SC/68D/SM/12

Sub-committees/working group name: SM

Preliminary results of 2021 and 2022 Sousa teuszii surveys in the Saloum Delta, Senegal

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Abstract:

The Saloum Delta, Senegal, is an inverse estuary with three main channels and an intricate network of secondary channels that increase in salinity with distance from shore. Small boat surveys were conducted from 9-29 July, 2021, and again from 18 March-6 April, 2022 with the aim of documenting the distribution, habitat parameters, and relative abundance of Critically Endangered Atlantic humpback dolphins (*Sousa teuszii* or AHD). The 2021 survey documented a total of 14 sightings over 12 days of effort, with the majority of sightings clustered in the Saloum 'River' in the northern portion of the delta. The 2022 survey documented a total of 22 sightings over 16 days of effort, again with the vast majority of sightings in the main Saloum River. Group sizes over both years of survey ranged from 1-30 with a mean estimated group size of 9 individuals. Depth at sighting locations ranged from a minimum of 2.4 m to a maximum of 15 m, with a mean of 9 m. Surface water temperature ranged from a minimum of 25º C to 33º C, with a mean of 29º C. Salinity readings taken at sighting locations ranged from a minimum of 34 ppt to a maximum of 42 ppt with a mean of 38 ppt. Thousands of photographs were taken and are currently being processed in order to establish a Saloum Delta AHD photo-identification catalogue that can be used to monitor individual dolphins' movements over time and to generate absolute abundance estimates using mark-recapture models. While formal comparison between 2021 and 2022 photos has not yet been conducted, at least two re-sights of photographed individuals have been documented between 2021 and 2022. Fieldwork included the deployment of one SoundTrap ST500-STD and one LF-POD in July 2021, and two LF-PODs and one SoundTrap ST500-STD in 2022. Analysis of data collected in 2021 is currently underway, with initial indication that both devices recorded dolphins. Fieldwork also included classroom based and hands-on training in cetacean survey methodology for Senegalese, Gambian, Mauritanian, Cameroonian and Nigerian colleagues, as well as collaboration and awareness-raising with managers and staff from the Delta Saloum National Park and five of the Marine Protected Areas in the Delta.

Introduction and Background

The Atlantic humpback dolphin (*Sousa teuszii* or AHD) has been a species of concern to the International Whaling Commission's Scientific Committee for many years. Current estimates suggest that fewer than 3000 AHD remain. The species occurs exclusively in shallow western African coastal waters between Western Sahara and Angola, a linear range of over 7000 km, although their distribution is likely to be fragmented (Collins, 2015; Collins et al., 2017). The species is listed as Critically Endangered on the IUCN Red List of Threatened Species (Collins et al., 2017), and is poorly studied in most countries where it is known to occur. Major threats to the species include fisheries bycatch, direct hunting, habitat loss and habitat degradation. These threats collectively present a severe risk of local extirpation for the populations that have been documented (Weir et al., 2021).

During the 2002 IWC SC meeting, the small cetacean subcommittee focused on the genus *Sousa* and identified *S. teuszii* as the species that was least studied, but potentially facing the most severe threats. Multiple recommendations were made to enhance regional and international collaboration, to create or improve the management of protected areas (including transboundary areas) and to improve capacity building, awareness and data collection efforts (IWC, 2003). These recommendations were reiterated in subsequent meetings, including the 2010 meeting that focused on West African cetaceans, the 2016 meeting that reviewed progress on recommendations made for the genus *Sousa*, and the 2019 meeting that focused on West African small cetaceans.

The IWC has not been alone in raising the alarm and making strong recommendations for AHD. In 2017, the Convention on Migratory Species (CMS) adopted a Concerted Action for Atlantic Humpback Dolphins (CMS, 2017), which was extended in 2020. In December 2018, an Integrated Conservation Planning for Cetaceans (ICPC) workshop was held in Nuremberg, Germany and AHD were identified as one of five small cetacean species most likely to become extinct without urgent conservation interventions (Taylor et al., 2020). These collective concerns led to a meeting at the December 2019 World Marine Mammal Conference, during which priority actions for the species were discussed. These discussions formed the basis of a paper presented to the IWC SC in 2020, titled 'Reinvigorating conservation efforts for the Atlantic humpback dolphin (*Sousa teuszii*): A brief progress report' (Weir et al., 2020 - IWC/SC/68B/SM07). This paper listed a number of short and medium-term priorities for AHD research and conservation. Among these priority targets was 'Target 2.1: Conduct an abundance-distribution survey of the Senegal-Gambia population' (Weir and Collins, 2020).

The population of AHD in the Saloum Delta, Senegal, has been identified by previous studies as a potentially healthy population that uses both the Senegalese and Gambian waters of the Saloum Delta and Gambia River (e.g. Van Waerebeek et al., 2004; Weir and Collins, 2015). A systematic boat-based survey of the Senegalese waters of the Delta in October-November 2015 documented 30 AHD sightings during three weeks of effort, with group sizes ranging from 1-29 individuals (Weir, 2016). During that study, 103 unique dolphins were identified through photographs of their dorsal fins. This minimum abundance estimate for the Saloum survey area represents the largest recorded population size estimate achieved through scientific methods for the species throughout its range, although the Saloum Delta is one of only five areas known or suspected to host significant concentrations of the species (Weir and Collins, 2015). Additionally, between 2018 and 2021, three dead *Sousa teuszii* were documented and sampled for genetics, and nine incidental sightings of live dolphins throughout Delta Saloum were also recorded (African Aquatic Conservation Fund,

unpublished data). Because of the population's size and status as a potential 'reservoir population', ongoing monitoring of its status and threats is of potential importance for the species as a whole.

