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Research Article

New sightings records of marine mammals and seabirds off French Guiana

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ABSTRACT. French Guiana region is one of the most productive in the world and hosts a wide variety of marine vertebrates. In the same time, anthropogenic activities are a growing concern in French Guiana, both in coastal and offshore areas. However, few studies are published on marine mammals, seabirds and potential interactions. Twenty-three marine mammal species are known to occur in the Exclusive Economic Zone (EEZ) and important seabird breeding sites are located in the area. Most of the existing literature relates to breeding birds and coastal cetaceans, but the continental slope appears to be an essential habitat for marine mammals and seabirds. Between October 22 and November 23, 2017, an oceanographic survey was conducted on the Guiana slope to study the quality of sediments and water. Three marine fauna observers (MFOs) were onboard to record sightings of marine mammals and seabirds opportunistically. During 462 h of visual effort in good sighting conditions, 313 sightings (824 individuals) were recorded: 61 marine mammals (501 individuals) and 252 seabirds (323 individuals). Seven seabird families were observed: Laridae (42%), Fregatidae (26%), Procellariidae (12%), Stercorariidae (10%), Hydrobatidae (4%), Sulidae (2%) and Phaethontidae (1%). 3% concerned wader species. The most frequently observed seabird species was the magnificent frigatebird (*Fregata magnificens*), as well as the common tern (*Sterna hirundo*), Cory's shearwater (*Calonectris diomedea*) and the pomarine jaeger (*Stercorarius pomarinus*). Many Delphinidae species were observed (*Stenella longirostris*, *Stenella attenuata*, *Stenella frontalis*, *Delphinus delphis*, *Tursiops truncatus)* in addition to sperm whales *(Physeter macrocephalus*) and humpback whales *(Megaptera novaeangliae).* Only a few sightings of humpback whales have been previously recorded in this area. Sighted individuals were mainly mother-calf pairs suggesting that the area may be an extended part of a calving ground for humpback whales.

Keywords: cetaceans; seabirds; humpback whales; distribution; opportunistic data; French Guiana

INTRODUCTION

Marine bodiversity in French Guiana is strongly influenced by the Approuage, Oyapock and Maroni rivers, as well as the Amazon River plume which constitutes a structuring factor for the ecosystems (Artigas *et al.*, 2003) French Guiana, is located on the northeast coast of South America with Suriname to the north and Brazil to the south. The convergence of the Malvinas and Brazil currents within this portion of the Atlantic Ocean make this region one of the most productive in the world; it hosts over 600 vertebrate species including seabirds, marine mammals and sea turtles (Miloslavich *et al.*, 2011). Despite limited studies, the Guiana marine mammal and seabird community appears to be diverse and abundant. For example, cetacean encounter rates are three times higher in Guiana than in French Antilles (Mannocci *et al.*, 2013).

Anthropogenic activities are increasing in the French Guiana EEZ (fisheries, shipping and oil & gas prospection) and raise a concern about potential impacts on marine biodiversity. Marine fauna species are vulnerable to human-related pressures as incidental

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bycatch, habitat degradation or pollution, acoustic disturbance and vessel strike (Van Waerebeek, 1990; Tyack, 2008; MacCauley *et al*., 2015). For a better understanding of anthropogenic impacts, and efficient avoidance or mitigation measures, there is a growing need to increase knowledge and identify sensitive areas for marine biodiversity in French Guiana (AAMP, 2009).

Based on the few published studies, 23 marine mammal species have been identified in these waters, 18 of which with certainty (UICN, 2017). These conclusions come from scientific aerial surveys, local monitoring by non-for-profit organizations, and sightings made by marine mammal observers during seismic surveys and environmental baseline studies (De Boer, 2013; Mannocci *et al*., 2013; UICN, 2017). Marine mammal species sighted in French Guiana include 14 Odontoceti, 3 Mysticeti, and one sirenian (De Boer, 2013; Mannocci *et al*., 2013; UICN, 2017) (Table 1).

Grand Connétable Island, located in the east border of French Guiana, is an important seabird breeding site for hosting colonies during the breeding season (between April and September). Several thousand pairs of royal terns (*Sterna maxima* Boddaert, 1783), 20,000 pairs of sandwich terns (*Sterna sandvicensis* Latham, 1787), 10,000 pairs of least terns *(Sternula antillarum* Lesson, 1847) and several hundreds of pairs of sooty terns (*Onychoprion fuscatus* Linnaeus, 1766) breed each year on this Island (BirdLife International, 2018a).

