CHARACTERIZATION OF SMALL-SCALE FISHING ACTIVITY IN LUANDA BAY (ANGOLA)

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ABSTRACT

Luanda Bay, the second largest bay and one of the most important ecosystems of the Angolan coast, supports many human activities. This bay supports a range of marine biodiversity that serves as a means of livelihood and source of income for more than fifty small-scale artisanal fisheries and collectors of worms and bivalve molluscs. The present study is the first record of this fishing activity in Luanda Bay and the objective was to characterize the resource exploitation in this bay based on field data obtained by distributing self-reported and structured questionnaires to the two fishing communities (fishermen and shellfish harvesters) in Luanda Bay: Luanda Island and Luanda Commercial Harbour. The results revealed that the two fishing communities used different vessel types during fishing activity. In the Luanda Island fishing community, the fishermen used rowboats ("Chata") and motorboats, and in the Commercial Port of Luanda fishing community, they used an adapted vessel made of Styrofoam boards. The main gears were line/hooks (34.1%), shovel (25.0%), seine (9,1%), gillnet (6.8%), trawl (4.5%) and traps (2.3%). According to the local fishing communities, *Pomadasys jubelini*, *Mugil cephalus*, *Dentex* spp., *Senilia senilis*, *Mactra glauca*, *Donax* spp., *Perna perna*, and *Lucinella divaricata* were the predominant species. In relation to the earnings by fishing day, the Luanda Island community had a higher income (average: 14.4 ± 8.3 euros; maximum: 39.0 euros) than Luanda Commercial Harbour community (average: 8.4 ± 5.1 euros; maximum: 24.2 euros). Thus, the quality of life of the fishing communities seems to be highly depending on this activity.

Keywords: Artisanal Fisheries, Fishing Community, Molluscs, Crustaceans, Fish, Coast of Angola.

JEL Classification: Q22

1. INTRODUCTION

Millions of people throughout the world, particularly in Asia, Africa, and Latin America, rely on small-scale artisanal fisheries as a major source of food, income or as a contribution to their livelihoods (McGoodwin, 1990; Kent, 1997; Berkes, Mahon, McConney, Pollnac & Pomeroy, 2001; FAO, 2003; Viswanathan, Nielsen, Degnbol, Ahmed, Hara & Abdullah, 2003). Characteristics of small-scale artisanal fisheries include smaller vessels and engines,

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simple or more traditional gear, proximity to the coast, smaller crews, family or locally owned, and importance for local livelihoods and subsistence (Kittinger, 2013; Smith & Basurto, 2019).

The sector represents half the world's fishing effort (Rousseau, Watson, Blanchard & Fulton, 2019), over one quarter of the volume of catches (Watson, 2018) and 90% of employment in the fisheries sector (FAO, 2015). There are an estimated 32 million directly employed as small-scale fishermen, an additional 76 million employed in post-harvest jobs, and 81% of catch is used for local human consumption (World Bank, 2012). Despite the central role of small-scale fisheries in contributing to food security, poverty mitigation and rural development, this sector has been neglected by fisheries managers over the years in favour of the commercial fisheries sectors (McGoodwin, 1990; Kent, 1997; Berkes et al., 2001; FAO, 2003; Viswanathan et al., 2003). The lack of understanding of the dynamics and nature of small-scale artisanal fisheries has contributed to their neglect and failure to design and implement appropriate policies and management systems to cater for their specific characteristics (Sowman, 2006). However, in recent decades, there has been an increase in effort to collect data regarding small-scale artisanal fishers through innovative methodologies to combat inaccuracies in existing data and the subsequent disregard of the sector. The Food and Agriculture Organization (FAO) has been collaborating with the World Bank and WorldFish researchers to generate better global estimates of small-scale artisanal fishers independent of self-reported national fisheries statistics (World Bank, 2012; WorldFish, FAO & Duke University, 2018).

The fishing sector is the third-most important to the Angola national economy after the oil and mining industries and supplies about 25% of the total animal protein intake of the Angolan population (FAO, 2011). Fishing is seen as playing a key role in combating hunger and poverty and ensuring national food security, with marine fisheries providing work and income-generating opportunities for coastal communities (e.g., Aquatic Biological Resources Law No. 6-A/04 of October 8 of Ministry of Fisheries, Angola, 2004; POPES, 2005; POPA, 2018). In Angola, small-scale artisanal fisheries have played a critical role in the livelihood and food security of coastal communities, particularly in the Luanda province, where, in recent decades, hundreds of unemployed youth and local fishermen have used Luanda Bay as a livelihood and source of income. Currently, the Angola coastline has about 102 artisanal fishing settlements, largely concentrated in the northern provinces, and the Angolan Institute for the Development of Artisanal Fisheries (IPA) estimates that approximately 35,000 artisanal fishermen and 6,600 artisanal fishing boats operate in its coastal waters (Duarte, Fielding, Sowman & Bergh, 2005). Since the 1990s, the Angolan government has adopted policies to promote both the industrial and artisanal fishing sectors in line with its national development objectives, establishing in 1994 the IPA for the development and support of the sector (Sowman & Cardoso, 2010). However, despite redoubled efforts, there is still little specific information and data on the artisanal fisheries operating in the coastal region of Angola, as well as their contribution to the food and livelihoods of hundreds of coastal communities.

