 doi:10.20944/preprints202104.0094.v1

Recent survey for delphinids at Tristao Islands, Guinea, reinforces concern for bycatches and marine bushmeat use

Idrissa Bamy[1], Abdoulaye Djiba[2], Koen Van Waerebeek[2,3]

1 Bureau du Directeur Général, Centre National des Sciences Halieutiques de Boussoura (CNSHB), Conakry, Guinea
2 COREWAM-Sénégal, c/o Centre National de formation des Techniciens des Pêches et de l'Aquaculture (CNFTPA), Thiaroye-sur-Mer, BP20965 Dakar, Senegal
3 Peruvian Centre for Cetacean Research /Centro Peruano de Estudios Cetológicos (CEPEC), Museo de Delfines, Lima 20, Peru

Abstract
Small-boat and shore-based surveys in 2017 confirm that Atlantic humpback (*Sousa teuszii*) and common bottlenose dolphins (*Tursiops truncatus*) are resident in shallow neritic waters surrounding the protected MPA Tristao Islands in northern Guinea. Inshore-type *T. truncatus* were encountered also between Conakry and Kayar. First documented in 2012, dolphin bycatches in local fisheries continue to occur. The frequency of beach-cast remains suggests a significant conservation issue. Both multi- and monofilament gillnets are widely deployed, but it remains unclear which gear is the main cause of mortality. Forensic evidence shows that captured dolphins are often utilized for local consumption. Marine bushmeat of cetaceans is documented in many coastal nations in West and Central Africa. In Tristao Islands their use is synchronous with and thought related to declining fish stocks. Significant anthropogenic mortality relative to their low abundance, besides suspected pressures such as prey competition with fisheries and habitat deterioration from coastal development, raise concern for the future of coastal dolphins, in particular endangered *S. teuszii*, even in this formally protected MPA. Conservation measures need to be re-evaluated for improved efficiency while surveys to monitor trends should be annual.

Résumé. - De récentes enquêtes menées à bord d'un petit vaisseau et sur le littoral confirment qu'en 2017, le dauphin à bosse Atlantique (*Sousa teuszii*) et le grand dauphin commun (*Tursiops truncatus*) sont résidents dans les eaux néritiques peu profondes entourant les îles Tristao (AMP) dans le nord de la Guinée. Des *T. truncatus* de type côtier ont également été rencontrés entre Conakry et Kayar. Documentées depuis 2012, les prises accessoires de dauphins dans les pêcheries locales continuent de se produire. Leur fréquence, depuis les cadavres échoués, suggère un problème de conservation important. Les filets maillants mono- et multifilaments sont largement déployés, mais il reste incertain quel engin de pêche est le principal responsable de la mortalité. Les analyses morphologiques indiquent que les dauphins capturés sont souvent utilisés, apparemment pour la consommation locale. L'utilisation de viande de brousse marine de cétacés est documentée dans plusieurs pays côtiers d'Afrique occidentale et centrale. Au îles Tristao elle est synchrone et probablement liée à la diminution des stocks de poissons. Une mortalité anthropogénique importante par rapport à leur faible abondance, outre les pressions présumées telles que la compétition de proies avec les pêcheries et la détérioration de l'habitat due au développement côtier, suscitent des inquiétudes pour l'avenir des dauphins côtiers, en particulier *S. teuszii*, même dans cette AMP protégée. Les mesures de conservation doivent être réévaluées afin d'en améliorer l'efficacité, tandis que les enquêtes visant à surveiller les tendances devraient être annuelles.

Key words : West Africa ; Atlantic humpback dolphin ; bottlenose dolphin ; bycatch ; marine bushmeat ; aquatic wild meat ; conservation

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

INTRODUCTION

The Republic of Guinea has taken a clear lead in efforts to promote regional conservation and research of cetaceans since its government co-organised with CMS/UNEP the West-African regional workshop *Conservation et gestion des petits cétacés de la côte atlantique d'Afrique* in May 2000 (Gouvernement de Guinée, 2000; Archer and Van Waerebeek, 2000). A series of activities ensued (Bamy et al., 2015). The present research on the status of dolphins around the Tristao Islands in northern Guinea forms part of the broader 2017 GoWAMER project *Gouvernance, politiques de gestion des ressources marines et réduction de la pauvreté dans l'Ecorégion WAMER (Mauritanie, Sénégal, Gambie, Guinée-Bissau, Guinée et Cap Vert)*, sponsored by the EU and the United Nations Development Programme (UNDP).

Previous marine mammal surveys at Tristao Islands were implemented in 2011 (Bamy, 2011) and 2012 (Van Waerebeek *et al.*, 2012, 2017) and, as now, targeted two species of special interest, the Atlantic humpback dolphin *Sousa teuszii* and the inshore form of the common bottlenose dolphin *Tursiops truncatus*. The Atlantic humpback dolphin is a middle-sized delphinid endemic to shallow coastal waters of West and Central Africa, with a distributional range from Western Sahara southeast to Angola (Van Waerebeek et al., 2004 ; Weir et al., 2011 ; Collins, 2015). The species, long referred to as 'Vulnerable' by IUCN, was extraordinarily uplisted to 'Critically Endangered' (Collins, 2015). While the latter adequately describes some populations (Van Waerebeek, 2003; Van Waerebeek *et al.*, 2003, 2004; Van Waerebeek and Perrin, 2007; Weir *et al.*, 2011; Collins, 2015; Bamy *et al.*, 2015), hope remains that the status for the species as a whole may not be critical as yet.

With improving data the initial recognition of two provisional management stocks of *S. teuszii* in the study region, one the *South Guinea stock*, centred around Conakry, and the other the *Canal do Geba-Bijagos stock* in Guinea-Bissau (Van Waerebeek *et al.*, 2004) was revised. These stocks were combined into a single *Guineas stock* which covers minimally the neritic waters of both Guinea-Conakry and Guinea-Bissau (Van Waerebeek *et al.*, 2017). The degree of reproductive isolation from the Saloum-Niumi stock of Senegal/The Gambia, to the north, is unknown. The south-eastern range boundary of the *Guineas stock* is also unclear as no *S. teuszii* records exist for some 1,900 km of coasts stretching from southern Guinea to western Togo (Van Waerebeek and Ofori-Danson, 1999; Van Waerebeek *et al.*, 2009, 2017).