For these reasons, seeking support to conduct systematic boat-based surveys in the Saloum Delta was a high priority for fund-raising for the Consortium for the Conservation of the Atlantic Dolphin (CCAHD) and the African Aquatic Conservation Fund (AACF). This paper describes the preliminary results of surveys conducted in July 2021 and March-April 2022. These surveys had five main objectives:

1. Collect baseline data essential for mapping dolphin distribution, relative abundance, habitat parameters, and habitat use, in order to detect any potential (seasonal) changes since the work conducted by Weir in October – November 2015.
2. Continue the photo-identification work initiated by Weir (2016), establish a Saloum Delta photo-identification catalogue and protocol, and begin work towards a mark-recapture abundance estimate and population trend.
3. Begin the process of testing additional methodologies that are relevant for expanding the effectiveness of research and conservation, with a focus on acoustic monitoring.
4. Host awareness-raising workshops with relevant management and community stakeholders to improve awareness of conservation concerns for AHD and other threatened estuarine taxa.
5. Develop local and regional capacity for cetacean research and conservation by providing training to relevant partners, including members of the AACF team, scientists from other AHD range countries, and government stakeholders.

Methods

Study area

The study area is a hypersaline 'inverse estuary' comprised of tidally influenced mangrove channels that increase in salinity with distance from the ocean (e.g. Ecoutin et al., 2010; Gning et al., 2010; Dieng et al., 2017; Descroix et al., 2020). Our study was designed to repeat as many of the survey tracks completed by Weir (2016) as possible, in order to provide similarly systematic and even coverage of the survey area and to provide a basis for comparison of distribution and encounter rates between the current and previous surveys. This also maximised the chances of encountering some of the same individual dolphins that were photo-identified in 2015. As such, boat surveys were conducted in the delta's three main channels, the Saloum 'River' to the North, the Diombos Channel in the middle, and the Bandiala Channel in the South, as well as the nearshore coastal waters of the delta and the intricate network of smaller mangrove channels around and between the three main channels (Fig 1). Coastal transects replicated the sawtooth design used by Weir in 2015 while navigation of inshore water ways was dictated by the presence of islands and tidally exposed sandbars that had to be avoided by relying on local boat drivers' knowledge and expertise.

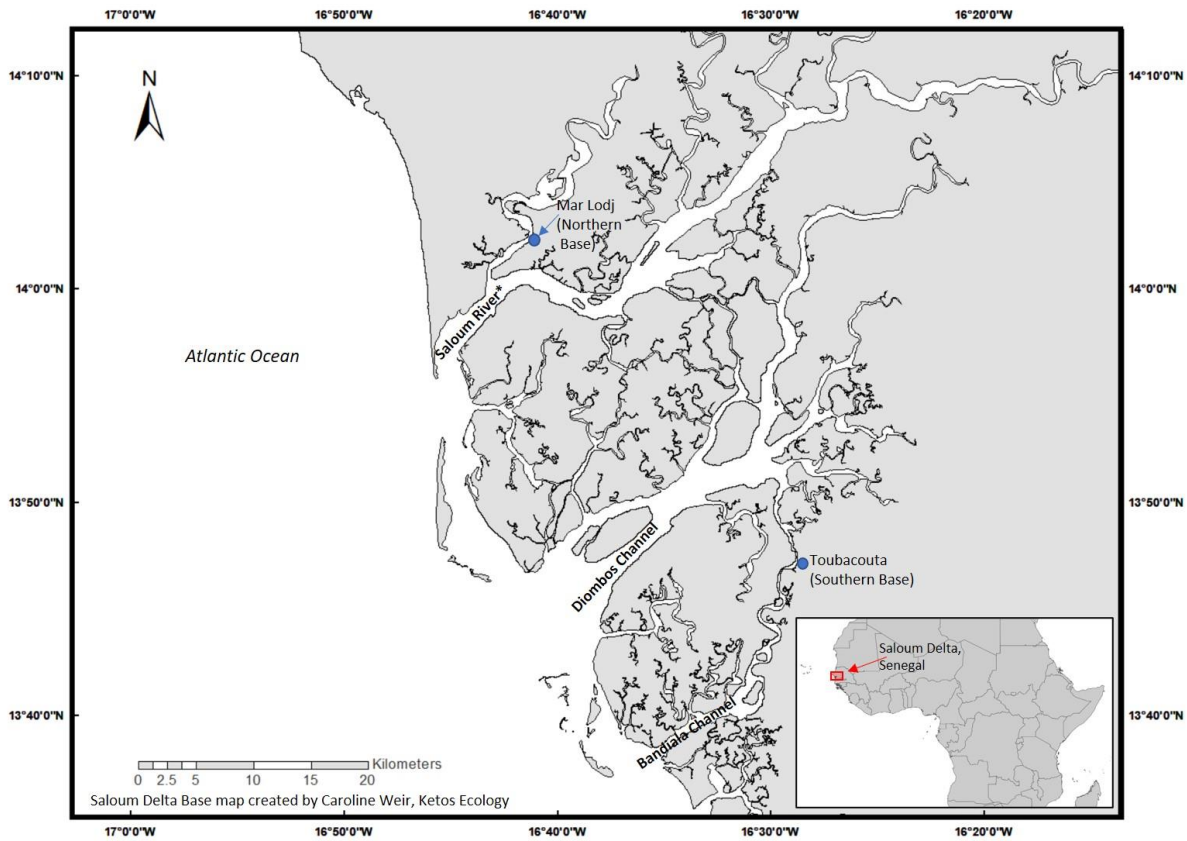

Figure 1: Saloum Delta survey area, denoting the three main channels and the northern and southern sites from which surveys were based. Note that while the Saloum River is called a river ('*fleuve'*) by local inhabitants, it is not a true river with consistent freshwater inputs.

