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Fisher perceptions of catch and trade of sharks and rays in Angolan small-scale fisheries

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Abstract

Small-scale fisheries ensure food security and employment in Angolan coastal communities. These dynamic, widespread fisheries remain mostly unregulated, with limited data available despite their likely significant impact on marine megafauna. We used an interview-based survey to investigate local fisher interactions with elasmobranchs (sharks and rays) and gather information on utilization, trade and perceptions. All fishers ($n = 83$) landed elasmobranchs. Most fishers considered sharks as bycatch (74.7%, $n = 62$), while 100% targeted rays (Order Myliobatiformes), and 62.8% ($n = 52$) targeted guitarfishes (Order Rhinopristiformes). Over 80% of fishers reported declining catches and sizes of elasmobranchs over the last 30 years, raising concerns about the sustainability of these fisheries. Utilization and trade routes varied depending on elasmobranch products, with exports to China (fins) and local market sales (meat). Specifically, 8.4% ($n = 5$) of fishers confirmed meat and fin exports to China (4.8%, $n = 3$). The protection of sharks was considered by 32.5% ($n = 30$) of respondents, while 21.7% ($n = 18$) believed only certain shark species should be protected. Most respondents reported that rays (80.5%, $n = 67$) and guitarfishes (61%, $n = 51$) should not be protected. Regarding the ban on fishing, none considered it for ray species, with only 6.1% ($n = 5$) supporting this idea for guitarfishes. We highlight the lack of elasmobranch-specific conservation measures and the need for a multi-pronged approach to inform policy. Considering the scale of these fisheries, management actions need to be urgently developed and implemented to ensure the sustainability of elasmobranch fisheries while securing the livelihoods of coastal communities.

KEYWORDS

Angola, conservation, guitarfish, interviews, local ecological knowledge, ray, shark

1 | INTRODUCTION

Overexploitation is recognized as a global threat to marine biodiversity (Knapp et al., 2017). Over the last two decades, populations of many elasmobranch species (sharks and rays) have drastically declined around the world due to the rapid and largely unregulated growth of target and bycatch fisheries (Dulvy et al., 2021; Jabado et al., 2018; Pacoureau et al., 2021). Understanding and monitoring such exploitive activities is an urgent priority for biodiversity conservation, especially in the Global South, where highly dynamic, yet unregulated, small-scale (or artisanal) and semi-industrial fisheries operate and can have a significant impact on marine megafauna populations (Bawa & Menon, 1997; Lewison et al., 2004).

Small-scale fisheries (SSF) comprise the large majority of the world's fishers, make a significant contribution to global fish captures with more than half of the world's annual catch and supply most wild fish consumed in the Global South (Berkes et al., 2001; Chuenpagdee et al., 2006; Béné et al., 2007). In many countries, the SSF sector plays a critical role as a source of animal protein and therefore food security, employment generation and the development of local economies as a potential route to poverty alleviation (Béné et al., 2007). In West Africa, SSF and subsistence fishers are estimated to employ at least 1.7 million people (Belhabib et al., 2015). Yet, there remains a paucity of information on this important sector, and, in most cases, fleet sizes and the number of people that depend upon it are unknown (Béné, 2006; Teh & Sumaila, 2013). West African SSF are geographically scattered, sometimes seasonal, mostly unlicensed and largely unregulated, with limited enforcement if legislation exists, leading to difficulties in quantifying their impact on target and non-target species (Béné, 2006; Berkes et al., 2001; Chuenpagdee et al., 2006; Lewison et al., 2004; Pauly, 2006; Teh & Sumaila, 2013). Due to these characteristics, even in resource-rich countries, SSF are challenging to monitor and study (Chuenpagdee et al., 2006). Indeed, in the Global South, due to insufficient resources and poor infrastructure, SSF and semi-industrial fisheries remain relatively understudied and low on research and policy agendas when compared with large industrial fisheries (Berkes et al., 2001; Lewison et al., 2004; Pauly, 2006; Salas et al., 2007). Yet, SSF are recognized as having a significant environmental impact and being an important source of mortality for marine megafauna, including sharks and rays (Lewison & Crowder, 2007; Mangel et al., 2010; Moore et al., 2010; Soykan et al., 2008).

Concerns over the global status of elasmobranch populations have been raised at an international level for decades (e.g. Dulvy et al., 2021; Stevens et al., 2000). In fact, since 1970, the global abundance of oceanic sharks and rays has declined by 71%, while relative fishing pressure has increased (Pacoureau et al., 2021). In the Mediterranean Sea, as well as the Arabian Sea and its adjacent waters, over 50% of shark and ray species are considered threatened with extinction (i.e. Critically Endangered, Endangered or Vulnerable) according to the IUCN Red List of Threatened Species™ (Dulvy et al., 2016; Jabado et al., 2018). Similarly, since the 1970s, significant declines have been reported in elasmobranch stocks in Northwest Africa (e.g. Diop & Dossa, 2011). More recently, reports have raised the alarm on the impact of fisheries on sharks and rays in other West African countries like Congo and Ghana (e.g. Momballa, 2020; Seidu et al., 2022b). Furthermore, a systematic quantitative assessment of sharks and rays landed by an artisanal fishery in the Republic of the Congo highlights that this region is a hotspot for threatened sharks and rays (Doherty et al., 2023).

However, such data are not available for Angola, where a significant SSF sector operates in parallel with a large industrial commercial fishing sector (Belhabib & Divovich, 2014; Sowman & Cardoso, 2010). Reports from over a decade ago already indicated that coastal elasmobranchs in Angola were threatened due to high fishing pressure (Sowman & Cardoso, 2010). However, a fishery monitoring programme has been nonexistent in the country due to Angola's post-colonial civil war (1975–2002) along with a lack of resources and capacity (Belhabib & Divovich, 2014; Sowman & Cardoso, 2010).

Angolan fisheries are characterized by three marine fishing sectors: large-scale industrial (comprised of mostly foreign fleets with many national vessels not in use due to lack of repairs and maintenance and unavailable spare parts), semi-industrial and small-scale artisanal (Belhabib & Divovich, 2014; Lankester, 2002). The SSF sector is extremely large, with an estimated 102 artisanal fisher settlements, mostly concentrated in the northern provinces (Duarte et al., 2005). It employs approximately 100,000 fishers, mostly using beach seines, as well as an additional 35,000 fishers using 5244 non-motorized boats (<12 m) and 3585 motorized boats (up to 14 m) in coastal waters (within four nautical miles from the shore) (Duarte et al., 2005; FAO, 2023; Sowman & Cardoso, 2010). Due to the difficulty in monitoring scattered locations and the lack of requirement for Angolan fisheries to report on levels of bycatch (Basson et al., 2007), there is a large gap in our understanding of catch and landing quantities, species composition and fishery impact on elasmobranch populations. Data on species diversity, historical and baseline data on relative abundance and characteristics of fisheries are urgently needed to understand the impact of the Angolan SSF sector on sharks and rays.

