

Using fishers' ecological knowledge to assess the status and cultural importance of sawfish in Guinea-Bissau

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ABSTRACT

1. Sawfishes have declined dramatically in West Africa and may be extinct throughout much of their historical range. Guinea-Bissau is considered to be one of the last remaining places in West Africa where sawfish persist.

2. Fishers' ecological knowledge (FEK) can provide valuable baseline data, which can be used to direct scientific studies, in situations where information is scarce or lacking and can also provide insight into local attitudes towards species of interest. Interview surveys were used to collect FEK data on the past and current range of sawfishes within Guinea-Bissau waters, perceived causes of the decline amongst fishermen, and the cultural importance of this species to Bissau-Guineans.

3. Data were collected from 274 respondents, of whom 85% could identify a sawfish from an image. The majority of respondents reported to have last seen a sawfish in the 1980s, although this varied considerably by region, and 30% of respondents in the south had seen or captured sawfishes in the past decade up to and including 2012.

4. Overfishing or excessive fishing pressure was most frequently cited as a perceived cause for the decline in sawfish, followed by shark finning and overseas fishermen. The sawfish is primarily of cultural importance in the Bijagos Islands, where it is central to many traditional ceremonies.

5. This information provides valuable insight into the cultural importance of sawfish to Bissau-Guineans and their concerns in relation to the sustainability of their local fishery resources. Information on recent catches will be useful for directing future work to locate and protect remaining sawfish in Guinea-Bissau.

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INTRODUCTION

Sawfishes (Pristidae) were formerly common in West Africa, but they have been in decline for at

least several decades (Robillard and Séret, 2006). Two species of sawfish were found historically in West Africa, *Pristis pristis* and *Pristis pectinata*¹. The historical range of both species probably

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¹The taxonomy for sawfish has recently been revised (Faria *et al.*, 2012), and *Pristis pristis*, *P. microdon* and *P. perotetti* are now all considered to be *P. pristis*.

included the coasts of the south-east and central eastern Atlantic (Cook and Compagno, 2005; Adams *et al.*, 2006), between Portugal in the north, and southern Angola in the south. Sawfish are now considered to be extinct throughout most of this range. As a result, all sawfish species are now listed as Critically Endangered, with decreasing population trends, by the IUCN Red List. The principal threat to all species of sawfish is fisheries, both targeted and accidental capture, because their long, tooth-studded rostrum makes them exceptionally susceptible to entanglement in fishing nets (Adams *et al.*, 2006; Seitz and Poulakis, 2006). In the past, their large size and littoral and riverine habitats made them vulnerable to over-exploitation (Robillard and Séret, 2006), and as tourism to West Africa increased, there was an increase in catches to provide sawfish rostra as curios for the developing tourism industry in this region (McDavitt, 1996; Robillard and Séret, 2006). As with all species of large elasmobranchs, they are slow-breeding and thus any depleted population requires considerable time and conservation measures in order to recover (Simpfendorfer, 2000).

In the past, fishing was primarily a subsistence activity in Guinea-Bissau, carried out mainly by farmers during their off-season, using hand-cast nets from shore or in small, dug-out canoes (Campredon and Cuq, 2001). This situation prevails in the Bijagos Islands, where most local fishermen do not have motorized canoes or access to modern fishing gear. However, since the 1980s, the use of outboard motors and the availability of cold storage techniques, both on land and at sea, have removed many of the former constraints on fishing activity throughout West Africa, allowing artisanal fishing to expand both spatially and temporally (Campredon and Cuq, 2001). Currently, fisheries account for between 25 and 40% of total state income, more than any other country in Africa (Lundy, in press). There are two main fishing sectors in Guinea-Bissau: artisanal and industrial (Amorim *et al.*, 2004). Industrial fisheries involve exclusively foreign vessels, using trawl nets or purse-seines to catch shrimp, members of the sciaenid community and small pelagics, and also targeting tuna (Fager and

Longhurst, 1968; Domain *et al.*, 1999; Amorim *et al.*, 2004). International fishing activities in Bissau-Guinean waters exert considerable pressure on fisheries resources and do not promote sustainable use (Kaczynski and Fluharty, 2002; Lundy, in press). Artisanal fisheries operate mainly around the Bijagos Islands and in coastal areas, from small open boats with outboard motors (<100 hp), using gill nets, long lines, hand lines and beach seines. This fishery targets mullets (*Mugil* sp. and *Liza* sp.), sharks and rays (*Carcharhinus* spp., *Sphyrna* sp. and *Rhinobatus* sp.), bonga shad (*Ethmalosa fimbriata*), ilisha (*Ilisha africana*), sardinellas, scads, grunts (*Pomadasyss jubelini*), and barracudas (*Sphyrna* sp.) (Lafrance, 1994). As well as local subsistence and commercial fishers, the artisanal fleet also comprises considerable numbers of fishers from neighbouring West African countries such as Guinea-Conakry and Senegal (Binet *et al.*, 2012), including the Nhominkas, who formerly migrated seasonally to the Bijagos but have more recently expanded and now have an unknown number of permanent camps in the Bijagos Islands for fishing and processing (Tvedten, 1990; Campredon and Cuq, 2001; Diop and Dossa, 2011).

Fishing pressure throughout West Africa has become greater in recent years due to increased human migration to the coasts (Diop and Dossa, 2011). Catch landings data for Guinea-Bissau are limited, and there are no historical data on sawfish catches for most African nations as in the past, there were no traditional fisheries targeting sawfish in West Africa (Robillard and Séret, 2006). Shark fishing began in West Africa in the 1970s and peaked in the 1990s owing to rising demand for shark fins in Asia (Diop and Dossa, 2011). A large proportion of Nhominka fishers have focused on shark and ray fishing for the expanding shark fin market (Dulvy *et al.*, 2008; Diop and Dossa, 2011), and as a result, many elasmobranch populations have declined dramatically in this region (Campredon and Cuq, 2001). As the demand for shark fin has increased in recent decades, sawfish have become a more desirable catch, which probably contributed to their continuing decline. Any remnant populations that persist in West Africa are still affected by broad-spectrum commercial and artisanal fisheries, particularly set

net and trawl fisheries (Adams *et al.*, 2006). Sawfish bycaught in these fisheries are retained because of the very high value of their products – the fins of sawfish and other rays are considered to be very valuable within the shark fin industry (Clarke, 2008). Field surveys in Mauritania, Senegal, Gambia, Guinea-Bissau, and Guinea-Conakry in 2005 revealed that sawfish were present only in the Bijagos Archipelago in Guinea-Bissau (Robillard and Séret, 2006). As part of the implementation of a National Action Plan for Sharks, the Centro de Investigação Pesqueira Aplicada (CIPA), a research branch of Guinea-Bissau's Ministry of Fisheries, has collected data on shark fisheries in Guinea-Bissau since 2009 (CIPA, 2007). Between 2009 and 2010, 18 species of sharks and 20 species of rays were recorded from Bissau-Guinean waters, but no sawfish were documented (Jung *et al.*, 2011).

Fishers' local ecological knowledge (FEK or LEK) can provide baseline data in areas where few or none exist, as well as supplement scientific data (Uprety *et al.*, 2012). Previous studies have documented FEK relating to the ecology, behaviour and long-term patterns in abundance of cetaceans (Tregenza, 1992; Turvey *et al.*, 2010; Carter and Nielsen, 2011; Zappes *et al.*, 2011), incidence and rates of bycatch of marine turtles, cetaceans and seabirds (López *et al.*, 2003; Carreras *et al.*, 2004; Moore *et al.*, 2010; Gore *et al.*, 2012), stock assessments for harvested marine resources (Gendron *et al.*, 2000), the decline of fish species (Dulvy and Polunin, 2004; Lavides *et al.*, 2009) and the cultural importance and decline of sawfish (Robillard and Séret, 2006). Such studies can also offer opportunities to develop a research approach that develops trust and collaborative relationships between researchers and fishers, building capacity for future research and management activities (Carruthers and Neis, 2011). However, fishers may not always wish to participate in such studies, fearing increased regulation or other negative repercussions (Silver and Campbell, 2005; Hartley and Robertson, 2009; Carruthers and Neis, 2011).

