

Domestic utilization of shark and ray: An example from Muncar Subdistrict, Banyuwangi Regency, East Java Province, Indonesia

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Abstract. Sharks and rays are among marine biota traded in local, national and international market. Muncar Subdistrict, Banyuwangi Regency, East Java Province is one of sharks and rays producing centers in Indonesia. In this region, sharks and rays have been utilized for generations. This study aimed to identify the utilization of sharks and rays at Muncar Subdistrict. Data were collected in October 2019 using the snowball sampling technique to gather information their utilization. The result showed that fishers at Muncar catch various species, i.e. 46 species of sharks and 26 of rays. There are 13 fishing vessels still operating to catch sharks, which use bottom longlines, drift longlines, and gillnets. Meanwhile, rays are mostly caught by gillnets or hand lines as by-catch. The fishing grounds were around Bali Strait, Kangean Island up to the waters of East Kalimantan, South and Southeast Sulawesi. The fishing season occurs throughout the year but catches decrease from March to April. Four actors are identified to utilize sharks and rays, those are fishers, collectors, pengembak (processors), and mlijo (retailers). All body parts of sharks and rays have economic value. Fins are important export commodity, meat are processed into smoked and salted fish, livers are transformed into fish oil, skins into crackers, cartilages into flour, viscera into feeds and teeth are for souvenirs. The utilization of sharks and rays at Muncar Subdistrict is zero-waste, with the products traded locally in Banyuwangi Regency, except for fins.

Key Words: shark-ray fisheries, shark-ray user, local utilization, trade-chain.

Introduction. Shark fishing in Indonesia started in the 1970s, when sharks became the by-catch of tuna fisheries (Fahmi & Dharmadi 2013). However, the increasing price of sharks fins in international market in 1988 drove fishers to target sharks. Since then, sharks were hunted by artisanal fishers (Anung & Widodo 2002). Mostly, fisheries in Indonesia catch sharks in waters within Fisheries Management Area (FMA) 573, i.e. the eastern Indian Ocean, starting from southern waters of Java to Nusa Tenggara, Savu Sea, and the western Timor Sea, as well as FMA 713, i.e. the Makassar Strait, Bone Bay, Flores Sea, and Bali Strait. Tanjung Luar-West Nusa Tenggara and Muncar-East Java are two major landing sites for sharks caught as target. Meanwhile, Cilacap-Central Java and Muara Baru-Jakarta are for sharks from tuna fisheries by-catch (Fahmi & Dharmadi 2015; Blaber et al 2009; Tull 2014).

In the early days of shark fishing, sharks were caught only for their fins, while the rests of the body were thrown to the sea, a practice known as shark-finning. Jaiteh et al (2017) reported that shark-finning still occurs in the eastern part of Indonesia. In contrast, artisanal fisheries have utilized almost all body parts of sharks (Fahmi & Dharmadi 2013). Sharks fins are the export commodity with a high economic value due to the international market's high demand. However, other products such as headless or finless bodies, headless-finless bodies, skins, and cartilages are sometimes exported as well (Fahmi & Dharmadi 2013; Muttaqin et al 2018; Charir & Lestari 2019). Meanwhile, local communities in Indonesia generally utilized only the meat, either fresh, frozen,

partially prepared (e.g., dried, salted, steamed and grilled) or cooked as traditional dishes (meatball, fish cake, floss and jerky) (Muttaqin et al 2018).

In addition to sharks, Indonesian fishers also catch rays, another group of Elasmobranchii subclass. Rays are mostly caught as by-catch from gillnet fishery. Local people utilize the meat which are further processed for domestic consumption. However, in the past, they also hunted manta rays intensively for their gill rakers, to fulfill high international demand. Manta gill rakers are believed to have the medical advantages for traditional Chinese medicine. Since 2014, manta rays in Indonesia have been fully protected under the Ministerial Decree of Marine Affairs and Fisheries Number 4 of 2014 (Kepmen KP 2014). Meanwhile, other species of rays are still caught until now.

Indonesia has attracted international attention with regard to its sharks and rays fisheries. Since 2007, Indonesia is a top catcher of sharks and rays, with the total catch averaged 110,737 tons year⁻¹ (Okes & Sant 2019). According to the Indonesian Capture Fisheries Statistics of 2017, during 2005-2016 the production of sharks and rays increased by approximately 1.9% year⁻¹ (DGCF 2017). Due to the increasingly massive exploitation in the world, some of elasmobranch species have been facing severe threats and resulted in the population declines globally. Based on the redlist of International Union for Conservation of Nature and Natural Resources (IUCN), 106 species of elasmobranch are classed as vulnerable (VU), 57 species are endangered (EN) and 42 are critically endangered (CR) (IUCN 2020).

