

Preliminary report on cetaceans and marine turtles observed in Suriname

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ABSTRACT

*Very little information exists about the cetaceans and marine turtles in the Guianas: Suriname and its neighbouring countries Guyana and French Guiana. During the first dedicated cetacean survey for the offshore waters of Suriname, the occurrence of sperm whales (*Physeter macrocephalus*), Bryde's whale (*Balaenoptera brydei*), false killer whales (*Pseudorca crassidens*), melon-headed whales (*Peponocephala electra*), rough-toothed dolphin (*Steno bredanensis*), long-beaked common dolphin (*Delphinus capensis*), Fraser's dolphin (*Lagenodelphis hosei*), Pantropical spotted dolphins (*Stenella attenuate*) and spinner dolphins (*Stenella longirostris*) was documented. Opportunistic records included common bottlenose dolphin (*Tursiops truncatus*), Atlantic spotted dolphin (*Stenella frontalis*) and short-finned pilot whale (*Globicephala macrorhynchus*). Four different species of turtles were identified in coastal and offshore waters, including green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Olive Ridley turtle (*Lepidochelys olivacea*) and leatherback turtle (*Dermochelys coriacea*). Apart from the sperm whale and the turtles, these represent all new state records for Suriname.*

In view of the growing need to identify critical areas for marine biodiversity conservation, both locally and regionally, this paper describes the general structure of the cetacean community encountered in Suriname waters. 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). The overall cetacean relative abundance was low which is consistent for tropical equatorial offshore waters however the species diversity was high. It is recommended that more continuous monitoring is carried out in order to gain a better understanding of the status of the different marine mammal and turtle species that occur in this tropical equatorial offshore region.

Keywords: Cetacean, Turtle, Guianas, Suriname, Platform of Opportunity, Wider Caribbean Region

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INTRODUCTION

A total of 31 cetaceans occur within the Wider Caribbean Region (WCR; Ward et al., 2001; Weir et al., 2011) but there is a marked lack of records in the Guianas (Sub-Region VI of the WCR, which includes the countries of Guyana, Suriname and French Guiana; Ward et al., 2001).

The Guianas and the Venezuelan Atlantic Front include about 1,900 km of coastline (Fig. 1). Because this region is under the influence of the River Amazon, the typical ecosystems are estuaries, mudflats, sandy beaches, and mangrove forests, which extend along most of the largely unexplored coastline (Miloslavich et al., 2011). The mammals of Suriname were listed by Husson (1978) and included only a handful of cetaceans that were either sighted in coastal waters or were found stranded (Husson, 1978). Species included sperm whale (*Physeter macrocephalus*), Guiana dolphin, minke whale (recorded as *Balaenoptera bonaerensis*), fin whale (*B. physalus*) and sei whale (*B. borealis*; Husson, 1978). The cetacean community is also under-recorded in the neighbouring countries (French Guiana and Guyana). Recently, cetacean sightings were made off French Guiana including fin whale, sperm whale, Cuvier's beaked whale (*Ziphius cavirostris*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), bottlenose dolphin (*Tursiops truncatus*) and Guiana dolphin (van Canneyt et al., 2009). Elsewhere in the Southern Caribbean more cetacean records exist with a total of 21 cetacean species reported for Venezuela (Romero et al., 2001). Apart from a recently initiated dedicated monitoring study of the Guiana dolphin (M. Pool pers comm), cetacean research (both at-sea studies, bycatch in fisheries and stranding monitoring schemes) clearly has been lacking for this region. The scarcity of cetacean records for the area can therefore not be interpreted as an absence of animals, but rather as an absence of sampling effort.

The five species of marine turtles observed in Suriname's waters are the Leatherback Turtle (*Dermochelys coriacea*), the green turtle (*Chelonia mydas*), the olive ridley turtle (*Lepidochelys olivacea*), the hawksbill turtle (*Eretmochelys imbricata*) and the loggerhead turtle (*Caretta caretta*). The first four species have been recognised as endangered in the Western Atlantic region and the loggerhead has been classified as endangered by the IUCN Red List 2010 (IUCN, 2012). Eastern Suriname and Western French Guiana contain some of the globally most important nesting beaches for Leatherback turtles. The most important nesting sites are generally found along the estuary of the Marowijne River, within and near to the Galibi Nature Reserve, and in the ocean facing beaches between the Marowijne and Suriname Rivers (Goverse and Hilterman 2006). Most research has focused on the nesting sites of marine turtles. More recently, turtle tagging programs have been carried out in the Guiana's to monitor the migration routes the different marine turtles undertake when leaving the nesting grounds (WWF, 2013).

During the past two decades, awareness of marine mammals and their habitats in the Wider Caribbean Region has increased. The Specially Protected Areas and Wildlife (SPAW) Protocol is the regional agreement for biodiversity and for the advancement of the conservation and protection of the marine environment in the WCR and became international law in June 2000 (UNEP, 2012). A specific Marine Mammal Action Plan (MMAP) was adopted in 2008 under the framework of UNEP's 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, 2012). The Guianas share potentially many cetacean and turtle species with neighboring countries and as such a need for increased coordinated action was recently identified between different countries, in northeastern Latin America, from northern

Brazil to Venezuela, including Trinidad and Tobago and the “ABC islands” of the Dutch Caribbean (Aruba, Bonaire, Curaçao; Brichett, 2012).

No dedicated offshore surveys have been conducted in Suriname marine waters and the opportunity to carry out such studies was afforded in May 2012. The distribution of cetaceans and other marine wildlife occurring in the waters offshore Suriname was investigated in an area that was located 220-300km from the coast. This study presented here, conducted between 17 May and 3 September 2012, describes (1) the occurrence of cetaceans and marine turtles in Suriname offshore waters; (2) their relative abundance; and (3) where possible describes the behaviour together with group compositions. In addition, we present information on species records for Suriname waters arising from other opportunistic surveys carried out in the area and also include information on strandings records. As such, the study provides baseline data for future investigations and monitoring as well as for conservation and management of cetaceans and marine turtles in the Guianas.

