



Diversity and Conservation Knowledge of Chondrichthyans in Northern Coastal Areas of Central Java

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Abstract

Northern coastal areas of Central Java potentially produces sharks and rays (Chondrichthyes) for dishes. However, lack of community understanding of protected species catchment affects the Chondrichthyans conservation management. This study aimed to identify of total Chondrichthyans that were captured by fisherman correlated to the conservation knowledge and action in northern coastal areas of Central Java. This research was conducted by using interview, and direct observation. Samples were collected in fish capture household places in Tegal, Pemalang, Pekalongan, Semarang, Pati, and identified in Animal Taxonomy Laboratory of Biology Department, Universitas Negeri Semarang. Data were analyzed using descriptive qualitative based on the morphology characteristic. This research found that every season, at least 1,106 individuals from 23 species of Rajiformis and Lamniformis (Chondrichthyes) orders was captured. This condition was aggravated with lack of access to information and low fisherman' awareness of protected species. It was also found that shark and ray trading generates value chain in culinary business. It increases fish consumption demand that only can be provided by fish catchment from the ocean. The implication of species catchment is declining population of Chondrichthyes in Central Java north areas. Based on the research, a high demand and lack of access to information correlated with declining community awareness on conservation actions. this research adds more information as an effort to conserve shark and ray species based on problems faced by fishermen. The information is also able to be applied as a foundation to develop community based conservation action.

How to Cite

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INTRODUCTION

In 2012, around 67 % of animal protein consumed by Indonesian people are from fish (1.7 million tons in total or 11.7 kg/ person/year) (Triarso, 2012). Most of caught fish are used as food commodities, and about 25 % are used as feed or for cattle feed mixture (Fahmi, 2005). Fish consumption in community comes from marine fisheries, mostly obtained from Osteichthyes, but consumption of Chondrichthyes (sharks and rays) is also high.

Chondrichthyes are relatively easy to catch in Indonesia and available in big amount and various species. Chondrichthyes that are captured by fishermen in north coast area fish markets of Central Java is a reliable coastal potential as an economic income from Central Java. In 2015, more than 320,000 tons of fish were captured and auctioned in more than 22,000 fish capture households (TPI) in Central Java's regencies and municipalities with money in circulation reached more than 1.8 billion rupiah (BPS Jateng, 2018).

Sharks and rays are primary commodities in several business because of their expensive price. The shark's fin is the most valuable part, even the sharks hunting just aim to pick up their fins and dispose their main body that are considered useless or throw back them to the ocean (Dulvy *et al.*, 2017, Fields *et al.*, 2018). In addition, sharks and rays are marine biological resources that are widely sold in the market either in fresh or in processed foods such as shredded fish, jerky fish, smoked fish, fish sausage, or salty fish (Lawson *et al.*, 2017, Bornatowski *et al.*, 2018).

From various species of captured "expensive" shark from Central Java, many of them have not been identified yet, and there is no information about their protection status. In addition, information about Chondrichthyes diversity has not been widely publicized by the Fisheries Department both in the city and in the province. The relevant agencies do not have data regarding the number and abundant species of Chondrichthyes especially the endangered ones. The lack of report and information about captured Chondrichthyes makes conservation effort is difficult to be performed. Reporting captured species is important to develop conservation activity as well as educate the community based on the main problems. So that, a problem identification research is needed to be conducted as an effort to conserve the endangered Chondrichthyes species. Based on the background above, this study aimed to identify the total Chondrichthyes that are captured by fisherman correlated to the conservation

knowledge and action in northern coastal areas of Central Java

METHODS

This research was an observational exploratory research by surveying fish-landing sites and interviewing fishermen in the North Coast Region of Central Java. Data sampling was conducted in three months, the samples were collected from fish capture households in Tegal, Pemalang, Pekalongan, Semarang and Pati. Every TPI was visited three times per week for one month. The samples were all individuals of the Chondrichthyes species caught by fishermen. Then, the samples were grouped by ordo, measured their body morphometric, and identified. The identification process was conducted in Animal Taxonomy Unit of Biology Laboratory, Faculty of Mathematics and Sciences, Universitas Negeri Semarang. Morphometric measurement includes body weight, standard length, fins width and long body weight. The data were collected to be further discussed during the species determination processes (data is not shown). In addition, gender (shark) and species identification were also conducted. Measurements were made by using caliper in centimeter scale with an accuracy of 0.05 cm. Additional characters observed include the length, weight and pattern of body colors; tail length; length and width of fin; shape and position of the mouth; position and shape of the teeth; as well as the condition and length of the clasper (males).