An exploratory dolphin survey of the vast shallow water biotope around the Tristao Islands (Doumbouya and Camara, 2009) first established the presence of *S. teuszii* in northern Guinea (Bamy, 2011). A second survey, by canoe, covering 172.3 km around the Tristao Islands, 4-9 June 2012, besides shore-based observations (Van Waerebeek *et al.*, 2017) encountered one of the largest groups ever reported, ca. 40 scattered specimens. However several dead, beach-cast specimens were also found (Van Waerebeek *et al.*, 2017). Later, in October-November 2013, Weir (2015) recorded six other sightings, in total minimum 47 animals, at the Rio Nuñez Estuary, located southeast of the Tristao Islands. Plausibly these all belong to a single community. The numbers sighted reinforce the idea that the Guineas stock may be one of the healthiest *S. teuszii* populations in its entire range. However, regular observations of remains from bycatches and evidence for the utilisation of dolphins as marine bushmeat at Tristao Islands, despite its MPA status, are of serious concern (Bamy, 2011 ; Bamy *et al.*, 2015 ; Van Waerebeek *et al.*, 2017).

The listing of *S. teuszii* on the Conservation of Migratory Species (CMS) Appendix I and II demonstrates the wide consensus among Parties and Range State stakeholders that this species' precarious conservation status deserves specal attention. CMS Parties which are a Range State to a migratory species listed in Appendix I shall endeavour to strictly protect them by: prohibiting the taking of such species, with very restricted scope for exceptions; conserving and where appropriate restoring their habitats; preventing, removing or mitigating obstacles to their migration and controlling other factors that might endanger them. By listing the species on Appendix II, CMS Parties have agreed that the species would benefit from an international agreement. As such, *S. teuszii* is included under the Western African Aquatic Mammals MOU concluded under CMS in 2008, and covered by the Small Cetacean Action Plan (CMS, 2008). At the 12th CMS Conference of the Parties in Manila, in October 2017, a proposal was adopted for 'A Concerted Action for the Atlantic Humpback Dolphin' which *inter alia* calls for a meeting of the Range States to revisit conservation strategies (Notarbartolo di Sciara *et al.*, 2017).

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

The second target species of the latest survey, *T. truncatus* is the most frequently encountered small cetacean in Guinean waters (Bamy, 2011 ; Bamy *et al.*, 2006, 2010, 2015 ; this paper), and thought to comprise two populations, one coastal (inshore) and another pelagic (offshore), as suggested from distributional considerations for Senegal, The Gambia and some other West African range states (Djiba *et al.*, 2015 ; Van Waerebeek *et al.*, 2016). In other ocean provinces with a comparative situation, the coastal population has a restricted neritic distribution, is the least abundant, occurs in significantly smaller groups and has a different feeding ecology and cranial morphology (Leatherwood and Reeves, 1990). Due to their nearshore residency, coastal stocks are also the most vulnerable to artisanal and other small-scale fisheries (Van Waerebeek *et al.*, 2016).

Of a total of 18 *T. truncatus* groups observed from R/V *Alawam* between 21 September and 22 October 2002 and R/V *ITAF-DEM* in December 2002, only 6 occurred beyond the shelf in >200m deep waters and possibly belonged to a pelagic stock. The majority however were sighted in neritic habitat although somewhat distant from shore (Bamy *et al.*, 2015). Other recent sightings of bottlenose dolphins, as well as captures indicate that *T. truncatus* is the most frequently encountered delphinid in Guinea's coastal waters. Known threats include bycatches, overfishing and demand for marine bushmeat. However, habitat encroachment, marine debris (ghost nets) and opportunistic deliberate takes are also suspected perils (Bamy, 2011; Bamy *et al.*, 2006, 2010 ; Van Waerebeek *et al.*, 2015). Below we discuss results from the most recent dolphin survey around the Tristao Islands.

MATERIAL AND METHODS

Study area

The survey effort focussed on the Tristao Islands (Fig. 1), Boké prefecture, northern Guinea, which since 1992, comprehends a 85,000 ha Marine Protected Area (MPA) and RAMSAR site. The MPA, bordering Guinea-Bissau, consists of four main islands (Katrak, Kapkin, Gnènè Souri and Fori Souri) and a number of smaller islets (Fig. 1). The islands are surrounded by the Rio Katchek, which forms the international border, the Rio Kampani and the Atlantic Ocean, respectively in the west, east and south (Fig.1).

Figure 1. Study area : Tristao Islands in northern Guinea, indicating the many small fishing villages.

Boat survey methodology

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Over a period of 9 days from 13 – 21 June 2017, both small-boat and shore-based visual surveys were implemented in search of free-ranging dolphins and beach-cast dolphin remains in the vicinity of the Tristao Islands. The inbound and outbound transits between Conakry and Kamsar ports were also surveyed. All observer effort was in neritic habitat, except for the offshore section of a sortie towards Alcatraz Island, which has pilot MPA status. For each sighting, date, hour, geographic coordinates (Map Datum WGS 84), estimated distance and angle, species, group size (best, minimum, maximum), group composition, main behaviour and reaction to vessel were logged. Waypoints (WPT) marked start and end of sightings. The predominant behaviour was noted as either slow travel, fast travel, feeding-foraging or social interaction.

The observer platform, a 9m long, steel-hulled open vessel was powered by two 40 hp outboard engines (Fig.2.) Observers included the three authors and two crew members. The average daily speed was v=17.9 km/h (range : 11.0-28.9 km/h) with the higher velocities attained during transits and Alcatraz sortie. Observer effort (status, duration, distance covered) and the vessel's activity were recorded on an effort datasheet. Weather conditions, including visibility (poor, good, excellent), swell (none, low, medium, high) and Beaufort scale (Bf) sea states were noted at 30min intervals. Encounter rate was defined as the number of sightings (groups) encountered per 100 km on-effort surveying. Relative abundance was defined as the number of dolphins (best estimate) sighted per 100 km on-effort surveying.

Cetaceans were searched both by naked eye and fixed-focus 7x50 Steiner marine binoculars. Photographs were taken with Canon EOS 50D and 350D cameras fitted with image-stabilized 70-300 mm zoom lenses. Navigational data were registered with a Garmin GPSMap64s. Positions were recorded at 0.5 min intervals. Bathygraphic information associated with sightings and distances were read from a Garmin HXAF003A-Western Africa (v.2016.5) enabled map. Nautical chart 34406-G was also consulted, mainly for fine-scale depth contours data.

Visibility ranged good to excellent, except for two brief episodes of heavy rain when observations were halted. Swell was absent to low. Total small-boat survey effort of coastal waters amounted to 505.9 km under conditions (Bf 0-2) optimal to detect *S. teuszii*, and 786.3 km including also fair conditions (Bf 0-3, some 4) still suitable for *T. truncatus* detection. Total on-effort observer time at sea was 2242.7 min or 37 h 37 min.

Figure 2. Open, steel-hulled vessel used for visual surveys for cetaceans in Guinea, June 2017. Eye-height above sealevel about 200 cm.

