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Scientific Report

A Closer Look at Socio-Economic and management perspectives of shark fishery in Ghana

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Abstract

Shark is an important fishery commodity globally. However, 70 % decline in the populations of shark species has cast doubt on the fishery's economic success, especially in Ghana. Therefore, studying the shark fishery activities in Ghana from the perspectives of production, socio-economic, and management will inform key stakeholders of the approaches needed to strengthen the conservation of the fishery. We interviewed ninety-one (91) shark fishers from four important landing sites, namely; Apam, Dixcove, Tema, and Axim along the coast of Ghana using a semi-structured interview guide, and recorded their landings between April and December 2022. Our findings show that the dominant shark species landed by fishers were Sphyrna sp., *C. leucas, C. carcahrias, R. acutus, C. carcharodon, I. oxyrinus,* and Aliopas sp. with Sphyrna sp. and *C. leucas* experiencing a drastic population decline. Togo and China were the main foreign destinations for shark fin products, particularly fins of Sphyrna sp., *C. leucas,* and Aliopas sp. (species classified by the IUCN Red List as Endangered species). The price of shark fins during the lean season was significantly higher than in the peak period, indicating the influence of seasonality on the pricing of shark fins. The main challenges confronting shark fishing in Ghana were a decline in the population of sharks, inadequate premix fuel, and the risky nature of shark fishing activities. From the study, developing a species-specific conservation action plan through consultative approaches, community awareness programmes and enforcement of these conservation measures are some of the recommendations proposed.

Keywords: shark-fin trade; conservation; sharks; endangered species, fisheries management

Introduction

Sharks are a small, evolutionarily conservative group, comprising approximately 1,000 species that have functioned successfully in diverse ecosystems for 400 million years (Abdulla, 2014). Worldwide, there are about 1,200 known species of sharks, rays, and chimeras, making up about 5 percent of all fish species (Bennett, 2005). Sharks are one of the important animal species protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973 regulation and also, important fisheries commodities in the world. CITES is an international agreement, signed by 184 parties in 1973, formulated to certify that international trade in animals and plants does not threaten their survival in the wild (Garrison, 1994). According to the International Union Conservation of Nature (IUCN), most of the existing shark species are categorized as endangered which shows that these species despite their economic values are vulnerable to extinction. About nearly one-quarter of shark species are considered vulnerable, endangered, or critically endangered by the IUCN (Dulvy et al., 2008; 2014). Development and increased shark fishing and trading for their fins are drivers for the observed population decline (Fowler et al., 2010). Globally, shark landings increased from 120,677 tons in 1950 to 414,345 tons in 1997 and since then landings of sharks declined to 383,236 tons in 2010 (Worm et al., 2013). This depletion in the population of the species has ecological consequences due to their life history which includes long life cycles, requiring at least 15 years to reach sexual maturity (Stevens et al., 2000). This global decline in shark populations has led to increasing concern over the future status of shark populations worldwide (O'Bryhim & Parsons, 2015), and cast doubt on the economic success of fishery in sub-Saharan coastal countries.

According to FAO (2014), the fisheries sector accounts for more than US$ 24 billion or 1.3% of the joined GDP of all African nations and also supports 30% of Africa's nutrition and food security. Nonetheless, the livelihoods of many artisanal fishing communities in West Africa are under threat, as the region continues to put increasing pressure on aquatic living resources for sustenance and income, posing a threat to the long-term sustainability of aquatic living resources for food security (Seidu et al., 2022). In the wake of declining aquatic resources, biodiversity loss and the desire to maintain or improve their livelihoods, many fishers in West Africa have shifted to shark fishing as one of the numerous survival strategies (Sall et al., 2021). The economic gain from shark fin products and shark meat at the local and international levels serves as an incentive for the continuous engagement of locals in shark fishing activities along the coast of West Africa

(Fong et al., 2002). Given this, shark fishing in West African countries has been in existence since the beginning of the 19th century and has developed as a result of the growing demand for shark oil for lighting purposes (Sall et al., 2021). As of 2010, the shark fishery underwent a third period of growth which occurred in response to the expansion of international markets for shark meat and, more importantly, the lucrative demand for shark fins in the Asian market (Failler, 2014). According to Sall et al. (2021), these shark fins were reported to be retailed at 350 euros per kg in 2013. One of the West African countries known to be highly involved in shark fishing across Africa and beyond is Ghana (Gelber, 2018). It is estimated about 10 % of the population in Ghana depend directly or indirectly on fish resource, which translates to 2.6 million people of the population (Nunoo et al., 2015). To ensure the sustenance of communities that depend on shark fisheries for survival, there is a need for effective management of this fishery.

Shark fishing among major artisanal fishing communities in Ghana commenced around the 1700s (Seidu et al., 2022). Many fishers and traders generate between 80 and 100% of their income from shark fisheries (Seidu et al., 2022). Since 1950, shark landings have increased erratically in Ghana, peaking at 10,000 tons in 2013 and declining to 8,152 tons in 2015. Since then landings of sharks in Ghana have continued on the declining path (Seidu et al., 2022). Sharks are mostly perceived to be bycatch with their meat mostly used as bait for higher commercial species such as tuna, anchovies, and mackerels, as such they are denied proper management measures (Gelber, 2018).

Currently, due to the expanding demand for shark products in Asian markets, the economic value of shark products, particularly shark fins has increased drastically, making the shark fish business less of a bycatch in Ghana. The participation of fishers in the shark supply chain has gained more economic recognition for various operators in the fishing industry leading to a decline in the production of shark catches which has been precipitated by the reduction of the shark population. In Ghana, some studies (e.g. Seidu et al., 2022; Sekey et al., 2022) have focused on the socio-economic characteristics of shark fishery with little attention to the management component of this fishery. There is limited data and understanding to sustainably manage the fishery. Given this, the study was aimed at assessing shark fishing in Ghana from the perspectives of production, trade, and management. In addition, the science-based information gained from this study will stimulate conversation between key stakeholders (i.e. fishers and traders) and policymakers for the conservation of these endangered species in Ghana.