In the context of conservation efforts, Indonesia has developed several management tools for shark and ray fisheries, including the National Plan of Action (NPOA), regulations on elasmobranch fishing and symposium of sharks and rays. The latest sharks and rays symposium generated recommendations: 1) species inventory and assessment of the population status of sharks and rays; 2) assessment of exploitation status; 3) studies on shark and ray ecosystem services; and 4) studies on the utilization of shark and ray products for domestic consumption. Of these four recommendations, information on domestic utilization of shark and rays products is still lacking, despite Indonesia's status as the largest shark exporter in the world (Dent & Clark 2015). Therefore, to fulfill this information gap, the study of identifying the utilization of shark and ray products at domestic scale should be conducted. This study focuses on a case study at Muncar Subdistrict, Banyuwangi Regency, East Java Province.

Material and Method

Description of the study site. This study was conducted in October 2019 at Muncar Subdistrict, Banyuwangi Regency, East Java Province (Figure 1). Muncar subdistrict is located to the west of Bali Strait at the positions of 08° 10' - 08° 50' S and 114° 15' - 115° 15' E. Administratively, the district consists of ten villages, namely: Blambangan, Kedungrejo, Kedungringin, Tembokrejo, Sumberberas, Wringinputih, Kumendung, Tapanrejo, Sumbersewu, Tambakrejo villages (BPS 2019).

The total population in 2019 was of 138,430 people (BPS 2020). The economy of the coastal community is dominated by fisheries, including in the Kedungrejo Village (Zulfiaty et al 2019). Fishing has long been carried out, i.e from around 1901 at the time the Madura community arrived at this region. The heterogeneity of the population at Muncar can be seen from the existence of various ethnic groups, namely Madura, Osing, Javanese, and Chinese (Puspasari 2014).

Muncar subdistrict is not only a landing site for sharks and rays, but also a fishing base for the fisheries. In Kedungrejo village, there exist quite developed landing sites, i.e., Muncar Coastal Fishing Port and Brak Fish Market. Muncar Coastal Fishing Port is one

of the largest shark and ray landing sites in East Java Province (Charir & Lestari 2019). Sharks are generally targetted by Muncar fishers using longlines (bottom and surface), and a small portion as by-catch from gillnets or hand lines. Meanwhile, rays are usually caught accidentally or by-catch from gillnet fishing gear. The interviews revealed that shark and ray fishing at Muncar has occurred from the 1980s and is a hereditary activity to date.

