



Cetaceans observed in Suriname and adjacent waters

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Abstract. Very little information exists about the cetaceans in the Guianas: Suriname and its neighboring countries Guyana and French Guiana. During a dedicated cetacean survey carried out from a geophysical seismic survey vessel in the offshore waters of Suriname (May-September 2012), the occurrence of 13 cetacean species was documented and of those, 11 were newly documented for this area. The species observed by the author included sperm whale (*Physeter macrocephalus*), Bryde's whale (*Balaenoptera edeni*), false killer whale (*Pseudorca crassidens*), melon-headed whale (*Peponocephala electra*), rough-toothed dolphin (*Steno bredanensis*), long-beaked common dolphin (*Delphinus capensis*), Fraser's dolphin (*Lagenodelphis hosei*), pantropical spotted dolphin (*Stenella attenuata*) and spinner dolphin (*Stenella longirostris*). During transit to the survey area (Trinidad to Suriname) incidental sightings were recorded which included common bottlenose dolphin (*Tursiops truncatus*) off Trinidad, *Stenella* sp. off Guyana and Guiana dolphin (*Sotalia guianensis*) at the entrance of the Suriname River. Opportunistic records originating from the periods December 2008-March 2009 and August-October 2012 were forwarded to the author. These records included common bottlenose dolphin, Atlantic spotted dolphin (*Stenella frontalis*) and short-finned pilot whale (*Globicephala macrorhynchus*).

There is a growing need to identify critical areas for marine biodiversity conservation, both locally and regionally. This paper describes the general occurrence of the cetacean community encountered in Suriname waters in summer. The study revealed that the offshore cetacean community in Suriname is best described as primarily a tropical community, dominated by odontocetes (dolphins and sperm whales). Although the species diversity was relatively high, the overall cetacean relative abundance index (number of animals *per* 100km effort) was low, which is consistent for tropical equatorial offshore waters. Apart from the sperm whale and the Guiana dolphin, all the other species recorded represent new species records for Suriname. It is recommended that more continuous monitoring in different seasons be carried out in order to gain a better understanding of the occurrence, distribution and status of the different cetacean species within the region.

Resumo. Pouca informação encontra-se disponível acerca de cetáceos nas Guianas: Suriname e seus países vizinhos, Guiana e Guiana Francesa. Durante um levantamento dedicado de cetáceos conduzido a partir de uma embarcação de sísmica nas águas de mar aberto do Suriname (maio-setembro 2012), a ocorrência de 13 espécies de cetáceos foi documentada, sendo 11 delas novos registros para aquela área. As espécies observadas pela autora incluíram cachalote (*Physeter macrocephalus*), baleia-de-bryde (*Balaenoptera edeni*), falsa-orca (*Pseudorca crassidens*), golfinho-cabeça-de-melão (*Peponocephala electra*), golfinho-dentes-rugosos (*Steno bredanensis*), golfinho-comum-de-bico-longo (*Delphinus capensis*), golfinho-de-fraser (*Lagenodelphis hosei*), golfinho-pintado-pantropical (*Stenella attenuata*) e golfinho-rotador (*Stenella longirostris*). Durante o deslocamento à área de levantamento (Trinidad ao Suriname), avistagens incidentais foram registradas, incluindo golfinho-nariz-de-garrafa-comum (*Tursiops truncatus*) em águas de Trinidad, *Stenella* sp. em águas da Guiana e boto-cinza (*Sotalia guianensis*) na entrada do Rio Suriname. Registros oportunistas dos períodos dezembro 2008 a março 2009 e agosto-outubro 2012 foram

encaminhados ao autor. Esses registros incluíram golfinho-nariz-de-garrafa-comum, golfinho-pintado-do-atlântico (*Stenella frontalis*) e baleia-piloto-de-peitorais-curtas (*Globicephala macrorhynchus*).

Existe uma necessidade crescente de identificar áreas críticas para a conservação da biodiversidade marinha, tanto a nível local quanto regional. Este artigo descreve a ocorrência geral da comunidade de cetáceos encontrada em águas do Suriname durante o verão. O estudo revelou que a comunidade de cetáceos de mar aberto do Suriname é melhor descrita como primariamente uma comunidade tropical, dominada por odontocetos (golfinhos e cachalotes). Embora a diversidade de espécies seja relativamente alta, o índice geral de abundância relativa de cetáceos (número de animais por 100km de esforço) foi baixo, o que é consistente para águas de mar aberto tropical equatorial. Exceto pelo cachalote e pelo boto-cinza, todas as demais espécies observadas representam novos registros para o Suriname. Recomenda-se a condução de monitoramento contínuo adicional em diferentes estações do ano, a fim de se obter um melhor entendimento da ocorrência, distribuição e status das diferentes espécies de cetáceos na região.

Introduction

A total of 31 cetacean species occur within the Wider Caribbean Region (WCR) but there is a marked lack of records in the Guianas (Sub-Region VI of the WCR, see Figure 1), which includes the countries of Guyana, Suriname and French Guiana¹ (Weir *et al.*, 2011; Mannocci *et al.*, 2013). The mammals of Suriname were listed by Husson (1978) and included six cetacean species that were either sighted in Suriname coastal waters or were found stranded. These were sperm whale (*Physeter macrocephalus*), Guiana dolphin (*Sotalia guianensis*), minke whale (recorded as *Balaenoptera bonaerensis* and *Balaenoptera acutorostrata*), fin whale *Balaenoptera physalus*) and sei whale (*Balaenoptera borealis*; Husson, 1978). The cetacean community is also under-recorded in the neighboring countries [French Guiana (Mannocci *et al.*, 2013) and Guyana²]. Recent aerial surveys reported the presence of cetaceans in French Guiana, including fin whale, sperm whale, Cuvier's beaked whale (*Ziphius cavirostris*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), common bottlenose dolphin (*Tursiops truncatus*) and Guiana dolphin (Mannocci *et al.*, 2013). In contrast, more detailed records exist for Venezuela in the southern Caribbean region (Romero *et al.*, 2001; Bolaños-Jiménez and Villarroel-Marín, 2003; Bermúdez-Villapol and Boher, 2003). Apart from a recent study on the Guiana dolphin³, cetacean research has been lacking for Suriname. The scarcity of cetacean records for Suriname can therefore be attributed to a lack of survey effort rather than an absence of marine mammals.

During the past two decades, awareness of marine mammals and their habitats in the WCR has increased (Hoyt, 2011). The Specially Protected Areas and Wildlife (SPAW)

Protocol, the regional agreement for biodiversity and for the advancement of the conservation and protection of the marine environment in the WCR, became international law in June 2000⁴. A specific marine mammal action plan was adopted in 2008 under the framework of the United Nations Environment Programme's (UNEP) Caribbean Environment Programme with the aims to provide training workshops on stranding response and networking, whale- and dolphin-watch training, and implementation of a regional manatee conservation plan (Hoyt, 2011). This has also resulted in an increase in conservation management action in the Guianas and neighboring countries along northeastern Latin America, ranging from northern Brazil to Venezuela, including Trinidad and Tobago and the 'ABC islands' (Aruba, Bonaire, Curaçao) of the Dutch Caribbean⁵.

The objectives of the study were to describe: (1) the occurrence of cetaceans in Suriname offshore waters; (2) their relative abundance; and (3) species diversity. In addition, we present information on anecdotal records for Suriname and adjacent waters. This study provides a list of cetacean species that have been recorded in Suriname waters. These baseline data can be used for future investigations and monitoring as well as for conservation and management of cetaceans in the Guianas.

Materials and Methods

Study Area

Suriname is located on the northeast coast of South America, bordering the Atlantic Ocean, with French Guiana to the east, Guyana to the west and Brazil to the southeast (Figure 1). The Guianas and the Eastern Venezuelan Atlantic

¹Ward, N., Moscrop, A. and Carlson, C. (2001) *Elements for the development of a marine mammal action plan for the wider Caribbean: a review of marine mammal distribution*. First Meeting of the Contracting Parties (COP) to the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region, Havana, Cuba. 83 pp.

²Kalamandeen, M. and Chesney, P. (2013) *Marine Mammals of Guyana*. Presented at the Marine Mammal Conservation Corridor for Northern South America workshop, Paramaribo, Suriname, 18-20 March 2013.

³M. Pool, pers. comm., 18 March 2013.

⁴UNEP, United Nations Environment Program (2012) *Report on the implementations of activities in support of the action plan for the conservation of marine mammals in the Wider Caribbean Region*. 7th Meeting of the Contracting Parties to the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region, Punta Cana, Dominican Republic, 23 October 2012. 5 pp.

⁵Brichet, M. (2012) Workshop 5: North East of South America, Regional Cooperation for a Marine Mammals Conservation Strategy Workshop – MAMA COCO SEA Project, in *Proceedings of the second International Conference on Marine Mammal Protected Areas*. ICMMPA 2: Endangered Spaces, Endangered Species, 7-11 November 2011, Fort-de-France, Martinique.