Material and methods

Study area

The coast of Ghana is divided into four regions (Greater Accra, Central, Western and Volta). For this study, four communities were selected, namely; Tema (5°38'39.2"N, 0°01'00.7"E) in the Greater Accra region, Apam (5°17'15.6"N 0°43'47.1"W) in the Central region, and Dixcove (4°47'37.6"N 1°56'50.0"W) and Axim (4°51'51.7"N 2°14'34.6"W) in the Western region of Ghana (Fig. 1). Many studies have recorded higher catches of sharks in these communities selected as sampling locations for the study (e.g. van Waerebeek & Ofori-Danson, 1999, Debrah et al., 2010). The high landings of sharks and active shark fishing were the reasons for selecting these locations for the study. The fishers in these fishing communities employ the use of purse seine nets (64%), hook and line (12%), *Ali* net (3%), drifting gillnet (13%), set gillnet (6%), and one-man canoe (2%) gears for fishing. *Ali* is a Sardinella drift/surround net, while the *Watsa* and poli are purse seines, the main difference between the two being the twine and mesh size. The poli, which has a much smaller mesh size, is used extensively for the capture of anchovies while the *Watsa* is mainly used for larger-sized pelagic species. Drift gillnets may be either multifilament or monofilament (Dovlo et al., 2016).

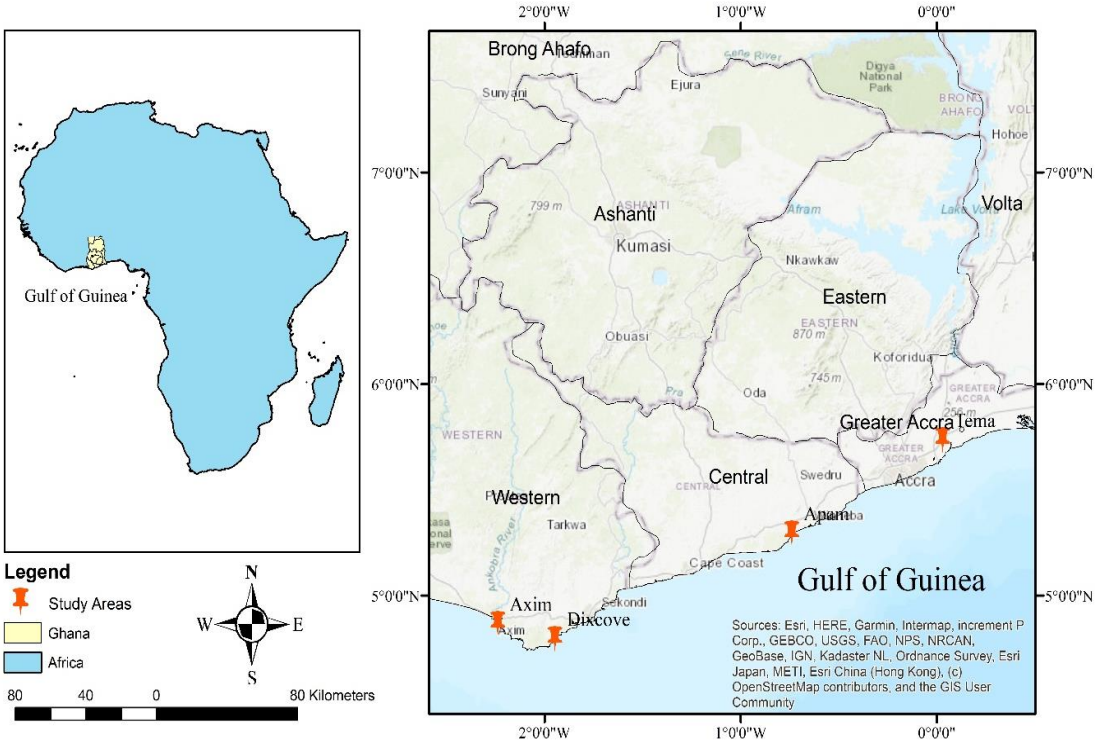

Figure 1. Map showing the study sites

Data collection

For shark production, the number of shark species landed by shark fishers along the sampling fishing communities was recorded daily from April to December 2022. Summation of daily landings of sharks was estimated for each month. The absence and presence of shark species were also documented at the various landing sites. Shark species recorded at each sampling were identified in situ using identification keys by Schneider (1990); Kwei & Ofori-Adu (2005). The total length measurement of the shark species was recorded to the nearest 0.1 cm using a graduated tape measure. Regarding the economic and management of shark fishing among shark fishers from the sampling communities, we conducted semi-structured interviews with ninety-one (91) fishers with the assistance of the local Fisheries Technical Officers. In each of the communities, purposive random sampling was applied in selecting the respondents. Verbal consent of the fishers was sought before the interviews were administered. Data collection at each sampling location was done early morning between the active hours of 6:30 am to 11 am. The inclusion criteria for the selection of respondents were; i) respondents must be shark fishers and ii), must be of age 20 years and above. In addition, key informants (i.e., Chief Fishermen and the Fisheries Technical Officers) were contacted and interviewed at the various communities.

Data processing and analysis

Data obtained from the study were cleaned, coded, and analyzed using the Statistical Package for Social Sciences (SPSS) software, version 26 and Minitab 19.1. The Anderson-Darling test was used to test for normality in the data, prior to analysis (Zar, 2010). Chi-square contingency tests were used to test for significant associations among categorical variables such as gender, years of education, fishing in foreign waters, knowledge of management measures, and presence/absence of shark species. Parametric or non-parametric test depending on the outcome of the normality test was done to determine the significant difference in price and quantity of shark species between peak and lean seasons. The significance difference for the study was taken as p-value = 0.05. A line graph was used to present the monthly production of shark species landed during the study period. Bar and pie charts were used to graphically present the outcome of the analysis conducted.

Results

Shark production

Landings of shark species increased steadily from 21 pieces in April to 142 pieces in June 2021 (Fig. 2). The landings of sharks rose sharply to 416 pieces in August 2021. From August, landings of sharks declined to 147 pieces in September 2021 and gradually to 100 pieces in December 2021.