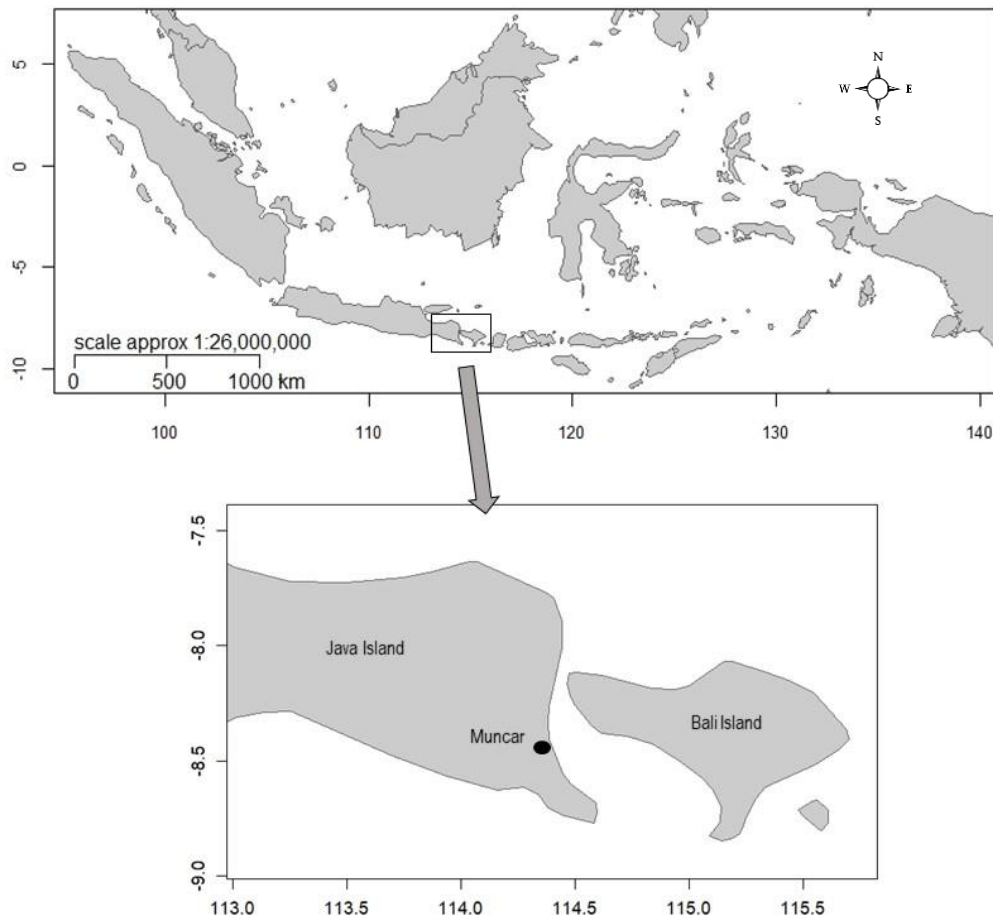


Figure 1. The study site at Muncar Subdistrict, Banyuwangi Regency, Indonesia.

Data collection. The data collected consist of primary and secondary data. Interview technique by selecting respondents through snowball sampling (Nurdiani 2014) was employed to obtain the primary data, i.e., information related to fishing and utilization of sharks and rays. Meanwhile, secondary data were collected from stakeholders, such as UPT Muncar Coastal Fishing Port and relevant publications.

Data analysis. The data obtained include the volume of sharks production, the actors utilizing sharks, various use of sharks and rays, as well as the trade chain. Monetary value that resulted from this research was converted from IDR to USD (1 USD equals IDR 14,107.05). All data were analyzed, presented in charts, tabulated, and discussed descriptively.

Results

Production of sharks and rays. Sharks and rays landed at Muncar Coastal Fishing Port are officially recorded by UPT Muncar Coastal Fishing Port, Provincial Department of

Marine Affairs and Fisheries of East Java. From 2008 to 2018, the trend of shark and ray productions was going down quite dramatically (Figure 2). Shark production in 2018 dropped to nearly one sixth of that in 2008. As for stingray production, the trend has generally declined, but since 2016 there has been a slight increase in production despite being still far lower than 2008 (UPT Muncar Coastal Fishing Port 2018).

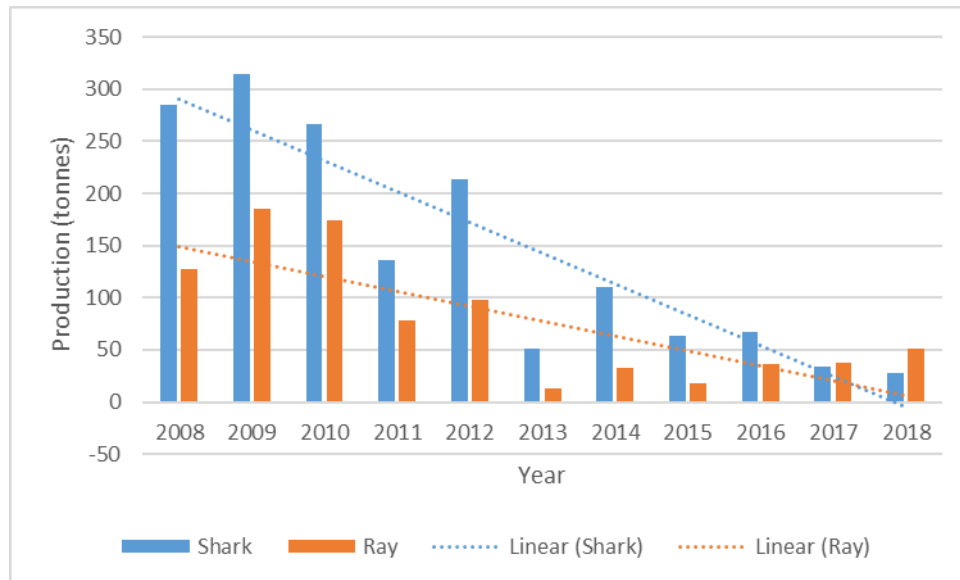


Figure 2. Annual shark and ray landings in 2008-2018 recorded by UPT Muncar coastal fishing port.

