch fisheries and trade in Indonesia. Data was collected on through direct observation and semi-structured interviews with key informants. Three key informant groups approached for data collection; i) fishers (a direct role in shark fishing activities), ii) collectors (engaged in buying and collecting shark and ray products directly from

fishers), and iii) sellers (sellers are people who sell shark and ray products directly to consumers). Collectors or middlemen could be engaged in processing or selling to other processing parties while sellers could be trading locally or internationally. All respondents were required to be persons involved in the industry for more than five years, so they would have a deeper knowledge of the industry, and better understanding of historic patterns (Table 2).

Fieldwork was conducted from April – June 2018, during which the survey team visited key coastal communities, landing sites and market sites identified during the desktop study. Within the case study provinces, a total of seven (7) sites were targeted for data collection: four in Aceh province, including: Banda Aceh, East Aceh, West Aceh, South West Aceh, and 3 in West Nusa Tenggara, including: East Lombok, Mataram and Central Lombok (Figure 1).

Due to some of the challenges associated with accurately identifying non-fin shark products in trade, samples were also collected for non-fin products at the case study sites, which were genetically tested using DNA barcoding technology with standardized gene region COI profile identification methods described in Hebert et al. (2003). This involved DNA amplification of specific markers that allowed verification of the commodities source, to the level of species. All tissue samples of elasmobranch products were refrigerated and stored at - 20°C. A total of 40 samples of products from five cities in Aceh and West Nusa Tenggara were successfully collected. Samples consisted of various shark and ray derivative products on sale in local traditional markets (e.g. meat, teeth, cartilage, skin, and liver oil).

Figure 1. Map of Indonesia highlighting non-fin commodity case study provinces: Aceh and West Nusa Tenggara .

Table 1. Types of data, methods and primary sources used for data collection.

No	Data/ Information	Data type	Scope	Methods	Data Source
1	Production	Primary, Secondary	National and Case Study Provinces	Landing monitoring and government enumeration, Semi-structured interviews with key stakeholders	Primary data collection during field survey, and secondary data (MMAF national fisheries statistics)
2	Domestic trade	Primary	National and Case Study Provinces	Semi-structured interviews with stakeholders	Primary data collection during field survey
3	Socio-economic	Primary	National and Case Study Provinces	Semi-structured interviews with stakeholders	Primary data collection during field survey
4	Local consumption	Primary	Case Study Provinces	Sampling and DNA analysis	Primary data collection during field survey
5	Export	Secondary	National	Government statistics	Ministry Marine Affairs and Fisheries (MMAF) including quarantine (AFQQI) and technical unit (BPSPL); customs; ComTrade.

Table 2. Number and type of key stakeholder respondents.

Respondents	West Nusa Tenggara	Aceh
Fishers	31	27
Collectors	7	10
Sellers	15	16
Total	53	53

RESULTS

National-Level Desktop Research

Production

Volume

Marine megafauna, including elasmobranchs, have been caught and consumed by Indonesian coastal communities for centuries (Barnes 1996, Christensen & Tull 2014). According to stakeholder interviews, before the 1940's coastal communities primarily caught sharks in mixed-species fisheries, with similar utilisation as for other species of fish, which were primarily consumed as food. International trade in shark products began gaining commercial importance in Indonesia in the 1970's, predominantly driven by international demand for shark fins in China and Hong Kong. By the beginning of the twenty-first century, Indonesia was described as the world's leading producer of elasmobranch products (Tull, 2014), with sharks targeted by dedicated longline fleets and their products retained as valuable secondary catch in incidental and mixed-species fisheries.

According to government production statistics, annual elasmobranch production has been relatively steady over the past decade (2005-2014), oscillating between approximately 90,000 to 120,000 tonnes per year, with a 10-year annual average of 104,898 (SD 8,124) tonnes per year (MMAF, 2016). On average, 46% of total annual production consists of shark species, while 54% consists of rays (Figure 2). It is also important to note that MMAF monitoring systems currently classify sawfishes as 'sharks', however they have been classified as rays for the purpose of this analysis in terms of their scientific classification as *Rhinopristiformes* (superorder batoidea).

Sharks and rays are most often landed whole in Indonesia, with the entire body utilised, including, meat, skin, cartilage, fins, liver oil, gills and offal, though which body parts are utilised will depend on the particular species or species group. Given that wet fins can be assumed to make up approximately 3% of total shark round mass (although also noting significant variation amongst species, from 1.1 – 10.9%) (Biery and Paul 2012), the vast majority of this total production volume will be processed in to non-fin commodities. More specifically, based on estimated conversion factors from local traders, we estimate that somewhere in the region of 102,000 tonnes of wet non-fin elasmobranch commodities are produced in Indonesia each year, with around 74% (75, 981 tonnes) consisting of shark and ray meat, and the remainder consisting of skin and cartilage (12,144 tonnes), offal (4,858 tones), mobulid gills (163 tonnes) and liver oil (volume unclear) (Table 3).

Note these figures are likely to be an underestimate of what is actually captured and retained, due to the prevalence of illegal, unreported and unregulated (IUU) fishing. Though even with this underestimation, available data recognises Indonesia as the largest shark producer in the world, responsible for approximately 13% of global catch (Dent and Clarke, 2015).

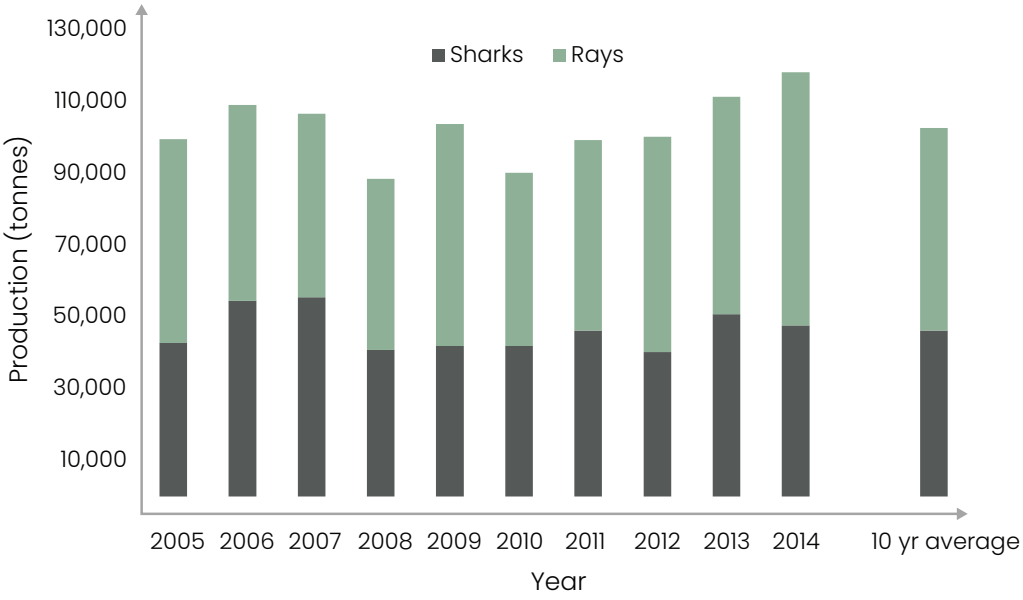


Figure 2. Sharks and rays national production in Indonesia (source: MMAF, 2016).

Table 3. Estimated annual production of non-fin commodities.

Product	Estimated. % of body weight (wet)	Sources for % estimate	Estimated total annual volume produced (wet) (tonnes) *
SHARKS			
Meat	60	Trader interviews	29,147
Skin & cartilage	25	Trader interviews	12,144
Offal (head & innards)	10	Trader interviews	4,858
Oil	-	-	Unclear
SHARKS TOTAL			46,149

RAYS			
Rays (excluding mobulids and rhinopristiformes)			
Meat	100	Trader interviews	43,728
Mobulid rays			
Gills	5	Lewis et al. 2015	163
Meat	95	Lewis et al. 2015	3,106
Rhinopristiformes			
Meat	95	EU 5% fin-to-carcass ratio (no data)	8,944
RAYS TOTAL			**55,941**
ESTIMATED TOTAL ANNUAL PRODUCTION OF NON-FIN COMMODITIES			**102, 090**

Note that liver oil is not included here, as no round weight to commodity weight conversions were available.
**Based on 10-year average production.*

Sources

Sites

Sharks and rays are caught across more than 200 fisheries in Indonesia, which vary widely in terms of scale and type (Booth et al. 2018, Figure 3). These include small-scale vessels (<10GT) up to industrial-scale vessels (> 10 GT), and range from highly-targeted (i.e. species-specific) shark fisheries to incidental fisheries. Priority provinces, with the largest numbers of identified shark fisheries, include Aceh, South Sulawesi, North Maluku, Maluku and East Nusa Tenggara. The most common fishing gears taking sharks include gillnets and longlines, as well as handlines and purse seine.

The majority of fisheries landing sharks in Indonesia are classified as small-scale (<10GT). However, the small-scale sector is not necessarily the largest in terms of total production. Due to significantly larger capacity and more consistent fishing effort, the commercial sector likely constitutes a major proportion of total production even from a smaller absolute number of fisheries/vessels. Commercial fisheries landing sharks predominantly operate from East Java, Jakarta and North Maluku, while small-scale fisheries are centred around South Sulawesi, Maluku and East Nusa Tenggara.

In terms of targeting, the majority of shark fisheries are considered 'incidental', with sharks caught and retained as valuable secondary catch in non-target or mixed species fisheries. This includes large pelagic fisheries such as tuna fisheries, small pelagic fisheries such as sardine and mackerel fisheries, through to demersal fisheries for shrimp. Available government data from 2007 to 2016 shows that shark and ray catch contributes an average of 5-6% of total catch landed in Indonesia, for incidental fisheries for which data is available (MMAF, 2016). Comparing with tuna fisheries in several landing sites, it is estimated that shark bycatch forms about 11% of landings from tuna fisheries in Indonesia (Blaber et al., 2009), while other studies estimate shark by-catch rates from as little as 1.3% (Novianto et al, 2014) to as high as 72% (Zainudin, 2011). Clearly this infers that by-catch rates are highly variable across different sites, fisheries and gear-types.

Several highly targeted shark and ray fisheries also exist in Indonesia. For example, in East Nusa Tenggara Province, some coastal communities specifically target mobulid rays and whale sharks. Other targeted fisheries are spread in several provinces including

Aceh, Java, West Nusa Tenggara, Kalimantan, Sulawesi, and the North Moluccas. These fisheries often use long-lines to target large, high-value pelagic species. In some locations these fisheries are highly seasonal.

Based on Fisheries Management Areas (FMAs), the majority of shark fisheries operate in FMA 573 (Indian Ocean). FMAs 712, 713, 714 and 718 are also frequently used as fishing grounds for catching sharks, with 712 and 718 primarily used by commercial vessels and 573, 714 and 718 primarily used by small-scale vessels (Figure 4.).

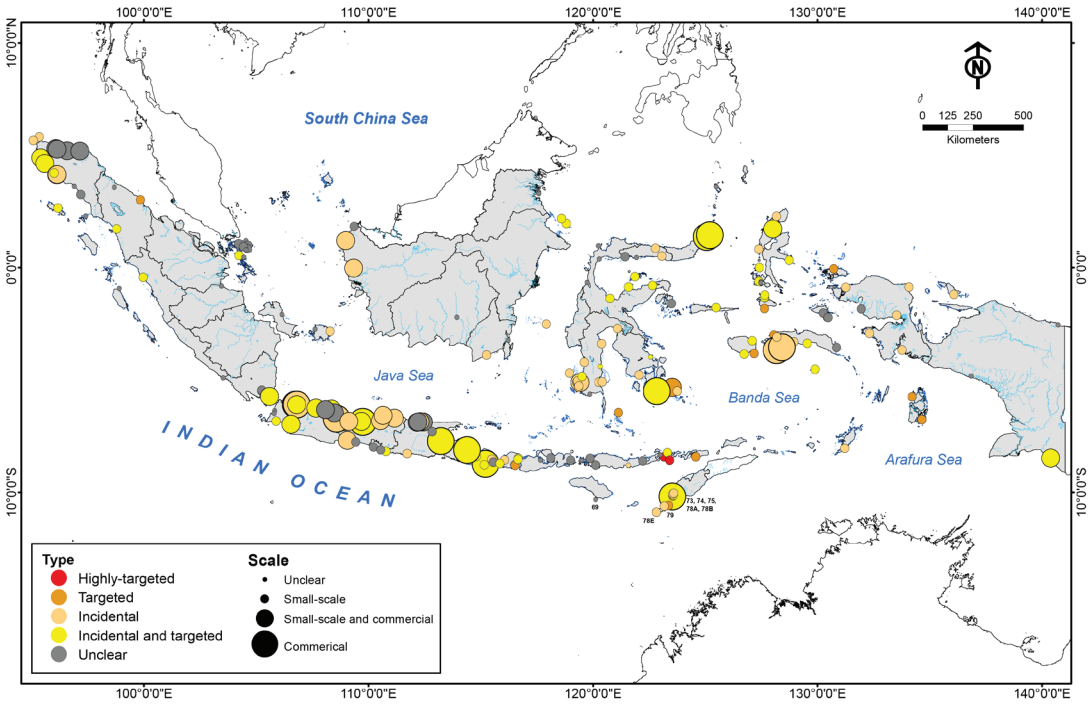


Figure 3. Shark and ray fisheries in Indonesia (Source: Booth et al. 2018).

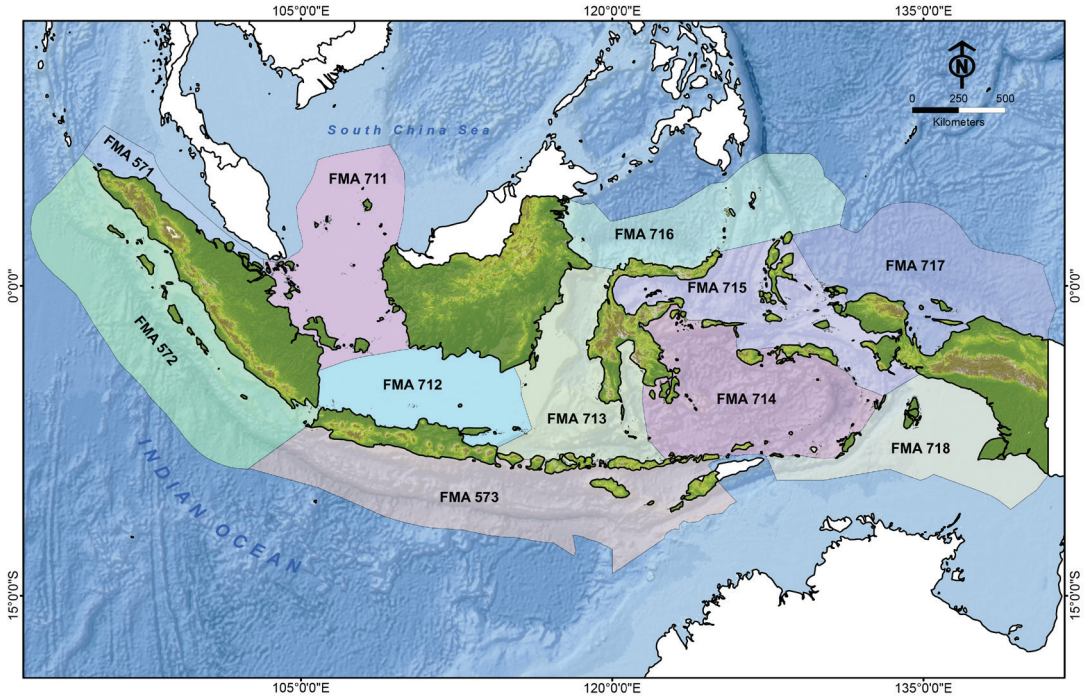


Figure 4. Fisheries Management Areas (FMAs) of Indonesia.

Species

National shark production is not recorded at the species level in Indonesia, therefore, no country-wide species-specific production data is currently available. Based on broad species groupings, as collected by MMAF, requiem sharks (Carcharhinidae) and thresher sharks (Alopidae) have made up the majority of shark production over the past 10 years, contributing 55% and 25%, respectively (Figure 5). Shark production from 2005 to 2014 fluctuated for each species group. Requiem and mackerel sharks have shown overall significantly increasing trends (for requiem sharks from 12,972 tonnes in 2005 to 31,113 tonnes in 2014, and for mackerel sharks from 272 tonnes in 2005 to 704 tonnes in 2015). Of those present groups, thresher sharks (Alopidae) and three species of hammerhead sharks (Sphyrna spp.) are CITES-listed, while CITES-listed silky sharks (*Carcharhinus falciformis)* and oceanic whitetip sharks (*Carcharhinus longimanus)* fall within the broader requiem shark group.

