



ANALYSIS TYPOLOGY OF TRADITIONAL SCALLOPED HAMMER-HEAD SHARK (*SPHYRNA LEWINI*) FISHERIES IN INDRAMAYU

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Hammerhead Shark, Indramayu, Karangsong and Traditional Fisheries and Typology

ABSTRACT

Research on the typology of fishers who capture hammerhead sharks is carried out in TPI Karangsong. This research aims to find out the social and technical typology of fishers who catch hammerhead sharks (*Sphyrna lewini*) in Indramayu. Traditional fishers in Indramayu who catch hammerhead sharks are commercial fishers who work full time as their main occupation, with the majority of respondents having basic education as much as 53%, the age of respondents dominated by the age group 46 - 51 years as much as 27%, while the level of work experience is dominated by groups of 31-36 years experienced fishers. were 30%. Technical typology analysis of hammerhead shark catchers in Indramayu using 5 GT Vessels with inboard motor. Shows all traditional fishers do one day trip or one day trip with late afternoon departures and early morning landings. With fishing areas around the dua island, the biawak island and balongan islands are 3-6 miles long. With the main catch are mackerel and baby tuna. Sharks caught by fishers are by-catch (caught accidentally entangled by nets).

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INTRODUCTION

The combination of a rapid expansion of shark fisheries in the last three decades in response to a booming market for shark fins and meat [1], the capture of sharks as bycatch in fisheries targeted at other groups [22][23] and their intrinsically low biological productivity has led to unprecedented declines in several shark populations around the world [2]. In practice, managing shark fisheries is difficult due to the high demand for shark products, particularly their fins [3]. Indonesia are the ones biggest shark resource, with 118 species shark biodiversity [4]. Shark play an important as apex predators that maintain the balance of marine ecosystems. Indonesia is one of the countries that utilizes the largest shark resources of world shark catching. contributing 16.8% of the world's shark fishing. High sharks fishing in Indonesia is due to market demand such as shark fins (WWF 2016). sharks in Indonesia is due to market demand such as shark fins (WWF 2016). Sharks are fish that are classified into subclass Elasmobranchii which breed viviparous and ovoviviparous with slow reproductive rate slow and long life cycle, which causes sharks prone to extinction due to catches [20]. One of the regions in Indonesia that Catches shark was Indramayu Regency. The catch of sharks in Indramayu Regency reaches 60-80 tons per month landed in PPI Karangsong, sometimes the catch of sharks can be more than the main catch.

One of shark that is often caught in Indramayu waters are Hammerhead shark (*Sphyrna lewini*) with the local name known as "hiu caping" (Java) Hammerhead shark (*Sphyrna lewini*) is a type of coastal and semi-pelagic shark oceanic which is often seen on continental shelf, exposure to islands and deep waters nearby, and surface to a depth of 275 m [6]. The protection status of shark hammerhead shark (*Sphyrna lewini*) is currently regulated in Fisheries and Marine affair ministerial regulation no 5/ 2018, On Prohibition Exporting Cowboys Shark (*Carcharhinus longimanus*) and Hammerhead Shark (*Sphyrna*spp) from the territory of the Republic of Indonesia Out Territory of the Republic of Indonesia which prohibits activities export to this commodity.

The need for typological analysis on hammerhead shark fishers is to find out the characteristics of fishing gear and the characteristics of fishers who catches of hammerheads and can be used as a reference for efforts to manage hammerhead shark resource in Indonesia.

METHOD

Research location

This research is conducted at the Karangsong Fish Landing Site (TPI) conducted in February - March 2019. following Figure 1 is the map of the research location.

