

Cetaceans of the Congo River Estuary, DRC: the first inventory, aided by citizen science

Samuel Mbungu Ndamba^{1,2}, Albert Maba Ngaka³, Serge Nzinga⁴, Jérémie Sambu Banganga⁵, Hong-Yu Lai⁶ and Koen Van Waerebeek^{7,8,*}

¹*Institut Supérieur de Navigation et de Pêche (ISNP), Muanda, Kongo Central, Democratic Republic of the Congo (DRC)*

²*Centre d'Initiatives pour la Conservation de la Biodiversité (CICOBIO), Avenue Lelo Luemba N°10, Q. Ocean, Muanda, DRC*

³*Service National de l'Aquaculture à Nsiamfumu, DRC*

⁴*Équipe d'observateurs des Cétacés, CICOBIO, Avenue Lelo Luemba N°10, Q. Ocean, Muanda, DRC*

⁵*Agence de Pêche Artisanal (Artisanal Fisheries Agency), Nsiamfumu, DRC*

⁶*Eco Institute, Favor Industrial Centre, 2-6 Kin Hong Street, Kwai Chung, N.T., Hong Kong*

⁷*Peruvian Centre for Cetacean Research/Centro Peruano de Estudios Cetológicos (CEPEC), Museo de Delfines, Pucusana, Lima-20, Peru*

⁸*Conservation and Research of West African Aquatic Mammals (COREWAM), c/o Faculty of Environment and Conservation, University College of Agriculture and Environmental Studies, P.O. Box 25, Bunso, Eastern Region, Ghana*

*Corresponding author ✉: albedo100@yandex.com

Citation: Mbungu Ndamba, S., Maba Ngaka, A., Nzinga, S., Sambu Banganga, J., Lai, H.-Y. and Van Waerebeek, K. (2023). Cetaceans of the Congo River Estuary, DRC: the first inventory, aided by citizen science. *Journal of Animal Diversity*, 5 (3): 1–18. <http://dx.doi.org/10.61186/JAD.2023.5.3.1>

Abstract

The first inventory of cetacean diversity in coastal waters of the Congo River Estuary, Democratic Republic of the Congo, was obtained between May 2021 and April 2022, through incidental sightings (n=17) reported mainly by artisanal fishers and direct observations of bycatches at fish landing sites. Confirmed records include five odontocete species: four Delphinidae: *Delphinus capensis* Gray, *Pseudorca crassidens* (Owen), *Stenella frontalis* (G. Cuvier), *Tursiops truncatus* (Montagu); and one Kogiidae: *Kogia sima* (Owen). There was one mysticete, Balaenopteridae: *Megaptera novaeangliae* (Borowski). Of six small cetaceans documented landed for use as aquatic bushmeat, four (66.7%) were *T. truncatus*. *Megaptera novaeangliae* was the most frequently sighted cetacean (47.1% of reported sightings), registered between 17 May–3 September 2021, with a seasonality (austral winter) consistent with the SE Atlantic breeding stock ('B-Stock'). All information was collected by locals, the at-sea sightings by trained fishermen in a citizen science framework. The main benefits included a welcome marine conservation educational component, and low-cost, opportunistic fishing boat use. Shortfalls comprised a deficiency in scientific detail and effort quantification, occasional data loss and lack of biological sampling. However, in a remote coastal region like the DRC's Congo River estuary, where marine mammals have never before been studied, local citizen science methodology proved effective and, after adjustments, should be scaled-up.

Received: 16 August 2023

Accepted: 30 October 2023

Published online: 15 November 2023

Key words: Bycatch, Central Africa, Delphinidae, Eastern Tropical Atlantic, humpback whales, *Kogia sima*, Marine (aquatic) bushmeat, whale shark

Introduction

The Democratic Republic of the Congo (DRC), situated in Central Africa, is one of very few coastal nations in the world for which virtually no information is available on its marine mammal fauna with a complete lack of dedicated studies (Weir, 2010; Perrin and Van Waerebeek, 2012; UNEP/CMS, 2012; Collins et al., 2019; Segniagbeto et al., 2019). The short (38 km) exposed coastline of the DRC (Fig. 1) is intrinsically dominated by fluvial waters flowing from the vast Congo River, the deepest (220 m) and third largest river in the world by discharge volume. The Congo River Estuary causes one of the longest sediment flows (>1,180 km) that connect to the deep sea of the eastern tropical Atlantic (Talling et al., 2022) but its ecological impact on marine organisms remains unassessed. Upstream, in terms of freshwater aquatic life, the Congo River Basin shows an unusually high species richness and features among the highest known densities of endemics (Dickman, 2009). However, for many major taxa, including Cetacea, the species diversity of the brackish/saline estuary habitat has hardly been documented.

Congolese coastal fishermen report observing dolphin groups (family Delphinidae) mainly from July to October which, they believe, come into DRC waters from the south and move towards the north, i.e. Cabinda (Angolan exclave); however this remains to be confirmed. To date, the species of cetaceans that occur along the DRC coastline have not been identified, and their ecology and natural history are unknown. The Atlantic humpback dolphin *Sousa teuszii* (Kükenthal, 1892), designated as 'Critically Endangered' on the IUCN Red List (Collins et al., 2018), likely ranges in DRC nearshore waters considering the species' documented preference for estuarine environments and its confirmed presence in neighboring Angola and Congo-Brazzaville (Van Waerebeek et al., 2004; Weir et al., 2011; Collins et al., 2013, 2019).

Fishermen of DRC also indicate that dolphins occasionally die entangled in artisanal gillnets. However, unlike in some other West and Central African coastal nations (reviewed by Segniagbeto et al., 2019), neither this conflict with small-scale fisheries nor general cetacean distribution have been investigated in the DRC. A concise check-list of West African small cetaceans (Perrin and Van Waerebeek, 2012) only mentioned two cetacean species for DRC, the short-beaked common dolphin *Delphinus delphis* Linnaeus and long-beaked common dolphin *Delphinus capensis* Gray, 1828. Based on information provided by the first author, Collins et al. (2019) listed two by-caught common bottlenose dolphins *Tursiops truncatus* (Montagu), however without data. No osteological material is curated at the Musée National de Kinshasa, or any other collection, that would allow an evaluation of the diversity of DRC marine mammals. This general lack

of data and material evidence negatively affects conservation efforts, as many members of Congolese coastal communities, and possibly even some authorities, are largely unaware of the need for pro-active conservation measures for vulnerable cetaceans.

Fishing port and beach surveys for captured and stranded cetaceans have proved to be an effective methodology to compile preliminary inventories of Cetacea and to collect specimens in several coastal states of West and Central Africa (e.g. Van Waerebeek et al., 2009; Ayissi et al., 2011; Bamy et al., 2010; 2021; Collins et al., 2013; 2019; Segniagbeto et al., 2012; Sohoun et al., 2013; Samba Bilal et al., 2023). However, a beach-combing effort has only recently been implemented in DRC. This is mainly secondary to the clean-up of beaches contaminated with plastic bottles, bags and other rubbish known to be harmful to marine megafauna. Cetacean remains tend to wash ashore at the same spots (K.V.W., pers. observations). Mbungu Ndamba (2022) directed a NGO (ACODES) project monitoring sea turtle nests/eggs and dead or moribund turtles that washed ashore following net entrapment or lethal ingestion of plastic bags in 2010–2019, which inspired this cetacean initiative. In order to address the data gaps identified above, this study enlisted the collaboration of Congolese fishers to document cetacean sightings, bycatch and strandings as a means to (i) conduct a preliminary assessment of the cetacean diversity of DRC territorial waters; (ii) document circumstances of anthropogenic mortality; (iii) offer training and raise local awareness about marine conservation, specifically utilizing megafauna flagship species including Delphinidae, sea turtles (Testudines: Chelonioidea) and African manatees (Sirenia: *Trichechus senegalensis*).