Shore survey methodology

Beaches of SW Katrak Island were walked in criss-cross pattern by three observers, covering both the littoral and supralittoral zones, while searching for beach-cast marine mammal specimens, including single bones. With rising tide, the surf zone was scanned for live dolphins. Specimens found were examined *in situ*, photographed, tagged and partially or completely collected. Standard specimen condition codes (C.C. 1-5) were applied. Skeletal parts were deposited at the CNSHB marine biological reference collection, Conakry. When feasible, a tissue sample was collected in 70% ethanol. Beach-combing effort stretched over 14.65 km between Katchek and a location 1.97 km SE of Nafaya village.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Interviews

In order to evaluate local folk knowledge and awareness of dolphins and whales in the study area, 25 artisanal fishermen were interviewed in five fishing communities (Nafaya, Katountoun, Katacstan, Nofui, Katchek). Structured interviews with 19 questions (Q) gauged fishermen's personal experience with marine mammals, including 16 multiple choice questions and 3 open-ended questions (see Appendix), were conducted by IB and a trained assistant (Aboubacar Sané). A few questions attempted to collect information on the frequency of bycatches and the utilisation of captured dolphins. For replies to Q5, when both rainy and dry seasons were cited, this was interpreted as meaning year-round.

Species	Location	Lat.	Long.	WPT	Date	Group size			Depth	Source
						min.	best	max		
Tursiops truncatus	off northern Guinea	N09°52.208'	W14°09.047'	2	13/06/17	8	9	10	12 m	This survey
Tursiops truncatus	off northern Guinea	N09°53.834'	W14°10.683'	3	13/06/17	19	19	22	10-13 m	This survey
Sousa teuszii	near Tristao Island	N10°42.442'	W15°05.277'	33	19/06/17	8	10	12	5-10 m	This survey
Sousa teuszii	near Taidi Island	N10°40.473'	W14°46.918'	36	20/06/17	6	8	9	5 m max.	This survey
Sousa teuszii	near Tristao Island	N10°45.332'	W15°08.912'	na	07/06/12	30	40	45	5 m max.	2012 survey

Table *1. Details for four dolphin sightings recorded during 2017 survey, and* one *S. teuszii sighting from 2012* survey (Van Waerebeek
et al. 2017).

RESULTS

Sightings

Four on-effort sightings were recorded, two each of *S. teuszii* and *T. truncatus* (Table 1), the latter during the Conakry-Kamsar transit leg. Fishermen reported a small group of unidentified dolphins from the beach at Nafaya on 17 June 2017, only hours after our departure.

Sightings of *S. teuszii* were at 12.8 km (WPT 33) and 3.8 km (WPT 36) from the shoreline when encountered (Fig.3). A 2012 record had been recorded at 11.9 km (Van Waerebeek *et al.*, 2017). Despite the great distance-to-shore all sightings occurred in very shallow water, i.e. 5-10 m, around barely submerged sand banks (Table 1). For 2017 the encounter rate for *S. teuszii* was 0.395 sightings /100 km and relative density was 3.558 dolphins /100 km.

The two groups of *T. truncatus* were also sighted in shallow water (10-13 m depth) despite the mainland being out of view, respectively at 19.2 km for WPT 2 and 20.2 km for WPT 3 (Fig. 4). The neritic habitat and very small group sizes (Table 1) are indicative for a coastal population. Encounter rate for *T. truncatus* was 0.254 sightings /100 km and relative density was 3.561 individuals /100 km.

WPT	Species	Field N°	Location	Lat.	Long.	Date
15	*Sousa teuszii*	G20170615-1	Katfoura beach	N10°48.235'	W15°02.094'	15/06/17
19	*Sousa teuszii*	G20170615-2	Katfoura beach	N10°47.598'	W15°01.571'	15/06/17
26	*Sousa teuszii*	G20170618-1	Katountoun	N10°48.854'	W15°02.596'	18/06/17
27	*Sousa teuszii*	G20170618-2	Katountoun	N10°49.072'	W15°02.771	18/06/17
16	*Tursiops truncatus*	G20170615-3	Nafaya beach	N10°47.398'	W15°01.421'	15/06/17
31	*Tursiops truncatus*	G20170618-4	Katchek beach	N10°52.109'	W15°04.548'	18/06/17
29	Delphinidae	G20170618-3	Katchek beach	N10°50.982'	W15°04.165'	18/06/17

Table 2. Cetacean items found beach-cast on the shores of Katchek Island, Tristao Islands, in June 2017.
See text for details.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Specimen records

Skeletal remains encountered at 7 locations (Table 2), are thought to belong to six individual dolphins (3 *S. teuszii*, 2 *T. truncatus*, 1 unidentified Delphinidae). Items found at near-by waypoints 26 and 27 were identified as parts of a single individual (Table 2). Density of beach-cast dolphins was 0.41 individuals /km. Details of specimens are as follows :

G20170615-1. *S. teuszii.* Mummified integument (C.C. 5) of juvenile. Broad flukes with rounded tips (Fig. 6A). Incomplete specimen, minimum body length 151 cm. The few posterior caudal vertebrae present were collected. Skin sample. Span of flukes, 21 cm; length leading edge, 19.5 cm; depth flukes to notch, 9 cm.

G20170615-2. *S. teuszii.* Complete specimen (C.C. 4-5). Standard length ca. 190cm (Fig. 6B). Physically immature. Presumably captured since found in immediate vicinity of Katfoura and Nafaya fishing villages. Organs amorphous except for forestomach containing fish bones and a number of large and small otoliths (collected), indicating peri-mortem feeding by a healthy dolphin, consistent with death from bycatch.

G20170618-1. *S. teuszii.* Incomplete cranial specimen (C.C. 5): damaged calvaria with left mandible and teeth (Fig. 6D). Right maxillary/premaxillary was missing. The left parietale with evidence of a sharp-edged, linear cut trauma (Fig. 6C) as made by cutting tool (knife, machete). Teeth alveoli: 28 (UR), 27 (LL). Tissue sample.

G20170618-2. *S. teuszii*. 11 vertebrae (7Cv + 4Th) found <100 m from G20170618-1. Based on proximity, identical maturity (cf. vertebral ankylosis), C.C. 5, same bone colour and complementary bones, it was concluded these two specimens belonged to the same individual.

G20170618-3. Unidentified delphinid. One immature, lumbar vertebra (C.C. 5) not *T. truncatus*. Collected.

G20170615-3. *T. truncatus.* Standard length ~317 cm (Fig.7D). Physically mature. C.C. 5. Complete skeleton and tissue sample collected, a few terminal caudal vertebrae missing. Few stomach contents (bones of 1 middle-sized fish, no otoliths) but were lost in transport. Condylobasal length ~582 mm, antorbital length ~66 mm (precise craniometrics to be taken with callipers).

