

Summary

Results of the ship-based survey carried out by GEPOG (Group for the Study and Protection of Birds in French Guiana) in French Guiana's Exclusive Economic Zone in 2011 and 2012

Processing and Analysis of Observation Data on Seabirds and Cetaceans

Text : Amandine BORDIN¹

Participation: Nyls de PRACONTAL¹, Antoine HAUSELMANN², Renato RINALDI³, Alexandre RENAUDIER¹

¹ Groupe d'Etude et de Protection des Oiseaux en Guyane, 15, avenue Pasteur, 97300 Cayenne, French Guiana

² Réserve Naturelle de l'île du Grand Connétable, 15, avenue Pasteur, 97300 Cayenne, French Guiana

³ Association Evasion Tropicale, rue des Palétuviers, 97125 Pigeon Bouillante, Guadeloupe

Contact : association@gepog.org

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The complete report is available (in French) on www.gepog.org.

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INTRODUCTION

Over the past several years, following the Grenelle Forum on the Sea and France's commitments relating to the creation of protected marine areas, the preservation of French Guiana's marine environment has become an increasingly important issue. This development has led to the implementation of various programs to acquire data on French Guiana's marine ecosystem, about which there is still very little knowledge. In 2008, the PELAGIS observatory (La Rochelle University) carried out aerial surveys as part of the EXOCET program, whose objective was to conduct a census of the marine megafauna in French Guiana's Exclusive Economic Zone (EEZ). Following the results of that census, which revealed large numbers of animals, GEPOG (Group for the Study and Protection of Birds in French Guiana) decided to carry out an inventory at sea of seabirds and cetaceans in 2011/2012. The project was funded by the Regional Department of the Environment, Planning and Housing (DEAL) and was carried out in collaboration with the Grand Connétable Island Nature Reserve.

The main objective was to improve knowledge on the pelagic fauna of French Guiana's EEZ during the dry and rainy seasons. The project required six 5-day fieldwork trips at sea including visual and acoustic surveillance and photographing of the animals encountered. This work contributes to the identification and enumeration of species present in French Guianese waters and to the determination of the most frequented areas.

MATERIALS AND METHODS

Period and study area

The inventory included six fieldwork trips at sea between July 2011 and June 2012. The study area corresponded to French Guiana's EEZ, which extends 300 km off shore, with a surface area of approximately 138,000 km². It is made up of three main habitats whose boundaries were established according to their bathymetric characteristics : a continental shelf, a slope and an oceanic area (Van Canneyt *et al.*, 2009)¹

Observers, equipment and sampling

The teams were made up of 5 to 9 observers as well as 2 crew members. During each trip, at least two people had experience in seabird and cetacean species recognition. Volunteers rounded out the teams to strengthen the survey effort.

The trips took place on board a maxi catamaran fitted out with all the necessary equipment to be self-sufficient for several consecutive days (Figure 1).

The objective of this exploratory sampling was to survey the three main bathymetric strata (shelf, slope and oceanic area) in the eastern portion of the EEZ. Visual surveys were carried out between 6 a.m. and 7 p.m., with observers stationed at the front, rear and on both sides of the boat in order to survey the largest possible area. For each bird and cetacean encountered, at least the species, number of individuals, direction of swimming or flight, behavior, geographical position and time of observation were recorded. Photos were also taken to determine the species and begin a photo identification catalogue for French Guianese waters (using the methodology developed by the non-profit organization Evasion Tropicale in Guadeloupe).

Acoustic surveys were also carried out by Renato Rinaldi using directional and omnidirectional hydrophones (between 20 Hz and 20 kHz) made available by Evasion Tropicale. Acoustic surveillance took place randomly, until the 1,000m drop-off, then every 6 nautical miles (approximately 11 km) beyond the depth of 1,000 to 1,500 m. Depending on the sound quality and constraints linked to the current, the animals detected were approached.



Figure 1. Catamaran used for the inventory fieldwork trips (a), observers at work (b) and lowering the hydrophone into the water (c).

¹ Van Canneyt, O., Certain, G., Dorémus, G., Laran, S., Ridoux, V., Bolaños, J., Jérémie, S. & Watremez, P. 2009. Distribution and Abundance of Marine Megafauna in French Guiana. EXOCET program, Marine Protected Areas Agency. Final report. 67p.

Data analysis

Data analysis included a summary of the number of animals counted as well as spatial representation of their distribution by group size and by species using ArcGis^{ESRI} 9.3 software. Estimations of the encounter rates and sighting rates for each of the bathymetric strata as well as an estimation of the densities were also made.

Encounter rates made it possible to identify the main areas frequented by the animals. They correspond to the number of individuals counted and to the sightings carried out per kilometer of effort travelled. The estimation of densities was calculated for all species and families observed during the effort. The number of individuals was divided by the surface area surveyed in each of the strata (within a 2 km detection radius around the boat). The most densely populated areas were spatially represented on a grid with 1 km² cells using the Kernel density method available in the Spatial Analyst extension of the ArcGis^{ESRI} 9.3 software program.