For rays, stingrays have constituted the majority of production over the past ten years, at 69% of total ray production, followed by white-spotted wedgefish (16%) and eagle rays (8%). Ray production for most species has generally increased over time, although white-spotted wedgefish saw dramatic declines between 2005 and 2008. Of these species groups, sawfishes (Pristidae) are listed on CITES Appendix I, while devil (*Mobula spp.*) and manta (*Manta spp.*) rays are CITES Appendix II.

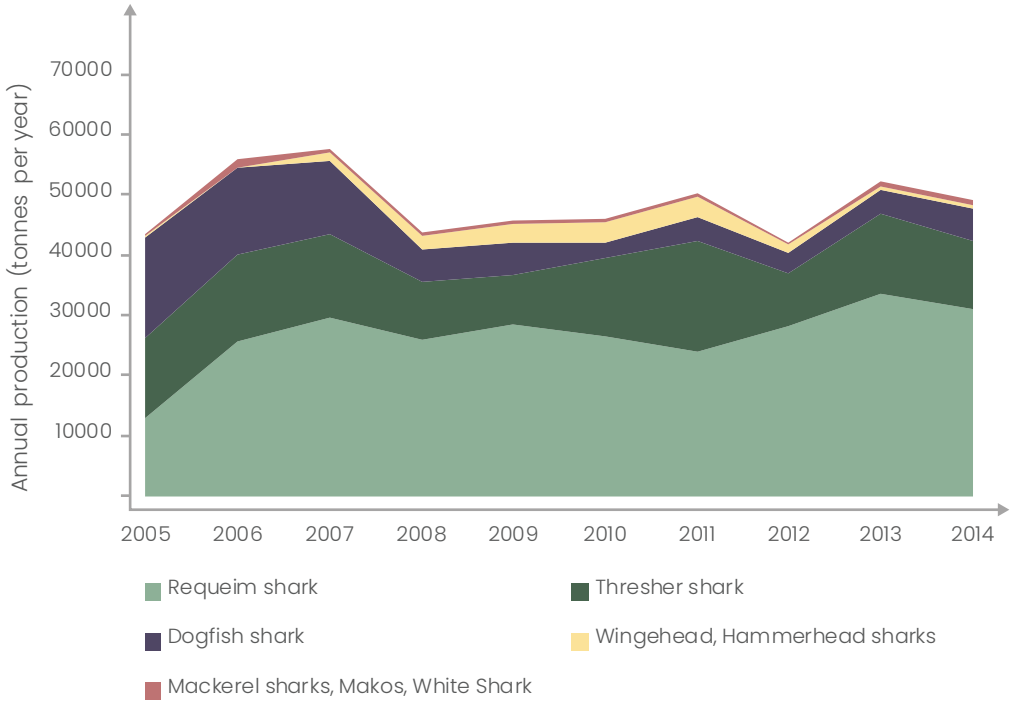


Figure 5. Sharks production in Indonesia by species group 2005-2014 (MMAF, 2016).

Based on available species-specific landing data, requiem sharks (carcharinidae) are the most commonly caught species in targeted long-line fisheries such as Tanjung Luar, Lombok, consisting primarily of silky sharks (*Carcharhinus falciformis)*, blacktip shark *(Carcharinus limbatus*) and hammerhead sharks (*Sphrynea lewini*) (Simeon, et al. 2017). Meanwhile, in by-catch fisheries, blue shark (*Prionace glauca)* and thresher sharks (*Alopias* spp.) are the most prevalent species captured in pelagic tuna longline fisheries operating in the Indian Ocean (Novianto et al., 2014: Fahmi and Dharmadi, 2015).

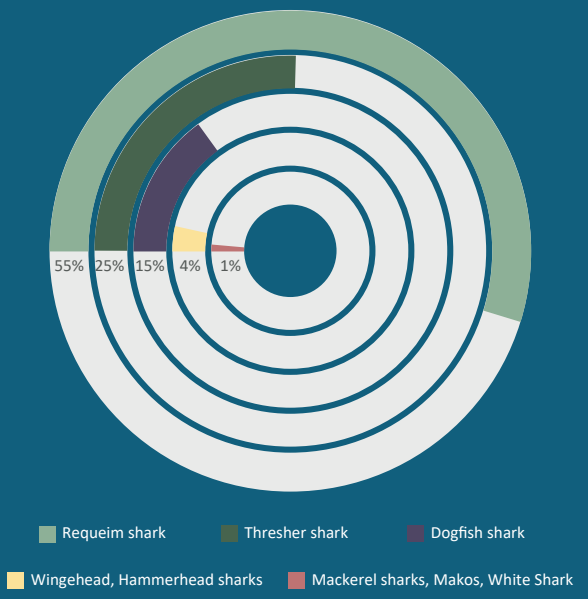


Figure 6. Composition of sharks production in Indonesia by species group 2005-2014 (MMAF, 2016) .

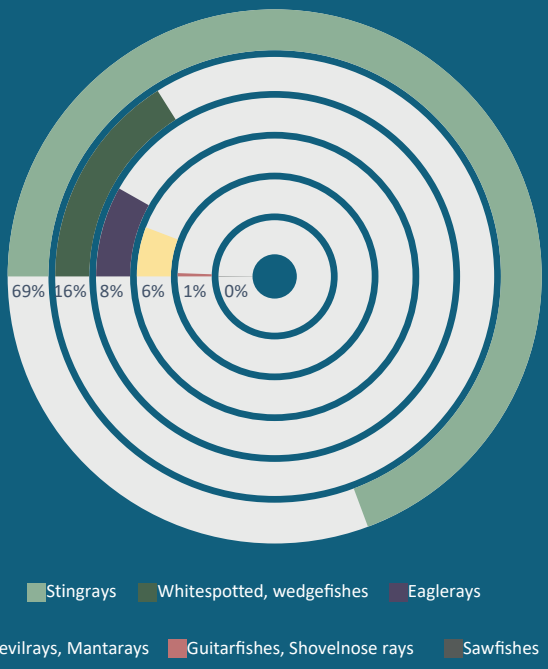


Figure 8. Composition of rays production in Indonesia by species group 2005-2014 (MMAF, 2016).

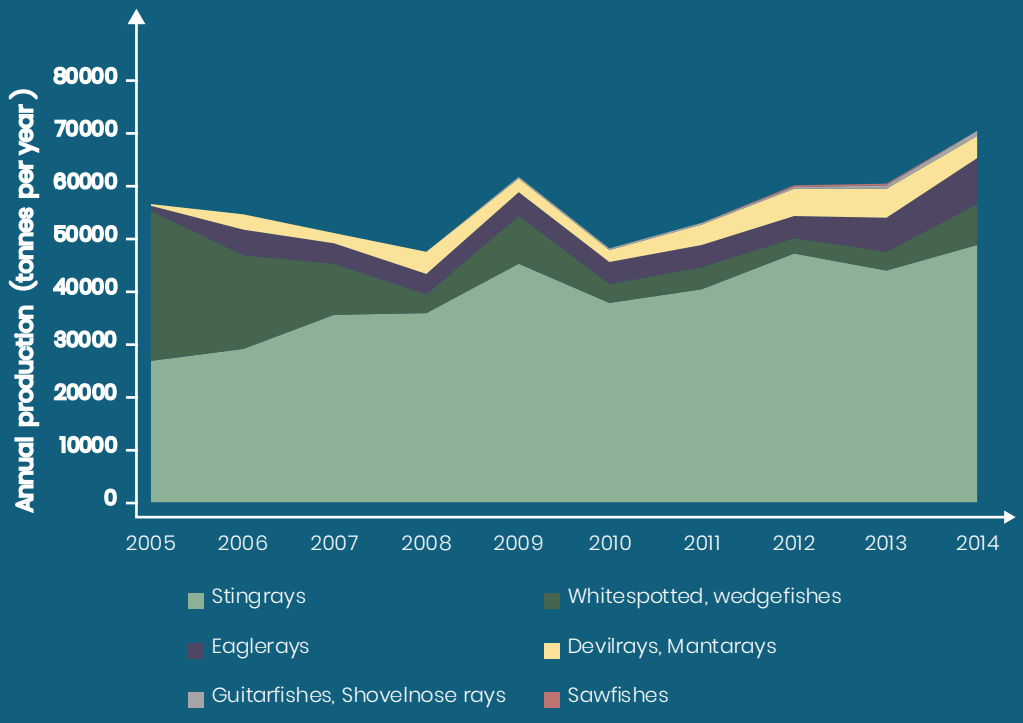


Figure 7. Rays production in Indonesia by species group 2005-2014 (MMAF, 2016).

Products

Based on government fisheries production statistics and estimated fin-to-body weight ratios, we can estimate that roughly 102,090 tonnes of shark and ray non-fin commodities are produced and sold in Indonesia each year (wet weight, see Table 4). Live elasmobranchs are also frequently sold for the aquarium trade, but these figures are not included in MMAF production statistics.

Table 4. Types and uses of elasmobranch non-fin commodities in Indonesia.

Product	Utilization	Primary market(s)
Meat	Food	Domestic (throughout Indonesia) and international
Skin	Food Fashion material	Domestic (throughout Indonesia) Domestic (primarily Jakarta and Jogjakarta) and international export
Liver oil	Medical and food supplements	International export
Cartilage	Medical and food supplements Cosmetics	International export
Gill plates	Traditional supplements	International export
Teeth	Souvenirs	Domestic (primarily Bali) and international export
Offal	Livestock feed	Domestic (Java)
Live shark	Aquarium	Domestic (primarily Jakarta and Bali), international export

Shark frozen

Drying shark teeth in Tanjung Luar

Salted shark meat in Aceh

Raw cartilage

Liver oil in Aceh

Cracker from shark skin

Figure 9. Sharks and rays product trade in Indonesia.

Trade

International exports

Volume

Of the approximately 120,000 tonnes of sharks and rays landed in Indonesia each year, annual export volumes are recorded at between 2,000 - 4,000 tonnes per year (MMAF 2016; ComTrade, 2017, AFQQI's 2016). Of this, approximately 10% by volume comprises shark fins, while the remainder are other non-fin frozen and chilled sharks and rays (Booth et al. 2018, Figure 10, Figure 11). Based on these data, we estimate that Indonesia exports a total of 1,800 - 3,600 tonnes of non-fin commodities per year. These volumes appear to have spiked in 2015, although this is also associated with a change in Indonesia's customs codes, and may therefore be attributed to a change in monitoring or recording methods as opposed to a real change (Figure 11).

Products

In current export data recording systems, non-fin commodities are not specified at the product level. According to ComTrade data, these non-fin commodities consist of 'shark, frozen'; 'shark, chilled', 'rays, frozen', and 'rays, chilled', as based on international Harmonized System (HS) classifications. Over the past 5 years, these non-fin products have made up on average 89% (+/- 4%) of total elasmobranch exports, by volume. The largest product category by volume is 'sharks, frozen' (Figure 11), although records of chilled and frozen ray exports increased considerably to make up more than 30% of export volumes in 2015 and 2016 (Figure 11).

Some non-fin elasmobranch products may also be recorded under general fish HS codes, as opposed to shark-specific codes, and are therefore missing from these records. For example, shark liver oil is often put under the same category as other fish oil products (Blaber, 2006). As such, it is difficult to obtain accurate data on export volumes of specific non-fin products. Based on observations in export facilities, we believe that 'frozen and chilled sharks and rays' primarily consists of meat products, while other more specialised commodities such as teeth, mobulid gill plates and liver oil are recorded under different codes.

Data from quarantine (AFQQI) provides additional information on non-meat commodities. This data indicates a significant increase of export in sharks and rays

products from 2014 – 2016, especially for shark cartilage (Figure 10). It should be noted that some categories of product are quite challenging to summarise due to unclear classification, such as sharks skin and rays skin that are mixed up with fin products (Figure 10).

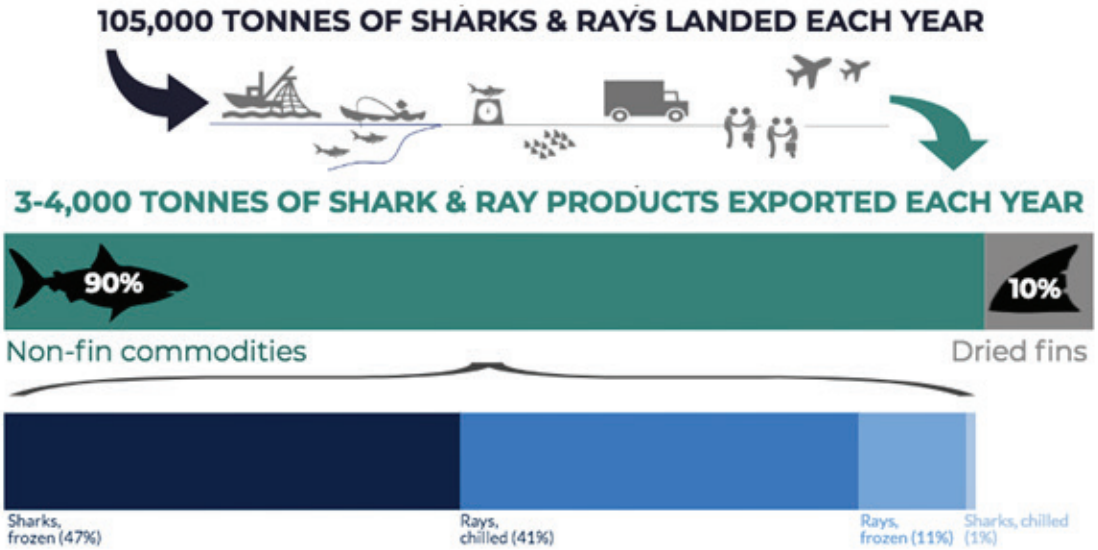


Figure 10. Sharks and rays annual export composition from Indonesia (MMAF, 2016; ComTrade, 2017).

All commodities, b) different types of non-fin commodities (MMAF, 2016; ComTrade, 2017).

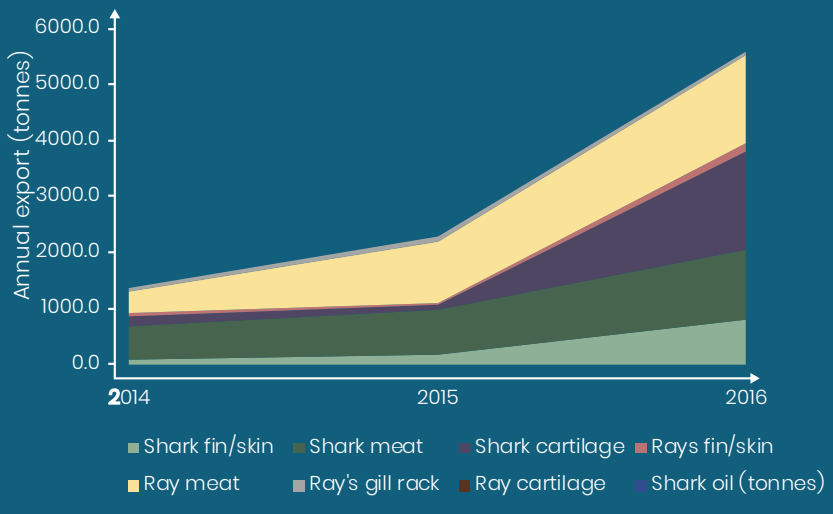


Figure 12. Trend of export for non-fin commodities from 2014-2016 (AFQQI's, 2017).

Value

Based on ComTrade data, export values (USD/kg) of 'chilled and frozen sharks and rays' average at just US$1.38 per kg, and bring in a total value of approximately US$ 20,803,273 annually. These values have remained relatively stable during the past five years. Therefore, despite making up 90% of the shark export market by volume, non-fin commodities contribute only 46% of total export value (Figure 13).