Consequently, the Angolan Governance Framework regarding sharks and rays is lacking, and there are no conservation or management measures for these species in Angola. In fact, species-specific data for Angola are not available to evaluate trends over time with country reports to the Food and Agriculture Organization of the United Nations (FAO) using the aggregated categories of 'sharks, skates, rays, etc, nei' and 'rays, stingrays, mantas nei' (FAO, 2023).

To overcome challenges in data collection and address knowledge gaps, scientists have increasingly drawn on new approaches to systematically collect data on bycatch from fisheries and understand the impact of SSF on various marine megafauna species (e.g. Jabado et al., 2015; Moore et al., 2010). Many studies have focused on using community-based social science interview and survey techniques (e.g. Colloca et al., 2020; Jabado et al., 2015; Seidu et al., 2022b). Furthermore, considered a well-established area of social and ecological research, local ecological knowledge (LEK) provides insight into local attitudes towards species of interest (e.g. Johannes et al., 2000; Sáenz-Arroyo, Roberts, Torre, & Cariño-Olvera, 2005; Temple et al., 2019). In data-poor regions where conservation concerns exist, LEK has been valuable to leverage the deep understanding of local resource users (Aylesworth et al., 2017; Menzies, 2006; Stocks et al., 2019).

In the absence of reliable fisheries statistics for any elasmobranch species in Angola, the scarce information on the contribution of SSF to the food security and livelihoods of hundreds of coastal communities, or its impact on elasmobranch stocks, LEK surveys represent the best available approach to profile Angolan fisheries and understand the current situation.

This study is the first attempt to understand and characterize small-scale elasmobranch fisheries in Angola. We present results stemming from fishers LEK and provide insights into the social, motivational, economic and conservation aspects of these fisheries. Our main objectives were to: (1) collect historical information and current insights on the status of elasmobranch fisheries; (2) understand the nature of interactions between fishers and elasmobranchs; (3) characterize the fisheries, including fishing sites, gears, target species and preferences, catch seasonality, species diversity and utilization; (4) understand perceptions on trends in elasmobranch catches and sizes over time; and (5) gather viewpoints on elasmobranch conservation and interest in contributing to future management decisions.

2 | METHODS

2.1 | Study area

Angola is located between the tropical waters of the Gulf of Guinea and the boundary of the temperate Benguela Current arising from the upwelling off the Namibian coast (Tweddle & Anderson, 2008) (Figure 1). With a coastline of 1650 km, it is considered a highly biodiverse area and is part of the Benguela Large Marine Ecosystem (BCLME), one of the most productive ecosystems in the world (Velho, 2011).

The Angolan coastline is delimited into three geographic fishing zones: (1) the Northern Fishing Zone, from the mouth of the Congo River to Luanda; (2) the Central Fishing Zone, extending from Luanda to Lobito; and (3) the Southern Fishing Zone, from Lobito to the mouth of the river Cunene (Lankester, 2002) (Figure 1). While there are no recent updates on the number of small-scale communities along the coast, Duarte et al. (2005) describe about 102 artisanal fishing settlements along the coastline, largely concentrated in the northern provinces. Moreover, the Angolan Institute for the Development of Artisanal Fisheries (IPA) estimates that approximately 35,000 artisanal fishers and 6600 artisanal fishing boats operate in its coastal waters (Duarte et al., 2005; Faria et al., 2021).

After undertaking a pilot survey in March 2018 to determine accessibility to small-scale fishing sites within this region, we decided to focus this study on fishers operating off the Central Fishing Zone, across the provinces of Luanda and Bengo. In the selection of the

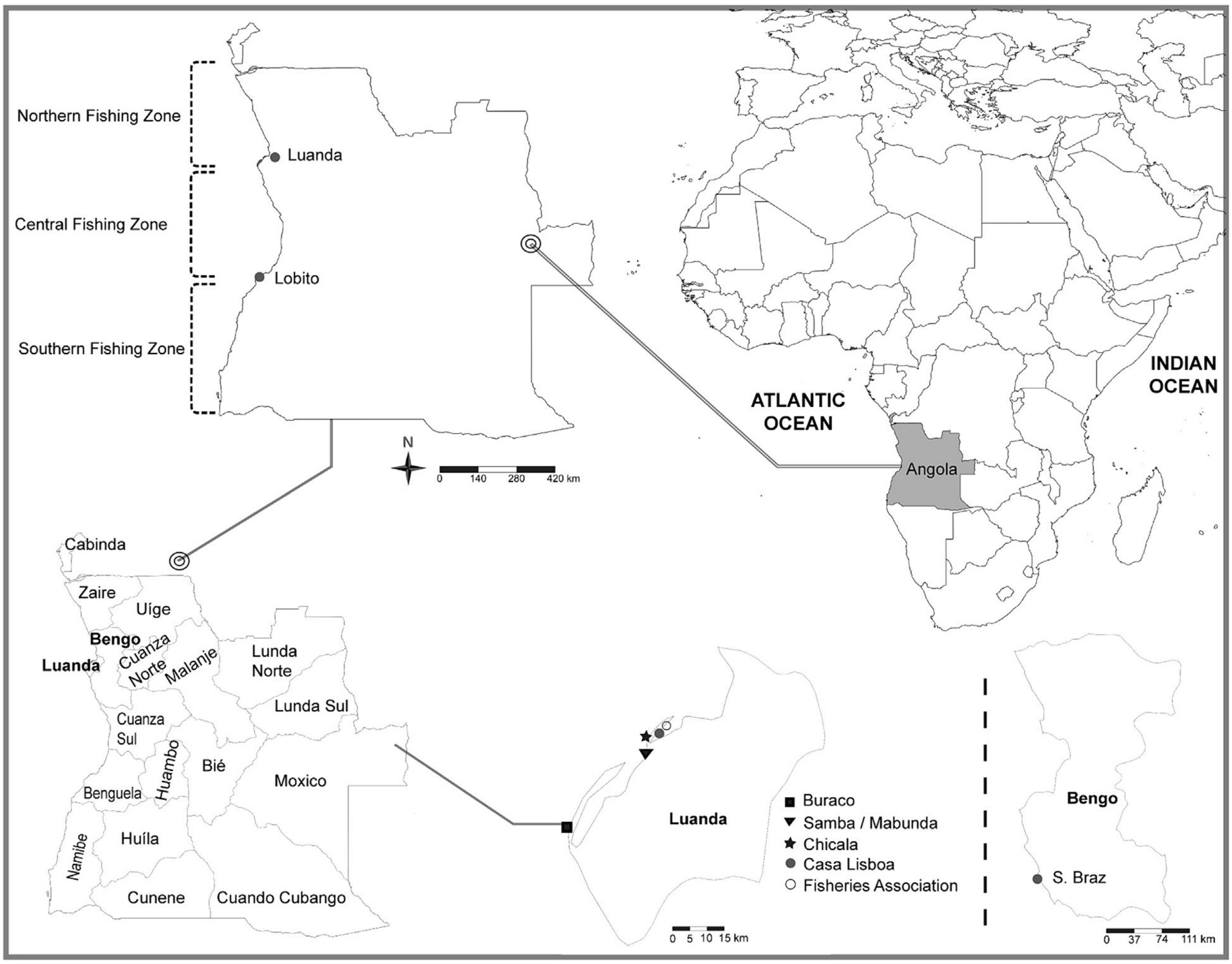

FIGURE 1 Location of the study area in Angola, with the three geographic fishing zones indicated: North, Central, and South. The five landing sites and fishers' association are located in the Central Fishing Zone, in the provinces of Luanda and Bengo.

initial sampling region, proximate to the capital of Angola, logistical considerations took precedence.