Utilizers of sharks and rays. At Muncar Subdistrict, four actors were identified as shark and ray beneficiaries. Those were fishers, collectors, processors (pengembak in local language) and retailers (mlinjo in local language).

Fishers of shark and ray. In 2018, the Ministry of Marine Affairs and Fisheries (MMAF) issued Ministerial Regulation number 5 of 2018 (Permen KP 2018) on the ban of releasing any product of hammerhead shark (*Sphyrna* spp.) and oceanic whitetip shark (*Carcharhinus longimanus*) from the territory of Indonesia. The regulation was a follow up to the listing of the two shark species into Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) at the 16th Conference of the Parties (CoP) in Bangkok, Thailand. The regulation has resulted in the reduced number of shark fishing vessels at Muncar. To date, there are 13 fishing vessels still operating to catch sharks and rays, one of which usually lands their catches at Tanjung Luar, West Nusa Tenggara. From our record, only one family dominates the vessel's ownership (owning seven units) and has been catching sharks for about 40 years. The vessel sizes are between 25-27 GT with the number of crews around 5 or 6 people for each vessel.

The vessels were equipped with various fishing gears, i.e bottom longline, surface (floating) longline and gillnet. Meanwhile, rays were more commonly caught by gillnets or hand lines as bycatch. The choice of gear used usually takes into account the location and time of fishing. Gillnets were generally used to catch bait such as sardine and mackerel tuna, but sometimes thresher sharks (*Alopias* spp.) and mobula rays (*Mobula* spp.) were also caught. Meanwhile, longlines usually target sharks and rays as the main catch. From October to March, fishermen from Muncar caught sharks and rays around the Bali Strait and the Indian Ocean (southern waters of Java) (Figure 3). At these locations, bottom longlines are used, placed at a depth of 100 m. A longline usually has a total of 300 hooks with 19 m distance between-hooks. From May to October, the location of

fishing shifted northward, i.e. around Kangean Island to East Kalimantan, even reaching south and southeast Sulawesi. At these locations surface longlines were used, consisting of 500 hooks and between-hooks distance of 30 m, placed at a depth of 21 m width.

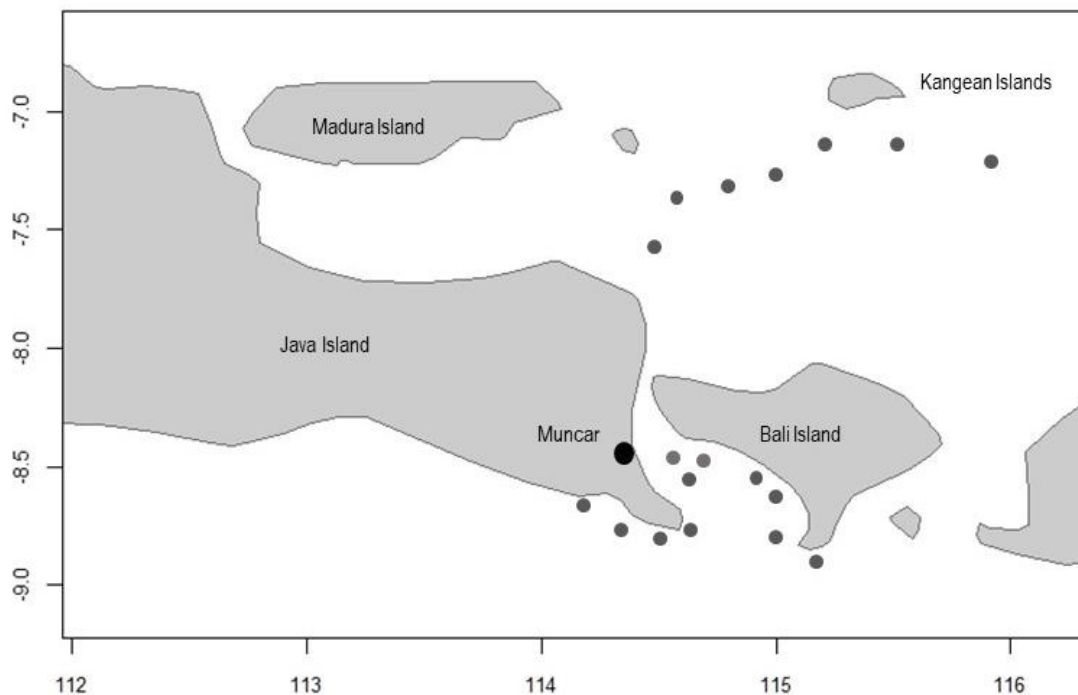


Figure 3. Main fishing locations of sharks and rays where fishers from Muncar subdistrict operate in October-March (in-depth interview with fishers 2019).