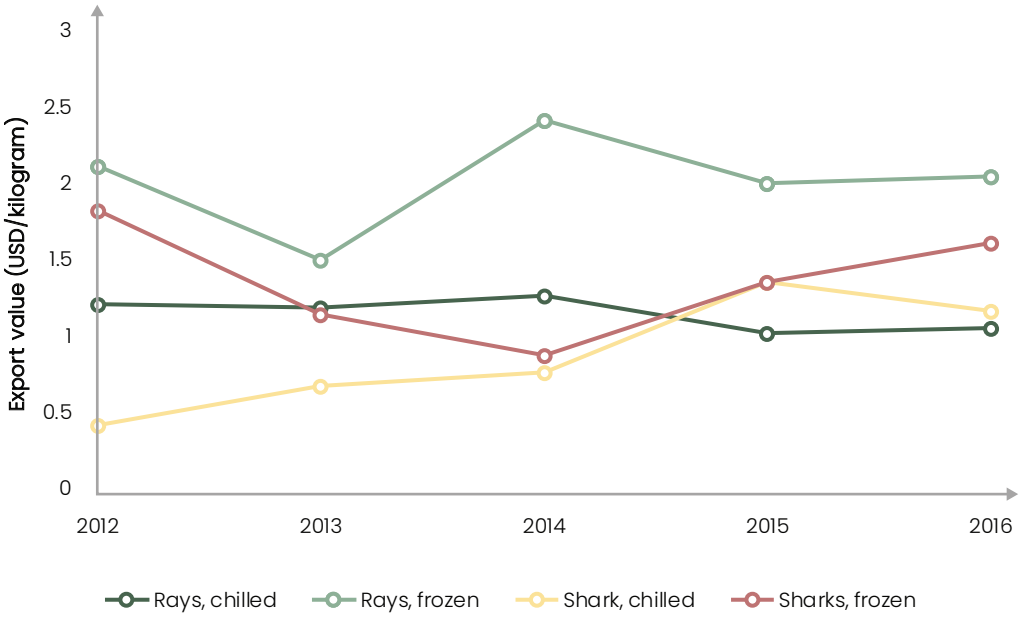


Figure 13. Export value of sharks and rays non fins product (MMAF, 2016; ComTrade, 2017).

It should be noted that mobulid gill plates fetch between 200-400 USD/kg at international markets in China, Hong Kong and Singapore (O'Malley et al 2016). Gill plates are of the most valuable non-fin elasmobranch commodities, and are likely not captured under the ComTrade statistics herein.

Destinations

Export destination countries are varied and spread across Asia, Europe, Australia and America (Figure 14). According to customs and ComTrade data, the largest importing countries of non-fin commodities from Indonesia are within Asia, particularly Malaysia, China, Hong Kong and South Korea (Figure 14).

The trade chains for these products - from fishers to export markets - are diffuse and fragmented, with different pathways for different products. At the local level, products pass through various collectors, processors and traders, depending on the nature and quality of the products, before reaching larger traders in major trading cities. Export commodities usually transit through Jakarta, Surabaya (East Java) and Denpasar (Bali) before being internationally exported from one of five major exit ports in four cities: Tanjung Priok seaport and Soekarno-Hatta airport in Jakarta; Pangkal Balam seaport in Bangka, Bangka-Belitung; Tanjung Emas seaport in Semarang, Central Java; and Tanjung Perak seaport in Surabaya, East Java. Most shark and ray products (68%) leave the country via Tanjung Priok seaport, although Tanjung Perak in Surabaya handle the largest share of shark fin exports (33%) (figure 14). According to customs data from October 2016 – March 2017, just 10 companies are responsible for handling 97% of the non-fin commodity exports through these ports.

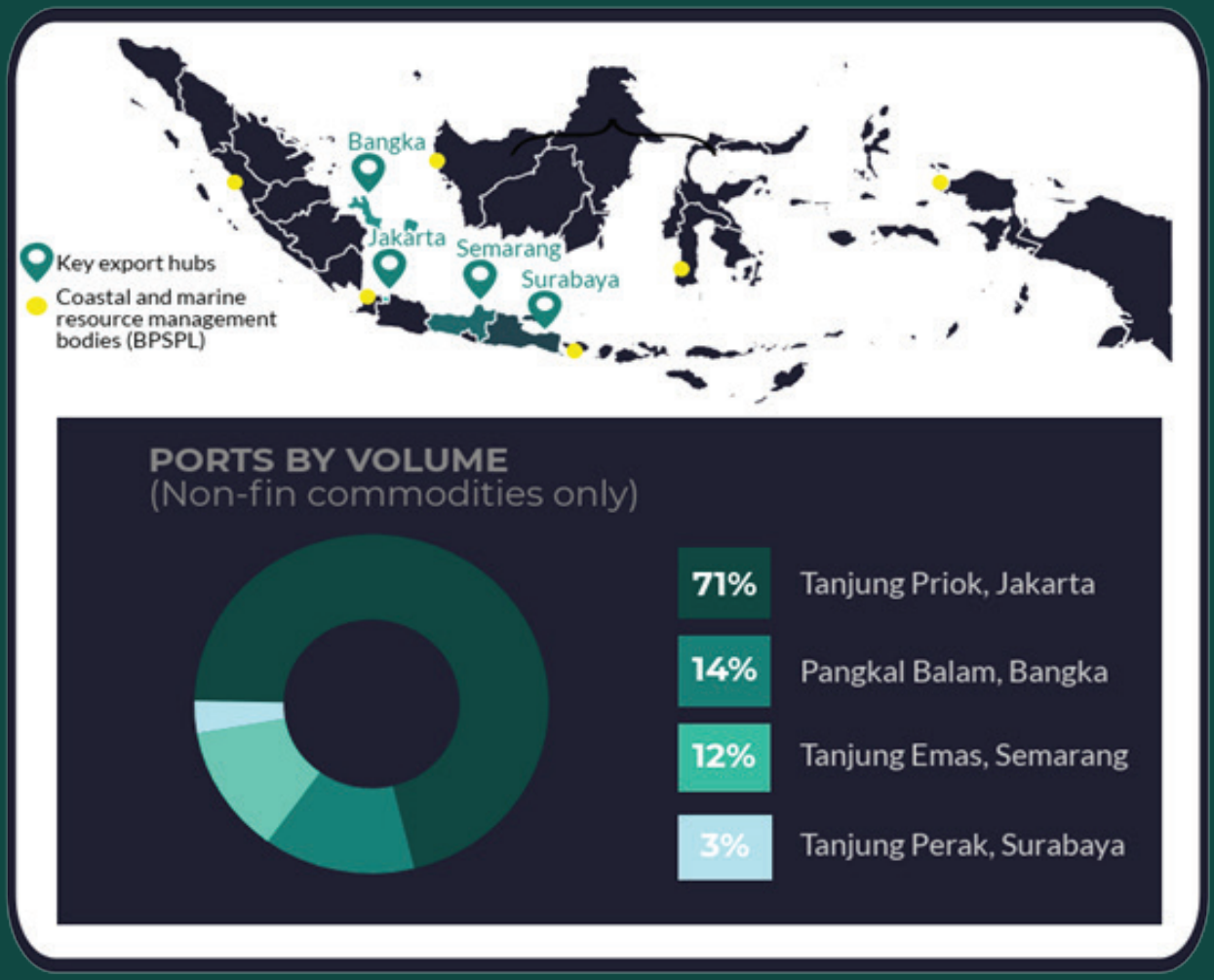
According to data from AFQQI's technical units, exports of live sharks and rays are mainly shipped to 5 countries: China, Hong Kong and Singapore, Malaysia and the United States. The data showed an increase of demands for live shark and ray within 2014-2016, before dropping significantly in 2017. AFQQI's data on shark liver oil indicates it is mainly shipped to Japan and New Zealand.

Figure 14. International export destinations for non-fin commodities.

Table 5. Volume and value of non-fin commodities (frozen and non-frozen sharks and rays) for top 10 export destination, 2012 – 2016.

	Volume (tonnes)						Value ($US)					
	2012	2013	2014	2015	2016	Total	2012	2013	2014	2015	2016	Total
Malaysia	789	1,122	1,152	1,146	891	5,100	972,246	1,373,224	1,492,799	1,181,545	901,110	5,920,924
China	126	327	899	1,239	1,081	3,672	153,540	251,936	662,449	1,587,633	1,364,588	4,020,146
Rep. of Korea	50	34	50	372	475	979	108,683	52,358	122,785	648,651	1,054,812	1,987,289
Other Asia, nes	126	311	81	210	102	830	86,264	156,653	47,584	204,494	198,635	693,630
Thailand	222	148	27	28	25	449	469,558	340,213	21,608	210,616	18,250	1,060,245
Viet Nam	132	2	-	127	-	261	146,490	2,026	-	120,275	-	268,791
China, Hong Kong SAR	90	1	31	51	63	235	287,951	2,440	80,860	347,576	389,179	1,108,006
Russian Federation	98	16	-	25	25	163	190,586	33,595	-	34,661	33,638	292,480
Singapore	8	9	1	50	54	121	12,299	38,896	2,074	158,310	203,841	415,420
Algeria	22	-	88	-	-	110	34,863	-	196,574	-	-	231,437

4 KEY TRADING HUBS



10 IMPORTING COUNTRIES

Figure 15. Summary of shark and rays export in Indonesia (Source: Customs, ComTrade 2017).

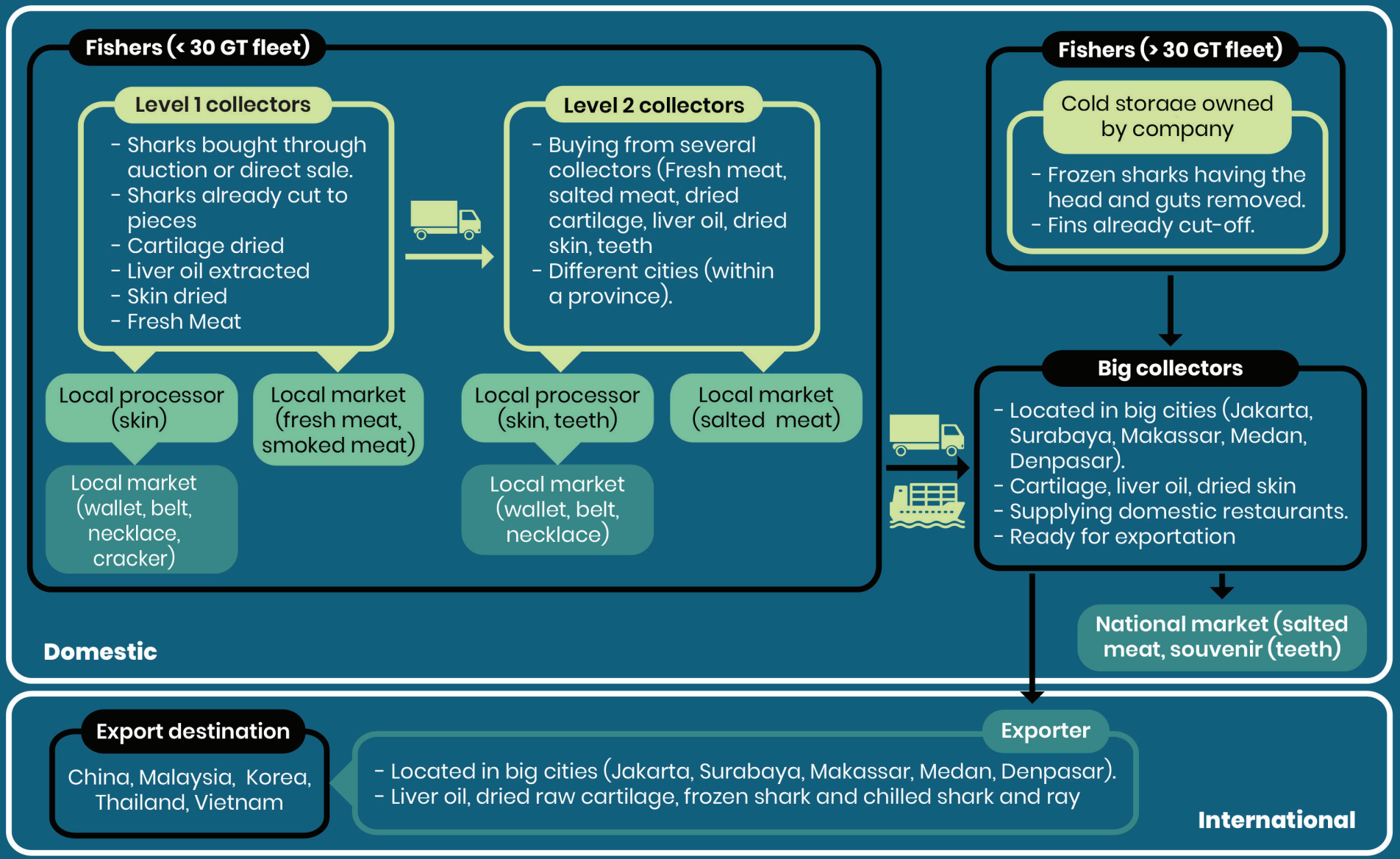


Figure 16. General pattern of trade in non-fin commodities – domestic and international export.

Species

All shark and ray products that are traded domestically and internationally are checked by MMAF technical units (BPSPL) in trader warehouses before the products are transferred to other provinces or internationally exported. According to verification data from BPSPL around 67% of products could not be specifically identified both in terms of species and volume due to a mixtures of products and species shipped together in one package, and challenges with visual ID and morphological similarity of different species, particularly for non-fin products. Several shark and ray species, though, were identifiable due to their unique characteristics. These include hammerhead sharks (*Sphyrna spp.*), zebra shark (*Stegostoma fasciatum*), blue shark (*Prionace glauca*) and several groups of rays including shovelnose rays (*Rhinchobatus australiae* and *Rhinobatus* spp.) and whiptail stingrays (Dasyatis spp).

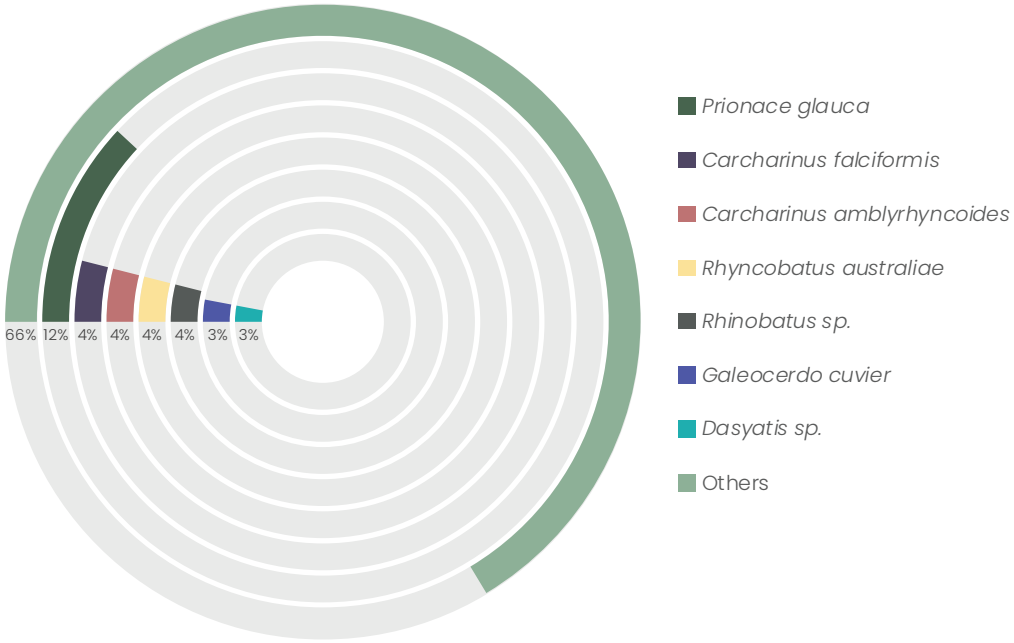


Figure 17. Composition of sharks and rays exported from Indonesia by group names and species. (Source: data unpublish MMAF, 2017)

Results of pilot genetic sampling of shark products in trade from Benoa, Bali and Muara Baru, Jakarta (WCS unpublished data), found that 15 out of 54 sampled products (27%) were CITES-listed species, with bigeye thresher (*Alopias superciliosus*), scalloped hammerhead (*Sphyrna lewini*) and silky shark (*Carcharhinus falciformis*) within the top six most frequently recorded species. (WCS unpublished data). Other frequently detected species included blue shark (*Prionace glauca*), graceful shark (*Carcharhinus amblythynchoides*), spot-tail shark (*Carcharhinus sorrah*) and several species of reef shark.

Coupling this with results from previous genetic testing studies on Indonesia's shark trade (e.g. Sembiring et al. 2014) and landings data from major ports (e.g. Simeon et al. 2017) indicates that CITES-listed species are likely make up at least 30% of products in export trade. Extrapolating based on total annual export figures from ComTrade, this could be a total volume of least 1,000 tonnes per year, and likely more given biases and uncertainties in available data. In particular, this is likely to be exacerbated for non-fin commodities, where species identification is much more challenging due to a lack of defining visual features.