Around 2,000 pairs of magnificent frigatebirds (*Fregata magnificens* Mathews, 1914) nested there year-round (BirdLife International, 2018a; Weimerskirch *et al*., 2006). The Amana Natural Reserve, located in the west border of French Guiana, is also a breeding site for least terns (around 3,000 pairs) and sandwich terns (around 5,000 pairs) (BirdLife International, 2018b).

Most of the published data on marine mammals off French Guiana have focused on coastal species (De Thoisy *et al*., 2003; Flores & Da Silva, 2009) and the knowledge on the offshore area is restricted to the gray literature. While most of the existing literature on seabirds relates to breeding birds (Weimerskirch *et al*., 2003, 2006; Martinet & Blanchard, 2009; Sebastiano *et al*., 2017), there have been few studies on individuals at sea (Mannocci *et al*., 2013). Some recordings come from observations during seismic surveys in Guiana and adjacent waters, but few data are published (De Boer *et al*., 2014; Willems *et al*., 2017).

The French Guiana Exclusive Economic Zone (EEZ, 4-9°N, 49-54°W) covers 132,000 km² and extends 200 nautical miles (nm) into the Atlantic Ocean, including a broad continental shelf, a slope and an abyssal plain. The slope seems to be an important habitat for cetaceans based on previously documented high encounter rates and species richness (Miloslavich *et al.*, 2011; Mannocci *et al*., 2013). In autumn 2017, an environmental baseline survey was conducted in the slope to collect data before an oil and gas drilling project. This survey provided some valuable mammal and seabird sightings which improve knowledge about marine biodiversity of the area. This study aims to describe the species diversity of cetaceans and seabird, opportunistically sighted during this scientific survey off French Guiana, and to discuss the ecological importance of the area.

MATERIALS AND METHODS

During October and November 2017, a scientific survey was conducted off French Guiana, mainly on the slope, to study the offshore ecosystems focusing on the quality of sediments and water as well as the benthic and planktonic communities concerning oil and gas development. The integration of biodiversity knowledge within oil and gas exploration activities is part of the approach concerning the protection of biodiversity (Chaineau *et al.*, 2010). Three marine fauna observers (MFOs) recorded opportunistic sightings data on marine mammals and seabirds during this survey.

Study region

French Guiana region is strongly influenced by the Amazon River, which causes high water turbidity and nutrient outflow and contributes to the extensive mudflats along the coast (Froidefond *et al*., 1988). Coastal ecosystems include estuaries, sandy beaches and littoral mangrove forests (Miloslavoch *et al*., 2011). The climate is typical of a wet equatorial area with a dry season from July to December, when steady southeastern trade winds are dominant and a rainy season from January to June (Artigas *et al*., 2003). The study area was around 65 nm off French Guiana within the EEZ, along with the slope, between 6°18'36"N, 52°26'42"W, and 6°25'22"S, 51°00'25"W (Fig. 1).

Surveys

The survey was conducted by Créocéan, a French company specialized in oceanographic studies, from October 22 to November 23, 2017 onboard the R/V *Proteus* as part of a global environmental baseline study concerning the Environmental Impact Assessment (EIA) process related to oil and gas exploratory drillings. The survey aimed to study the sediments and water as well as plankton and benthic community in the study area. Since the survey was not dedicated to marine mammal and seabird observations, the 49.38 m

Table 1. Main marine mammal species present in French Guiana (De Boer, 2013; Mannocci *et al.*, 2013; UICN, 2017).

Family	Comnon name	Scientific name
Odontoceti	Spinner dolphin	*Stenella longirostris (*Gray, 1828*)*
	Pantropical spotted dolphin	*Stenella attenuata* (Gray, 1846)
	Atlantic spotted dolphin	*Stenella frontalis* (Cuvier, 1829*)*
	Common dolphin	*Delphinus delphis* Linnaeus, 1758
	Rough-toothed dolphin	*Steno bredanensis* (Cuvier *in* Lesson, 1828)
	Cuvier's beaked whale	*Ziphius cavirostris* Cuvier, 1823
	Short-finned pilot whale	*Globicephala macrorhynchus (*Gray, 1846)
	Risso's dolphin	*Grampus griseus* (Cuvier, 1812)
	Common bottlenose dolphin	*Tursiops truncatus* (Montagu, 1821)
	Sperm whale	*Physeter macrocephalus* Linnaeus, 1758
	Guiana dolphin	*Sotalia guianensis* (Van Beneden, 1864)
	False killer whale	*Pseudorca crassidens* (Owen, 1846)
	Killer whale	*Orcinus orca* (Linnaeus, 1758)
	Melon-headed whale	*Peponocephala electra* (Gray, 1846)
Sirenia	West Indian manatee	*Trichechus manatus* Linnaeus, 1758
	Humpback whale	*Megaptera novaeangliae* (Borowski, 1781)
Mysticeti	Fin whale	*Balaenoptera physalus* (Linnaeus, 1758)
	Blue whale	*Balaenoptera musculus* (Linnaeus, 1758)