Information collected from qualitative fishers' knowledge interviews with artisanal fishermen throughout Guinea-Bissau demonstrates the value of FEK for directing ecological research and

conservation efforts for endangered species in data-poor areas. The aims of this study were: (1) to assess whether sawfish were still present in Bissau-Guinean waters and specifically, where they were most likely to still be found; (2) to gain insight into local perceptions of the causes for the decline in sawfish; and (3) to document the cultural significance of these fish throughout Guinea-Bissau as a means of supporting future community-based conservation efforts. While FEK can provide valuable baseline data on rare or depleted species, the process of engaging local communities in both collecting and providing fishers' knowledge influences the quality of the research, as well as future research and management opportunities. A final objective was therefore to train community members in data collection, raise awareness of the importance of reporting sawfish catches and initiate relationships of trust and data-sharing within communities, that should support future research and conservation activities.

METHODS

The study took place in four regions of coastal Guinea-Bissau: Orango National Park, Cacheu in northern mainland Guinea-Bissau, the capital, Bissau, and Cacine in the south (Figure 1). Orango National Park was chosen as a study site because sensitization efforts, to encourage reporting of catches of sharks and rays, had already been carried out by a local NGO (Noé Conservation) in that area. However, since considerably less sensitization work had been carried out on the Bissau-Guinean mainland, and information on sawfish in mainland coastal waters was lacking, it was considered important to expand the study to include other areas. The Cacheu National Park and Artisanal Fisheries Research Centre in Cacine both provided accommodation for interview teams and a training venue, and thus allowed for regional teams in the south and north of the country to contribute to the study. The study was carried out for Noé Conservation, in consultation with IBAP (Institute for Biodiversity and Protected Areas) and CIPA. Noé Conservation has had a presence in Guinea-Bissau since 2009 and works closely with

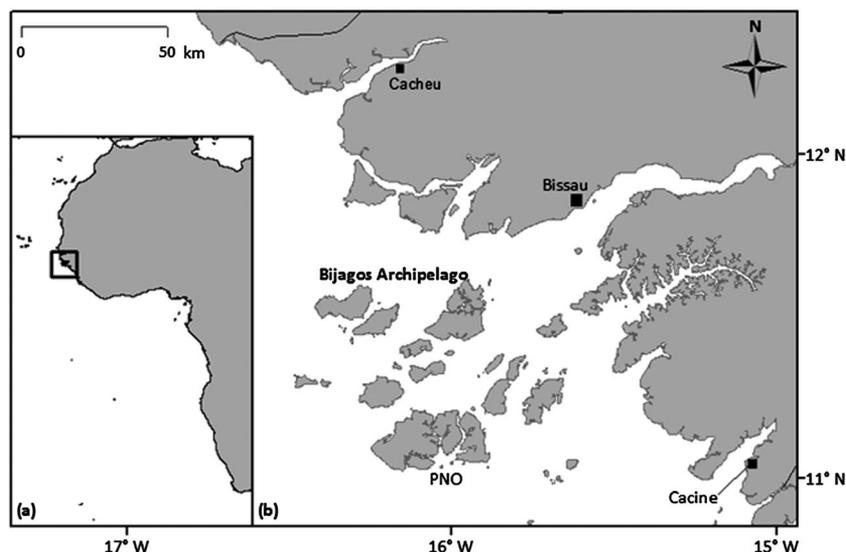


Figure 1. Study area. (a) The west coast of Africa, showing the location of Guinea-Bissau. (b) The four study areas where training took place and around which questionnaires were carried out: Orango National Park (PNO), Cacheu, Bissau and Cacine.

both institutions on protected area management, biodiversity monitoring and conservation, working alongside local communities to provide natural resources-related education and training, and leading community-based activities. IBAP is a government body that manages the country's national parks and promotes research, conservation and the wise use of natural resources. CIPA conducts monitoring of fisheries resources and promotion of sustainable fishing practices, and is responsible for the implementation of the National Action Plan for Sharks (CIPA, 2007).

Members of local communities participated in the study as interviewers. Most interviewers were already employed by CIPA and Noé Conservation to collect fisheries landings data. Local interviewers were used based on the assumption that interviewees would be more comfortable and therefore open when speaking to someone known to them or their community. Training for local interviewers was provided at three sites: Eticoga, on the island of Orango (Bijagos Islands, four interviewers); Cacheu in northern mainland Guinea-Bissau and Cacine in the south (Figure 1; eight and 11 interviewers, respectively). In each case, a number of local people who had previously been involved in data collection for the National Action Plan for Sharks or the Manatee Monitoring

Network (an IBAP project) and in some cases, additional fishermen, attended a training session. During this session, the aims of the study were presented, the questionnaire was explained and discussed in detail, interview techniques were discussed and mock interviews were conducted. The next day, trainees conducted one or two interviews in the nearby port or fishing village, followed by a debriefing session during which these interviews were checked. Missing data and other challenges encountered were discussed. The same exercise was repeated on the third day, but in the debriefing session, pairs of interviewers discussed each other's questionnaire responses. This afforded everyone in the group an opportunity to see what mistakes were likely to be made, the difficulties that others had encountered, and to share guidance on how to address these.

In the Orango National Park, the training course was followed by 4 days of questionnaires in various villages on Orango and the neighbouring islands of Orangozinho, Menegue and Canogo (Figure 2(a)), accompanied by one of the authors (RHL). Whenever possible, RHL interviewed the village chief in each of these villages, and occasionally several other village elders also. Following the training courses in Cacheu and Cacine, each interviewer was provided with blank questionnaires

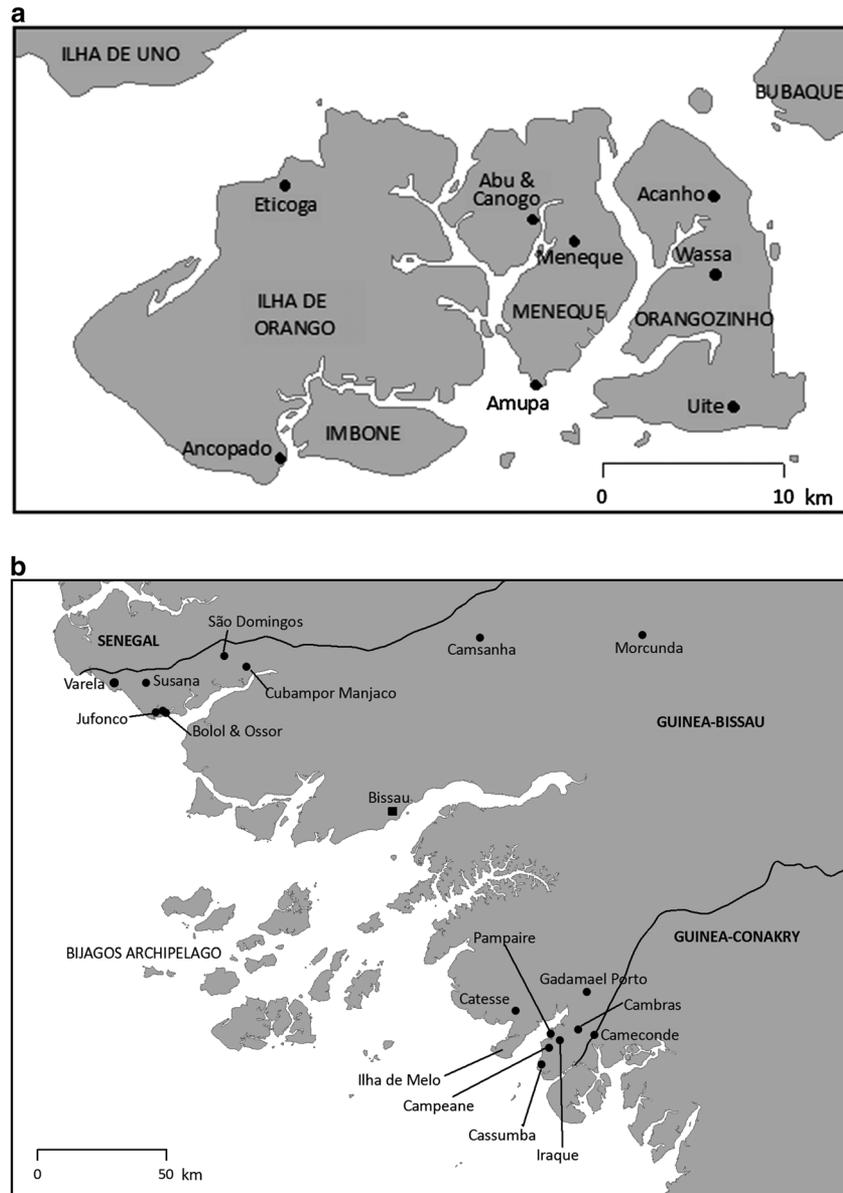


Figure 2. (a) Location of villages in PNO where interviews were carried out. (b) Map of Guinea-Bissau, showing locations of villages in the north and south mainland where interviews were carried out. Coordinates were not available for the following villages: Cabascane, Cadico, Camsanha, Canali Fula, Tribunal (in the south) and Porto Aribada (in the north). At least one interview was carried in all locations marked on the map.

and was requested to carry out a further 1–3 days of questionnaires in surrounding villages (Figure 2(b)). One interviewer from Bissau joined the training course in Cacine and then returned to Bissau to carry out interviews there.