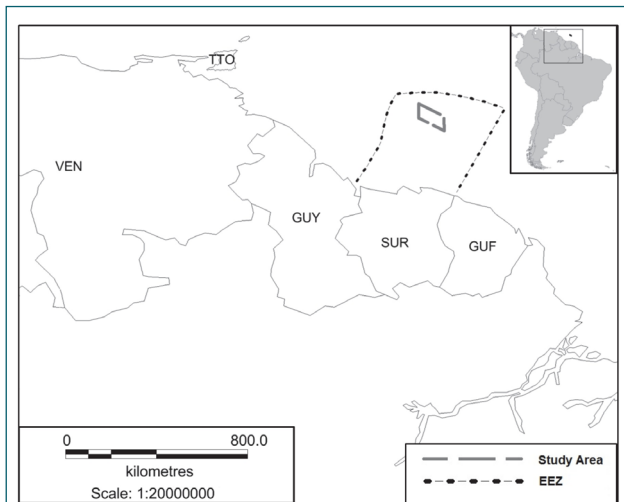


Figure 1. The Guianas: Guyana (GUY), Suriname (SUR) and French Guiana (GUF), Venezuela (VEN) and Trinidad and Tobago (TTO). The study area is shown in grey, and the outline of the Exclusive Economic Zone (EEZ) is also shown (some parts of the EEZ between Guyana and Suriname are disputed).

Front (also known as the Guiana Shield) are under the influence of the Amazon River. The typical ecosystems include estuaries, mudflats, sandy beaches, and mangrove forests, which extend along most of the largely unexplored coastline (Miloslavich *et al.*, 2011). The tides along the coast of Suriname are semi-diurnal with tidal amplitudes ranging 1.3-2.3m. Sea surface temperatures (SST) are almost constant throughout the year (27-29°C). Within the Guianas, the Guiana Current is the main current which is composed predominantly of the warm North Brazil Current which flows north along the northeastern coast of South America. Upon reaching French Guiana this current separates from the coast and joins the North Equatorial Countercurrent. The rest of the North Brazil Current continues flowing northwestward to form the Guiana Current (Condie, 1991). It is generally accepted that in Suriname's offshore areas the currents mainly flow from the southwest to the northeast quadrant and the highest current speeds are measured in April-May along the edge of the continental shelf⁶.

Dedicated survey (effort-related)

Dedicated (effort-related) cetacean observations were carried out within Suriname waters (08°29'N, 54°41'W) between 17 May and 3 September 2012 during a geophysical seismic survey onboard the *Western Regent*. The 93.2m-long vessel acted as a platform of opportunity where the distribution of survey effort was determined by parallel survey transects (n = 114) designed for the geophysical activities. The only sightings recorded, and used in this study, were when the vessel did not deviate from the track-line. The vessel left Trinidad on 15 May and transited to the prospect area which extended between 220 and 300km north of Paramaribo. There were three different survey periods (17 May-24 June;

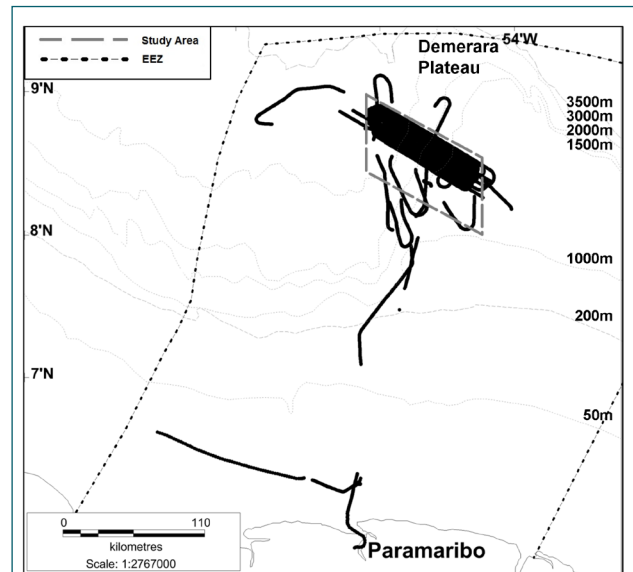
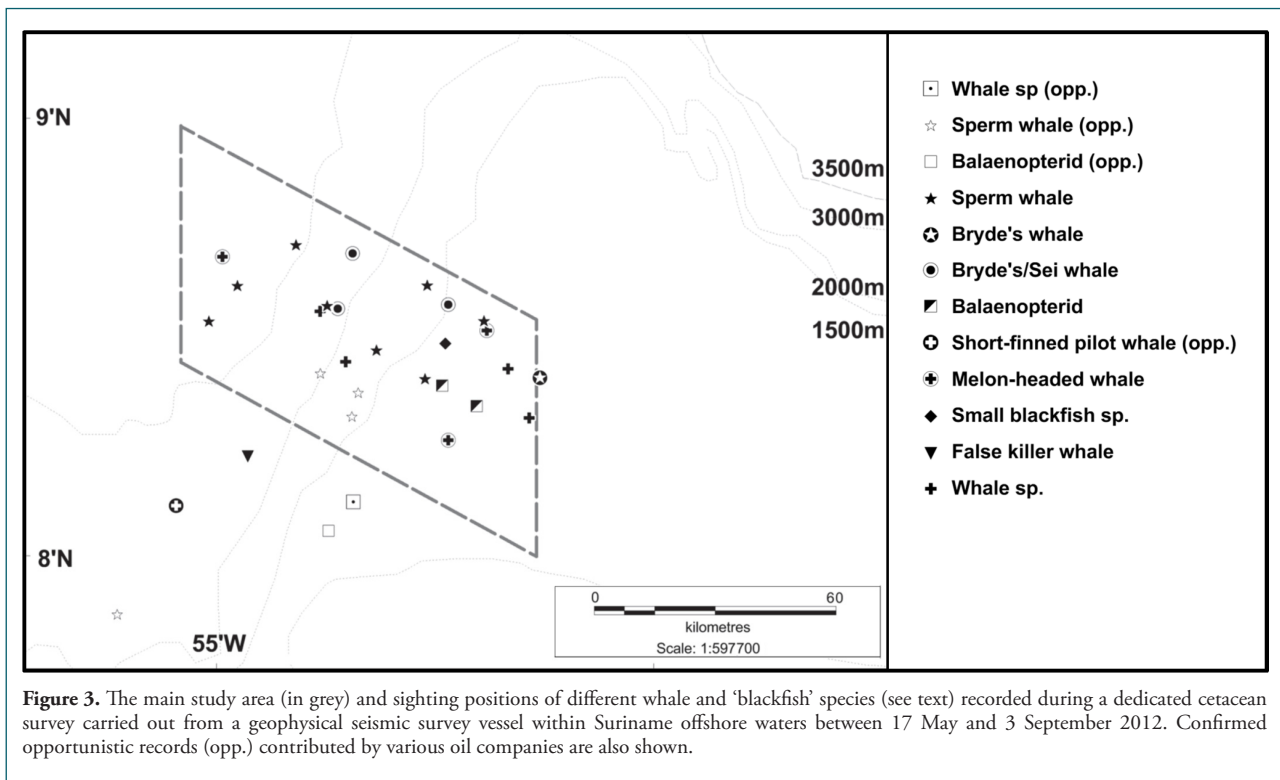


Figure 2. The main study area (in grey) where effort-related cetacean observations were carried out from a geophysical seismic survey vessel together with the GPS tracks (in black) within Suriname waters 17 May to 25 July 2012; some parts of the Exclusive Economic Zone between Guyana to the west and Suriname are disputed. No GPS tracks were available from 25 July onwards; however, effort-related observations continued from the survey vessel within the study area until 3 September 2012.

25 June-24 July; 25 July-3 September). The main survey area comprised of water depths between 1200-3600m and covered approximately 3000km² (Figure 2). The vessel operated with a speed over ground of *ca.* 4 knots. Observations were carried out during all daylight hours (09:00-22:00 UTC). During the survey, teams of two observers carried out observations of either 1.5 or 2 hours duration. Observational effort was conducted from the bridge wings and foredeck at 14m height with one observer monitoring ahead and to the port side of the vessel and the other observer watching ahead and to the starboard side. The observers scanned the sea predominately with the naked eye but used binoculars (8x43 and 10x42) for searching the horizon, aiding species identification and group-size estimations. Once a sighting was made the radial sighting distance was determined using person-specific range-sticks (Heinemann, 1981). The bearing to the sighted animals and their heading were estimated using the ship's mounted compasses which were positioned on both the starboard and portside bridge wings. Sightings data also included the time (UTC), GPS position, water depth, species identification, group-size and the presence of calves and/or subadults. DSLR cameras were used with zoom lenses (*e.g.* Sony 700alpha with a 200mm f2.8 lens and a Canon EOS550D with a 100-400mm f4.5-5.6 lens). Environmental observations were also collected during the survey, such as wind speed and direction (using the ship's wind meter), swell height and visibility (estimated by eye) and Beaufort sea state (BSS) according to the Beaufort scale. Water depth and SST were measured throughout the survey period (Acoustic Doppler Current Profiler data). A Garmin GPS (GPSMAP76CSx) was used to log the ship's position every

⁶Gyory, J., Mariano, A. and Ryan, E. (2005) *The Guiana Current*. Ocean Surface Currents. Available online at <oceancurrents.rsmas.miami.edu/atlantic/guinea.html>.



minute (Figure 2). During the third leg the author was not present; however, the two observers who were present on the first leg were again present during the third leg. All observers had previous experience of conducting cetacean surveys in tropical waters. Global positioning system, speed and course data were not continuously logged during the third leg; however, information on effort was provided as hours on watch.