RESULTS

Sampling effort and surface area surveyed

On average, the duration of the fieldwork trips was four days. A total of 24 trip days were carried out or 296 hours of effort (Table 1). Initially, 30 trip days were planned or 390 hours of effort, but weather and sea conditions disrupted certain trips, especially during the rainy season.

Table 1. Date of fieldwork trips and effort (in hours).

Trip	Month	Start date	End date	Time of departure	Time of arrival	No. of days	Total number of hours	No. of daylight hours (effort)	No. of days planned	No. of hours (effort) planned	% carried out
1	July	07/25/2011	07/29/2011	9:00	11:30	4.5	99	54.5	5	65	84
2	September	09/12/2011	09/16/2011	7:00	9:00	4	98	54	5	65	83
3	November	11/14/2011	11/18/2011	9:30	12:00	4.5	99	54.5	5	65	84
4	January	01/30/2011	02/01/2012	9:30	7:00	2	46	22.5	5	65	35
5	March	03/19/2012	03/23/2012	9:30	9 :30	4	96	52	5	65	80
6	May-June	05/30/2012	06/03/2012	9:30	16:00	5	103	58.5	5	65	90
						24	541	296	30	390	76

Figure 2 represents the study area, showing the bathymetric stratification proposed by the PELAGIS observatory, which includes a stratum P (continental shelf), a stratum T (continental slope) and a stratum O (oceanic area).

The routes travelled during the fieldwork trips are represented in Figure 3. Departures and arrivals took place in Kourou, except in March, when the departure was planned from Cayenne. The routes follow approximately the same profile on the continental shelf, then vary starting at the slope and in the oceanic area. Itineraries were adapted to navigating conditions and results obtained during acoustic surveillance.

A total of 2,447 km were travelled during daylight hours (on effort) over the six fieldwork trips, which represents 1,026 km in stratum P, 900 km in stratum T and 521 km in stratum O. The average speed per day was approximately 8.5 km/hour.

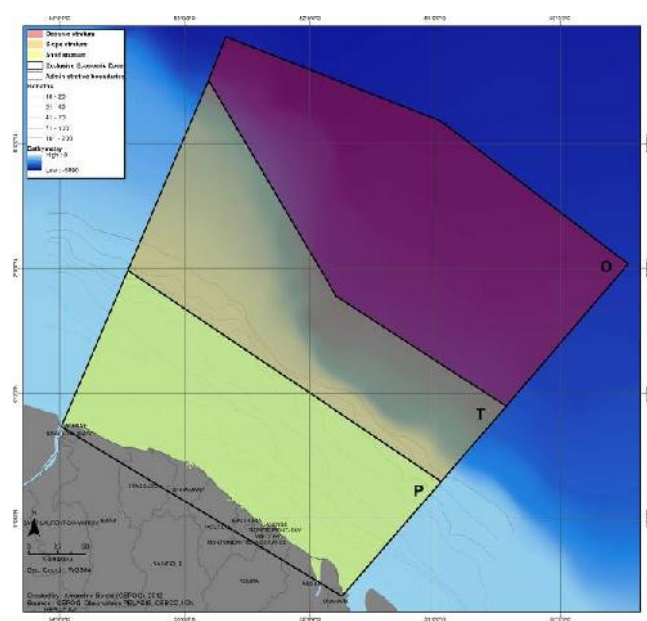


Figure 2. Study area and bathymetric stratification.

(a)

Routes of July, September and November 2011 trips

*Ship-based survey (cetaceans and seabirds)
carried out by GEPOG in 2011/2012*

Routes

- Route travelled by daylight from 7/25 to 7/29/2011
- - - Route travelled by night from 7/25 to 7/29/2011
- Route travelled by daylight from 9/12 to 9/16/2011
- - - Route travelled by night from 9/12 to 9/16/2011
- Route travelled by daylight from 11/14 to 11/18/2011
- - - Route travelled by night from 11/14 to 11/18/2011