Luanda Bay, a semi-enclosed body of saline water, is located on the Luanda providence, northern coast of Angola (Figure 1). This postcard of Luanda City is protected by Luanda Island, and contain in its area a commercial harbour, a refinery, a fuel station, cargo terminals, and a naval base that contributes to water pollution (Leitão, Santos & Boaventura, 2016; Baptista et al., 2021). Despite the multiple anthropogenic pressures that are threatening Luanda Bay (e.g., solid waste, domestic wastewater, and industrial effluents without treatment; Leitão et al., 2016), this ecosystem works as an area for growth, recruitment and feeding for many species of fish, crustaceans, bivalve molluscs, cephalopods, etc., as well as for livelihood and income for the local fishing communities (Cox, 2013).

In this context, the current work aims to characterize the small-scale artisanal fishing activity in Luanda Bay, as a livelihood and source of income for its users. For this purpose, self-reported and structured questionnaires were distributed in two fishing communities of Luanda Bay, namely, Luanda Island and Luanda Commercial Harbour communities. Beyond the sociodemographic data, the questionnaire included data related to the fishing activity, such as the main species caught, fishing gear, seasons, and income.

Figure 1. Location of the Luanda Bay (Luanda, Angola), the two fishing communities (Luanda Island and Luanda Commercial Harbour), and the main landing sites (Praia dos Pescadores, Luanda Commercial Harbour, Ministério do Interior and Floresta/Salga).

Source: Map retrieved from Google Earth; Edited by the authors

2. METHODS

The study is based on a descriptive research, with a qualitative approach although it includes quantitative elements, based on field data obtained by distributing self-reported and structured questionnaires to the fishing community of the Luanda Bay. The questionnaire included sociodemographic data and data related to the fishing activity, such as the main species caught, fishing gear, seasons, and income.

The questionnaire was distributed in May 2021 to two fishing communities (fishermen and shellfishermen) in Luanda Bay: Luanda Island and Luanda Commercial Harbour communities (Figure 1). Enumerators clarified any questions and helped respondents when needed, without interfering with the responses.

A total of 30 individuals (13 in Luanda Island and 17 in Luanda Commercial Harbour) answered the questionnaire. All of these were male (100.0%). Respondents' age ranged between 18 to >65 years old, with 13.3% of them ranging between 18 and 24 years old, 30.0% between the ages of 25 to 34 years old, 40.0% between 35 and 44 years old, 10.0% between 45 and 54 years old, and 6.7% with ≥65 years.

Descriptive statistics were used to summarize the data.

3. RESULTS AND DISCUSSION

In the two fishing communities of Luanda Bay studied in the present work, the activity was characterized by small-scale artisanal fishing (100.0%), using smaller and traditional vessels, operate non-industrialized and traditional methods (Figure 2), such as passive gear and manually hauled, with low impact on the ecosystem, and provides livelihoods for local communities (Cox, 2013; Kittinger, 2013; Smith & Basurto, 2019).

Figure 2. Vessels and gears used by fishermen in fishing communities of Luanda Island and Luanda Commercial Harbour in Luanda Bay (Luanda, Angola): rowboat and trawl net (a), rowboat and seine (b), Styrofoam board (c), line/hook (d, f), Styrofoam board and line/hook (e), cast net (g).

Source: Own Elaboration

The two fishing communities used different vessel types (Table 1). In the fishing community of Luanda Island, the predominant vessel types were rowboats (called "Chata";

N = 8; Figures 2a,2b), and motorboats (N = 4). The total length of motorboats varied between 3.0 and 4.0 m and support a payload of 240.0-360.0 kg and 4 and 6 crew members. The motorboats include an inboard engine of 40-100 hp and can reach 14.0 m in length (Sowman & Cardoso, 2010). In the rowboats, the total length varied between 3.0 and 6.0 m, supporting a payload of 80.0-360.0 kg and 2 to 6 fishermen. The rowboats or "Chatas" are characterized by a flat bottom, with a maximum of 7.0 m in length, with or without a motor (Sowman & Cardoso, 2010; POPA, 2018). In the fishing community of Luanda Commercial Harbour, the respondents solely used an adapted vessel made of Styrofoam boards (N = 17; Figures 2c, 2e). These rudimentary and adapted vessels are not described yet, and they are probably improvised by locals to provide some income for their families. In fact, they had small length (1.6 and 1.7 m), supporting small payload (20.0–40.0 kg) and just one to two fishermen. Contrarily to the artisanal fishing on the coast of Africa, where it is estimated that for every person involved in artisanal fishing, four additional jobs are created, including fisher processors and fish traders (Cox, 2013), all the fishermen answered that they or some family members are responsible for processing and selling the fish on land.