We chose sites based on referrals from fishers, government officials, and the current available literature. The continental artisanal fishing activity includes a total of 4050 fishers and 6111 boats in the province of Bengo and 4500 fishers and 4130 boats in the province of Luanda (Fisheries and Agricultural Institute of Angola, 2021) (Table 1).

2.2 | Interviews

Between November 2018 and October 2019, we used a questionnaire adapted from Moore et al. (2010) and Jabado et al. (2015) to conduct one-on-one interviews using semi-structured questions at markets, beach landing sites and fisher associations. We acquired permission from the village chief's prior to conducting the interviews. Before the start of each interview, we informed respondents that this was an independent scientific investigation, not affiliated with any government or fishery management body. Fishers may be hesitant to honestly respond to governmental and fishery bodies due to concerns that their practices, possibly not legally registered, could jeopardize their livelihood. We explained survey objectives and sought consent to conduct interviews while guaranteeing anonymity unless fishers voluntarily provided their names. When conducting one-on-one interviews, I requested that respondents convene at a designated location to ensure a disturbance-free environment.

The questionnaire was divided into six sections to gather information on: (1) fisher's background; (2) fishing practices including gear and vessel characteristics, targets and catch locations; (3) interactions with sharks (Order Carcharhiniformes); (4) interactions with rays (Order Myliobatiformes); (5) interactions with guitarfishes (Order Rhinopristiformes); and (6) perceptions on species conservation and interest in contributing to future management decisions (Data S1). Interviews were conducted in Portuguese by the lead author and lasted approximately 20 min each. We determined the number of fishers to approach per site depending on respondent availability and topical saturation. When similar themes kept recurring between respondents and no new insights were given, interviews were concluded (Guest et al., 2006). To ensure accurate species identification and mitigate potential discrepancies arising from variations in local terminology (Jabado et al., 2015), species identification was supported through the development and use of an identification poster with illustrations of shark and ray species known to occur in West Africa. The utilization of an illustrated guide was substantiated by the linguistic diversity observed among the fishers, as even though proficiency in Portuguese was prevalent, particularly older participants occasionally resorted to local species names, influenced by Indigenous languages. Species occurrence, and therefore the accuracy of species identification during interviews, was also confirmed through landing site surveys undertaken in parallel with the interviews (Soares, unpublished data).

2.3 | Data analysis

All interviews were translated to English, and data were summarized to deliver broad qualitative descriptions of how fishers responded to individual questions. Open and occasionally axial coding (to group responses with similar open codes) were utilized for further analysis with SPSS (Statistical Package for Social Sciences 27.0.1).

3 | RESULTS

3.1 | Overview of fishers' background

In total, 83 interviews were conducted in the provinces of Luanda (75%, $n = 62$) and Bengo (25.3%, $n = 21$) at five small-scale fishing sites and one fisher association, where fishers were active in small-scale and semi-industrial fisheries. Because fishing is exclusively a male activity, all respondents were Angolan male fishers and ranged in age from 17 to 73 years old (mean = 40.6 years ± 14.43 SD). Fishers between 30 and 49 years old accounted for almost half of respondents (45.8%, $n = 38$), while younger age groups (17–29 years old) accounted for 27.7% ($n = 23$) (Figure 2).

Respondents started fishing aged 7–20 years old, with more than half having started fishing activities before the age of 14 (58%, $n = 48$). Fishing was a family tradition for all respondents, having learned their skills from their fathers or close relatives, and more than half had between 10 and 30 years of fishing experience (57.8%, $n = 48$), while 38.6% ($n = 32$) had between 40 and 62 years of experience (range from 6 to 62 years of fishing experience (mean = 27.83 ± 13.71 SD).

Site	Province	Number of fishers	Number of fishing boats
Buraco	Luanda	98	~100
Samba/Mabunda	Luanda	~150	≥ 200
Chicala	Luanda	~50	~20
Casa Lisboa	Luanda	~50	~49
Fishers Association	Luanda	~40	~33
S. Braz	Bengo	~100	~37

TABLE 1 The six sites sampled across the Angolan Central Fishing Zone with information on the province, the number of fishers and the number of small-scale fisheries (SSF) boats operating in the various communities (Fisheries and Agricultural Institute of Angola, 2021).

3.2 | Characterization of fishing gear, techniques and sites

Fishing was the main occupation for all respondents, each holding various positions on vessels. The majority of fishers served as boat owners and operated as captains (53%, $n = 44$), followed by 41% ($n = 34$) in the capacity of staff. Furthermore, 6% ($n = 5$) owned boats but employed crew members for fishing operations. The exclusive utilization of three vessel types was observed: pirogas (8.5%, $n = 7$), chatas (65%, $n = 54$) and catrongas (26.5%, $n = 22$).

Pirogas are non-motorized wooden canoes measuring 4–5 m in length. Fishers typically spend between 1 and 6 h at sea, often operating between 6:00 AM and 12:00 PM. These vessels are manned by a crew comprising 2–3 local workers.

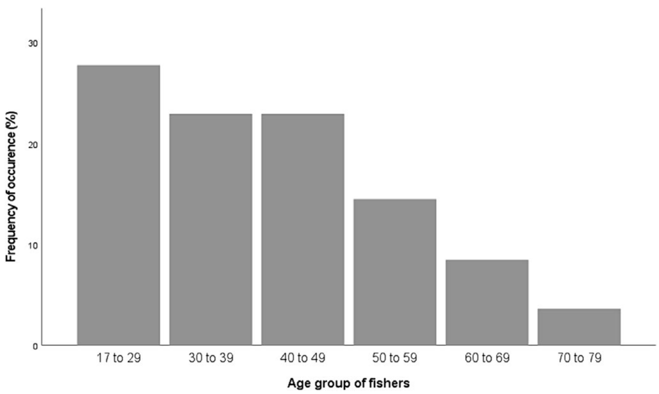

FIGURE 2 Fishers' age group according to the frequency of occurrence of respondents in each age category.

Due to the unstable nature of *pirogas*, fishers restricted their coverage to areas within 1 km from their departure port. These vessels capture on average 20–30 kg of fish per day. *Pirogas* were the vessel least utilized across all sites and were more commonly employed as 'support boats' for larger vessels such as *chatas* and *catrongas* (Figure 3).

Chatas are wooden or fibreglass planked boats (5–7.5 m in length) with one outboard engine of 25–40 HP and 3–5 crew members. Fishers operating these vessels had varying and flexible schedules, with trip durations ranging from 1 h, landing mainly fresh fish, to up to 5 days, predominantly landing mainly salted fish (68.5%, $n = 57$). Moreover, some fishers preferred several trips in 1 day between 6:00 AM and 12:00 PM or 18:00 PM and 00:00 AM (31.5%, $n = 26$). *Chatas* were used to fish in coastal areas or, if the weather allowed, up to 15 km offshore to find more.