G20170618-4. *T. truncatus.* Standard length 331 cm. Incomplete carcass (C.C. 4-5), partially flensed. Four teeth collected. Indeterminate sex. Lumbar vertebrae damaged apparently by scavengers (Fig. 7 A). No recognizable organs. Pectoral fin with scapula found a few meters away. Evident knife cutmarks visible on remaining blubber (Fig. 7B). Tooth counts: 20(UL), 21(UR), 21(LL), 22(LR).

Interview data

A total of 25 artisanal fishermen of all age groups were interviewed on 18 June 2017 (Table 3) in five small fishing villages on the SW shore of Tristao Island (Nafaya, n=5 ;Katountoun n=5 ; Katacstan n=5 ; Nofui n=4 ; and Katchek n=6). Except one, all (96%) were familiar with dolphins at sea, and most (68%) had also observed dolphins from the beach. Most fishers (76%) see dolphins 'once in a while', while 20% encountered them 'very frequently'. About half (48%) observed dolphins year-round, 14 % mainly in dry season, and 16 % mainly in the rainy season. All fishermen readily recognised the Atlantic humpback dolphin from photos. Only one fisher reported to have seen a whale close to the coast, another fisher had seen one further offshore, while 92 % denied having encountered whales. Interestingly, 55 % indicated to often observe ‘small whales’, and 18 % saw them rarely. It remained unclear what species they might refer to. On the question (Q13) ‘whether they had experienced accidental dolphin entanglements’, 87 % replied 'never', 8.7 % admitted it happened 'very rarely' and a single fisher (4.3 %), from Katchek, indicated it occurred 'once in a while'. They unanimously denied ever hunting any dolphin. A single fisherman replied to Q17 ‘when fishermen started to utilise dolphin meat’, with 'fairly recently'.

DISCUSSION

Abundance and distribution

The two dolphin species encountered are neritic Delphinidae, thought to be residents of the wide, shallow Guinean continental shelf (Doumbouya and Camara, 2008). Two of three *S. teuszii* groups sighted in 2012-2017 were found at 12-13 km from the mainland but around sand banks with water depths of only 5-10 m. Similarly, Weir (2015) reported two groups in the outer estuary of the Rio Nuñez (south of Tristao) with initial positions at 5.1 km and 7 km from the coast and also in very shallow water of 5-7 m depth. With rising tides, the distant sand banks provide an equivalent habitat for humpback dolphins as the inshore zone

 doi:10.20944/preprints202104.0094.v1

adjacent to mainland shores. Fourteen cetacean species but no Atlantic humpback dolphins were encountered during 13,694 km of surveying of West African continental shelf waters from R/V *Fridtjof Nansen*, in 2011-2013, for which the 20 m isobath was the closest inshore approach (Van Waerebeek et al., 2012 ; Djiba *et al.*, 2015). The new records presented here further support the notion that the normal habitat for *S. teuszii* is restricted by the 15-20 m isobaths.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

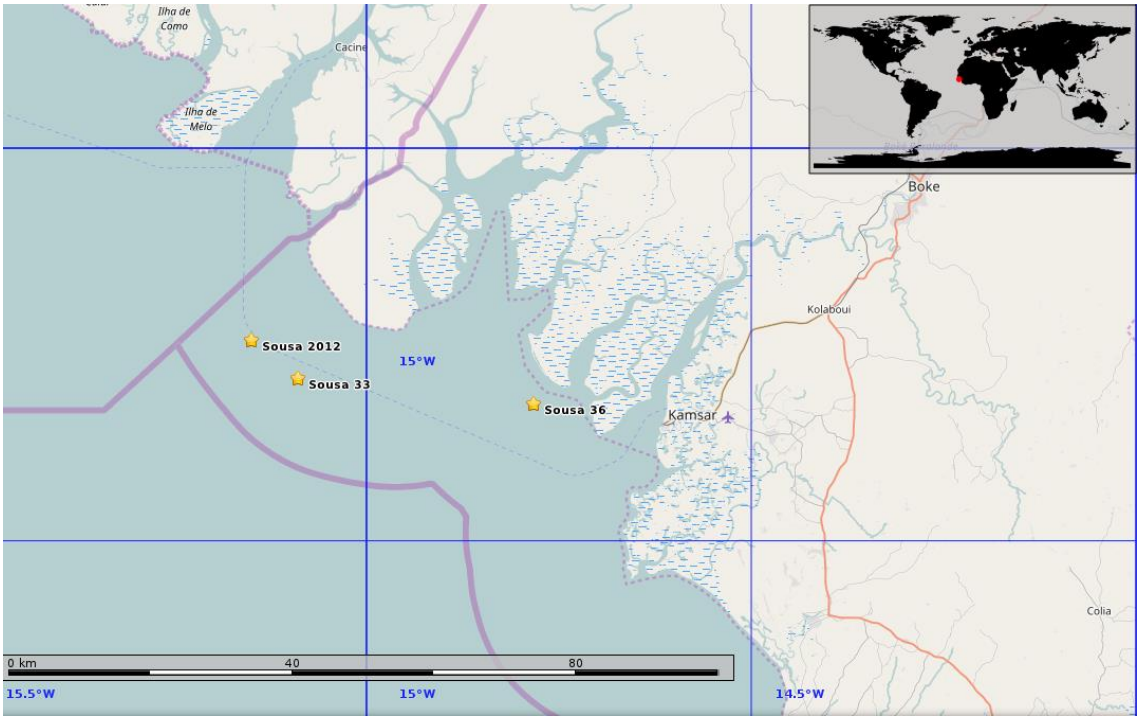

Figure 3. Three sightings of *Sousa teuszii* in neritic habitat near Tristao Islands : two in June 2017 (Sousa 33 and Sousa 36, this report) and one on 7 June 2012 (Van Waerebeek *et al.*, 2017). Purple line indicates the international border between northern Guinea and Guinea-Bissau and 12 nmiles territorial waters.