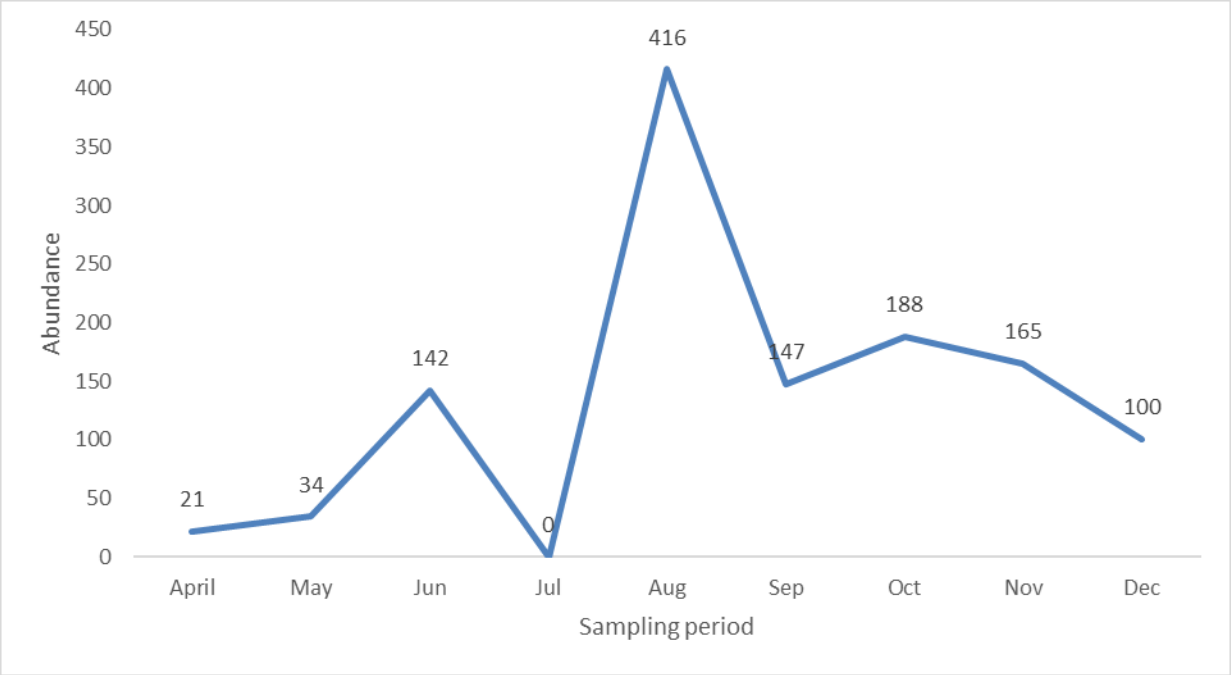

Figure 2. Time series graph of shark species catches sampled (April – December 2022)

Eight species were identified from catches landed at the various sampling stations. Of the eight shark species identified, *P. glauca*, *R. acutus* and *S. lewini* were the dominant species accounting for about 89 % of the total catch (Fig. 3). The remaining species identified from catches landed at the coast were *C. leucas*, *C. taurus*, *I. oxyrinchus*, *I. oxyrinchus*, *C. brevipinna* and *A. supercilliosus.* From the temporal distribution of shark species landed at the various sampling sites, the majority of the species were recorded during the upwelling period (i.e. June – October) as shown in Table 1. Only *C. taurus*, *C. leucas* and *A. supercilious* were not recorded during this period (Table 1). Furthermore, only *S. lewini* and *P. gluaca* were the only shark species recorded throughout the study period (Table 1).

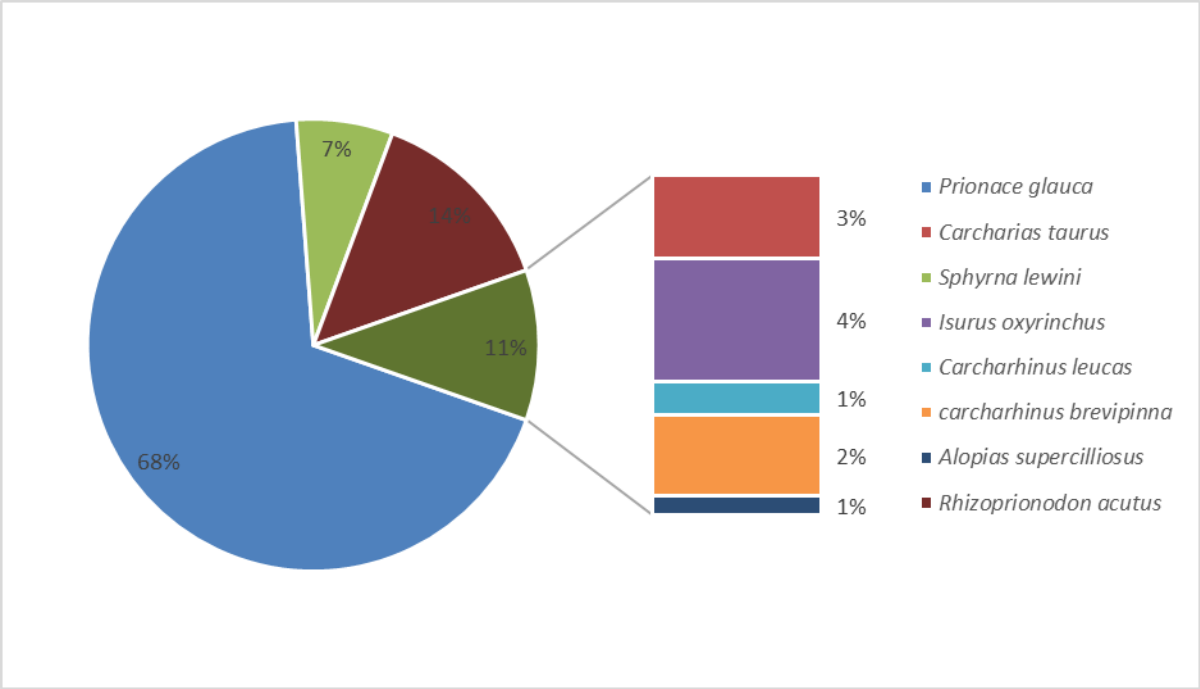

Figure 3. Pie chart of shark species encountered during the study period

Table 1. Temporal distribution of shark species identified during the study period