All interviewers were members of a local community in the region in which they were to carry out interviews. Interviewers were required to be able to read and write Portuguese, however, not

all interviewers were well-practised in reading or writing and because of this, interviews often took some time (R. Leeny, pers. obs.). For this reason, and in order to maximize the number of fishermen interviewed over a short study duration, the questionnaire was kept relatively simple. This also ensured that interviewees, who were often engaged in mending nets, harvesting crops or other activities when approached for an interview, were

not required to stop work for too long and did not lose interest in the interview process.

Participant sample

Interviews were conducted according to the availability of each fisherman when approached by an interviewer and took place throughout the day, either in the respondent's residence or at landing sites and harbours. Interviewers were asked to speak to local, Bissau-Guinean fishers wherever possible, and to otherwise note if the interviewee was not a local. The interviewers began by introducing themselves, explaining that the project was being carried out by Noé Conservation in collaboration with IBAP. Most interviewees were familiar with at least one of these institutions, and reactions of interviewees in Orango National Park to this introduction suggested a positive relationship with Noé Conservation. No particularly negative attitudes towards IBAP were reported by interviewers, although this issue was not specifically addressed during interviews. The interviewers then explained that they were collecting information about important marine species in Guinea-Bissau, with a view to better protection of marine resources for the Bissau-Guinean people. They assured the interviewee that the questionnaire was anonymous and likewise explained that the respondent was not obliged to answer any question he did not wish to. Each interviewer was provided with a picture of a sawfish (in some cases, a colour photocopy of a photograph was used and in others, a line drawing of both profile and dorsal views; both came from fish identification guide books). The interviewer then asked the fisherman whether he recognized the image and knew what type of fish it was. If the respondent could not identify the sawfish, the interviewer did not proceed any further with the questionnaire. If the respondent could identify the sawfish, the interview went ahead. Interviewees were also asked if they owned, or knew of any sawfish rostra or ceremonial masks in the village.

The majority of the interviews were carried out once the three-day training session had been completed (rather than during the training sessions). With the exception of all the village chiefs in PNO, one village chief in Cacine and

three other interviews (12 in total), who were interviewed by RHL, accompanied by a translator and a local interviewer, interviews were carried out without the presence of foreigners. Fishermen may fear consequences (such as regulation of their activities) of responding to interviews (Silver and Campbell, 2005), and are more likely to feel comfortable in the presence of a fellow fisherman or someone from a neighbouring community (R. Leeney pers. obs.). The use of local interviewers thus ensured that interviewees were at ease and more likely to be honest in their responses.

Between 23 October and 31 November 2012, 295 questionnaires carried out by the trained interviewers were completed in the PNO, Cacheu, Bissau and Cacine - São Domingo regions. Twenty-nine questionnaires were discarded, including 12 from a single interviewer, because either too many questions were left unanswered or because of the preponderance of irrelevant answers. RHL also carried out eight interviews with chiefs of the following villages: Eticoga, Uite (deputy chief and chief), Acanho (chief), Wassa (chief), Amupa (deputy chief), Ancopado (deputy chief and chief), all in the PNO, as well as one interview with the village chief in Cacine. Village chiefs were interviewed in the hope that they might provide a longer-term view of the local prevalence of sawfish (most chiefs were among the oldest people in their village) or greater insight into the cultural significance of sawfish for their village. These data were integrated into the larger data set. Excluding the discarded questionnaires, data from a total of 274 respondents were available, comprising 84 individuals in the northern region, 20 in Bissau, 92 in the southern region and 78 in the Bijagos Islands.

There are 77 artisanal fishers officially registered for the PNO (IBAP, unpubl. data), although this is probably an underestimate. Of the 79 questionnaires and interviews carried out in the Bijagos Islands, five were on the island of Uno and one was carried out with a village chief who had knowledge of the fishing industry but was himself a farmer. Thus, the 73 fishermen interviewed in the PNO probably account for about 90% of the registered fishing community there. Tvedten (1990) estimated that there were about 900 fishermen (both

nationals and foreigners) working in the Bijagos Islands, but provided no number for the mainland. A socio-economic study of artisanal fisheries carried out by CIPA (2011), estimated that there were 4141 fishermen in Guinea-Bissau (data from 17 localities including the Bijagos Islands). Using this figure, the 274 questionnaires carried out for this study represent about 6.6% of the entire artisanal fishing community in Guinea-Bissau.

The questionnaire

A standard semi-structured questionnaire, containing both open and closed questions, was designed to collect basic background information from fishers and coastal community members as well as details of recent sightings and captures of sawfishes and cultural importance to each community (Appendix). Interviews were guided by this questionnaire and were conducted in an informal fashion. Several questions relating to dolphins were also included at the end of the interview, but those data have not been included as a part of this study. The questionnaire itself was divided into categories with questions about the fisherman's age, village of residence and the type of fishing gear used, questions relating to sawfish distribution and patterns of occurrence over time, and questions about the cultural practices and uses of this species. A map of the region in which the questionnaires were being carried out was included with each questionnaire, and interviewers asked respondents to indicate their fishing area and any sites where sawfish had been caught, on the map. The questionnaire was translated into Portuguese by a local Bissau-Guinean translator. The questionnaire was discussed with interviewers during each training session to ensure that they understood the information they should collect and were comfortable with the task. This also provided an opportunity for them to voice any concerns regarding the possible sensitivity of fishers to the topics they would cover.

Analysis

Of 274 respondents, 15% either did not know what a sawfish was (33 individuals), or had heard of them but had never seen one (8 individuals). These

individuals were excluded from the data analyses that follow.

Respondents were asked when they last had observed a sawfish. Ten responses were not considered further because the respondent was calculated to be age 5 or younger at the year of last sighting, and in 10 additional cases, no year of last sighting was noted. The 213 remaining responses (including 11 people for whom age was not provided) were binned by decade, with dates from 2000 onwards grouped into the periods 2000–2004 and 2005 to present.

For the remaining analyses, data from all respondents who claimed to have seen a sawfish were used, regardless of whether calculated age-at-sighting was reasonable considering the age of the respondent.

Additional data collection

A web search was carried out for sport fishing activities for tourists in Guinea-Bissau. Informal interviews were carried out with three fishing tour operators during the field period.

RESULTS

All interviewees were male, as women play no role in fishing in Guinea-Bissau. Many women are involved in the collection of shellfish from tidal flats, but it was considered more appropriate to interview fishermen who had potentially caught sawfish during their time at sea and could therefore provide more detailed information on the areas where sawfish used to be, or still can be found. Respondents were aged between 19 and over 80 (one respondent claimed to be 103 years of age) but the majority were aged between 30 and 59 (Figure 3(a)). The interviewers mentioned that some boys start fishing when they are still in their teens or even younger, going to sea with their father or another relative, however, in this study, interviewees were not asked how long they had been fishing.

Some 23 ethnic groups inhabit Guinea-Bissau, thus there are many local names for the sawfish, as well as the Portuguese name 'peixe-serra' (sawfish) and the Crioulo name 'peixe-espada' (spade fish).