Search effort

Surveys were conducted from two different types of vessels: an 8m long wooden pirogue with a 15hp (and later 40hp) tiller-steered outboard engine when working form the southern base of Toubacouta, and a 9m long fiberglass-hulled skiff powered by a 75 or 100hp engine when working from the northern base in Mar Lodj (Fig. 1). In both cases, observers attempted to sit or stand so that their eye-eight would be a minimum of 2m above the water line. Search effort was systematically recorded throughout each survey day, with observers considered 'on effort' when the vessel was traveling at 11-15 km/hr (with a target of 12 km/hr) and a minimum of two observers actively scanning an arc of 180 degrees directly in front of and to either side of the vessel. Observers were considered 'off effort' when traveling at faster speeds to and from start or end-points of survey tracks, when following dolphin groups, or when taking breaks for refuelling/meals/water sampling. In order to assess the possible impacts of environmental conditions on detectability of dolphin groups, sea state, swell and visibility were recorded at regular intervals throughout the day and whenever they changed during survey effort. Track and waypoint data were collected using a Garmin 78 SC Handheld GPS unit and downloaded using Garmin Basecamp® software at the end of each day.

Water parameters

Depth and water surface temperature were measured using a hand-held Hawkeye ® depth sounder, which was deployed during every dolphin sighting as well as at 5km intervals during all search effort. Salinity of surface water was also measured at the same locations using a hand-held refractometer. Turbidity was measured using a Secchi disk during the first few days of both the 2021 and 2022 surveys, but was abandoned due to strong tidal currents that pulled the disc horizontally in the water making it difficult to obtain accurate readings.

Dolphin sightings and photo-identification

All AHD sightings were documented, including information about GPS location, group size and composition, behaviour (using categories adapted from those defined by Parra et al. 2005), and human activity within an estimated 100m radius of the dolphins during the observation.

Upon sighting a dolphin group, the vessel went 'off effort' and attempted to approach the group slowly without disturbing the animals' natural behaviour in order to obtain as many photographs suitable for the identification of individuals as possible (e.g. Wursig and Jefferson, 1990). The main camera used for photo-identification was a Canon EOS7D Mark II with a 100-400mm image-stabilising zoom lens (in 2022 two of these cameras were used on some days). A second Canon EOSD30 with a 100-300mm lens was used to obtain additional images and to provide photographing experience for trainees.

Encounter rates were calculated as the number of encounters documented during optimal survey effort divided by the number of kms navigated while on effort. Following Weir (2016), a second encounter rate was calculated by dividing the best estimate of the total number of individuals encountered on effort by the kms searched on effort.

Passive Acoustic Monitoring

'LF-PODs' provided by Chelonia Ltd. were deployed in three different sites over the course of the study in channels thought to be used regularly by AHD based on previous documented sightings. F-PODs are fully automated, static, passive acoustic monitoring systems that detect porpoises, dolphins and other toothed whales by applying an automated detection method to identify putative trains of echo-location clicks (Chelonia Ltd. User Guide, 2020). F-PODs sample at 1 million samples per second and select clicks in the frequency range 20 – 200kHz for storage in real time. The stored data on each click is a 16 byte record of time-domain features at a resolution of 250ns. No continuously sampled audio stream is retained. During post-processing on a PC, click trains from cetaceans and other train sources are identified by the KERNO-F classifier. The positively buoyant LF-POD was floated approximately 1 m off the bottom at depths of roughly 5m (during high tide).

A SoundTrap ST500-STD manufactured by Ocean Instruments Ltd. was deployed in two of the same locations where F-PODs were deployed. The SoundTrap was programmed to record at a sample rate 144kHz, recording a 16bit continuous audio file stream, with a frequency response of 20-60,000Hz +/- 3 dB and a gradual roll off of response between 60 kHz and 72 kHz (the frequency band maximum). The SoundTrap was placed on a static bottom mount without an associated buoy, with the hydrophone approximately 1 m off the bottom at a depth of approximately 5 m (next to an LF-POD).

Fisheries observations

GPS locations were recorded for all active fishing gear observed during survey effort. The survey team relied on the vessel captains (both local inhabitants who also work part time as fishermen) and/or accompanying marine protected area staff (see details below on the MPAs and parks that were involved) to help identify and categorise the types of gear observed and species targeted by the gear.

Results

Survey effort and encounters

In July 2021, a total of 1,044 kms were navigated over 12 days, with 776 kms, and 70 hours recorded on optimal search effort. A total of 14 dolphin sightings were recorded, of which ten were made in the last two days of the survey in the northern portion of the delta, and only five were made over 10 days of survey effort in the southern area (Fig 2). The on-effort encounter rate for the survey overall was 0.0167 encounters/km, or 0.13 individual dolphins per km of effort with stark differences between encounter rates in the North and South (Table 1). Weather conditions and vessel safety issues prevented the team from completing the majority of the coastal saw-toothed transects that were planned. Furthermore, the survey was cut short due to rising COVID numbers in Senegal and safety concerns for the team.

Table 1: Survey effort and *Sousa teuszii* encounter rates for the 2021 and 2022 Delta Saloum surveys. *Note that the 28-29 July 2021 sightings most likely include re-sights of the same groups – to be confirmed through analysis of photo-identification data.

Dates	**Survey base (North/South)**	**Total hours on boat**	**Hours on effort**	**Total kms navigated**	**Kms on effort**	**Number of on-effort Sousa teuszii sightings**	**Encounter rate (number of on-effort sightings/kms searched on effort)**
9-18 July 2021	South	84:39:00	55:54:00	897.9	657.74	3	0.0076
28-29 July 2021	North	16:53:00	14:05:00	146.7	118.5	10*	0.0844
2021 total		101:32:00	69:59:00	1044.6	776.2	13	0.0167
19-29 March 2022	North	96:55:00	48:15:00	1061.5	546.63	15	0.0274
2-5 April 2022	South	31:59:22	19:48:52	368.3	220.14	1	0.0045
2022 total		128:54:22	68:03:52	1429.8	766.8	16	0.0209