long vessels served as a platform for opportunistic marine megafauna observations.

The visual monitoring protocols were based on international standards (JNCC) and conducted by three experienced MFOs. Two MFOs visually scanned the water simultaneously when the vessel was underway; they scanned a 180° arc ahead of the vessel. When the vessel was stationary or maneuvering for benthic sampling, only one MFO actively scanned the water and other MFOs were in a break or entering data in the database. Shifts were organized so that each MFO observed for two hours and then had a one-hour break. Observations were conducted with the naked eye from the upper deck of the vessel or the bridge. Binoculars (7×50) and a reflex camera with a 70-300 mm lens were used to identify species. Identification was made to the lowest taxonomic level possible. The distance to the sighted cetaceans, turtles and landed seabirds was determined using the binocular's reticles or rangefinder sticks. The distance to flying seabirds was estimated with naked eyes by experienced MFOs. The bearing of the animals was determined using an angle-board. Data collected also included environmental informations such as weather, sighting conditions, vessel activity, course, speed and position. Sighting informations included species identification, time (GMT), number of indivi-duals, behavior (swimming speed, flying behavior, diving, breaching, milling, bow riding and foraging behavior) and presence of calves/juveniles. Sightings of marine mammals, seabirds, sea turtles, large pelagic fishes and anthropogenic activities were recorded. All the maps were made using QGIS 2.16 with a WGS84 projection.

RESULTS

A total of 462 h of visual effort was conducted during the survey (Fig. 2). Approximately 250 h were made when the vessel was transiting at a speed of at least 5 knots. A total of 212 h of visual effort was conducted when the vessel was stationary.

More than 80% of the observational effort was made in good weather conditions (swell <2 m, Beaufort Scale <3, and visibility >3 km). Three hundred thirty-nine sightings (869 ind) were recorded: 61 sightings of marine mammals (501 ind), 252 sightings of seabirds (323 ind), and 26 sightings of another marine mega-fauna (turtles and large pelagic fishes).

Marine mammals

Three families and seven species were identified (Table 2). Of the total 61 sightings, 26% could not be identified to the species level (one unidentified large cetacean and 15 unidentified small cetaceans).

Most of the sightings were of delphinids (27 sightings and 337 individuals) who represented 44% of cetaceans sightings. As they were often sighted in large groups, delphinids represented more than 67% of individuals sighted. Interestingly, over 26% of the total sightings were of Balaenopteridae (*i.e.*, humpback whales) with 16 sightings and 24 individuals. Physe-teridae represented approximately 3% of cetaceans sightings and less than 0,5% of individuals.

Sightings were located in areas with a bathymetry ranging from 50 to 2,300 m (mean = 600 m). Most sightings were between the 200 and 2,000 m isobaths