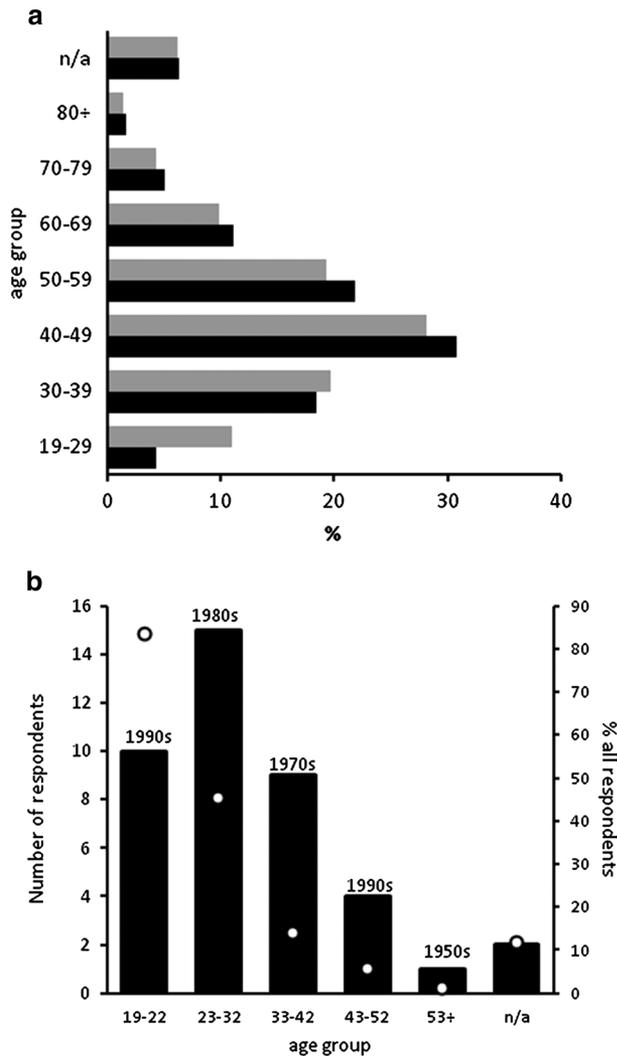


Figure 3. (a) Age profile (as %) of all respondents (black, $n = 274$), and those who had seen a sawfish (grey, $n = 233$). (b) Number of respondents in each age group who had never seen a sawfish or did not recognize the image of a sawfish (black bars, $n = 41$) and as a percentage of all respondents in each age group (white points, $n = 274$). The decade above each bar corresponds to the year of birth of the age group below it.

In the Bijagos Islands, sawfish were most commonly referred to as *caês*; in the south as *n'canque* or *dequema iequé*; in the north there were over 19 different names or variations of names provided, including *ugate*, *djagarai/ djacarai* and *djagarai catinga*. These names are listed in the Appendix, Table A1.

Last sightings of sawfish

The greatest proportion of respondents (39%) provided a date in the 1980s as the last time they

observed (either in a net or elsewhere) a sawfish, suggesting that sawfish populations were noticeably in decline by that decade (Table 1). However, when the data were viewed separately by region, differences in this timeline became apparent (Table 1). In the Bijagos, the majority of respondents (53%) who could identify a sawfish reported their last sighting as in the 1980s, and only a single respondent claimed to have seen a sawfish after 2000 (in 2004). Many of the interviewees in Bissau did not recognize the sawfish or had never seen one; of the nine who had, most had last seen the species in the 1980s or 1990s. Similarly, in northern mainland Guinea-Bissau, the majority of respondents stated that they had last seen sawfish in the 1980s (31%) or 1990s (24%). Only 11 individuals (16%) claimed to have seen a sawfish since 2000. The same pattern was evident in the south, with the majority of respondents placing their last sighting in the 1980s or 1990s, but 30% of respondents ($n = 25$) claimed to have seen a sawfish since 2000, and ten of these respondents said their sighting occurred in 2010 or later.

There was a distinct difference in proportions of respondents in each age group who had never seen a sawfish or did not recognize the sawfish image. Of all those who had never seen a sawfish (41 individuals), 76% were aged 39 or younger. Only 14% of all 33–42-year-olds who were interviewed (i.e. those born in the 1970s) had never seen or could not identify a sawfish, and even fewer in older age groups. In contrast, 45% of 23–32-year-olds and 83% of 19–22-year-olds interviewed (born in the 1980s and 1990s, respectively) fell into this category (Figure 3(b)).

Changes in sawfish abundance

In total, 94% of respondents stated that numbers of sawfish in their region had declined ($n = 233$). No interviewee thought that sawfish abundance was increasing in their area, but 2% ($n = 5$, all of whom were in the south) stated that numbers were the same as in the past. The question relating to the time period over which fishers had seen a change was rarely answered, and it was sometimes evident that the respondent (or the interviewer) had not

Table 1. Last year in which interviewees stated they had seen a sawfish, as proportions (%) of all interviewees per region

Year	North (n = 68)	Central (n = 9)	South (n = 82)	Bijagos (n = 54)	All regions (n = 213)
1960-69	4.4	0	2.4	0	2.3
1970-79	19.1	22.2	3.7	7.4	10.3
1980-89	30.9	44.4	34.1	53.7	38.5
1990-99	23.5	33.3	29.3	20.4	25.4
2000-2004	7.4	0	6.1	1.9	5.2
2005-2012	8.8	0	24.4	0	12.2
Don't remember	5.9	0	0	16.7	6.1

understood the question, thus the few data collected in response to this question were not analysed.

The responses of 220 interviewees who stated that sawfish had declined in their region were analysed to assess the possible causes for this decline (Table 2). Many respondents provided more than one potential reason for this decline. The open question, 'What do you think is the reason for the change in numbers of sawfish?', provided a great diversity of responses, which were

Table 2. Reasons for decline of sawfish in each region, as proportion (%) of all responses in that region.¹ Number of responses per region indicated (> number of respondents). The two most frequently-cited reasons in each area are highlighted in grey

Reason	North (n = 88)	Central (n = 10)	South (n = 142)	Bijagos (n = 74)
<i>Overfishing</i>	21.6	30	20.4	22.9
<i>Overseas fishermen</i>	11.4	10	14.8	36.5
<i>Motors</i>	13.6	10	11.3	1.4
<i>Nets</i>	19.3	0	3.5	5.4
<i>Finning</i>	5.7	0	18.3	0
<i>Authorities</i>	1.1	20	0	0
<i>Blood</i>	0	0	14.8	0
<i>Rain</i>	4.5	10	0	0
<i>Methods</i>	3.4	0	6.3	1.4
<i>Mangroves</i>	0	10	0.7	0
<i>Deep nets</i>	3.4	0	0	5.4
<i>Saw</i>	0	0	0	5.4
<i>Pollution</i>	1.1	0	2.8	0
<i>Local fishermen</i>	1.1	0	0	2.7
<i>Value</i>	1.1	0	2.1	0
<i>Other</i>	1.1	0	2.1	2.7
<i>n/a</i>	11.4	10	2.8	16.2

¹Overfishing – Any mention of too many fishermen/ too many boats/ the species in question was much sought-after; Overseas fishermen – fishers from other countries; Motors – noise of boat motors/ more motors used; Nets – more nets/ bigger nets/ many different types; Finning – any mention that people just cut off fins and discard the body, or the large market for/ high value of fins; Authorities – any mention of government/ authorities; Blood – any mention of discarding body & blood in water after removal of fins; Rain – Less rain in recent years/ change in climate; Methods – mention of fishing methods deemed inappropriate; Mangroves – cutting of mangroves; Deep nets – specific mention of use of nets for deeper waters; Saw – rostrum is easily caught in nets; Pollution – any mention of 'industrial'/ artificial materials or boat fuel in sea; Local fishermen – specific mention of overfishing by locals; Value – saw or meat in demand; n/a – no answer or did not know reason.

placed into categories to provide an overview. Some interpretation of answers was required in order to categorize responses. For example, overfishing was rarely directly stated as a possible reason for the decline, but was often intimated by responses such as 'too many fishermen' and 'too much demand for this fish'. These categories, and the various answers grouped within each, are detailed in the Appendix, Table A2. Figure 4 shows the frequency with which each category was mentioned by respondents. Interviewees suggested a wide variety of causes for the decline in sawfish populations, of which overfishing, overseas fishermen and the noise of boat motors were most frequently cited (Figure 4(a)). Overfishing or excessive fishing pressure was a primary reason in all areas, but other cited reasons differed by region. Thus, responses were separated by region (Table 2). Figure 3(b)–(d) presents the cited reasons for the decline in sawfish by region, for the north, south and Bijagos regions. The sample size in Bissau (n = 10) was small, thus these data have not been presented separately.