METHODS

Study Area

Suriname is located on the north east coast of South America, bordering the Atlantic Ocean, with French Guiana to the east, British Guyana to the west and Brazil to the south (Figure 1). The Guiana Current is the main current which is composed predominantly of the warm North Brazil Current (NBC). This flows north along the northeastern coast of South America and upon reaching French Guiana, it separates from the coast and retroflects to join the North Equatorial Counter Current. The rest of the NBC continues flowing northwestward to form the Guiana Current (Condie, 1991). Although the oceanography is not yet fully understood, it is generally accepted that in Suriname's offshore areas, the currents mainly flow from the southwest to the northeast quarter (Gyory *et al.*, 2005). The Guiana current speed varies between 10 and 216 cm s⁻¹ (Febres-Ortega and Herrera 1976), with its highest velocities occurring along the edge of the continental shelf and a mean speed of 41.6 cm s⁻¹ (Gyory *et al.* 2005). The maximum current speed occurs in April-May, while the minimum speed occurs in September (Gyory *et al.*, 2005). The tides along the coast of Suriname are semi-diurnal, with two high waters and two low waters during a tidal day and a tidal amplitude ranging between 1.3 and 2.3 m (Artigas *et al.* 2003). The wave patterns of Suriname are predominantly north easterly, controlled primarily by the strength and direction of the trade winds (Febres-Ortega and Herrera 1976). The largest waves are observed from February to May when wind velocities are highest, and the smallest waves occur from June to November when wind velocities decrease. Surface water temperatures are almost constant throughout the year, ranging between 27°C and 29°C. Near-shore areas are permanently under the influence of riverine inputs, and during the rainy seasons salinity levels can drop below 25 to 30‰ (e.g. Miloslavich *et al.*, 2011).

Main survey

Dedicated cetacean and turtle observations were carried out in the offshore Suriname waters (08° 29' N, 054° 41' W) between 17 May and 3 September 2012. A geophysical seismic survey vessel, the *Western Regent* was used to collect data on cetaceans and turtles. Cetacean data were collected in an opportunistic manner, with the distribution of the survey effort determined by the geophysical survey work and where the vessel did not deviate from the track-line when a sighting was made. The vessel left Trinidad on 15 May and transited to the prospect area which extended between 220 and 300 km North of Paramaribo. There were three different survey periods: 17 May – 24 June, 25 June – 24 July & 25 July – 3 September. The main survey area comprised water

depths of 1200-3600m and covered approximately 3,000 km² (Fig. 2). The observational platform had a working deck height of 14 metres. The vessel operated with a speed over ground (SOG) of 4.7 knots. Typical daylight hours were 09:00-22:00 UTC. During the survey, teams of 2 observers carried out observations of 2 hours duration, 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 high quality binoculars (8x43 & 10x42) for searching the horizon, aiding species identification and group size estimations. Once a sighting was made the radial sighting distance to a sighted cetacean was determined using person-specific range-sticks. The bearing to the sighted animals and their heading were determined using the ship's mounted compasses which were positioned on starboard and portside. Sightings data also included the time (GMT), GPS position, water depth, species identification, the presence of calves and/or juveniles, school size (maximum, minimum and best), travel mode (slow, moderate or fast), group composition and behaviour. DSLR cameras with zoom lenses (Sony 700alpha with a 200mm f2.8 lens and a Canon EOS550D with a 100-400 f4.5-5.6 lens) were used to take photographs. This allowed for subsequent identification checks of difficult and/or distant species and to provide a source of visual reference material. Most observational effort was made from the bridge wings and foredeck.

The survey ran simultaneously with environmental observations, such as wind speed and direction, visibility, swell height and Beaufort sea state (BSS). Water depth and sea surface temperature (SST) were measured throughout the survey period. A Garmin GPS was used to log the ship's position every minute (Fig. 2). Only records collected within Suriname waters (17 May – 3 September) are presented in this paper. During the third part of the survey the author was not present (25 July – 3 September). Observers involved during the third part had previous experience of conducting cetacean surveys in tropical waters. Specific records were not accepted unless verifying information in the form of photographs or detailed species descriptions were provided. The data regarding the GPS, speed and course were not continuously logged during the third shift, however, information was provided regarding the hours on watch.

Cetacean and turtle sightings reported 'off effort' and those recorded with a BSS>4, swell>4m and visibility<1km were regarded as incidental. The species identification provided by observers was checked and verified using written descriptions and photographs. Animals too distant from the vessel to allow definite identification (>1 km) for similar looking dolphins or *Balaenopterid* whales were classed as *Stenella sp*, *small blackfish* (melon-headed/pygmy killer whales) or *Sei/Bryde's whales*.

Opportunistic records

Other oil companies in Suriname were contacted and information on cetacean and turtle occurrence in the region was requested. Specific cetacean records were not accepted unless verifying information in the form of photographs was provided or detailed descriptions. For these a list of sightings, species descriptions and photographs was supplied, together with information on date, time, position and group size.

Stranding records

Strandings occurring in Suriname waters are not very well documented (M. Pool, pers comm). The only known stranding records of cetaceans have been reported by Husson (1978). Where relevant these strandings are listed with contributing information regarding species ID. No other information was obtained where enough data was collected in order to confirm species ID.

RESULTS AND DISCUSSION

Main survey

During shifts 1-2, a total of 765 observation hours over 6073 km were carried out in good conditions (BSS 0–4, swell <4 m and visibility >1 km; Table 1). A total of 502 observation hours was carried out in good conditions during shift 3 (effort in km was not available; Table 1).

A total of 68 sightings of 2,152 animals involving 9 different cetacean species were made during the dedicated survey (Shifts 1-3; Table 2). In addition, 5 incidental sightings of 22 animals were made and one more cetacean species was verified. In total, three marine turtles were sighted, including Olive Ridley (probable ID), Loggerhead turtle (probable ID) and one large hard-shelled turtle (green or loggerhead turtle). Many sightings remained unidentified during the main survey ($n = 30$, 44.1%) due to their distance from the vessel. Confusion over species identifications also occurred with similar looking species, ($n=8$, 11.8%).

The majority of the survey was carried out in water 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 this survey ranged between 26 and 30°C and averaged 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 main survey and data presented here are potentially influenced by unknown reactions of cetaceans to air gun operations.

Opportunistic records

A further 45 opportunistic sightings of 1063 animals were made during opportunistic surveys carried out between December 2008-March 2009 and August-October 2012. This opportunistic dataset provided photographic evidence of a further three cetacean species and a possible fourth species. Five turtle sightings were also made in shallow waters, including green turtle, loggerhead turtle and one leatherback turtle.

Strandings records

Only stranding records were found which had previously been reported by Husson (1978), these were checked for species ID and are discussed below. Corpses of the Guiana dolphins are regularly found in the estuary and rivers and monitoring is carried out accordingly (M. Pool, pers comm) and those records are not discussed here.