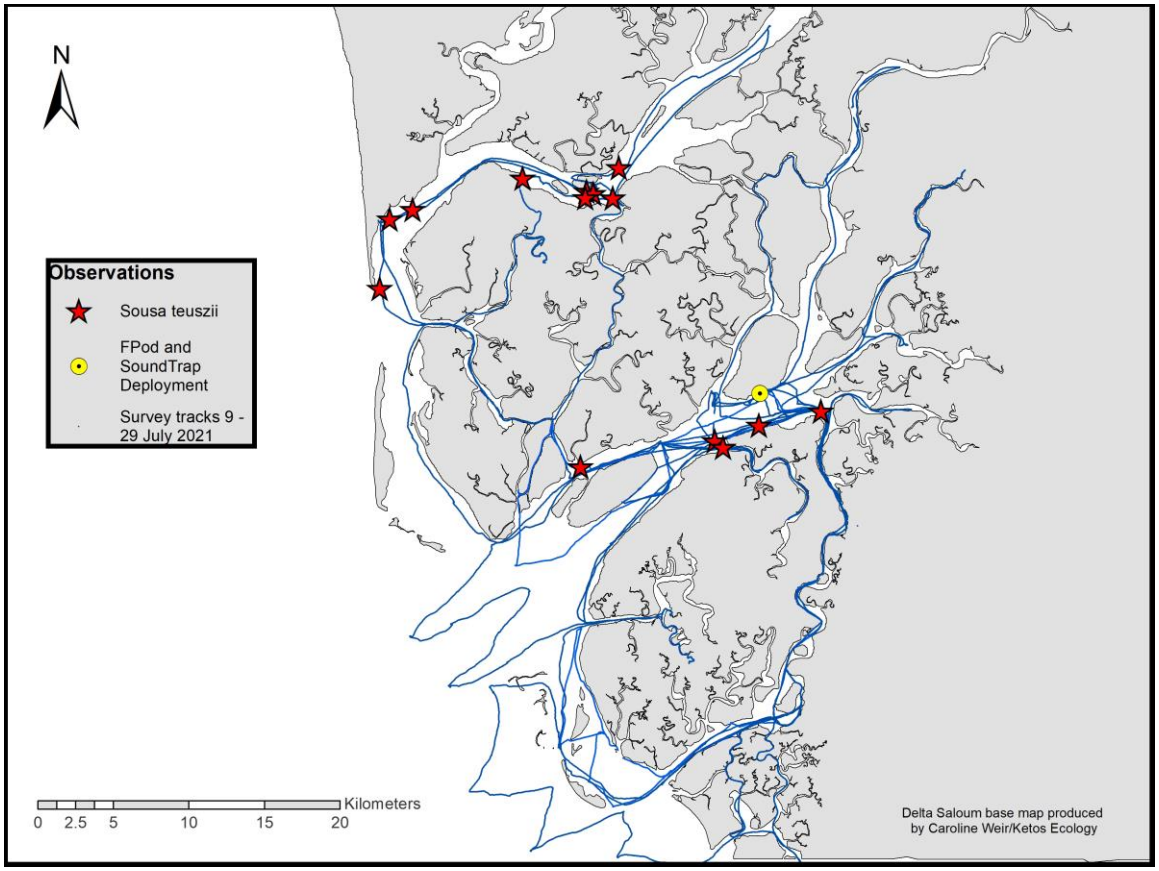

Fig 2: Survey tracks, sightings, and location of F-POD and SoundTrap deployments from the boat-based survey conducted over 12 days between July 9th and 29th, 2021. Note that survey tracks represent both on- and off-effort tracks. Further analysis is planned to calculate relative densities in relation to search effort.

Between March 19th and April 6th, 2022, 1,430 kms were navigated over 16 days, of which 766 kms and 68 hours represented optimal survey effort. A total of 22 dolphin sightings were recorded, of which 20 were made in the first 12 days of survey effort in the Northern portion of the Delta and only two were made while the team was based in the South (Fig 3). The on-effort encounter rate for the survey overall was 0.021 encounters/km, or 0.29 individual dolphins per km of effort. The reason for the lower proportion of survey effort in 2022 was predominantly the higher sighting rate, which resulted in more time being spent following and photographing dolphin groups, as well as a more powerful boat engine, which allowed the team to speed to and from transect start and end points, thus covering more ground. While a small 'weather window' allowed the team to conduct coastal saw-toothed transects in the North, strong winds during most of the survey prevented completion of these planned transects in the southern portion.