Samples obtained from the field were preserved with 4 % formalin and stored in 70% alcohol-containing sample containers. Identification was carried out to the species level by following the identification key from several references such as Carpenter & Niem (2002); Rosa, *et al.*, (2010); Ebert *et al.* (2013); and Hoffmayer & Hickerson (2011). The identified samples were also confirmed to the Biological Laboratory of the Center for Oceanographic Research (P2O) LIPI, Jakarta.

Socialization of Conservation-based Chondrichthyes Management

The socialization was conducted to the fishermen about the species of sharks and rays that have been fully protected (not allowed to be caught), the sharks and rays with regulation trading (may be arrested by certain rules) and the species of sharks and rays that can still be caught based on government rules. After that, guidance delivered about law enforcement aspect and

sanction in case of rules breaking which usually delivered by local policy. The socialization event was held at all TPIs, which was attended by fishermen, shark and ray collectors and public.

RESULTS AND DISCUSSION

Based on observations of trading activities in TPI areas in north coastal areas of Central Java, marine fisheries commodity is the largest component of trading and auction activities in TPI. The sharks and rays are auctioned then received by collector to be processed or sold. In addition, consumers can buy fish directly from both fishermen and collectors. However, oftentimes, buying and selling activities occur through one to several classes of intermediary traders.

Most of the culinary business and restaurant in coastal areas of Central Java provides special cuisine that is made from sharks or rays and they provide it as daily meal. In other hand, Chondrichthyes especially rays cannot be separated with popular culinary of local people. In Semarang City, ray's consumption is common, even it becomes local identity cuisine (Rochmawati *et al.*, 2013). But currently, consumption of protected species is a concern of the global community in term of creating development sustainability, securing food resources and protecting consumers (Reisch *et al.*, 2013).

Consumer protection measures are increasingly tightened through the standard mechanisms including hazard analysis and critical control points (HACCP), Residue Monitoring, Colable, ISO 22000, and traceability systems (Pearson & Dutson, 2012). The standard is a systematic approach to protect food from chemical, physical and biological hazard or illegal issues. Therefore, the impact of the implementation of these standards on fisheries is the increasingly tight supervision of production, especially in the production unit, including fishing and cultivation, early handling, factory, wholesale and retailers (Lupin *et al.*, 2010).

In recent years, various parties, especially environmentalists, have highlighted TPI in Indonesia. It is caused by the center of sharks and rays' fin trade occurs in those places. There are 260 units of motorboats 3-60 GT, 800 units of motorboats, and 40 units of boats without a motor that operates in Central Java's TPI, and 60 of them are sharks and rays catcher. This often occurs because of low fishermen's understanding regarding the regulations in catching the marine resources.

The issues of sustainability and conservati-

on of endangered species is crucial in sustainable food production, especially marine products (Fabinyi, 2012). The fishing activities of shark and ray species that are clearly protected by legislation is a common thing that occurs in almost all parts of Indonesia. The lack of fishermen understanding in fishing leads to an excessive exploitation behavior that affects environmental damage (Dell'apa *et al.*, 2014). This condition makes the development of fishery business using international standard is difficult to grow.

Based on the observation, there were 1,106 fish from 23 species was found in the research locus areas (Tabel 1). The data was only representing five regencies in coastal areas, so it is possible that a total species and captured fishes can be more than this research's finding if more areas are added. The shark and ray habitat as well as their behavior that tend to appear in shallow water increase their risk of being caught by fishermen (O'Shea *et al.*, 2010). The catching of sharks and rays was done by the north coast fishermen uses a long line fishing gear that can reach a depth of approximately 400 meters.

The different number of species (Table 1) is likely due to the different habitat of the species. Shark and ray has different territory and habitat, depend on their species. *Aetobatis nichofii* is the most captured species from ray population of Rajiformes family (Figure 1). Usually, a large number of this individual has an activity in the same place and same time. The species usually lives and preys hunting around shore and shallow-sea (O'Shea *et al.*, 2010). While the big Lamniformes order majority live in the middle-sea where the small fish population is abundant. The small fish tend to swim together in areas where the plankton is available abundantly. But some sharks and rays, especially the small ones, commonly appear around coastal areas look for their prey which hiding in the coral.

Actually, shark and ray distribute in various areas depend on supply and abundance of the food (Espinoza *et al.*, 2014). All sharks are carnivore, fish is main prey for most giant sharks, but sea bird, tortoise even land animals are also become their preys. In contrast, Ray's preys are fish, shell, crustacean, sea urchin, plankton, and other deep-sea species.