Confirmed species for Suriname including new state records

Bryde's whale (*Balaenoptera cf. brydei*) – Olsen (1913)

Bryde's whales are notoriously difficult to identify to species level as they are very similar to Sei whales (*B. borealis*) in appearance. The dorsal fins of Bryde's whales monitored off Venezuela range from almost triangular in shape, with a broad base and can be rather tall in profile (Notarbartolo di Sciara, 1983). As such they can easily be confused with those of sei whales and this similarity warns against the use of dorsal fin as the sole distinguishing feature (Jefferson *et al.*, 2008). In most cases, relatively close views of the head are needed to confidently determine the presence/absence of ancillary head ridges before the two species can be positively distinguished. The difficulty of observing this feature is confounded by the fact that Bryde's whales are rapid swimmers and are not easy to view closely from a vessel (Jefferson *et al.* 2008). For this reason,

three sightings made during the dedicated survey were logged as 'Bryde's/Sei whale', two sightings were logged as large Balaenopterid (baleen whale) and one whale was later confirmed as Bryde's whale through acoustic recordings. The low frequency calls of Bryde's whales have been recorded off the north coast of Venezuela (Olesun et al., 2003) with calls having a fundamental frequency of 44 Hz which was close to the frequencies recorded during the present detection (de Boer et al., 2012; Baines and Lewis; 2012 for technical details).

Most sightings involved single animals. Two of the Bryde's/Sei whales were actively foraging and accompanied by birds (terns and shearwater species). Several lunge feeding events were also observed and on one occasion a whale was seen breaching. These whales were seen at large distance from the vessel (3000m) although two whales were seen at a closest distance of 400 (a juvenile) and 700m respectively. The confirmed Bryde's whale was seen in waters with a depth of 1225m, the other whales were seen in waters with depths ranging from 1217m to 2241m. All Balaenopterid whale observations took place between 14 June and 19 July, beyond this day no further sightings were made.

The Bryde's whale is the only baleen whale present in significant numbers and likely present year-round in the WCR (Reeves, 2005a) although it appears to be principally a southern Caribbean species (e.g. Watkins et al. 1979; Notarbartolo di Sciara 1983; Romero *et al.* 2001; Debrot *et al.* 1998). No sightings or stranding records of Bryde's whales are known for Suriname or its neighbouring countries. However, according to a recent review, Bryde's whales are by far the most common mysticete in Venezuela, in particularly in the eastern part of the country (Romero et al., 2001). The distribution of Bryde's whales also appears to vary with season with whales occurring mainly East-Venezuela between March and August whilst from August to December the whales occur further west. The group-size has been reported to increase from mid-June with sightings of 2-3 whales, sometimes including young (Notarbartolo di Sciara, 1983). The lack of sightings in the present survey from August onwards match those findings reported by Notarbartolo di Sciara (1983).

Sei whale (*Balaenoptera borealis*)

A stranding of a live sei whale was recorded on 11 February 1964 in the Prodobong Creek (NW Suriname; Husson, 1978). The whale died the next day and the following measurements were taken some ten days later: Length 15.5m, width 3m; length of pectoral fin 1.65m. Total number of grooves 50, the grooves extended beyond the end of the flippers (Husson, 1978). The photograph in Husson (1978) corresponds to the general skull morphology of a sei whale but detailed measurements are needed in order to confirm species identification.

Several sighting surveys undertaken in the Bahamas and Caribbean in late winter and spring did not detect sei whales either in coastal or offshore waters (Roden & Mullin 2000, Swartz et al. 2001, Yoshida et al. 2010). There are only a few records for sei whales in the Caribbean and the species is considered rare (Notarbartolo di Sciara, 1983; Romero et al., 2001). There are pelagic ("at sea") records (Slijper et al., 1964; Erdman, 1970; Erdman et al., 1973) as well as coastal ones from Cuba (Varona, 1965, 1974), the Dominican Republic (Mead, 1977; Bonnelly de Calventi, 1994), and the British Virgin Islands (Erdman, 1970). There are only four reliable records for the Gulf of Mexico (Jefferson and Schiro, 1997). However, Romero et al (2001) reports that only Mead's (1977) sightings of sei whales can be considered fully reliable. Mignucci-Giannoni (1998) reported two sightings of sei whales in waters off Puerto Rico and the Virgin Islands, but it is not clear in

which circumstances these sightings were made and whether the whales were positively differentiated from Bryde's whale (Prieto et al., 2011).

Fin whale (*Balaenoptera physalus*)

Two or three records of fin whales are known for Suriname (Husson, 1978). The first one stranded in 1910 and involved a 20m long whale and according to Husson (1978) it seems likely that the specimen belonged to *B. physalus*. The second record occurred on 22 May 1923 and involved a live animal (17m in length) swimming up the Suriname River where it was subsequently shot (Husson, 1978). The identification of this whale was also later confirmed by Dr. F.C. Fraser (*in* Husson, 1978). The baleen morphology indeed matches that of fin whale although blue whale (*B. musculus*) cannot be ruled out at this stage (van Waerebeek, Pers. Comm). In addition, a specimen of baleen definitely belonging to *B. physalus* was also described by Husson (1978) although it is unclear whether or not it belonged to one of the stranded whales recorded between 1910 and 1923.

During the opportunistic surveys, three large *Balaenopterid* sightings were made on 2 October 2012 (water depth 1282-1776m). These whales were identified as probably fin whales but the sighting descriptions and photographs were not found to be conclusive.

There are only a few records for fin whales for the Caribbean. Sightings are listed "at sea" (Slijper et al., 1964), for Colombia (Prieto Rodríguez, 1988; Vidal, 1990); Venezuela (Romero et al., 2001) and the Gulf of Mexico (Jefferson and Schiro, 1997). More recently, fin whale sightings were recorded off French Guiana during aerial surveys in October 2008 (Ridoux et al., 2010) and during boat surveys in October 2009 (Vines et al., 2010).

Minke whale (*Balaenoptera acutorostrata* or *B. bonaerensis*)

Husson (1978) reports on a minke whale seen swimming in the mouth of the Coppename River on 21 October 1963 and which was killed two days later. The total length of this female was 8.25m and the upper surface of the pectoral fins was uniformly dark unlike showing the characteristic white band present on the pectoral fins of the common minke whale (*B. acutorostrata*). Furthermore, the present Suriname specimen also had a wide and conspicuous dark band along the outer margin of the baleen plates shown in the photographs included in Husson's report (1978). Husson (1978) concluded that the whale was considered to be the southern form of *B. acutorostrata* (nowadays recognised as a separate species *B. bonaerensis*). The specimen indeed resembles that of *B. bonaerensis* but closer inspection is needed. *B. bonaerensis* has been recorded in Togo, and possibly in Benin, and these minke whales are therefore capable in crossing the equator (van Waerebeek, ref).

As for other minke whales recorded within the WCR, in the early seventies there were occasional observations of *B. acutorostrata* in the (northerneastern) Caribbean (Rice 1998). Because strandings in the Gulf of Mexico occur during winter and spring months, there is speculation that these animals may represent a northwards migration from the open ocean or Caribbean Sea (Würsig et al. 2000; Reeves et al., 2005a).