Species categories

The tall, falcate dorsal fins of Bryde's whales (*Balaenoptera brydeiedeni*; e.g. Notarbartolo di Sciarra⁷) are easily confused with those of sei whales. Baleen whales too distant from the vessel to allow definite identification (>1km) were therefore classed as 'balaenopterid' (i.e. large rorqual with vertical blow and well-defined fin; definitely not blue or humpback whale) or 'Bryde's/Sei whale' (i.e. large rorquals with prominent, upright and falcate dorsal fin). Depending on sighting distance and glare intensities, similar looking dolphins were classed as follows: *Stenella/Delphinus* sp. (definitely one of the five *Stenella* species: pantropical spotted, Atlantic spotted, spinner, clymene, striped and/or *Delphinus* species); '*Stenella* sp.' (i.e. definitely a *Stenella* species with a mid-length beak: pantropical spotted, Atlantic spotted, clymene or striped; but definitely not spinner dolphin or long-beaked common dolphin); 'spinner/clymene sp.' (i.e. small active dolphins seen

'spinning' and likely to be one of these two species); or 'small blackfish sp.' (melon-headed whale or pygmy killer whale). All other unidentified animals were classed as 'dolphin sp.' or 'whale sp.'

Data analysis (effort-related)

The data in the present study are not suitable to estimate the abundance of species because the survey track-lines fail to provide equal coverage probability (e.g. Buckland *et al.*, 2001). Instead, the relative abundance (or encounter rate) was measured and expressed as the number of individuals per 100km effort (BSS ≤ 4, swell ≤ 4m, visibility ≥ 1km). However, these relative abundances were only calculated for legs 1-2 for which detailed GPS tracks were available.

The bearing and distance to sightings were used to estimate the position of each sighting taking into account the location of the vessel at the time of the sighting and the observation eye-height (using the GEOFUNC Software with spherical trigonometry functions⁸). All GPS records were imported into MapInfo Geographic Information System (v. 11) using the projection WGS84.

To estimate species diversity, the Shannon-Wiener index was calculated. Only sightings which were identified to species level were used (Ricklefs, 2007): $H = -\sum P_i * \ln P_i$, where H is a measure of diversity and P_i is the proportion of individuals belonging to species *i*.

⁷Notarbartolo di Sciarra, G.N. (1983) *Bryde's whales* (*Balaenoptera edeni Anderson 1878*) off eastern Venezuela (*Cetacea Balaenopteridae*). Hubbs Sea World Research Institute, Technical Report 83-153. 15 pp.

⁸NOAA National Oceanic and Atmospheric Administration - National Marine Mammal Laboratory (2013) Software - Excel Geometry Functions. Available online at <www.afsc.noaa.gov/nmml/software/excelgeo.php>. Consulted on 1 March 2013.

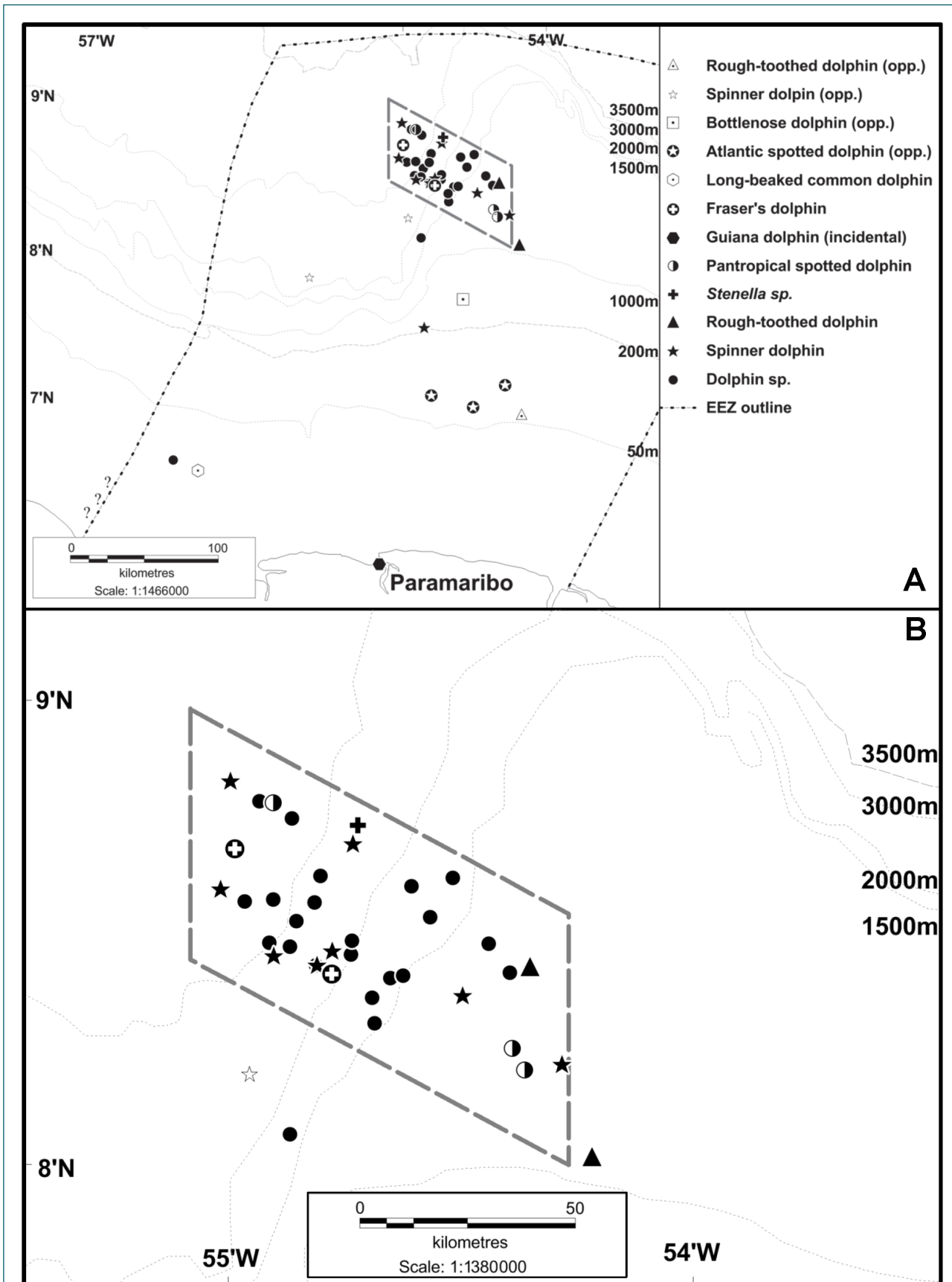


Figure 4. The main study area (in grey) and sighting positions of different dolphin species recorded during a dedicated cetacean survey carried out from a geophysical seismic survey vessel within Suriname offshore waters between 17 May and 3 September 2012. Confirmed opportunistic records (opp.) contributed by various oil companies are also shown together with incidental records made during transits to and from the study area (some parts of the EEZ between Guyana and Suriname are disputed). All sighting records are shown at the top (A) and those within the study area are separately shown below (B).

Table 1. Summary of cetacean sightings and number of animals (N) recorded during the dedicated (effort-related) survey in Suriname (Legs 1-3), including information regarding incidental sightings recorded during transit to and from the study area. Those incidental sightings recorded in the waters of Trinidad/Guyana are marked (*). Opportunistic records (non-effort related at-sea sightings forwarded by oil companies) and strandings (†) previously recorded in Suriname are also listed.