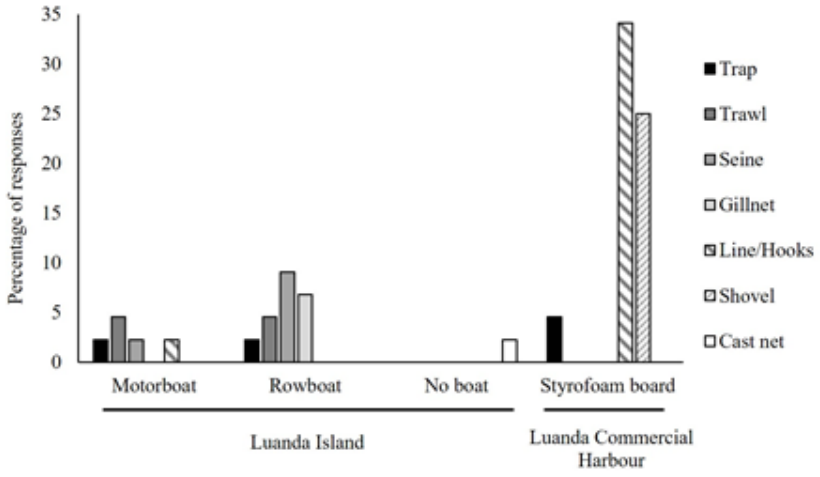
Table 1. Characteristics of vessels used by fishermen in fishing communities of Luanda Island and Luanda Commercial Harbour in Luanda Bay (Luanda, Angola)

Vessel type	Luanda Island				Luanda Commercial Harbour			
	Number	Total length (m)	Number of fishermen	Payload (kg)	Number	Total length (m)	Number of fishermen	Payload (kg)
Motorboat	4	3.5 ± 0.6 (3.0–4.0)	5.0 ± 1.2 (4.0–6.0)	320.0 ± 56.6 (240.0–360.0)	-	-	-	-
Rowboat	8	4.1 ± 0.8 (3.0–6.0)	3.6 ± 1.3 (2.0–6.0)	245.0 ± 101.3 (80.0–360.0)	-	-	-	-
Styrofoam board	-	-	-	-	17	1.6 ± 0.0 (1.6–1.7)	1.1 ± 0.3 (1.0–2.0)	28.2 ± 10.1 (20.0–40.0)

Source: Own Elaboration

The fishing gear used in the fishing activity in Luanda Bay varied according to fishing communities and vessel types (Figures 2, 3). In the Luanda Island community, trawl (4.5%), traps, seine, and line/hooks (2.3%) were used in motorboats, and seine (9,1%; Figure 2b), gillnet (6.8%), trawl (4.5%; Figure 2a), and traps (2.3%) were used by rowboats. The cast nets were used without a support vessel (2.3%; Figure 2g). In the Luanda Commercial Harbour community, the main gear used in Styrofoam boards was line/hooks (34.1%; Figure 2d, 2e, 2f), followed by shovel (25.0%) and traps (4.5%). This is in accordance with the small-scale artisanal fisheries' methods described for Angolan coast, that include handlines, gillnets, seine, traps, longline, beach seine and lift nets (Sowman & Cardoso, 2010; POPA, 2018).

Figure 3. Fishing gear by vessel type used by fishing communities of Luanda Island and Luanda Commercial Harbour in Luanda Bay (Luanda, Angola)



Source: Own Elaboration

In the Luanda Island community, the fishing site was in Section I of Luanda Bay (Figure 1) for all the vessel types (N = 13), while in Luanda Commercial Harbour community, the fishing site varied between Sections I (N = 14), II (N = 1), and III (N = 2) of Luanda Bay. The fishing activity occurred mainly inside the bay, with the exception of the two fishermen who carry out their activity outside the bay, near its entrance (Section III). In relation to the landing site, the fishermen of Luanda Island answered that they landed on Praia dos Pescadores (Section I; motorboats- N = 4; rowboats- N = 8) and Luanda Commercial Harbour (Section II; No vessel- N = 1), while fishermen of Luanda Commercial Harbour (Styrofoam boards) landed on Luanda Commercial Harbour (Section II; N = 12), Ministério do Interior (Section I; N = 4) and Praia dos Pescadores (Section I; N = 1). As an alternative landing site, the fishermen of Luanda Island reported Floresta/Salga (Section II; motorboats- N = 3; rowboats- N = 7).

The predominant species (most frequently reported by fishermen) were *Pomadasys jubelini* (matona, N = 15; Figure 4g), *Senilia senilis* (mabanga, N = 10; Figure 4o), *Mactra glauca* (quingole, N = 10; Figure 4p), *Mugil cephalus* (tainha, N = 9; Figure 4j), *Donax spp*. (conquilha, N = 8), *Perna perna* (mexilhão, N = 8), *Lucinella divaricata* (ameijoinha, N = 6) and *Dentex spp.* (*Dentex canariensis* or *Dentex macrophthalmus*, cachucho, N = 6; Figure 4m) (Table 2). Reported fish species, such as *P. jubelini* (N = 11), *Dentex spp.* (N = 6) and *M. cephalus* (N =5), were mainly caught by line/hooks and with Styrofoam boards as support vessels. *Pomadasys jubelini* was also caught by seine and gillnet (motorboat and rowboat) and *M. cephalus* by trawl and seine (motorboat and rowboat). Trawl and seine (motorboat and rowboat) were also used to catch *Sardinella spp.* (*Sardinella aurita* and *Sardinella maderensis*, sardinelas; Figure 4c) and *Sarda sarda* (quimbumbo; Figure 4k). Cast net only captured one species, the *Oreochromis niloticus* (cacusso; Figure 4b). This species is one of the most exploited species in inland waters of Angola (POPA, 2018). Bivalve molluscs (*S. senilis*, *Donax spp*., *L. divaricata*, *M. glauca* and *P. perna*) and gastropods (*Perrona quinteni*, *Hexaplex rosarium* – búzios; and *Paratectonatica tigrine* – caracol) were caught by shovel, with Styrofoam boards as the support vessel. Cephalopods (*Sepia spp.* – choco; Figure 4q) were caught by trap, trawl, seine, and gillnet (motorboat and rowboat), and crustaceans (*Callinectes marginatus* – caranguejo; Figure 4r) were caught by trap and line/hooks (motorboat and rowboat). Target species varied according to fishing community, for example, *Sardinella spp.*, *S. sarda* and *Sepia spp*. were exclusively caught in the Luanda Island community, and bivalves, gastropods,