Sperm whale (*Physeter macrocephalus*) - Linnaeus (1758)

The sperm whale was the most abundant whale documented during the main survey with a relative abundance of 0.955 whales km⁻¹ (Table 2). A total of 67 animals were counted including eight juveniles and three calves during eight separate sighting events. The whales were seen in large groups ranging between 2 and 20 whales and were monitored up to two hours. The groups are best described as nursing groups (Photo) and nursing was observed on one occasion when a small calf was seen making several short peduncle dives (a behaviour which has been described as indicative of suckling; Gero and Whitehead, 2007). No male sperm whales were observed. The sperm whale groups were seen making short dives and were rarely lifting their flukes before a deep dive indicating that they were probably not engaged in foraging. On several occasions the whales were seen heading in a southwesterly direction and these whales were probably following the contours of the Demerara Plateau (Fig. 3). The whales were seen in waters with an average depth of 2152m (SD 711.4m; Range 1293-2974m). The whales were seen in June-August. In addition, sperm whales were also seen during opportunistic surveys carried out in September 2012, totalling 10 sighting records of 39 animals (four sightings were confirmed by photographs and all other sightings had detailed descriptions).

The first published record of a sperm whale in Suriname was that of a stranded animal east of the mouth of the Suriname River in 1938 (Husson, 1978). The description of this specimen confirmed species ID as it lacked a dorsal fin, had a large blunt head and a narrow lower jaw, containing about 24 to 30 large conical teeth and there were no teeth in the upper jaw ... (Husson, 1978).

In the northeastern Caribbean, sperm whales are strongly seasonal and are rarely seen from April through September (Mignucci-Giannoni 1998). In the southeastern Caribbean, during November and March, sperm whales were consistently found throughout most areas surveyed (Watkins *et al.* 1985; Ward *et al.*, 2001). The Eastern Caribbean Cetacean Network (ECCN) reported three stranding events from Antigua in August (1984-1985) and December (1986; ECCN 2000). Sightings and strandings of sperm whales have also been reported in the summer months off Venezuela (Linares and Bolaños, 1995; Bolaños and Boher, 1996). Three at-sea sightings were reported for French Guiana in October (Ridoux *et al.*, 2010) and two sightings were recorded in November and February; Vines *et al.*, 2010).

Nursery groups of sperm whales were observed in the present study and it would be of interest to assess the seasonal status of this species. It is unclear whether the Suriname sperm whales migrate to and from Suriname waters or that they stay in the area year-round. However, judging on the relatively low presence of sperm whales off French Guiana between September and February, it is possible that Sperm whales are more abundant in the Guiana Shield between June and September and that they migrate to the northeastern Caribbean during winter.

Melon-headed whale (*Peponocephala electra*) - Gray (1846)

Three sightings were made during the main survey of melon-headed whales (Fig. 4) involving 485 adults, 28 juveniles and seven calves. On one occasion they were associating with Fraser's dolphins and on another occasion they were seen moving actively around floating mats of *Sargassum*. This species was seen in waters with a depth ranging from 1191m to 3063m. The first sighting occurred on 9 June (120 animals), the second on 28 June (200 animals) and the last sighting was made on 30 July 2012 (200 animals). In addition, on 3 July a group of 30 *small blackfish sp.* (either melon-headed or pygmy killer whales) were seen but the animals were too

distant to allow species identification. One opportunistic record was made of small blackfish on 15 March 2009 in waters with a depth of 688m.

The most widely used common name, melon-headed whale or mango-headed whale (as they are called in the lesser Antilles; Ward et al., 2001), comes from the species' blunt rostrum and rounded head, which appears almost triangular when viewed from the side or above. During the three encounters described above, the following features were seen: (a) a rounded head which tapered giving it a pointed profile; (b) the animals appeared mostly dark gray in colour and some white pigmentation was evident around the mouth (Jefferson and Barros 1997; Photo); (c) a faint, but darker gray dorsal cape was only visible on occasion (due to bad light conditions). This usually can be seen quite clearly, along with a broad dark eye band or patch that gives the appearance of the animal wearing a mask (e.g. Perryman 2009); (d) the pectoral fins were sharply pointed; and (e) the dorsal fin was falcate and prominent, located in the middle dorsal region of the body and this was observed during the frequent short porpoising movement of the animals. Males tend to be slightly longer and more robust, and have longer pectoral flippers, taller dorsal fins, rounder heads, and wider tail flukes than females (Perryman 2009). Additionally, a pronounced ventral keel posterior to the anus is present in adult males (Perryman 2009) which was also a feature seen on several large adults presumed to be males (Photo).

Within the region, the species occurs in the Gulf of Mexico and this species is occasionally taken in the Lesser Antilles in the St. Lucian and Vincentian small cetacean fisheries (Ward et al., 2001). Sightings of small groups were reported by Watkins *et al.* (1997) in an area west of Dominica. Debrot *et al.* (1998) report records in Bonaire in the Leeward Netherland Antilles. Surveys in the Caribbean during 1988, 1990, 1991, 1994 and 1995 did not yield any sighting of the melon-headed whale (Palacios *et al.*, 1995-1996; Jefferson and Lynn, 1994; Ward et al., 2001). This species has also not been recorded off Venezuela (Romero et al., 2001). A large group of melon-headed whales and Fraser's dolphins was encountered off Carriacou (IFAW 1996) and Mignucci-Giannoni (1998) reports the first record of a melon-headed whale stranded off Puerto Rico.

The species has not been recorded off Suriname. Three sightings were made of small blackfish sp (either pygmy killer or melon-headed whales) off French Guiana in October (Ridoux et al., 2010) and three sightings were also made between September, November and December at sea (Vines et al., 2010).

False killer whale (*Pseudorca crassidens*) - Owen (1846)

On 13 July 2012, a group of three false killer whales was observed and photographed (Photo; Fig. 4). The group was seen in waters with a depth of 2444m and were seen crossing the bow. The animals were observed for one hour whilst the vessel was retrieving cables, during which the whales were seen making a series of intense splashes, rapid pursuits and directional changes, interspersed with slower intermittent surface appearances. Although relatively robust animals, these individuals were very difficult to track or photograph. The animals were identified based on their (a) overall black colour, long head with a rounded beak (Photo), (b) lack of 'white lips' and (c) large dorsal fin with a rounded tip (Stacy et al., 1994; Luksenburg 2011; Photo). On a few occasions, when the whales were still quite far away from the vessel (3 km), small bushy blows were seen.

One opportunistic record (unconfirmed) was made of ten false killer whales on 12 December 2008 in shallow waters (77m; Fig. 4).