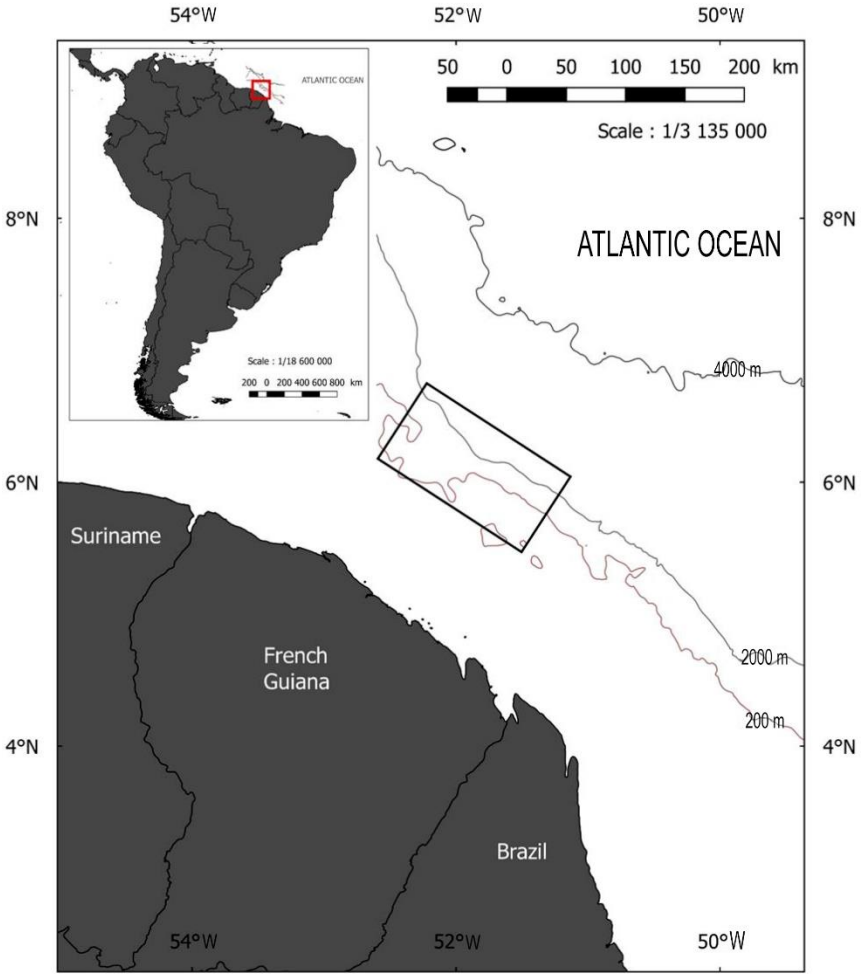

Figure 1. Location of the study area. The red rectangle represents French Guiana, the black rectangle represents the prospected area, on the slope off French Guiana.

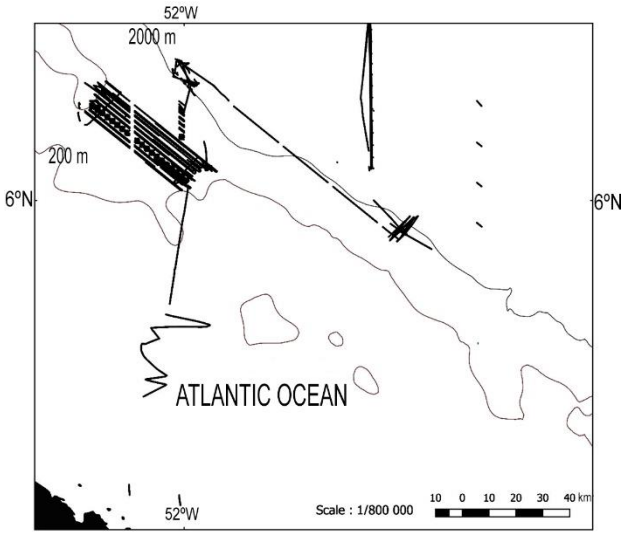

Figure 2. Visual effort conducted during the survey. The black lines are the GPS tracks with sighting effort during the transect.

(Fig. 3). Atlantic spotted dolphins, bottlenose dolphins, long-beaked common dolphins and humpback whales were sighted within this depth range.

On the continental shelf, sightings were limited and included bottlenose dolphins and Atlantic spotted dolphins. Spinner dolphins, pantropical spotted dolphins and sperm whales were the only species sighted in waters deeper than 2,000 m. The mean group size of delphinids was 12 (SD = 10.2). Larger groups of over 40 individuals were sighted, especially groups of *Stenella* dolphins. Less than 10 small groups with one to three animals were also sighted.

Of the 16 sightings of humpback whales, 8 were mother-calf pairs. Due to the opportunistic nature of the survey, we could not calculate abundance estimates for any species. Also, the humpback whales were typically far from the vessel (mean distance 1,400 m), so we could not obtain suitable photos for individual identification which would have enabled us to determine if

Table 2. Marine mammals sighted during the survey off French Guiana in number of sightings and number of individuals.