In the north, overfishing (22%) and more or bigger nets (19%) were the two most frequently cited causes of the decline in sawfish abundance (Figure 4(b)). In the south, fishers most often mentioned overfishing (20%) and finning activities (18%) when asked what they believed was the cause of the decline of the sawfish (Figure 4(c)). Uniquely in this region, fishers mentioned that the practice of discarding the blood and remains of a fish back into the sea, once the fins had been cut off, would cause a decrease in fish in the area. Fifteen per cent of respondents mentioned this reason, explaining that the blood and flesh in the water would cause other fish in that area to become afraid and abandon the area. In Cacine,

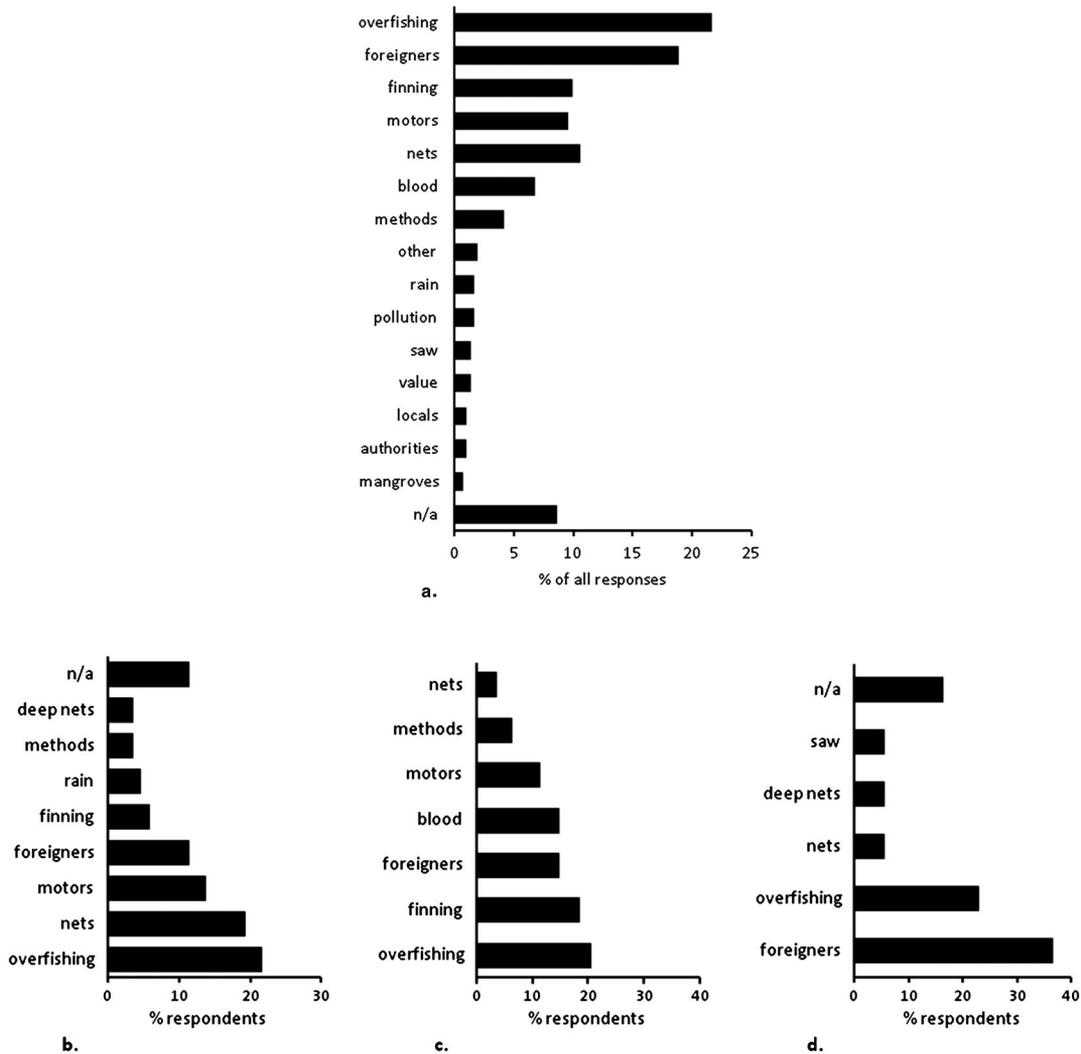


Figure 4. Beliefs regarding causes for the decline in sawfish. (a) Data from all regions combined ($n = 314$ responses from 220 interviewees); (b) northern mainland ($n = 88$ responses from 66 interviewees); (c) southern mainland ($n = 142$ responses from 82 interviewees); (d) Bijagos Islands ($n = 74$ from 63 interviewees). For (b)–(d), only reasons accounting for $>3\%$ of all responses per region are displayed. A full description of the answers included in each category is provided in Table A.2. X-axis categories. *Foreigners* – overseas fishermen. *Finning* – any mention of fins being removed or the value of fins at market. *Motors* – noise of boat motors/ more motorized vessels. *Nets* – more/ bigger nets. *Blood* – throwing the blood and body parts of the fish back into the sea. *Methods* – inappropriate fishing methods. *Rain* – less rain in recent years/ change in climate. *Saw* – the sawfish's saw means it is easily caught in nets. *Value* – any mention of the saw or meat being in demand, or for sale. *Locals* – overfishing by locals. *Authorities* – any mention of local authorities. *Mangroves* – cutting down of mangroves. *N/a* – no answer or did not know the reason.

an older fisherman (claiming to be 103 years old) said that in the past, when a sawfish was caught, it was usually too big to get into the boat whole and had to be cut into pieces. He stated that the release of the sawfish's blood into the water caused other sawfish to leave the area. These sawfish were so big that there was too much meat for just one family, and so parts of the fish would be sent to other family members in Bissau, or across the border in Conakry, for example. Respondents in

both the north and south also believed that the noise of boat motors, or the increase in the use of outboard engines, may have had an effect on sawfish abundance. In the Bijagos, overseas fishermen were most often mentioned as a likely cause of sawfish decline (36% of all responses), followed by overfishing (23%). There was considerably less diversity in the responses of fishers in this area, compared with the other regions (Figure 4(d)).

Some of the older respondents remembered a time when nets were not used by local fishermen, and suggested that the current frequent use of nets of all types had seriously affected the sawfish population because it made it easier to catch them. Previously, fishers would go to the beach at night, so that they would be less visible to the sawfish, using a torch to light their way. They could then find and spear sawfish in the shallow waters just off the beach. In some cases, respondents blamed the illegal use of monofilament nets, which they claimed are used by Senegalese fishers, for declines in sawfish, but the majority of respondents did not specify any one type of net.

In the south, 18% of respondents mentioned finning as a reason for the decline in sawfish abundance, whereas in the north, it was suggested by only 6% of interviewees, and not at all by fishers in the Bijagos. A fisherman in Cameconde stated that sawfish fins could fetch 70 000 CFA kg⁻¹ (roughly €100 kg⁻¹).

Cultural importance of sawfish

In the Bijagó culture, the sawfish is an important species which is used in many of their ceremonies (Figure 5(a)). The ceremonies mentioned in relation to sawfish were male circumcision

(*fanado*), a ceremony for progression through the social ranks (*grandesa*), ‘women’s ceremony’ (possibly related to female circumcision) and the *camabes* ceremony. Sawfish were also mentioned as important to the *Canhocam* age class (adolescent boys of 12 to 17) in Bijagó society (Biai *et al.*, 2003). Respondents stated that in many of these ceremonies, a candidate must catch a sawfish and present it to the elders of the village before he can complete the ceremony. As a food, sawfish was held in high regard among interviewees in the Bijagos. A traditional dish called *catoré* was prepared for ceremonies, whereby the sawfish flesh was boiled, skinned, mixed with palm oil and eaten with rice. The interviewers in the PNO stated that masks using sawfish rostra were only part of the cultural practices on two of the Bijagos islands, Formosa and Uno. Ceremonial masks observed during this study, which traditionally bore the rostrum of a young sawfish (Robillard and Séret, 2006), all bore miniature ‘saws’ carved from wood.