Species	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Carcharhinus leucas	+	+	-	-	+	-	+	-	-
Carcharias taurus	+	+	-	-	-	-	+	+	-
Isurus oxyrinchus	-	+	+	-	+	+	+	+	-
Prionace glauca	+	+	+	-	+	+	+	+	+
Sphyrna lewini	+	+	+	-	+	+	+	+	+
carcharhinus brevipinna	--	-	+	-	+	+	+	-	+
Alopias supercilliosus	-	-	-	-	+	+	-	-	-
Rhizoprionodon acutus	-	-	-	-	+	+	+	+	+

Note: + = Present; - = absent

From the length distribution Table (Table 2), the maximum length (315 ± 9.09 cm TL) was recorded by *A. supercilious* while *C. leucas* recorded a minimum length of 134.8 ± 15.46 cm TL. The mean length of the remaining shark species is shown in Table 2 below.

Table 2. Descriptive statistics of length measurement for shark species recorded

Species	Mean length (cm)	SE	Minimum (cm)	Maximum (cm)
Alopias supercilliosus	315.4	9.09	250	345
Rhizoprionodon acutus	183.4	4.53	68	350
carcharhinus brevipinna	206.5	12.51	77	358
Sphyrna lewini	203.0	6.78	76	320
Carcharias taurus	146.6	16.42	99	310
Carcharhinus leucas	134.8	15.46	96	187
Isurus oxyrinchus	216.4	7.09	297	297
Prionace glauca	201.8	2.06	23	363

Shark product trade

Three forms of shark fish products were reported by respondents in the various communities (Fig. 4). These were smoked, dried and fermented products with fermented products (42 %) as the main form of shark fish products.

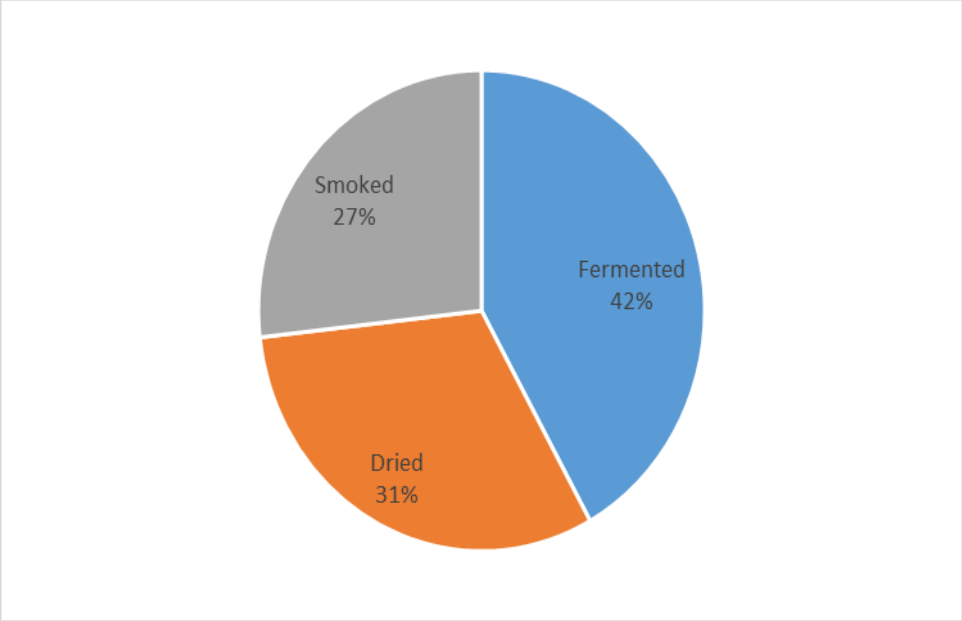

Figure 4. Processed forms of shark meat products

In terms of community, Dixcove and Axim were the communities where all three forms of shark fish products were reported. In Tema, only dried and fermented products were reported while in Apam, only fermented product was recorded (Fig. 5). Chi-square analysis revealed a significant difference among these shark fish products between the sampling communities (χ^2= 71.8, df = 3, $P < 0.001$).

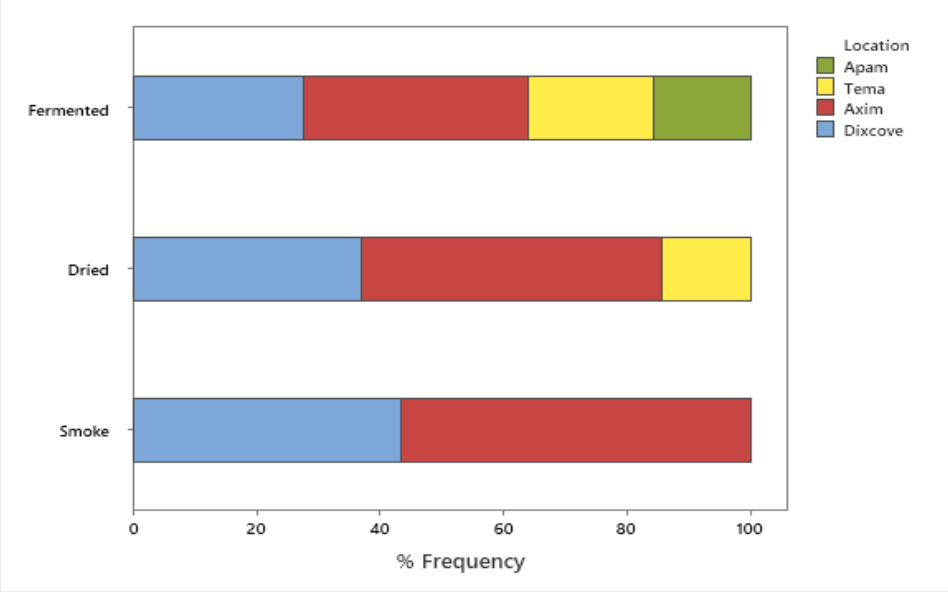

Figure 5. Processed shark products utilised in sampling communities

From Fig. 6, seven shark species were identified as having high economic value for their fin. These include *Sphyrna sp.*, *C. carcharis*, *C. leucas*, *P. gluaca*, *Alopias sp.*, *R. acutus*, and *C. taurus*. Individuals of *Sphyrna sp.* (51 %) were reported to have the highest price for their fins (Fig. 6).