Common name	Scientific name	Number of sightings	Number of individuals
Balaenopteridae			
Humpback whale	*Megaptera novaeangliae*	16	24
Physeteridae			
Sperm whale	*Physeter macrocephalus*	2	2
Delphinidae			
Spinner dolphin	*Stenella longirostris*	1	15
Common dolphin	*Delphinus delphis*	3	61
Atlantic spotted dolphin	*Stenella frontalis*	8	94
Pantropical spotted dolphin	*Stenella attenuata*	9	119
Bottlenose dolphin	*Tursiops truncatus*	6	48
Other			
Unidentified large cetacean	-	1	1
Unidentified small cetacean	-	15	137
Total		**61**	**501**

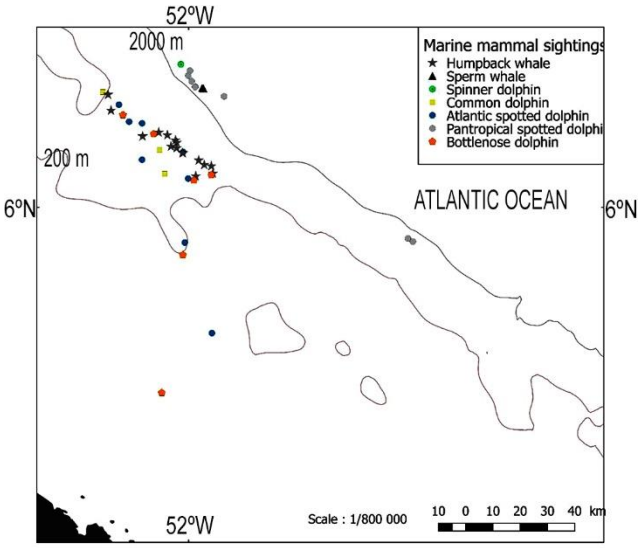

Figure 3. Marine mammal sightings during the survey off French Guiana.

we were seeing some of the same individuals during our survey.

Marine mammals sighted during the survey exhibited different types of behavior (Fig. 4).

Many delphinids, particularly bottlenose dolphins, Atlantic spotted dolphins, long-beaked common dolphins and, to a lesser extent, pantropical spotted dolphins, were attracted to the vessel and approached to ride the bow waves. Most of the species sighted demonstrated traveling behavior without particular attention to the vessel. Humpback whales and pantropical spotted dolphins were often seen breaching. Only the sperm whale exhibited diving behaviors.

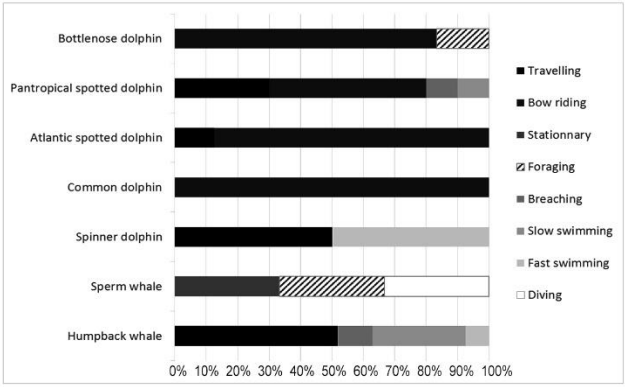

Figure 4. Marine mammal behaviors observed during the survey (from black = traveling to white = diving).

Bottlenose dolphins and sperm whales both were seen foraging in the study area.

Seabirds

In total, seventeen species were identified. Seven families were observed during the survey, as well as many waders (Table 3).

The most frequently observed species was the magnificent frigatebird. The common tern was the second most frequently sighted species. Cory's shearwaters and pomarine jaegers were also common. Few differences were observed between the composition by the number of sightings or by the number of individuals. Approximately 42% of the observations were from the family Laridae. Common and unidentified terns represented most of the Laridae observations. The family Fregatidae was the second most represented family with 26% of sightings and 29% of individuals, all of which were magnificent

Table 3. Seabirds sighted during the survey off French Guiana in number of sightings and number of individuals.