Catrongas are wooden, fibreglass or steel (or a combination of these materials) boats, 10–15 m in length with a crew of up to 15 individuals, inboard engines of up to 400 HP, facilities for fish preservation and often lack mechanized equipment for fishing or navigation. Fishers dedicate varying durations to each trip. Fishing trips can range from 12 h and up to 5 days mainly between 6:00 AM and 12:00 PM and 18:00 PM and 00:00 AM (42.1%, $n = 35$). However, most spent 3–5 days on each trip (57.9%, $n = 48$), covering distances up to 150 km offshore and capturing 500–900 kg of fish per day. *Catrongas* were only utilized within the city of Luanda at sites with appropriate landing docks (Samba [62.5%, $n = 52$] and Casa Lisboa [75%, $n = 62$]). At sites with no landing docks and where

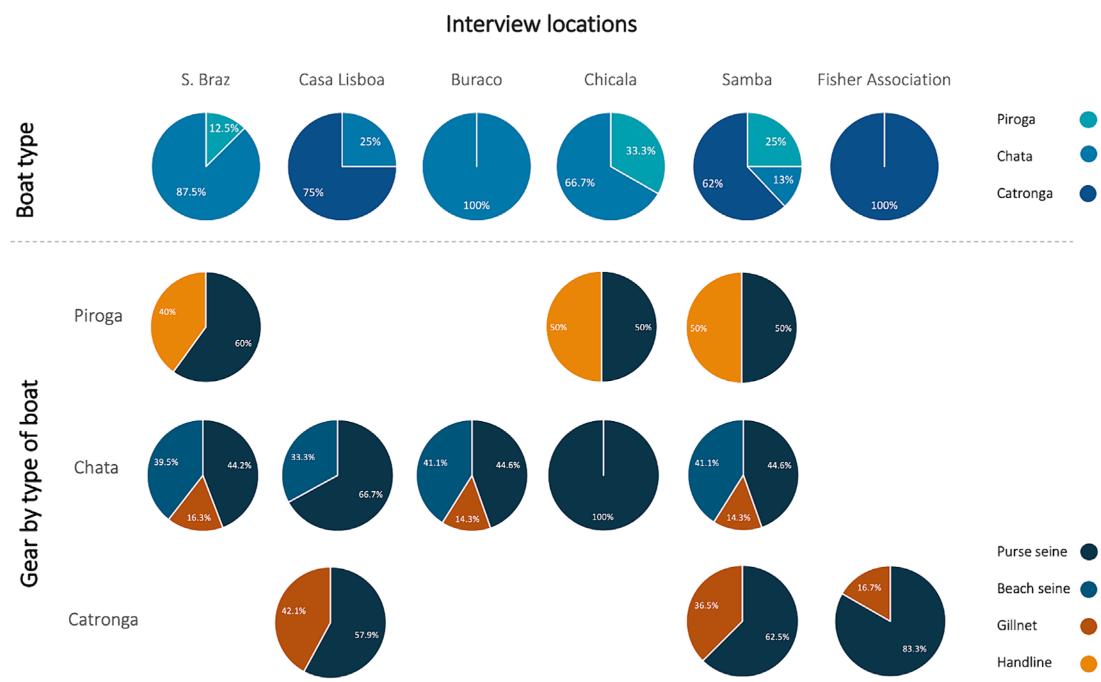

FIGURE 3 Type of boats utilized (piroga, chata and catronga) at each site (by frequency of response) and frequency of gear type (beach seine, purse seine, gillnet and handline), mentioned by site according to the type of boat utilized.

catrongas cannot reach the beach, fish is transported to the shore mostly by *chatas* (but sometimes by *pirogas*) to be sold at markets.

Sites surveyed showcased the diversity of small-scale fishing villages in Angola. Sites within the city, such as Samba and Casa Lisboa, had landing facilities as well as processing and trading areas for fishers using *catrongas* and often *chatas* and/or *pirogas*. On the other hand, in Chicala and São Braz, fish were landed on the beach, where fishers using a combination of *chatas* and *pirogas* organized and coordinated sales with women who oversaw the processing and marketing of fish products. Buraco also had some infrastructure to support local fisheries, such as traditional fish drying stalls and a small fish treatment area where women separate, clean and cut fish. Consequently, landings in Buraco were mainly fresh in comparison to the other sites where fish processing (cutting and drying) is done onboard due to limited ice supply and drying facilities.

All fishers used a multi-species and multi-gear approach according to the boat type utilized. When operating *chatas*, fishers utilized multiple fishing gears, such as beach seines, gillnets and purse seines. Handlines were only used on *pirogas* in combination with seine nets, while on *catrongas*, a combination of seine nets and gillnets was used (Figure 3). Overall, the main fish targets were various species of Scrombridae (mackerels) (91.6%, $n = 76$), Nematistiidae (roosters) (72.3%, $n = 60$), Clupeidae (sardines) (61.4%, $n = 51$) and Lutjanidae (red snappers) (61.4%, $n = 51$), although 9.63% ($n = 8$) of respondents had no target species.

3.3 | Fishing seasonality

Shark fishing was described as having two distinct seasons. Most respondents (89.2%, $n = 74$) highlighted winter (May to August) as the high season for shark fisheries, with up to 50 sharks caught per season. Summer (September to April) was considered the low season (89.2%, $n = 74$), with up to 20 caught sharks per season. Respondents stated that rays (34%, $n = 28$) and guitarfishes (44.7%, $n = 37$) were captured throughout the year. Nonetheless, fishers highlighted winter as the peak season for ray (53.2%, $n = 44$) and guitarfish (42.6%, $n = 35$) landings, with catches ranging between 4 and 100 animals, and summer as the low season, with the number of captured rays and guitarfishes ranging between 4 and 40.

3.4 | Species diversity and utilization

When presented with species illustrations, the ability to distinguish between species for all fishers was low. Only a few fishers (4.8%, $n = 4$) were able to distinguish between various shark and ray families; however, 42% ($n = 35$) of respondents commented on general appearance and distinct features. These included comments such as 'heads in the shape of a hammer' (Sphyrnidae, hammerhead sharks), 'big eyes and sharp teeth' (Lamnidae, mako sharks), 'elongated upper tail' (Alopiidae, thresher sharks), 'devil horned shaped and wide head' (Mobulidae, mantas and devil rays), 'eye-like pattern on the upper body' (Rajidae, African brown skate) and 'combination of ray and shark' (Glaucostegidae and Rhinobatidae, guitarfishes).

Although it was not possible to obtain species-specific information on catches, some of the species described and confirmed during field surveys (Soares, unpubl. data) include the silky shark (*Carcharhinus falciformis*), bull shark (*Carcharhinus leucas*), common blacktip shark (*Carcharhinus limbatus*), milk shark (*Rhizoprionodon acutus*), smooth-hound shark (*Mustelus mustelus*), shortfin mako (*Isurus oxyrinchus*), thresher sharks (*Alopias* spp.), scalloped hammerhead (*Sphyrna lewini*), daisy whipray (*Fontitrygon margarita*), pearl whipray (*Fontitrygon margaritella*), African brown skate (*Raja parva*), Seret's butterfly ray (*Gymnura sereti*), whitespotted guitarfish (*Rhinobatos albomaculatus*), spineback guitarfish (*Rhinobatos irvinei*) and blackchin guitarfish (*Glaucostegus cemiculus*).