Species	All sightings (n)	S (n)	S (n)	S (n)	Incidental Sightings (n)	Relative Abundance Index (encounter rate n/100km)	Opportunistic Records and Strandings† (n)
Cetacean species	Leg 1-3	Leg 1	Leg 2	Leg 3	Leg1-3	Leg1-2	Other
<i>Balaenoptera physalus</i>	-	-	-	-	-	--	2† (2)
<i>Balaenoptera edeni</i>	1 (1)	1 (1)	-	-	-	0.016	-
<i>Balaenoptera borealis</i>	-	-	-	-	-	--	1† (1)
Sei/Bryde's whale	3 (5)	1 (3)	2(2)	-	-	0.082	-
Balaenopterid	2 (2)	-	2 (2)	-	-	0.033	3 (4)
<i>B. acutorostrata/bonaerensis</i>	-	-	-	-	-	--	2† (2)
<i>Balaenoptera bonaerensis</i>	-	-	-	-	-	--	1† (1)
<i>Physeter macrocephalus</i>	8 (67)	1 (20)	5 (38)	2 (9)	-	0.955	4, 1† (27, 1†)
<i>Globicephala macrorhynchus</i>	-	-	-	-	-	--	1 (8)
<i>Pseudorca crassidens</i>	1 (3)	-	1 (3)	-	-	0.049	-
<i>Peponocephala electra</i>	3 (520)	1 (120)	1 (200)	1 (200)	-	5.269	-
Small Blackfish sp.	1 (30)	-	1 (30)	-	-	0.494	-
<i>Stenella longirostris</i>	9 (410)	-	4 (155)	5 (255)	1 (5)	2.552	2 (250)
<i>Stenella attenuata</i>	3 (290)	-	1 (60)	2 (230)	-	0.988	-
<i>Stenella frontalis</i>	-	-	-	-	-	--	3 (65)
<i>Lagenodelphis hosei</i>	2 (90)	-	1 (30)	1 (60)	-	0.494	-
<i>Delphinus capensis</i>	1 (50)	1 (50)	-	-	-	0.823	-
<i>Steno bredanensis</i>	2 (65)	-	1 (40)	1 (25)	-	0.659	1 (3)
<i>Tursiops truncatus</i>	-	-	-	-	1* (14)	--	1 (10)
<i>Sotalia guianensis</i>	-	-	-	-	2 (13)	--	(Resident)
<i>Stenella</i> sp.	1 (30)	-	1 (30)	-	1, 1* (4, 4)	0.494	-
'Dolphin sp.'	24 (582)	6 (123)	6 (85)	12 (374)	1,3* (2, 19*)	3.425	-
'Whale sp.'	4 (4)	1 (1)	2 (2)	1 (1)	-	0.049	2 (3)
Total	65 (2149)	12 (318)	28 (677)	25 (1154)	10 (61)	16.38	17, 7† (370, 7†)

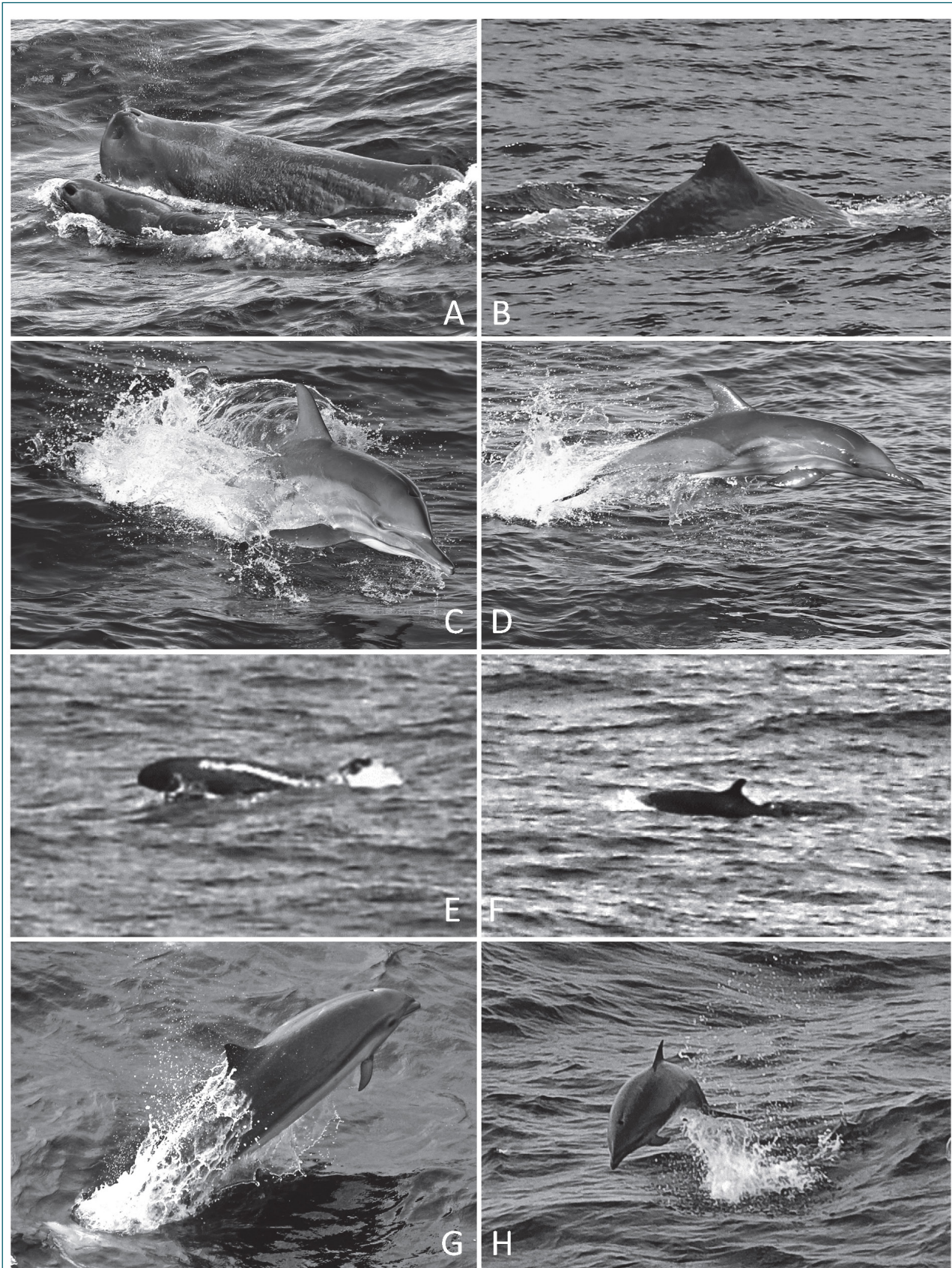


Figure 5. Photographs of sperm whale (*Physeter macrocephalus*) with calf (A), adult sperm whale (B), long-beaked common dolphin (*Delphinus capensis*; C-D), false killer whale (*Pseudorca crassidens*; E-F) and Fraser's dolphin (*Lagenodelphis hosei*; G-H). Photographs © M. de Boer (A, C-F, H), J. Saulino (B) and A. Williams (G).

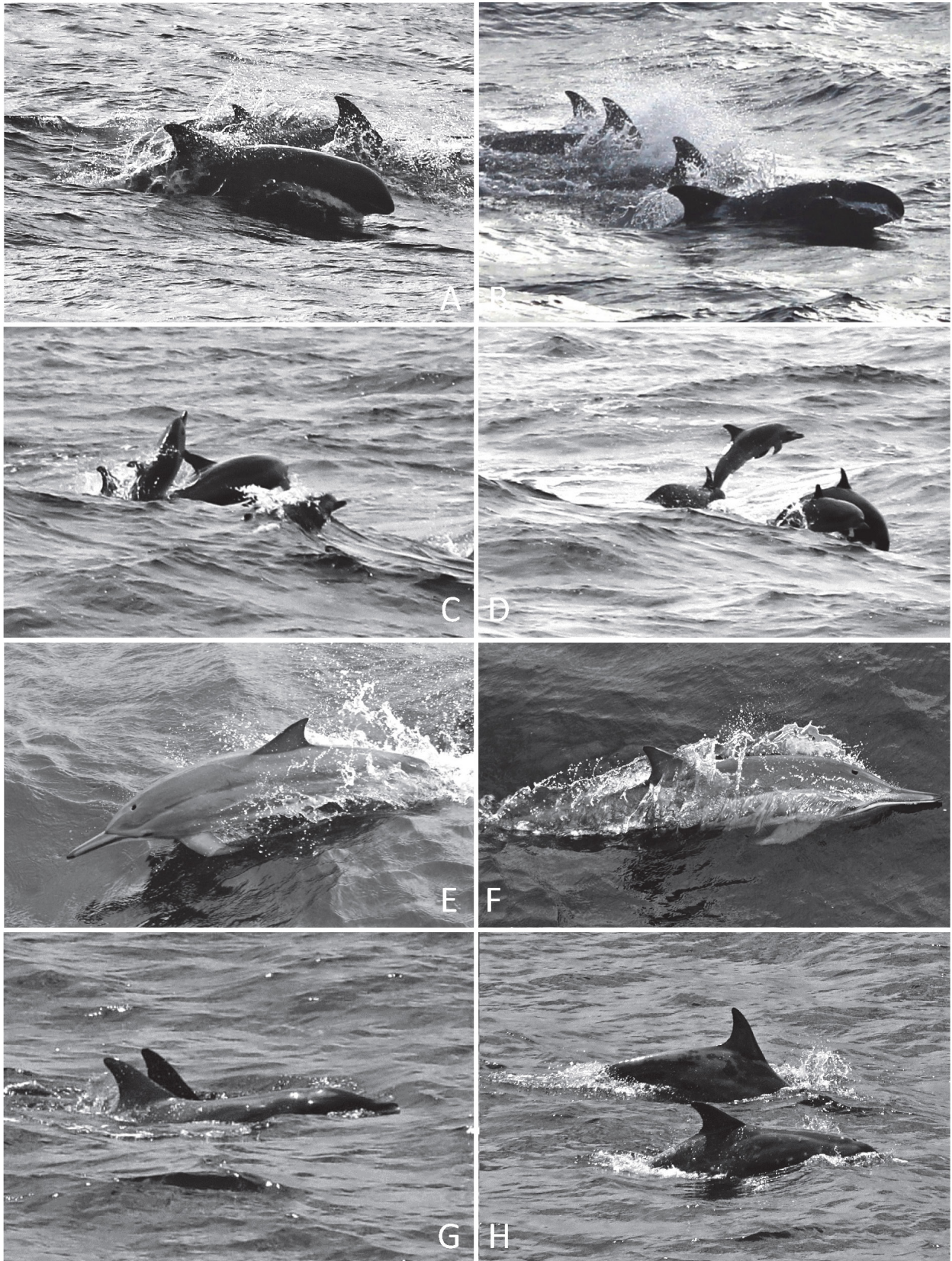


Figure 6. Photographs of melon-headed whale (*Peponocephala electra*; A-B), pantropical spotted dolphins (*Stenella attenuata*) with calf (C-D), spinner dolphin (*Stenella longirostris*; E-F) and rough-toothed dolphins (*Steno bredanensis*; G-H). Photographs © M. de Boer (E-H) and A. Williams (A-D).