The distribution of false killer whales 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), Aruba (Luksenburg, 2011) and Venezuela (Bolanos and Boher, 1996; Romero et al., 2001). All records off Venezuela have been exclusively from coastal waters (Romero et al., 2001).

This species has not been recorded off Suriname. During surveys in September and October, false killer whales were sighted on five occasions off French Guyana (Vines et al., 2010). Ridoux et al (2010) reports on a sighting with *Globicephala* or *Pseudorca* in October off French Guiana and Van Canneyt et al. (2009) received reports of false killer whales seen off the coast of the Salut islands, French Guiana.

Short-finned pilot whale (*Globicephala macrorhynchus*)

Short-finned pilot whales were not encountered in Suriname waters during the main survey. However, during the opportunistic surveys one encounter was made on 7 September 2012 (Fig. 4). A group of eight whales were seen at a distance of 40m from the vessel. The animals were described as having (a) black colouration, (b) distinct broad-based and falcate dorsal fins and (c) the presence of rather thick tailstocks was also noted. There was no mention of observing the characteristic bulbous melons of this species however the photographs together with the descriptions were found to be conclusive (Photo). The encounter lasted 15 minutes and the whales were seen in waters with a depth of 2549m.

Pilot whales are extremely common in the Caribbean (Ward et al., 2001) and the species is recorded in the eastern part of Venezuela (Casinos and Bou, 1980; Romero et al., 2001). Pilot whales have not been documented in Suriname waters. Off French Guiana this species was recorded on eight occasions in October 2008 (Ridoux et al., 2010) and on eleven occasions during boat-based surveys (September-December 2009; Vines et al., 2010). On one of these occasions the whales were associating with Risso's dolphins (*Grampus griseus*; Vines et al., 2010)

Rough-toothed dolphin (*Steno bredanensis*) - Cuvier in Lesson (1828)

Rough-toothed dolphins were seen on two occasions (1 July and 24 August 2012) in groups of 40 and 25 (Fig. 5). The group sighted on 1 July was observed for almost one hour and included one juvenile and one calf. The water depths at the sighting locations were 1241 and 1018m respectively. Both encounters involved slow surfacing dolphins which were seen in separate groups traveling abreast. Such synchronous swimming behaviour among tightly spaced sub-groups is a behavior often described for this species (de Boer, 2010).

The dolphins were identified as rough-toothed dolphins based on observations in the field and photographs confirming the characteristic features of this species, these included (a) robust dolphin with prominent broad-based tall dorsal fin, (b) conical head shape with a poorly-defined beak (no melon-crease), (c) white-lips, (d) thick tail-stock and (e) rather uniform dark grey colouration with a narrow cape in front of dorsal fin (Photo).

Two opportunistic records (unconfirmed) were made in much shallower waters in January and February 2009 (49 and 42m).

This species has not been recorded in Suriname waters and generally at-sea sightings are rare (de Boer, 2010). The rough-toothed dolphin is uncommon in the Caribbean with records reported for the Gulf of Mexico, the West Indies, Colombia and Venezuela (see Romero et al., 2001; Ward et al., 2001). Off French Guiana this species was validated by van Ganneyt et al. (2009) and was also seen at sea in January 2010 (Vines et al., 2010).

Fraser's dolphin (*Lagenodelphis hosei*) - Fraser (1956)

Fraser's dolphins were sighted on two occasions (28 June and 20 August 2012; Fig. 4). The first record was a group of at least 30 to 40 dolphins which were associating with a group of melon-headed whales. This encounter occurred in waters with a depth of 3063m and lasted 20 minutes. The second encounter, involving at least 60 dolphins (water depth 2100m), lasted 7 minutes. The first encounter is described in more detail below as the encounter was much longer and also at low distant range.

The dolphins approached the vessel and briefly were seen bow-riding during which a group of melon-headed whales also approached. These consisted of many sub-groups of approximately 6-8 animals traveling in a tight group formation whilst the Fraser's dolphins were spread out scattered around the bow of the vessel. Some large males were seen with prominent and taller dorsal fins and rather thick tailstocks with pronounced keels. No direct interaction occurred between the two species although the Fraser's dolphins followed the melon-headed whales once they had crossed the bow. When the sub-groups of melon-headed whales had passed our bow these animals changed their group formation and became more spread out. Some distinct splashes were seen as if the dolphins were surfacing rapidly but low through the water and this may indicate feeding. The vessel was not in operation at the time of the first sighting. The second encounter involved a group of animals which were observed milling at a distance of 2000m and slowly moving away whilst the vessel was in operation.

The dolphins were identified as Fraser's dolphins based on observations in the field and photographs confirming the characteristic features of this species, these included (a) small stocky body but appearing less robust behind the dorsal fin, (b) a short stubby but well-defined beak, (c) small and erect dorsal fins with pointed tips, (d) a dark face mask and (e) a thick dark lateral stripe from the eye to the genitals (Photo).

Fraser's dolphins are a little known tropical species. No records for Suriname or its neighbouring countries exist. Within the Atlantic Ocean the reported number of sightings of Fraser's dolphins are in the low tens (Hersh & Odell, 1986; Jefferson *et al.*, 1997; Ward et al., 2001; Weir et al., 2013) and just over a dozen for the Caribbean Sea (Witte et al., 2012). Records exist for the species from the Puerto Rican Bank (Mignucci-Giannoni *et al.* 1999b), the Lesser Antilles including Dominica and St. Vincent and the Grenadines (Caldwell *et al.* 1976; Caldwell and Caldwell 1983; ECCN 2000), and the Gulf of Mexico (Würsig *et al.* 2000). Other sightings off Dominica, offshore Carriacou and off La Martinique have also been reported (Carlson *et al.*, 1995; IFAW 1996; Boisseau *et al.*, 2000; Jeremie et al., 2006). Recently, Gero and Whitehead (2006) report on seven sightings with Fraser's dolphins off the leeward shore of Dominica. From 1992 through 1997 there were five sightings in offshore waters of the northern Gulf of Mexico and four of the five sightings were associated with melon-headed whales (Würsig *et al.* 2000). The sightings in the northwestern part of the Gulf were in waters around 1000 metres deep (Davis and Fargion 1996).

The Caribbean strandings records include three specimens harpooned and taken by a cetacean fishery at St. Vincent between 1972 and 1973 (Caldwell *et al.* 1976) and two strandings records in Puerto Rico (Mignucci-Giannoni *et al.* 1999). In the Gulf of Mexico, a mass stranding occurred in 1981 in the Florida Keys (Hersh and Odell 1986). Witte *et al.* (2012) reported on an adult Fraser's dolphin found stranded on Bonaire in August 2011 in the Dutch Caribbean. Two dolphins live stranded in June 1999 in Venezuela (Bolanos & Villarroel-Marin, 2003).