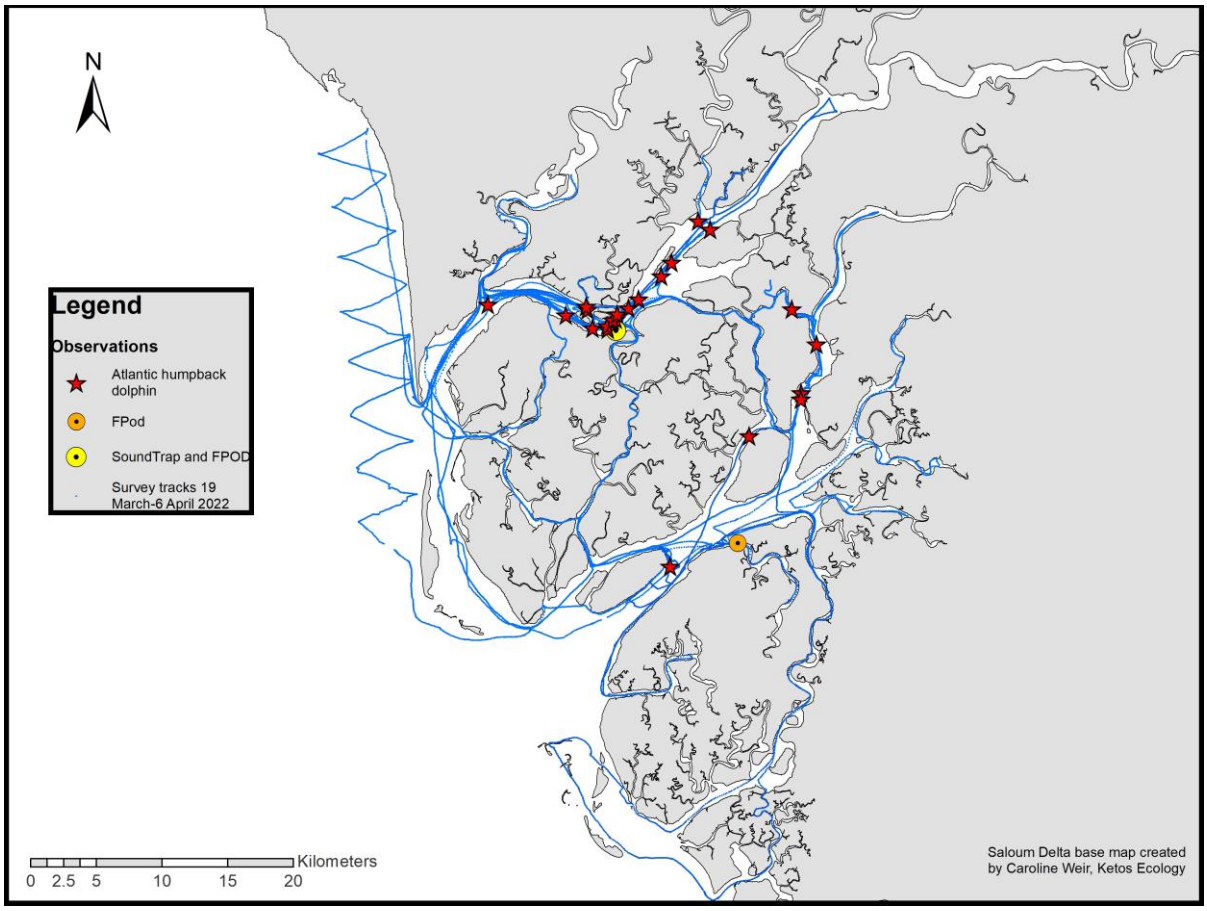

Figure 3: Survey effort, sightings, and location of F-POD and SoundTrap deployment from the boat-based survey conducted over 16 days between March 19th and April 6th, 2022. Note that survey tracks represent both on- and off-effort tracks. Further analysis is planned to calculate relative densities in relation to search effort.

Group size, composition and behaviour

Best estimates of AHD group sizes over both years of survey (n=35 as for one distant sighting group size could not be estimated) ranged from 1-30 with a mean estimated group size of 9 individuals. Sixty percent of all sightings (n=21) were of mixed age classes with groups containing at least one juvenile or calf. Twenty-three percent (n=8) of groups appeared to only contain adults. Two encounters (5%), involved lone individuals, and five sightings (14%) were too brief to be able to confirm group composition.

When assigning behaviour categories to sightings, feeding or probable feeding was judged to be the most prominent activity during 40% of all sightings (n=14). Definite feeding was assigned to sightings only when dolphins were seen actively chasing fish or diving in among fish leaping at the surface. Traveling was the second most common behaviour observed during 29% of encounters, although traveling and feeding often seemed to be combined, with dolphin groups slowly and steadily moving in a constant direction, but frequently pausing to circle and dive in among fish or appear to herd fish up against mangrove stands or sand banks, before carrying on in the same direction.

Behaviour categories could not be assigned to 31% of encounters (n=11) because the encounters were too brief, too distant, or animals were very dispersed and difficult to follow and assess. While never assigned

as the primary activity of the majority of the group when first encountered, socialising was also observed as a secondary activity between subgroups during the course of encounters, with body rubbing and surface active displays (Fig 4).

Figure 4: Dolphins engaged in social contact and aerial behaviour.

Photo-identification

Over 3000 photos were taken in 2021, over 10,000 were taken in 2022. Photo-identification analysis of 2021 photographs is nearing completion, but still requires matching between encountered groups. Analysis of 2022 photographs has not yet begun, but Figure 5 shows a selection of dorsal fin photos that will contribute to the catalogue of identified individuals for use in mark-recapture analysis to estimate abundance and monitoring of individual movements over time. Initial perusal of photos has revealed at least two re-sights of individuals that were photographed in both 2021 and 2022.

The authors are collaborating with other scientists who will be leading future AHD fieldwork in Guinea to develop a simple photo-identification cataloguing system for other AHD research projects that will not require users to be online and only use commonly/freely available software, but will also allow imports to Flukebook.org as and when users have access to strong enough internet connections and want to make use of computer assisted matching.

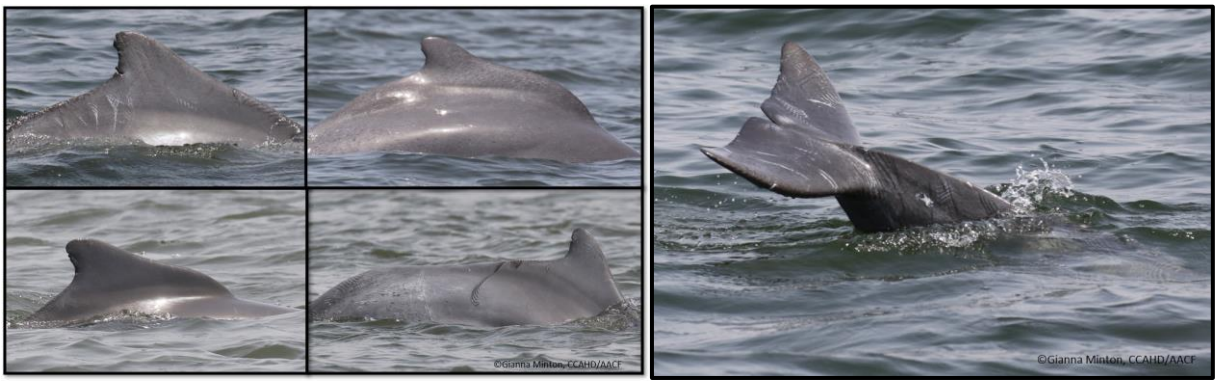

Figure 5: Examples of dorsal fin photographs taken in 2022, that will contribute to the Saloum Delta photo ID catalogue of recognisable individuals (left) and an example of the heavy rates of tooth-rake scarring observed on many individuals (right).