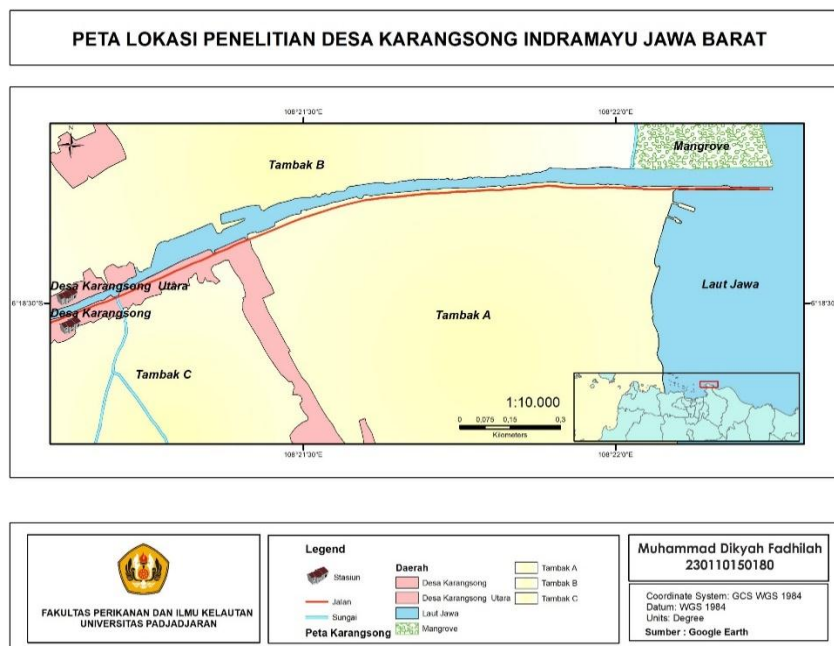


Figure 1. map of research location

Research Method

This research are using survey method at TPI Karangsong, a research method by using questionnaires as an instrument for collecting data. The purpose is to obtain information about respondents who are considered to represent a particular population

Sampling Method

method uses purposive sampling technique, respondent is considered to have the ability to answer the questions posed well and can understand the existing problems

Sources and Types of Data Collection

Data collected consists of primary data and secondary data. The primary data is live data collected through interviews with respondents and using a questionnaire, While secondary data is data obtained from relevant instance.

Data Analysis

data analysis used in this research is descriptive quantitative analysis.

RESULTS AND DISCUSSION

Indramayu Fishing

Indramayu Regency is one of the capture fisheries centers in west java province According to statistics (2016) Indramayu contributed 50.2% of the catches in west java or 136,048.3 tons with small pelagic fishes dominating the catches, with catches value in 2016 Rp. 1,996,048,114,000. the majority of fishers in Indramayu are traditional fishers. traditional fishers are fishers who go fishing with ≤5 GT vessels to carry out fishing.

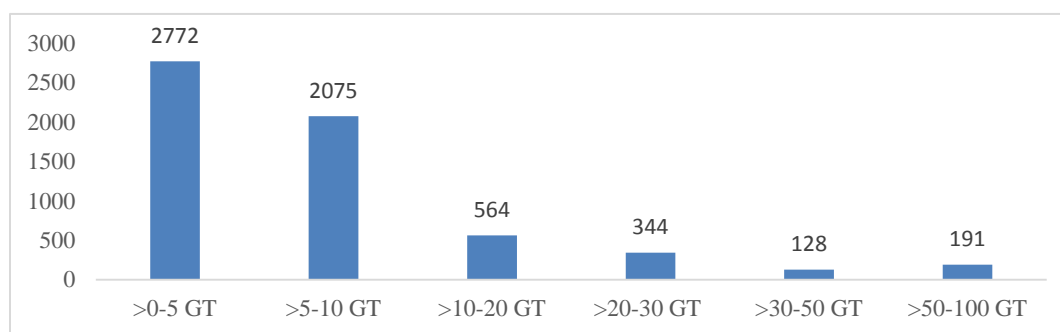


Figure 2. Number of fishing fleets in Indramayu Regency based on Grosstonnage (GT)

Based on the graph above the fishing armada in Indramayu Regency are dominated by <5 GT fishing armada with 2,772 armada, which means fishers in Indramayu are dominated by traditional fishers.