In contrast, on the mainland, 58% of respondents asserted that sawfish had no cultural value and 19% considered sawfish solely as a source of either meat or fins, either for personal consumption or for sale, as well as the sale of saws (Figure 5(b)). Some respondents mentioned that the painted saw was used as a decoration in a fisherman’s house.

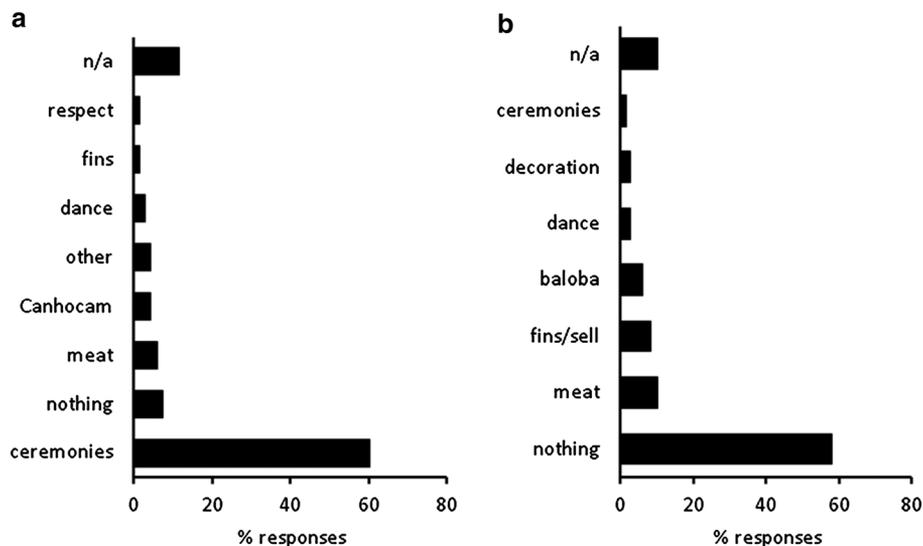


Figure 5. Cultural importance and uses of sawfish in (a) the Bijagos (n = 68 responses), and (b) mainland Guinea-Bissau (north, Bissau and south areas combined; n = 183). *Meat* – any mention of sawfish as food. *Canhocam* – cultural practices of adolescent boys. *Dance* – ceremonial dances. *Fins and fins/sell* – any mention of removing or selling fins or sale of any part of the sawfish. *Baloba* – placing a sawfish saw in a sacred area. *Decoration* – use of saw for decoration inside a house. *Respect* – presenting sawfish to village elders as a sign of respect.

Several respondents mentioned that a sawfish could be butterfied and dried to keep it for longer, perhaps in order to sell it. Only 10% of respondents mentioned the use of sawfish in relation to traditional practices such as ceremonies, dances and placing the rostrum of a sawfish in a *baloba*, a sacred place used for religious practices. Sawfish rostra are placed in these areas as a 'sinal de espanto' (literally: a sign of astonishment), possibly to indicate danger and keep villagers away from these places. All respondents mentioning the use of sawfish rostra in *balobas* were in the north (n = 8). In Cacine, one fisherman stated that the penis of the sawfish was cooked and eaten, as a way for a man to increase his strength in sexual relations with his wife.

Distribution of sawfish

Many respondents indicated the areas where they had seen, or used to see, sawfish on a map of their region, but the areas indicated were often vague. In many cases the interviewer did not collect this information. This may have been because the interviewee did not recognize or know how to read the map (as was apparent in many cases), or in a small number of cases, because the interviewee was located in one region at the time of the interview but provided information on a different region, where most of his fishing experience had been amassed.

In conversations with the interviewers in PNO, more detailed information was collected on the areas where sawfish most likely persist or at least areas where sawfish could be found. An unreported catch of one sawfish occurred off Bolama (an island south of Bissau) in 2011, according to the Noé Conservation interviewers in the PNO. A fisherman on Orango mentioned a sandbank off the island of Orango where he was certain that sawfish could still be located. Another, also on Orango, named a river on the island of Meneque where sawfish might still be found. Many chiefs and village elders in the PNO noted that they used to see many sawfish at the beaches close to their villages, and that the sawfish would come into shallow waters as the tide rose, where the villagers could then spear them at night. One interviewee in Cacine (questionnaire

#110) stated that local fishermen who went on fishing trips of 5 days or more, to offshore areas, still caught sawfish. This group of fishers were at sea during the study, but future work in this region should attempt to contact these fishers and ask them targeted questions regarding recent sawfish catches and specific areas where sawfish might still be located.

Ten respondents in the south claimed to have seen a sawfish in 2010 or more recently, of which nine provided details of the area where they last saw or used to see this species (interviewers did not differentiate between location of last sighting and general information on past habitats). The details of specific locations will be investigated as a priority in future research. Sandbanks were mentioned by some interviewees as an important habitat for sawfish, and the use of nets on sandbanks was suggested as a cause for their decline. However, the variety of responses suggests that sawfish were formerly widespread in riverine and coastal areas, as well as offshore waters.

Additional information collected from village chiefs

The village chiefs in the PNO stated that since the demise of the sawfish, other fish or sometimes cows have been used as offerings to village elders. One village chief in the PNO stated that the lack of sawfish is not something that he was indifferent to; rather, they would be glad if this fish were to return to their area. Several of the village chiefs interviewed stated that they would strongly support any future plans to conserve and protect the sawfish, in the hope that it might eventually return to its old range. According to the village chief of Ancopado in the PNO, people on Orango used to use sawfish saws in their ceremonial dances, but these groups have gone from Orango or the tradition has died, and only now occurs on the islands of Uno and Formosa.

Sport fishing operators

All three sport fishing operators stated that they had never seen or caught a sawfish, and had no information on catches in the past. Of these operators, one had been living and fishing on the island of Bubaque for over 20 years, one had spent

over 30 years fishing in the Rio Buba, on the mainland and one has run fishing tours around the Bijagos Islands since 2001. The operator on Bubaque stated categorically that sawfishes had been extinct for a long time in Bissau-Guinean waters.

DISCUSSION

Local knowledge can be used to assess declines or extinctions of species, and is particularly useful for marine species, where extinctions often go undetected for some time (Dulvy and Polunin, 2004). Although sawfishes may be considered 'charismatic' species, and have been culturally important in parts of West Africa, their disappearance from African waters has gone largely undocumented until recently. This study's documentation of recent sawfish catches suggests that even in Guinea-Bissau they are now rare, but may still persist in the region in small numbers.

This study built upon previous research by expanding the geographical area from which data were collected. Landings data on sawfishes and other shark and ray species were previously collected from sites in the Orango National Park, Cacheu and Bissau (Jung *et al.*, 2011), thus this study has broadened the sampling area by covering the southern part of Guinea-Bissau. Robillard and Séret (2006) visited the 'main landing sites' in Guinea-Bissau, along with several (unnamed) fishing villages and processing areas, but the current study sampled a larger number of fishermen. This study further differentiates the differences in cultural significance of sawfish, and perceived causes for decline, among the various regions and communities in Guinea-Bissau. Interviews with artisanal fishermen throughout Guinea-Bissau provided information that can be used to focus future research on sawfish in the area, and to support the design of conservation and management measures. This research has also created a basis for future collaboration between researchers and local communities, although the confidence of fishers in the research process and its benefits for them will need to be addressed.

Based on the dates of last known sightings, it is likely that sawfish started to decline noticeably in the

1980s. The relatively low proportions of respondents born in the 1970s and 1980s who could recognize a sawfish from an image supports this suggestion. Shark fishing started in West Africa in the 1970s but lower yields and decreasing profitability quickly indicated that this industry was not sustainable (Diop and Dossa, 2011). Among those who did recognize the sawfish image, almost all noted a decline in abundance. All questionnaire respondents in the PNO and many in the Cacheu region (north) indicated that the most recent catches were many years ago. However, 30% of interviewees in the south of Guinea-Bissau, and 16% in the north, claimed to have seen a sawfish since 2000. Because of the mismatch between respondent age and the year in which they claimed to have last seen a sawfish, it is debatable whether all such dates for most recent sawfish sightings are reliable. Although they may not be entirely accurate, they do have validity as qualitative measures of local decline, and suggest that recent catches have been more numerous in southern Guinea-Bissau. Little assessment of fish landings or sensitization has been carried out in this region, which should thus be prioritized in any future work to locate sawfish in Guinea-Bissau. This finding is also in contrast to that of Robillard and Séret (2006), who suggested that in this region, sawfishes had become mainly limited to the Bijagos Archipelago.