Habitat parameters

Pooling all sightings with habitat data (n=35), depth at sighting locations ranged from a minimum of 2.4 m to a maximum of 15 m, with a mean of 9 m. Surface water temperature ranged from a minimum of 25º C to 33º C, with a mean of 29º C. Salinity readings taken at sighting locations ranged from a minimum of 34 ppt to a maximum of 42 ppt with a mean of 38 ppt.

The sighting that occurred furthest 'inland' was 26km distant in a straight-line from the nearest access to the ocean (and at least 30km following the course of the Saloum River). The group seen at this location was continued swimming further upstream when the encounter ended. The majority of sightings were made in the two widest channels - the Saloum River and the Diombos Channel - with only one single sighting made in one of the smaller mangrove channels connecting the two. More detailed analysis of relative abundance in relation to water parameters, distance from shorelines, and tidal state are planned.

Passive Acoustic monitoring

An LF-POD and a SoundTrap were deployed in the Diombos Channel on July 10, 2021 (Fig. 2), and recovered on December 4, 2021. Data from both of these units have been successfully retrieved and are currently being assessed for the presence of dolphin vocalizations. Initial review of results is encouraging, indicating that dolphins appear to have been successfully recorded by each device. The LF-POD operated for 62 days between 10 July and 10 September, 2021, during which time it logged 56 million clicks of which 32,243 clicks were subsequently identified, during automated post-processing, as being in click trains resembling dolphin trains. These occurred in 364 minutes on 32 days, giving an average of 11.4 min/day on days with detections. Detected clicks were in the frequency range 20 to 140 kHz with incidence peaks at 61kHz and 112kHz. The diel pattern of activity showed a distinct nocturnal pattern to these detections.

The SoundTrap operated during the same period as the LF-POD, however due to problems with the mount during the deployment, its expected recording period was substantially reduced. Review of the 144 kHz sound files (16 bit wav format) indicated that there is useful data from 10 July until at least 10 August. Although the SoundTrap frequency response did not cover the entire frequency range of dolphin clicks, review of data indicated the presence of what appeared to be echolocation click trains as well as short duration "burst pulses", or buzzes, and tonal whistles, starting on the evening of 10 July when the recorder

was deployed. An initial review of the SoundTrap data on a random subset of LF-POD detection events between 10-16 July indicated that the SoundTrap recorded click trains during the same minutes indicated by the LF-POD, as well as during minutes and some days that the LF-POD did not record events. Click trains were observed in the SoundTrap recordings on every evening from 10 to 20 July in a first preliminary assessment of daily presence, during which period the LF-POD reported detections on only 6 of those 11 days. These positive initial results indicate that the SoundTrap data will be useful for comparison to the LF-POD data, and together with visual observations of dolphin presence during recording, will allow evaluation of the efficacy of each instrument and development of a cost-effective monitoring method. The SoundTrap data will also be useful for describing the spectral characteristics of dolphin tonal vocalizations, which has not yet been attempted.

With validation of the LF-POD results, detailed frequency information in the complete high frequency spectrum can be used to describe the spectral characteristics of AHD echolocation, as well as for discrimination between AHD and *Tursiops* once local data can be collected on the presence of species during recording. It is important to consider that currently we do not have confirmed observations of dolphins during recorded acoustic events, so species confirmation is lacking; however, due to the observation of only *Sousa teuszii* during surveys, it is strongly suspected that any recorded vocalizations that can be confidently attributed to a delphinid are from this species.

An LF-POD and SoundTrap ST500-STD were deployed in the Saloum River on March 26, 2022 (Fig. 3). These are expected to be retrieved in June or July 2022 at which time batteries and SD cards may be replaced and the units redeployed in the same location to increase recording times. A second LF-POD was also deployed in the main Diombos Channel on April 2, 2022, and will be retrieved and re-deployed in June 2022. A SoundTrap ST600-HF, with a broader frequency response range of 20 Hz - 150 kHz ± 3dB (maximum sample rate of 384kHz) was purchased by the project, but delays due to COVID-related supply chain interruption and then customs clearance prevented deployment in April/March 2022; ideally, it will be deployed during June or July in the vicinity of the second LF-POD. All recording equipment was deployed in locations where dolphins have been sighted on multiple previous occasions by these surveys as well as incidentally by AACF and protected area staff (see notes below no which MPAs and parks have been involved).

Fisheries observations and other human activity

A total of 116 fisheries observations were recorded during active search effort. Traps reported to be targeting cuttle fish (‘calamar’) and shrimps (‘crevettes’) were the gear most frequently observed in the inland waters of the delta. Calamar traps were marked by buoys or floats at the surface, while shrimp ‘traps’ were supported by wooden beams and floats with heavy small mesh black net held between parallel wooden crossbars apparently used to trap shrimp with the ebb and flow of the tides. Dolphins were frequently observed swimming near these traps and were suspected to be feeding around them.

Wooden pirogues carrying large quantities of monofilament gillnets were frequently observed throughout the survey area. While some observations of unattended nets or vessels setting or hauling nets were made in inland waters (Fig 7), most vessels appeared to be heading to coastal waters outside the delta. Nets were set so densely in the offshore area surveyed in March 2022, that it was almost impossible to complete the planned transects due to the frequent deviations required to avoid them.

Figure 6: dolphin swimming among shrimp 'traps'. Although referred to locally as traps (*pieges*), Each wooden crossbar supports a configuration of wooden struts and heavy small-meshed black synthetic net used to trap prawns on the rising and falling tides. These traps were prevalent in the main Saloum River and dolphins were frequently observed in close proximity to them.