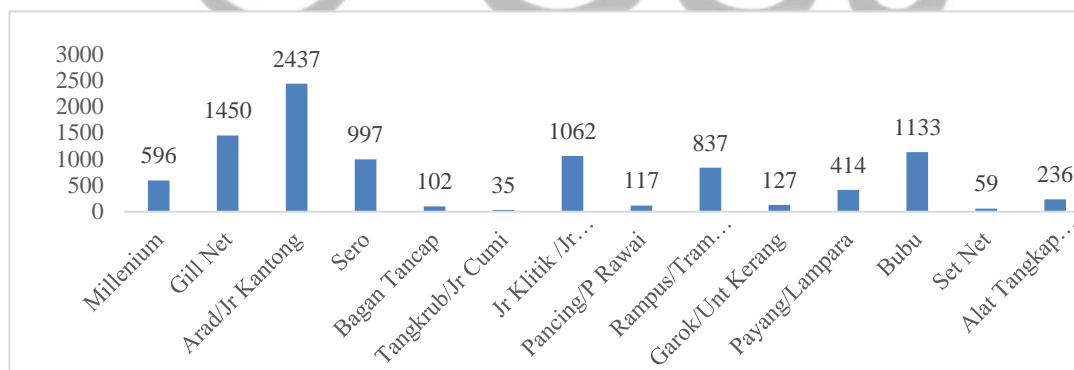


Figure 3. Fishing gear used by Indramayu Fishers

Social Typology

Fishing Background

Based on interviews with fishers who caught hammerhead sharks, all respondents answered they catch fishes for money, or it can be said that fishers are a group of commercial fishers, who carry out fishing activities to sell their catch.

Based on Work Time

Based on the results of interviews with fishers who caught hammerhead sharks, 100% of the respondents answered that being a fisherman was their only job, in other words the fisherman used all his working time as a fisherman. This is because there is no other work that can be done by the respondents besides being a fisherman, because the respondents have been taught to be fishers since graduating from elementary school or from an early age, so fishing are the one skill that they good at.

Age

Characteristics of respondents based on age distribution indicate that fishers in Indramayu Regency in the study locations ranged from 28 to 61 years with the highest percentage of fishers in the 46 - 51 years group with a percentage of 27% and the lowest percentage in fishers at the age of 58-63 and ages 28 - 33 with a percentage of 13%. According to the Central Bureau of Statistics, the age group that occupies the productive age is a group aged 15-65 years. Referring to Central Bureau Of Statistic all respondents interviewed were still in their productive age

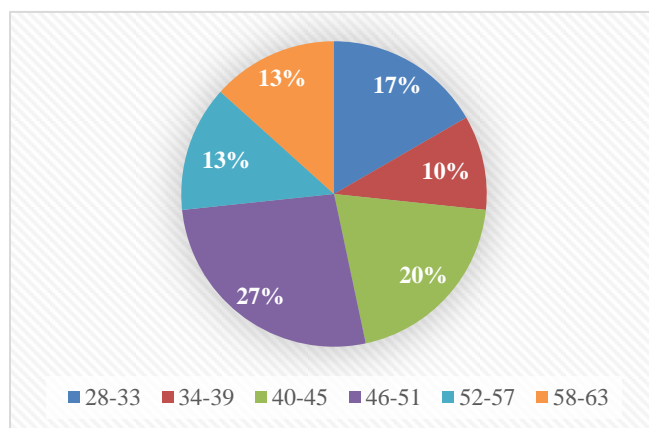


Figure 4. Respondent age distribution

Education Level

Education level is formal education that have been taken by respondent. The education level of the respondents interviewed was mostly elementary school education with a percentage of 53%, then there were never attend any with a percentage of 40% and junior high school at 7%, according to the chart (figure 5) traditional fishers in indramayu regency are still at low level education, it is because most of fishers didn't continue their studies are looking for money from fishing at young age or after their graduated from elementary school, so they more concern about looking for money to help the economy of the family. Low education level on fishers due fishers are being rational assessing all action based on material benefit. [7]