Common bottlenose dolphin (*Tursiops truncatus*) - Montagu (1821)

Common bottlenose dolphins were not encountered in Suriname waters during the main survey. However, three opportunistic encounters were made with bottlenose dolphins in relatively shallow waters (58 to 77m; Fig. 4) in December 2008. A fourth sighting was made on 8 October 2012 in waters with a depth of 451m. During all encounters the dolphins were observed bow-riding the vessel with encounters lasting between 5 and 23 minutes.

The dolphins were identified as common bottlenose dolphins based on observations in the field and photographs confirming the characteristic features of this species, these included (a) robust dolphin with prominent broad-based tall dorsal fin, (b) a stubby well-defined beak and visible melon-crease, (c) thick tail-stock and (d) rather uniform dark grey colouration (Photo).

Bottlenose dolphins are common in 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 (Ward *et al.*, 2001).

No other records for Suriname waters are known although some tentative observations had previously been forwarded to the Green Heritage Fund Suriname but without photographic evidence (M. Pool, pers.comm). Bottlenose dolphins were present in high densities off French Guiana and were found in large groups in the continental slope zone, as appeared from an aerial survey in French Guiana (Van Canneyt, 2009).

Atlantic spotted dolphin (*Stenella frontalis*) - Cuvier (1829)

No Atlantic spotted dolphins were encountered during the main survey. However, five opportunistic records were made between December 2008 and March 2009 (Fig. 4). The dolphins were observed in groups of 10 to 30 animals and were frequently observed bow-riding or approaching the vessel. The water depths measured at the sighting locations were ranging between 57 and 80m with one record of 354m.

The two 'spotted' dolphins *S. frontalis* and *S. attenuata* are closely related sister-taxa (Kingston *et al.*, 2009). The two species are difficult to separate in the field for the untrained observer and identification is ideally documented by photographic evidence (Mignucci-Giannoni *et al.*, 2003). The photographs revealed the following characteristics, (a) robust small body, (b) the presence of a spinal blaze that sweeps up and backwards, (c) dorsal spotting, (d) tri-colour pattern: dark cape, lighter grey lateral side and white ventral side and (e) tall falcate dorsal fin and (f) a prominent narrow beak and distinct melon-crease (Photo).

In Venezuela, the Atlantic spotted dolphin is widespread in both inshore and offshore waters (Romero *et al.*, 2001). In Colombia this species is also found to be more common than Pantropical spotted dolphins (Vidal, 1990; Pardo & Palacios, 2006). Atlantic spotted dolphins were recently

observed in Aruba in the southern Caribbean. There are no records for Atlantic spotted dolphins in Suriname or its neighbouring countries (Guyana and French Guiana).

Pantropical spotted dolphin (*Stenella attenuata*) - Gray (1846)

Three encounters were made with Pantropical spotted dolphins during the main survey (11 July, 7 and 10 August 2012; Fig. 4). The encounters were made in waters with a depth ranging between 1140 to 3043m. Group sizes ranged between 30 to 200 including small numbers of juveniles. On all occasions the dolphins were porpoising fast and in tight group formations. Some breaching and high leaping was also observed and the dolphins approached to 500m. During all three encounters the vessel was not in operation.

The dolphins were identified as Pantropical spotted dolphins based on observations in the field and photographs confirming the characteristic features of this species, these included (a) small dolphin with (b) prominent but rather narrow-based dorsal fin, (c) long narrow beak and visible melon-crease, (d) Dorsal cape reaching lower on flanks in front of the dorsal fin (e) white tipped beak and (f) darker cape which contrasts with grey facial and lower flanks but spotting not visible. The light or lack of spotting has been noted for Caribbean Pantropical spotted dolphin and they are also found to be more robust than those observed in the Gulf of Mexico (Jefferson and Lynn, 1994). Some of the dolphins seen in the present survey appeared all dark.

Two opportunistic records (unconfirmed) were made on 24 December 2008 in shallow waters (60m). Both groups briefly were seen briefly bow-riding the vessel.

Pantropical spotted dolphins are sighted less frequently in the Caribbean than Atlantic spotted dolphins (Ward et al., 2001). Numerous sightings have been made of groups in waters deeper than 100 metres (Würsig *et al.* 2000) and they occur in the Gulf of Mexico in all seasons (Ward et al., 2001). Pantropical spotted dolphins have been reported off the Dominican Republic, Dominica, St. Vincent and the Grenadines, St. Lucia, Tobago, Colombia (Ward et al., 2001) and the ABC islands (Aruba, Bonaire and Curacao; LeDuc et al., 1997; Debrot et al., 1998). Only one record is known for Venezuela and this was in the eastern region (Romero et al., 2001).

There are no other records for Pantropical spotted dolphins in Suriname waters. Several records were made off French Guiana (water depth 975-2230m) during September-December 2009 (Vines et al., 2010) and photographs were found to be conclusive.

Spinner dolphin (*Stenella longirostris*) - Gray (1828)

During the main survey, eight sightings were made of spinner dolphins between 11 July and 3 September 2012 and one incidental sighting was made during transit on 25 July 2012 (Fig. 4). The dolphins were seen in waters with a mean depth of 2251m (*SD* 720.95, *n*=8, range 1154–3094m). The incidental sighting was made in waters with a depth of approximately 200m. The group size ranged between 5 to 100 animals and 14 juveniles and 4 calves were observed. In some cases the dolphins were observed for up to one hour. Spinning was seen on quite a few occasions with up to 5 longitudinal spins in a row. Also head slapping, dorsal fin slapping and breaching was observed. Flocks of sooty terns were also associating with the dolphins on one occasion and bow-riding was observed on three separate occasions.

The dolphins were identified as spinner dolphins based on their (a) very long, narrow beak with distinct melon-crease (b) tall upright dorsal fin which was occasionally forward sloping, (c) tricoloured pattern with white belly and (d) distinct post-anal keel (Photo).

During the opportunistic surveys nine additional records were made of spinner dolphins in the months of August through to October (water depths 1847-2634m; Fig. 4). One sighting occurred in shallow waters (61m) in December and another sighting was made in February (25m) although these were not confirmed by photographs.

In the western North Atlantic, spinner dolphins have been documented from Florida, the Caribbean, the Gulf of Mexico, and throughout the West Indian chain southwards to Venezuela (Würsig *et al.* 2000). It has also been reported in the Bahamas, Cuba, Puerto Rico, Dominica, St. Vincent, the Grenadines (in Romero *et al.*, 2001) and the Caribbean in general (Jefferson and Lynn, 1994; Palacios *et al.*, 1996). The species also occurs off the ABC Islands in the southern Caribbean (Debrot *et al.*, 1998; Debrot and Barros, 1994; Debrot, 1998; Luksenburgh, 2011) and they are fairly common in Venezuela (Romero *et al.*, 2001). No sighting records exist for Suriname but off French Guiana, the species was regularly encountered during September and October 2009 but only a few sightings were made between November on February 2010 (Vines *et al.*, 2010).