One fishing trip usually takes 12 to 15 days, costing between USD 1,063.30-1,417.73. The trip generated a revenue between USD 2,481.03-4,253.19, depending on the amount of catches. Half of this revenue was handed over to the vessel owner, while the remainder was divided by the number of joining crew members. If the revenue did not cover the operational cost, each crew was still paid USD 35.44. According to fishers, the peak fishing season of sharks and rays usually occurs in July, August and September.

Collectors. Collectors were the second level of sharks and rays utilizers at Muncar. Around Muncar Coastal Fishing Port, only one collector existed who specifically gathered sharks and rays from longline fishers. Other parties collected sharks and rays caught by gillnet fishers. Meanwhile, in Brak Fish Market, sharks and rays were sold to collectors or sellers in the market directly.

Collectors only focused on gathering shark and ray fins. These fins were dried and then sent to the large collectors in Surabaya or Jakarta. By collectors, these dried fins were sold for USD 49.62 to 212.66 kg⁻¹, depend on the species and size. Dried fins for export usually consist of a pair of pectoral fins, one first dorsal and one lower lobe of caudal fin, whereas for wedgefish and certain giant guitarfish, they consist of two dorsal fins and one caudal fin (Figure 4 & 5). Other fins such as the upper caudal fin were sold domestically, such as to nearby restaurant.

Collectors handed over shark and ray meat to pengembak or processors. Other body parts, such as liver, were usually taken away by other parties to be made shark oil, bones for fish meal and jaw for handicrafts. Fresh or frozen meat was also sent outside Banyuwangi.



Figure 4. A set of dried shark fins for export (Oktaviyani 2020).



Figure 5. A set of dried giant guitarfish fins for export (Oktaviyani 2020).

Processors (pengembak). Pengembak or product processor occupied the third level in the utilization of sharks and rays at Muncar Subdistrict. This study identified five pengembak coming from the Kedungrejo Village and other 15 coming from the Sumberberas Village. Similar with fishers, a pengembak consisted of one family and have been working since decades. Pengembak bought shark or ray either as a whole (for small sharks and rays), headless and finless bodies or just body parts. The interview revealed that each day a pengembak (one family) was able to process an average of 50 kg of shark and ray meat into smoked fish. In a single day, all pengembak at Muncar collectively processed 1 t of meat. Pengembak usually worked for 20 days month⁻¹, thus, the processed shark and ray meat amount to 20 t month⁻¹ or 240 t year⁻¹. The purchase price of shark and rays for pengembak varied, ranging between USD 0.71 to 1.13 kg⁻¹. Rays were a little more expensive, around USD 1.21 kg⁻¹ or more, due to the higher consumer interest in their meat compared to shark.

Shark and ray meat were mostly made smoked fish. The smoked fish production was relatively simple, but it depends on the type of fish to be processed (Figure 6). For fish with thick skin such as tiger shark (*Galeocerdo cuvier*) and guitarfish (*Rhynobatos*

spp.), the process was preceded by a short time boiling for softening the skin so it was easy to remove the skin and chop the meat. Meanwhile, thin-skinned fish such as ribbontail stingray (*Taeniura lymma*), bluespotted maskray (*Neotrygon caeruleopunctata*), whipray (*Himantura* spp. and *Dasyatis* spp.) were chopped into pieces immediately. Next, pieces of meat were bound on a bamboo skewer and then smoked.



Figure 6. The production flow of smoked fish at Muncar Subdistrict (Sjafrie 2019).

The production of smoked fish involved one family with each member assigned specific roles. One person purchased shark and ray meat as well as chopped the meat; another person prepared bamboo and banana midrib; the other skewered the meat and smoked it. Everyday a pengembak was able to smoke an average of 50 kg of shark and ray meat which results in 500 skewers of smoked fish. The details of cost and benefit of smoked fish production is summarized in Table 1.