Majority of fisherman uses trawl net as a main tool to fishing. This kind of net is able to catch all different size of fishes from under to the top part of the sea. When the fisherman scatters the net, and pull it up, there will be many fish in different species are captured. Whereas, the fisherman explained that many fish especially

Table 1. Identification result of Chondrichthyes species from north coastal areas in Central Java

Ordo	Family	Genus	Species	Vern Name	individual		Total	
					♂	♀		
Lamniformes/ Selachii	Scyliorhinidae	<i>Atelomycterus</i>	<i>Atelomycterus</i> sp	Hiu tokek	-	2	2	
	Stegostomidae	<i>Stegostoma</i>	<i>Stegostoma tigrinum</i>	Hiu macan/ kembang	-	3	3	
	Hemiscyllidae	<i>Chiloscyllium</i>	<i>Chiloscyllium</i> sp	Hiu sembilang	-	4	4	
	Sphymidae	<i>Sphyma</i>	<i>Sphyma lewini</i>	Hiu martil	15	4	19	
			<i>Sphyrna zygaena</i>	Hiu martil	2	-	2	
	Carcharhinidae	<i>Carcharhinus</i>	<i>Carcharhinus leucas</i>	Hiu beruang/ banteng	27	31	58	
			<i>Carcharhinus falciformes</i>		-	4	4	
			<i>Carcharhinus dussumieri</i>	Hiu Pasir	76	80	156	
			<i>Lamiopsis temmincki</i>	Hiu Banteng	84	105	189	
	Pseudocharchariidae	<i>Pseudocharcharias</i>	<i>Pseudocharcharias kamo-harai</i>			3	3	
	Rajiformes/ Batoidea	Dasyatidae	<i>Hymantura</i>	<i>Hymantura uarnak</i>	Pari cambuk	4	-	4
			<i>Urogymnus africanus</i>		-	6	6	
			<i>Dasyatis</i>	<i>Dasyatis annotatus</i>	Pari duri	-	5	5
<i>Dasyatis</i>			<i>Dasyatis sephen</i>	Pari bendera	9	2	11	
<i>Gymnura</i>			<i>Gymnura micrura</i>	Pari kupu	18	23	41	
<i>Dasyatis</i>			<i>Dasyatis uarnak</i>	Pari beting	39	38	77	
<i>Dasyatis</i>			<i>Dasyatis kuhlii</i>	Pari kembang	58	66	124	
<i>Dasyatis</i>			<i>Dasyatis flaviorum</i>	Pari duri	36	38	74	
Rhynchobatidae			<i>Rhynchobatus</i>	<i>Rhynchobatus djiddensis/</i>	Pari kekeh/ lanjaman	2	7	9
				<i>Rhynchobatus typus</i>		2	-	2
Aetobatidae	<i>Aetobatis</i>	<i>Aetobatis narinari</i>	Pari burung	17	12	29		
		<i>Aetobatis nichofii</i>	Parri burung	140	108	248		
Total					629	447	1.106	

sharks and rays were captured accidentally. Actually, the main targets from fisherman are small fish, which are also become shark and rays' preys. All captured fish will be sold to the TPI, including all captured species from Chondrichthyes. The reasons why the fisherman does not release the shark and ray are 1) Chondrichthyes has a large number of market demand; 2) shark's fin is expensive in the market; 3) there is no detail information about endangered species and how to preserve it; 4) there is no proper information about protected species, makes fish catchment activity conducts carelessly and unsustainably. It can be assumed that the high number of captured rays and sharks in the fish capture household for sale indicates of low public's awareness regarding the conservation of threatened species. This condition is quite different compared with the behavior of fishermen in fishing in the southern coast of Cilacap, Central Java, who consciously relinquish the protected species of fish which is accidentally

captured (Dharmadi et. al., 2015).

The facts and finding from this research about number and protected species of fish was developed into socialization strategies. These socialization strategies aimed to deliver the information about importance of Chondrichthyes species on environmental balance to northern coastal areas in Central Java. Based on the observations on October 2017, total number of daily captured fish was an average of 0.5 tons, including various species of sharks and rays. During on October, the weather is not friendly (with hard wind and high sea waves), that makes the small-boat unable to reach middle sea. Based on that fact, the number of captured fish is possibly increase in the fishing season and normal weather.