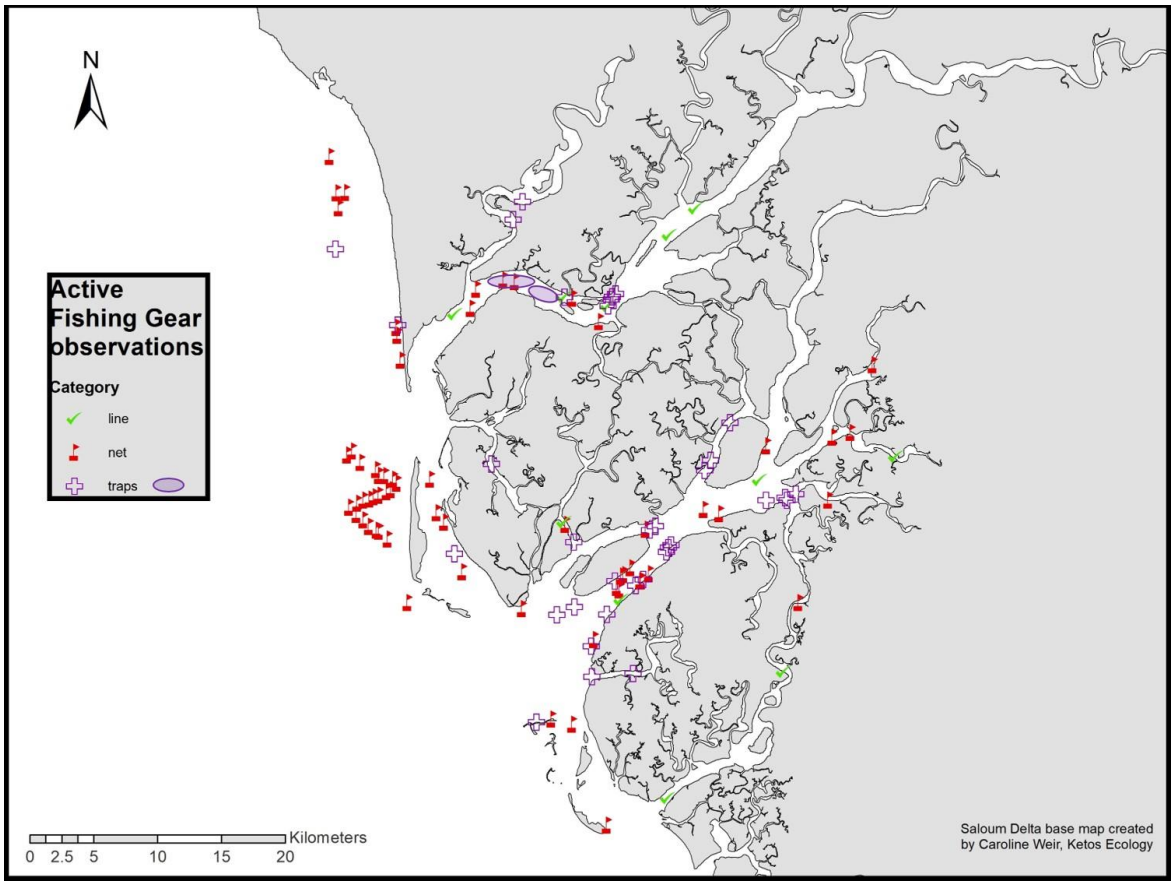

Figure 7: Map depicting the distribution of different categories of active fishing gear observed during active search effort.

Capacity building and awareness raising

A young Senegalese scientist working as a research assistant with the AACF (DS) participated in every day of boat-based survey effort in 2021 and 2022 and was responsible for data download, entry and initial post-survey processing. A scientist from The Gambia (YSM) joined five days of boat surveys in 2021, and colleagues from Mauritania (CS), Cameroon (ATK) and Nigeria (EE) each participated in at least five days of survey effort in 2022. All of these scientists received 'classroom' based training on cetacean survey methodology, as well as hands-on practice with data collection, photo-identification, and data download and entry. A detailed survey protocol with hyperlinks to data sheet templates, free software needed to download and manipulate data, and cetacean ID cards and factsheets was provided to each participant. In addition, managers and staff from five Marine Protected Areas within the Delta (Joal, Palmarin, Sangomar, Gandioul, Bamboung), as well as the Saloum Delta National Park participated in boat surveys and day-long workshops designed to raise awareness about AHD and the need to protect them.

Discussion

The preliminary results of these two surveys confirm that the AHD population using the Senegalese portion of the Sine-Saloum Delta is still present and apparently healthy. The frequent encounters in the northern portion of the Delta with a concentration in the main Saloum River are encouraging. However, further analysis of relative abundance and collection and analysis of photo-identification data is required to determine whether the population abundance remains within the same range as the minimum estimate of 103 individuals that were identified by Weir in 2015 (Weir, 2016).

Preliminary comparison with 2015 survey results

Our surveys indicate a shift in relative densities from the Diombos Channel where Weir documented the highest density of sightings in October-November 2015 (Weir 2016 – Fig 8) to the Saloum River, where densities were highest during both the July 2021 and March-April 2022 surveys. Further analyses and repeated surveys are required to determine whether this shift is driven by regular annual seasonal factors, or longer term changes in environmental conditions or human activity in the six years between the surveys. Overall on-effort encounter rates from the 2021 survey (0.016 sightings/km) and the 2022 survey (0.021 sightings per km), were similar to the 0.018 sighting/km encounter rate reported by Weir (2016). The 2021 and 2022 individual encounter rates of 0.13 individuals/km and 0.29 individuals/km respectively were also in the same general range as Weir's 2015 individual encounter rate of 0.175 individuals/km.