All fishers landed elasmobranchs (100%, $n = 83$), with 25.3% ($n = 21$) targeting sharks, while the majority reported incidental catches (i.e. bycatch) (74.7%, $n = 62$). Rays were targeted by all respondents ($n = 83$), and more than half taimed for guitarfishes (62.8%, $n = 52$). A small percentage of sharks were used for personal consumption, either fresh (20.5%, $n = 26$) or dried (68.7%, $n = 8$), compared with those who sold fresh (79.5%, $n = 54$) as whole animals or cut in pieces. Moreover, only three fishers (4.8%) mentioned finning (i.e. removing fins and discarding carcasses at sea). Even though 20.5% ($n = 17$) of respondents could not point to the final destination of shark products, they described a possible export to China, sales at markets and local fish cooperatives, or mostly direct sales to external buyers (especially in remote areas such as S. Braz and Buraco) to then re-auction and resell in other provinces. Ray and guitarfish handling processes (i.e. from landing and processing of products to subsequent utilization for personal consumption and sale) were similar to sharks. However, these products were mostly used for local meat consumption (either fresh [43.4%, $n = 36$] or dried [19.3%, $n = 16$]), with no indication of exports of products (including guitarfish fins) (Figure 4).

Shark prices depended on the size (50.6%, $n = 42$) or weight (30.1%, $n = 25$) of the animals. Some respondents (19.3%, $n = 16$), mainly crew members who focused on fishing and were not involved in trading, did not have details because boat owners were responsible for selling catches. Respondents stated that ray prices were based on size (53.2%, $n = 44$) or weight (9.6%, $n = 8$), while 24.5% ($n = 20$) did not have details on trade aspects as they were not involved in it. While fishers did not indicate any relationship between elasmobranch species and price, they believed prices fluctuated with the US dollar exchange rate to the local currency, availability of freezing facilities (greater trading control as fishers do not have to sell it directly or salt it), product freshness and location, with a lower price per kg and whole elasmobranch at landing sites further from the Luanda city centre. In Buraco and S. Braz, fresh shark meat was reportedly sold between $US 0.5–1 per kg, and whole sharks (>1.5 m) were sold at $US 35, while fishers at landing sites within the city (Casa Lisboa, Chicala, Samba and Fishers Association) reported slightly higher market prices, between $US 0.9–1.2 per kg or as a bulk up to

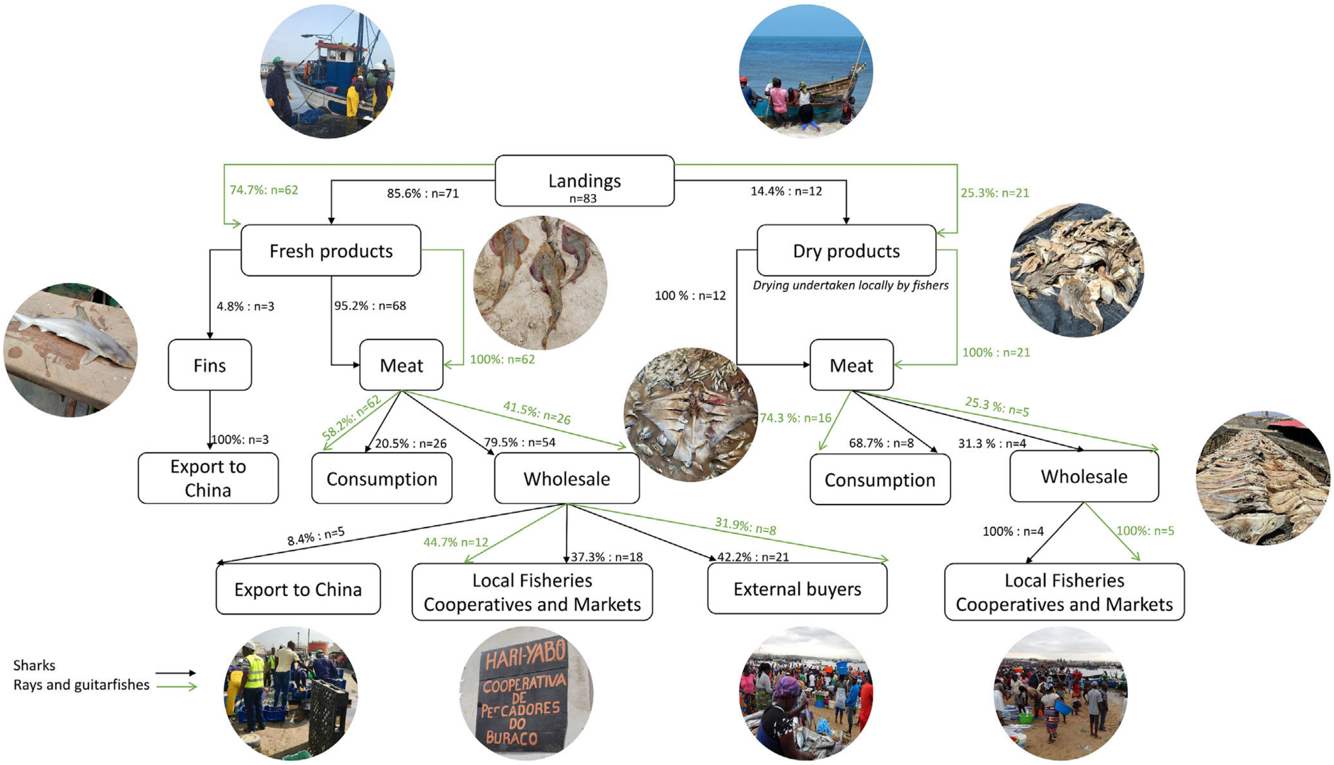

FIGURE 4 Overview of handling processes of sharks (black arrows), and rays and guitarfishes (green arrows) across sites in the provinces of Luanda and Bengo. Percentages and numbers indicate the frequency at which each step was described by fishers.

$US 50 for a large shark (>1.5 m). Although many fishers did not know the price of fresh fins (48.1%, n = 40), the prices provided ranged between $US 18–25 per kg. Similar price trends were described for fresh ray meat, with prices in Buraco and S. Braz between $US 0.2–1 per kg and between $US 0.4–1.3 per kg within the city, depending on the buyer. At all sites, dried shark and ray meat had lower prices ($US 0.2–0.5 per kg) and were mostly for local consumption as external buyers (often with higher income) preferred fresh products.

3.5 | Changes in elasmobranch stocks over time

Most fishers reported a significant decline in shark landings (83.1%, n = 69) and changes in the sizes of these species landed (84.3%, n = 70) over the last 30 years. Respondents (68.2%, n = 57) stated that larger sharks had become rare in landings, reporting overfishing and overexploitation (57.2%, n = 47) as the main causes of lower shark catches. Some fishers believed shark stocks had declined due to extensive industrial trawling during the civil war (18.3%, n = 15). Moreover, they attributed the growth in targeted shark fisheries to increased demand brought about by Chinese immigration to Angola (18.4%, n = 15). Another 6.1% (n = 5) blamed the type of gear used, observing that smaller-sized sharks were now commonly landed.