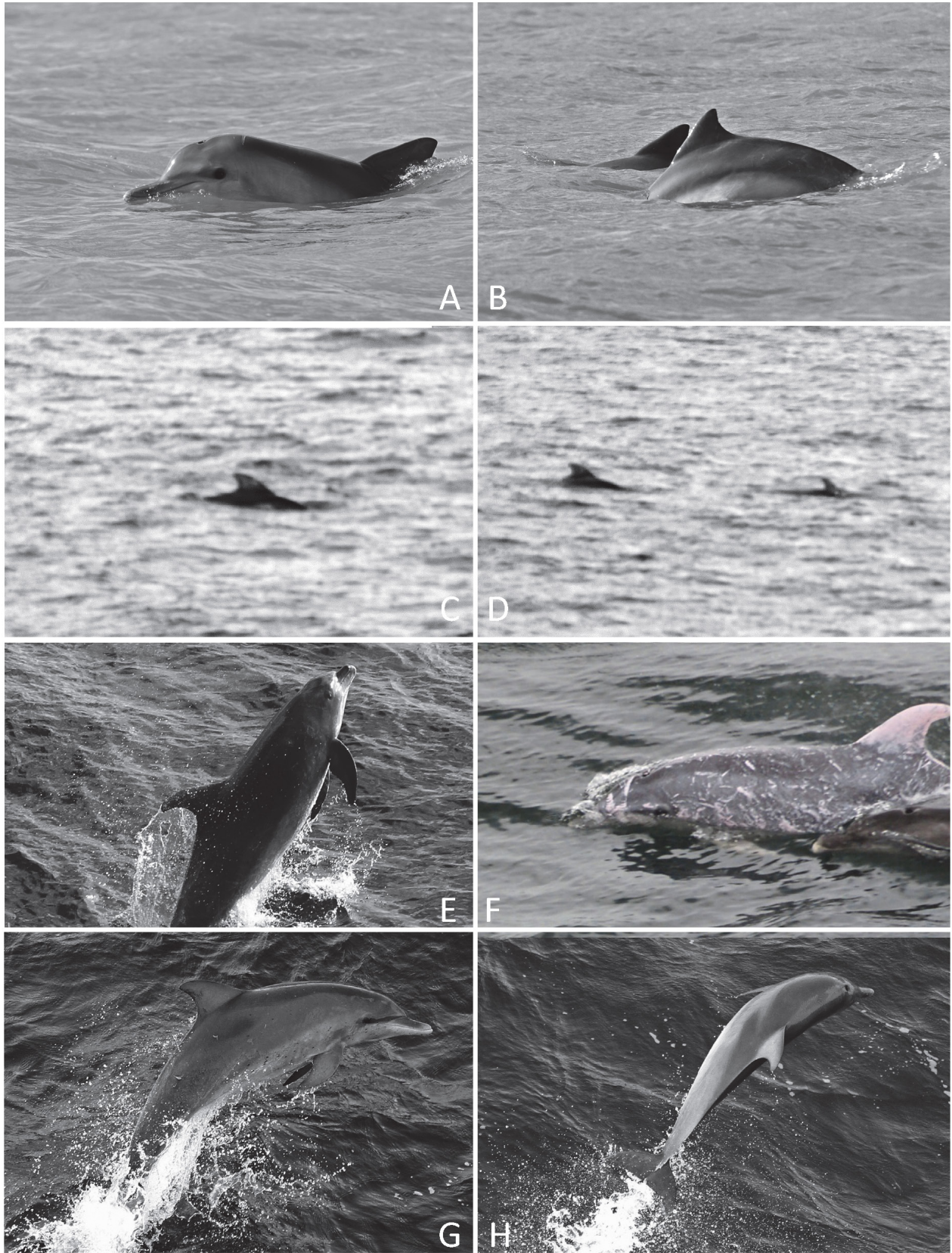


Figure 7. Photographs of Guiana dolphin (*Sotalia guianensis*; A-B), short-finned pilot whale (*Globicephala macrorhynchus*; C-D), bottlenose dolphin (*Tursiops truncatus*; E-F) and Atlantic spotted dolphin (*Stenella frontalis*; G-H) in Suriname. Photographs © M. de Boer (A-B, E-H) and F. Penin (C-D).

Incidental sightings (off-effort)

Cetacean sightings recorded during transit or those recorded when conditions were poor (*i.e.* BSS > 4, swell > 4m and visibility < 1km) were regarded as *incidental* (*i.e.* 'off-effort'). The species identification was checked and verified using written descriptions and photographs.

Opportunistic records (not effort-related)

Oil companies were contacted to request information about observed cetaceans within Suriname waters. These opportunistic records were integrated into the analysis only when verifying information in the form of photographs was available. Specimens of stranded cetaceans were inspected at the National Zoological Collection of Suriname (NZCS) in Paramaribo.

Results

Dedicated survey (effort-related)

A total of 1268hrs of observational effort were carried out in fair weather conditions (BSS 0-4, swell ≤ 4m and visibility ≥ 1km). During Leg 1 a total of 389hrs of effort (2922km) and during Leg 2 a total of 376hrs of effort (3151km) were carried out. During the third leg a total of 503hrs of effort were carried out. A total of 68 effort-related sightings and 2152 animals were recorded. An additional 10 incidental sightings were also recorded (Table 1). A total of 44.1% of sightings remained unidentified (n = 30) due to their distance from the vessel. In addition, 11.8% of sightings were identified to species categories (*i.e.* similar looking species; n = 8). During transits (Trinidad to Suriname) a total of five incidental sightings were recorded. Whilst off Trinidad these included a sighting with 14 bottlenose dolphins and one with unidentified dolphins and whilst off Guyana, a further two sightings were recorded involving 'dolphin sp.' and a group of four *Stenella* sp. (Table 1). The dedicated survey was carried out in waters with depths of 1000-2000m (51.3%) whilst 1.4% was carried out in waters with depths < 1000m, 35% between 2000-3000m and 12.2% > 3000m. The SSTs recorded during the survey ranged from 26 to 30°C (mean 28.3°C). The SSTs were the highest between 11 June and 22 July and again between 16-24 August. The vessel was in seismic operation for 57.2% of the visual effort and data presented here are potentially influenced by unknown reactions of cetaceans to seismic operations. The species richness during the dedicated survey was nine. The Shannon-Wiener diversity index was 1.62 for the whole survey period.

The different species encountered and the species categories are described below. The sightings are depicted in Figures 3 and 4 and photographic evidence for each species can be found in Figures 5 to 7.

Bryde's whale (*Balaenoptera edeni*): The taxonomic status of Bryde's whale is complex and *B. edeni* is used here

to refer to this species⁹. Three sightings of Bryde's/Sei whale were recorded, one sighting was confirmed as Bryde's whale through acoustic recordings and two balaenopterids were seen at close distances (*i.e.* at 400m a juvenile, and at 700m an adult). The confirmed Bryde's whale was seen in waters with a depth of 1225m whilst the other whales were seen in 1217-2241m water depth. All baleen whales were sighted between 14 June and 19 July.

Sperm whale (*Physeter macrocephalus*): Sperm whales were the most abundant whale species (0.955 ind./100km; Table 1). An estimated 67 animals (including several subadults, at least three calves and no adult males) were seen in waters with an average depth of 2152m (SD = 711.4m; range = 1293-2974m) between June-August. The group sizes ranged from two to 20. On one occasion, a small calf was seen making several short peduncle dives, behavior which has been described as indicative of suckling¹⁰.

Melon-headed whale (*Peponocephala electra*): Three sightings were made of melon-headed whales involving 485 animals (28 subadults, 7 calves). They were associating with Fraser's dolphins (*Lagenodelphis hosei*) and floating mats of *Sargassum*. This species was seen in 1191-3063m water depth and sightings occurred on 9 June (120 animals), 28 June (200 animals) and 30 July (200 animals).