Long-beaked common dolphin (*Delphinus capensis*) - Gray (1828)

On sighting was made of long-beaked common dolphins on 17 May 2012 whilst in transit (water depth 35.8m; Fig. 4). The group consisted of at least 50 dolphins which were spread out in sub-groups. The dolphins briefly approached the bow but soon were seen traveling away from the vessel. The encounter lasted 15 minutes.

The dolphins were identified as long-beaked common dolphins based on (a) their small size; (b) long beak and slender head profile with relatively flatter melon but nevertheless distinct melon crease, (c) overall fairly dark, muted colour pattern, (d) dark cape with v-shaped dip under tall falcate dorsal fin and (e) front half of the flank had a dark tan colour (Photo).

No sighting records for long-beaked common dolphins exist for Suriname. Although the overall population distribution remains poorly known because of past confusion with *D. delphis* (Rice, 1998), a recent review shows that the long-beaked common dolphin is common along the eastern coasts of Venezuela where coastal upwelling occurs (Romero *et al.*, 2001) and this is also one of the few places where the species is taken in fisheries (Romero *et al.* 1997). A recent review by Jefferson *et al.* (2009) shows that the species is not known to occur in the Gulf of Mexico. The only reliable records to the east outside of Venezuela are of a long-beaked common dolphin captured off Trinidad in April 2006 (Boisseau *et al.* 2006) and a stranding in the Gulf of Paria (Bolanos-Jiménez, unpubl. data), and these may represent the eastern extent of this population's range (Jefferson *et al.*, 2009). Van Canneyt *et al.* (2009) validate the presence of long-beaked common dolphins in French Guiana.

It seems that common dolphins are absent throughout most of the Caribbean Sea, only occurring in this very limited coastal area off Venezuela, however it is expected to occur in adjacent waters (Jefferson *et al.*, 2009). There is no reliable evidence that the short-beaked common dolphin occurs anywhere in the Caribbean region (see Van Waerebeek in International Whaling Commission (IWC, 2007).

Guiana dolphin (*Sotalis guianensis*) - van Bénédén (1864)

The Guiana dolphin was seen on two occasions during the main survey whilst transiting between Paramaribo and the study area. Both (incidental) encounters occurred at the river mouth and involved small groups of feeding dolphins (Photo; Fig. 4).

The Guiana dolphin inhabits the Caribbean and Atlantic coasts of South America, including some estuarine and riverine areas (Borobia et al., 1991). This dolphin is the most frequently encountered in Suriname (Gomez-Salazar et al., 2010) with a first record of this species in freshwater described in the locality of the Marowijne River and in the lower parts of main rivers (HersHKovitz, 1963). Husson (1978) reported the Guiana dolphin to be rather common in the mouths of the larger rivers ascending them as far as the limit of the tidal influence. This species is regarded as a coastal species that has been recorded to 23 km up from the river mouth of the Suriname River (Paramaribo city; Gomez-Salazar et al., 2010). These dolphins are also recorded in the Commewijne River (38 km from the Suriname River mouth) and they are occasionally seen up to the locality of Bakkie during the long dry season (Gomez-Salazar et al., 2010). In addition, there are reports of Guiana dolphins in the Corantijn River, the Marowijne and the Coppename Rivers. Overall, these dolphins only swim up-river during the dry season when the saltwater incursion is further upriver and the salinity of the water is high enough (Gomez-Salazar et al., 2010). It is of serious concern that pollution from Paramaribo city may be one of the factors causing this restriction in their movements (M. Pool, pers. comm.). Recently, causes for concern were raised regarding dolphin displacement following river seismic activities (Pool, 2012). Other threats to this species are entanglement in fishing gear (so-called bycatch). The Guyana dolphin is known to be incidentally killed in gillnets set at the mouths of the Suriname and Coppename Rivers (Vidal et al., 1994; Husson, 1978). The carcasses probably do not strand as some are discarded at sea (Vidal et al., 1994) or are likely to be flushed out by tidal currents (M. Pool, pers comm). In French Guiana, a single study of the Guiana dolphin conducted in 2001 by Bouillet *et al.* (2002) showed that the dolphin can be sighted in estuaries along the entire coast, particularly in the dry season, and in rocky areas throughout the year. Threats impacting the species in French Guiana include incidental catches in large-mesh fishing nets, often towed by vessels registered in Brazil and Suriname (van Waerebeek, 1990; Plouvier et al., 2012). The Guiana dolphin is listed as Vulnerable in Venezuela (Bolaños-Jiménez et al., 2008) and its status in Suriname has yet to be established

Unconfirmed records for Suriname and additional species recorded within the Guianas

Humpback whale (*Megaptera novaeangliae*)

At least two of the large baleen whale opportunistic records made in October 2012 were considered very likely to be a humpback whale, based on a tall, vertical bushy blow and apparent dorsal ridges. No fluking was observed and unfortunately no photographs were available showing the body. Those photographs showing the blows were not found to be conclusive.

Within the Wider Caribbean Region, humpback whales are known to come to the winter breeding grounds in the Greater Antilles extending from the Dominican Republic to Anguilla (where the greatest present-day concentrations of humpbacks aggregate; Mattila et al., 1989; Swartz et al., 2003); and also in the Lesser Antilles from Guadeloupe south to Venezuela where historical concentrations of whales occurred but present density appears to be low (Townsend, 1935; Swartz et al., 2003). No sightings or stranding records of humpback whales are known for Suriname. One record at sea exists for French Guiana during boat surveys carried out between September 2009-

February 2010 (Vines et al., 2010). Due to the records off Venezuela and French Guiana, this species is likely to also occur in Suriname waters.

Beaked whale

Cuvier's beaked whales (*Ziphius cavirostris* - Cuvier, 1823) were recorded on three occasions in October 2008 off French Guiana (Ridoux et al., 2010). Another Cuvier's beaked whale was observed off French Guiana in November 2009 (Vines et al., 2010).

Sightings and strandings of beaked whales particularly Cuvier's beaked have been reported from many locations in the Caribbean, leading researchers to conclude that this species may be common (Debros and Barros, 1994). Cuvier's beaked whales have also been reported in the southern Caribbean, for the islands of Bonaire (van Bree and Kristensen, 1974), Aruba (Agudo and Ponson, 1996), and Curaçao (van Bree et al., 1973; Debrot and Barros, 1994; Debrot et al., 1998) as well as in adjacent waters (van Bree et al., 1973). There are also a few records off Venezuela (Romero et al., 2001). The Cuvier's beaked whale seems a likely species to occur in Suriname waters in particularly along the steep edges of the Demerara plateau. Due to the records off Venezuela and French Guiana, this species is likely to also occur in Suriname waters.