Common name	Scientific name	Number of sightings	Number of individuals
Laridae			
Unidentified tern	-	58	71
Great black-backed gull	*Larus marinus*	2	2
Sooty tern	*Onychoprion fuscatus*	2	2
Sooty tern/Bridled tern	*O. fuscatus/anaethetus*	4	4
Common tern	*Sterna hirundo*	40	51
Procellariidae			
Unidentified shearwater	-	2	2
Cory's shearwater	*Calonectris diomedea*	21	23
Manx shearwater	*Puffinus puffinus*	8	8
Stercorariidae			
Unidentified skua	*Stercorarius* sp.	4	4
Pomarine jaeger	*Stercorarius pomarinus*	16	17
Great skua	*Stercorarius skua*	4	5
Hydrobatidae			
Unidentified storm petrel	-	5	15
Wilson's storm petrel	*Oceanites oceanicus*	2	2
Band-rumped storm petrel	*Oceanodroma castro*	4	6
Sulidae			
Masked booby	*Sula dactylatra*	5	5
Fregatidae			
Magnificent frigatebird	*Fregata magnificens*	66	94
Phaethontidae			
Unidentified tropicbird	*Phaethon* sp.	1	2
Wader			
Ruddy turnstone	*Arenaria interpres*	2	3
Semipalmated plover	*Charadrius semipalmatus*	2	3
American golden plover	*Pluvialis dominica*	1	1
Snowy egret	*Egretta thula*	1	1
Western cattle egret	*Bubulcus ibis*	2	2
Total		**252**	**323**

frigatebirds (n = 66). The Procellariidae represented 12% of sightings with many observations of Cory's shearwaters (n = 23).

The Stercorariidae represented 10% of the total sightings and were mainly composed of pomarine jaegers (n = 16), while the Hydrobatidae, Sulidae and Phaethontidae families represented 4, 2 and 1% of the sightings, respectively. Finally, some waders were also sighted (Scolopacidae, Charadriidae, and Ardeidae families) and represented 3% of the sightings recorded.

Laridae were distributed throughout the entire study area. Few Laridae were sighted on the continental shelf: common terns, sooty terns and unidentified terns. Most Laridae sightings were recorded between the 200 and 2,000 m isobaths (Fig. 5). Fregatidae was also common in the study area from the continental shelf to beyond the 2,000 m isobath (Fig. 5). Shearwaters and boobies were exclusively sighted between the 200 and 2,000 m isobaths (Fig. 5). Some pomarine jaegers and unidentified skuas/jaegers were sighted on the continental shelf, but the majority of individuals of these species and groups, as well as storm petrels, were sighted from the 200 m isobath to around the 2,000 m isobath (Fig. 5). Most of the seabirds sighted during the surveys exhibited traveling behaviors (Fig. 6). Some species showed an attraction to the vessel: western cattle egret, magnificent frigatebird, pomarine jaeger, Cory's shearwater and common tern. Other individuals were relatively stationary (*i.e.*, sitting on the water or the vessel): western cattle egret, magnificent in one word, pomarine jaeger, Manx and Cory's shearwater and great black-backed gull. The magnificent frigatebird, common tern, and unidentified tern were also seen foraging.

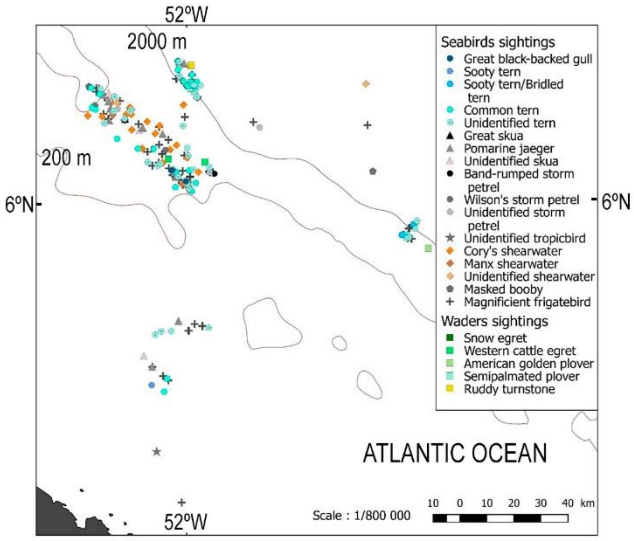

Figure 5. Location of seabirds and waders sightings during the survey off French Guiana.

DISCUSSION

A variety of marine mammal and seabird species were observed in the areas surveyed and appear to use the area for foraging (*e.g.*, delphinids and sperm whales) and possibly calving (*e.g.*, many juvenile delphinids and humpback whales sighted). The high productivity of the area may explain the species richness, especially of delphinids, which usually choose the highest-productivity areas to meet their energetic requirements (Mannocci *et al.*, 2013). However, the survey was not dedicated to marine mammal and seabird therefore, it did not include standard recommendations for estimating abundance as line transect sampling (Buckland *et al.*, 2001). Due to the opportunistic nature of this survey and the long periods spent in the same area, it is possible that the same individuals, particularly humpback whales, were recorded multiple times.