Fishers also reported changes in ray (100%, n = 83) and guitarfish (83%, n = 69) landings as well as decreases in sizes (rays: 84.3%, n = 70; guitarfishes: 79.3%, n = 66) over the last 30 years. The main stated causes for these declines were overfishing and overexploitation (30.5%, n = 25), extensive industrial trawling during the civil war (24.4%, n = 20) and the type of gear utilized (10.2%, n = 8). However, 34.9% (n = 29) of respondents could not point to a specific reason for this decline in quantity and size, frequently stating, 'it should be a similar reason as for sharks and other fish'.

Responses pertaining to the time when changes in landing quantities and sizes occurred were similar for all elasmobranchs. Some fishers were unsure of when changes had begun (25.3%, n = 21), most respondents had observed it in the last 10 years (39.8%, n = 33), 27.7% (n = 23) between 10–20 years ago and 7.2% (n = 6) up to 30 years ago.

3.6 | Perceptions on elasmobranch conservation

The status of elasmobranch fisheries was a concern for most fishers (88%, n = 73), and a majority (67.5%, n = 56) agreed on the inevitability of fishing regulations to manage some of these species, such as limits of the minimum size allowed to capture and species-specific protection (e.g. mako shark, n = 3).

A third of respondents agreed that a complete ban on shark fishing was needed (32.5%, n = 30). Moreover, while not a species level of identification and utilizing the poster guide developed for this study as an identification tool, 21.7% (n = 18) felt that the protection of certain species, such as hammerhead sharks, was important because they were 'rare' and 'beautiful'. In contrast, most respondents stated that rays (80.5%, $n = 67$) and guitarfishes (61%, $n = 51$) should not be protected, with no respondent considering the possibility of a ban on ray fishing. Only 6.1% ($n = 5$) supported the idea of protecting guitarfishes. Fishers who disagreed with the protection of sharks (42.2%, $n = 35$), rays (80.5%, $n = 67$), and guitarfishes (61%, $n = 51$) were mainly from the age group between 17 and 29 years old, while older and more experienced fishers emphasized the importance of sharks due to their role in the ecosystem (32.5%, $n = 27$). Fishers highlighted this perception by utilizing expressions such as 'they would bring fish', 'there is no interest in eating them' and 'they will soon disappear completely if there are no measures'.

Most respondents (62.5%, $n = 52$) did not have knowledge regarding national laws and regulations concerning the conservation of marine ecosystems; 30% ($n = 25$) provided information regarding dolphins, turtles and certain illegal fishing practices (e.g. trawling and explosives); and only 7.2% ($n = 6$) had some knowledge regarding national laws and regulations.

While there are no policies regarding sharks and rays in Angola, the main fisheries policy is the POPA 2018–2022 (Fisheries and Aquaculture Management Plan 2018–2022), which includes the 'Aquatic Biological Resources Act 2004' (Lei n. 6-A/04 - Recursos Biológicos Aquáticos) covering information on allowed catch size regulations for certain fish and crustacean species, permitted gear type and mesh sizes, protection of freshwater mammals and reptiles, and duties and rights of fishers. Nearly all fishers (98.8%, $n = 82$) felt they were not consulted by the government on fisheries decisions and demonstrated disappointment that some regulations did not reflect their concerns.

4 | DISCUSSION

This study represents the first attempt to assess the status of elasmobranchs in Angola and their interactions with SSF. Our findings emphasize the complex social, motivational and economic aspects of the fishing sector, along with the importance of using survey methods that incorporate LEK to gather information in data-poor regions and confirm the nature of fisher interactions with elasmobranchs. Importantly, by assessing the LEK of fishers, we uncover evidence of increasingly depleted elasmobranch stocks and extensive targeted fisheries for rays and guitarfishes. Yet, most fishers agree on the need to conserve and protect some of these stocks, especially older fishers. This suggests that engaging with fishers to develop management actions would produce beneficial outcomes for the long-term sustainability of elasmobranch resources.

Despite the scarcity of West African elasmobranch-specific studies, reports from over a decade ago already highlighted the depletion of sharks and rays from Mauritania to Sierra Leone (Diop & Dossa, 2011). More recent studies suggest significant population declines along with the disappearance of some species (e.g. sawfishes, family Pristidae) across the West African region (e.g. Guinea-Bissau, Leeney & Poncelet, 2015; Congo, Momballa, 2020; Ghana, Leeney & Quayson, 2022; Seidu et al., 2022b). Overall, there is an urgent need to improve elasmobranch catch monitoring across the fishing sector in Angola, as official estimates are unreliable (Basson et al., 2007; Belhabib & Divovich, 2014; Lankester, 2002), precluding the development of any type of science-based management measures. These higher-level taxonomic groupings for elasmobranchs hinder our understanding of species-specific catch trends, likely disguising the disappearance of species, and do not allow us to prioritize management actions for species showing drastic declines.

Historical data from Angola indicate drastic declines in overall marine fisheries catches and sizes of landed fish, pointing to overfishing of all marine resources (Lankester, 2002). The scale of SSF fisheries in West Africa is a cause for concern, notably because, similar to the results of this study, most fishers have no other occupation and fully depend on these fisheries for employment and food security. Employing close to 135,000 fishers (Duarte et al., 2005; FAO, 2023; Sowman & Cardoso, 2010), with limited infrastructure available along most of the Angolan coast (i.e. lack of refrigeration, outdated processing facilities, beach landing sites), coastal communities are likely losing or unable to sell many of the fish captured, which exacerbates the situation and leads to additional pressure on marine resources.

Declines in Angolan elasmobranch catches have been attributed to the civil war era, with suggestions that overexploitation has been ongoing for decades (Belhabib & Divovich, 2014). With large-scale population displacements from rural to coastal zones during the war, as well as the development of post-war national development goals promoting the industrial and SSF sectors, fishing effort has substantially increased in the last 20 years (Duarte et al., 2005; Sowman & Cardoso, 2010). This increased pressure has been exacerbated by foreign industrial fleets from China, Korea, Spain, Namibia, Japan and Russia operating both legally and illegally in Angolan waters (Agostinho et al., 2005; Belhabib & Divovich, 2014; Salopek, 2004). Indeed, several regional studies have documented Chinese big diesel-powered trawlers undertaking daily incursions into coastal waters, directly competing with SSF, and generating additional pressure on resources (Belhabib & Divovich, 2014; Momballa, 2020; Ojukwu et al., 2013; Salopek, 2004). The limited capacity to enforce regulations and monitor fishing activities has allowed an increase in illegal, unreported and unregulated (IUU) fishing practices within the entire Angolan EEZ (SNFPA, 2017), particularly linked to tuna and shark fisheries (Códia, 2018). Furthermore, industrial fishing vessels, especially foreign trawlers (Belhabib & Divovich, 2014), have been described as 'hammer patches of coastline so hard that fish became locally scarce; a blow to a nation where a million people rely on United Nations food aid' (Angonotícias, 2013; Salopek, 2004). This situation is similar in Congo, Senegal, Mauritania, Guinea-Bissau, Ghana and many coastal West African countries where incursions by industrial trawlers into zones reserved for artisanal fisheries or even close to established marine protected areas have led to conflicts and complaints that marine resources (including elasmobranchs) are being depleted (Belhabib et al., 2020; Leurs et al., 2021; Momballa, 2020; Seidu et al., 2022b). While certain young fishers suggested there were no declines in catches and sizes of elasmobranchs over time, their perception contrasts with broader concerns expressed by fishers across all age groups. Overfishing and overexploitation were generally considered a key factor in changes in abundance and sizes.