Isobaths

- 10 - 20
- 21 - 40
- 41 - 70
- 71 - 100
- 101 - 200

Bathymetry

High : 0
Low : -5090

— Exclusive Economic Zone

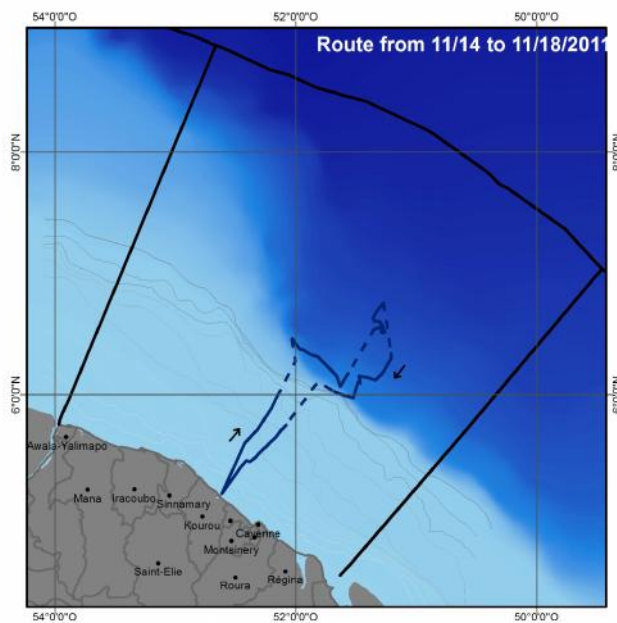
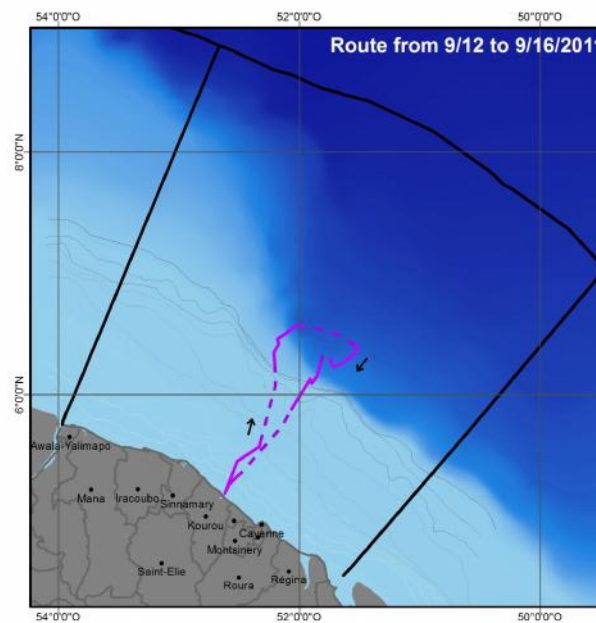
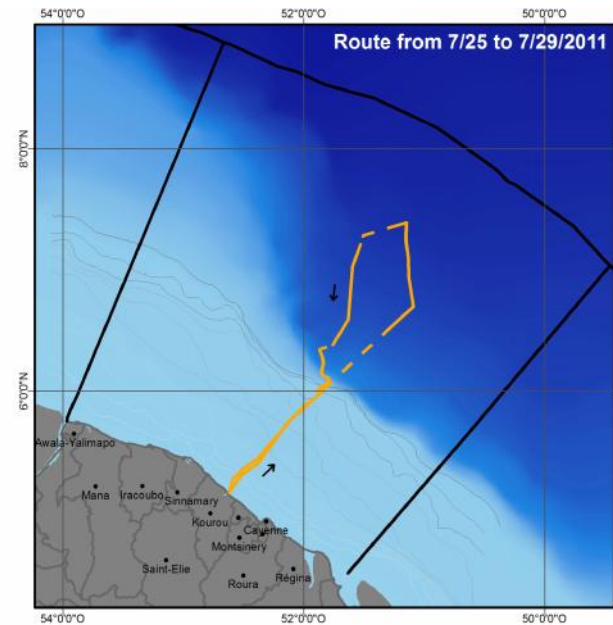
— Administrative boundaries



0 50 100 150 200
Kilometers

Geo. Coord. : WGS84

Created by : Amandine Bordin (GEPOG), 2012
Sources : GEPOG, GEBCO, IGN



(b)