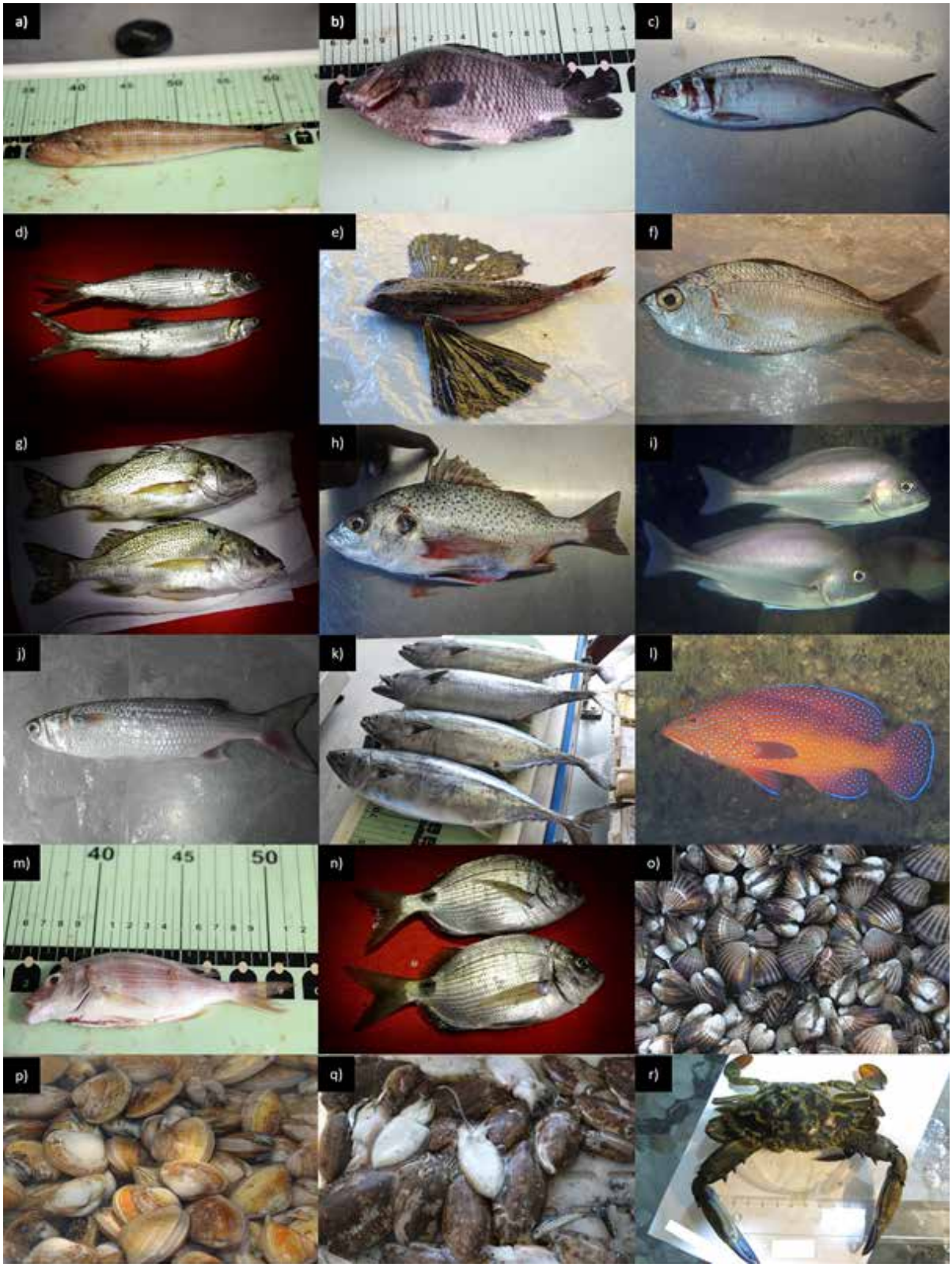
and a large number of fish species were only caught in the Luanda Commercial Harbour community.