This shifting baseline syndrome was also documented in nearby São Tomé and Príncipe islands, where experienced fishers (>40 years of fishing) noted strong declines in reef fish populations while only one-third of inexperienced fishers recognized it (Maia et al., 2018). This 'generational amnesia' has been reported from many fisheries around the world (e.g. Sáenz-Arroyo, Roberts, Torre, Cariño-Olvera, & Enríquez-Andrade, 2005) and is an important factor to consider, as the transmission of knowledge and experience is important to understand long-term changes in exploited populations, helping identify baselines against which current populations can be benchmarked (Colloca et al., 2020; McClenachan et al., 2012). Such a situation is especially challenging because young SSF fishers are unlikely to be willing to address their own destructive fishing practices and overfishing—something critical in the short term (Leeney & Quayson, 2022).

Declines in elasmobranch stocks and high levels of bycatch were also blamed on net fisheries. Indiscriminate gillnets and seine nets were most commonly utilized across SSF vessel types in multi-species fisheries. The use of cheap monofilament nets expanded across West Africa a few decades ago and has been linked to the decline in elasmobranch populations (e.g. sawfishes, Downing & Leeney, 2018; Sekey et al., 2022). Managing solutions for increasing pressure on species captured by indiscriminate gear can be challenging (Aylesworth et al., 2018; Reuter et al., 2010). Targeted ray fisheries are a growing concern around the world and are believed to be developing as a response to declining teleost fish stocks (e.g. Haque et al., 2022; Tyabji et al., 2022). However, the situation in Angola is markedly different from other countries, with results indicating that rays were targeted by most fishers for meat consumption (dry and fresh) as a national traditional dish for coastal communities. While no information is available on population trends for these species within Angola, this implies that fisheries for these species have been intensive and ongoing for decades rather than having recently developed to support protein needs. Considering that global extinction risk assessments indicate that 56.3% of rays are considered threatened with extinction (Dulvy et al., 2021) and that all four species of guitarfish (i.e. common guitarfish, *Rhinobatos rhinobatos*; *R. irvinei*; *R. albomaculatus*; and *G. cemiculus*) known to occur in Angola are Critically Endangered (Kyne & Jabado, 2019; Jabado, Chartrain, et al., 2021; Jabado, Pacoureau, et al., 2021; Jabado, Dia, et al., 2021), these targeted fisheries are a major cause of concern. Overall, only small quantities of skates have been recorded in landings monitoring (Soares, unpubl. data), yet these species are also reportedly commonly caught and discarded by Chinese vessels and overall demersal finfish and shrimp trawl fisheries operating in Angola (Belhabib & Divovich, 2014; Cofrepeche, 2013). Mortality for these species is likely to also be high, likely impacting the overall stocks of these species. Yet, there are currently no elasmobranch conservation initiatives, bycatch mitigation measures, or regulations in Angola (Petersen et al., 2007). Marine conservation frameworks are limited to a Fisheries and Aquaculture Management Plan (2018–2022), a National Strategy and Action Plan for Biodiversity, and the National Programme for Environmental Normalisation, all of which do not consider elasmobranch conservation (Nakamura & Amador, 2022). Despite many fishers expressing concerns in relation to declining elasmobranch stocks, coupled with a concurrent increase in fishing effort, the prevailing perspective is an acknowledgement of the necessity to take actions and implement legislative measures to address these concerns.

In fact, older and more experienced fishers recognized the importance of ensuring the persistence of elasmobranchs, associating them with a healthy ecosystem and fish abundance. This latter group had limited elasmobranch knowledge and fishing experience and perceived elasmobranch declines to have only started in the last 10 years. Furthermore, it was clear that for these younger fishers, concerns were related to their fear of regulations and bans and how these might interfere with their income and protein source. Indeed, a marked difference between many West African countries is that Angolans were retaining sharks and targeting rays for local consumption.

A marked difference compared with other West African countries is that Angolan fishers were generally not targeting sharks, and while their meat was not a preference, a considerable percentage of incidentally caught animals were utilized for local consumption (e.g. Diop & Dossa, 2011; Sall et al., 2021; Seidu et al., 2022a). This is largely because there is a lack of protein available in the country due to the underdeveloped farming and fishery sectors (Sowman & Cardoso, 2010). In contrast, many other African countries, such as Mauritania, Senegal and Guinea, export all or the majority of their elasmobranch meat primarily to Ghana (Diop & Dossa, 2011; Jabado unpubl. data), where there is very high demand for elasmobranch meat (Seidu et al., 2022a). Fishers raised concerns about the current local demand for shark fins by Asian traders that have established themselves in Angola. Indeed, the Far Eastern market is no longer able to support Asian demand, and fisheries (particularly distant water fishing (DWF)) and trade have quickly expanded into new regions (Clarke, 2004; Clarke et al., 2007). However, even though fishers noted that fins were exported to China, there are no official records of this trade. It is likely that, similar to other regions where fishers note China as the main destination, they are referring to the Hong Kong Special Administrative Region (hereafter 'Hong Kong'). For example, fishers in Congo commonly note that all the trade is destined to China, but records in Hong Kong indicate that imports of almost 132 tons of fins originated from Congo between 2005 and 2019 (Momballa, 2020). The trade in shark fins and elasmobranch meat seems to be dynamic and complex across the West Africa region and warrants targeted studies to understand the distribution chain of these products from the point of landing to the end point for each type of product (i.e. shark and guitarfish fins, shark meat, ray meat, mobulid gill plates and liver oil). When comparing the Angolan market product prices for various elasmobranch products from different regions, notable differences emerge. The Angolan market appears to have some of the lowest reported shark fin and meat prices. Fishers noted prices ranging between $US 18–25 per kg for large fins, which corresponds to a similar United Arab Emirates (UAE), where, depending on the species, one large fresh fin could sell at a starting price of $US 17 (Jabado et al., 2015). Higher market prices are reported from India and range between $US 24.13–26.82 per kg for small fin sizes, up to $US 80.45 per kg for large fins, and with guitarfish fins ranging between $US 29.49–107.26 (Tyabji et al., 2022). Similarly, in Ghana, dried shark fins are sold at prices between $US 8.7–104.0 per kg, averaging $US 38.4 per kg (Sekey et al., 2022). It is surprising that fins in the UAE, one of the top shark fin exporters in the world (Jabado & Spaet, 2017), are sold cheaper than in India or in some West African countries. This discrepancy in price might be due to changes in prices over the last 8 years because the research was undertaken in the UAE. Nevertheless, many fishers and traders across Senegal and Mauritania (Jabado, unpubl. data) have noted that prices for fins have increased in West Africa as a result of demand paralleled with an increasing scarcity in supply, particularly of large fins from large animals. While most fishers did not appear to know details of what might influence fin prices in Angola, we note that, similarly to Ghana (Sekey et al., 2022), shark and ray products are dependent on the geographical location of the market, with higher prices within the city. Differences in the value of shark and ray meat between Angola and Ghana are apparent. In Ghana, high market prices for shark meat (up to $US 10 per kg) have been attributed to increased demand for other fish sources as a result of declining pelagic fish stocks (Sekey et al., 2022). These stand in contrast to notably lower shark meat prices in Angola. In fact, Angolan prices are closer to those reported in the UAE, highlighting regional variations in market dynamics and pricing factors (Jabado et al., 2015).