Material and Methods

Study Area

The deep-sea environment of the DRC is dominated by sedimentary processes (Talling et al., 2022). The Congo deep-sea fan, one of the largest abyssal fans in the world to be affected by active turbidity currents, extends off northern Angola and southern Gabon, connecting the Congo River Estuary to the offshore Congo Canyon, and thereby facilitating the deposit of sediments into the deep-sea environment (Savoye et al., 2009; Talling et al., 2022). Eventually questions will need to be raised about the ecological implications of the massive sediment-rich freshwater input for Congo's marine mammals.

Fishing activities and the landing of dolphins (and sea turtles) were monitored at the artisanal fishing communities of Banana (06°01'S, 12°25'E), Nsiamfumu (05°52'S, 12°17'E) and Tschiede (05°48.75'S, 12°13.65'E), in Kongo-Central Province (Fig. 1). The latter two villages are situated north of Muanda (05°56.05'S, 12°20.97'E), at the Congo River mouth. Banana is located inside the estuary.

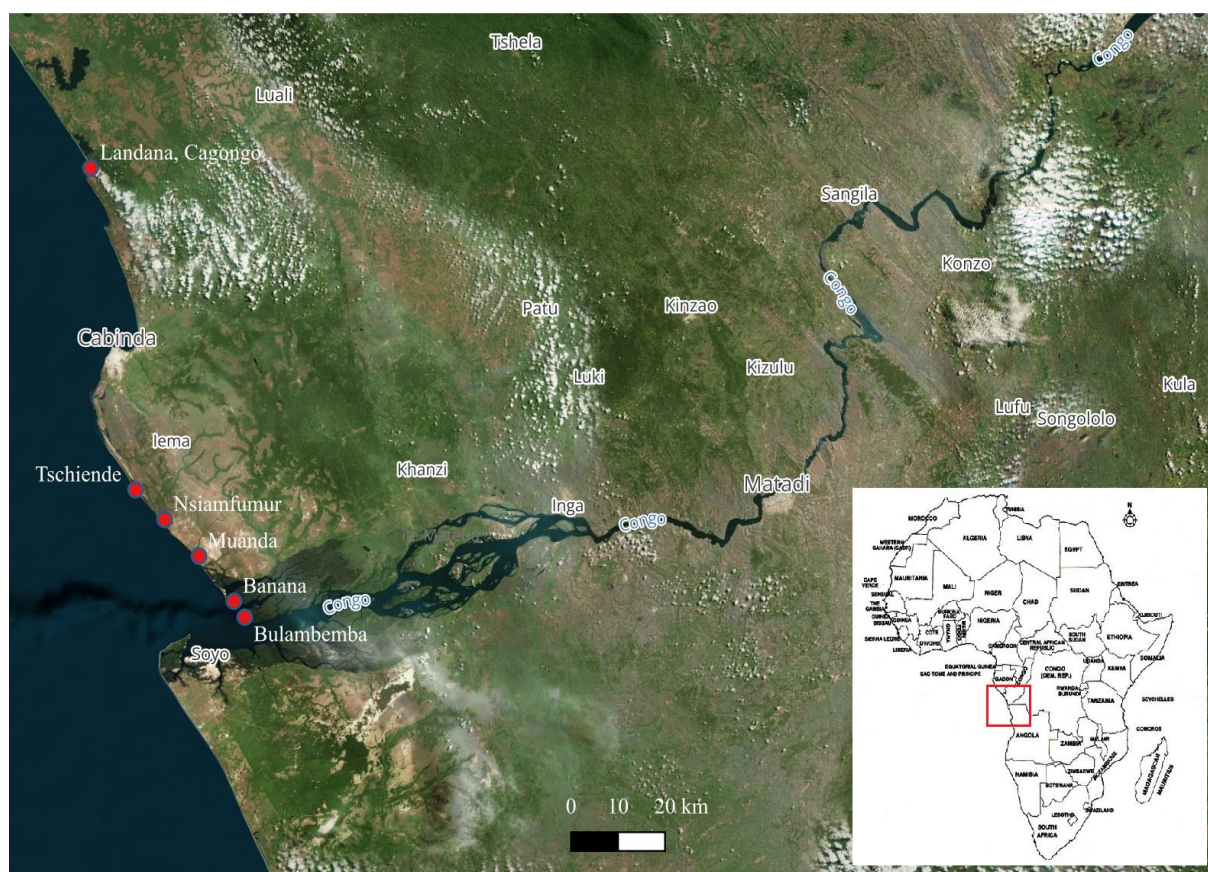


Figure 1: Map of the coast of the Democratic Republic of the Congo. Fishing villages and other relevant coastal sites as mentioned in the text are indicated. Poste Frontalier de Malongo, the DRC's northern shore-based border with the Cabinda exclave (Angola), is located 24 km south of Cabinda city.

Field work

The main survey work was conducted May 2021–15 April 2022. The first author selected a group of ten fishermen to help search for cetaceans in a relatively novel approach for Africa, referred to as citizen science. It consists in the training of a number of non-scientists to participate in opportunistic data collection. The rationale is that small-scale fishermen (the ‘citizen scientists’) have major exposure to incidental observations, of both at-sea sightings and bycatches. With post-authentication, citizen science has recently generated valuable information in marine mammalogy studies, particularly in data-poor regions (e.g., García-Cegarra et al., 2021; Kiani et al., 2021; Mwangi'mbe et al., 2021; Tollab et al., 2023).

The selected fishermen, members of two local fishing agencies (‘Gloire a Dieu’ and ‘Chadrack’), received basic training on cetacean biology and were instructed on how to best record videos and photographs with Android smartphones when out at sea. In addition, a digital SLR camera (Nikon D300s) was donated to Centre d’Initiatives pour la Conservation de la Biodiversité (CICOBIO). The daily management of activities was guided by S. M. N., head of CICOBIO at Muanda. Technical support and a supervisory role were assured by both the Chief

(A. M. N.) of the High Institute of Navigation and Fisheries (Institut Supérieur de Navigation et de Pêche; ISNP/Muanda) and the Chief (S.N.) of the National Aquaculture Service (Service National de l’Aquaculture) at Nsiamfumu. Training briefings with fishermen were regularly organised.

The artisanal fishermen who registered cetacean sightings and monitored fishing operations were dedicated mainly to the small-scale gillnet fishery for sharks and rays (Fig. 2) which resulted in occasional net entanglements (bycatch) of small cetaceans and sea turtles. Normally one fishing sortie per vessel was made each week. The fishers typically set out to sea at night (ca. 1 am) to return 2–3 days later in the evening. GPS positions of sightings were recorded, although not systematically.

Beach surveys

Beach surveys on foot were conducted regularly (1–2 times a week) by the first author S.M.N. and a few trainees. However, due to inexperience, survey effort (distance/duration) was not quantified. In direct coordination with S.M.N., fishermen of the citizen science team reported any cetaceans seen landed during their daily beach-based operations and movements around the fishing villages (Fig. 3).



Figure 2: A large shark, *Carcharinus* sp. (possibly a bull shark) is hauled onboard, entangled in a large-mesh, multifilament drift gillnets. The artisanal fishery for sharks and rays (species composition unknown) is the main cause of anthropogenic mortality of small cetaceans in DRC waters. Photo © CICOBIO.



Figure 3: Juvenile common bottlenose dolphin *Tursiops truncatus* taken in a drift gillnet off Muanda, 11 September 2012. The specimen was cut up for human consumption (marine bushmeat). Photo © CICOBIO.

Data processing

For species identification and confirmation, available videos were examined frame-by-frame by cetacean taxonomist K.V.W. using the Linux-based VLC media player (3.0.11.1 Vetinari).