Domestic trade

Volume

There is limited data available on the magnitude of domestic trade of non-fin commodities in Indonesia, as there are currently no well-established monitoring systems for this. Of the ~102,000 tonnes of shark and ray non-fin wet commodities produced in Indonesia per year, the annual recorded export volume for sharks/rays frozen/chilled is around 2,400 tonnes per year (ComTrade data, 2012-2016 5-year average). Acknowledging that no export statistics are available for skin and cartilage (12,000 tonnes annual production), and assuming that all offal is used in-country (5,000 tonnes annual production), and all mobulid gills are exported (163 tonnes), we can infer that the total volume of Indonesia's domestic market is in the region of 87,000 tonnes (wet weight, Table 6). The majority of this export volume is shark products, while national production of sharks and rays is relatively similar. Therefore, it can also be inferred that the domestic consumption of rays is quite high, compared to that of sharks. (Figures 10 and 11).

Table 6. Estimated annual utilisation of non-fin commodities in Indonesia.

Product	Estimated total annual volume produced (tonnes, wet)	Estimated annual exports (tonnes)	Estimated total volume utilised in-country (tonnes, wet)
SHARKS			
Meat	29,147	1,163	27,984
Skin & cartilage	12,144	No Data	Unclear
Offal (head & innards)	4,858	0	4,858
Oil	Unclear	Unclear	Unclear
RAYS			
Meat	55,778	1,263	54,515
Gills (Mobulid)	163	163	0
Total	102,090	2,589	87,357

Products

There are several categories of domestic utilisation of elasmobranch non-fin commodities in Indonesia: consumption for food (meat and skin), fashion materials (skin), livestock feed (offal) and souvenirs (teeth).

The largest market is for meat, with products sold frozen; partially prepared (e.g. dried, salted and steamed); or cooked and prepared in local dishes (e.g. curry, meatball). These products are marketed both domestically and internationally.

Shark and ray skin is eaten in some areas. Low quality and smaller pieces of skin are processed in to crackers, which are sold in local markets in close proximity to landing sites or processing unit. Shark and ray skin is also used as 'leather' for fashion materials, and is becoming increasingly popular, especially with the growth of online markets over the past five years. Shark and ray leather products are most commonly found in East Lombok and Yogyakarta, as well as Bali; Jakarta; Sidoarjo and Surabaya (East Java); and Boyolali (Central Java). They are usually processed in to fashion items such as wallets, bags, bracelets, buckles and shoes. Tiger shark, hammerhead shark, zebra

shark, wedgefishes, guitarfishes and whiprays are most often used to manufacture these goods.

Shark teeth and jaws are also sold domestically as a souvenirs in traditional art or fashion jewellery stores. Traditional art usually use preserved shark teeth and jaws in bottles, as a souvenir in local areas, while necklaces made from shark teeth are mostly marketed online or in Bali to local and foreign tourists.

Other domestic uses of shark and ray products are fertilizer and fishmeal, which is made from waste products of liver oil extraction.

Value

According to the data form AFQQI, the value of shark and ray non-fin domestic products in Indonesia during 2014-2016 reached over USD 10,000,000 (Figure 18). "Rays" provided the highest value at USD 7,224,153, with "shark" at USD 2,921,290 and "shark liver oil" at USD 796,829 over three years. These values have increased each year, five-fold from 2014 to 2015, and doubling again in 2015 to 2016. (Figure 20).

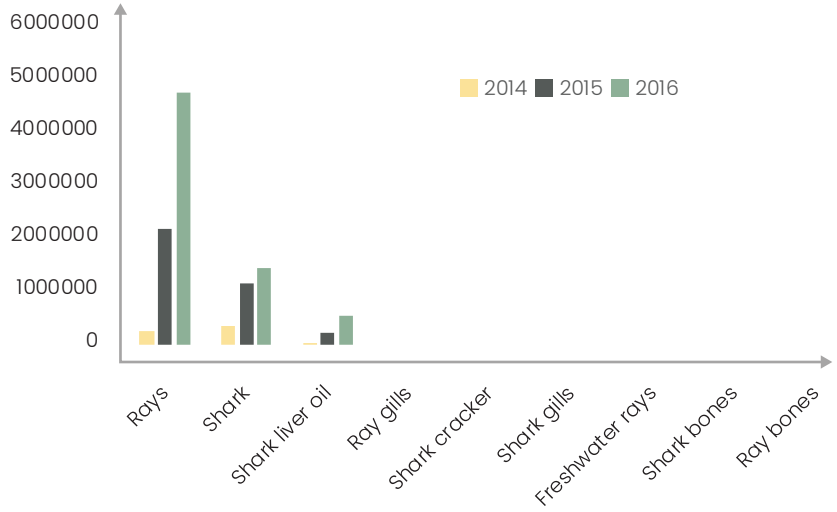


Figure 18. Domestic Market Value of Non-Fin Shark and ray product in Indonesia between 2014-2016 (Source: AFQQI's).

Trade patterns

Domestic trade chains for non-fin elasmobranch products in Indonesia are complex, and inter-related with international export and fin trade. Products are traded locally (i.e. within the same province they are caught), and nationally (i.e. between provinces), and the final market destination and associated trade routes vary across fisheries, provinces and products.

Elasmobranch products originating from <30 GT vessels are usually sold through an auction process to a level one collector in the port (although this is not always the case in some provinces, such as Aceh, see Section 4.1). Following the auctions, level 1 collectors conduct primary processing (i.e. removing the head and cleaning). Further processing usually takes place in local processing centres, run by small and medium scale enterprises (MSMEs) located nearby landing sites. After primary processing, some meat may be sold locally, within markets nearby the port, for household consumption or for preparation and sale in local food retailers. Fresh shark meat for local markets is processed in a variety of methods depending on local preferences, and may be sold raw, baked, smoked, steamed or dried and salted. Shark meat is also processed into

local delicacies such as ***abon*** (fish floss), ***dendeng*** (jerky), meatballs, ***otak-otak*** (grilled fish cake) and fish crackers.

Products that are not consumed locally, such as liver oil, skin, cartilage and any remaining meat (usually salted and dried), are sold to level 2 collectors to be marketed in big cities. In general, these level 2 collectors aggregate products from several level 1 collectors in various coastal cities located within a province, and trade them onwards to domestic consumption centres and/or export hubs in big cities such as Jakarta, Surabaya and Medan.

Products originating from > 30 GT industrial vessels are usually transported directly to refrigeration facilities owned by the vessel owners or private entities, before being sold directly to level 2 collectors. These products are then also sent to big cities in Java, such as Jakarta and Surabaya.

Domestic trade in shark and ray products is influenced by the level of local consumption. If the production of shark products exceeds local demands, products are aggregated and marketed to big cities. The destination city depends on the location of the fishing port. In Sumatra, shark products from the West Coast that are not absorbed by local markets are aggregated in Banda Aceh before being shipped to Medan, while in Lampung and Bangka Belitung, products that are not absorbed by local markets are sent to Java. The trade chain in Java is complex because the island has its own shark-producing regions such as Banten, Jakarta and cities in the North Coast of Java. In addition to being producers, cities in Java, such as Jakarta, Semarang and Surabaya are also known as the largest collectors of sharks and rays both from Java and other islands such as Kalimantan, Sulawesi, West Nusa Tenggara, East Nusa Tenggara, Maluku and Papua. Meat products are marketed in local restaurants (***warungs***) or supermarkets, while the skin is made into fashion items such as bags and wallets.

Consumption

There is considerable qualitative and anecdotal evidence of domestic consumption of shark products in Indonesia, but limited quantitative data on the magnitude of the domestic market. Available information suggests that there are at least three types of consumers of shark and ray products in Indonesia, depending on the product, geography and demographic group. Broadly, these groups are: luxury consumers, traditional consumers and passive consumers. Total volumes and values of these market segments are still not well understood. Several regions in Indonesia were identified as centres of traditional and passive shark and ray product consumption, based on anecdotal information and expert opinion (figure 20).

Regions with traditional consumption are usually located in coastal areas, and associated with shark fisheries. In these areas, shark meat provides a source of cheap, readily available animal protein and micronutrients, and therefore plays a role in food security. In some locations, shark consumption may be a tradition passed down through generations, with local beliefs relating to health and wellness benefits, or taste preferences. Passive consumption occurs in areas further from the coast, where people generally consume shark meat in salted or fillet form. In these cases shark is marketed as generic fish (often salted fish, ***ikan asin***), and people are not aware of the species of origin.

Based on anecdotal information and semi-structured interviews with traders, the regions with the highest levels of shark consumption in Indonesia are Java, Aceh and

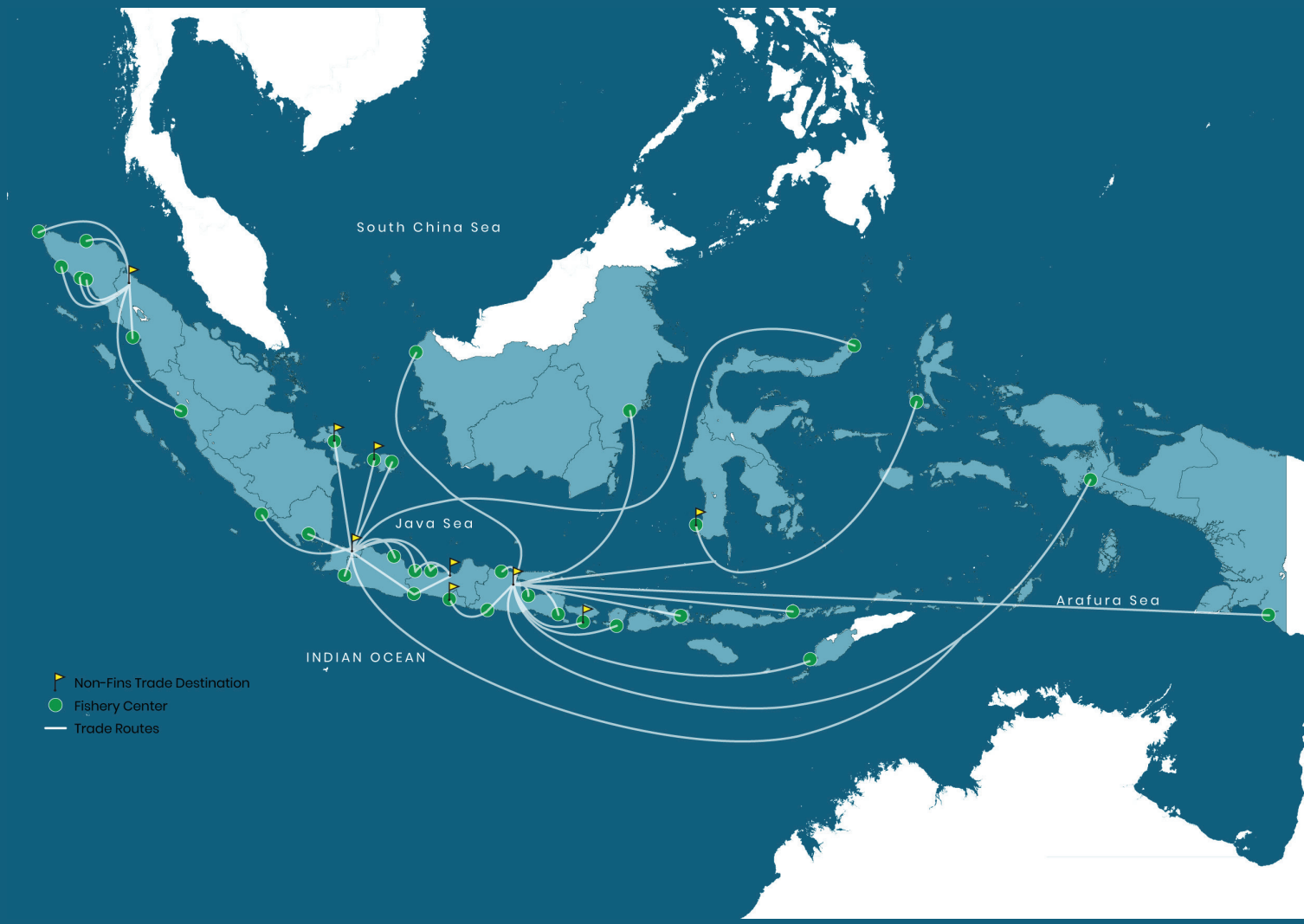


Figure 19. Trade chain for domestic trade in non-fin shark commodities in Indonesia.

Figure 20. Shark and ray consumption distribution with categories (Source: Booth et al. 2018).

West Nusa Tenggara (specifically Lombok island). Other regions such as Kalimantan, East Nusa Tenggara, and Papua were also identified as shark consuming regions, albeit in lower volumes. The type of shark consumption in these regions is dominated by traditional consumption of various meat products (Table 7).

Table 7. Summary of know shark consumption hotspots in Indonesia, based on anecdotal data (Source: Booth et al. 2018).

Type of consumption	Province	Known hotspots	Product(s)
Traditional	West Nusa Tenggara	East Lombok	Dumplings, salted fish, smoked meat, crackers (made from skin)
	West Kalimantan	Pontianak	Salted fish, smoked fish
	East Kalimantan	Balikpapan	Salted fish
	South Sulawesi	Makassar	Salted fish, smoked fishes
	East Nusa Tenggara	Maumere, Kupang, Solor	Salted fish, smoked fish, mobulid meat
	West Java	Ciamis, Garut, Pangandaran, Ciamis, Cirebon, Indramayu, Bogor, Sukambumi	Salted fishes
	South Kalimantan	Muara Kintap – Tanah Laut	Salted fishes
	Papua	Biak, Sorong, Kaimana	Salted fish, smoked fish
	Banten	Lebak, Tangerang	Salted fish
	Aceh	Banda Aceh, Aceh Besar, Aceh Jaya, Aceh Selatan, Aceh Barat	Traditional curry, salted fish, meatballs
	Central Java	Semarang, Demak, Probolinggo, Lamongan, Pati, Cilacap	Salted fish, smoked fish, meatballs
	East Java	Probolinggo, Muncar, Banyuwangi	Salted fish, smoked fish
Passive	Jakarta	Jakarta	Salted fish
	West Java	Bogor	Salted fish

Management

The types of shark commodities traded in Indonesia are diverse, and the fisheries of origin are spread throughout the coastline. Shark fisheries management remains limited in Indonesia, besides regulations under regional fisheries management organisations (RFMOs), and full species protection status for manta rays, whale sharks and sawfish. International trade bans are also in place for other CITES Appendix II listed species, though efforts to link these to domestic fishing and trade quotas are hampered by data limitations.

Nonetheless, existing systems are in place to check and verify shipments of shark products which are being transported from shark-producing cities to major consumer cities in different provinces. This verification process is conducted by the Coastal and Marine Resources Management Center (BPSPL), a technical unit under the Directorate of Biodiversity Conservation (KKHL) of the Directorate General of Marine Spatial Planning of the Ministry of Marine Affairs and Fisheries (MMAF). There are six BPSPL offices located throughout Indonesia, which are responsible for checking and verification of all shark products that are transferred between provinces or across international borders. At these offices shipments are visually checked to ensure that paperwork is in order and shipments are being accurately reported in terms of species, volume, product type etc. The BPSPL offices are therefore a critical management unit for detecting trade in protected or CITES-listed shark species.