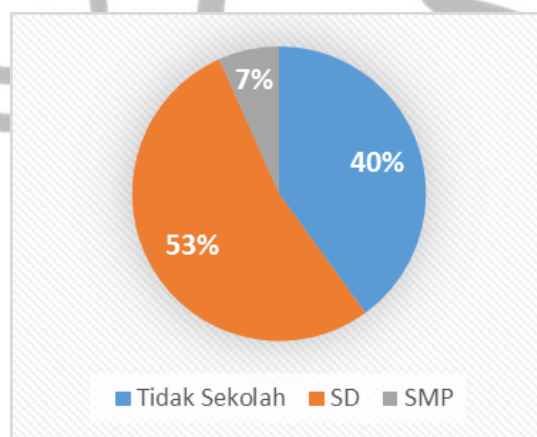


Figure 5. Respondent level of Education

Working Experience

work experience of a fisherman can influence the catches obtained, Suartawan. fisherman income is closely related to age, outpouring of work time and level of experience working as a fisherman. These factors are strongly related to the income of fishers, because fishers are menial jobs where the higher the experience of working as a fisherman, affects the catches captured in fishing activities.[8]

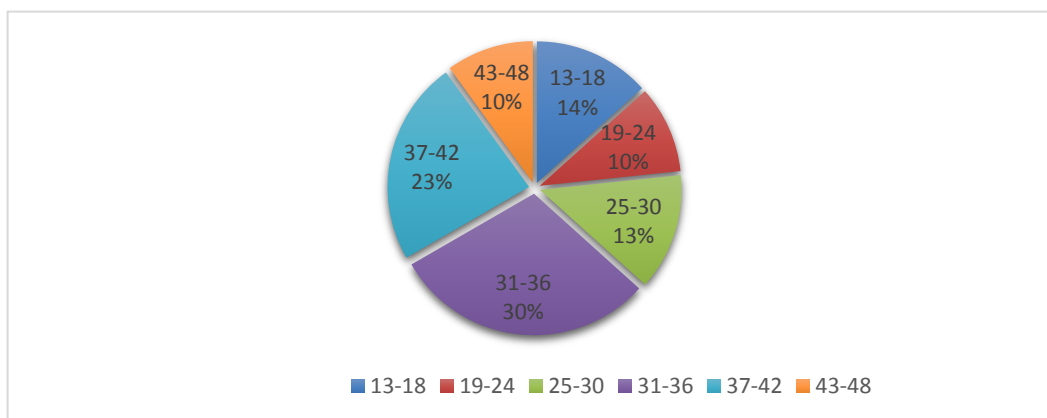


Figure 6. Respondent Working Experience

The level of experience of fishers interviewed was divided into 6 classes, with the highest number of class members in the 31-36 year experience class as much as 30% and at least in the work experience 19 - 24 years class and class of 43-48 years with a percentage of 10%. As seen from the results of field data, fishers who make Catches using vessels with a size of 5 GT are dominated by fishers who have experienced more than 30 years as much as 63%. According to Firdaus [9] fishers on ships \leq 5 GT are dominated by fishers aged over 40 years with a total of 56% which shows fishers on ships \leq 5 GT dominated by fishers who have experienced

Technical Typology

Based on Fishing Time Length

Based on fishing time length fishers are grouped into 2 groups according to Pollnack [7]. There is fishers who go fishing for more than 1 day. Next is a group of fishers who carry out fishing activities a day or less than one day. Results of interviews with fishers who made catches of hammerhead sharks, all respondents stated that they made catches under one day, because all respondents were small fishers who use the $<$ 5 GT fishing vessels. with departures varying, with the earliest departure time is 2.30 a.m and the latest is 04.00 a.m , and the earliest return time is 08.00 a.m and the latest is 12.00 p.m, departure and return time very flexible, can change according to the situation. All traditional fishers do one day fishing due to low tank capacity that lead to short cruise distance.