Results

Sightings

The at-sea sightings of cetaceans (n= 17) observed in DRC coastal waters, are listed in Table 1, and those with associated coordinates are shown in Fig.4. Thirteen sightings were identified to species, two to genus level (*Delphinus/Stenella* sp.) and two remained unidentified. The confirmed records include four species, three of which were odontocetes (Delphinidae): long-beaked common dolphin *Delphinus capensis* Gray, 1828 (sensu Best, 2004; see Discussion), Atlantic spotted dolphin *Stenella frontalis* (G. Cuvier), false killer whale *Pseudorca crassidens* (Owen). One mysticete (Balaenopteridae) was observed: the humpback whale *Megaptera novaeangliae* (Borowski) (Fig. 4). Humpback whales comprised 47% of all cetacean sightings documented in this study: they were present in DRC coastal waters for 3.5 months during the austral winter, from 17 May (earliest sighting) until 3 September 2021 (latest sighting) (Table 1; Fig. 5). Long-beaked common dolphin was the second-most frequently encountered cetacean (17.6% of at-sea sightings, however by total numbers it was by far the most numerous cetacean (group size range: 50–90). The species was positively identified from its morphological features: a middle-sized dolphin; triangular dorsal fin; diagnostic criss-cross coloration on flanks; a long rostrum forming a distinct crease with the melon (Best, 2007; Perrin, 2018; Carwardine, 2020). In August 2022, 4–5 Atlantic spotted dolphins were seen bowriding and leaping near a fishing boat. These delphinids, while also middle-sized, showed a tall falcate dorsal fin, a white-tipped rostrum with pale lips, dark dorsal cape, white belly, relatively indistinct spotting and a strong tailstock (Best, 2007; Carwardine, 2020).

At least one individual (group size was not reported) false killer whale *Pseudorca crassidens* (Owen) was photographed when surfacing near a fisher vessel in DRC waters (Fig. 6). This large delphinid of tropical to warm-temperate waters is also documented from Angola and Gabon (Van Waerebeek and De Smet, 1996; Weir, 2007). Four dolphin sightings, for lack of video of adequate resolution, could not be identified more accurately than *Delphinus/Stenella* sp. or ‘unidentified’ (Table 1). All sightings with associated coordinates occurred within 6.5 km from the nearest coastline (Fig. 4).

Cetacean bycatch

The typical drift gillnets used in the small-scale shark fishery of the littoral zone of DRC are nylon with twine type 210/36 up to 210 /240¹, and 16 cm mesh size. The net length ranges 300–600 m with a depth of 30–40 mesh widths (4.8–6.4 m). Sharks are captured mainly during February–April and September–November of each year. The species composition of the shark fishery is largely unknown (Fig. 2). Of six documented cetacean bycatch records in DRC (Table 2), four were common bottlenose dolphin *Tursiops truncatus* (Montagu) (Figs. 3, 7, 8), one an unidentified *Delphinus/Stenella* (Fig. 9) and one dwarf sperm whale *Kogia sima* (Owen) reportedly found floating nearshore (Fig. 10). *Kogia* spp. are known to wash ashore in Atlantic Africa, often moribund, with some regularity (Best, 2007; KVVW, pers. observations). The juvenile *T. truncatus* captured off Muanda in 2012 (Fig. 3; Table 2) corresponds to one of two bottlenose dolphins listed in Collins et al. (2019); information on the second dolphin was irretrievable. One fisherman team member photographed (Fig. 11) a freshly dead, juvenile/calf delphinid, likely a common dolphin *Delphinus* sp., landed on a beach of Landana, Cacongo, Cabinda (Angola exclave) at ca. 05°13.2886’S, 12°08.4612’E. No further details are available on this capture, but it suggests that the dolphin bycatch situation is similar in Cabinda as in DRC.

1. Industry standard 240/36 ‘twisted thread’ with 240/260 tensile strength in lb (pounds).

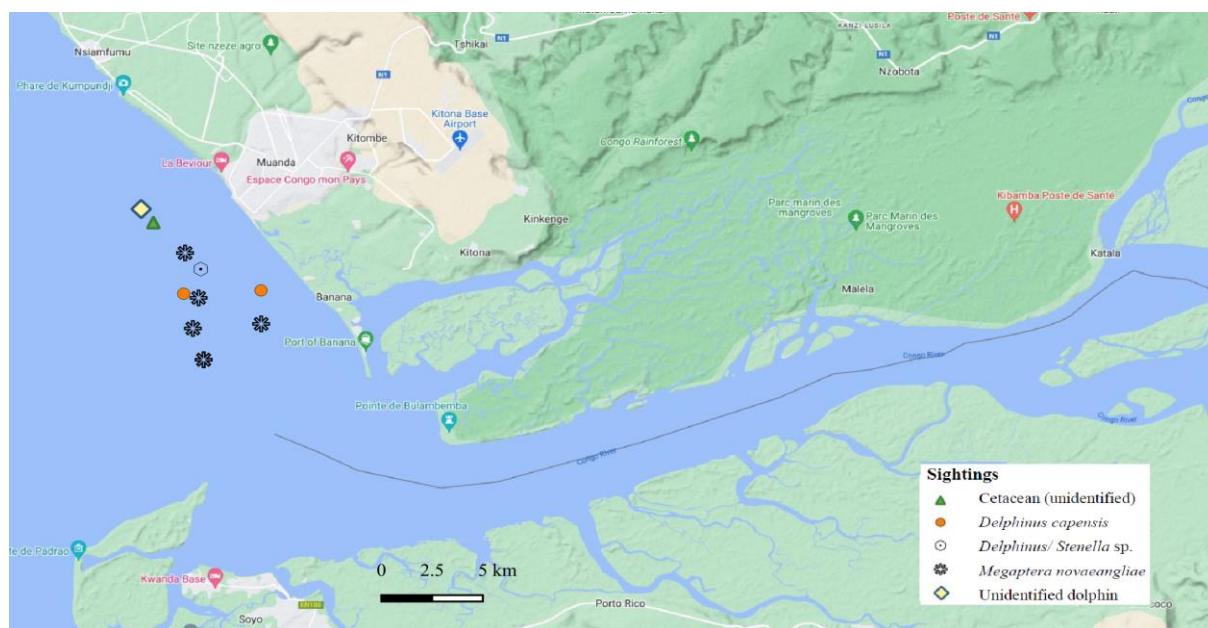
Table 1: Sightings of cetaceans made in DRC waters from small artisanal fishing boats. Departure always between 06:00-08:00; return 15:00-18:00 except on 05/10 and 13/10 (13:00)