The former distribution of this species around the Bijagos was probably extensive because most interviewees from the small villages throughout the Orango National Park stated that they used to catch sawfish very close to their own village, usually at the nearest beach. They were probably also common off the mainland coast; many fishers from this region mentioned having caught them in deeper water, and sandbanks were mentioned by many respondents as areas where they had found sawfish in the past. This supports the previous findings of Le Douget (2009) – ‘*Piss spada ita fila sempre com banco d'areia*’ *Ce qui veut dire que de part son expérience, les poissons scies sont toujours autour des bancs de sables et jamais autour des bancs de vase, de gravier ou de roche*’ (translation of the French text: In his experience, sawfish are always around sandbanks and never found around banks of mud, gravel or rock).

Perceived causes for decline were assessed at a finer scale among fishermen from multiple communities and ethnic groups in Guinea-Bissau. While these data are not necessarily an accurate representation of the actual drivers of the demise of sawfish in this region, they do provide insight into the issues that local fishers face and their understanding of the impacts of various activities on the marine environment. For example, many fishers mentioned the behaviour of finning and discarding carcasses as a cause for decreasing sawfish numbers. While their understanding of why this activity is detrimental may not be biologically accurate – they believed that the presence of blood and dead conspecifics in the water would scare sawfish away from an area, but attraction of predatory fish might be a more likely result – the fact that this behaviour is recognized as having a negative impact is significant. Excessive fishing pressure was perceived to be the main reason for the decline in sawfish numbers. Some respondents on the mainland proposed that the noise of boat motors had caused sawfish to leave, which might suggest that the decline in sawfishes was coincident with a rise in the use of outboard motors. Greater access to diverse habitats, facilitated by motorized boats, may also have contributed to the decline of sawfishes.

The differences among regions in perceived causes for sawfish decline may be due to sensitization or education programmes having taken place in certain regions. Alternatively, these differences may be due to actual differences in impacts on different parts of the country's coastline or because, in the PNO, there is a high level of awareness among fishers of regulations relating to fishing activities, due to considerable sensitization work in that area. For example, loss of mangroves, a key concern for coastal conservation and fisheries health throughout Guinea-Bissau (Corcoran *et al.*, 2007), was mentioned only by respondents in Bissau and the southern mainland. A mural, seen on the wall of a house in Cacine during this study, discouraged the destruction of mangroves (R. Leeney pers. obs.), thus it is likely that some level of sensitization has occurred in that region, at least. A lack of direct culpability was evident in the attitudes of fishermen towards the decline in

sawfish abundance. Very few respondents mentioned overfishing by local people, with most either mentioning overfishing in more vague terms, or specifically placing blame on fishers from overseas. This may represent well the situation in Guinea-Bissau, where although artisanal fishing has a considerable impact on local fisheries, this is mostly due to the influx of fishers from neighbouring West African nations (Henriques and Campredon, 2007), often with larger vessels and more modern and effective gear (Tvedten, 1990). Overseas fishers were particularly of concern for fishermen in the Orango National Park. Although non-resident fishers are prohibited from fishing inside the park boundaries (IBAP, 2008), this is rarely enforced and foreign vessels are a common sight throughout the Bijagos Islands.

Robillard and Séret (2006) summarized the cultural significance of sawfish in West Africa. In various parts of the region, sawfish are associated with prosperity and fecundity, as a protective force, demonstrate courage and strength, or may be used for medicinal purposes. Within Guinea-Bissau, the cultural connections between people and sawfish (as well as other marine species such as the hammerhead shark) are strongest in the Bijagos Islands because of their animist traditions, while less significance is accorded these species by people on the mainland. In the Bijagos Islands, the links between sawfish and community go beyond the market value of these fish, and have a central role in numerous community events such as ceremonies. This provides an ideal setting for a community-led conservation project, given that the Bijagó people might be considered to have far more investment in the protection of sawfish than their mainland counterparts. Village chiefs who were asked whether they would support a ban on the capture of sawfish for a defined period of time, as part of a community-led effort to conserve these fishes and allow them to recover, all supported the idea. Several noted that most children in their villages did not know what a sawfish was; something they hoped could change by allowing populations to recover.

Traditionally, fishing was never an intensive activity for the Bijagó people. The Bijagó culture deemed many of the islands in the archipelago as

sacred sites, thereby restricting access to these islands and thus limiting human impacts on their biodiversity (Henriques and Campredon, 2007). In addition, the structure and traditions of communities in Bijagó villages was such that it has probably prevented, or at least delayed, the shift from subsistence to commercial fishing (Tvedten, 1990). These elements may well have combined to act as a form of resource management, even if not intended as such. McClanahan *et al.* (1997) noted that the traditional practices of coastal populations may take the same form as restrictions practised by modern fisheries organizations, and even if not implemented with the intention of increasing fish stocks, may nonetheless have that effect. The traditions of the Bijagó people are declining as the mainland becomes more accessible, influences from there and further afield permeate the islands, and younger generations become frustrated with their culture (Bordonaro, 2006). The large proportion of people in this study who had never seen a sawfish is significant given the cultural importance of this species, and the fading prevalence of sawfish in Bijagó society may add to the continuing loss of cultural practices which, in turn, has the potential to impact negatively on traditional resource management. The decrease in abundance of sawfish in Bissau-Guinean waters, and more generally in the West Africa region, has implications especially for the Bijagó culture, which faces the loss of one of its most totemic animals alongside influences of the outside world on its traditions and environment (Henriques and Campredon, 2007). The symbolic status of sawfish to the Bijago people, as well as other communities throughout West Africa, has significance for management, in that it may be possible to develop a sense of stewardship for particular species in communities that attach a greater importance to those species. However, Turvey *et al.* (2010) noted that once even large marine species cease to be encountered on a regular basis, they are quickly forgotten by communities, leading to a baseline shift in the cultural perception of decline of regional species. This process is clearly underway in Guinea-Bissau, where many younger people have never encountered a sawfish during their lifetime. Nonetheless, conservation efforts for sawfish, which incorporate collaboration between

researchers and West African coastal communities, may also promote the conservation of traditions in these communities, even as they evolve in response to external influences (Robillard and Séret, 2006).

Formal interviews can, in some cases, cause interviewees to become intimidated and suspicious (Aragones *et al.*, 1997). Negative responses of fishers to the data collection process may reflect disagreement with perceived conservation goals, or a fear that their responses will result in tighter regulations or implications for fishers involved in illegal activities, which in turn inhibits the data collection process (Silver and Campbell, 2005). The use, in this study, of local interviewers may have avoided this issue. Although some questionnaires had to be discarded owing to a lack of responses, this was mainly the case for data collected by a small number of interviewers, who routinely skipped questions or did not provide intelligible responses, and was thus not likely to be the result of a more widespread negative reaction among interviewees. During discussions of the questionnaire with interviewers, some interviewers also mentioned that respondents may not give (detailed) information on sawfish locations or recent catches, because this might be considered 'secret' information, or because they might fear repercussions from authorities for admitting to catching a sawfish. Le Douget (2009) documented a fear of communicating with researchers or authorities, and of the consequences of reporting a sawfish catch, among fishermen in Guinea-Bissau. Such attitudes can only be overcome by longer-term collaborations between researchers and fishing communities. FEK can act as a means by which to connect and develop relationships with the fishing community, in order to strengthen their sense of stewardship of fisheries resources and increase their involvement with management strategies (Silver and Campbell, 2005; Carr and Heyman, 2012). Collaborative research with fishers can also result in participants finding the end results of the research more credible (Hartley and Robertson, 2009), which is also essential for longer-term management at a local level.

Imperfections in memory, as well as cultural and other factors, mean that FEK cannot be used in isolation as a reliable indicator of species prevalence,

distribution and trends (McKelvey *et al.*, 2008). The data collected for this study are thus not a substitute for an ecological survey. Nonetheless, the large sample size and the consistency with which certain elements (such as a downward trend in sawfish abundance; overfishing and overseas fishers as reasons for sawfish decline) were mentioned by groups of fishermen across Guinea-Bissau lend weight to the value of this data set.