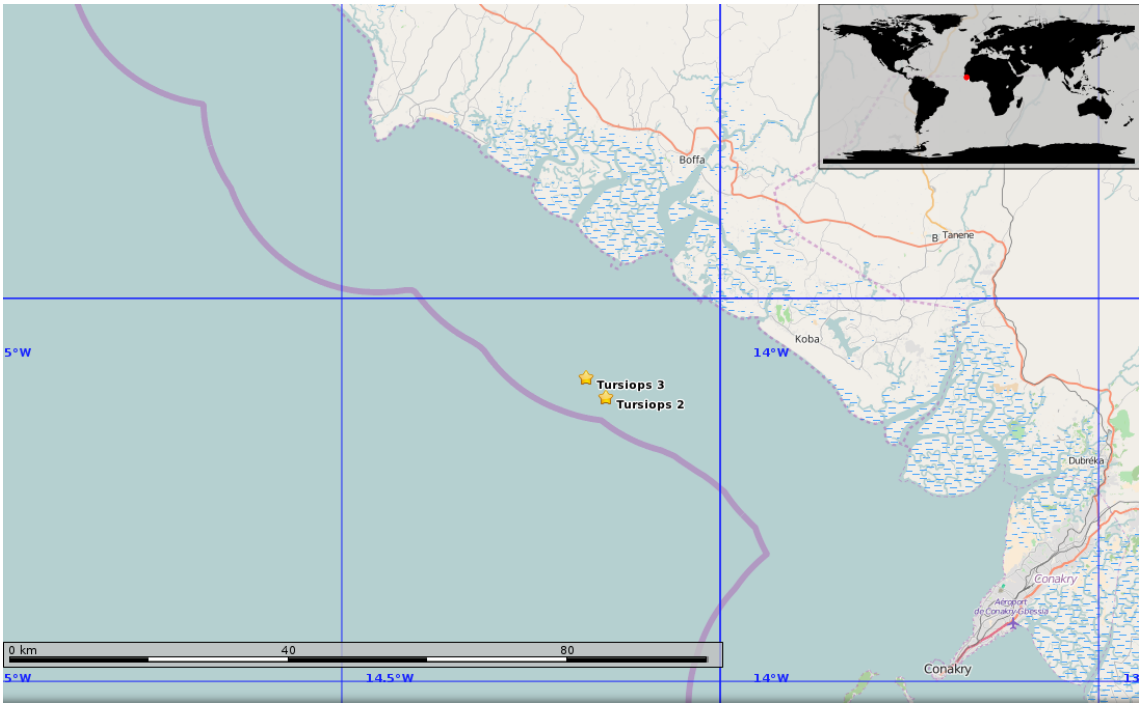

Figure 4. Two sightings of *Tursiops truncatus* (WPT 2 and 3) registered in Guinean coastal waters, June 2017. Purple line indicates the 12 nmiles of territorial waters.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Figure 5. (clockwise A-D, starting upper left) : (A) coastal *T. truncatus* including a mother-calf pair (WPT 2); (B) *T. truncatus* approaching vessel (WPT 3); (C,D) small group of *S. teuszii* off Katrak Island (WPT 33).

	Locality	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	18	Q19
1	Nafaya	A	D	A	B	B-C	A	A	A		A		B	D	D				Katacstan	Nafaya
2	Nafaya	A	D	A	B	C	A	A	C		A		A	D	D					
3	Nafaya	A	C	A	B	C	A	A	C		A		A	D	D				Nafaya Katacstan	
4	Nafaya	A	D	A	A	C	A	A	C		A	A	D	D					Katountoun-Kacheck	
5	Nafaya	A	A	B	C	A	A	C		A		A	D	D		NR			Nafaya	Nafaya
6	Katountoun	A	C	A	B	B-C	A	A	C	A		A	D	D		C			Katacsan	Katountoun
7	Katountoun	A	C	A	B	B-C	A	A	C		A	B	D	D	D				Katountoun	Katountoun-Katacstan-Beulei-Wonsomba
8	Katountoun	A	B	A	B	B-C	A	A	C		A		A	D	D				Katountoun-Katacstan	Camp
9	Katountoun	A	C	A	A	B	A	A	C	A			D	D	D				Nafaya	Kamtchlambin-Nafaya-Katacsan-Benkidou-Calehi
10	Katountoun	A	C	A	A		A	A	B	B	A		B	C	D	D		B	OUI	Nafaya-Katacstan—Katcheck-Kateinty
11	Katacstan	A	E	A	B	C	B	A	C		B		A	D	D					Nafaya-Katountoun
12	Katacstan	A	E	A	B	B-C	A	A	C		B		A	D	D				Katacstan-Waf n souneyin	
13	Katacstan	A	C	A	B	B	B	A	C		B		A	D	D					Woussonba
14	Katacstan	A	C	A	B	B	A	A	C		C		A	D	D				Nafaya	Benteima
15	Katacstan	A	C	A	B	B	B	A	C		B		A	D	D				Nafaya	Benkima
16	Nofui--	A	B	A	B	B	B	A	C		C		A		D				Wofrin-Bounghi	Pami banlehi benki
17	Nofui--	A	D	A	B	D	B	A	C		C		A	D	D				Wofrin Bounghi	Wossomba
18	Nofui--	A	D	A	B	B	B	A	C		C		A	D	D				Wofrin bougni-Katacstan	Pani bantchi-Katacstan-beulama
19	Nofui--	A	B	A	B	B-C	B	A	C		C		A	D	D				Wofrin bougni-Katacstan	sanleyi
20	Katcheck	A	C	A	B	B	A	A	C		A		A	D	D				Katacstan	Katcheck
21	Katcheck	A	E	A	B	B-C	A	A	C		A		A	D	D					Wonson
22	Katcheck	A	C	A	A	A	A	A	C		A		A	B	D	D			Wofrin Boughi	Benkima
23	Katcheck	A	D	A	B	A	B	A	C		C		A							
24	Katcheck	A	E	A	A	B-C	A	A	C		A	A	D	D						
25	Katcheck	A	B	A	B	B-C	A	A	C		A		A	C	D				Cantaya	

Table 3. Results of interview survey. Replies by 25 artisanal fishermen to questions (Q1-Q19 ; see Appendix) related to dolphins and whales, Tristao Islands, 18 June 2017.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

The encounter rate for *S. teuszii* (0.395 groups /100 km) off Tristao in 2017 was lower but still comparable to the 2012 encounter rate (0.580 groups /100 km ; Van Waerebeek *et al.*, 2017) and remarkably similar to the 0.386 groups /100 km recorded in Cameroon in 2011 (Ayissi *et al.*, 2014) which followed an equivalent survey protocol.

However, the relative density of *S. teuszii* at Tristao in 2017 (3.558 dolphins /100 km) was more than six times lower than in 2012 when 23.218 dolphins /100km were recorded (172.3 km search effort; Van Waerebeek *et al.*, 2017). The 2017 Tristao density was at the Cameroon level of 3.86 humpback dolphins /100km in 2011 (Ayissi *et al.*, 2014). A potential explanation is that the long-distance transects (both inbound and outbound) between Conakry and Kayar in 2017, and the Alcatraz sortie, crossed areas of low-density for *S. teuszii* (none were sighted). The 2017 survey therefore was poorly comparable to the 2012 survey which was limited to waters around Tristao. Group size of the two *S. teuszii* encounters were small (8 and 10 individuals) compared to the unusually large group encountered in June 2012 (40 individuals) (Van Waerebeek *et al.*, 2017). Weir (2015) reported a mean group size of 12.1 (median=11.5) for the Rio Nuñez Estuary which is comparable to our data for 2012 and 2017 (median= 10).