False killer whale (*Pseudorca crassidens*): On 13 July, a group of three false killer whales was photographed in 2444m water depth.

Rough-toothed dolphin (*Steno bredanensis*): Rough-toothed dolphins were seen on two occasions: a) 1 July: water depth 1018m, group size 40 and b) 24 August: water depth 1241m, group size 25. The group sighted on 1 July was observed for almost one hour and included one subadult and one calf.

Fraser's dolphin (*Lagenodelphis hosei*): Fraser's dolphins were sighted on two occasions (28 June and 20 August). The first record was a group of at least 30 to 40 dolphins which were associating with a group of melon-headed whales (water depth: 3063m). The second encounter involved at least 60 dolphins, not associated with other species (water depth: 2100m).

Common bottlenose dolphin (*Tursiops truncatus*): One incidental sighting of common bottlenose dolphin was recorded off Trinidad. The group of 14 was briefly bow-riding the vessel (water depth: 48m). One adult displayed a large degree of scarring and was unusually pale and pinkish in colour (Figure 7F). This species was also recently recorded and photographed by the author in the coastal waters of Suriname (June 2013; Figure 7E).

⁹IUCN, International Union for Conservation of Nature (2013) *Status of the world's cetaceans*. IUCN-SSC Cetacean Specialist Group. Available online at <www.iucn-csg.org/index.php/status-of-the-worlds-cetaceans/>. Consulted on 18 July 2013.

¹⁰Gero, S. and Whitehead, H. (2006) Opportunistic sightings of small cetaceans off the leeward shore of the Commonwealth of Dominica. Paper SC/58/SM1 presented at the 58th annual meeting of the Scientific Committee of the International Whaling Commission, St Kitts and Nevis, 16-20 June 2006.

Pantropical spotted dolphin (*Stenella attenuata*): Three encounters were recorded with pantropical spotted dolphins in 1140-3043m water depth (11 July, 7 and 10 August) with group sizes ranging from 30 to 200.

Spinner dolphin (*Stenella longirostris*): Eight sightings of spinner dolphins were recorded between 11 July and 3 September and one incidental sighting was recorded during transit on 25 July whilst heading back to Paramaribo. The dolphins were seen in waters with a mean depth of 2251m (SD = 720.95, n = 8, range = 1154-3094m) but the incidental sighting occurred in waters with a depth of 200m. The group size ranged between 5-100 animals (at least 14 subadults and four calves).

Stenella sp.: Two sightings were recorded involving *Stenella* sp. and one sighting was recorded off Guyana on 16 May in 78.6m water depth.

Long-beaked common dolphin (*Delphinus capensis*): On 17 May long-beaked common dolphins were observed whilst in transit between Trinidad and Suriname at a distance of 66km from the coast (water depth: 35.8m). This species was also recently recorded and photographed by the author in the coastal waters of Suriname (June 2013; Figure 5C-D).

Guiana dolphin (*Sotalia guianensis*): The Guiana dolphin was seen on two occasions at the mouth of the Suriname River during transits to and from the study area.

Opportunistic records (not effort-related)

A total of 17 opportunistic records were accepted which related to the periods December 2008-March 2009 and August-October 2012 (Table 1; Figures 2-3).

Mysticetes: Two sightings with large whales were recorded as humpback whale (*Megaptera novaeangliae*) in October 2012. However, no photographs were available to confirm species and these sightings were therefore classed as 'whale sp.'. Three sightings of unidentified large balaenopterids were recorded on 2 October 2012 (water depth: 1282-1776m).

Odontocetes: Sperm whales were recorded in September 2012, totaling four confirmed sighting records of 27 animals. Short-finned pilot whales (*Globicephala macrorhynchus*) were recorded on 7 September 2012 in 2549m water depth (Figure 7). Rough-toothed dolphins were recorded once in shallow waters (49m) in January 2009. Two sightings of spinner dolphins were recorded in the months of August and September (water depths: 1946-1974m). One sighting involving bow-riding bottlenose dolphins was recorded on 8 October 2012 in 451m water depth. Three sightings of Atlantic spotted dolphin (*Stenella frontalis*) were recorded between December 2008 and March 2009. The water depths ranged between 57 and 72m. This species was also recently recorded on several occasions by the author in the coastal waters of Suriname (June 2013; Figure 7G-H).

Discussion

Records of cetacean species in Suriname waters were anecdotal and this study confirmed the presence of 13 species,

of which 11 are new species records for Suriname. The most abundant species were the sperm whale and melon-headed whale. It was found that the spinner dolphin and pantropical spotted dolphin were also frequently encountered in large groups. The relative abundance index for all cetaceans (16.38 inds/100km) was relatively low as was expected considering the survey was confined to deep water only (1200-3300m). When comparing these estimates to other systematic surveys in tropical regions in the east Atlantic, off Gabon in west Africa, the estimates were found to be much higher in areas which spanned both deep and shallow waters (20.9 inds/100km; De Boer, 2010). Indeed, tropical shallow shelf waters, for example off the Maldives in the Indian Ocean, generally hold a much more diverse and abundant cetacean community (35.3 inds/100km; Clark *et al.*, 2012).

The diversity of cetaceans, as measured by the Shannon-Wiener index, was relatively high (1.62). This index assumes that all species are represented in a sample and that they are randomly sampled (Ricklefs, 2007). This is difficult to achieve with the current survey design; however, the four months duration of the dedicated study together with the systematic transect lay-out probably increased our chances of recording different species. The present index is similar to those presented for Aruba (1.29) by Luksenburg (2013). Various other studies have used the Shannon-Wiener index to measure local diversity of cetaceans (Dulau-Drouot *et al.*, 2008; Gannier, 2009; Kizka *et al.*, 2010); however, comparison with the present study is hampered by differences in spatial and temporal sampling effort among survey areas.

Caution is also required because overt responses to the seismic sound source by some cetacean species may have occurred. For example, responses by short-finned pilot whales and Atlantic spotted dolphin were documented off west Africa¹¹ (Weir, 2008a, b).

Species accounts

Mysticetes: Bryde's whales off the north coast of Venezuela (Oleson *et al.*, 2003) have low frequency calls with a specific frequency of 44Hz which was close to those recorded during the present detection (a 40Hz signal was located in approximately the same position where the whale was seen at the time of the sighting¹². This species is the only baleen whale present year-round in significant numbers within the WCR¹³

¹¹Cerchio, S., Collins, T., Strindberg, S., Bennett, C. and Rosenbaum, H. (2010) Humpback whale singing activity off northern Angola: an indication of the migratory cycle, breeding habitat and impact of seismic surveys on singer number in breeding stock B1. Paper SC/62/SH12 presented at the 62nd annual meeting of the Scientific Committee of the International Whaling Commission, Agadir, Morocco, 21-25 June 2010.

¹²De Boer, M.N., Riechelt, M., Saulino, J., Williams, A., Baines, M. and Lewis, T. (2012) *Marine Fauna Report to Tullow Oil*. Unpublished Report n°-6, RPS Energy, Axminster, UK. 5 pp.

¹³Reeves, R.R. (2005) Insights of marine mammals of the Wider Caribbean Sea Region (including the Gulf of Mexico) derived from whaling history documents. Pages 1-9 in *Proceedings of the Regional Workshop of Experts on the Development of the Marine Mammal Action Plan for the Wider Caribbean Region*, 18-21 July 2005, Bridgetown, Barbados.

and especially in the southern Caribbean (e.g. Notarbartolo di Sciarra⁷; Debrot *et al.*, 1998; Romero *et al.*, 2001). No other sightings or stranding records of Bryde's whales are known for Suriname or adjacent waters; however, they are common in Venezuela (Romero *et al.*, 2001; Acevedo-Galindo, 2007). The distribution of Bryde's whales appears to be seasonal with whales occurring mainly to the east between March and August whilst from August to December the whales occur further west⁷. This might explain the lack of sightings in the present survey from August onwards. In the coastal waters off central Venezuela, the Bryde's whale can be present between October and February¹⁴ (Acevedo-Galindo, 2007).

Odontocetes: Sperm whales were seen regularly and most frequently in the vicinity of the Demerara Plateau. In the northeast of the Caribbean, sperm whales are strongly seasonal and are rarely seen from April through September (Mignucci-Giannoni, 1998). In the southeast of the Caribbean, between November and March, sperm whales are consistently found (Ward *et al.*, 2001). Sightings and strandings of sperm whales have also been reported off Venezuela (Bolaños-Jiménez and Villarroel-Marín, 2008a). Three at-sea sightings were reported for French Guiana in October (Mannocci *et al.*, 2013). The present study highlights that this species is relatively abundant between June and September and that it uses the area for breeding/nursing.

Melon-headed whales were recorded in deep waters throughout this survey and within the region this species occurs in the Gulf of Mexico, off the Lesser Antilles and Dominica (Ward *et al.*, 2001). A mixed group of melon-headed whales and Fraser's dolphins was reported off Carriacou¹⁵. Records exist for Puerto Rico and Venezuela (Mignucci-Giannoni, 1998; Bolaños-Jiménez and Villarroel-Marín, 2003).