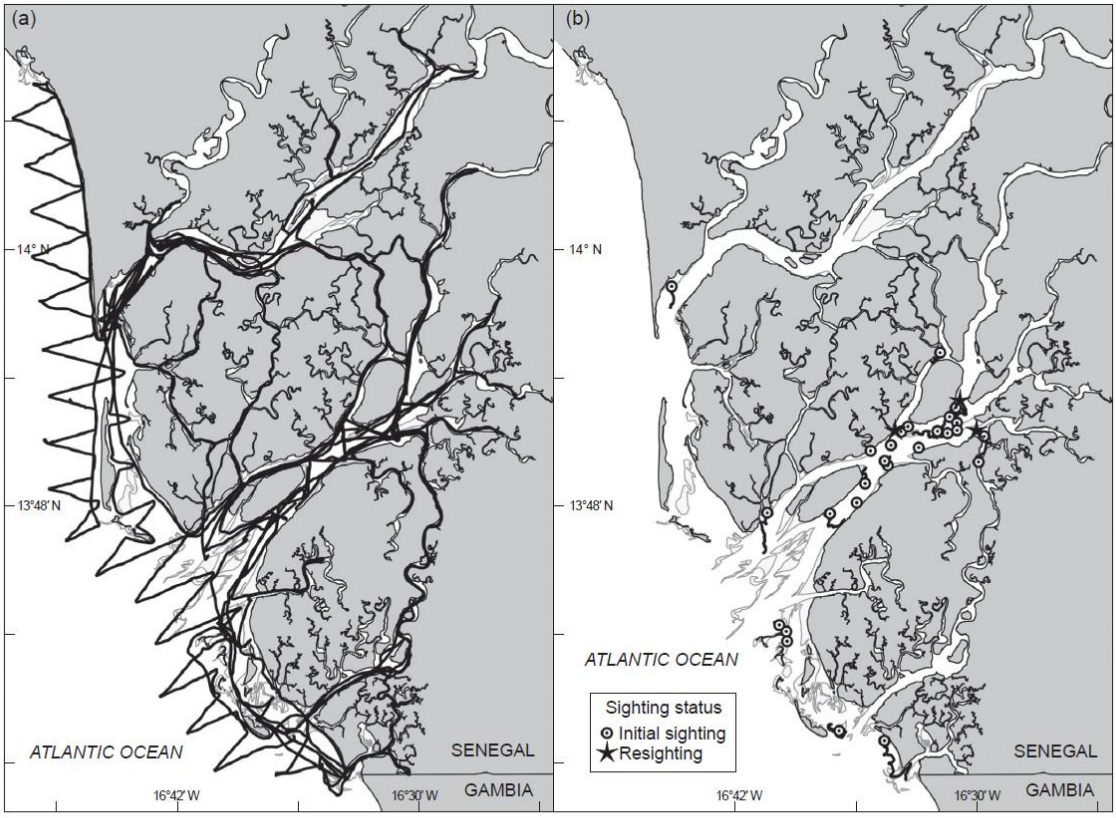

Figure 2: Location in the Saloum Delta study area of: (a) search effort (thick black line); and (b) the initial locations of 30 *Sousa teuszii* sightings/resightings and subsequent encounter effort (thick black lines associated with certain sightings)

Figure 8: Figure reproduced from Weir et al. 2016, illustrating the survey effort and sightings recorded during surveys conducted in October-November 2015. Note the concentration of sightings in the Diombos Channel and southern coastal area, in contrast to the 2021 and 2022 surveys' concentration of sightings in the Saloum River to the north. Repeated surveys and analysis are required to determine whether this is likely due to annual seasonal shifts, or longer term changes to the environment.

Follow-up and recommendations

Funding has been secured for a third survey, which is planned to take place in November-December 2022, and which will again attempt to cover the same survey area and use the same methods, in order to provide a basis for comparison of relative densities in relation to season/time of year, as well as improve the data available for a population abundance estimate. Passive acoustic devices will also be retrieved and re-deployed during this survey.

Analysis of data already retrieved from the F-POD and Sound Trap that were deployed in 2021 is ongoing, as is analysis of photographs for individual identification, and finer-scale analysis of relative abundance in relation to habitat parameters including depth, temperature, salinity, distance to shore, and tidal state. Future detailed analysis of photographs obtained during both surveys will also include examination of any visible signs of pathology and human-induced injury/scarring.

It is anticipated that three or more manuscripts dealing with different aspects of the survey methodology (e.g. acoustics, relative density in relation to habitat parameters and the results of photo-identification

analyses) will be submitted to peer-reviewed journals once the second 2022 survey has been completed and data from all three surveys and multiple acoustic deployments can be analysed in full.

The protocols and training resources developed for these Saloum surveys will serve as the basis for similar surveys planned to commence in Guinea in May/June 2022, and can be shared with other *S. teuszii* range country scientists planning to conduct similar surveys.

The authors recommend ongoing monitoring of this important population beyond the next planned survey in December 2022. Future surveys could be adapted to target identified 'hotspots' and focus on photo-identification with the aim of generating reliable abundance, trend and survival estimates for the population and monitoring population health. The combination of data from the LF-POD, SoundTrap, and visual observations should be used to describe the vocalizations and confirm the presence of AHD, and discriminate it from other dolphin species in an automated approach; thereby the use of solely F-PODs (which may likely be the most cost-effective method) may be confidently applied for acoustic monitoring of AHD throughout the species' range. Furthermore, the authors recommend ongoing collaboration with local communities and protected area staff to continue raising awareness and ensure that survey results are shared with relevant stakeholders for use in conservation planning. Finally, it is of the utmost importance that Senegalese and, where possible also other AHD range country scientists, should continue to be involved in fieldwork, analysis, and publication of results.

Acknowledgements

The authors would like to thank the Loro Parque Foundation for the funding provided for the surveys in 2021 and 2022. Furthermore, they would like to thank Caroline Weir for making the shape file of the Delta Saloum base map available for use in GIS analysis, as well as sharing her survey tracks, knowledge and experience from the 2015 survey to optimise effectiveness of the 2021 and 2022 surveys. They would also like to thank Tim Collins for his essential contributions to the survey funding proposal and assisting with survey design. And they would like to thank Danielle Cholewiak and NOAA Fisheries for support with the acoustic data collection. Permissions for conducting research were provided by Senegal's Direction of Marine Protected Areas, Delta Saloum National Park, and Senegal's Ministry of Water and Forestry. We would also like to thank boat drivers Lamine Sarr and Demba Dia for their important contributions to our work, and all of the protected area and national park staff who joined our boat surveys.

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