Table 1
Cost and benefit of smoked fish production at Muncar Subdistrict

<i>Cost</i>				
Raw material	Purchasing price (USD)	Used for	Cost for one production cycle (USD)	Total cost (USD)
Shark/ray meat 50 kg	56.71	1 production cycle	56.71	
Bamboo 6 m	3.54	1 production cycle	3.54	
Banana midrib	1.17	2 production cycles	0.89	62.03
Coconut coir	14.18	1 month	0.47	
Electricity	12.41	1 month	0.41	
<i>Benefit</i>				
Product	Selling price skewer ⁻¹ (USD)		Total selling price (USD)	Profit (USD)
Smoked fish 500 skewers	0.16		79.75	17.72

Data processed from the interviews 2019.

Smoked fish were sold to retailers (mlijo) in local markets around Banyuwangi, such as Karadenan dan Rogojampi Market. Smoked fish at pengembak were sold between USD 0.16-0.25 skewer⁻¹. Other body parts of sharks and rays such as skin, bones, viscera were resold by pengembak to other parties. Skins were sold at USD 3.54 kg⁻¹ as raw material for crackers. The cartilages were sold at USD 0.35 kg⁻¹ to be made flour, while the entrails were sold at a price of USD 0.071 to 0.14 kg⁻¹ for catfish or crab feed.

Retailers (mlijo). A mlijo is a retailer, which is the fourth level of shark and ray utilizers at Muncar Subdistrict. Mlijo purchased the smoked fish from pengembak and peddled them from house to house, usually using vegetable carts, or sold them at markets using special baskets. The profit gained by a mlijo ranged between USD 0.035 to 0.14 skewer⁻¹.

Utilization of sharks and rays at Muncar. Sharks and rays at Muncar Subdistrict (Banyuwangi Regency) were mostly used at local scale (Figure 7). Only fins were traded outside the Regency, while local people used other body parts for daily consumption (mainly in the form of smoked fish). Other body parts were used for crackers, fish oil, flour, feed. Figure 7 indicates sharks and rays as zero-waste fisheries commodities.

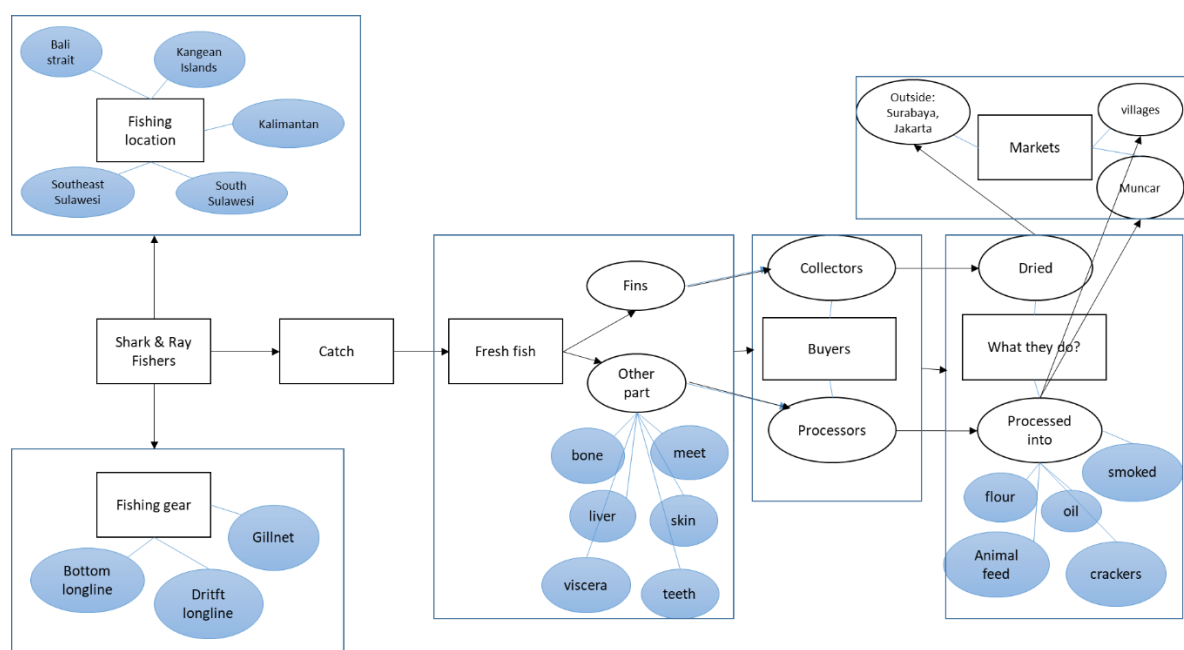


Figure 7. The utilization flow of sharks and rays at Muncar Subdistrict.