Interaction with fisheries

Despite fishermen's predictable denials, our findings indicate that fisheries-caused mortality of coastal dolphins continues to occur around the Tristao Islands. Along a 14.3 km stretch of beaches linking five fishing villages, remains of six dolphins were found (0.42 individuals /km). An additional complete specimen reported by a villager during our study period was searched for but not encountered, presumably it had been re-floated with high tide. Evident cut marks on a humpback dolphin skull (Fig. 6C) and clear indications of partial flensing of a bottlenose dolphin (Fig. 7A,B) are firm evidence that dolphin carcasses are utilized, as evidenced before (Van Waerebeek *et al.*, 2017). Unsurprisingly only two formally interviewed fishermen (8%), both from Katchek, admitted that dolphins are occasionally captured accidentally. None replied affirmatively on the question 'whether dolphins are at times hunted', as it is illegal to do so. Four fishers (16%) refused to even answer the question. When asked what is done with dead dolphins found in nets, a single fisher replied that they were discarded, inherently admitting captures. When queried off-the-record, several additional fishermen confirmed that the carcass remains found on beaches were from incidentally taken dolphins and that their meat was often consumed.

Fish landings, and presumably fish stocks, have very significantly declined at Tristao over the past two decades. At least 23 fish landing sites were identified (Camara, 2015). During 2019 and 2020 overall fishing effort (all gears and all vessel types) has basically remained stable at about 40,000 fishing-days. However, while total fish landings at Tristao in 2019 amounted to about 18,100 MT, in 2020 these had reduced to about 15,700 MT, a 15.3 % decline in just one year (Bamy, 2020). The anthropogenic impact is rather evident as cause.

It could not be ascertained which categories of fishing gear and boats are mainly responsible for the dolphin bycatch, as a variety of gear are deployed at Tristao. Among the most suspect feature the bonga fish (*Ethmalosa fimbriata*) drift gillnets, the encircling gillnets for mullet (*Mugil* sp.), and other gillnets with mesh sizes ranging from small to very large (see Camara, 2015). During this survey large numbers of monofilament gillnets were seen in the islands (Fig. 7C), including many discarded (ghost) nets washed ahore. The human population of the islands have increased significantly as important numbers of migrant fishermen from Sierra Leone, Liberia and Senegal have established in the area (Bamy, 2020).

In Ghana, increased demand for terrestrial source bushmeat was demonstrated to be related to diminished fish landings (Brashares et al., 2004). In western Ghana, declining fish catches occurred concurrently with increasing landings of dolphins, commercialised as marine bushmeat[1], a phenomenon thought correlated (*e.g.* Van Waerebeek and Ofori-Danson, 1999; Debrah *et al*., 2010; Ofori-Danson *et al*., 2019). A similar trend may be developing also in other coastal nations of West Africa (Van Waerebeek *et al*., 2017 ; Segniagbeto *et al*., 2019) and central Africa (Collins *et al*., 2019) but has not been studied in any detail. The potential for zoonotic diseases neither has been investigated, but marine mammals are known carriers.

1 Sometimes referred to as « aquatic wild meat » which is a neologism, however in Africa these products are known and commercialised as (marine) bushmeat (*viande de brousse*).

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Figure 6. Beach-cast remains of *S. teuszii*, Tristao Islands, June 2017 (clockwise A-D, starting upper left) : (A) specimen G20170615-1 ; (B) mummified specimen G20170615-2 ; (C) skull of specimen G20170618-1 showing evidence of cut-marks on the left parietal bone; (D) skull of specimen G20170618-1. For further details see text.

Figure 7. Beach-cast remains of *T. truncatus*, Tristao Islands, June 2017 (clockwise A-D, starting upper left) : (A) head of specimen G20170618-4 ; (B) trunk of same specimen with evidence of partial flensing (edges of blubber were cut) ; (C) monofilament gillnets arranged on beach ;

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

(D) specimen G20170615-3. Further details see text.

We did not observe any large commercial fishing boats operating in the study area, and interaction with industrial fishery operations may be low. The ubiquitous sand banks of the Tristao Islands clearly physically protect the habitat from access by large fishing vessels. However Weir (2015) documented one commercial trawler passing close to foraging humpback dolphins in the more southern Río Nuñez area, indicating the potential for interaction in areas adjacent but outside of the Tristao MPA. A narrow deep-water lane to the Río Nuñez is maintained through regular dredging, assuring access for ocean-going cargo vessels to the bauxite-exporting Kamsar harbour (pers. observations).

CONCLUSIONS

1. *Sousa teuszii* and *T. truncatus* are two delphinids resident in the shallow neritic waters surrounding the Tristao Islands and the adjacent Río Nuñez area. Other small cetacean species may only infrequently occur. Large whales seem impeded from approaching the islands by the shallows and sand banks. Inshore-type *T. truncatus* inhabits also the coastal waters between Conakry and Kayar, but *S. teuszii* was not encountered.

2. As reported earlier (Bamy *et al.*, 2010, 2015 ; Van Waerebeek *et al.*, 2017), bycatches, mostly gillnet entanglements, of both dolphin species have continued to occur in small-scale fisheries around Tristao till at least 2017. Their relative frequency suggests a potential significant threat to long-term conservation. Monofilament gillnets are widely deployed, but it is as yet unclear which fishing gear kills most dolphins.

3. Forensic evidence indicate that bycaught dolphins are often utilized for local consumption. While in formal interviews fishers mostly denied this, because considered illegal, off-the-record statements confirmed use of dolphins as food. Bycatches in small-scale fisheries and consumption of marine bushmeat of cetaceans is well-documented in many coastal nations in West and Central Africa (reviewed in Collins *et al.*, 2019 ; Van Waerebeek *et al.*, 2017 ; Segniagbeto *et al.*, 2019). Van Waerebeek *et al.* (2017) suggested a potential correlation between dwindling fish landings in West Africa and increasing consumption of marine bushmeat (*e.g.* dolphins, sea turtles, whales). We here suggest this may also be the case in the Tristao Islands as fish landings have greatly declined.

4. Significant anthropogenic mortality relative to their low abundance, besides suspected pressures such as prey competition from fisheries, disturbance and habitat loss from coastal development, raise concern for the future of coastal dolphins even in this protected MPA. Because of its restricted distribution and low abundance, *S. teuszii* is of greatest concern. A critical review of national conservation measures, improved implementation, as well as consideration of active bycatch mitigation techniques are recommended. At least annual surveys of relative abundance should monitor trends so that any signs of population decline can be detected and addressed in time.