These dynamics can be supported by the fact that fishers in both countries note that shark meat is not preferred for local consumption. Furthermore, the low prices place shark meat at a similar level to low-value fish species, such as sardinella, which is usually purchased by low-income people in Angola (Chilamba, 2016). Shark meat, which is increasingly considered an important and cheap source of protein for low-income people and is widely consumed by local communities, is of concern as it will continue fueling the overexploitation of shark resources. This is also the case with ray meat, where the driving force behind their continued consumption also stems from cultural traditions and is unlikely to be sustainable.

While the data collected were insufficient to comprehensively capture the social, economic and motivational aspects of all elasmobranch fisheries (i.e. SSF, recreational and industrial) in Angola, the findings of this study provide an important baseline for future elasmobranch studies in the region. LEK represents a fast source of information that allows us to understand changes observed in ecosystems (Jabado et al., 2015; Moore et al., 2010) and is essential for the design and implementation of environmental policies and programmes aimed at sustainable elasmobranch fisheries (Seidu et al., 2022b). Fishers may sometimes overestimate or underestimate fishing effort and catches when they perceive that this information can eventually be utilized as a tool against them to place further fishing restrictions and regulations (Jabado et al., 2015; Moore et al., 2010). However, due to the general lack of legislation and monitoring in Angola, fishers are unlikely to have feared such outcomes. However, interviews were only undertaken in northern Angola, and recent surveys suggest that large SSF elasmobranch fisheries are operating in the Namibe Province (Soares, unpubl. data), the largest fishing province in the country (Códia, 2018). Fisher interviews in southern Angola are therefore warranted to get a holistic overview of elasmobranch fisheries in the country. Furthermore, trader interviews are required to elucidate some key questions in relation to the trade in fins and meat. For example, none of the fishers noted that guitarfish fins were being exported. However, these fins are usually considered some of the most high-quality fins for shark fin soup and are in high demand in West Africa (e.g. Ghana, Leeney & Quayson, 2022; Mauritania, Senegal, Jabado unpubl. data) and several regions of the world (Haque et al., 2022; Jabado et al., 2018; Kyne et al., 2020). Finally, with women playing a key role in the processing of all elasmobranchs, information on their views and perceptions would provide additional insights into this complex sector.

5 | CONCLUSION

Despite Angola's lack of species-specific fisheries data, the LEK approach used in this study to understand elasmobranch fisheries has proven to be a valuable tool to gather baseline data for future assessments and evaluate the impact of the SSF sector on elasmobranchs. Results raise concerns that sharks, rays and guitarfish are incidentally caught and retained or targeted in the SSF sector. With increasing reports of largely unregulated semi-industrial and industrial fisheries also operating in Angola in substantial numbers (Belhabib & Divovich, 2014), pressure on these species is likely much higher. Simultaneously, these industrial fisheries are generating competition with small-scale fishers, causing financial loss, local food scarcity and coastal habitat destruction. The situation is complex considering that fish is the main source of income for small-scale fishers and their increasing dependency on elasmobranchs for local consumption.

While older fishers acknowledged the need to take action to preserve certain species, the human dimension factor of shark fisheries and the trade-offs between conservation and socioeconomic objectives need to be considered in the management decision-making process (Booth et al., 2019; Tanna et al., 2021; Seidu et al., 2022b). Engaging with fishers throughout this process will ensure that management decisions are accepted and implementation can be successful (Booth et al., 2019; Haque et al., 2022). Thus, immediate fisher awareness initiatives focused on the importance of elasmobranchs in aquatic ecosystems are critical, along with information on the effects of indiscriminate fishing practices, particularly for younger fishers, who tend to disagree with elasmobranch protection as an outcome of the perceived current fish scarcity. Such campaigns have proven successful in other countries (e.g. whale shark protection in Gujarat, India; Bloch et al., 2016) and could be emulated in Angola, where there is a similar low awareness level among fishers of the importance of species conservation.

Overall, our results provide new insights and substantially improve our knowledge of the current state and complex dynamics of elasmobranch fisheries in Angola, while also serving to inform conservation and management in West Africa and beyond. Considering the fundamental role of fisheries in fighting hunger and poverty, along with guaranteeing national food security and generating income and employment opportunities for coastal communities (Sowman & Cardoso, 2010), interventions for elasmobranch conservation are urgently needed. These must consider the social, economic, and biological nature of fisheries (Aylesworth et al., 2018; Gerrodette et al., 2002; Salomon et al., 2011). A long list of actions can be provided to support the long-term sustainability of elasmobranch fisheries; however, the key recommendation is for a concerted, four-pronged approach to the conservation of these species to be developed, implemented and monitored. Actions need to (1) use opportunities offered by existing fisheries aid programmes to improve elasmobranch data collection and reporting; expand on monitoring, control and surveillance of both SSF and industrial fisheries; update national regulatory frameworks to conserve threatened elasmobranch species; and work towards minimizing bycatch within these sectors; (2) identify critical habitats for elasmobranchs (see Hyde et al., 2022) and establish a spatial planning framework; while simultaneously (3) reconcile food security needs of coastal communities with biodiversity conservation by ensuring they have access to relevant information and sharing examples of positive and beneficial conservation outcomes in relation to fisheries; and (4) work towards improving local livelihoods and providing alternative employment opportunities for fishers. These actions are intricately linked, and without prioritizing conservation work, the long-term sustainability of the species cannot be guaranteed, and in turn, we risk losing any opportunity to secure the long-term food security and livelihood of coastal communities. Notwithstanding these priorities, continuous engagement with fishers and allowing them to co-design approaches are critical to overcome these challenges and ensure their knowledge and participation can inform decisions and ensure sustainability and success.

AUTHOR CONTRIBUTIONS

Both authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by Ana Lúcia Furtado Soares and Rima Jabado. The first draft of the manuscript was written by Ana Lúcia Furtado Soares, and Rima Jabado commented on all versions of the manuscript. Both authors read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest (financial or non-financial) to declare relating to the content of this article.

ETHICS STATEMENT

Informed consent was acquired to conduct this research involving human participants. We comply with ethical standards, as approval was obtained from the Ethics Committee at the United Arab Emirates University.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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