Fishing area

trips made by fishers with \leq 5 GT vessels are one day fishing. With fishing area are close from shore (3-6) miles from shore. They usually made a catch around biawak island, dua island, and balongan. The fishing area are close to the shore due to short cruise distance. They sometimes get hammerhead that migrate around the fishing area. Scalloped hammerhead sharks that caught by traditional fisheries expected to be the species that move widely from north coast Australia. [8]. Fishers that catch this species usually cut off the head (figure 7) to trick off the officer at the auction place due a new fishing regulation on this species (Indonesia Marine Affairs and Fisheries Ministerial Regulation no 5/2018).



Figure 7. Cutted-off hammerhead shark at TPI karangsong

Fishing Gear

Based on interview with fishers all fishers are using gillnet with 4" mesh size and made by nylon. The length of gillnet are vary from 1 mile to 5 miles length. Mesh size are mainly used to catch pelagic fish as main target. Scalloped hammerhead are accidentally caught by this gear as sharks hit gill net and get tangled or gilled. Scalloped hammerhead sharks that caught by traditional fisheries expected to be the species that move widely from north coast Australia.

Economic typology

\leq 5GT Fishing Vessels in indramayu regency are fishing armada with motor boat uses 30 HP and 24 HP power that powered by diesel. with \pm 30 liters of diesel fuel consumption in one trip. In fishing armada there are usually more than one fishing gear (multi gears).

Fishing Cost

Fishing Cost are incurred cost for one trip of fishing. The amount of cost are uncertain it's depends on the trip made on that period. These cost are include food costs, cigarettes and the cost of fuel used. The operational costs needed by traditional fishers are include fuel, supplies and ice blocks bulk. For fuel used for fishing, diesel fuel is used to operate the engine. While the supplies brought are food, drinks and cigarettes. With the total cost of operating a ramp net in one trip it is IDR 640,500. costs incurred for making catches are assumed to be constant. With the average catch of pertrip sharks is 7.26%, the total cost incurred in one trip is Rp. 46,116. with the selling price of hammerhead sharks at TPI karangsong are Rp. 15,000 per kilo.

No	Detail	Unit	Volume	Price (Rp)	Percentage	Trip Cost (Rp/trip)
1	Diesel	Litre	30	5,150.00	7.2%	11,124
2	Food	Pack-	4	20,000.00	7.2%	5,760
	Cigarettes	age	10	16,000.00	7.2%	11,520
3	Ice	Bulk	4	24,000.00	7.2%	6,912
	Fee	Per-	3	50,000.00	7.2%	10,800.
	Total					46,116

Table 1. Catch Cost per Trip

Investment cost

investment costs are costs that last for a relatively long time. Usually the time for investment costs is set to more than one year. Investment costs in capture fisheries include vessel ,machinery, fishing equipment and other supporting equipment such as cooking equipment, batteries and lighting equipment.

Detail	unit	Price (Rp)	Technical Age (years)	Depreciation Value
5 GT Vessels	Unit	19,700,000	10	Rp 1,970,000.00
Machinery	Unit	4,920,000	10	Rp 492,000.00
Fishing Gear				
Gillnet	Unit	3,900,000	2	Rp 1,950,000.00
Support Item				
Batteries	Unit	270,000.00	2	Rp 135,000.00
Lighting Equip-	Unit	130,000.00	2	Rp 65,000.00
Cookware	Unit	1,000,000.00	3	Rp 333,333.33
Navigation Equip-	Unit	2,500,000.00	4	Rp 625,000.00

Table 2. Investment Cost of Traditional Fisheries

While the depreciation value for shark hammer fisheries is 7.2% of the total depreciation costs and total overall investment costs (table 3)

Detail	Unit	Price (Rp)	Technical age	Depreciation Value	A month
5 GT Vessels	Unit	1,418,400	10	141,840	11,820
Machinery	Unit	354,240.	10	35,424	2,952.000
Fishing Gear					
Gillnet	Unit	280,800	2	140,400	11,700
Supporting Equipment					
Batteries	unit	19,440	2	9,720	810
Lightning Equipment	unit	9,360	2	4,680	390
Cookware	unit	72,000	3	24,000	2,000
Navigation Equipment	unit	180,000	4	45,000	3,750