False killer whales were seen only once and the distribution of this species in the Caribbean is poorly known (Ward *et al.*, 2001). In the southern part of the Caribbean, it has been reported in Colombia (Alberico *et al.*, 2000; Pardo *et al.*, 2009), Aruba (Luksenburg, 2011) and the coastal waters of Venezuela (Bermúdez-Villapol and Boher, 2003; Romero *et al.*, 2001).

Short-finned pilot whales were recorded on only one occasion in September yet this species is regarded as very common in the Caribbean (Ward *et al.*, 2001). Off French Guiana this species was recorded regularly in October

(Mannocci *et al.*, 2013) and also during boat-based surveys (September-December 2009)¹⁶. Pilot whales have also been recorded in Venezuela but only in the eastern waters (e.g. Romero *et al.*, 2001).

Rough-toothed dolphins were observed on three occasions and this species is generally regarded as uncommon in the Caribbean with reports for the Gulf of Mexico, the West Indies, Colombia, Venezuela (e.g. Romero *et al.*, 2001) and off Aruba (Luksenburg, 2013). Off French Guiana this species was validated by Van Canneyt *et al.*¹⁷

Fraser's dolphins were encountered on two occasions yet no records for Suriname or adjacent waters currently exist. Within the Atlantic Ocean the reported number of sightings of Fraser's dolphins is low (e.g. Hersh and Odell, 1986; Weir *et al.*, 2013). Records exist from the Puerto Rican Bank (Mignucci-Giannoni *et al.*, 1999), the Lesser Antilles including Dominica, St. Vincent, the Grenadines¹⁸ (Caldwell *et al.*, 1976) and the Gulf of Mexico (Würsig *et al.*, 2000). Other sightings, offshore Guadeloupe, offshore Carriacou and offshore La Martinique have also been reported^{15, 19, 20, 21}. Recently, Fraser's dolphins were reported off the leeward shore of Dominica¹⁰ and offshore Montserrat (Weir *et al.*, 2011). Within the region, two dolphins stranded in Venezuela (June 1999; Bolaños-Jiménez and Villarroel-Marín, 2003) and one dolphin stranded on Bonaire (August 2011; Witte *et al.*, 2012).

Common bottlenose dolphins were recorded twice and are generally described as common in the coastal waters and outer edge of the continental shelf in the Gulf of Mexico and in the waters of the Caribbean and southwards to Venezuela and Brazil (Swartz and Burks, 2000; Ward *et al.*, 2001). In the Venezuelan Atlantic, near Trinidad and Tobago, this species has been observed in mixed aggregations with Atlantic spotted dolphin¹⁴. Bottlenose dolphins were reported in high densities in the continental slope zone off French Guiana (Mannocci *et al.*, 2013) and probably regularly occur within the Guiana Shield.

¹⁴Bolaños-Jiménez, J., Guada, H. and Lentino, M. (2007) 7. Fauna Relevante. Pages 120-133 in Martín, A., Malavé, L., Sánchez, D., Aparicio, R., Arocha, F., Bone, D., Bolaños, J.A., Bolaños-Jiménez, J., Castañeda, J., Cárdenas, J.J., Carbonini, A.K., Díaz, Y.J., Guada, H.J., Klein, E., Lazo, R., Lemus, A., Lentino, M., Lira, C., Lodeiros, C., López, R., Marín, B., Martínez, G., Márquez, B., Márquez, A., Molinet, R., Morales, F., Posada, J., Prieto, A., Riera, A., Rodríguez, C.T., Ramírez, A., Senior, W., Solana, P., Severejn, H., Spiniello, P., Valera, E., Yanes, E. and Zoppi, E., Eds (2007) *Línea base ambiental plataforma Deltana*. Petróleos de Venezuela, S.A., Caracas, Venezuela.

¹⁵IFAW, International Fund for Animal Welfare (1996) *Cetacean field research conducted from Song of the Whale off Dominica and Grenada: Spring 1996*. IFAW, Yarmouth Port, USA. 17 pp.

¹⁶Vines, J., Teixeira, M. and Paixão, I. (2010) *Marine mammal observer's report during Guiana Maritime 3D/2D seismic survey*, RPS Energy, Axminster, UK. 30 pp.

¹⁷Van Canneyt, O., Certain, G., Doremus, G., Laran, S., Ridoux, V., Bolaños, J., Jeremie, S. and Watremez, P. (2009) *Distribution and abundance of marine megafauna in French Guiana*, REMMOA Campaign - Guiana. CRMM, La Rochelle, France. 41 pp.

¹⁸ECCN, Eastern Caribbean Cetacean Network (2000) *Stranding and sightings database*, Bequia, St. Vincent and the Grenadines, West Indies.

¹⁹Boisseau, O., Carlson, C.A. and Seipt, I. (2000) *A report on cetacean research conducted by the International Fund for Animal Welfare (IFAW) off Guadeloupe, Dominica, Martinique, Grenada and Tobago from 12 January to 30 March 2000*. Unpublished Report to IFAW, Yarmouth Port, USA. 17 pp.

²⁰Rinaldi, C., Rinaldi, R. and Sahagian, P. (2006) Report of surveys conducted on small cetaceans off Guadeloupe 1998 to 2005. Paper SC/58/SM17 presented at the 58th annual meeting of the Scientific Committee of the International Whaling Commission, St Kitts and Nevis, 16-20 June 2006.

²¹Jérémie, S., Gannier, A., Bourreau, S. and Nicolas, J.C. (2006) Cetaceans of Martinique Island (Lesser Antilles): occurrence and distribution obtained from a small boat dedicated survey. Paper SC/58/SM23 presented at the 58th annual meeting of the Scientific Committee of the International Whaling Commission, St Kitts and Nevis, 16-20 June 2006.

Atlantic spotted dolphins were recorded only in shallow waters during this survey and no previous records for Suriname or adjacent waters currently exist. Off Venezuela, the species is widespread in both inshore and offshore waters (Romero *et al.*, 2001; Acevedo-Galindo, 2007), in Colombia it is found to be more common than pantropical spotted dolphins (Vidal, 1990; Pardo and Palacios, 2006) and this species was recently recorded off Aruba (Luksenburg, 2013).

Pantropical spotted dolphins were recorded in deep waters (> 1000m) and this species has been reported off the Dominican Republic, Dominica, St. Vincent and the Grenadines, St. Lucia, Tobago, Colombia (Ward *et al.*, 2001) and the ABC Islands (Debrot *et al.*, 1998) but only one record is known for Venezuela (eastern sector; Romero *et al.*, 2001). Confirmed at-sea sightings were reported off French Guiana between September-December 2009¹⁶.

Spinner dolphins were sighted regularly and mainly in deep waters and commonly occur in the Caribbean, the Gulf of Mexico, and throughout the West Indian chain southwards to Venezuela (Würsig *et al.*, 2000). The species has also been recorded in the Bahamas, Cuba, Puerto Rico, Dominica, St. Vincent, the Grenadines and the Caribbean in general (*e.g.* Jefferson and Lynn, 1994; Romero *et al.*, 2001). The species also occurs off the ABC Islands and they are fairly common off Venezuela (Debrot *et al.*, 1998; Romero *et al.*, 2001; Acevedo-Galindo, 2007; Luksenburg, 2011).

Long-beaked common dolphins were recorded on one occasion in shallow waters and this species commonly occurs along the eastern coasts of Venezuela in areas with coastal upwelling²² (Romero *et al.*, 2001). A recent review by Jefferson *et al.* (2009) shows that the species is expected to occur off the Guianas. The only reliable records are of a long-beaked common dolphin captured off Trinidad in April 2006²³, a stranding in the Gulf of Paria (Oviedo *et al.*, 2010), a sighting off Aruba (Luksenburg, 2013), and recently the species was validated for French Guiana¹⁷, central-western Venezuela²² and Colombia (Palacios *et al.*, 2012). The species has not been confirmed to occur in most of the Caribbean Sea, *i.e.* Central America, Greater Antilles or West Indies (Jefferson *et al.*, 2009).

Guiana dolphins were recorded at the entrance of the Suriname River. This coastal species is the most frequently encountered cetacean in Suriname which may swim up rivers, particularly during the dry season, when the saltwater incursion is further upriver and the salinity is high enough (Gómez-Salazar *et al.*, 2010). Recently, causes for concern were raised regarding dolphin displacement following river seismic activities in Suriname (Pool, 2012). The Guiana dolphin is known to be incidentally killed in gillnets at the

mouths of the Suriname and Coppename rivers and also in French Guiana²⁴ (Husson, 1978; Van Waerebeek, 1990; Vidal *et al.*, 1994). The Guiana dolphin is listed as vulnerable in Venezuela (Bolaños-Jiménez *et al.*, 2008) and its status in Suriname has yet to be established.

Previous records for Suriname

Several cetacean species have previously been reported in Suriname waters (Husson, 1978; Table 1).