Table 2. Species caught in Luanda Bay (Luanda, Angola) by fishing communities of Luanda Island and Luanda Commercial Harbour, considering vessel and gear types

Family	Scientific name	Common name	Vessel				Gear						
			Motorboat	Rowboat	Styrofoam board	No vessel	Trap	Trawl	Seine	Gillnet	Line/ Hooks	Shovel	Cast net
Fish													
Acropomatidae	*Kaperangus microlepis*	Peixe-sabonete			1						1		
Carangidae	*Caranx hippos*	Macoa			2						2		
Cichlidae	*Oreochromis niloticus*	Cacusso			1	1					1		1
Clupeidae	*Sardinella spp.*	Sardinelas	2	2				3	2				
Elopidae	*Elops lacerta*	Peixe-banana			4						4		
Exocoetidae	*Parexocoetus brachypterus*	Peixe-voador			1						1		
Gerreidae	*Eucinostomus melanopterus*	Mussosso			2						2		
Haemulidae	*Pomadasys incisus*	Mabolobolo			1						1		
	Pomadasys jubelini	Matona	1	3	11				1	3	11		
	Pomadasys perotaei	Roncador			2						2		
	Plectorhinchus mediterraneus	Peixe-burro			4						4		
Mugilidae	*Mugil cephalus*	Tainha	2	2	5			2	3		5		
Scombridae	*Sarda sarda*	Quimbumbo	1					1	1				
Serranidae	*Cephalopholis taeniops*	Garoupa-das-pedras			3						3		
	Epinephelus spp.	Garoupa			4						4		
Sparidae	*Dentex spp.*	Cachucho			6						6		
	Diplodus capensis	Mariquita			4						4		
	Pagrus spp.	Pargo			1						1		
	Pagrus auriga	Pargo-rosa			3						3		
Bivalves													
Arcidae	*Senilia senilis*	Mabanga			10							10	
Donacidae	*Donax spp.*	Conquilha			8							8	
Lucinidae	*Lucinella divaricata*	Ameijoinha			6							6	
Mactridae	*Mactra glauca*	Quingole			10							10	
Mytilidae	*Perna perna*	Mexilhão			8							8	
Cephalopods													
Sepiidae	*Sepia spp.*	Choco	3	2			2	3	2	1			
Crustaceans													
Portunidae	*Callinectes marginatus*	Caranguejo	1		3		3	1			1		
Gastropods													
Clavatulidae	*Perrona quinteni*	Búzios			1							1	
Muricidae	*Hexaplex rosarium*	Búzios			1							1	
Naticidae	*Paratectonatica tigrina*	Caracol			1							1	

Source: Own Elaboration

Figure 4. Species caught in Luanda Bay (Luanda, Angola): *Kaperangus microlepis* **(a)**, *Oreochromis niloticus* **(b)**, *Sardinella maderensis* **(c)**, *Elops lacerta* **(d)**, *Parexocoetus brachypterus* **(e)**, *Eucinostomus melanopterus* **(f)**, *Pomadasys jubelini* **(g)**, *Pomadasys perotaei* **(h)**, *Plectorhinchus mediterraneus* **(i)**, *Mugil cephalus* **(j)**, *Sarda sarda* **(k)**, *Cephalopholis taeniops* **(l)**, *Dentex canariensis* **(m)**, *Diplodus capensis* **(n)**, *Senilia senilis* **(o)**, *Mactra glauca* **(p)**, *Sepia* **spp. (q), and** *Callinectes marginatus* **(r).**



Source: Own Elaboration

The species listed as being of greatest commercial interest in Luanda Bay varied according to fishing communities, with greater diversity recorded in the community of Luanda Commercial Harbour (Table 3). *Pomadasys jubelini* was the species reported as having a greater commercial interest in both communities of Luanda Island (N = 5) and Luanda Commercial Harbour (N = 15), followed by *Sardinella spp.* (N = 3), *Caranx hippos*, *O. niloticus*, *M. cephalus* and *S. sarda* (N = 1) in Luanda Island; and by *Dentex spp.* (N = 7), *Epinephelus spp*., *Eucinostomus melanopterus* (N = 2; Figure 4f), *Kaperangus microlepis* (Figure 4a), *Pomadasys perotaei* (Figure 4h), *Plectorhinchus mediterraneus* (Figure 4i) and *Pagrus auriga* (N = 1) in Luanda Commercial Harbour. In relation to bivalve species, *M. glauca* (N = 1) was the only reported species with major commercial interest in the Luanda Island community, having been the most reported species (N = 10) in the Luanda Commercial Harbour community, followed by *S. senilis* (N = 9), *Donax spp*., *P. perna* (N = 6) and *L. divaricata* (N = 4). Cephalopods (*Sepia spp.*) had the same commercial importance in the two communities (N = 5) and crustaceans (*C. marginatus*) were only commercially important in Luanda Commercial Harbour (N = 1).

Table 3. Species with High Commercial Importance in Fishing Communities of Luanda Island and Luanda Commercial Harbour, Luanda Bay (Luanda, Angola)