In the other hand, the support from government institution is still needed, because it needs more intensive action from stakeholders to keep the stock of fish and the environment balance (Friedrich et al., 2014). Conservation actions that can be developed in the way of protection of

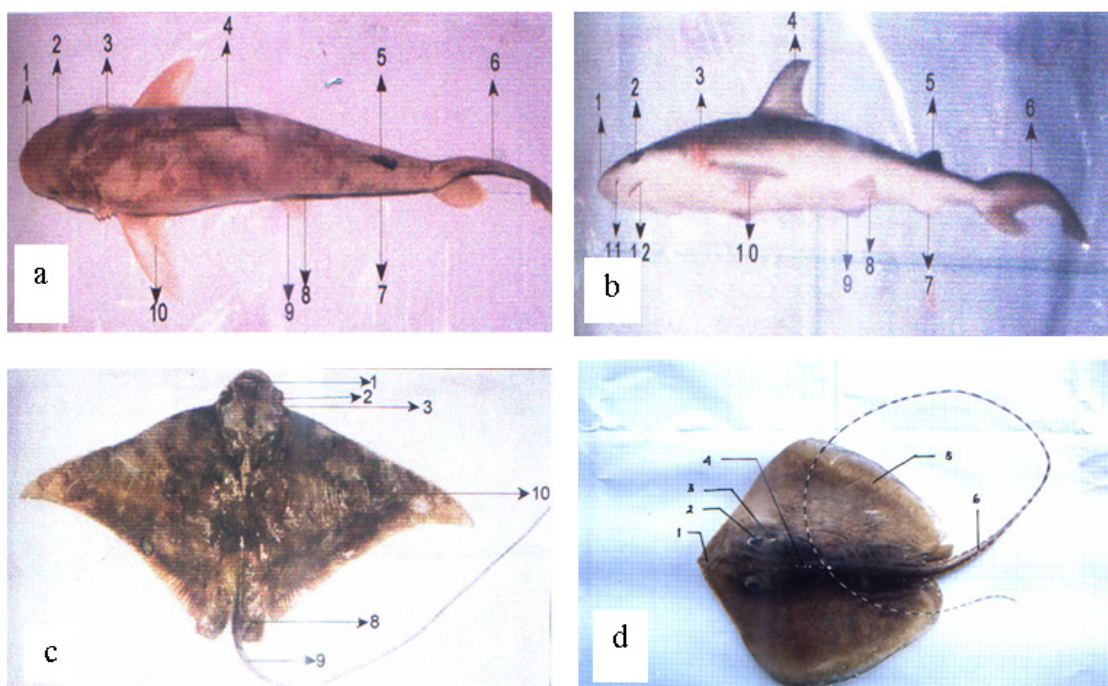


Figure 1. Four dominant species that was found in TPI of the North Coastal Market of Central Java. Species from Lamniformes such as, a) *Lamiopsis temmincki*; b) *Carcharinus dussumieri*; and from Rajiformes such as c) *Aetobatis nichofii*; d) *Himantura uarnak*. Number description (1) muzzle (2) eye (3) gill slits (4) fin spines (5) first dorsal fin (6) second dorsal fin (7) caudal fin (8) anal fin (9) kiasper (10) pelvic fin (11) pectoral fins (12) teeth (13) nostrils (14) jaws

sharks and rays include: (a) releasing caught fish if it is still alive; (b) carry out the handling and/or weeding of the fish caught dead and land it intact; and (c) documenting the species of dead caught fish, and report to the local Fisheries Department through the head of the Port as stated in fishing permit license (SIPI) (Bottema & Bush, 2012). The current regulation focuses more on the tuna fisheries. As for other fish species like sharks there is no regulation. That condition makes the fishermen are continuously catching endangered species and threatening environment sustainability.

Encouraging the fisherman in protecting the sea should be actively improved. Community awareness needs to be supported by the improvement of roles of related institutions in providing facilities and infrastructure, education, information access and alternative commodity (Fahrian et al., 2015) as well as actively involved in understanding the problems being faced by fishermen.

In addition, as a preventive action of stakeholders in this case, the Office of Marine and Fisheries is also responsible to awaken the community, especially fishermen in the importance of conservation of natural resources. The government can develop more favorable catchment schemes and fishing mechanisms (Beddington et al., 2007).

CONCLUSION

A total 1,106 individuals of 23 Chondrocytes species were identified in the northern coast areas of Central Java. The highest number of catch was from Rajiformes order which reached 630 individuals and *Aetobatis nichofii* was the most captured. The low awareness of fishermen in protected species makes shark and ray catches (accidentally catch) is sold. It was triggered by the high price of both shark and ray. Moreover, there is no strict enforcement from rules and regulations by relevant agencies to protect endangered species. The fishermen has difficulty in the captured species recording and reported to the relevant agencies. The fishermen also needs to get the provision of appropriate efforts related to the conservation of endangered species.

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