ACKNOWLEDGEMENTS

We acknowledge the support of many Guinean contributors who helped ensure the success of the dolphin survey work in the Tristao Islands MPA. In particular we thank Aïdara, Bamba Camara, Honoré Haba, Ansoumana Kéita, and Aboubacar Sané. We thank also skippers Sékou Oumar Camara and Mohamed Camara for their skillful piloting of the vessel. We are grateful to the villagers of Katfoura and especially the village chief and his family for their great hospitality and collaboration. The parent GoWAMER project (N° 00081901) was sponsored by the European Union and the United Nations Development Programme (UNDP).

REFERENCES

Archer E. and Van Waerebeek K. (2000) Workshop in Guinea-Conakry on the conservation and management of marine mammals in West Africa. *CMS Bulletin* 11: 12-13.

Ayissi, I., Segniagbeto, G.H., Van Waerebeek, K. (2014). Rediscovery of Cameroon Dolphin, the Gulf of Guinea population of *Sousa teuszii* (Kükenthal, 1892). ISRN Biodiv., 2014: 1-6.

DOI:10.1155./2014/819827.203

Bamy, I.L. 2020. Les cétacés des îles Tristao. Rapport Interne du Centre National des Sciences Halieutiques de Boussoura (CNSHB), Conakry, Guinée. (Unpublished internal report).

Bamy, I.L., Van Waerebeek, K., Bah, S.S., Dia, M., Kaba, B., Keita, N., Konate, S. and Tall, H. (2006) The cetaceans of Guinea, a first check-list of documented species. IWC Scientific Committee Document SC/58/O15, St Kitts, May-June 2006. 7pp.

Bamy I.L., Van Waerebeek K., Bah S.S., Dia M., Kaba B., Keita N. and Konate S. (2010) Species occurrence of cetaceans in Guinea, including humpback whales with southern hemisphere seasonality. Marine Biodiversity Records 3 (e48): 1-10. doi:10.1017/S1755267210000436

Bamy, I.L. (2011). Inventaire des cétacés dans la zone des Iles Tristao. Projet de Gestion Côtière et Marine de la Biodiversité. Ministère de la Pêche et de l'Aquaculture, Conakry, Guinée (unpublished).

Bamy, I.L., Oulare, A. and Soumah, N.L. (2015). Menaces sur des petits cétacés rencontrés sur les côtes guinéennes. Bulletin du Centre Halieutique de Boussoura, 5 (1-2): 24-31.

Brashares, J.S., Arcese, S.M.K., Coppolillo, P.B., Sinclair, A.R., Balmford, A. (2004) Bushmeat hunting, wildlife declines, and fish supply in West Africa. Science 306 (5699):1180-1183.

Camara, S.B. (2015). Identification des pressions halieutiques dans l'AMP de Tristao/Alcatraz. Bulletin du Centre Halieutique de Boussoura, 5 (1-2): 18-23.

CMS (2008). Memorandum of Understanding concerning the conservation of the manatee and small cetaceans of western Africa and Macaronesia. Convention on the Conservation of Migratory Species of Wild Animals (CMS/UNEP).

Collins, T. (2015). Re-assessment of the conservation status of the Atlantic humpback dolphin *Sotalia teuszii* (Kükenthal, 1892), using the IUCN Red List Criteria. Pp. 47-77 In: T.A. Jefferson & B.E. Curry (eds.), Advances in Marine Biology, 72, Academic Press, Oxford.

Collins, T., Van Waerebeek, K., Carvalho, I., Boumba, R., Dilambaka, E., Mouissou, E., Thonio, J., Minton, G., Kema Kema, R., Mbungu Ndamba, S., Musgrave, R., Ngouessono, S., Rosenbaum, H. (2019). An assessment of cetacean bycatches, strandings and other mortalities from Central Africa, including evidence of use by people. Document SC/68A/SM/05, IWC Scientific Committee Meeting, Nairobi, May 2019. 12pp.

Debrah J.S., Ofori-Danson P.K. and Van Waerebeek K. (2010). An update on the catch composition and other aspects of cetacean exploitation in Ghana. Document SC/62/SM10, Scientific Committee Meeting, International Whaling Commission, Agadir, Morocco, June 2010. doi: 10.13140/RG.2.1.4537.9928

Djiba A., Bamy I.L., Samba Ould Bilal A., Van Waerebeek K. (2015) Biodiversity of cetaceans in coastal waters of Northwest Africa: new insights through platform-of-opportunity visual surveying in 2011-2013. *In:* (eds.) Valdés L. and Déniz-González I. Oceanographic and Biological Features in the Canary Current Large Marine Ecosystem. IOC-UNESCO, Paris. IOC Technical Series 115, pp.283-297. DOI: 10.13140/RG.2.1.4820.3929

Doumbouya, A. and Camara , O.A. (2009). L'AMP des Iles Tristao et Alcatraz en Guinée: choix et processus de création. Bull. Centre Halieut. Boussoura, 4 (1): 65-67.

Gouvernement de Guinée. (2000) Rapport sur réunion « La Conservation et la Gestion des Petits Cétacés de la Côte d'Afrique » , Conakry, du 08 au 12 mai 2000 (Unpublished).

Leatherwood, S. and Reeves, R.R. (editors). (1990) The Bottlenose Dolphin. Academic Press, San Diego. 653 pp.

Notarbartolo di Sciara, G., Van Waerebeek, K., Whale and Dolphin Conservation. (2017). Proposal for a Concerted Action for the Atlantic humpback dolphin (*Sousa teuszii*) already listed on Appendix I and II of the Convention. UNEP/CMS/COP12/Doc.26.2.3, 12th Meeting of the Conference of the Parties, Manila, Philippines, 23-28 October 2017.

Ofori-Danson PK, Debrah J, Van Waerebeek K. (2019). The status and trends of small cetacean landings at Dixcove artisanal fishing port, western Ghana. PeerJ Preprints 7:e27749v1 https://doi.org/10.7287/peerj.preprints.27749v1

Segniagbeto, G.H., Ayissi, I., Bamy, I.L., Debrah, J., Djiba, A., Dossou-Bodjrenou, J., Ofori-Danson, P.K., Samba Ould Bilal, A., Sohou, Z., Tchibozo, S., Uwagbae, M. and Van Waerebeek, K. (2019). On the utilisation of by-caught, hunted and stranded cetaceans in West Africa. Document SC/May19/AAWW/04, IWC Scientific Committee Meeting, Nairobi, May 2019. 14pp. https://www.researchgate.net/publication/334249267

Van Waerebeek, K. (2003). The Atlantic humpback dolphin: In retreat ? CMS Bulletin, 17:10-11.