Sighting number	Date	Duration days	Principal observer	Sighting position (GPS)	Group species	Size	Observations
1	26/01/2022	na	na	position not registered; DRC coastal waters	<i>Pseudorca crassidens</i>	na	diagnostic are rounded head, falcate dorsal fin mid-way along dorsum with rounded tip; dorsal fin taller than it is long.
2	17/05/2022	3	SERGE NZINGA	6°01'02.36"S 12°19'51.57"E	<i>Megaptera novaeangliae</i>	3	forceful tail-slaps by min. 2 individuals; the 3 are in immediate vicinity
3	26/05/2022	4	PA DIEU	5°59'03.29"S 12°21'23.49"E	<i>Delphinus capensis</i>	50 (40-60)	long-beaked morph; triangular dorsal fin, criss-cross colouration on flanks diagnostic for common dolphin
4	04/06/2022	4	MBULISI	6°00'00.83"S 12°21'23.76"E	<i>Megaptera novaeangliae</i>	2-3	all adults; several surfacings expose dorsum and dorsal fins diagnostic for humpback whale
5	25/06/2022	4	SERGE NZINGA	5°57'58.97"S 12°19'21.82"E	<i>Megaptera novaeangliae</i>	2	adult with calf; initially almost motionless, possibly lactating; shape of dorsum and dorsal fins conclusive for humpback whale
6	02/07/2022	1	PA DIEU	5°59'08.96"S 12°19'19.57"E	<i>Delphinus capensis</i>	70 (50-80)	triangular dorsal fin, long-beaked phenotype; several full-body leaps, no spinning
7	10/07/2022	5	SERGE NZINGA	5°59'16.18"S 12°19'43.59"E	<i>Megaptera novaeangliae</i>	1	low bushy blow, low DF
8	21/07/2022	4	SERGE NZINGA	6°01'02.36"S 12°19'51.57"E	<i>Megaptera novaeangliae</i>	2	3 violent tail-lashings observed between 2 animals close to each other
9	28/07/2022	4	MBULISI	5°58'26.75"S 12°19'46.97"E	<i>Delphinus/Stenella</i> sp.	> 10	porpoising; rather triangular dorsal fin reminiscent of common dolphin but no definite ID possible.
10	05/08/2022	3	MBULISI	5°56'43.53"S 12°18'11.53"E	unidentified dolphin	1	no photo/video available
11	13/08/2022	5	PA DIEU	5°57'06.57"S 12°18'31.03"E	unidentified cetacean	na	no photo/video available
12	23/08/2022	na	na	position not registered; DRC coastal waters	<i>Stenella frontalis</i>	4-5	large falcate dorsal fin; strong tailstock; white-tipped rostrum and pale lips; dark dorsal cape and white belly, spotting indistinct. Bow-riding with full-body leaps.
13	23/08/2022	na	na	position not registered; DRC coastal waters	<i>Megaptera novaeangliae</i>	1	full-body leap near boat showing all diagnostic features
14	03/09/2022	1	MBULUSI	6°00'08.66"S 12°19'34.34"E	<i>Megaptera novaeangliae</i>	2	repeated forceful tail-lashings by both whales in close vicinity; side-lunges; consistent with male-male competition. No predators seen.
15	na	na	Cicobio	position not registered; DRC coastal waters	<i>Stenella</i> sp.	8-15	very falcate, pointed dorsal fins (distinct from common dolphin), long beaks; slender bodies; several agile leaps in pairs
16	na	na	Cicobio	position not registered; DRC coastal waters	<i>Megaptera novaeangliae</i>	2-3	at least 2 adults in competitive behaviour with forceful lobe-tailing for an extended time
17	na	na	Cicobio	position not registered; DRC coastal waters	<i>Delphinus capensis</i>	90 (60-90)	middle-sized dolphins with long rostra and triangular dorsal fins consistent with <i>Delphinus capensis</i>

na = not available.

Table 2: Small cetaceans recorded landed (chronologically) as bycatch at Congolese landing beaches, for human consumption use. Except for No. 2, records are photographically supported.

No.	Species	Locality	Date	Comments
1	<i>Tursiops truncatus</i>	Muanda	11 September 2012	Juvenile female taken in drift gillnet (Fig. 3); body length 114 cm and weight 72 kg. Relatively short, stubby rostrum attributed to immature status.
2	<i>Tursiops truncatus</i>	Between Muanda and Banana	Indeterminate before 2019	Listed (without data) in Collins et al. (2019).
3	<i>Delphinus/Stenella</i> sp.	Northern coast	April 2020	Uncut carcass abandoned by local fishers for unknown reason (Fig. 9).
4	<i>Kogia sima</i>	Nsiamfumu	10 February 2022	Reported 'floating dead nearshore' (Fig. 10).
5	<i>Tursiops truncatus</i>	Banana	07 April 2022	Adult dolphin butchered on the beach (Fig. 7). Long-rostrum phenotype (see Discussion).
6	<i>Tursiops truncatus</i>	Nsiamfumu	28 July 2022	Adult dolphin at landing beach (Fig. 8). Long-rostrum phenotype.

**Figure 4:** Incidental sightings of cetaceans (for which coordinates are available) made in DRC coastal waters by trained artisanal fishermen ('citizen scientists'), from small fishing boats. Sightings of Atlantic spotted dolphin *Stenella frontalis* and false killer whale *Pseudorca crassidens* were made in the same general area.

No biological samples of landed cetaceans were successfully conserved due to a lack of reliable cold-storage facilities and chemical preservatives. Also despite weekly beach-combing efforts, no skeletal remains of marine mammals were found. Some smaller items, like caudal vertebrae, chevron bones, ribs, may have been overlooked, due to inexperience.

Discussion

Odontocetes

While the most frequently captured cetacean is *T. truncatus* (Table 2), the most commonly sighted small cetacean in DRC coastal waters is *D. capensis* (Table 1). Although a taxonomic discussion is beyond the scope of this brief inventory, we acknowledge that molecular genetic evidence suggests that *D. capensis* Gray, 1828 may be a junior synonym of *D. delphis* Linnaeus (e.g., Cunha et al., 2015; Ngqulana et al., 2019). Morphological studies however suggested two distinct

species in the eastern Pacific (e.g. Heyning and Perrin, 1994; Van Waerebeek et al., 1994). While recently interpreted as subspecies, there is no definitive taxonomic consensus. Off South Africa, three outlier skulls, consistent with (offshore) *D. delphis*, were cranially very distinct from the nominal coastal form *D. capensis* (Jefferson and Van Waerebeek 2002; Samaai et al., 2005; Best, 2007). A preliminary note, based on common dolphin specimens from Central and West Africa, concluded similarly (Van Waerebeek, 1997). If not at species level, the long-beaked *capensis* morph (type locality: Cape of Good Hope) should be managed as an evolutionary significant unit (ESU), perhaps as a common dolphin subspecies *D. delphis capensis* endemic to coastal waters of the SE Atlantic Ocean and South Africa's east coast (Best, 2007). A comprehensive multidisciplinary study addressing cranial, external morphologic, molecular genetic and ecological evidence for common dolphins off southern Africa needs to be undertaken.



Figure 5: (A) Humpback whales *Megaptera novaeangliae* lifting flukes before diving; (B, C) breaching whales in DRC coastal waters. (C) Note the nearshore occurrence, a few 100s meters from the shoreline, a common habitat for this balaenopterid. Photos © CICOBIO.



Figure 6: A false killer whale *Pseudorca crassidens* approaching a fishing boat in RDC waters on 26/01/2022. Note the overall dark pigmentation, and (A) a short conical head with non-bulbous melon and no discernible beak; (B) a tall and falcate dorsal fin with rounded tip, positioned midway along the back. Photos © CICOBIO.



Figure 7: Large common bottlenose dolphin *Tursiops truncatus*, reportedly stranded, cut-up for use as marine bushmeat, at Banana village, 07 April 2022. A video demonstrates poor body condition, suggesting the dolphin may have been diseased. Photo © CICOBIO.



Figure 8: Bycaught adult common bottlenose dolphin *Tursiops truncatus* landed by artisanal fishermen at Nsiamfumu, 28 July 2022. Note the long rostrum, a characteristic *T. truncatus* phenotype in some parts of their range in West Africa, here first documented for DRC. Photo © CICOBIO.

Interestingly, the three adult by-caught *T. truncatus* appeared to compare well with a long-rostrum morphotype previously described for Senegal and Mauritania (Robineau and Vely, 1997; Van Waerebeek et al., 2008). Measurements and cranial specimens should be collected to substantiate this.