The trade chain of shark and ray at Muncar. Shark and ray products consisted of main products and by-products. Figure 8 shows that the main products of sharks and rays were fins, flesh and skin, while the by-products were liver, viscera, bones and teeth. The two products were handled by different actors and had different markets. The main products were handled by collectors and pengembak.

Collectors traded in national, regional and international market with the main product being fins, while pengembak and mlijo sold the main products locally in the form of smoked fish, salted fish and crackers. Consumers of by-products included crab and catfish cultivators. In addition, shark teeth were sent to Bali to be made pendants, while shark bone flour was used as a mixture in pellet.

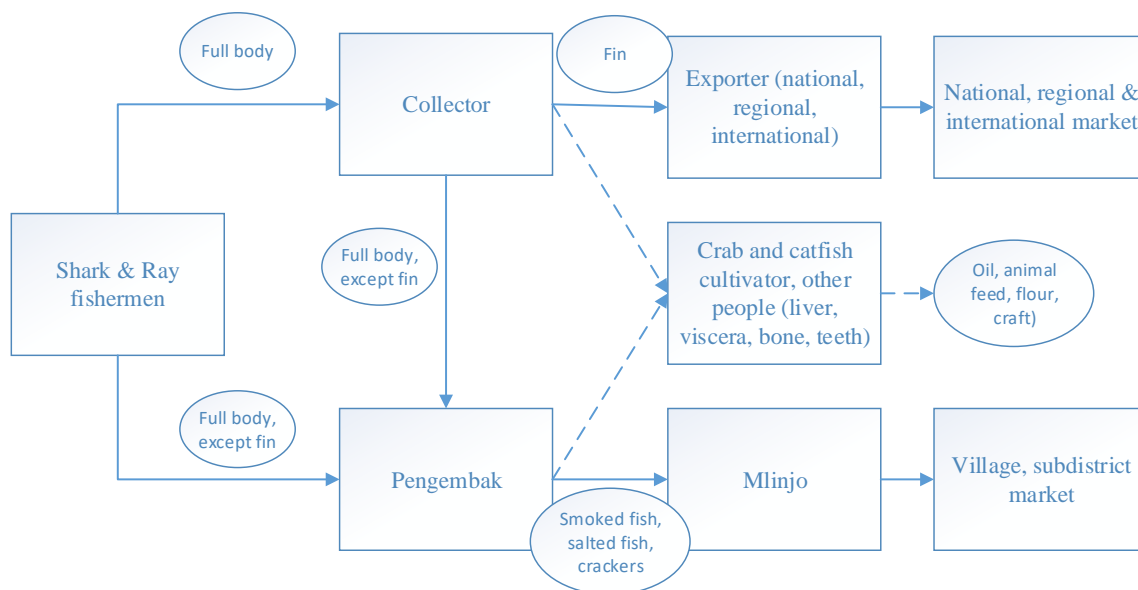


Figure 8. Trade flow of shark and ray products (solid line: primary product; dash line: secondary product).

Discussion

Shark and ray species. Shark and ray species landed at Muncar Coastal Fishing Port and Brak Fish Market are diverse, consisting of 49 species of sharks and 26 species of ray (Oktaviyani et al 2020). This number is more significant compared to the previous studies at the same location, namely 12 dominant shark species as recorded by Hariyan et al (2016). A comparison of the number of species with other locations is shown in Table 2.

The differences in the number of species found, both at Muncar and other locations depend on several factors, such as the durations of studies, shifting in fishing grounds and gears used (Fahmi & Dharmadi 2013; Oktaviyani et al 2020). Local people utilized almost all shark and ray species landed by Muncar fishers either as sources of food or as an export commodity.