Table 3. Investment cost of Hammerhead Fishing

Amount the investment value for hammerhead sharks fishing is Rp.2,334,240 with yearly depreciation of Rp. 401,064 per and monthly for Rp. 33,422

Catches

fishers with a ≤ 5 GT Vessels usually catch, mackerel and tuna as the main catch because of the high economic value of the commodity [9] Hammer head shark are usually caught as a bycatch. Hammerhead sharks are acting as apex predators which means preying on the same fish as fishers main target, so that sharks are caught accidentally. According to [11] hammerhead sharks caught in the intestine are part of the fish, hammerhead sharks to be caught accidentally, according [10] hammerhead sharks that examines mostly had fish bone in the intestine (58%), elasmobranch, octopus and squid.

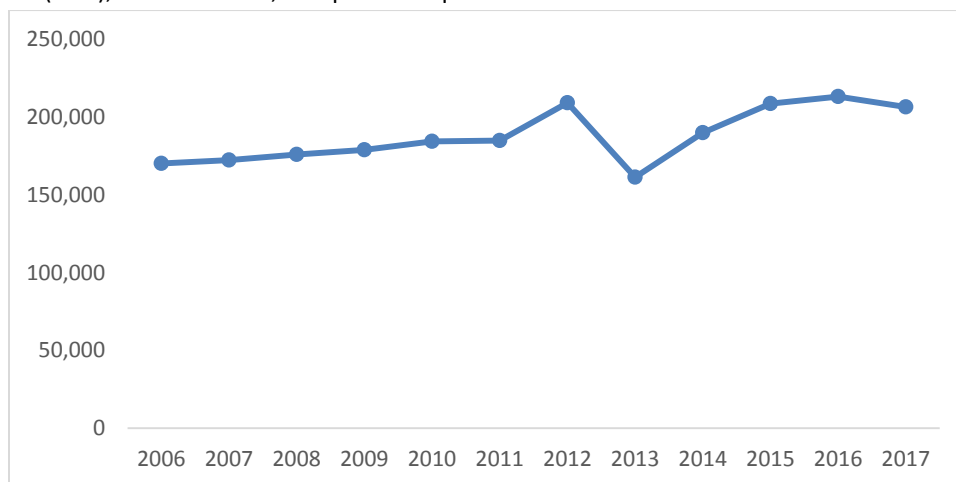


Figure 8. Scalloped hammerhead sharks Production in Indramayu

Hammerhead sharks fishing in indramayu are shows increasing trend through year. This production data can be higher due to unreported fishing on small-scale fisheries, the production is increasing but the size of the fish are decreasing through years. lot of sharks that caught in indramayu are in immature size below (229cm (F) and 179cm(M)). mainly due to their high and frequent reproductive output, Sphyrna lewini had the potential to recover at a faster rate than other assessed species if they were protected from fishing pressure. But mostly this species caught in immature size, suggesting this species are overfished.

All fishers who caught hammerhead sharks claimed to have accidentally caught hammerheads because hammerheads were in the same area as the main target fish. Fishers do not restore hammerhead shark caught to the water because at time Nets hauling that have been soaked overnight hammerhead shark have been dead so will be useless to restore into the waters, and fishers claim when hammerheads who died returned to the waters did not increase profits. Revenue from 5 GT vessels are fluctuating depending on Composition of fish caught and the price of the fish . For this reason, the average catches are averaged to simplify the calculation of net business revenues within one month

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Catches	Variable cost (Rp)	Fix cost (Rp)	Catches (Rp)	Value Profit (Rp)	Profit percentage
Hammer Head	691,740	33,422	1,273,500	548,338	75.62%
Other fishes	8,915,760	430,772.4	20,603,250	11,256,718	120.44%