Most odontocetes confirmed for neighboring Congo-Brazzaville and Angola (Table 3) can be expected, at least occasionally, to occur also in DRC waters. Two notable exceptions include Heaviside's dolphin *Cephalorhynchus heavisidii* (Gray) and dusky dolphin *Lagenorhynchus obscurus* (Gray) ranging north only as far as southern Angola, respectively Baía dos Tigres (16°30' S) and Lobito Bay (12° S) (Findlay et al., 1992; Van Waerebeek et al., 1995; Best, 2007; Morais, 2012). Both these delphinids are adapted to the Benguela Current Large Marine Ecosystem, a cool-water upwelling habitat off southwest Africa, and are unlikely to range into the eastern tropical Atlantic (Van Waerebeek et al., 1995; Best, 2007; Carwardine, 2020).

The cosmopolitan sperm whale *Physeter macrocephalus* Linnaeus is widely distributed throughout the Gulf of Guinea and in waters off southwestern Africa (Townsend, 1935; Best, 2007; Weir, 2010), so there is little doubt the species occurs in deeper waters off the DRC coast. Off Angola, Weir (2007) encountered sperm

whales seaward of the shelf break and found them clustered particularly to the west of the Congo River mouth. Natural history and ecological parameters would be comparable as for sperm whales off the southwest coast of South Africa (e.g. Best, 1967; 1969; 1970).

Mysticetes

The seasonality of humpback whale observations off the DRC is concordant with the expected timing and distribution of the population of whales known as the IWC-defined 'B stock', the Eastern South Atlantic population that feeds in the Antarctic and breeds in coastal waters of Angola, Congo-Brazzaville, Gabon, Cameroon, the Bight of Benin and likely other shelf waters of the northern Gulf of Guinea (Van Waerebeek et al., 2001; 2009; 2013; Best, 2007; Rosenbaum et al., 2009; 2014; Weir, 2010; Ayissi et al., 2011; Sohou et al., 2013). The IWC-defined B-Stock, or an unnamed sub-stock, ranges as far north as Guinea (Bamy et al., 2010) and Dakar, central Senegal (Van Waerebeek et al., 2013; Djiba et al., 2015). Behaviour observed in DRC was consistent with competitive groups, characterised by forceful tail-lashings (lobtailing), lunging and breaching (Fig. 11), activities typical for a humpback whale breeding ground. Zoogeographic considerations suggest that DRC humpback whales possibly belong to the B2 sub-stock, like those off Angola (Rosenbaum et al., 2014).

No other baleen whales were documented in DRC waters, however Bryde's whales *Balaenoptera brydei* Olsen are commonly sighted off Angola, Namibia and South Africa (Best, 2007; Weir, 2010), and are likely to be present in DRC waters. Recently, a southern right whale *Eubalaena australis* (Desmoulins) was reported at 07°16'S in northern Angola (Whitt et al., 2023). This rare mysticete could also occasionally visit the DRC coast, considering it is also found at a comparable equatorial latitude with recently confirmed southern right whale sightings (n=3) in northern Peru and Ecuador (Castro et al., 2023).

Bycatch and strandings

While the lack of stranded bony remains (skulls, vertebrae, etc.) may seem surprising, it reflects similar situations in several other western African coastal nations (e.g. Ghana, Togo, Benin, Nigeria) where bycaught and stranded cetacean carcasses are cut up entirely, including the head. Muscle and blubber are not separated from bones but the carcass is hacked into chunks with machetes, then commercialized smoked, cooked or salted as marine bushmeat ('wild meat'). Even caudal and dorsal fins, which are primarily connective tissues, are processed this way. Very few skeletal parts are discarded (Ofori-Danson et al., 2003; Van Waerebeek et al., 2009; Uwagbae and Van Waerebeek, 2010; Ayissi et al., 2011; Segniagbeto et al., 2012; Sohou et al., 2013). Equally, whale carcasses found stranded, even in moderate decomposition, are hacked into pieces for human consumption and/or animal feed (e.g. Ayissi et al., 2011).

Table 3: Cetaceans documented in contiguous waters of Congo-Brazzaville (Republic of the Congo) and Angola, hence likely to occur in DRC, minus two species [in square brackets] for being adapted to cool waters of the Benguela Current. (Sources: Van Waerebeek, 1997; Best, 2007; Rosenbaum et al., 2007; Weir, 2006, 2007, 2010; Morais, 2012; Collins et al., 2019; Whitt et al., 2023).

Parvorder	Both Congo-Brazzaville and Angola	Angola only
Odontocetes	<i>Delphinus capensis</i> (long-beaked form), <i>Sousa teuszii</i> ; <i>Stenella clymene</i> ; <i>Steno bredanensis</i> ; <i>Tursiops truncatus</i> ; <i>Physeter macrocephalus</i>	[<i>Cephalorhynchus heavisidii</i>]; <i>Delphinus delphis</i> (short-beaked form); <i>Globicephala macrorhynchus</i> ; <i>Grampus griseus</i> ; <i>Kogia sima</i> ; [<i>Lagenorhynchus obscurus</i>]; <i>Orcinus orca</i> ; <i>Peponocephala electra</i> ; <i>Pseudorca crassidens</i> ; <i>Stenella attenuata</i> ; <i>Stenella longirostris</i> ; <i>Stenella coeruleoalba</i> ; <i>Ziphius cavirostris</i>
Mysticetes	<i>Megaptera novaeangliae</i>	<i>Balaenoptera borealis</i> ; <i>Balaenoptera brydei</i> ; <i>Balaenoptera physalus</i> ; <i>Eubalaena australis</i>



Figure 9: Unidentified mid-sized delphinid with long rostrum (*Delphinus/Stenella* sp.), reportedly abandoned by local fishers on the northern DRC coast, April 2020. Encountered during beach survey effort by S.M.N. Photo © CICOBIO.

Procedures in much of West and Central Africa are very similar (see Segniagbeto et al., 2012; Collins et al., 2019), but not for instance in Mauritania where locals rarely consume cetaceans, and many carcasses and bones are found along the shores (Samba Bilal et al., 2023). The massive outflow of the Congo River (Savoie et al., 2009) arguably may also contribute in flushing out any cetacean carcasses, or other remains, from bycatches or natural mortality, away from the mouth of the estuary.

In other cases caution is advised with reports of live-stranded small cetaceans in western Africa as some fishermen may play an active role in the stranding. In Benin, for instance, a Cuvier's beaked whale *Ziphius cavirostris* G. Cuvier was driven towards shore (Sohou et al., 2013). At Bass Island, Nigeria, a live common bottlenose dolphin was hauled onto the beach and killed (Uwagbae and Van Waerebeek, 2010), amongst other examples of what are de facto directed takes (Segniagbeto et al., 2019). Common bottlenose dolphins are the main cetacean bycatch victims (66.7%) in DRC, however with the caveat of a small sample.

Conclusion

The newly authenticated cetacean species for waters of the Democratic Republic of the Congo include five odontocetes (*Tursiops truncatus*, *Delphinus capensis*, *Stenella frontalis*, *Pseudorca crassidens*, *Kogia sima*) and the humpback whale *Megaptera novaeangliae*. Another 16 species recorded either in Angola only, or in both Angola and Congo-Brazzaville (Table. 3) are, most probably, also occasionally present in DRC waters and likely will be encountered as field research progresses. Part of the information, including most at-sea sightings, were collected by local fishermen in a citizen science framework. Insufficient expertise and paucity of specialist training was problematic. For instance, lack of experience with sophisticated SLR cameras impeded efficient use of the camera provided. Fishermen recorded videos and photos with basic smartphones, typically of low resolution, thus often difficult to interpret. Also, participants regularly failed to record key data such as location and date. While decidedly promising, field protocols require adjustments as to improve future data collection.



Figure 10: Dwarf sperm whale *Kogia sima* reportedly found floating nearshore (but tailstock was severed) by local fishermen at Nsiamfumu landing beach, 10 February 2022. Note small body size (<2 m); dorsal fin situated at about mid-back and absence of distinct neck behind a relatively small head, distinguishing it from congener *K. breviceps* (Best, 2007; Carwardine, 2020). Photo © CICOBIO.