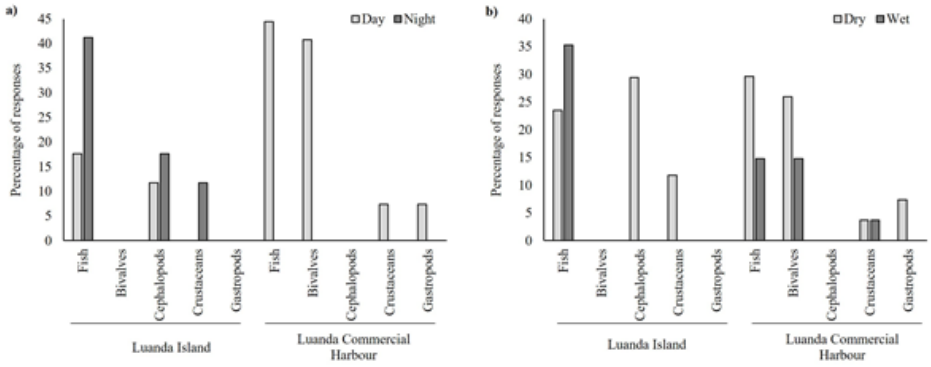
Family	Scientific name	Common name	Luanda Island	Luanda Commercial Harbour
Fish				
Acropomatidae	*Kaperangus microlepis*	Peixe-sabonete		1
Carangidae	*Caranx hippos*	Macoa	1	
Cichlidae	*Oreochromis niloticus*	Cacusso	1	
Clupeidae	*Sardinella spp.*	Sardinelas	3	
Gerreidae	*Eucinostomus melanopterus*	Mussosso		2
Haemulidae	*Pomadasys jubelini*	Matona	5	15
	Pomadasys perotaei	Roncador		1
	Plectorhinchus mediterraneus	Peixe-burro		1
Mugilidae	*Mugil cephalus*	Tainha	1	
Scombridae	*Sarda sarda*	Quimbumbo	1	
Serranidae	*Epinephelus spp.*	Garoupa		2
Sparidae	*Dentex spp.*	Cachucho		7
	Pagrus auriga	Pargo-rosa		1
Bivalves				
Arcidae	*Senilia senilis*	Mabanga		9
Donacidae	*Donax spp.*	Conquilha		6
Lucinidae	*Lucinella divaricate*	Ameijoinha		4
Mactridae	*Mactra glauca*	Quingole	1	10
Mytilidae	*Perna perna*	Mexilhão		6
Cephalopods				
Sepiidae	*Sepia spp.*	Choco	5	5
Crustaceans				
Portunidae	*Callinectes marginatus*	Caranguejo		1

Source: Own Elaboration

In the fishing community of Luanda Island, fishing activity occurred mainly during the night for fish (41.2%), cephalopods (17.6%) and crustaceans (11.8%) (Figure 5a). However, in the fishing community of Luanda Commercial Harbour, fishing activity occurred for all species groups during the daytime (fish 44.4%, bivalves 40.7%, cephalopods 7.4%, and crustaceans 7.4%).

When questioned about the major fishing season, the fishermen from the two communities answered in different ways (Figure 5b). In Luanda Island, fishermen said that the major fishing season was the wet season, with hot weather (summer) for fish species (35.3%), and dry season, with cold weather (named "cacimbo"), for cephalopods (29.4%) and crustacean species (11.8%). In Luanda Commercial Harbour, the dry season was reported as the best season for fish (29.6%), bivalves (25.9%) and cephalopod species (7.4%), and for crustaceans there was no distinction reported between seasons (3.7%).

Figure 5. Species Groups caught in Lunda Bay (Luanda, Angola) by Fishing Communities of Luanda Island and Luanda Commercial Port, according to Daytime (a) and Season (b)



Source: Own Elaboration

The number of fishing days per week was similar in the two communities, varying between four and seven in Luanda Island, and between three and seven in Luanda Commercial Harbour (Table 4). The number of fishing events per day was also similar in two communities, varying between one and two in Luanda Island, and between one and three in Luanda Commercial Harbour. The number of fishing events per day depended on the income generated by each event, at least until the fishermen reached the minimum necessary to support their families. The number of hours spent fishing per day was higher in Luanda Commercial Harbour community (4.8 ± 1.3; 1.0-7.5 hours) than in Luanda Island community (3.0 ± 1.0; 1.0-5.0 hours).

Table 4. Characteristics of fishing activity in fishing communities of Luanda Bay (Luanda, Angola)

		Luanda Island	Luanda Commercial Harbour
Fishing days per week		5.3 ± 0.9 (4.0–7.0)	5.7 ± 1.2 (3.0–7.0)
Number of fishing events per day		1.4 ± 0.5 (1.0–2.0)	1.6 ± 0.6 (1.0–3.0)
Hours spent fishing per day		3.0 ± 1.0 (1.0–5.0)	4.8 ± 1.3 (1.0–7.5)
Earning (€) by fishing day	Fish	17.2 ± 8.6 (5.2–39.0)	6.6 ± 1.8 (4.2–10.9)
	Bivalves	-	5.5 ± 3.0 (4.2–14.4)
	Cephalopods	9.5 ± 3.6 (5.9–13.0)	-
	Crustaceans	-	9.1 ± 0.0 (9.1)

Source: Own Elaboration

In relation to the earnings by fishing day, the Luanda Island community had the higher average (14.4 ± 8.3 euros) and maximum values (39.0 euros) than Luanda Commercial Harbour community (average: 8.4 ± 5.1 euros; maximum: 24.2 euros) (Table 4). Fish species represented the higher average values in the Luanda Island community (17.2 ± 8.6 euros), reaching the maximum value of 39.0 euros, followed by cephalopods with an average value of 9.5 (± 3.6) euros and a maximum of 13.0 euros. In the Luanda Commercial Harbour community, the crustaceans generated a higher average daily income (9.1 euros), followed by fish species (average: 6.6 ± 1.8 euros; maximum: 10.9 euros), and by bivalves (average: 5.5 ± 3.0 euros; maximum: 14.4 euros). In 2018 and 2019, the average monthly income per person in Angola was 20.09 euros (Faria, 2021), and the minimum wage in 2020 was 43.68 euros (Presidential Decree No. 13/19 of January 09 of Ministry of Fisheries, Angola, 2019). Thus, the quality of life of the fishing communities of Luanda Bay is highly depending on the fishing activity in the bay.