Sea bird occurrence

Data on the distribution and abundance of seabirds are limited due to a few studies in this area. Dujardin & Tostain (1990) and Mannocci *et al.* (2013) suggest that breeding site availability and colony size may influence at-sea community composition. The limited space available for seabirds to breed (Grand Connétable Island) and the commonality of frigatebirds may explain their high presence at sea and the low abundance of other pelagic species, such as tropicbirds or boobies, who may not be able to find enough suitable breeding sites in the area.

Frigatebirds appear to be opportunistic feeders, occurring in coastal waters over 200 km away from the colony (Weimerskirch *et al.*, 2003; Sebastiano *et al.*, 2017). Their wide distribution range in the survey reflects this high plasticity. Few Frigatebirds demonstrated a foraging behavior in this study. The sooty tern is known as a dominant species in the seabird community in the area (De Boer, 2014; Willems *et al.*, 2017), especially during autumn and offshore (Artigas *et al.*, 2003; Mannocci *et al.*, 2013), but few sooty terns were observed during our survey. In contrast, Mannocci *et al.* (2013) forecasted a low abundance of frigatebirds offshore in autumn and a high abundance only around the Grand Connétable Islands, whereas we recorded many frigatebirds on the slope during the survey. Other species, such as gulls or coastal terns, only forage around their breeding sites and are not often sighted offshore (Dujardin & Tostain, 1990; Artigas *et al.*, 2003; Mannocci *et al.*, 2013). Our low sightings of gulls and a low percentage of foraging behaviors support this conclusion.

Shearwaters were widely observed during the survey. These species are known to be abundant in Suriname waters between May and July (De Boer, 2014) with a peak in June (Willems *et al.*, 2017). Our results confirm their frequent occurrence in French Guiana waters during autumn. Cory's shearwaters inhabit warm-temperate and subtropical seas and breed on islands of the eastern Atlantic and Mediterranean. Non-breeders disperse to the western Atlantic during the summer and autumn (Haney & McGillivary, 1985; Gonzalez-Solis *et al.*, 2007; Dias *et al.*, 2011). This long-distant migrant can winter on the southwest Atlantic coast, as reflected in our study and others (De Boer, 2014; Willems *et al.*, 2017).

Skuas and jaegers were also present during our survey, whereas previous studies in Suriname suggest a peak in May (Willems *et al.*, 2017). All skuas and jaegers breed at moderate to high latitudes and disperse after breeding *via* transequatorial migrations down to South American waters, both in the Atlantic and Pacific Oceans (Furness, 1987). Details on their movements and timing of migration remain mostly unknown (Simeone *et al.*, 2014). Regarding wader species, their presence is known in Guiana, where they arrive during their post-nuptial migration between August and October (Artigas *et al.*, 2003).

Marine mammal occurrence

Humpback whales were the most commonly observed species. Despite the inability to identify individuals, at least one mother-calf pair was observed, which suggests the area may be an extended part of calving ground. The humpback whale is a migratory species that move between polar feeding grounds and tropical or subtropical breeding/calving grounds (Chittleborough,