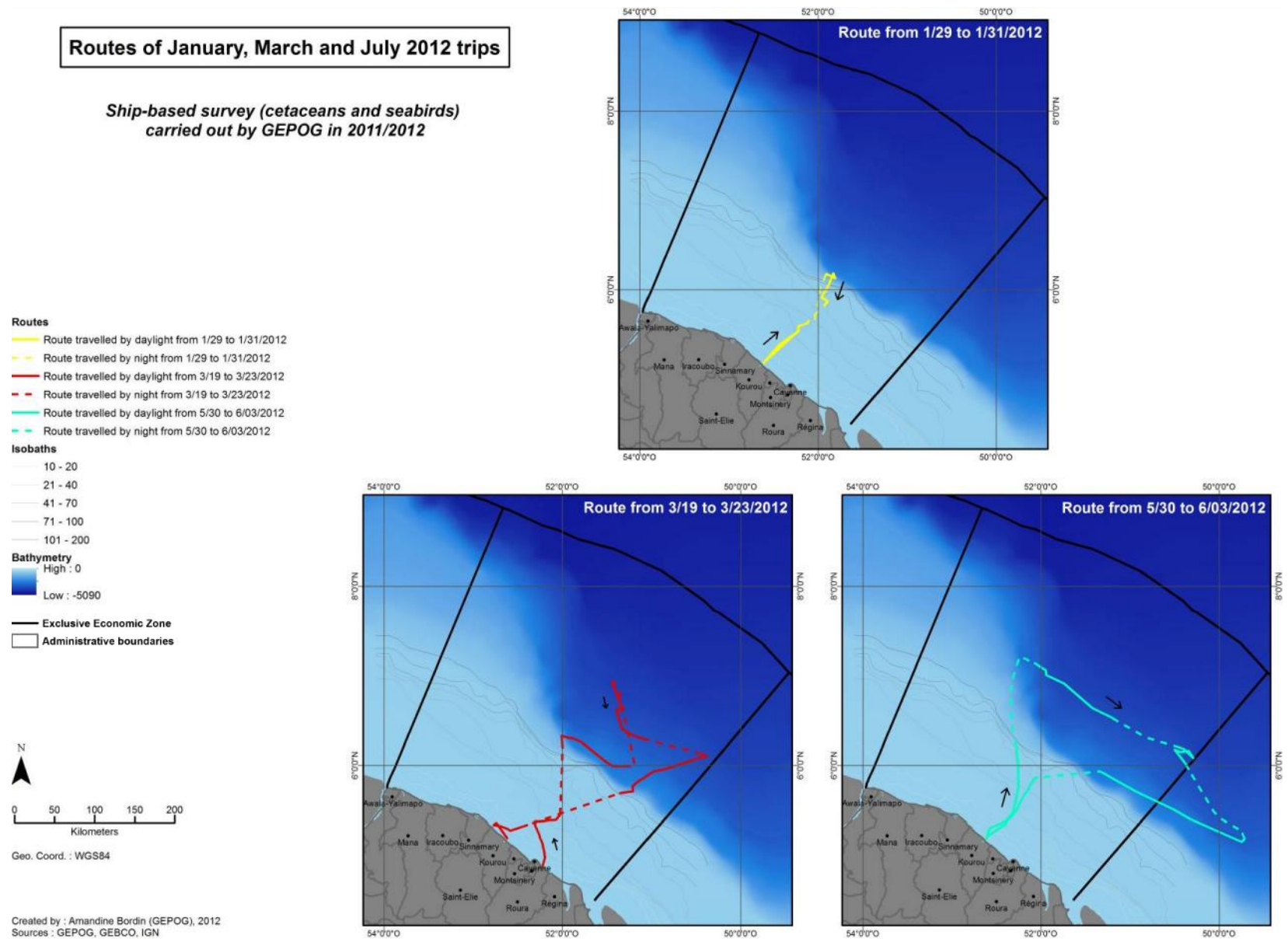


Figure 3. Routes travelled on the July, September and November 2011 Trips (a) and the January, March and May-June 2012 trips (b).

Summary of numbers

Seabirds

A total of 1,167 birds (410 sightings) were sighted during the six fieldwork trips, with 8 families and 29 species counted (Figures 4 and 5). The most frequently-sighted seabirds were the Laridae, with 70% of the individuals sighted and 46 % of recorded sightings, the Hydrobatidae (13% of individuals, 22% of sightings) and the Procellariidae (9% of individuals, 16% of sightings). The animals were the most present in September, November and July, but for the Fregatidae, Hydrobatidae and Procellariidae, the highest numbers were recorded in March and May-June.

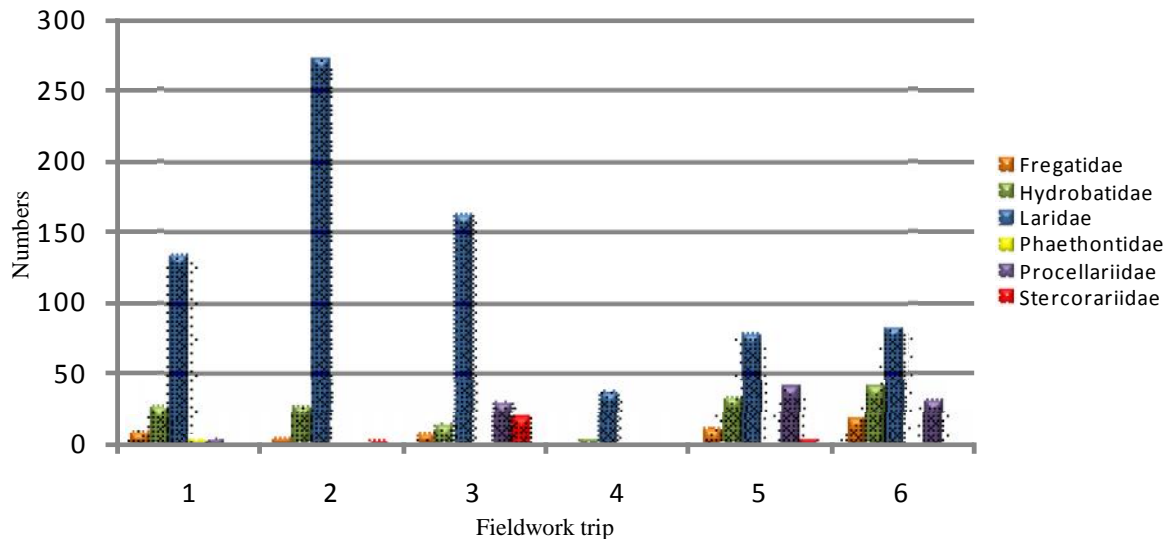


Figure 4. Numbers of seabird families counted per fieldwork trip.