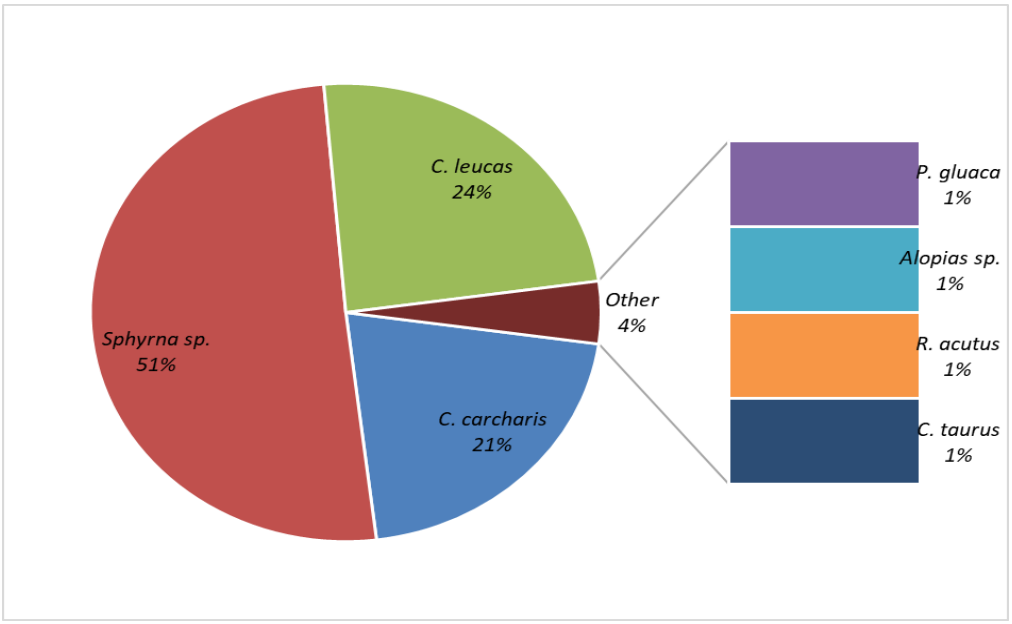

Figure 6. Shark species with valuable fins

Though, the majority had no idea of the final destination of the shark fin products (mostly dried), China, Togo, Hong Kong, Nigeria and Ivory Coast were the main foreign markets for trading in

shark fins as reported by some respondents (Fig. 7). China (18 %) and Togo (14 %) appeared to be the main foreign markets for shark fin products from Ghana.

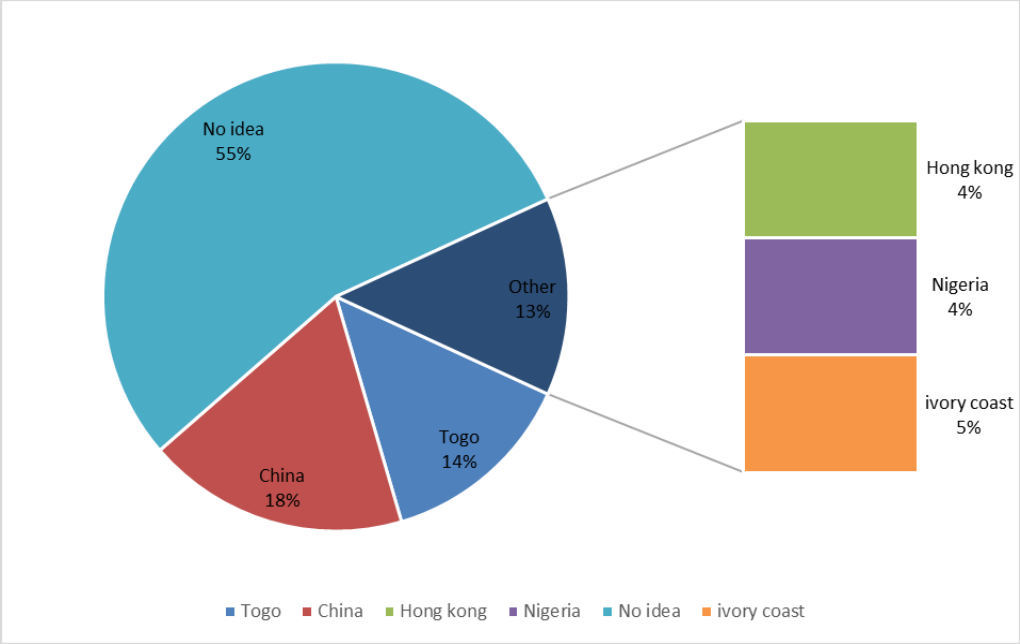

Figure 7. Foreign market for shark trade

The majority of the fishers (97.7 %) affirmed that all the fins of the landed shark species are processed and sold while a few (2.3 %) indicated that only the caudal fin are sold (Table 3). Again, (86.2 %) of respondents indicated that they mostly deal with middlemen (i.e. intermediaries) in their shark fin business while the minority (13.8 %) reported doing direct business with customers involved in the shark fin trade. Most of the respondents (64.7 %) affirmed that the value of the fins has not changed over time with about 35 % reporting a change in the value of shark fin products. When asked about the price of shark fin in the final market, most of the respondents (70.1 %) showed no idea of the final price whereas 29.9 % reported knowing the final price of the shark fin.