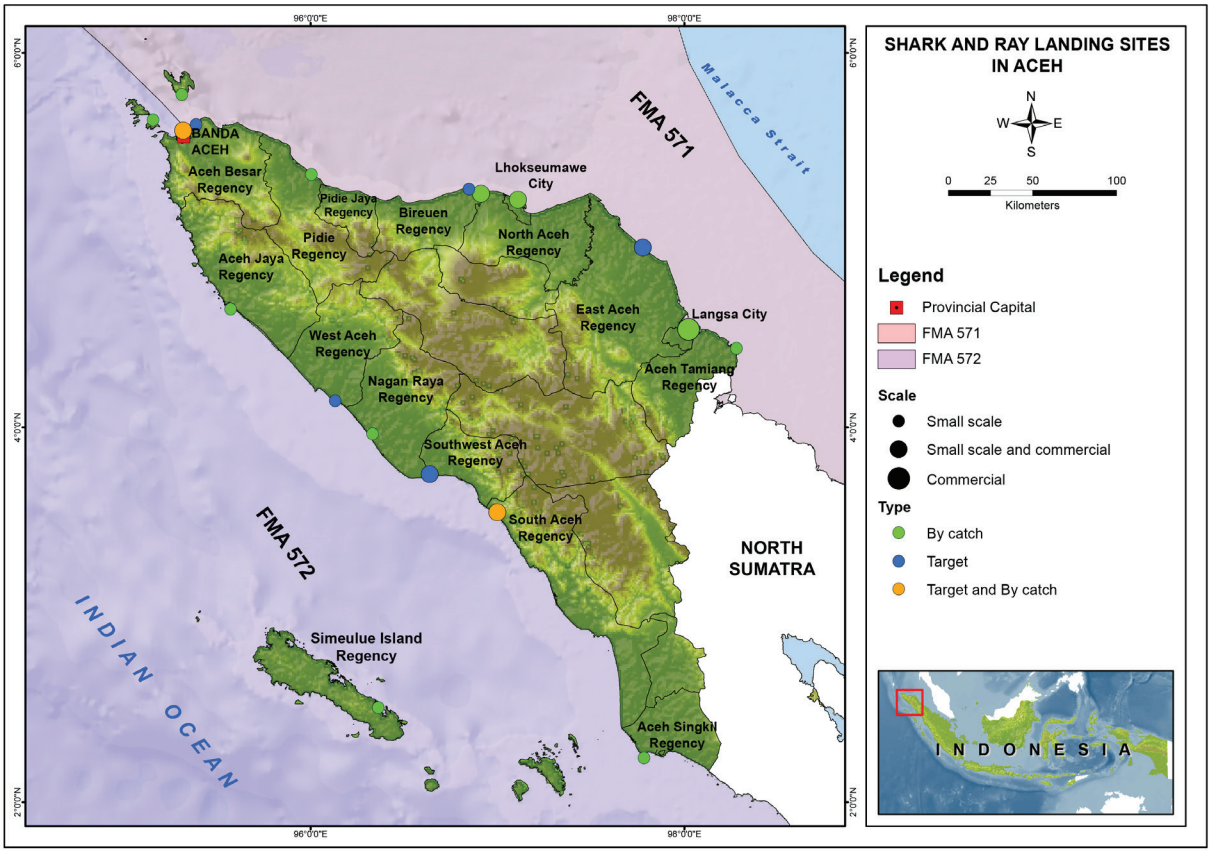
Case study field research

Fishery

Based on field-based observation and data collection conducted in Aceh and West Nusa Tenggara, elasmobranchs are caught across multiple fisheries throughout the coastal areas of each province. Several fleets in both provinces specifically target sharks using longlines, while others take sharks as secondary catch in gillnet, purse seine and handlines. The size of these vessels ranges from small-scale (<10GT) to semi-commercial (<25 GT).

In Aceh, 18 landing sites were identified (Figure 1a), with fishing grounds in the Indian Ocean (FMA 572) for landing sites on the west coast, and in the Malacca Strait (FMA 571) for landing sites on the east coast. Most of these landing sites service a mixture of targeted shark vessels (using longlines) and non-target vessels using purse seine, gillnet, hand line and longlines. The highest production of sharks and rays is found in the west coast, with the districts of South Aceh, West Aceh, Aceh Singkil, Southwest Aceh and Aceh Besar being the biggest contributors. On the east coast, East Aceh, Bireun and Pidie districts are also significant contributors (Figure 21a).

In West Nusa Tenggara 5 landing sites were identified, with catch from the Makassar Strait/Flores Sea/Bali Sea (FMA 713) and the Indian Ocean (FMA 573) (Figure 21b). The largest of these is Tanjung Luar, East Lombok, which is a well-known targeted longline fishery. A small number of vessels also target sharks in Mataram, Lombok (4 vessels) and Bima, Sumbawa (5 vessels). Others catch sharks as secondary valuable catch in gillnets and handlines.



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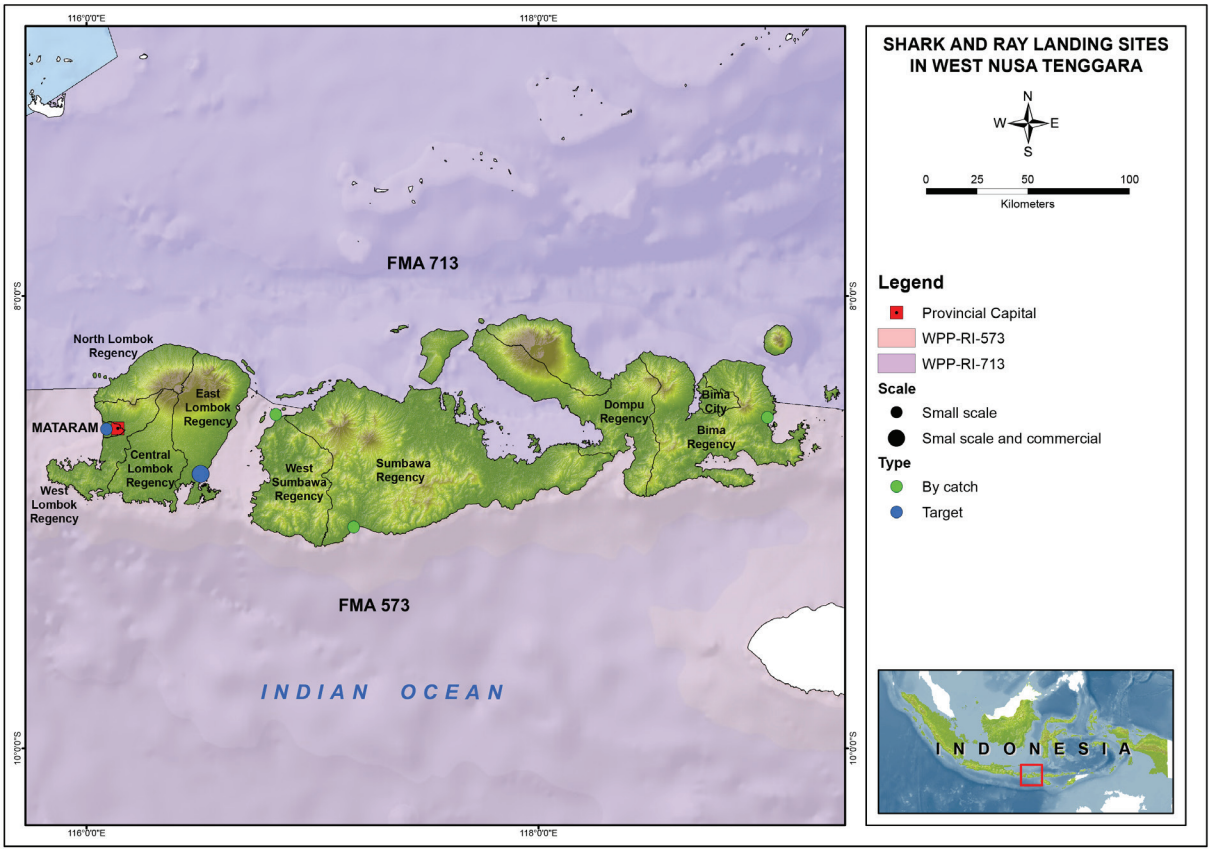

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Figure 21. Shark landing sites in Aceh (a) and West Nusa Tenggara (b).

Local trade and consumption

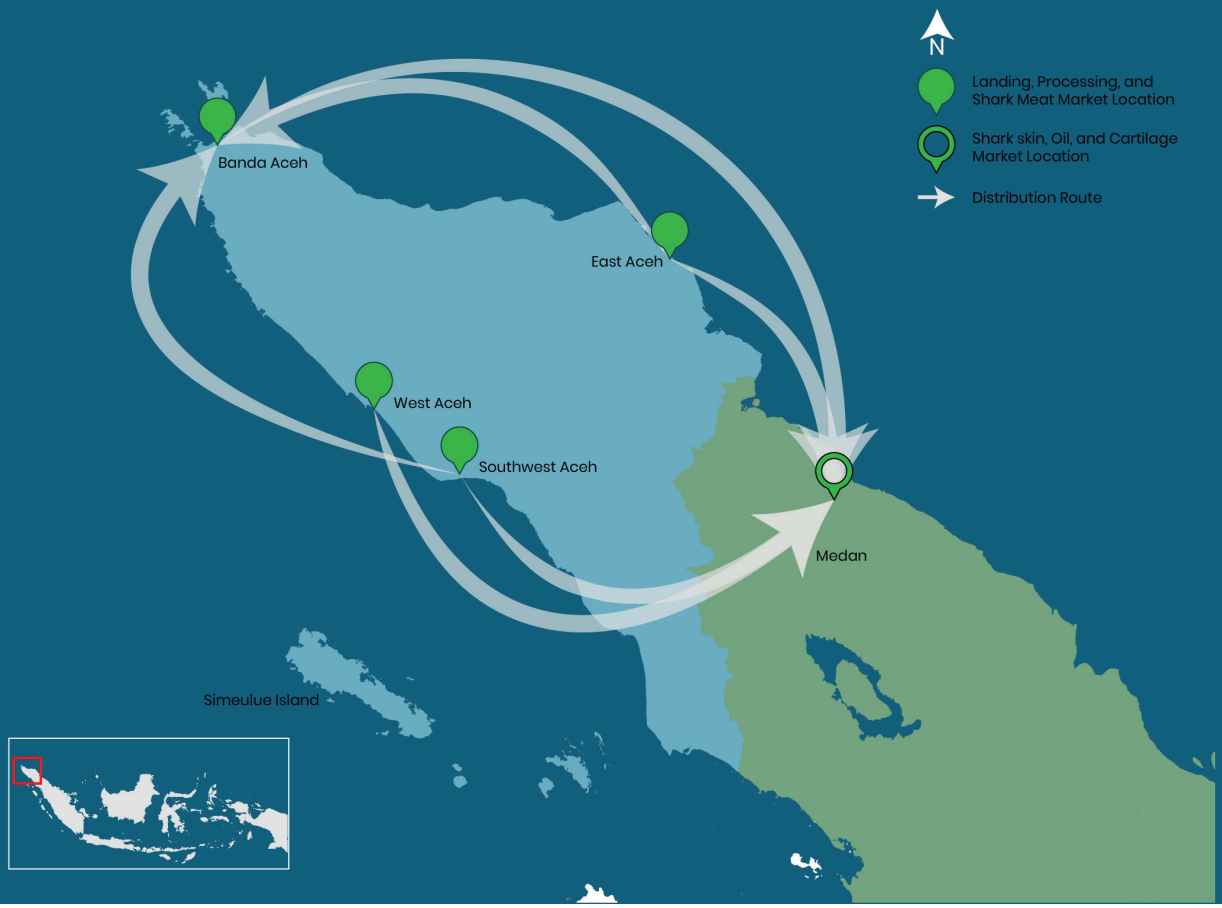
Trade chains for non-fin commodities are diffuse. Following landing, sharks are bought whole, directly from fishers or at auction in the harbour, by a first buyer. Primary processing is carried out by local post-harvest workers, with the sharks dissected in to the constituent commodities: fins, meat, skin, cartilage, liver oil, teeth and offal. All non-fin parts are used, each of which have their own specific buyers, trade chains, derivative products and end consumers at local, domestic and international levels (Figure 22, Table 8). First buyers collect elasmobranchs from fishers throughout each province (records show a total of twelve active first buyers in West Nusa Tenggara and thirteen throughout Aceh), then distribute to local retailers and next level buyers in large cities. Second buyers in big cities tend to be more specialized towards specific products, and sell products on to domestic retailers or exporters. Some of the larger buyers in Medan and Surabaya also act as credit providers for the fishers and/or vessel owners.

Meat is predominantly processed, distributed and consumed locally. It is usually dried, smoked, or salted by local collectors, ready to be made into local dishes such as salted fish, meatballs, shark curry (Aceh specialty) or satay (West Nusa Tenggara specialty). Hotspots of local shark meat consumption are generally spatially associated with nearby shark landing sites (e.g. East Lombok in West Nusa Tenggara), where it is retailed in markets or small restaurants, or larger cities, such as Mataram (the capital of Lombok, West Nusa Tenggara) or Banda Aceh (the capital of Aceh), where it is retailed in traditional restaurants (Figure 23). There are three hotspots of local shark and ray consumption in West Nusa Tenggara and four in Aceh (Figure 23). In both provinces, reported consumer motivations were related to price (low cost), supply (high availability/ easy to find), taste preferences, and perceived health benefits. Indeed, shark meat is one of the cheapest available sources of animal protein in both provinces (Table 8, 11).

Based on interviews with local retailers in four districts, at least 73,000 kg of shark meat is consumed locally per month across Aceh, which brings in an estimated total value of US$ 94,900 – 146,000 per month (Table 9). In West Nusa Tenggara, processors in East Lombok are capable of processing 3,000 kg of sharks and rays in one day during the peak fishing season. Sharks and rays that have been processed are marketed by retailers in traditional markets with volumes reaching 1-2 tonnes per day. Based on interviews, it is estimated that around 24.4 tonnes of shark meat are consumed per month across Lombok (estimated consumption rate of up to 20 tonnes per month in East Lombok, 4 tonnes per month in Mataram and 0.4 tonnes per month in Central Lombok). With prices at IDR 25,000 (US$ 1.70) per kg, this brings in a total value of at least US$ 40,000 per month (Table 9).

Salted meat that is not absorbed by local markets may be transported and retailed more widely to larger domestic markets in major cities such as Medan, North Sumatra or Surabaya, East Java (Table 8). Salted shark meat is also found for sale in markets and supermarkets in other big cities, such as Jakarta and Bogor (West Java), where it is often marketed as generic fish products (i.e. ***ikan asin*** – salted fish). However, it is unclear whether these are sources from fisheries in Aceh and West Nusa Tenggara, or other parts of Indonesia. Other non-fin products - liver oil, cartilage, skin and teeth - are predominantly sold on for trade in big cities (Medan and Surabaya), or for export to key international markets in China, Malaysia, Taiwan, Hong Kong, Singapore etc. (Table 9, Figure 15). Liver oil and cartilage are processed in to beauty products and health

supplements, skin is processed in to clothing and accessories, while teeth are used for souvenirs and jewelry (Table 8). The notable exceptions with regard to local use of these commodities is the skin of juvenile requiem sharks (Carcharhinidae) and some liver oil, which are consumed in West Nusa Tenggara. Skin of juvenile sharks is consumed as food ('crackers') while liver oil may be drank directly or applied to the skin due to perceived health benefits. Offal is also retained locally as livestock feed.