Figure 11: Juvenile/calf delphinid [in background], likely a common dolphin *Delphinus* sp. (cf. bulbous melon, short rostrum, ochre thoracic patch, somewhat triangular dorsal fin) landed alongside a small whale shark *Rhincodon typus* (A. Smith) in Landana, Cacongo, Cabinda (Angola), in June 2023. The whale shark is thought to be a first record for Cabinda. Photographed by a ‘citizen science’ participating fisherman, which underscores again the value of the program. Photo © CICOBIO.

We conclude that important benefits of the citizen science program include a novel marine conservation educational component, opportunistic boat use and modest cost. Internal communication was greatly facilitated thanks to the all-Congolese team, cognizant of local fishers’ idiosyncrasies. Main shortfalls comprise a deficiency in scientific details and the lack of biological sampling. However, in a coastal area of difficult access such as the Congo River Estuary, where marine mammals have never been studied, the positive net value of citizen science methodology is undeniable. The preliminary results are expected to inspire and inform future research and conservation efforts which may focus on the areas where at-sea sightings and bycatches have been recorded. The current effort should be continued and scaled up to encompass improved year-round data and sample collection and additional training. Although the full potential of citizen science, particularly the extensive opportunistic use of year-round fishing trips, has so far not yet been exploited, at some point dedicated small-boat survey effort should also be considered, although this would require a dramatic increase in budget.

Poverty plays an important role where dolphin and sea turtle bycatches form part of the local food economy (marine bushmeat trade), as is the case in many coastal states of West and Central Africa (e.g. Ofori-Danson et al., 2003; Collins et al., 2019; Segniabeto et al., 2019; Ingram et al., 2022). Our results underscored the necessity to significantly expand educational efforts directed to fishermen, fisheries managers, local conservationists and other coastal inhabitants. Considering the DRC’s very

short coastline despite being the second largest country in Africa, current awareness about the presence of cetaceans and generally the marine environment is understandably scarce. Further work, including dedicated studies and sampling of bycaught specimens, additional training and enhancement of public awareness to report cases will be required to complete the cetacean inventory for DRC. Natural history and ecological studies should directly involve Congolese biologists and students. Finally, we recommend the continuation of locally-steered and sovereign marine conservation, research and management initiatives.

Acknowledgements

We warmly thank the many volunteer collaborators (‘citizen scientists’) who greatly contributed to the implementation of the CICOBIO project, most especially Philippe Bongo Kobe, Benjamin Benamambote Matoko, Maurice Duli Memo, Denise Kimuendo Ndembo, Joseph Pfingu Ndudi, Charles Phuna Khonde, Rebecca Samba Mbungu, and Delpech Valend Pezo. Victor Peddemors is thanked for examining the shark photo. We greatly acknowledge also the helpful comments by Vassili Papastavrou and two anonymous reviewers that improved the manuscript. The authors are immensely grateful to two Hong Kong based sponsors, Eco Institute (<http://www.eco-institute.com.hk/>) and the NGO Care for Dolphins (<http://www.carefordolphins.net/en/index.php?cat=d>). Particularly, Samson So, Iris Yuen and Patty Tse were instrumental in obtaining support. The Peruvian Centre for Cetacean Research (CEPEC) is an all-volunteer working group studying cetacean conservation biology and medicine.

Author contributions

Conceptualization of this study was led by SMN and KVW, with contributions from AMN, SN, JSB and HYL. Data collection and training of fishermen-observers were steered by SMN, AMN, SN and JSB. AMN, SN and JSB assured institutional and legal authorizations. Species identification and other cetological aspects were directed by KVW and HYL. Manuscript preparation was led by SMN and KVW, with contributions by AMN, SN, JSB and HYL. All authors approved the final version of the manuscript. International liaison initiatives that facilitated funding from Hong Kong were expertly managed by HYL.

Conflict of interest

The authors declare that there is no conflicting issue related to this research article.

References

- Ayissi, I., Van Waerebeek, K. and Segniagbeto, G. (2011). Report on the Exploratory survey of cetaceans and their status in Cameroon. Document UNEP/CMS/ScC17/Inf.10. Presented to 17th Meeting of CMS/UNEP Scientific Council, Bergen, 17–18 November 2011. http://www.cms.int/sites/default/files/document/Inf_10_Rpt_Cameroon_cetaceans_exploratory_survey_Eonly_0.pdf
- 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. <https://doi.org/10.1017/S1755267210000436>
- Bamy, I., Djiba, A. and Van Waerebeek, K. (2021). Recent Survey for Delphinids at Tristao Islands, Guinea, Reinforces Concern for Bycatches and Marine Bushmeat Use. *Preprints* 2021040094. <https://doi.org/10.20944/preprints202104.0094.v1>
- Best P. B. (1967). The sperm whale (*Physeter catodon*) off the West coast of South Africa. 1. Ovarian changes and their significance. *Investigational Report, Division of Sea Fisheries of South Africa*, 61: 1–27.
- Best P. B. (1969). The sperm whale (*Physeter catodon*) off the West coast of South Africa. 4. Distribution and movements. *Investigational Report, Division of Sea Fisheries of South Africa*, 78: 1–12.
- Best P. B. (1970). The sperm whale (*Physeter catodon*) off the West coast of South Africa. 5. Age, growth and mortality. *Investigational Report, Division of Sea Fisheries of South Africa*, 61: 1–27.
- Best, P. B. (2007). *Whales and Dolphins of the Southern African Subregion*. Cambridge University Press, Cape Town, South Africa. 338 pp.
- Carwardine, M. (2020). *Handbook of whales, dolphins and porpoises*. Bloomsbury Wildlife, London. 528 pp.
- Castro, C., García-Cegarra, A. M., Uceda-Vega, P., Aguilar, L., Kelez, S., Buchan S. J., and Van Waerebeek, K. (2023). First documented records of Southern right whale (*Eubalaena australis*) of the Chile-Peru population: first observations in Ecuador and north of Peru. Document SC/69A/CMP/25, International Whaling Commission Scientific Committee, Bled, Slovenia. Available from: <https://www.researchgate.net/publication/370400607>
- Collins, T., Braulik, G.T. and Perrin, W. (2017). *Sousa teuszii* (errata version published in 2018). The IUCN Red List of Threatened Species 2017: e.T20425A123792572.
- Collins, T., Strindberg, S., Boumba Dilambaka, E. R., Thonio, J., Mouissou, C., Boukaka, R., Saffou, G. K., Buckland, L., Leeney, R., Antunes, R. and Rosenbaum, H. C. (2013). Progress on Atlantic humpback dolphin conservation and research efforts in Congo and Gabon. Document SC/65a/SM16rev, International Whaling Commission, Scientific Committee. 24pp. [Available from the IWC Secretariat, Cambridge, UK].
- 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. and 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, International Whaling Commission Scientific Committee Meeting, Nairobi, May 2019. 12 pp. [Available from the IWC Secretariat, Cambridge, UK].
- Cunha, H. A., de Castro, R. L., Secchi, E. R., Crespo, E. A., Lailson-Brito, J., Azevedo, A. F., Lazoski, C. and Solé-Cava, A. M. (2015). Molecular and morphological differentiation of Common Dolphins (*Delphinus* sp.) in the Southwestern Atlantic: testing the two species hypothesis in sympatry. *PLoS ONE*, 2015; 10 (11): e0140251. <https://doi.org/10.1371/journal.pone.0140251>
- Dickman, K. (2009). Evolution in the Deepest River in the World. *Science and Nature. Smithsonian Magazine*, Issue 2009-11-03.
- Djiba, A., Bamy, I. L., Samba Ould Bilal, A., and Van Waerebeek, K. (2015) Biodiversity of cetaceans in coastal waters of Northwest Africa: new insights through platform-of-opportunity visual surveying in 2011-2013. pp. 283–297 In: L. Valdés and I. Déniz-González (eds.). *Oceanographic and Biological Features in the Canary Current Large Marine Ecosystem*. IOC-UNESCO, Paris. *IOC Technical Series* 115. Available from: <https://www.researchgate.net/publication/285507686>