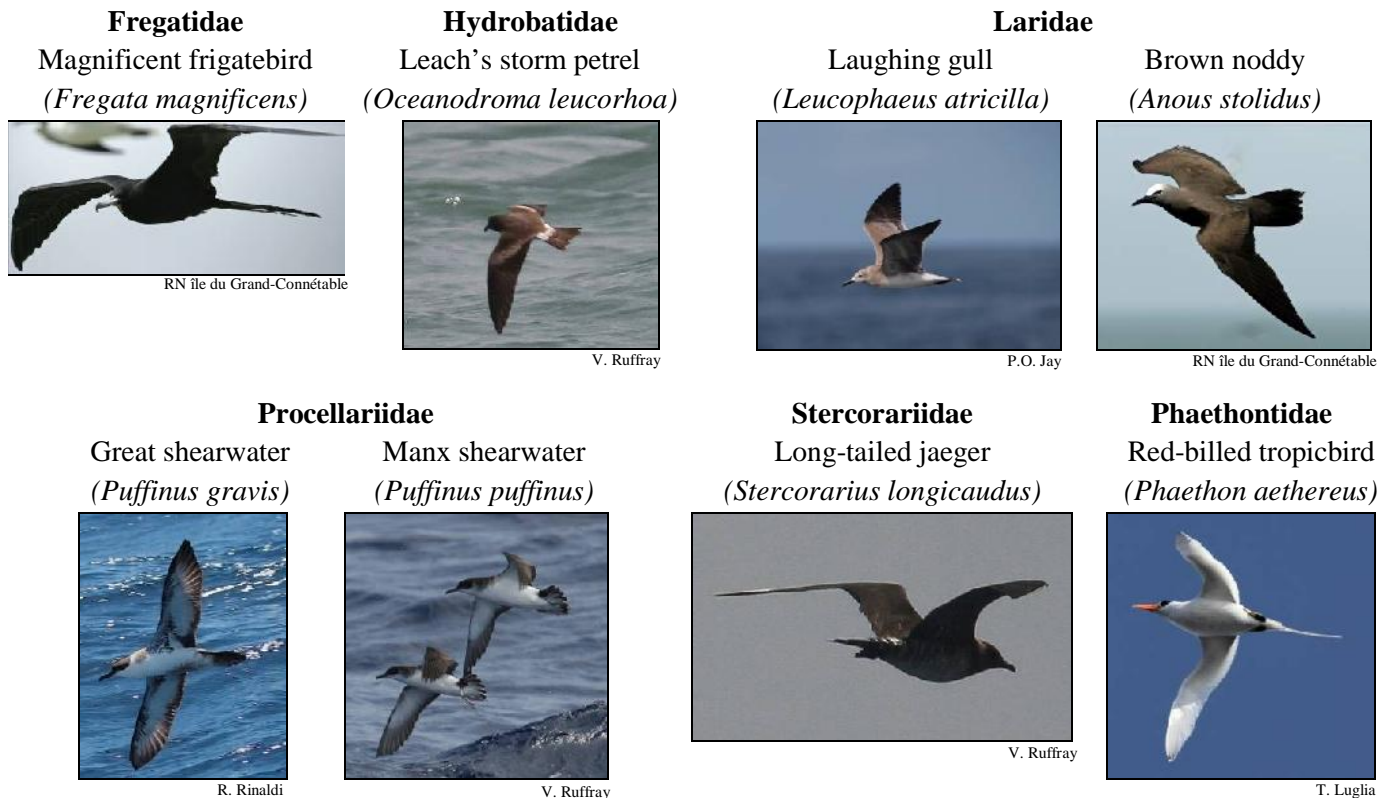


Figure 5. Species of seabirds sighted.

Cetaceans

A total of 1,678 cetaceans (65 sightings) were sighted during the six fieldwork trips, with 2 families and 10 species counted (Figures 6 and 7). The families encountered were the Delphinidae, with 1,652 individuals and 58 sightings recorded, and the Physeteridae, with 26 individuals and 7 sightings.

The most frequently encountered species were the spinner dolphin (*Stenella longirostris*), the pantropical spotted dolphin (*Stenella attenuata*) and the Atlantic spotted dolphin (*Stenella frontalis*), with respectively 443 (38% of individuals, 9% of sightings), 435 (37% of individuals, 12% of sightings) and 208 individuals (18% of individuals, 11% of sightings). These species travel mainly in large groups (between 100 and 200 individuals), whereas the other species were more often sighted in smaller groups. Sperm whales (*Physeter macrocephalus*) were counted in November, then in May-June.