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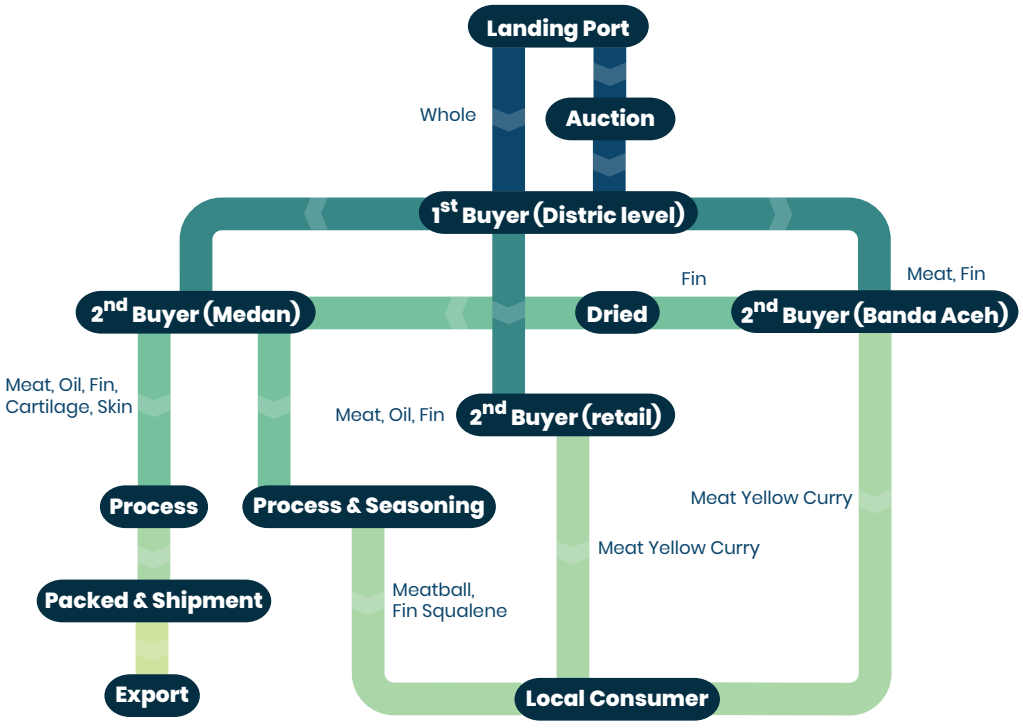

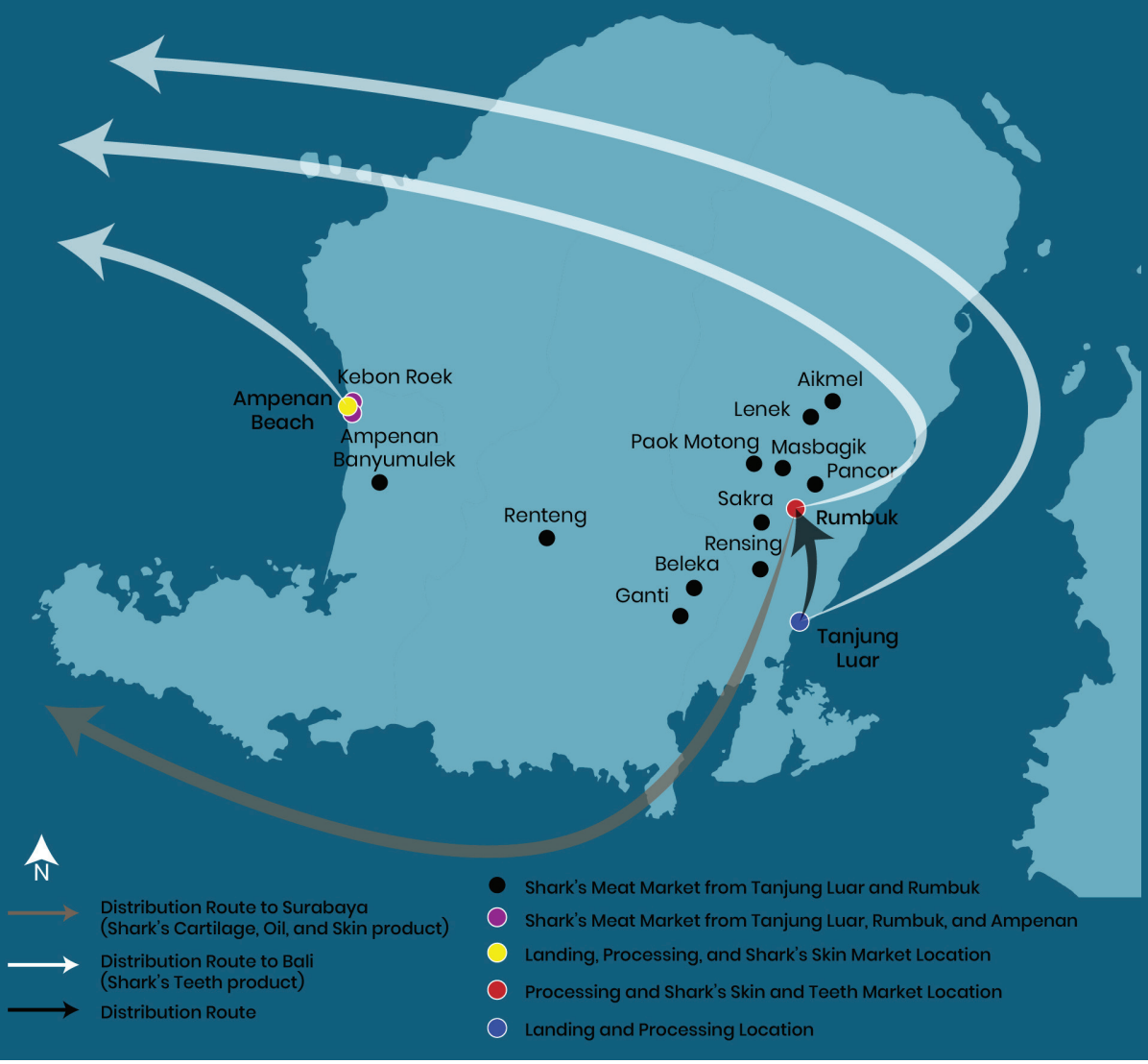

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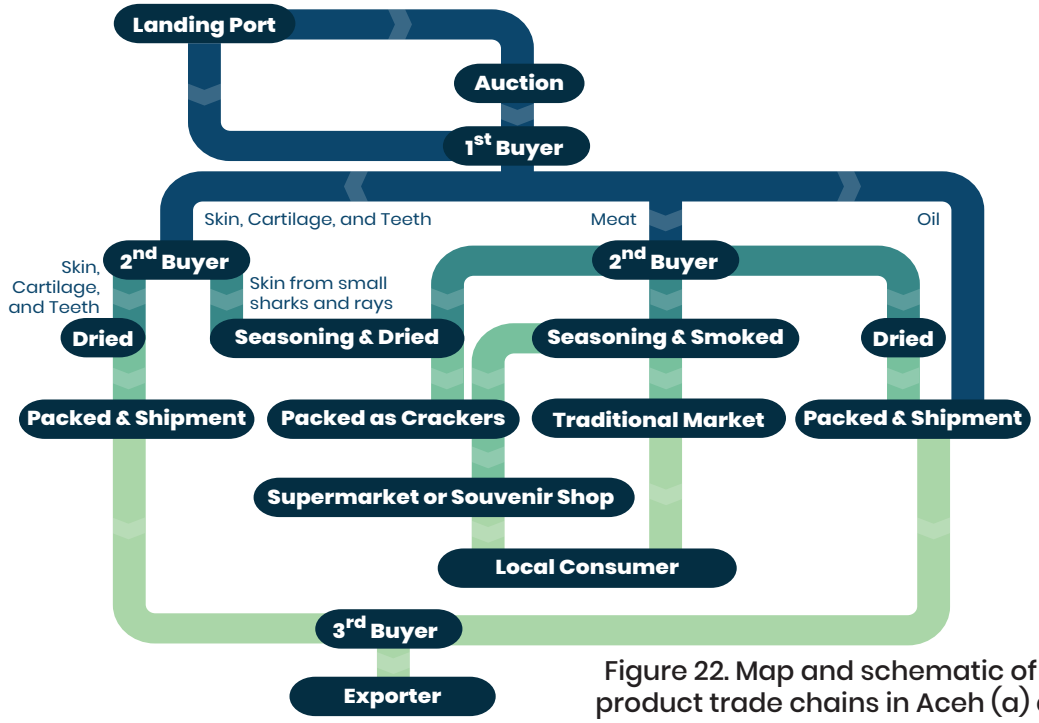


Figure 22. Map and schematic of supply non-fin product trade chains in Aceh (a) and West Nusa Tenggara (b).

Table 8. Summary of non-fin commodities that are produced and sold locally in Aceh and West Nusa Tenggara.

Province	Product	Species	Price (USD @ USD 1 = IDR 15,000)	Derivative product(s)	End consumer		
					Local	Domestic	International
Aceh	Meat	All species	$1.30–2.00/kg	Food: shark curry, meatball	✓	✓ (Medan)	
	Cartilage	All species	$3.30/kg	Beauty product, health supplement		✓ (Medan)	✓ (Singapore, Malaysia)
	Skin	Stegostoma fasciatum, Himantura Fava, H. undulata	$0.60–1.00/Inch^2	Fashion: wallet, belt, shoes		✓ (Medan)	
	Liver Oil	Centrophorus squamosus, Centrophorus isodon, Squalus spp.	$18/l	Beauty product, health supplement		✓ (Medan, Surabaya)	
West Nusa Tenggara	Meat	All species	$1.70/kg	Food: fresh, salted, satay, bakso	✓ (East Lombok, Mataram, Bima, Lunyuk)		✓ (Malaysia, China, Singapore, Vietnam, Japan, Thailand, Russian, Sri Lanka)
	Cartilage	All species	$0.87/kg	Beauty product, health supplement		✓ (Surabaya)	✓ (Thailand, New Zealand, Japan, Hongkong, Singapore)
	Skin	Carcharhinus spp. (juvenile)	$1/kg	Food: crackers	✓ (East Lombok, Mataram)		
		Rhynchobatus australiae, Galecerdo cuvier Carcharhinus sp.	$1.67/kg	Fashion: Jacket, Wallet, Handbag, Bag, Bracelet		✓ (Surabaya)	✓ China, Singapore, Italy, Japan, Hongkong, Thailand, Vietnam, Malaysia
	Liver Oil	Squalidae and Centrophoridae	$6.67/l	Beauty product, health supplement	✓ (East Lombok)	✓ (Surabaya)	✓ (Japan, New Zealand)
	Teeth	Galeocerdo cuvier, Carcharhinus spp.	$13/batch*	Jewellery		✓ (Denpasar)	

*Teeth are sold in large batches, usually with hundreds of teeth mixed together. Exact weight and number is unknown.

Table 9. Estimated volumes and values of local sales of non-fin commodities (fresh meat) in Aceh and West Nusa Tenggara.

Province	District	Est total sales (Kg per month)	Value per kg (USD)	Est total value (USD per month)
Aceh	Banda Aceh	54,000	1.30-2.00	70,200 – 108,000
	Aceh Barat	10,500		13,650 – 21,000
	Southwest Aceh	8,500		11,050 – 17,000
	Aceh Timur	Unclear		Unclear
	TOTAL	73,000		94,900 – 146,000
West Nusa Tenggara	East Lombok	20,000	1.70	34,000
	Central Lombok	400		680
	Mataram	4,000		6,800
	TOTAL	24,400		41,480
	GRAND TOTAL	97,400		136,380 – 187,480

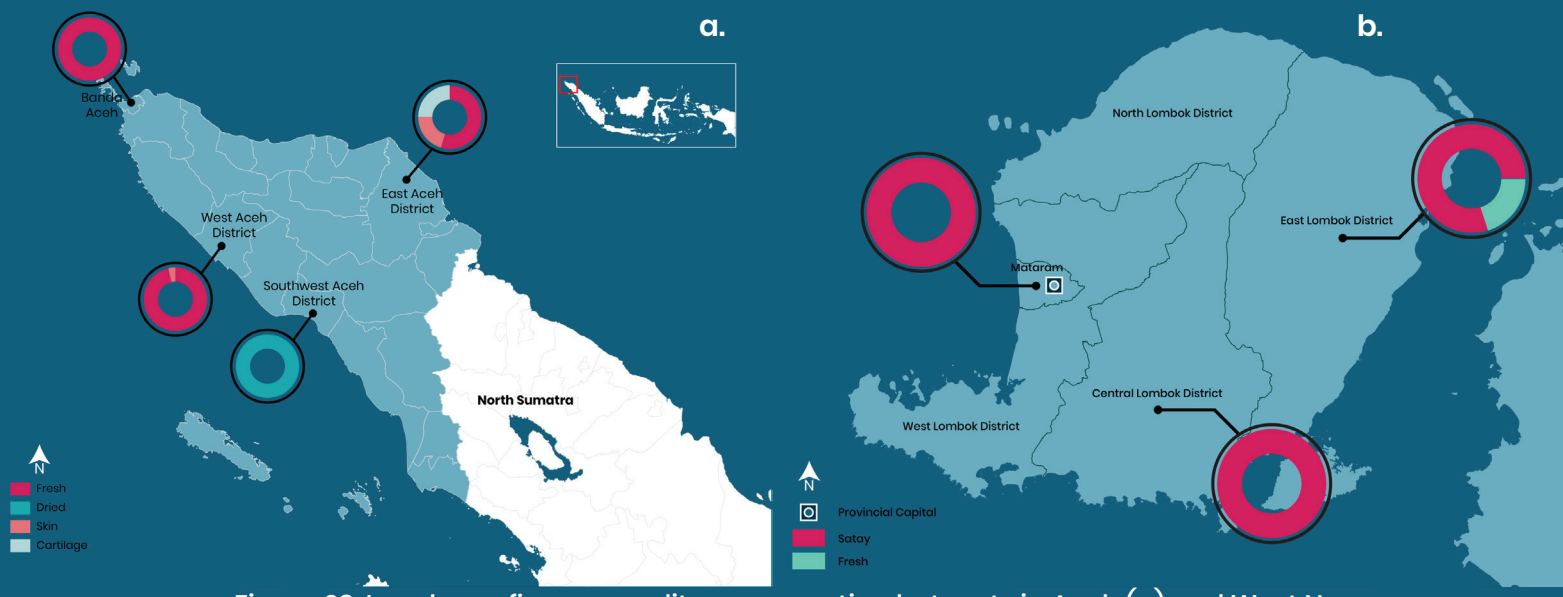


Figure 23. Local non-fin commodity consumption hotspots in Aceh (a) and West Nusa Tenggara (b).

Governance

There is no formal governance of utilization and trade of non-fin products at the local level, the industry is almost entirely informal. Traded shark products only enter in to monitoring and management systems once they are transported between provinces. At this point they require a verification check and recommendation letter from one of six Coastal and Marine Resource Management Bodies (BPSPL), which are dotted throughout the country and operate under the Ministry of Marine Affairs and Fisheries (MMAF) (Figure 15).

Historic context and trends

Sharks and rays have been a component of small-scale mixed-species fisheries in West Nusa Tenggara and Aceh for hundreds of years. Historically, sharks and rays were treated similarly to any other marine fisheries resource, and consumed locally. However, in both Aceh and West Nusa Tenggara, shark fisheries reportedly expanded rapidly in the mid- to- late 1900's (1950-1980) following demand for high-value commodities, such as fins and gill plates, in international markets in China, Hong Kong and Taiwan. The late 1900's were reportedly the peak of elasmobranch fisheries in both Aceh and West Nusa Tenggara. Since then, shark fishing effort and production has reportedly declined in both provinces, with reductions in the number of vessels targeting sharks.

In Aceh, more than 50% of survey respondents reported reductions in catch volumes compared to catches before the tsunami (12 years prior). Respondents attributed declines in catch to disturbances in the marine ecosystem due to the tsunami, leading to a declining shark population and a decline in size and maturity of catch. Fishers also reported fishing gear modernisation as a contributing factor, with gears that are able to catch more fish with less effort, which are mostly unselective regarding the size, species and level of maturity of the catch. Reductions in shark fishing effort and catch volumes in Aceh can also be attributed to the provincial governments' efforts to increase value and production of tuna by revitalizing ports and cold storage facilities. This incentivised some fishers and traders to shift their target species from sharks to tuna. National-level regulations regarding species protection and trade restrictions may also be playing a role, with some fishers reportedly fearing enforcement action for catching and trading sharks. These patterns are broadly reflected in the provincial government fisheries statistics, which indicate a decline in shark production of almost 75% between 2002 and 2016. Low production during 2004-2006 can be attributed to the tsunami. More recent declines (i.e. 2012-2016) are likely due to a combination of shark population declines and reductions in shark fishing effort, as discussed above.

Fisher perceptions and production trends in West Nusa Tenggara contrasted those in Aceh. In Tanjung Luar fishers reported that commonly caught species such as silky shark (*Carcharhinus falciformis),* scalloped hammerhead shark (*Sphyrna lewini*) and thresher shark (*Alopias spp*) had stable to increasing yields, and fishers perceive these species as abundant. Meanwhile, capture trends of oceanic whitetip shark (*Carcharhinus longimanus*), devil rays (*Mobula spp*) and manta rays (*Manta spp*) declined significantly in recent years, although fishers attributed these changes to government regulations as opposed to population declines.