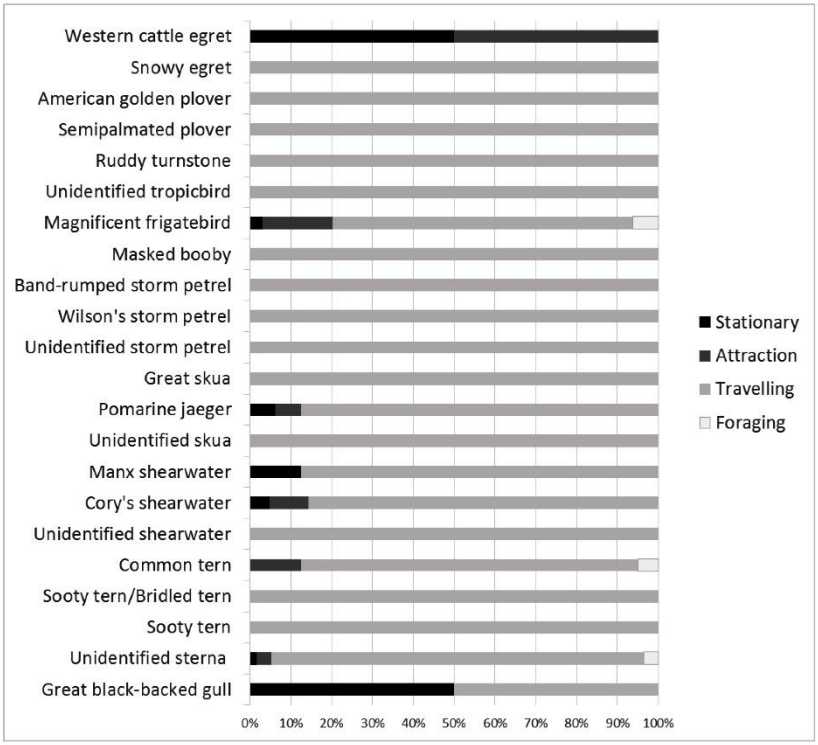

Figure 6. Seabird behaviors observed during the survey (from black = stationary to white = foraging).

1965; Dawbin, 1966; Whitehead & Moore, 1982; Weinrich, 1998; Clapham & Meads, 1999). A total of 14 geographically separated populations (stocks) are currently recognized by the International Whaling Commission (IWC) in the wintering grounds in the southern hemisphere (7) and the northern hemisphere (IWC, 2006). The populations closest to French Guiana breed in the West Indies and along the Brazilian coast (Stevick *et al*., 2003; Swartz, 2003; Andriolo *et al*., 2010; Martins *et al.*, 2013).

The northern Atlantic humpback whales migrate to the broader Caribbean region, from Cuba to the Caribbean coast of Venezuela, to mate and calve each winter between January and May (Martin *et al.*, 1984; Mattila & Clapham, 1989; Swartz, 2003; Reeves *et al.*, 2004). They come from a broad range of summer feeding grounds across temperate and high latitudes, ranging from the Gulf of Maine to the Arctic (Mattila *et al*., 1989; Vu *et al.*, 2012; Kennedy *et al.*, 2013). The Brazilian coast breeding southern humpback whales population (Stock A) migrates from austral summer feeding grounds in the Antarctic to breeding grounds in tropical and subtropical regions (Chittleborough, 1965). Although the Brazilian coast is known to be a breeding ground for southern hemisphere humpback whales, some findings indicate that these whales may use habitats farther north (Pretto *et al.*, 2009). These whales seem to leave South America for Antarctic waters between October and December (Zerbini *et al*., 2006).

Because we sighted humpback whale mother-calf pairs during November, we believe these whales are likely from the southern population. These whales may range north of the equator due to space limitations or other density-dependent processes which have been observed in humpback whales along the Pacific coast of Colombia and Costa Rica (Rasmussen *et al*., 2007). In 2005, the number of humpback whales wintering off the Brazilian coast was estimated to be 6,404 (CV = 0.11) and was mainly located over the Abrolhos Bank (Andriolo *et al.*, 2010). In 2011, the abundance estimate was 8,832 (CV = 0.14) (Wedekin *et al.*, 2017) With an annual growth rate around 12% per year (95% CI = 8-16%; CV = 17%), the Brazilan population demonstrates a good recovery after commercial whaling (Wedekin *et al.*, 2017). Additional research is needed to determine if French Guiana waters are indeed a new breeding and/or calving ground for this species.

Caveats

Our survey results do not reflect the year-round occurrence of local marine mammals and seabirds. Our surveys were during the post-breeding period for most seabird species. The breeding season may strongly

influence our results; during our survey, breeding individuals may have been on regional colonies (for seabirds) or breeding grounds (for marine mammals). Seabirds sighted at-sea were likely non-breeders, whereas the humpback whales sighted in the area may have been breeders. Species composition and animals' behavior may widely differ according to the season.

CONCLUSIONS

The sightings data from this study provide a snapshot view of marine mammals and seabirds occurrence off French Guiana during autumn and contribute to the limited data for this region. To further understand marine mammal and seabird distribution and abundance in this area, we recommend additional visual monitoring in addition to year-round acoustic monitoring and systematic surveys. Sharing and publishing data collected are also encouraged and would provide suitable ways to improve knowledge in the area.

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ETHICAL APPROVAL

All necessary permits for sampling and observational field studies have been obtained by Créocéan. No animal testing was performed during this study.

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