Table 3. Opinions of respondents on aspects of shark fish trade (n = 91)

Opinion		Frequency	Percent
Do you trade in all the fins	Yes	79	86.8
	No	12	13.2

Has the value of the fin changed over time	Yes	30	33.0
	No	49	53.8
	No idea	12	13.2
Any middle agents	Yes	75	82.4
	No	4	4.4
	No idea	12	13.2
Any idea about the price in the final markets	Yes	26	28.6
	No	53	58.2
	No idea	12	13.2

The majority of the fishers (86.8 %) affirmed that all the fins of the landed shark species are processed and sold while a few (13.2 %) indicated that only the caudal fin are sold (Table 3). Again, (82.4 %) of respondents indicated that they mostly deal with middlemen (i.e. intermediaries) in their shark fin business while the minority (4.4 %) reported doing direct business with customers involved in the shark fin trade. Most of the respondents (53.8 %) affirmed that the value of the fins has not changed over time with a few (33 %) reporting a change in the value of shark fin products. When asked about the price of shark fin in the final market, most of the respondents (58.2 %) showed no idea of the final price whereas few (28.6 %) reported knowing the final price of the shark fin.

Table 4. Economic characteristics of shark fishing in Ghana

Variable	Mean	SE	Min	Max	Mann Whitney Test (W-value)	P-value
Price of the fin during peak season per kg	30.9	3.4	20.6	34.4	10.0	0.03

(US $)						
Price of the fin during lean season per kg (US $)	48.7	5.4	41.2	63.9		
Quantity of sharks during peak season (Daily)	29.0	1	1	100	6552.5	< 0.01
Quantity of sharks during the lean season (Daily)	2.0	0.3	1	20		

NB: 1 Ghana cedis = 0.069 USD (2022). Bank of Ghana, Inter-Bank Exchange Rate-End Period (GHC/US$) https://www.bog.gov.gh/economic-data/exchange-rate/

Challenges, Management and Conservation of Shark Species

Fig. 8 shows the challenges confronting shark fishing activities in Ghana as indicated by respondents. From these challenges, the decline in the shark population (25.4 %) was identified as the main challenge facing shark fishing in Ghana. In terms of community-specific challenges, low capital and high fishing effort were challenges observed in the Tema fishing community. Rejected shark fins was a challenge only reported by respondents in Dixcove fishing communities. Oil exploitation and inadequate bait were only recorded in Axim fishing communities. Inadequate premix, risky work and a decline in shark populations were the main challenges reported by respondents in Apam fishing communities which could suggest that these fishers are possible migrant fishers (Fig. 9).