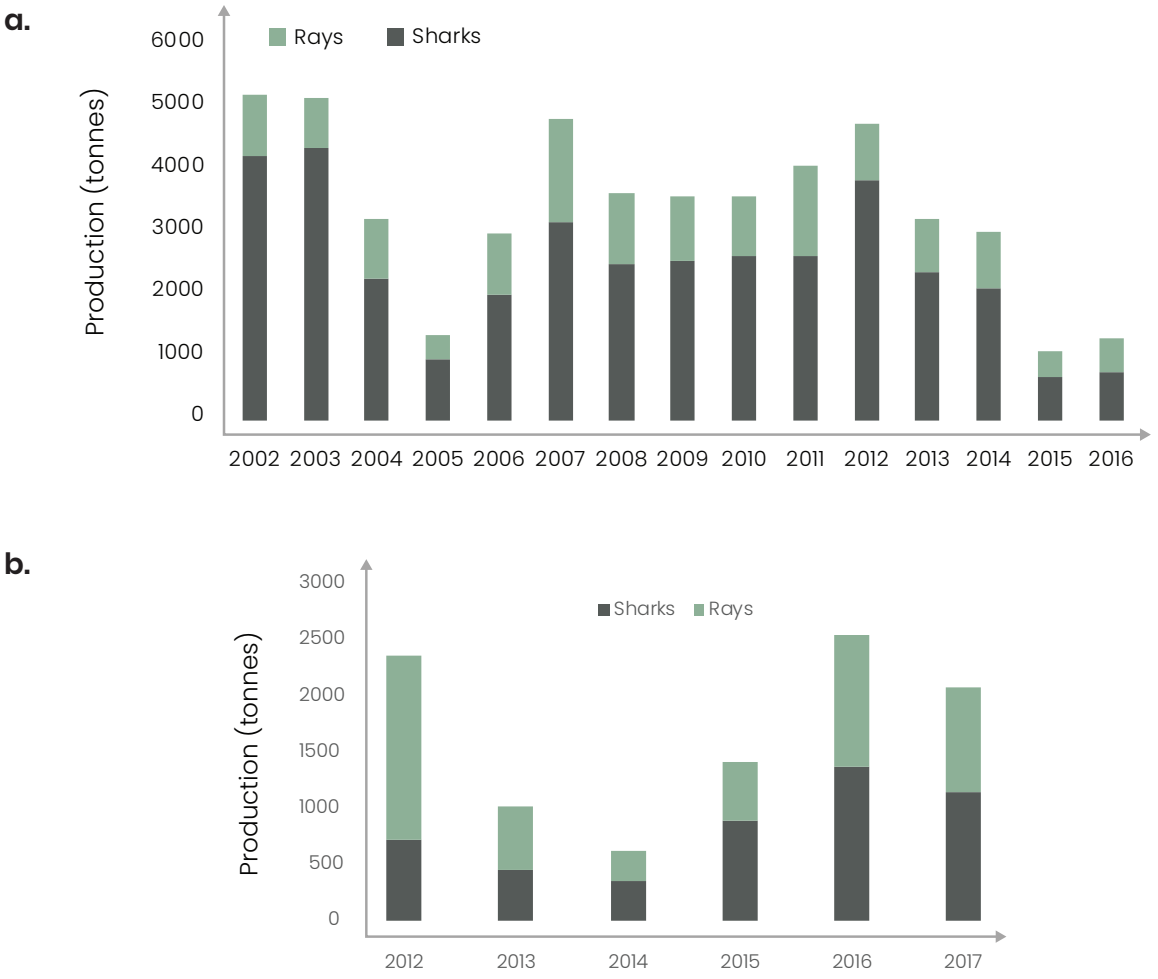


Figure 24. Trends in total shark and ray production in Aceh (a) and West Nusa Tenggara (b) (source: Fisheries data statistic).

In Aceh, volume of trade in all shark and ray products has reportedly decreased in recent years, mirroring declines in production. The price of non-fin commodities such as cartilage, liver oil and skin have reportedly increased due declining supply but stable demand. However, declining supply has reportedly not affected the local price of shark meat, which suggests that local demand may be elastic, and largely driven by supply.

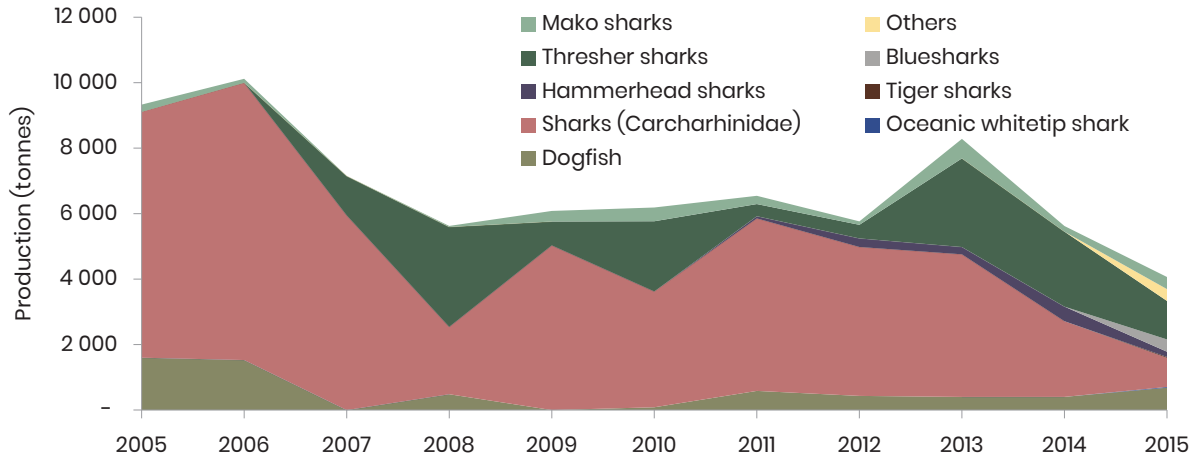
In West Nusa Tenggara, volume of trade in non-fin commodities appears to be stable or increasing. Reportedly, shark and ray meat has been widely consumed in Tanjung Luar, East Lombok since the 1940s, although skin, bones and teeth were initially discarded. However, the increasing number of sharks and rays landed, and growing commercial demand for non-fin products, prompted fishers to begin use skin, cartilage, and teeth. Today, even the stomach contents are used as livestock feed. Interviews with local retailers indicate that in recent years local consumption of shark and ray meat continues to increase, with local markets also expanding to other cities in Central Lombok and Mataram (the provincial capital). In part, this trend can be attributed to the stable or increasing fishery supply, as well as a rapidly increasing population in West Nusa Tenggara Province. Current population growth in West Nusa Tenggara is estimated at 50,000 people per annum (approximately 1.17%), and it is one of the poorest provinces in Indonesia, which may be driving increasing demand for cheap sources of animal protein.

Species

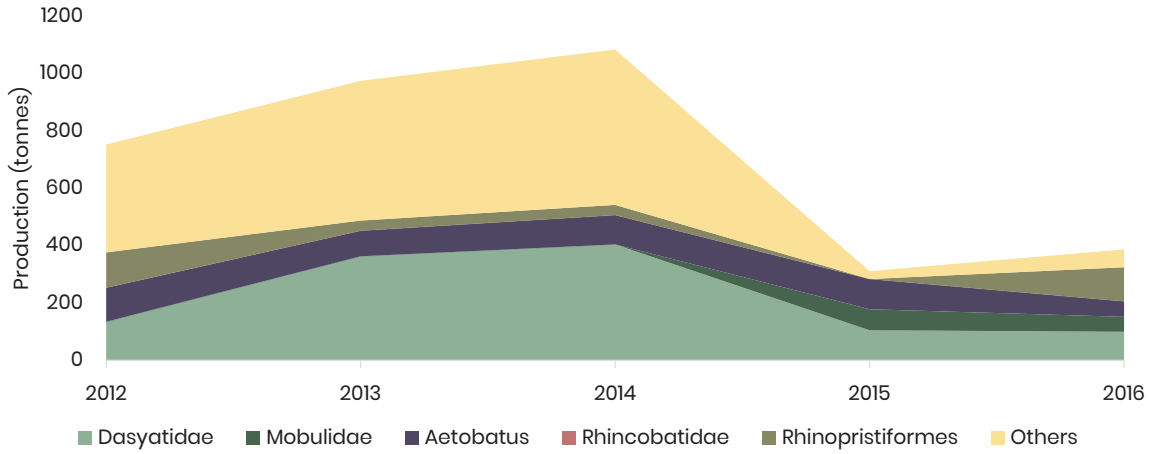
Fishery statistics

According to Aceh Province fishery statistics, shark catches from FMA 572 and 571 in these two FMAs are dominated by requiem sharks (Carcharinidae), in particular silky sharks (*Charcharhinus faciformes*); thresher sharks (*Alopidae spp*) (both FMAs) and hammerhead sharks (Sphyrnidae) (FMA 571 only). All of these species are currently listed on CITES appendix II. Rays are also commonly caught, in particular whiptail stingrays (Dasyatidae), and increasing volumes of shovelnose rays (Rhinopristiformes) in FMA 571 (Figure 25).

Based on species-specific data collected by WCS in Lampulo, Banda Aceh, catch is dominated by thresher sharks (*Alopias pelagicus*), scalloped hammerhead sharks (*Sphyrna lewini*), slit eye shark (*Loxodon macrorhinus*) and silky sharks (*Carcharinus falciformes*), blue-spotted stingray (*Neotrygon kuhlii*) and white-spotted wedgefish (*Rhyncobatus Australiae*) (WCS Unpublished data).



a.



b.

Figure 25. Trends of shark (a) and ray (b) production in Aceh province from Fisheries Management Area 572.

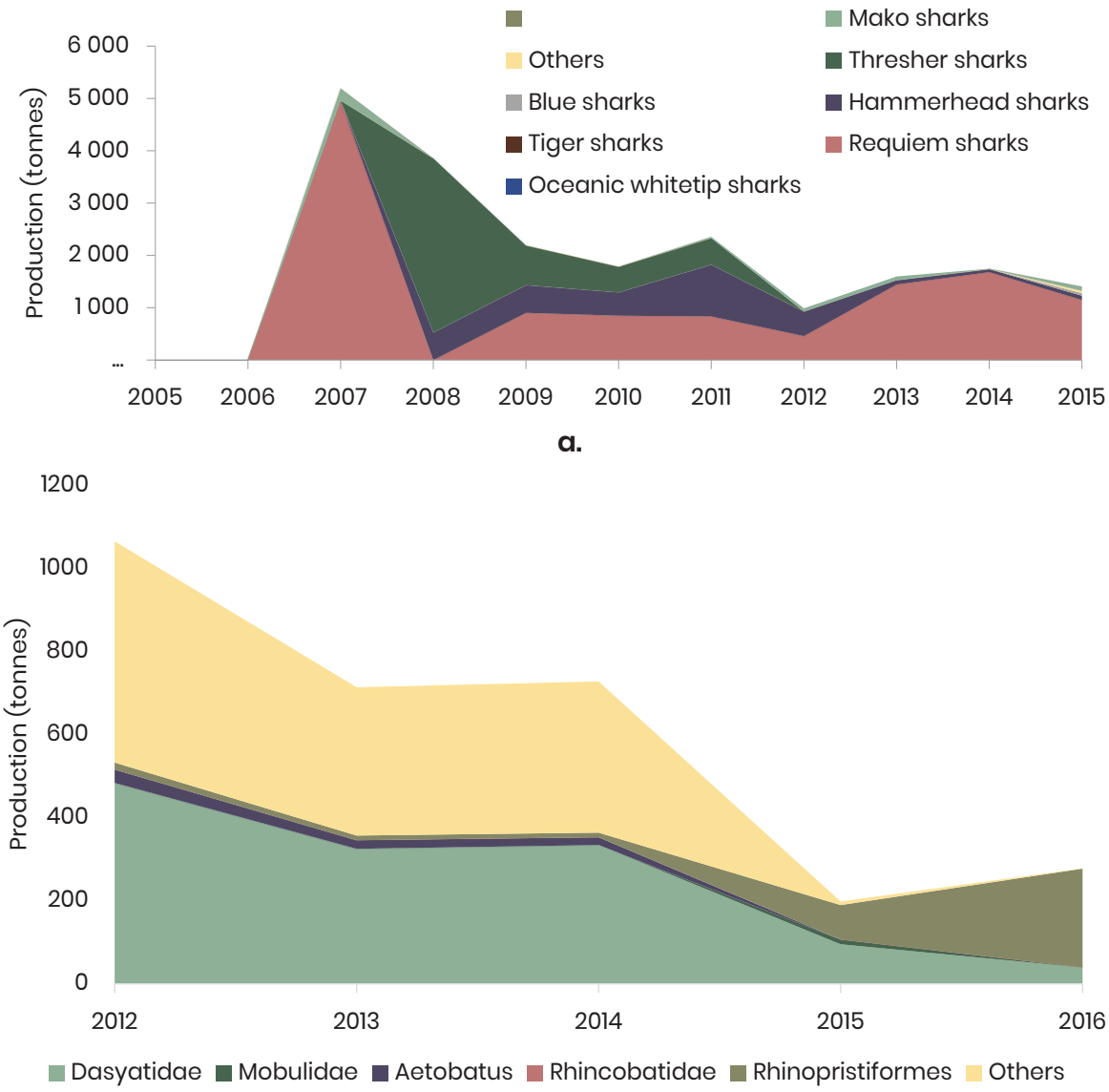


Figure 26. Trends of shark (a) and ray (b) production in Aceh province from Fisheries Management Area 571.

Somewhat similarly, catches in West Nusa Tenggara are also dominated by requiem sharks (Carcharinidae) and thresher Sharks (Alopidae) (both FMAs). Hammerhead sharks (Sphyrnidae) were also a significant contributor to catches from FMA 713 from 2006 to 2013, with capture declining in recent years. Dogfish, and to a lesser degree, tiger sharks, are also present in West Nusa Tenggara shark catches (Figure 26).

Based on species-specific landings data collected by WCS in West Nusa Tenggara, species dominating these catches include silky shark (*Carcharhinus facliformes*), Carcharhinus limbatus, scalloped hammerhead (*Sphyrna lewini*), tiger sharks (*Galeocerdo cuvier*) and blue sharks (*Prionace glauca*).

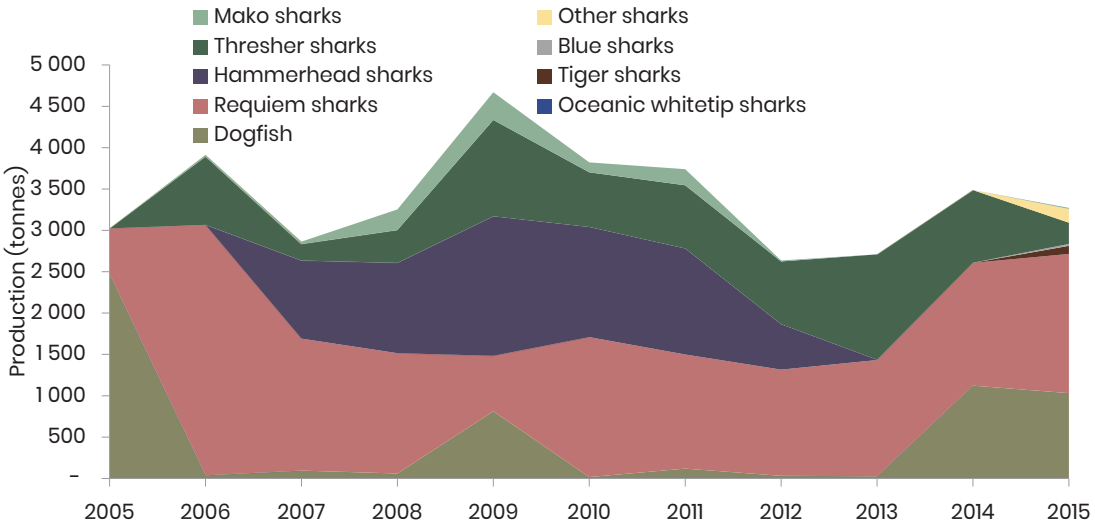


Figure 27. Trends of shark and ray production in Fisheries Management Area 713.

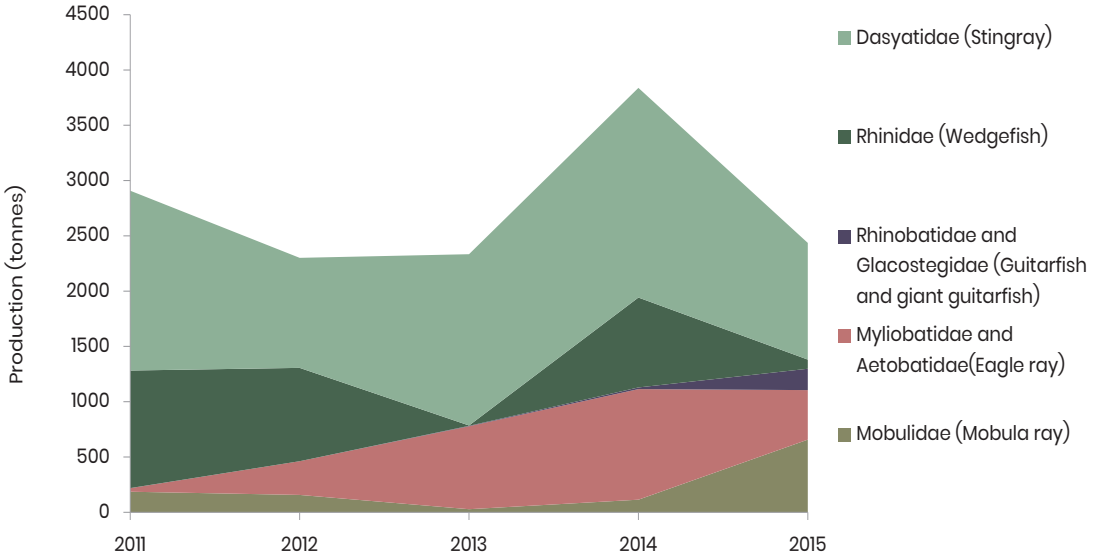


Figure 28. Trends of ray production in Fisheries Management Area 713.