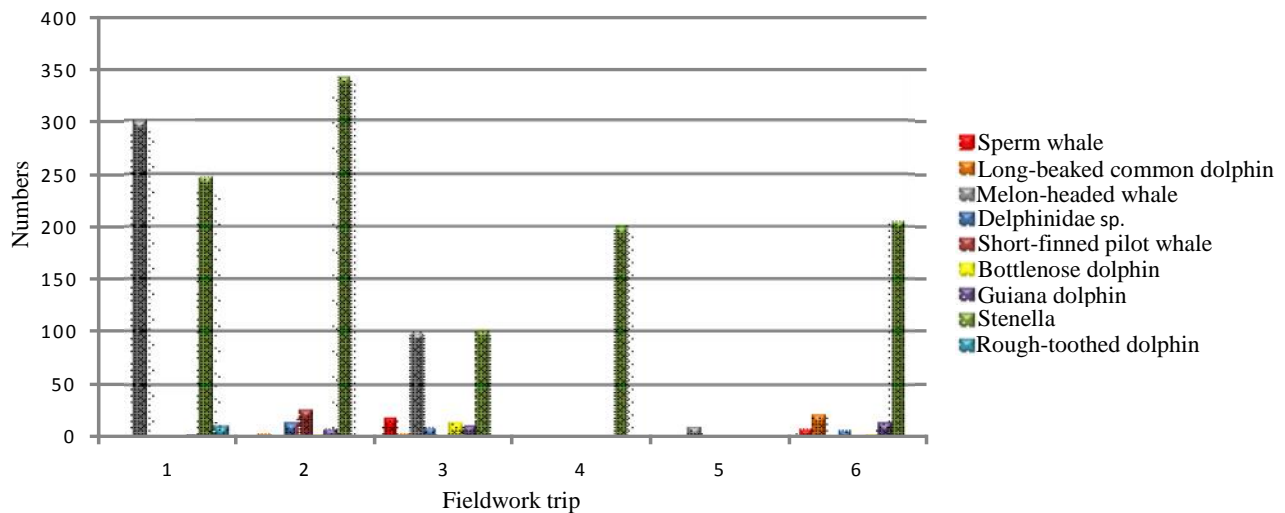


Figure 6. Numbers of cetacean species encountered per trip.

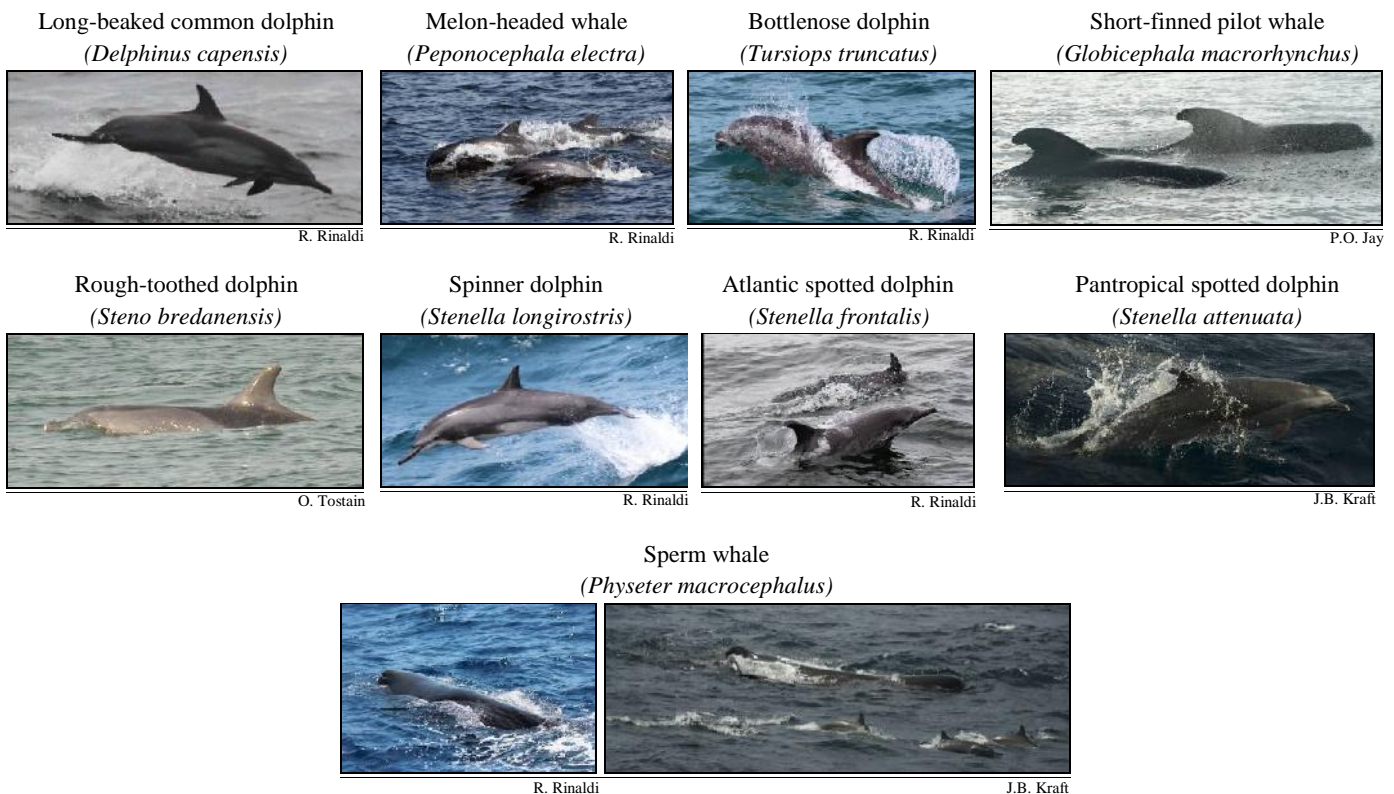


Figure 7. Species of cetaceans sighted.