Table 4. Comparison of Economic profit between hammerhead and other fish by ≤5GT Vessels

From the simple calculation net revenue it was found that the capture of hammerhead sharks was beneficial for fishers with a percentage of profits of 75.62% of capital. But catching other fish are far more profitable than hammerhead, the percentage of profit given from fishing other than hammerhead sharks is 120.44% of capital, which is 44.82% higher than the capture of hammerhead. The catches of hammer head sharks by traditional fishers have been done smoothly due to lack of regulation pertaining on sharks fishing. In fact in Indonesia small-scale fisheries are not required to have fishing permits [14]. nor are their vessels likely to have insulated fish holds or refrigeration units [15], increasing the incentive for shark finning by this sector [18]. So their fishing activity remain unreported [14]. Due to high fishing activity in Indramayu have caused change in catch composition (large, valuable species replaced by smaller, short-lived species) and displaced fishing effort for larger sharks further west into Australian waters [19] this phenomenon are now happening (figure 9) as shark that caught are in small size around (60 -80 cm) far from the mature length of this species 229cm (F) and 179 (M) [12][13].



Figure 9. Catch at TPI karangsong (TL =69cm)

high fishing activity on this species due to high demand on shark fin in the world, higher demand are come with higher price on this commodity. Fishers usually sells shark at fish auction place and the buyer are the one who process shark fin into dried shark fin to sell it abroad (eastern Asia ; Japan, China, Hongkon, South Korea). With high price around Rp. 1.200.000/ kg. high demand on shark fin especially form hammer head sharks (1st grade fin quality)[20] are taking this species in danger due catchment by exclusive shark-fisher and secondary targetd by tuna fishers. Conservation strategies for hammerhead sharks should therefore extend beyond export bans to include fishing restrictions throughout the country's territorial waters[21].

Conclusion

Based on the results of the research analysis of the typology of fishers in Indramayu Regency who caught hammerhead sharks. Concluded that, according to the social typology of traditional fishers in Indramayu district who caught hammerhead sharks were commercial fishers who worked full time and as their main occupation, with the majority of respondents having basic education as much as 53%, respondents aged 46 - 51 years as much as 27%, while the level of work experience is dominated by a group of 31-36 years experienced fishers as much as 30%. Technical typology analysis of hammerhead shark catchers in Indramayu district using 5GT Vessels Shows all traditional fishers do one day trip or day trip with late afternoon departures and early morning landings. With fishing areas around dua island, biawak island and balongan as far 3-6 miles. With the main catches are tuna, mackerel. Sharks caught by fishers are by-products and caught accidentally entangled by nets.

Hammerhead shark fin are the most valuable fin among other sharks, catches on this species are increasing but decreasing in size through years, this phenomenon suggesting this species overfished year by year. Conservation strategies for hammerhead sharks

should therefore extend beyond export bans to include fishing restrictions throughout the country's territorial waters. To help saving this species from extinction.