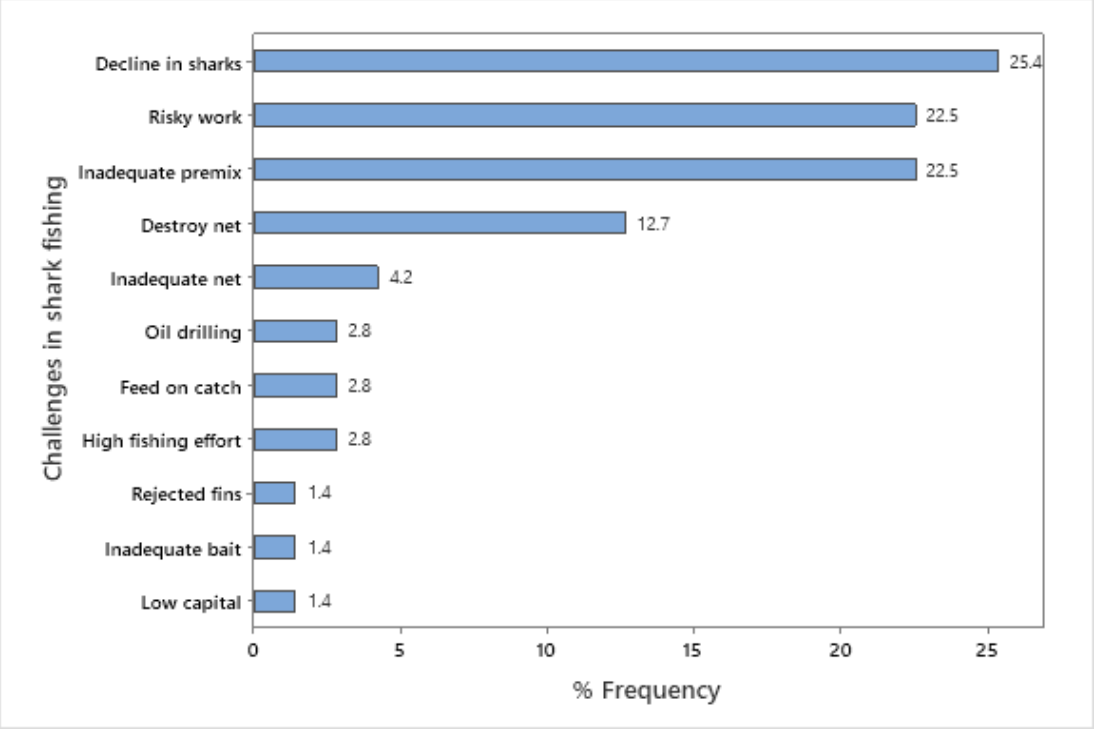

Figure 8. Challenges in shark fishing

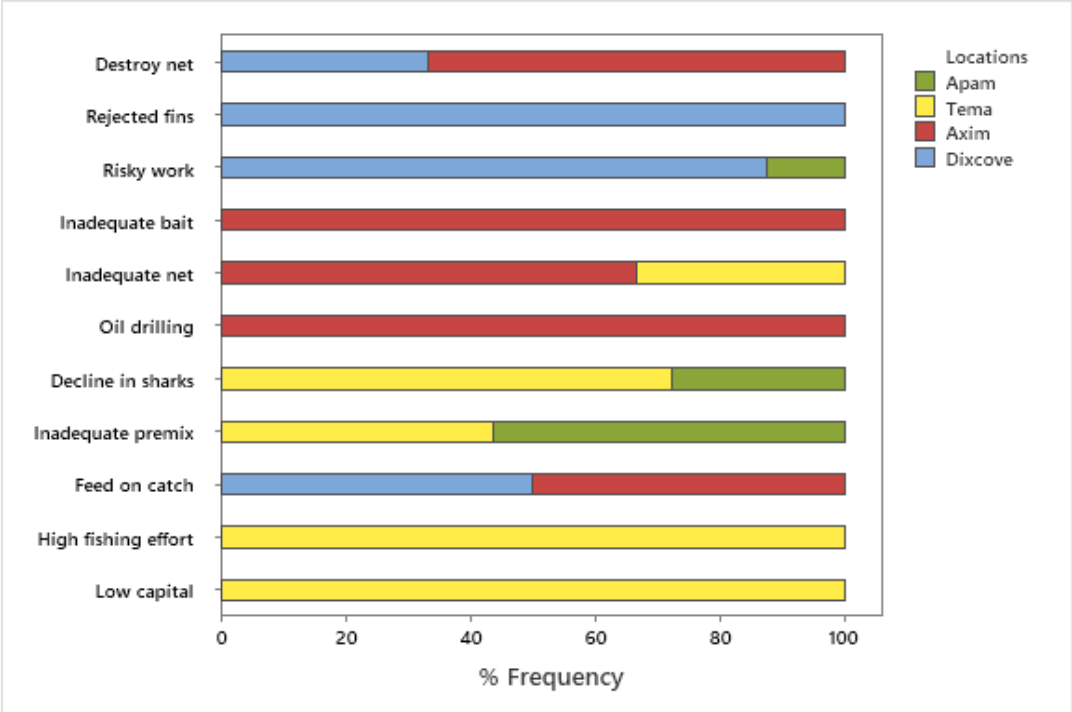

Figure 9. Community-specific challenges in shark fishing

Discussion

Ghana's fish production is largely influenced by the upwelling season. The upwelling season also influences shark production. The first half of the year (i.e. January - May) is seen as a "means to an end" while these fishers await the return of the upwelling fishing period. It is therefore not surprising that a decline in the catches of sharks was recorded during the second half of the year (June – December) which denotes the beginning of the major upwelling period. During the second half of the year, fishers target pelagic species like tuna, sardines, and others which are of higher economic returns to fishermen than shark and shark products. This may have accounted for the reduced shark catches during the studied period. Generally, the rising trend in shark catches from April to December 2022 may correlate inversely with the catches of pelagic fishes in Ghana (Sekey et al., 2023). The number of shark species identified in the current study was in variance to findings from other studies (e.g. Stevens, 2000; Seidu et al., 2022; Gelber, 2018). Possible factors accounting for the variation in other studies may include factors such as environmental parameters, time of sampling, sampling duration, depth and type of fishing gear, biological activities of fish species, geographical location, and the intensity of fishing activities. In terms of relative abundance of species, the Blue shark (*P. glauca*) was the most landed shark species from the coast of Ghana, which was similar to the finding by Gelber (2018). The abundance of Blue sharks suggests a conducive habitat for their survival. Consequently, it is crucial to establish effective management measures to guarantee their sustainable exploitation. The presence of *S. lewini, P. glauca,* and *I. oxyrinchus* in the catches throughout most of the sampling periods except July which was designated as a closed fishing season suggests that these shark species are resident in the Ghana marine waters. Possibly, these species find the marine waters of Ghana conducive for their existence. Furthermore, it demonstrates that these shark species have a wider range of distribution and, hence can be harvested by fishermen along the entire coast of Ghana. However, species like *R. acutus, A. supercilious, C. taurus,* and *C. leucas* are species with possible limited distribution and hence are vulnerable to capture within a certain range of zoogeographical radius (Ebert et al., 2013; Klein et al., 2020). As such, these species are less susceptible to overexploitation than species with a wider range of distribution.

Shark meat is not only seen as an export commodity in fishing communities along the coast of Ghana. Fishers in many fishing communities along the coast of Ghana also consume shark meat, thus providing dietary protein to many of the coastal dwellers. Seidu et al. (2022) indicated that

about 80% of fishers in Ghana preferred consuming meat from Bull Shark (*Carcharhinus leucas*), Hammerhead sharks (*Sphyrna spp*), Mako sharks (*Isurus spp*), other requiem sharks (*Carcharhinus spp*) and Sand Tiger Shark (*Carcharias taurus*). In addition, these fishers also perceive shark meat as a cash crop, as such they sell the shark meat either in the smoked, dried, or fermented form. From the study, fermented shark meat products were the most preferred shark products for trade in all four sampling locations, thereby helping to meet food and nutrition security needs. This suggests that the consumption of fermented shark products is highly patronized in these fishing communities. The use of fermented shark products as a condiment in the preparation of local dishes has qualified it as the most patronized shark product among consumers in Ghana (Essuman, 1992). In addition, the consumption of shark products appeared to be peculiar to certain fishing communities. This may be due to factors such as market opportunities, consumer preferences, and how these landed sharks are processed. Seidu et al. (2021) reported that some Ghanaians do not consume smoked shark products due to the nauseating way they are processed and associated health factors. Based on these factors, traders may limit the trading of such products in the fishing communities. One of the significant dried shark products is the dried fin, which fetches more money than selling the whole body of the fish. Irrespective of the food security needs that are being met by the consumption of sharks, human consumption of sharks is widely recognized as a threat to biodiversity loss (Rodenbiker et al., 2023), and this must be a critical look at in Ghana.