Spatial distribution by group size

Figure 8-a is the spatial representation of the distribution of seabirds according to the number of individuals counted per sighting for all six trips. The continental shelf was the most frequented stratum ($n = 530$; sightings = 184) with numerous groups of between 2 and 20 animals, located mainly off the coast of Kourou. On the continental slope, the birds were generally alone or in groups of between 2 and 5 animals, except in November, when slightly higher concentrations were observed. The number of sightings recorded in the oceanic stratum ($n = 187$; sightings = 59) was lower, with a large variety of group sizes. No colony or large group was observed during the fieldwork trips.

Figure 6-b is the spatial representation of the distribution of cetaceans according to the number of individuals counted per observation for all six trips. Sightings consisted of groups of between 1 and 200 individuals. The continental shelf ($n = 131$; sightings = 27) was mainly frequented by lone individuals or small groups of between 2 and 10 dolphins. On the continental slope ($n = 1339$; sightings = 24), there were fewer sightings than on the continental shelf, but the groups were much larger, especially during the 2011 fieldwork trips, with concentrations of about 100 to 200 dolphins. In the oceanic area ($n = 196$; sightings = 11), despite a lower sighting rate, the abundance of cetaceans was higher than on the continental shelf.

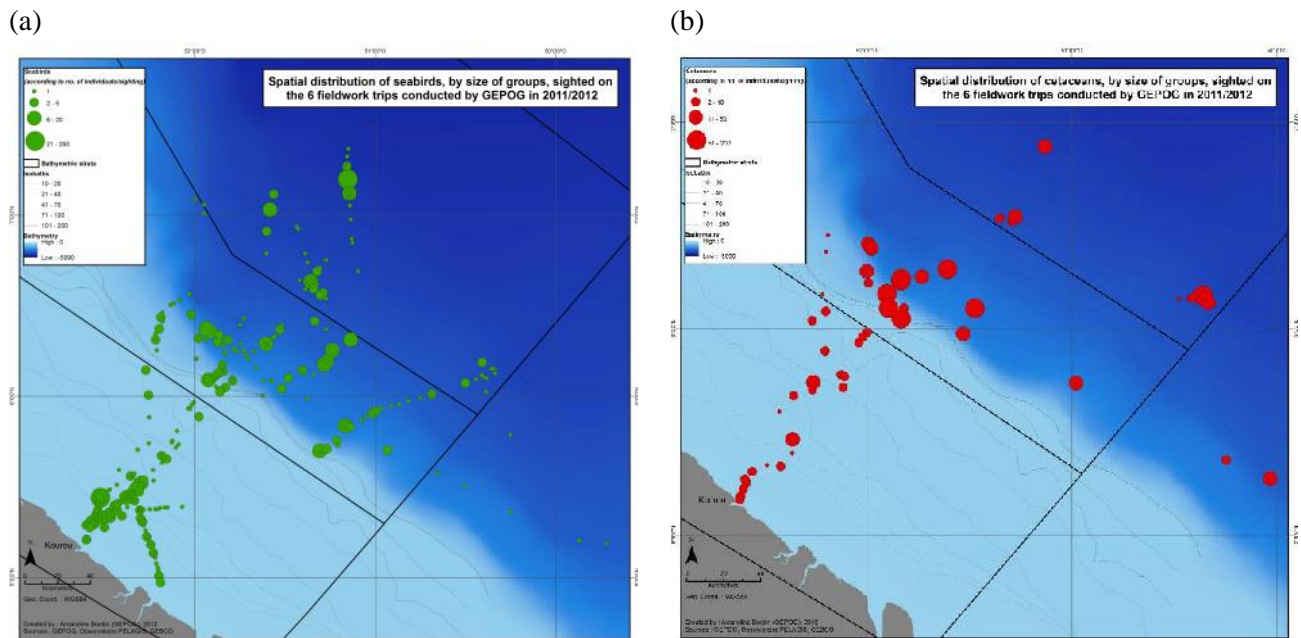


Figure 8. Spatial distribution of seabirds (a) and cetaceans (b) according to the number of individuals sighted for all six trips.

Acoustic data

On three trips (November, March, May-June), 54 listening stations were set up every 2 to 3 hours on average (consisting of one listening point per station). There were 30 positive detections (at 27 points) and 27 negative detections. A total of five species of Delphinidae and the sperm whale were detected. The Delphinidae were mainly heard on the continental slope, except for the long-beaked common dolphin (*Delphinus capensis*) and the bottlenose dolphin (*Tursiops truncatus*), which were only heard on the continental shelf. All the acoustic detections of sperm whales occurred in the oceanic stratum. Animals of the genus *Stenella* were also heard in this area.

The number of detections of cetaceans was lower in the month of March (30% of detections positive) compared to the two other trips (approximately 70% of detections positive). Still, despite a low visual detection rate, the presence of cetaceans was confirmed during this period.

Estimated encounter rates and densities of individuals

The encounter rate for seabirds was 40.29 individuals/100 km with a sighting rate of 15.45 sightings/100 km. Animals were regularly sighted on each fieldwork trip, alone or in small groups (less than 5 individuals). The density was estimated at 9.95 individuals/100 km². The shelf was the most frequented stratum, while values were slightly lower in the two other strata. The family Laridae was dominant in each of the strata, followed by the Hydrobatidae and the Procellariidae.