Table 2
Number of shark and ray species landed at several sites in Indonesia

Location	Number of shark species	Number of ray species	Reference
Muncar, East Java	49	26	Oktaviyani et al 2020
Java Sea	12	-	Hariyan et al 2016
Balikipapan	46	21	Tirtadanu et al 2019
Sungai Kakap, Kalimantan Barat	20	20	Hidayat et al 2019
Kupang	7 families	2 families	Pumpun et al 2019
Tanjung Luar, West Nusa Tenggara	47	14	
Kedongan, Bali	49	32	Dharmadi et al 2009
Palabuhanratu, West Java	27	9	
Kupang, East Nusa Tenggara	5		
Merauke, Papua	4		
Cilacap, Central Java	16-32	13	Dharmadi et al 2009 Prihatiningsih et al 2018

Domestic utilization of sharks and rays in Banyuwangi. Generally, the local consumption of shark and ray products was smaller than the total production. Balikpapan, for example, in 2017 produced 178.58 t shark, but only 4.48 t were used for local consumption (Efendi et al 2019). However, this pattern was not the same as the Banyuwangi Regency. UPT-MCFP recorded that the total number of sharks and rays landed in 2018 was 79.1 t consisting of 27.65 t sharks and 51.45 t rays. In contrast, this study identified that shark and ray meat used for local consumption (as smoked fish) was approximately 20 t month⁻¹ or 240 t year⁻¹. This means that the amount of shark products for local consumption is greater than the record of UPT-Muncar Coastal Fishing Port (MCFP). This condition may be due to the data recorded by UPT-MCFP, which focus only on "important" shark species, such as *Carchahinus falciformies* that has been listed in CITES Appendix II. So that, the catch of other shark and ray species is of less concern. *C. falciformis* was indeed the target of shark fishers at Muncar (Charir & Lestari 2019). Therefore, in the future, a more accurate data recording methodology is required.

Local utilization of shark and ray bodies varies in each region. Fins, in particular, are all exported and there is no report of local consumption (Dent & Clarke 2015; Efendi et al 2019; Easteria et al 2019; Hernawati et al 2019). Dried fin of sharks and certain ray species do not respond to a demand from local people, but are export commodities usually sent by local collectors to large collectors or exporters in Surabaya and Jakarta, as happening in Muncar. According to Dent & Clarke (2015), Indonesia is one of the largest shark and ray exporters globally and the majority of fin products are sent to countries in East and Southeast Asia, such as China, Hong Kong, Taiwan, Singapore, Malaysia and Vietnam. Actually, few Chinese restaurants in Indonesia also serve shark fins as flagship menu. However, the amount is not well documented. It is suspected to be very small and limited to certain communities, namely the Chinese community.

The utilization of shark and ray meat is varied in different regions. In Bali, the bodies of sharks and rays are sold in the form of fresh meat. In addition, some restaurants serve sharks and rays a mainstay menu, namely shark grill, manta grill (despite its name, manta grill is not made from manta ray; instead, various types of ray fish are used), shark's fin soup, shark soup, shark head steam (Easteria et al 2019). In Pangandaran, shark and ray meat are sold fresh and only a few are made smoked fish (Hernawati et al 2019). In Balikpapan, the bodies of sharks are consumed locally only in proportion of 2.67%, in the form of smoked meat and salted fish, the rest (97.33%) beingsold out of Balikpapan in the form of wet meat, fins, skins and snouts. In Kupang, shark and ray meat are mostly sent to Bogor and their fins to Surabaya (Pumpun et al 2019). Meanwhile, at Muncar Subdistrict, all parts of shark and ray bodies (except fins) are utilized locally, especially meat, in the form of smoked fish, and it where sold limited within the Banyuwangi Regency. Therefore, it can be said that the utilization of shark and ray bodies in Banyuwangi Regency is limited within the district.

In general, there are three types of shark and ray consumers in Indonesia based on product type, geography and demography, i.e. luxury consumers, traditional consumers and passive consumers (Booth et al 2018). Referring to Booth's categorization, the Muncar community belongs to the group of traditional consumers who mostly utilize shark and ray products in the form of marinated or smoked meats. This type of consumers has an attachment to the fishing system at the location and meat products are considered cheap and easily available sources of animal protein, playing an important role in food safety (Booth et al 2018).

Conclusions. Muncar Subdistrict, Banyuwangi Regency is among the regions using sharks and rays for local food needs. Actors taking parts in shark and ray utilizations are fishers, collectors, processors (pengembak), retailers (mlijo), as well as fish cultivators. Sharks and rays are used essentially for meeting the daily food needs of the local community, in the form of smoked fish. The main products in the form of fins are

marketed at national, regional and even international scale, while smoked fish and crackers are marketed at local scale. By-products (liver, viscera, bones, teeth) have a limited local market. Our findings show that the utilization of sharks and rays at Muncar is zero-waste fisheries, because all parts from both types of fish are utilized, and also have an important role in local food safety.

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