Van Waerebeek, K. and Ofori-Danson, P.K. (1999). A first checklist of cetaceans of Ghana, Gulf of Guinea, and a shore-based survey of interactions with coastal fisheries. Paper SC/51/SM35, presented to 51st Annual Meeting of the IWC Scientific Committee, May 1999, Grenada.

Van Waerebeek, K., Barnett , L., Camara , A., Cham, A., Diallo, M., Djiba, A., Jallow, A., Ndiaye, E.,Ould-Bilal, A.O. & Bamy, I.L. (2003). Conservation of cetaceans in The Gambia and Senegal, 1999–2001, and status of the Atlantic humpback dolphin. WAFCET-2 Report. UNEP/CMS Secretariat,Bonn, Germany 56pp. DOI: 10.13140/RG.2.1.3917.9602.

Van Waerebeek, K., Barnett , L., Camara, A., Cham, A., Diallo, M., Djiba, A., Jallow, A.O., Ndiaye, E., Samba Ould, Bilal, A.O. & Bamy, I.L. (2004). Distribution, status and biology of the Atlantic humpback dolphin *Sousa teuszii* (Kükenthal, 1892). Aq. Mamm., 30: 56-83.

Van Waerebeek, K. and Perrin, W.F. (2007). Conservation status of the Atlantic humpback dolphin, a compromised future? CMS/ScC14/Doc.6, 14th Meeting of the CMS Scientific Council, Bonn, Germany, 14-17 March 2007. DOI: 10.13140/RG.2.1.2801.2888.

Van Waerebeek, K., Ofori-Danson, P.K. and Debrah, J.S. (2009). The cetaceans of Ghana: a validated faunal checklist. W. Afr. J. Appl. Ecol., 15: 61-90.

Van Waerebeek K., Bamy I.L., Djiba A. and Samba Ould Bilal A. (2012) Marine mammal observations during FAO/CCLME Ecosystem Survey off Northwest Africa, and Guinea coastal survey, May-July 2012. Final report to UNESCO. 42pp. (unpublished).

Van Waerebeek, K., Ofori-Danson, P.K., Debrah, J., Collins, T., Djiba, A., Samba Ould Bilal, A. (2016) On the status of the common bottlenose dolphin *Tursiops truncatus* in western Africa, with emphasis on fisheries interactions, 1947-2015. Paper SC/66b/SM19 submitted to the IWC Scientific Committee, June 2014, Bled, Slovenia, 19pp. DOI: 10.13140/RG.2.1.4159.128

Van Waerebeek K., Uwagbae M., Segniagbeto G., Bamy I.L. and Ayissi I. (2017) New records of Atlantic humpback dolphin (*Sousa teuszii*) in Guinea, Nigeria, Cameroon and Togo underscore fisheries pressure and generalised marine bushmeat demand. Revue d' Ecologie (Terre et Vie) 72(2): 192-205.

Weir, C.R. (2015). Photo-identification and habitat use of Atlantic humpback dolphins *Sousa teuszii* around the Río Nuñez Estuary in Guinea, West Africa. Afr. J. Mar. Sci. DOI: 10.2989/1814232X.2015.1069757.

Weir C., Van Waerebeek K., Jefferson T.A. and Collins T. (2011). West Africa's Atlantic humpback dolphin: endemic, enigmatic and soon Endangered? African Zoology 46(1): 1-17.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Appendix (Form)

In-depth interview

Scientist : _____ Date : _____

Location : _____ N° interview : _____

Q1 : Which is your profession ?

A) Active artisanal fisherman B) Active fisherman (industrial fisheries)
C) Fish monger (all sea products) D) Other (Please explain)

Q2 : Which is your age group ?

A) 20 years or less B) 21-30 years C) 31-40 years D) 41-50 years E) 51 and more yrs

Q3 : Do you sometimes see dolphins at sea when you go fishing ?
A) yes B) no

Q4 : If yes, with what frequency do you see dolphins ?
A) Very frequently (almost every fishing trip)
B) Once in a while (a few times each month)
C) Rarely (a few times per year)

Q5 :Which months of the year do you see dolphins ?

A) Year-round
B) Mainly during the dry season (which months ?)
C) Mainly during the rainy season (which months ?)
D) I do not remember

Q6 : Do you sometimes see dolphins from the beach (if so, which season) ?

A) Yes B) No

Q7 : Have you seen some 'strange' dolphins which have their dorsal fin sit on top of a hump ?

(+ Show photos of Atlantic humpback dolphin)

A) Yes B) No C) If yes, where and when did you observe them ? _ _ _ _ _ _ _ _ _ _

Q8 : Do you sometimes observe whales when at sea ?

A) Yes, close to the coast (inshore) B) Yes, far from the coastline C) No
(Show photos of the humpback whale)

Q9 : If yes, with which frequency do you encounter whales at sea ?

A) Very often (almost on every fishing trip)
B) Once in a while (a few times per month)
C) Rarely (only a few times per year)

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 April 2021 doi:10.20944/preprints202104.0094.v1

Q10 : Have you observed very young, small whales (newborns) ?

A) Often B) Rarely C) Never

Q11 : Which periods of the year do you see the whales most often ?

A) Year-round
B) Mainly in the dry season (which months ?)
C) Mainly in the rainy season (which months ?)
D) Other (please explain)

Q12 : Have you ever seen somewhere a stranded whale on the beach ?

A) No B) Yes, please explain (where, when, some description ?)

Q13 : Do dolphins sometimes become accidentally entangled in your nets (or in another fishing device) ?

A) Frequently (at least once every week)
B) Once in a while (a few times per month)
C) Very rarely (a few times per year)
D) Never

Q14 : Have you ever hunted or tried to capture dolphins ?

A) Frequently (about every week)
B) Once in a while (a few times per month)
C) Very rarely (a few times per year)
D) Never

Q15 : What do you do with captured (dead) dolphins ?

A) Dolphins may be landed and sold like any other fish, to serve as food for local people
B) Dolphins are typically cut in pieces in the boat and used as fish bait
C) Other (please specify)

Q16 : What is a typical price for a freshly dead dolphin ?

Q17 : When did fishermen started to utilise dolphins (meat) ?

A) Since a very long time, it is an old tradition
B) It is a fairly recent development, and has only started in the past 10-15 years

Q18 : Where can we find bones from dolphins or whales ?

Q19 : In which areas could we best encounter live dolphins or whales ?

Thanks for your collaboration

General remarks : _____

_____

_____

_____