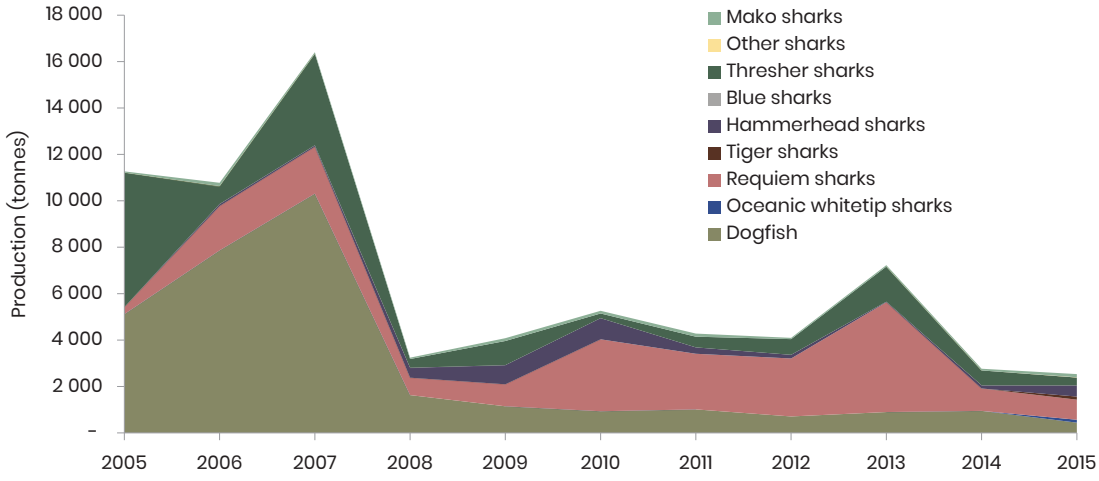


Figure 29. Trends of shark production in Fisheries Management Area 573.

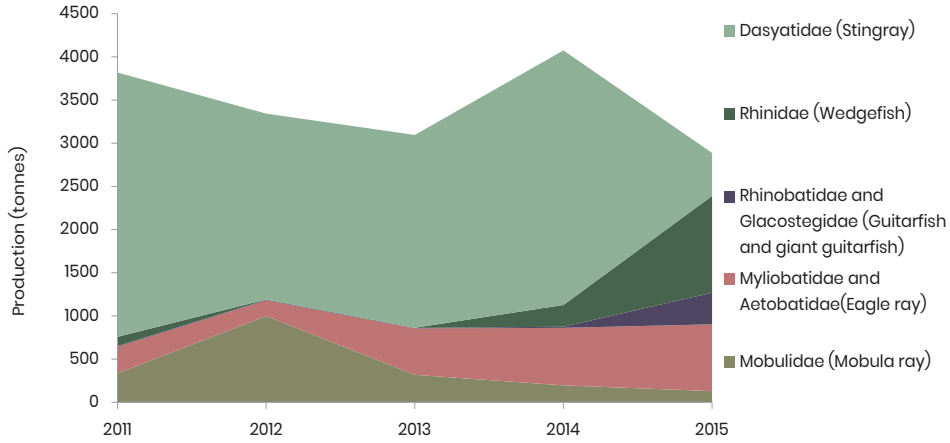


Figure 30. Trends of ray production in Fisheries Management Area 573.

Products in trade

Based on results of genetic testing conducted on tissue samples from non-fin commodities collected across West Nusa Tenggara and Aceh, silky shark (*Carcharhinus falciformis*) and wedgefish (*Rhynchobatus spp.*) were found to be the most common, with four out of twelve samples found to be derived from silky sharks (both meat and skin), and four out of twelve samples found to be derived from, white-spotted (*Rhynchobatus australiae*) and braodnose wedgefish (*Rhynchobatus cf.laevis*), used for meat, skin and soup (Table 10).

Table 10. Results of genetic testing on selected non-fin commodity products.

Province	Product type	Species	No. confirmed Samples
West Nusa Tenggara	Meat	Silky shark (*Carcharhinus falciformis*)	3
		Spot-tail shark (*Carcharhinus sorrah*)	1
	Skin	White-spotted wedgefish (*Rhynchobatus australiae*)	2
		Shortfin mako (*Isurus oxyrinchus*)	1
		Silky shark (*Carcharhinus falciformis*)	1
	Soup	Broadnose wedgefish (*Rhynchobatus cf.laevis*)	1
Aceh	Meat	White-spotted wedgefish (*Rhynchobatus australiae*)	1
		Thresher shark (*Alopias pelagicus*)	1
	Skin	Shortfin mako (*Isurus oxyrinchus*)	1

Livelihoods and food security

Socio-economically, dependence on shark and ray commodities in Aceh and West Nusa Tenggara is high, especially in West Nusa Tenggara. This dependence is related to livelihoods, culture and food security. As a source of livelihood, shark fishing (boat owners and crew), labour and post-harvest processing, and retail of non-fin products, employs at least 377 local people in Aceh and 312 local people in West Nusa Tenggara, based on the districts where data was collected (Table 11). Assuming an average of five people per household, this industry supports at least 3,400 people across these two provinces, and brings in more than US$ 1 million per year in local household incomes (Table 11).

For many of these fishers and post-harvest workers in West Nusa Tenggara, particularly in East Lombok, there is currently a lack of legal, sustainable alternatives to shark fishing and trade that bring in similar levels of income. The processing industry is also a particularly important form of employment for women in West Nusa Tenggara (Figure 31).

Although the shark industry in Aceh employs more people in total, dependency is lower, as the tuna industry has emerged an accessible market for many ex-shark fishers, particularly through government developments and subsidies. However, more needs to be done to understand the differences and motivations of those that have transitioned to the tuna industry and those that have not.

Figure 31. Women processing non-fin commodities in East Lombok.

Table 11. Employment and income in shark non-fin commodities industry.

Type of employment	Approx No. people employed			Approx. annual income per person (USD)	Approx total local income (USD)
	Aceh	West Nusa Tenggara	Total		
Fishing crew	179	200	379	1,000	379,000
Captain	48	40	88	2,000	176,000
Fishing boat owner	48	10	58	4,000	232,000
Harbour labourer	13	20	33	700	23,100
Local processors	7	28	35	700	24,500
Local buyers	38	12	50	3,000	150,000
Local retailers	44	12	56	3,000	168,000
TOTAL	377	312	689		1,152,600

Culturally, utilization of shark and ray commodities in both Aceh and West Nusa Tenggara has reportedly been passed on for generations. Some examples include Acehnese shark curry, which is a traditional delicacy found throughout coastal areas in Aceh, and many interviewees reported strong taste preferences for shark curry. In East Lombok, there are particular cultural ties to shark fishing itself, and fishers have preferences for particular fishing methods and gears, which are reportedly inherited from their fathers and grandfathers. People also report taste preferences and health benefits of shark meat.

In terms of food security, shark meat is cheaper than almost all other sources of animal protein available in both Aceh and West Nusa Tenggara (Table 12), and it is often available in small quantities (e.g. one satay stick, Figure 32), which makes it easy for low income families to purchase. As an example, the average price of shark meat is only around 1 USD / kg while other common local sources of animal protein, such as chicken, skipjack, etc, cost two to four times the price at USD 2 – 4/kg. Accordingly, interviewees reported the low price as a key motivator for consuming shark meat, as well as supply and taste preferences. This dependency is particularly pronounced in West Nusa Tenggara, which is one of Indonesia's poorest provinces. Interviews with local retailers reveal that local consumption of shark and ray meat continues to increase every year (Figure 33). In addition, the market for shark and ray meat is growing wider, to new locations. These trends may be attributed to supply, and to high population growth in West Nusa Tenggara placing increasing pressure on marine resources for food and nutrition.

Figure 32. Sticks of shark satay for sale in West Nusa Tenggara. They are sold for 0.30 USD per stick.

Table 12. Local prices of shark meat in Aceh and West Nusa Tenggara in comparison to other animal protein sources.

Type of meat	Price (USD/Kg) in Aceh	Price (USD/Kg) in West Nusa Tenggara
Beef	8.70 - 9.30	6.00 – 7.00
Shrimp	8.00 - 9.30	3.50 - 4.00
Lamb	6.00 - 9.30	7.00 – 8.50
Snapper	3.30 - 5.30	2.70 - 4.00
Grouper	2.70 - 3.70	2.70 - 4.00
Tuna	2.30 - 2.60	4.00 -5.00
Mackerel	2.00 - 2.70	1.50 - 1.70
Squid	1.70 - 2.70	3.80 - 4.00
Chicken	1.70 - 2.70	2.50 - 3.00
Skipjack	0.87 - 1.00	3.80 - 4.20
Shark	0.70 - 3.30	1.00 - 1.70
Mackerel tuna	0.53 - 2.00	3.80 - 4.20

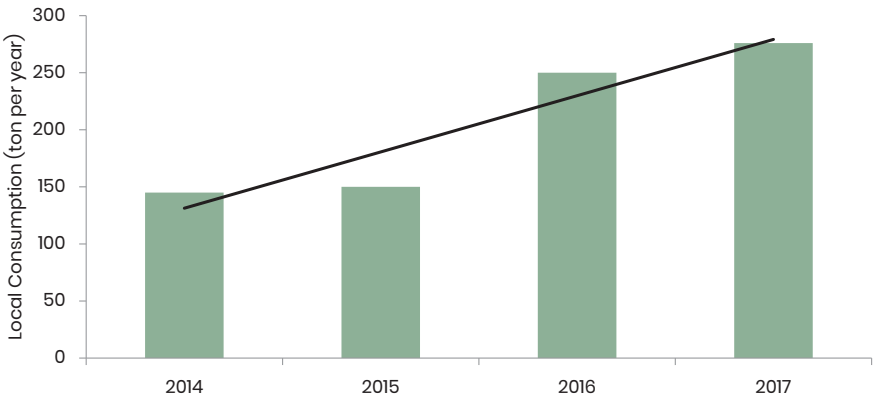


Figure 33. Trend in local demand for shark and ray meats in East Lombok, West Nusa Tenggara (East Lombok Fisheries Agency 2016 and field survey result).

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

Overall, it is clear that the trade in non-fin commodities in Indonesia is large, diverse, and potentially growing, at least in certain locations such as West Nusa Tenggara. The market forces driving this trade are complex, and occur at both domestic and international scales. The production of these commodities is in part linked to the international fin trade, which creates the primary economic driver for targeting and retaining sharks, with non-fin commodities representing by-products that also hold some (albeit lesser) value. However, stand-alone international markets also exist for certain non-fin commodities, such as liver oil, cartilage and mobulid gill plates, while the domestic trade in shark meat is influenced by local needs for income and animal protein. Though the value of this market is much smaller, it is significant and important for those who depend on it. What is more, these local demands are increasing in many parts of Indonesia, where growing human populations are leading to higher pressure on natural resources for sustenance and livelihoods.

For several products, particularly meat, demand for non-fin commodities is species ambivalent (with the exception of specialist products such as mobuild gill plates and liver oil, which is primarily from squalid sharks). As such, the overall species composition of the non-fin commodities appears to reflect those that are common in fisheries and the fin trade. Many of these are threatened and/or internationally protected species such as silky sharks, thresher sharks and hammerhead sharks. Within Indonesia, there are few regulations and systems for monitoring and verifying the provenance of food products on sale, in particular within local-scale informal markets. As such, processed shark and ray products are often not labelled or mislabelled, and there is a lack of consumer awareness (or indeed desire for information) regarding the products they

consume, and the associated sustainability or health risks. As a result, many people consume shark products without knowing it.

Regarding the international export trade, it remains challenging to detect and address illegal and unsustainable exports of CITES-listed non-fin commodities, since non-fin products often lacking visually distinguishable features for different species, particularly for non-specialists. This highlights the need to improve shark trade monitoring and forensics, both for international and domestic trade in fin and non-fin products. This can involve traceability from point of catch/landing to verify species and provenance and/or improved visual and genetic identification methods for products in trade. Such systems can help to seize illegal and unsustainable exports of products from CITES-listed species, and help to ensure that domestic utilisation is sustainable, through controls over which species and associated volumes are permitted for catch and domestic retail, for example. This should also be coupled with efforts to improve consumer awareness about seafood, and the associated sustainability and health implications of consuming certain products. This may drive people, particularly in more wealthy and educated demographics, to demand reliable information about the provenance and quality of their food, which could in turn drive change within the retail sector, and ultimately the fisheries they source from. If commercial, industrial-scale fishing pressure on sharks declined, this could lead to recovery of shark populations, and would allow for continued low levels of sustainable artisanal offtake, for coastal communities who are highly dependent on shark resources for livelihoods and food security, and have less capacity to adapt or switch to substitute animal protein sources.

At present, the degree to which CITES regulations and increasing control of the international fin trade influences trade in non-fin commodities remains unclear. It is plausible that declines in the international retail price of shark fins would reduce the primary economic driver for targeting and retaining sharks, and therefore overall shark production and associated non-fin products would shrink in parallel. On the other hand, an extensive and profitable market for non-fin commodities, particularly within Indonesia's borders, may reduce or negate the impact of international- and/or fin-focused interventions. What is more, there may be unintended consequences for both shark populations and people. For example, a decline in household income due to reduced shark fin profitability could feasibly drive local fishers to simply fish further or fish harder in order to maintain their income. Coastal communities may also see reduced access to sources of animal protein and micronutrients. This potential scenario highlights the importance of developing fisheries management measures in parallel with international trade management interventions, such that trade controls also translate in to measurable reductions in shark fishing mortality. Such measures should consider systems and incentives to support the transition of shark fishers towards more sustainable practices - particularly those which are small-scale, marginalised and possess limited adaptive capacity.

Many of the abovementioned challenges are also exacerbated by data deficiencies and limited co-ordination/capacity amongst responsible government parties. For example, available data on national production of sharks is likely an underestimate due to a prevalence of illegal, unreported and unregulated fishing in Indonesia. There is low compliance of fishing vessel operators providing log book catch data, while data from on-board observers is limited to a very small number of vessels and trips, and is highly susceptible to bias. In addition, government efforts in

enumerating catches at fish landing ports have not reached many areas in eastern Indonesia and small-scale fisheries. Catch from these locations remains un-monitored. In addition, accurate data on levels of domestic demand, trade and utilization is lacking. National-level estimates are based on several broad assumptions, according to production and export data, as opposed to dedicated information on the magnitude of the domestic trade. This highlights a lack of integrated domestic trade monitoring, and no legal umbrellas for uniting these issues across different sectors from fisheries to trade to retail. In many cases it remains unclear in terms of the responsible parties for developing and enforcing domestic trade regulations. This is further exacerbated by the complex and segmented trade routes, and the current focus on export data collection and controls due to pressures from international conventions such as CITES. Finally, the case studies included herein could only cover two provinces, which are both quite different in terms of their utilisation contexts. It is therefore unlikely that the full range of domestic usage contexts has been appropriately covered for us to make any national-level extrapolations or draw any nation-wide conclusions.

Based on these findings and limitations, we can make several recommendations:

1. **Expansion and standardization of data collection**: there is a need for expanded, better distributed and fully-integrated data collection throughout the supply chain, from landing sites to domestic trade to export, in order to better track shark production, trade in associated commodities, and to verify the legality and sustainability of the commodity sources.
2. **Improved fisheries management measures**: trade regulations should also be coupled with practical and ethical fisheries management interventions that result in changes in fisher behaviour and measurable reductions in fishing mortality of threatened and protected species. Trade regulations alone may result in unintended and perverse consequences for sharks and people.
3. **Strengthening product traceability and labelling, and improved verification and forensics systems**: before being sent out for distribution, processed shark and ray products should be recorded thoroughly in terms of product type, source, quantity and destination of distribution. This information should be available for domestic consumers as well as international exporters. Government monitoring and enforcement officers should also be equipped with improved skills, capacity and technology for detecting illegal/unsustainable shark products in trade – particularly for non-fin commodities, which are difficult to identify and supported to take appropriate enforcement action to deter non-compliance with trade controls.
4. **Increased knowledge and awareness of consumers**: increased demand for sustainable, traceable products, with people understanding and being critical of the type and origin of the products they consume, could help to drive more responsible seafood labelling and sustainable trade and production.

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