Shark fins are among the most economically valuable seafood commodities with a market value of approximately US$ 400-550 million a year (Clark et al., 2006). According to Jaiteh et al. (2017), the average price of shark fin in Asian markets averages around US $ 45 per kg while shark meat costs about US $ 4 per kg as indicated by (Okes & Sant, 2019). This was relatively similar to the average price of sharks during the lean season in Ghana, potentially due to the scarcity of shark species. However, during the peak season when shark landings are higher, the average price globally was higher than the average price recorded from the study. However, not all shark species attract very good prices for their fins as some shark species are seen to be more valuable than others. Given this, the study discovered that *Sphyrna spp., C. leucas*, and *C. carcharias* attract the highest economic value for their fins because these species are tough and their fins are durable. The study by Seidu et al. (2021) confirmed these findings by reporting that Hammerhead sharks (*Sphyrna spp*) and Bull Shark (*C. leucas*) are of high quality and therefore are priced higher than the fins from other shark species. Consequentially, the perceived high value

of their fins may have catalyzed the fishing pressure on these few shark species leading to their drastic decline in population. As such, the government needs to identify measures to control the trade of fins from these endangered species to maintain their populations in the marine waters of Ghana. In addition, few fishers also trade in specific shark fins (e.g. caudal fins) these fins are longer and stronger than the other set of fins. In addition, the type of fin whether dorsal or caudal fins affects the price of the shark fins (Clarke et al., 2007). Again, demand, dry weight, and seasonality affect the price of shark fin as price increases when there is less abundance of shark species during the lean season and vice versa during the peak season (Seidu et al., 2021). Within China market, the prices of shark fin products are highly influenced by economic, cultural, and traditional factors (IOC, 2015; Clarke et al., 2007). Culturally, shark fin soup is served at the wedding banquet, symbolizing the passage of an individual from one stage to the next (Cheung & Chang, 2011). Fowler & Seret (2010) also pointed out that factors influencing shark fin value are driven by the type of species, position of the fin, and size of the fin. Nonetheless, the price of shark fin in Ghana in both fishing seasons fell within the range of price for shark fin trade in Asia (i.e. US $ 2 to US $ 75 per kg) as reported by Jaiteh et al. (2017). Discrimination in the economic value of shark fins could lead to a high decline in the population of the affected shark species.

Many fishers are oblivious to the final destination of their shark fin products that intermediaries buy from them, mainly because they are only concerned with the income they obtain from these intermediaries and as such careless about the final destination nor the price charged at these final destinations by intermediaries in the shark-fin value chain. In line with this, Karnard et al. (2020) opined that most shark fishers are disconnected from the high profits that characterize the international trade in shark fin but are well acquainted with the price of shark meats in local markets. Disconnecting fishers from price information at the final markets implies that intermediaries make more income from the shark fin trade (Karnad et al., 2020) than the shark fishers despite the risky nature of fishing for sharks (Iwane & Leong, 2020). Many Ghanaian shark fishers significantly engage the activities of intermediaries in their shark fin trade activities because they lack the financial ability to connect directly with customers at the final destination or markets. However, once they become financially stable, these fishers bypass these intermediaries to trade directly with the customers in the final markets. Nonetheless, if most fishers are made aware of the price of shark fin products at the final destination their economic conditions will improve as they will be able to negotiate better prices for their shark fin products. Final shark fin markets in China and Togo appeared to be the preferred shark fin markets in Asia and Africa

respectively for fishers who knew the final markets for their shark fin products. The presence of West African countries like Togo, Ivory Coast, and Nigeria in the shark fin supply chain suggests that these countries are potential links between shark fishers in Ghana and the final destinations in the Asian continents including markets in China and Hong Kong. These sub-Saharan countries engage in the shark fin trade because they attain economic boost from shark fin trade (Jaiteh *et al.,* 2017). For decades, Hong Kong and China have been the center for world trade in shark fin products, processing about 50% - 85% of global shark fin imports from about 85 countries (Shea &To, 2017; Jabado et al., 2015; Clarke, 2006; Schaeffer, 2004). China and Hong Kong have maintained the number one spot for shark fin trade because these countries treat shark fins as legal fishing products (Shea &To, 2017). Jabado et al. (2014) revealed that approximately 500 mt of dried raw sharks is exported annually to Hong Kong. Pincinato *et al.* (2022) reported that the high value of shark fins in Asian countries has given incentives to fishers from Africa to continuously engage in shark fin trade, even to the extent of using intermediaries to reach these Asian countries. No livelihood activity involving humans occurs without challenges, and shark fishing in Ghana is no exception. From the present study, the risky nature of this activity, and inadequate premix fuel were the main challenges experienced by shark fishers in Ghana. Following the risky nature of shark fishing activities (Iwane & Leong, 2020), affordable and accessible personal protective equipment (PPEs) should be made available to shark fishers in all shark fishing communities. According to Asiedu et al. (2022), the distribution of premix fuel is mostly done based on the headcount of local fishers in a particular fishing community, without cognizance of the presence of migrant fishers. Therfeore, recoginazing the migratory nature of shark fishers (Asiedu et al., 2022; Sall et al., 2021) is essential for equal distribution of premix fuel.

Generally, the conservation of aquatic organisms faces challenges (Rodenbiker et al., 2023). To promote a conservation-based approach to shark fishing, Press et al. (2016) indicated that government officials have to recognize the decline in the population of the shark species and obtain a greater scientific understanding of the role of sharks in the ecosystem. This will aid in the formulation species-specific management action plan for the conservation of these species. Education and awareness programs are also necessary to increase knowledge about endangered shark species or environmental problems affecting their populations and shark fishers' attitudes toward conservation (Karnard et al., 2020; O'Bryhim & Parsons, 2015; Friedrich et al., 2014).

Conclusion

The study aimed to assess shark fishery in Ghana from the perspectives of production, trade, and management. Shark exploitation was relatively high during the lean season which demands proper management measures to avoid over-exploitation. The use of live bait by fishers in shark fishing activities may negatively impact marine biodiversity. In terms of socio-economics, critically engaged shark species including Sphyrna sp. and C. leucas were highly exploited for their highly valued fins. China and Togo were the main international markets for shark fin trade through the activities of intermediaries. Inadequate fuel and the risky nature of shark fishing activities were the main challenges facing shark fishers in Ghana. To ensure proper management of shark species in Ghana, species species-specific management plan should be developed. In addition, education and awareness programmes should undertaken in fishing communities to foster voluntary adherence to conservation and management measures.

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