The findings of the current study also offer some insight into methods for future questionnaire studies in the West Africa region. A well-designed study using interview methods should plan for time before the start of the study, in which the interview structure and approach can be developed with local stakeholders. Important information to establish includes the likely education level of the respondents, local concepts of time, cultural factors such as the use of collective, rather than or in combination with individual knowledge and the most appropriate language in which to word a questionnaire (Upreti *et al.*, 2012). This information was not available before the start of this study, which may have influenced the effectiveness of the methods used. In West African countries many languages are spoken, and it is essential that the questionnaire be provided in one or more languages in which both the interviewer and potential respondents will be proficient. In this study, questionnaires were worded in Portuguese and responses were written mostly in Portuguese, but occasionally in Crioulo and for one interviewer, in French. Portuguese is not the first language of most Bissau-Guineans, with each of the many ethnic groups having their own language and Crioulo being a common language for most. Interviews were mostly carried out in Crioulo but were sometimes conducted in the local language of the area. Therefore, multiple levels of translation sometimes had to occur between the interviewer's questions, at the start of the data collection process, and the analysis of data at the end of this process. It is likely that this resulted in loss of information or incomprehensible answers that were not used in the analysis. Language will be essential to consider when designing future interview studies in this region. Likewise, collecting geographic information using maps is only useful if interviewees are able to

read a map of their area, which was not always the case in this study.

A particular issue with the data resulting from this study was the accuracy with which dates were recalled. Regarding the mismatch, in some cases, between age of last sighting of a sawfish and the age of the respondent, it was impossible to assess post hoc whether interviewees gave inaccurate information about their age (although this might be assumed to be less likely), or gave false information for the year of last sawfish sighting. Interviewer error in noting responses might also be involved. A society where collective knowledge (sometimes termed 'cultural memory' or 'social memory'; Olick and Robbins, 1998; Turvey *et al.*, 2010) replaces or supplements personal experience might result in many respondents speaking about an event in the past that they personally may not have witnessed. However, in such a situation, one would then expect the response to be uniform for all respondents in a particular village. Since no such pattern was observed in the responses regarding year of last sawfish sighting, it is likely that interviewees were not providing their response based on the collective knowledge of their village. Many respondents gave a surprisingly precise date (specifying the year, rather than the decade), when asked the last time they had seen a sawfish. Binning these responses into decades may have dealt with the possible inaccuracy of these dates, assuming this inaccuracy is only to within several years either side of the stated date. The data on most recent sightings of sawfish must be interpreted with caution, but they do provide some insight into differences among the three regions in which interviews were carried out.

Bissau-Guinean waters were once considered one of the last strongholds for sawfishes in the West Africa region (Robillard and Séret, 2006), but it appears that even in this area sawfishes are now scarce. Immediate follow-up work is required in Guinea-Bissau to establish where sawfishes might still be found and whether conservation actions can preserve a population likely to be on the brink of extinction. A communication and monitoring network is currently being developed with local actors, such that sawfish catches can be reported

to local authorities. However, research to locate live sawfishes is now essential, in order to assess whether further conservation efforts are worthwhile. If not, attempts at reintroduction of sawfishes from more stable (but nonetheless depleted) stocks, such as in southern Florida for *P. pectinata* (Carlson *et al.*, 2007; Carlson and Osborne, 2012) might be considered. Although all sawfishes are now listed on Appendix I of the CITES Convention on Migratory Species, which prevents international trade, exceptions may be made for scientific research. Before such an undertaking, however, the local causes for sawfish decline in Guinea-Bissau would have to be addressed and considerable improvements to infrastructure for monitoring and management would be required. Any reintroduction efforts should take place within well-managed marine protected areas. Sawfish are a totemic animal for a distinctive culture which has afforded *de facto* protection to the biodiversity of the Bijagos Islands. This, along with their biological uniqueness and their place in the biodiversity of West African aquatic ecosystems, provides an additional incentive for conserving sawfishes and ensuring that an integral piece of the Bijagó culture does not disappear. Baseline data collection is now also urgently required in parts of east Africa where anecdotal reports of sawfish captures still persist (S. Pierce, pers. comm.), in the hope that at least some remnants of Africa's formerly extensive network of sawfish populations might be preserved.

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APPENDIX

Questionnaire on marine species in Orango National Park, Guinea-Bissau (English version)

1. Type of net
2. Sex
3. Name of village

4. Do you know what this is? (IMAGE OF SAWFISH HERE)
 - If the respondent does not know what it is, continue to questions on dolphins.
5. What is your name for this?
6. Have you ever seen a sawfish alive or dead?
 - If yes, when was the last time you saw one?
7. Where did you see it? (specify – in the water/ in a fishing net/ at a landing site/ in a village, etc.)
 - Please mark on the map where you last saw a sawfish, or where you used to see them.
8. Have you noticed a change in the number of sawfish in this area?
 - If yes, give details (decrease/ increase; many more 20 years ago, etc.)
 - What do you think is the cause of this change?
9. What are the cultural beliefs relating to sawfish in your village?
10. Can you describe any ceremonies?
11. Age of interviewee

Finally, please ask about images of sawfish in art or everyday items, or any sawfish rostra (saws) in the village, so that the researchers can photograph them.

Table A1: Local names for sawfish throughout Guinea-Bissau

Region	Name for sawfish	Notes
North	Agate osinhi	
	Anhane	
	Anhante	
	Buga	Used for a big sawfish
	Bugassaiaba	
	Cagaháei	
	Cagalaiacun	
	Cagaraiaico/ cagasaiaico	
	Cagataha/cagatapa	
	Cagataiaicu	
	Djagarai/ djacarai	Used by Flupe ethnic group
	Djagarai catinga	Used for a small sawfish
	Djagarai-ogotingan	
	Djagassaiaco	
Erundo	Used by Flupe ethnic group	
Gagaharau/ gagarahacu		
Ghalô		
Ôgate		
Sanhe		
Ugate		
Bissau	An-nhan	
	South	
South	N'canque	
	Dequema iequé/ Dequemayeke	Used by Sousou ethnic group
	Peixe tarcado	
	Jaqui	
Bijagos	Caês	
	Chamar-ghoies	

Table A2: Categorization of questionnaire data on perceived causes of decline in sawfish

Category	Answers falling into each category
<i>Nets</i>	More nets/ many different types/ more types of fishing gear/ 'bigger' nets
<i>Motors</i>	More boat motors Noise from boat motors
<i>Deep nets</i>	Use of fishing nets for deeper waters or with a greater length from top to bottom
<i>Finning</i>	Any mention that a lot of money can be made from fins, or that people just cut off fins and discard the body, or the large market for fins, 'people search for its fins a lot'. Many mentions of finning were linked to comments about the lucrative nature of this activity
<i>Overseas fishermen</i>	'Invasion of fishermen' was taken to mean overseas fishers ('invasion of overseas fishermen' was also frequently used). Sometimes, fishermen of specific nationalities were mentioned (Senegalese, Gambian, Malian and Guinean)
<i>Overfishing</i>	'Captura abusiva' (overfishing) and 'pesca abusiva' Any mention of too many fishermen, too many boats, or that the species in question was much sought-after
<i>Local fishermen</i>	Overfishing, with specific mention of local people
<i>Bad fishing practices</i>	'Mau prática de pesca' (bad fishing practices) and 'inappropriate fishing methods'
<i>Blood and body discarded in the sea</i>	When practising finning, fishermen may discard unwanted parts of the fish back into the sea, or when catching a large fish, its blood may get into the water in the process of catching it or bringing it aboard. Respondents suggested that this would scare away other fish in that area.
<i>Saw</i>	Easy to catch because of its saw
<i>Accidental capture</i>	Accidental capture
<i>Rain</i>	Less rain in recent years, or 'climate'
<i>Pollution</i>	'Industrial' and 'artificial' materials in the sea. Pollution of the sea; boat fuel in the sea
<i>Authorities</i>	'Sawfish has no value so it is not part of a conservation plan' 'Government not interested in protecting them' 'No control by authorities'
<i>Value</i>	'The sawfish is in demand and has a value' 'Caught for the saw and meat'/ 'Caught to sell the saw and meat'
<i>Mangroves</i>	Cutting of mangroves