- Findlay, K. P., Best, P. B., Ross, G. J. B. and Cockcroft, V. G. (1992). The distribution of small odontocete cetaceans off the coasts of South Africa and Namibia. *South African Journal of Marine Science*, 12: 237–270.
<https://doi.org/10.2989/02577619209504706>
- García-Cegarra, A. M., Toro, F. and Gonzalez-Borasca, V. (2021). Citizen science as a tool to assess cetacean diversity in the Atacama Desert coast. *Ocean and Coastal Management*, 213: 105858.
<https://doi.org/10.1016/j.ocecoaman.2021.105858>
- Gray, J.E. (1828). *Spicilegia Zoologica; or original figures and short systematic descriptions of new and unfigured animals*. Treüttel, Würtz and Co., London. 30 pp.
- Heyning, J.E. and Perrin, W.F. (1994). Evidence for two species of common dolphins (Genus *Delphinus*) from the eastern North Pacific. *Contributions in Science*, 442: 1–35.
<https://doi.org/10.5962/p.226804>
- Ingram, D. J., Prideaux, M., Hodgins, N. K., Frisch-Nwakanma, H., Avila, I. C., Collins, T., Cosentino, M., Keith-Diagne, L. W., Marsh, H., Shirley, M. H., Van Waerebeek, K., Djondo, M. K., Fukuda, Y., Glaus K. B. J., Jabado, R. W., Lang, J. W., Lüber, S., Manolis, C., Webb, G. J. W. and Porter, L. (2022). Widespread Use of Migratory Megafauna for Aquatic Wild Meat in the Tropics and Subtropics. *Frontiers in Marine Science*, 9: 837447.
<https://doi.org/10.3389/fmars.2022.837447>
- Jefferson, T. A. and Van Waerebeek, K. (2002). The taxonomic status of the nominal dolphin species *Delphinus tropicalis* van Bree, 1971. *Marine Mammal Science*, 18 (4): 787–818.
<https://doi.org/10.1111/j.1748-7692.2002.tb01074.x>
- Kiani, M. S., Nawaz, R., Moazzam, M., Shafiq, B. and Van Waerebeek, K. (2021) Longman's Beaked Whale *Indopacetus pacificus* and *Mesoplodon* spp. entanglements off Pakistan: Are Pelagic Gillnet Fisheries a Potential Threat? *Preprints* 2021, 2021100051.
<https://doi.org/10.20944/preprints202110.0051.v1>
- Kükenthal, W. (1892). *Sotalia teuszii* n. sp. ein pflanzenfressender (?) Delphin aus Kamerun. *Zoologische Jahrbücher Abt. Systematick*, 6 (3): 442–446.
- Mbungu Ndamba, S. (2022). Contribution à l'étude des dauphins fréquentant le littoral de la RDC. Rapport d'Activité N° 1 couvrant la période allant du 1 Novembre 2021 au 15 avril 2022. Unpublished report CICOBIO, Muanda, Democratic Republic of the Congo. 19 pp. [In French].
- Morais, M. (2012). Marine mammal sightings off the Angolan coast recorded from the R/V *Dr. Fridtjof Nansen* in August 2004 and July 2005. pp. 26–30. In: K. Van Waerebeek (ed.). *Conserving cetaceans and manatees in the western African Region. CMS Technical Series*, No. 26. CMS Secretariat, Bonn, Germany.
<https://www.cms.int/aquatic-mammals/en/publication/conserving-cetaceans-and-manatees-western-african-region-ts-no-26>
- Mwango'mbe, M., Spilsbury, J., Trott, S., Nyunja, J., Nina, W., Collins, T., Gomes, I. and Pérez-Jorge, S. (2021). Cetacean Research and Citizen Science in Kenya. *Frontiers in Marine Science*, 8: 642399.
<https://doi.org/10.3389/fmars.2021.642399>
- Ngqulana, S.G., Plön, S., Galatius, A., Pistorius, P. and Hofmeyr, G. J. G. (2019). Cranial variation in common dolphins *Delphinus* spp. off South Africa, with the inclusion of information from the holotype of *Delphinus capensis*. *African Journal of Marine Science*, 41 (3): 247–260.
<https://doi.org/10.2989/1814232X.2019.1648318>
- Ofori-Danson, P.K., Van Waerebeek, K. and Debrah, S. (2003). A survey for the conservation of dolphins in Ghanaian coastal waters. *Journal of the Ghana Science Association*, 5 (2): 45–54.
- Perrin, W. F. (2018). Common Dolphin *Delphinus delphis*. pp. 205–209. In: (eds. B. Würsig, J.G.M. Thewissen, K.M. Kovacs). *Encyclopedia of Marine Mammals. Third Edition*, Academic Press.
<https://doi.org/10.1016/B978-0-12-804327-1.00095-9>
- Perrin, W. F. and Van Waerebeek, K. (2012). The Small-Cetacean Fauna of the West Coast of Africa and Macaronesia: diversity and distribution. pp. 7–17. In: K. Van Waerebeek (ed.). *Conserving cetaceans and manatees in the western African Region. CMS Technical Series* 26, UNEP/CMS, Bonn, Germany.
<https://www.cms.int/aquatic-mammals/en/publication/conserving-cetaceans-and-manatees-western-african-region-ts-no-26>
- Robineau, D. and Vely, M. (1997). Données préliminaires (taille corporelle, craniométrie) sur le grand dauphin (*Tursiops truncatus*) des côtes d'Afrique du nord-ouest (Mauritanie, Sénégal). *Mammalia*, 61 (3): 443–448.
<https://doi.org/10.1515/mammalia-1997-610310>
- Rosenbaum, H. C., Pomilla C., Mendez, M., Leslie, M. S., Best, P. B., Findlay, K. P., Minton, G., Ersts, P. J., Collins, T., Engel, M. H., Bonatto, S. L., Kotze, D. P. G. H., Meÿer, M., Barendse, J., Thornton, M., Razafindrakoto, Y., Nguouessono, S., Vély, M. and Kiszka, J. (2009). Population structure of humpback whales from their breeding grounds in the South Atlantic and Indian Oceans. *PLoS ONE*, 4: 1–11.
<https://doi.org/10.1371/journal.pone.0007318>
- Rosenbaum, H., Maxwell, S., Kershaw, F. and Mate, B. (2014) Long-range movement of humpback whales and their overlap with anthropogenic activity in the South Atlantic Ocean. *Conservation Biology*, 28: 604–615.
<https://doi.org/10.1111/cobi.12225>
- Samaai, T., Best, P.B., Gibbons, M. J. (2005). The taxonomic status of common dolphins *Delphinus* spp. in South African waters. *African Journal of Marine Science*, 27: 449–458.
<https://doi.org/10.2989/18142320509504103>