In relation to the gender, the questionnaire revealed gender inequality in fishing activity of Luanda Bay, with all the respondents being male and when questioned about their perception of local fishing activity, all responded that, in Luanda Bay, fishing activity is performed exclusively by men. The women wait for the fishermen to return, to help sell the catch in the market. In fact, the Assessment Report on Small Scale Fisheries in Africa (Cox, 2013) reported that African women are marginalised in the small-scale fishing sector, not only in fishing related activities but also in decision-making processes.

Although fishing in Luanda generates income for the local communities, the legislation only allows fishing in the bay for subsistence (Aquatic Biological Resources Law No. 6-A/04 of October 8 of Ministry of Fisheries, Angola, 2004; Presidential Decree No. 41/05 of June 13 of Ministry of Fisheries, Angola, 2005). Moreover, according to Presidential Decree No. 28/15 of January 13 of Ministry of Fisheries, Angola (2015), the capture of mollusc bivalves is prohibited in closed areas of Luanda Bay. However, there is no control of this activity in the bay, and the legislation is poor, encouraging undeclared landings, that makes resource management difficult. Even information about the number of fishermen and boats operating in the bay does not exist, as determined by fishermen perception. When questioned about the number of fishermen and vessel harvesting in Luanda Bay, the respondents' answers varied between more than 30 to more than 150, with many responses concentrated between more than 30 to more than 75 (N = 24) fishermen and boats. Other problems caused by the lack of control of fishing activity in Luanda Bay come from the consumption of captured species. The bay is highly impacted by a growing population of the city of Luanda, intense urbanization, and the presence of industrial and harbour complexes, that negatively affect the water quality, and fish species, and consequently the quality of life of the local communities (Santos, 2012; Leitão, Santos & Boaventura, 2014; Leitão et al., 2016). The appearance of biotoxins has also been reported in Luanda Bay, contaminating mostly bivalves and some fish species, and causing health problems in humans, like intoxication with neurotoxic effects – Amnesic Shellfish Poisoning (ASP) and Paralytic Shellfish Poisoning (PSP) (Vale, Rangel, Silva, Coelho & Vilar, 2009; Branco, Livramento & Rangel, 2010).

4. CONCLUSION

The present study revealed that the small-scale artisanal fishing activity in Luanda Bay varied between the fishing communities of Luanda Island and Luanda Commercial Harbour. Moreover, the quality of life of the fishing communities of Luanda Bay seems to be highly dependent on fishing activity in the bay. Despite the small sample size, this is the first study that characterizes the fishing activity and mollusc harvesting in Luanda Bay, describing

fishing vessels, including an adapted vessel made of Styrofoam boards, fishing gear, as well as the main species caught. Further studies related to these activities in the Bay should be carried out, namely on the specification of the characteristics of fishing gear used in Luanda Bay, as well as referring to the fisheries' assessment and biology of fishing resources. Catches must be monitored in the bay so that solid data on landings can be obtained, and consequently resources can be managed properly in a suitable way. Thus, this study could provide a foundation for further studies of fisheries in the Bay of Luanda.

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REFERENCES

Aquatic Biological Resources Law No. 6-A/04 of October 8 of Ministry of Fisheries, Angola (2004). Republic Diary: I Serie, No. 81. Retrieved from http://extwprlegs1.fao.org/docs/pdf/ang50971.pdf

Baptista, V., Encarnação, J., Serrão, E. A., Wirtz, P., Pestana, L. B., Faria, S., & Teodósio, M. A. (2021). New Records of Fish Species from the Coast of Luanda, Angola. *Thalassas: An International Journal of Marine Sciences*, 1-9. doi: 10.1007/s41208-021-00297-1

Berkes, F., Mahon, R., McConney, P., Pollnac, R., & Pomeroy, R. (2001). Managing small-scale fisheries: alternative directions and methods. Ottawa, Canada: International Development Research Centre (IDRC).

Blanco, J., Livramento, F., & Rangel, I. M. (2010). Amnesic shellfish poisoning (ASP) toxins in plankton and molluscs from Luanda Bay, Angola. *Toxicon*, *55*(2-3), 541-546. doi: 10.1016/j.toxicon.2009.10.008

Cox, J. (2013). Assessment report on small-scale fisheries in Africa. Masifundise Development Trust for Inter African Bureau for Animal Resources (AU-IBAR) of the African Union.

Duarte, A., Fielding, P., Sowman, M., & Bergh, M. (2005). Overview and analysis of socio-economic and fisheries information to promote the management of artisanal fisheries in the Benguela Current Large Marine Ecosystem (BCLME) region (Angola). Final Report no. LMR/AFSE/03/01/B, Environmental Evaluation Unit, University of Cape Town.