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References

- [1] Clarke, S. C., McAllister, M. K., Milner-Gulland, E. J., Kirkwood, G. P., Michielsens, C. G. J., Agnew, D. J., Pikitch, E. K., et al. 2006. Global estimates of shark catches using trade records from commercial markets. *Ecology Letters*, 9: 1115–1126.
- [2] Davidson, L. N. K., Krawchuk, M. A., and Dulvy, N. K. 2015. Why have global shark and ray landings declined: improved management or overfishing? *Fish and Fisheries*, 1–21
- [3] Barker, M. J., and Schluessel, V. 2005. Managing global shark fisheries: suggestions for prioritizing management strategies. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 15: 325–347
- [4] Nadon, M. O., Baum, J. K., Williams, I. D., McPherson, J. M., Zgliczynski, B. J., Richards, B. L., Schroeder, R. E., et al. 2012. Recreating missing population baselines for Pacific reef sharks. *Conservation Biology*, 26: 493–503.
- [5] Kurniasari, N., C. Yuliaty. 2014. Social Culture Fisher Community at Negeri Latulihat, Ambon. *Buletin Riset Sosek Kelautan dan Perikanan* Vol. 9 No. 1, 2014
- [6] Putra Putu M.S, Nengah K. 2019. Analysis the effect of capital, age, working hours, work experience, and education on the income of fishermen in the kedongangan. *E-Journal EP Unud, Universitas Udayana, Bali*.
- [7] Pollack, Richard. B. 1998. Social culture characteristic on development of small-scale fisheries. *PT Raja Grafindo Persada*
- [8] Ovenden, J.R., Kashiwagi, T., Broderick, D., Giles, J. and J. Salini. 2009. The extent of population genetic subdivision differs among four co-distributed shark species in the IndoAustralian archipelago. *BMC Evolutionary Biology* 9: 40
- [9] Firdaus.M and Riesti Triyanti.2017. Fishers business characteristics of capture fisheries at north coast with <5GT Vessel in indramayu distric. *Economic and social of fisheries and marine journal*.
- [10] Rocio Noriega, J.M.Werry, W. Sumpton, D. Mayer, and S.Y. Lee., Trends in annual CPUE and evidence of sex and size segregation of *Sphyrna lewini*: management implications in coastal waters of northeastern Australia. *Elsevier. Fisheries Research* 110(2011) 472-477
- [11] Widodo AA dan Mahiswara. 2007. Sharks resource that caught by fishers at java province water. *Indonseia ichtology journal*. Volume 7, Nomor 1. Juni 2007. Hlm 1-14
- [12] White, W. T., and Cavanagh, R. D. 2007. Whale shark landings in Indonesian artisanal shark and ray fisheries. *Fisheries Research*, 84: 128–131.
- [13] White, W. T., Last, P. R., Stevens, J. D., and Yearsley, Fahmi G. K., and Dharmadi. 2006. Economically important sharks and rays of Indonesia. *ACIAR Monograph Series*. 329 pp.
- [14] Varkey, D.A., Ainsworth, C.H., Pitcher, T.J., Goram, Y. and R. Sumaila. 2010. Illegal, unreported and unregulated fisheries catch in Raja Ampat Regency, Eastern Indonesia. *Marine Policy* 34: 228-236.
- [15] Tull, M. 2009. The history of shark fishing in Indonesia: A HMAP Asia Project Paper. Murdoch Business School and Asia Research Centre, Murdoch University: Working Paper No. 158, September 2009.
- [16] Lack, M. and G. Sant. 2008. Illegal, unreported and unregulated shark catch: A review of current knowledge and action. Department of the Environment, Water, Heritage and the Arts and TRAFFIC, Canberra.
- [17] Lack, M. and G. Sant. 2011. The future of sharks: A review of action and inaction. TRAFFIC International and the Pew Environment Group.
- [18] Lack, M. and G. Sant. 2012. An overview of shark utilisation in the Coral Triangle region. TRAFFIC & WWF.
- [19] Field, I.C., Meekan, M.G., Buckworth, R.C. and C.J.A. Bradshaw. 2009. Protein mining the world's oceans: Australasia as an example of illegal expansion-and-displacement fishing. *Fish and Fisheries* 10: 323-328.
- [20] Stefania Vannuccin, Shark Utilization, Marketing and Trade *FAO FISHERIES TECHNICAL PAPER* 389 Rome, 1999
- [21] Drew, M., White, W. T., Dharmadi, Harry, a. V., and Huveneers, C. 2015. Age, growth and maturity of the pelagic thresher *Alopias pelagicus* and the scalloped hammerhead *Sphyrna lewini*. *Journal of Fish Biology*, 86: 333–354.
- [22] Stevens, J. D., Bonfil, R., Dulvy, N. K., and Walker, P. A. 2000. The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems. *ICES Journal of Marine Science*, 57: 476.
- [23] Oliver, S., Braccini, M., Newman, S. J., and Harvey, E. S. 2015. Global patterns in the bycatch of sharks and rays. *Marine Policy*, 54: 86–97