For cetaceans, the encounter rate was 67.08 individuals/100 km, with a sighting rate of 2.53 sightings/100 km. The groups were often very large, particularly over the slope. The density was 16.81 individuals/100 km². Only Delphinidae were sighted in the P and T strata and the oceanic area was generally frequented by *Stenella* and deep divers such as the sperm whale.

Identification of the most densely populated areas

Densities are represented spatially in Figure 9. The most densely populated sector for seabirds was located on the continental shelf off the coast of Kourou (probably correlated to a greater observation effort in this area). Two other densely-populated sectors were located in the northeastern portion of the stratum T as well as in the north of stratum O.

The most densely-populated sector for cetaceans was located on the continental slope where depths are greater than 200 m. Another densely-populated sector was identified in the eastern portion of stratum O, on the boundary of French Guiana's EEZ.

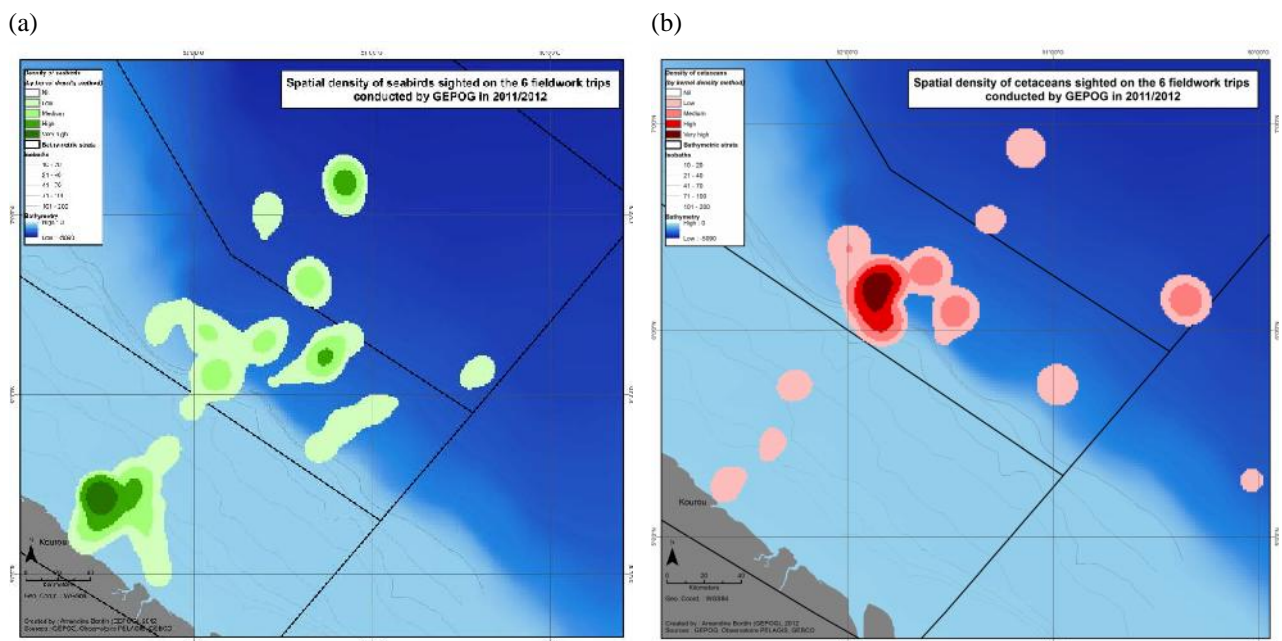


Figure 9. Spatial Representations of densities, estimated using the Kernel density method, of seabirds (a) and cetaceans (b) for all six trips.

CONCLUSION

This inventory adds to our knowledge on the species diversity and distribution of pelagic fauna in French Guianese waters. A large number of animals were counted, with determination to species level for the birds and the small Delphinidae. We were able to identify pelagic seabirds (puffins, jaegers) that have been little studied in French Guiana and cetaceans whose presence had not been confirmed until now, such as the rough-toothed dolphin (*Steno bredanensis*) and the long-beaked common dolphin (*Delphinus capensis*). We were also able to reveal the existence of very densely populated areas as well as discover that sperm whales carry out certain vital activities in French Guianese waters (nursing of very young individuals).

Knowledge of marine environments in French Guiana, in particular offshore, is very sketchy for the moment. In the present context, with heavy industrial activity being developed in French Guiana's EEZ, significant efforts must be made to improve knowledge on large marine fauna in order to prioritize the issues emerging in these waters.

Human activities, including fishing, shipping or exploitation of the resources of the marine subsoil, are developing rapidly. Increased knowledge of these areas therefore seems fundamental in order to better determine the impacts of these activities. These impacts, both direct and indirect, on marine resources inevitably include cetaceans and possible interactions include incidental captures in fishing gear, disturbance, and physiological injury to the animals as well as deterioration of habitats. Species and habitat preservation thus require better integration and management of human activities in French Guiana's marine landscape. By pursuing our efforts to address the lack of knowledge on ecosystems but also on the conduct of human activities, we can reconcile environmental protection and economic development.