Mysticetes: A stranding of a sei whale was recorded in 1964 in northwestern Suriname (Husson, 1978) and the skull of this specimen was recently examined by the author at the National Zoological Collection of Suriname (NZCS) in Paramaribo. It was concluded that the skull probably was that of a sei whale²⁵. There are a few records for sei whales in the Caribbean and the species is considered rare⁷ (Romero *et al.*, 2001).

Two or three records of fin whale are reported for Suriname in 1910 and 1923 (Husson, 1978). The baleen morphology as shown in Husson (1978) seems to be consistent with that of the fin whale although physical inspection of the baleen would be required to exclude other large rorquals²⁵. The author could not locate the fin whale specimens at the NZCS. There are a few records for fin whales for the Caribbean (Slijper *et al.*, 1964), for Colombia (Prieto Rodríguez, 1988; Vidal, 1990); Venezuela²⁶ (Swartz and Burks, 2000; Romero *et al.*, 2001) and the Gulf of Mexico (Jefferson and Schiro, 1997). On the basis of a stranding in August and a sighting in March, Bolaños-Jiménez and Villarroel-Marín (2008b) speculated that Venezuelan waters could be visited by fin whales coming from both the northern and southern hemispheres. More recently, fin whales were sighted off French Guiana during aerial surveys in October 2008 (Mannocci *et al.*, 2013).

The skeleton of a minke whale (unknown stranding date) was collected around 1923 or 1924 near Coppename Punt in Suriname and identified by Husson (1978) as *Balaenoptera acutorostrata*. However, the identification cannot be verified, as insufficient voucher material is available. More recently, another minke whale stranded in Suriname (approximately 12 years ago²⁷), but no associated data appear to exist. Only occasional records of common minke whale are known for the northeastern Caribbean (Rice, 1998). Another record of minke whale involved an animal seen swimming in the Coppename River in October 1963 which was subsequently killed and identified as Antarctic minke whale *B. bonaerensis* (Husson, 1978). This specimen showed a wide, conspicuous dark band along the outer margin of the baleen plates which

²²Bolaños-Jiménez, pers. comm., 18 December 2014.

²³Boisseau, O., Leaper, R. and Moscrop, A. (2006) Observation of small cetaceans in the eastern Caribbean. Paper SC/58/SM24 presented at the 58th annual meeting of the Scientific Committee of the International Whaling Commission, St Kitts and Nevis, 16-20 June 2006.

²⁴Plouvier, D., Gomes, L., Verweij, P. and Verlinden, N. (2012) *Living Guianas*. WWF-Guyana Report. 84 pp.

²⁵K. Van Waerebeek, pers. comm., 22 May 2013.

²⁶Lira, C., Bolaños, J. and Mondolfi, E. (1995) On two strandings of fin whale (*Balaenoptera physalus*) and its presence in Venezuelan waters. Page 169 in Abstracts, XI Biennial Conference on the Biology of Marine Mammals, 18-21 December 1995, Orlando, Florida, USA.

²⁷P. Oubote, pers. comm., 15 March 2013.

Table 2. List of cetaceans occurring off Venezuela, Suriname and French Guiana, including strandings (†), sightings (x) and those expected to occur based on records elsewhere within the Wider Caribbean Region.

Species	Latin name	Venezuela	Suriname	French Guiana
Humpback whale	<i>Megaptera novaeangliae</i>	x	(unconfirmed)	x
Fin whale	<i>Balaenoptera physalus</i>	x	†?	x
Sei whale	<i>Balaenoptera borealis</i>		†	
Bryde's whale	<i>Balaenoptera edeni</i>	x	x	expected
Common minke whale	<i>Balaenoptera acutorostrata</i>		†	
Antarctic minke whale	<i>Balaenoptera bonaerensis</i>		†	
Sperm whale	<i>Physeter macrocephalus</i>	x	x, †	x
Dwarf sperm whale	<i>Kogia sima</i>	x	expected	expected
Pygmy sperm whale	<i>Kogia breviceps</i>	expected	expected	expected
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	x	expected	x
Gervais' beaked whale	<i>Mesoplodon europaeus</i>	x	expected	expected
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	expected	expected	expected
Killer whale	<i>Orcinus orca</i>	x	expected	x
Pygmy killer whale	<i>Feresa attenuata</i>	x	expected	expected
Melon-headed whale	<i>Peponocephala electra</i>	x	x	x
False killer whale	<i>Pseudorca crassidens</i>	x	x	x
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	x	x	x
Risso's dolphin	<i>Grampus griseus</i>	x	expected	x
Bottlenose dolphin	<i>Tursiops truncatus</i>	x	x	x
Rough-toothed dolphin	<i>Steno bredanensis</i>	x	x	x
Long-beaked common dolphin	<i>Delphinus capensis</i>	x	x	x
Striped dolphin	<i>Stenella coeruleoalba</i>	x	expected	x
Fraser's dolphin	<i>Lagenodelphis hosei</i>	x	x	expected
Pantropical spotted dolphin	<i>Stenella attenuata</i>	x	x	x
Atlantic spotted dolphin	<i>Stenella frontalis</i>	x	x	expected
Spinner dolphin	<i>Stenella longirostris</i>	x	x	x
Clymene dolphin	<i>Stenella clymene</i>	expected	expected	expected
Guiana dolphin	<i>Sotalis guianensis</i>	x	x, †	x

Data sources: Husson, 1978; Romero *et al.*, 2001; Ward *et al.*, 2001; Bolaños and Villarroel-Marín, 2003; Van Canneyt *et al.*, 2009; Vines *et al.*, 2010; Mannocci *et al.*, 2013; this study.

were recently inspected and photographed by the author at the NZCS in Paramaribo. The coloration and morphology of the baleen as shown by the photos are consistent with those of the Antarctic minke whale²⁵. A specimen of *B. bonaerensis* recently recorded in Togo (Gulf of Guinea, western Africa) led Segniagbeto and Van Waerebeek²⁸ to conclude that this species may at least occasionally cross the Equator into the Northern Hemisphere.

²⁸Segniagbeto, G. and van Waerebeek, K. (2010) A note on the occurrence and status of cetaceans in Togo. Paper SC/62/SM11 presented at the 62nd annual meeting of the Scientific Committee of International Whaling Commission, Agadir, Morocco. 21-25 June 2010.

Odontocetes: A sperm whale stranded in 1938 was described by Husson (1978). The Guiana dolphin was originally described by P.J. Van Bénédén in 1864 based on dolphins taken at the mouth of the Marowijne (Maroni) River (Husson, 1978), *i.e.* at the border area between French Guiana and Suriname.

Species Inventory

An inventory of the cetacean species for Suriname and those previously documented within the Guiana Shield and along the Venezuelan Atlantic region is shown in Table 2 and shows that Suriname has a species rich and diverse cetacean fauna. It is expected that increased future survey effort expanding to shelf and coastal waters and carried out year-round will likely result in the identification of additional species, especially those that are known to occur elsewhere within the WCR. The survey described here can only provide a 'snap shot' view of the presence and distribution of cetaceans recorded during the months May-September (dedicated survey) and August-March (opportunistic records). The data show that the Suriname cetacean community is primarily composed of odontocetes (sperm whales and dolphins). Mysticetes, particularly large balaenopterids, were also observed although their occurrence was probably seasonal with Bryde's/Sei whales recorded only during June and July when the SSTs were reaching 30°C. The opportunistic records highlighted that large baleen whales were recorded from early October and that shelf waters are probably more important for the dolphin community compared to deep waters.

Cetaceans are vulnerable to human-related threats in the WCR, including direct exploitation (removal from populations by live-captures), incidental bycatch in fishing gear (van Waerebeek, 1990; Vidal *et al.*, 1994), habitat degradation or loss from coastal development, pollution, acoustic disturbances, unregulated whale-watching operations and vessel strikes (*e.g.* Reeves²⁹; Borobia and Barros³⁰; Bolaños-Jiménez *et al.*, 2007). Information on the occurrence of cetaceans in the Guianas is therefore vital to investigate and subsequently mitigate such potential threats. The listing of Protected Areas under the SPAW Protocol is under development⁴ and the present study therefore provides a timely overview of baseline data to inform UNEP's Marine Mammal Action Plan for the WCR. It is emphasized that more systematic at-sea surveys, photo-identification and behavioral studies are needed in order to assess the status of cetaceans and to develop effective regionally and nationally specific conservation measures not only in Suriname waters

but within the Guinea Shield as a whole. It is considered important and recommended that all research activities in this area document and report their opportunistic records, in order to gain a better understanding about the occurrence, distribution and ecology of cetacean species within the Guiana Shield.

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²⁹Reeves, R.R. (2005) *Distribution and status of marine mammals of the wider Caribbean region: an update of UNEP documents*. UNEP, Report UNEP (DEC)/CAR WG.27/INF.3. 8 pp.

³⁰Borobia, M. and Barros, N.B. (2006) Major threats to small cetaceans in the Caribbean region: a summary report. Paper SC/58/SM15 presented at the 58th annual meeting of the Scientific Committee of the International Whaling Commission, St Kitts and Nevis 16-20 June 2006.

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