FAO (2003). Advisory Committee on Fisheries Research (ACFR). Report on the second session of the Working Party on Small-scale Fisheries, FAO Report No. 735. Bangkok, Thailand. Accessed on 12 June 2021. Retrieved from http://www.fao.org/3/y5808e/y5808e.pdf

FAO (2011). Fishery and aquaculture country profiles: Republic of Angola. Food and Agriculture Organization of the United Nations, Rome, Italy. Accessed on 12 June 2021. Retrieved from www.fao.org/fishery/facp/AGO/en

FAO (2015). Voluntary guidelines for securing sustainable small-scale fisheries. Food and Agriculture Organization of the United Nations, Rome, Italy.

Faria, J. (2021). Monthly income per person in Angola from March 2018 to February 2019, by area (in Kwanzas). Accessed on 14 July 2021. Retrieved from https://www.statista.com/statistics/1134935/monthly-income-per-person-in-angola-by-area/

Kent, G. (1997). Fisheries, food security, and the poor. *Food Policy*, *22*(5), 393-404.

Kittinger, J. N. (2013). Human dimensions of small-scale and traditional fisheries in the Asia-Pacific Region. Pacific Science, *67*(3), 315-25. doi: 10.2984/67.3.1.

Leitão, A., Santos, A., & Boaventura, R. (2014). Especiação do cobre na baía de luanda usando técnicas electroquímicas. *Blucher Chemical Engineering Proceedings*, *1*(2), 9619-9626.

Leitão, A., Santos, A. M., & Boaventura, R. A. (2016). Complexation of lead by organic matter in Luanda Bay, Angola. *Environmental Monitoring and Assessment*, *188*(10), 1-17. doi: 10.1007/s10661-016-5557-z

McGoodwin, J. R. (1990). Crisis in the world's fisheries: people, problems and policies. Stanford, CA: Stanford University Press.

POPA (2018). Plano de Ordenamento de Pescas e Aquicultura (POPA) 2018-2022. Ministério das Pescas e do Mar, Governo de Angola.

POPES (2005). Plano de Ordenamento das Pescas (POPES) 2006/2010. Ministério das Pescas, República de Angola.

Presidential Decree No. 41/05 of June 13 of Ministry of Fisheries, Angola (2005). Republic Diary: I Serie, No. 70. Retrieved from http://extwprlegs1.fao.org/docs/pdf/ang116916.pdf

Presidential Decree No. 28/15 of January 13 of Ministry of Fisheries, Angola (2015). Republic Diary: I Serie, No. 8. Retrieved from http://extwprlegs1.fao.org/docs/pdf/ang148508.pdf

Presidential Decree No. 13/19 of January 09 of Ministry of Fisheries, Angola (2019). Republic Diary: I Serie, No. 4. Retrieved from http://www.ucm.minfin.gov.ao/cs/groups/public/documents/document/zmlu/mdu3/~edisp/minfin057170.pdf

Rousseau, Y., Watson, R. A., Blanchard, J. L., & Fulton, E. A. (2019). Evolution of global marine fishing fleets and the response of fished resources, *Proceedings of the National Academy of Sciences*, *116*, 12238-12243. doi: 10.1073/pnas.1820344116.

Santos, A. (2012). Estudo da Qualidade da Água da Baía de Luanda: Distribuição de Metais Pesados na Água, Sólidos Suspensos e Sedimentos. Tese de Doutoramento, Faculdade de Engenharia, Universidade Agostinho Neto.

Smith, H., & Basurto, X. (2019). Defining small-scale fisheries and examining the role of science in shaping perceptions of who and what counts: A systematic review. *Frontiers in Marine Science*, 6(236). doi: 10.3389/fmars.2019.00236.

Sowman, M. (2006). Subsistence and small-scale fisheries in South Africa: A ten-year review. *Marine Policy*, *30*(1), 60-73. doi: 10.1016/j.marpol.2005.06.014

Sowman, M., & Cardoso, P. (2010). Small-scale fisheries and food security strategies in countries in the Benguela Current Large Marine Ecosystem (BCLME) region: Angola, Namibia and South Africa. *Marine Policy*, *34*(6), 1163-1170. doi: 10.1016/j.marpol.2010.03.016

Vale, P., Rangel, I., Silva, B., Coelho, P., & Vilar, A. (2009). Atypical profiles of paralytic shellfish poisoning toxins in shellfish from Luanda and Mussulo bays, Angola. *Toxicon*, *53*(1), 176-183. doi: 10.1016/j.toxicon.2008.10.029

Viswanathan, K. K., Nielsen, J. R., Degnbol, P., Ahmed, M., Hara, M., & Abdullah, N. M. R. (2003). Fisheries co-management policy brief: findings from a worldwide study. Malaysia: Worldfish Center.

Watson, R.A. & Tidd, A. (2018). Mapping nearly a century and a half of global marine fishing: 1869-2015. *Marine Policy*, *93*, 171-177. doi: 10.1016/j.marpol.

World Bank (2012). Hidden harvest: The global contribution of capture fisheries. 66469-GLB. Washington, D.C.: The World Bank.

WorldFish, FAO & Duke University (2018). Illuminating Hidden Harvests: The Contribution of Small-Scale Fisheries to Sustainable Development. WorldFish; Rome: Food and Agriculture Organization of the United Nations; Durham, NC: Duke University. Retrieved from https://www.worldfishcenter.org/content/illuminating-hidden-harvests-contribution-small-scale-fisheries-sustainable-development