- Samba Bilal, A., Wagne, M. M., Wagué, A., Dia, A. and Van Waerebeek, K. (2023). The Cetaceans of Mauritania, West Africa: a concise zoogeographical review with two new species records. *Journal of Animal Diversity*, 5 (1): 1–35. <https://doi.org/10.52547/JAD.2023.5.1.1>
- Savoie, B., Babonneau, N., Dennielou, B. and Bez, M. (2009). Geological overview of the Angola–Congo margin, the Congo deep-sea fan and its submarine valleys. *Deep-Sea Research Part II: Topical Studies in Oceanography*, 56: 2169–2182. <https://doi.org/10.1016/j.dsr2.2009.04.001>
- 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., Tchiboza, S., Uwagbae, M. and Van Waerebeek, K. (2019). On the utilisation of by-caught, hunted and stranded cetaceans in West Africa. Document SC/May19/AWW/04, International Whaling Commission Scientific Committee, Nairobi, May 2019. 14pp. Available from <https://www.researchgate.net/publication/334249267>
- Segniagbeto, G. H., Van Waerebeek, K., Bowessidjaou, E. J., Ketoh, K., Kpatcha, T. K., Okoumassou, K. and Ahoedo, K. (2012). Annotated checklist and fisheries interactions of cetaceans in Togo, with evidence of Antarctic minke whale in the Gulf of Guinea. *Integrative Zoology*, 9 (1): 378–390. <https://doi.org/10.1111/1749-4877.12011>
- Sohou, Z., Dossou-Bodjrenou, J., Tchiboza, S., Chabi-Yaouré, F., Sinsin, B. and Van Waerebeek K. (2013). Biodiversity and Status of Cetaceans in Benin, West Africa: an Initial Assessment. *West African Journal of Applied Ecology*, 21 (1): 121–134. Available from: <https://www.ajol.info/index.php/wajae/article/view/94736>
- Talling, P., Baker, M., Pope, E., Ruffell, S., Silva J. R., Heijnen, M., Hage, S., Simmons, S., Hasenhündl, M., Heerema, K., McGhee, C., Apprioual, R., Ferrant, A., Cartigny, M., Parsons, D., Clare, M., Tshimanga, R., Trigg, M., Cula, C. and Hilton, R. (2022). Longest sediment flows yet measured show how major rivers connect efficiently to deep sea. *Nature Communications*, 13: 4193. <https://doi.org/10.1038/s41467-022-31689-3>
- Tollab, M. A., Rezaie-Atagholipour, M., Ali Abedi, H., Askari Hesni, M., Abedi, E., Ahmadi, F. and Van Waerebeek, K. (2023). After two decades: extremely rare records of dugongs, *Dugong dugon* (Sirenia: Dugongidae), in the Iranian Persian Gulf. *Journal of Animal Diversity*, 5 (1): 108–112. <https://doi.org/10.52547/JAD.2023.5.1.7>
- Townsend, C. H. (1935). The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica* (NY), 19 (1–2): 1–50. <https://doi.org/10.5962/p.203715>
- UNEP/CMS (2012). Conserving cetaceans and manatees in the western African region. (ed. K. Van Waerebeek). *CMS Technical Series*, 26. Bonn, Germany. 88 pp.
- Uwagbae, M. and Van Waerebeek, K. (2010). Initial evidence of dolphin takes in the Niger Delta region and a review of Nigerian cetaceans. IWC Scientific Committee Document SC/62/SM1, International Whaling Commission, June 2010, Agadir, Morocco. 8 pp. <https://doi.org/10.13140/RG.2.1.1883.7848>
- Van Waerebeek K., Bamy I.L., Jiddou A.M., Sequeira M., Diop M., Ofori-Danson P.K., Tchiboza S. and Campredon P. (2008). Indeterminate status of West African populations of inshore common bottlenose dolphins *Tursiops truncatus* cautions against opportunistic live-capture schemes. Technical Report to the Fondation Internationale du Banc d’Arguin (FIBA). 9 pp. <https://doi.org/10.13140/RG.2.1.2772.0801>
- Van Waerebeek K., Ofori-Danson P.K. and Debrah J. (2009). The cetaceans of Ghana: a validated faunal checklist. *West African Journal of Applied Ecology*, 15: 61–90. <https://doi.org/10.4314/wajae.v15i1.49428>
- Van Waerebeek K., Reyes J.C. and Van Bresse M.F. (1994). Presencia de dos especies de *Delphinus* en el Pacífico sureste. pp. 78–79. In: A. Ximenez and P.C. Simoes-Lopes (eds.) *Anais 6a RT Especialistas em Mamíferos Aquáticos da América do Sul*. Universidade de Santa Catarina, Florianópolis, Brasil. [In Spanish].
- Van Waerebeek, K. (1997). Long-beaked and short-beaked common dolphins sympatric off central-west Africa. Document SC/49/SM46, International Whaling Commission Scientific Committee, September 1997, Bournemouth, UK, 5pp. Available from <https://www.researchgate.net/publication/257931862>
- Van Waerebeek, K. and De Smet, W.M.A. (1996) A second record of the false killer whale *Pseudorca crassidens* (Owen, 1846) (Cetacea, Delphinidae) from West Africa. *Mammalia*, 60 (2): 319–322. Available from: <https://www.researchgate.net/publication/247770040>
- Van Waerebeek, K., Barnett, L., Camara, A., Cham, A., Diallo, M., Djiba, A., Jallow, A. O., Ndiaye, E., Bilal, A. O. and Bamy, I. L. (2004). Distribution, status, and biology of the Atlantic humpback dolphin, *Sousa teuszii* (Kükenthal, 1892). *Aquatic Mammals*, 30 (1): 56–83. <https://doi.org/10.1578/AM.30.1.2004.56>
- Van Waerebeek, K., Djiba, A., Krakstad, J.-O., Samba Ould Bilal, A., Almeida, A. and Mass Mbye, E. (2013) New evidence for a South Atlantic stock of humpback whales wintering on the Northwest African continental shelf. *African Zoology*, 48 (1): 177–186. <https://doi.org/10.3377/004.048.0120>
- 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. Document SC/66b/SM19, International Whaling Commission Scientific Committee, Bled, Slovenia, June 2016. 19 pp. Available from: <https://www.researchgate.net/publication/304629563>

- Van Waerebeek, K., Tchibozo, S., Montcho, J., Nobime, G., Sohou, Z., Sohohou, P. and Dossou, C. (2001). The Bight of Benin, a North Atlantic breeding ground of a Southern Hemisphere humpback whale population, likely related to Gabon and Angola substocks. Document SC/53/IA21, International Whaling Commission Scientific Committee, July 2001, London. 8 pp. Available from: <http://www.vliz.be/imisdocs/publications/243239.pdf>
- Van Waerebeek, K., van Bree, P. J. H. and Best, P. B. (1995). On the identity of *Prodelphinus Petersii* Lütken, 1889 and records of dusky dolphins *Lagenorhynchus obscurus* (Gray, 1828) from the Indian and southern mid-Atlantic Oceans. *South African Journal of Marine Science*, 16: 25–35. <https://doi.org/10.2989/025776195784156584>
- Weir, C. R. (2006). First confirmed records of Clymene dolphin *Stenella clymene* (Gray, 1850) from Angola and Congo, south-east Atlantic Ocean. *African Zoology*, 41 (2): 297–300. <https://doi.org/10.1080/15627020.2006.11407366>
- Weir, C. R. (2007). The distribution and seasonal occurrence of cetaceans off northern Angola, 2004–05. *Journal of Cetacean Research and Management*, 9 (3): 225–239. <https://doi.org/10.47536/jcrm.v9i3.671>
- Weir, C. R. (2010). A Review of Cetacean Occurrence in West African Waters from the Gulf of Guinea to Angola. *Mammal Review*, 40: 2–39. <https://doi.org/10.1111/j.1365-2907.2009.00153.x>
- 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. <https://doi.org/10.1080/15627020.2011.11407473>
- Whitt, A. D., Warde, A. M., Blair, L., Deslarzes, K. J. P. and Chaineau, C.-H. (2023). Recent occurrence of marine mammals and seaturtles off Angola and first report of right whales since the whaling era. *Journal of the Marine Biological Association of the United Kingdom*, 103, e9: 1–9. <https://doi.org/10.1017/S0025315422001084>