Risso's dolphin (*Grampus griseus*) - Cuvier (1812)

No sightings were made of Risso's dolphins during the main survey and no opportunistic sighting records or stranding records were obtained for Suriname waters. For now the species remains unconfirmed for Suriname. However, this species has been recorded in the Guianas with sightings been recorded off French Guiana and Venezuela (Romero et al., 1991; Ridoux et al., 2010; Vines et al., 2010). There are only a few records for Risso's dolphins from the Caribbean (Romero et al., 2001). It has been reported for Cuba, Puerto Rico, St. Croix, St. Vincent, Grenadines, Aruba and Colombia (see references in Romero et al., 2001). The species is very common, however, in the Gulf of Mexico (Mullin et al., 1994; Jefferson and Schiro, 1997). Due to the records off Venezuela and occurrence off French Guiana, this species is likely to also occur in Suriname waters.

Killer whale (*Orcinus Orca*) – Linnaeus (1758)

No sightings or stranding records of killer whales are known for Suriname. There are records of killer whales for Venezuela, particularly from the nearby oceanic islands, but relatively few for other parts of the Caribbean (Romero et al., 2001; Bolaños-Jiménez et al., 2008). One unconfirmed sighting was made off French Guiana in November 2009 (Vines et al., 2010). Due to the records off Venezuela and possible occurrence off French Guiana, this species is likely to also occur in Suriname waters.

Clymene dolphin (*Stenella clymene*) - Gray (1850)

There is considerable overlap in the range of *S. clymene* and *S. longirostris* in the Atlantic, and they are difficult to distinguish at sea. In the past, the clymene dolphin was regarded as a rare cetacean, but this is certainly the result of taxonomic confusion with *S. longirostris* and the striped dolphin (*S. coeruleoalba*; Jefferson and Schiro 1997). The species is regarded as uncommon in the WCR and there is only one record in the eastern region of Venezuela (Romero et al., 2001).

Striped dolphin (*Stenella coeruleoalba*) - Meyen (1833)

No records currently exist for striped dolphin in Suriname. However, a probable sighting (unverified) was recorded off French Guiana in October 2009 (Vines et al., 2010). Three records have been reported for Venezuela (Romero et al., 2001) but records of striped dolphins in the Caribbean are not common (Debrot *et al.* 1998; Mignucci-Giannoni 1998).

Marine Turtles

During the main survey only three sightings with turtles were made (Fig. 3). One incidental sighting occurred on 10 June (water depth 1349m) which involved a large hard-shelled turtle which was most likely a green or loggerhead turtle. An Olive Ridley turtle (probable identification based on its nearly circular shaped carapace, relatively small head and overall small size) was seen on 17 June swimming amongst some floating mats of *Sargassum* algae (water depth 1322m). Although the turtle was not observed to be feeding its association with *Sargassum* is suggestive of this. It has been reported that the olive ridley sea turtles use feeding grounds on the continental plateau of Surinam and Guyana (Feuillet and de Thoisy, 2007). A third turtle was identified as a loggerhead turtle (probably identification based on the large head, long-shaped carapace and presence of 5 lateral scutes) which was found floating dead and already quite decomposed (water depth 3065m). In addition, five sightings with marine turtles were made during the opportunistic surveys (Fig. 3). All of these were made between December 2008 and February 2009 and included three green turtles (December and February), one loggerhead turtle (January) and one leatherback turtle (December). These opportunistic sightings occurred in shallow waters ranging from 45 to 65m and involved basking animals, some of which were covered with barnacles. Those turtles sighted in shallow waters probably involved females preparing for mating or nesting. The nesting season of the green turtle runs from February to July and that of the Olive Ridley turtle is from mid-May to the end of July (Reichart et al., 2003). The loggerhead turtle is rare in Suriname waters and only once has been seen on a Suriname beach and for all practical purposes can be ignored as a species nesting in Suriname but it does nest off Venezuela and occurs in Suriname waters (Reichart et al., 2003). The leatherback turtle is rarely seen offshore during the nesting season (January-August) and studies have shown that the species spends the inter-nesting interval diving continuously attaining depths greater than 1000m (Reichert and Fretey, 1993). Direct nest counts in Suriname and French Guiana between 1967 and 2002 were used in a modelling study by Girondot *et al.* (2007), which stated that the entire population of Leatherbacks in French Guiana and Suriname is stable or slightly increasing. Preferred offshore habitats for this species have not been defined, but tagging studies have shown that after nesting the animals disperse widely across the Atlantic Ocean (WWF, 2013).

CONCLUSIONS

Observations of cetacean species in Surinam waters were previously hypothetical and this study enabled to confirm the presence of 11 new species. An inventory of the confirmed cetacean species for Suriname and those previously documented in the Guianas and along the Venezuelan Atlantic region is shown in Table 4. All turtle species were previously reported within Suriname waters. Only a few turtle sightings were made with most records made closer to the coast prior the main nesting periods.

The survey described here can only provide a 'snap shot' view of the presence and distribution of cetaceans and marine turtles recorded during the months May-September and August-March

(opportunistic records). All cetacean species identified during this study were previously reported within the WCR. The data show that the Suriname cetacean community is primarily composed of odontocetes (Sperm whales and dolphins). Mysticetes, in particularly large *Balaenopterids* were also observed although their occurrence appeared to vary. Bryde's/Sei whales were recorded during June and July after which they were no longer recorded. The opportunistic surveys indicated that large baleen whales (probably fin whales and humpback whales; unconfirmed) were recorded in October. Some of the recorded species (bottlenose dolphin and Guiana dolphin) are expected to be present year-round in the coastal zone with bottlenose dolphins likely to also have an affinity to continental slope waters.

Our results show that Suriname has a species rich and diverse cetacean fauna. The index of abundance for all cetaceans was 16.38 animals/100km. The most abundant species included the melon-headed whale with an abundance index of 5.27 animals/100km. It was found that the spinner dolphin and sperm whales were also relatively abundant (2.55 and 0.95 animals/100km). Off French Guiana the overall relative density of cetaceans based on aerial surveys (in October) was reported to be slightly lower (11.2 animals/100km; Ridoux et al. 2010) and for those sightings recorded only within the offshore region this was 6.5 animals/100km (van Canneyt et al., 2009). Nevertheless these figures are low when comparing them to other systematic surveys in tropical regions in the East Atlantic, for example those off Gabon in West Africa (>20 animals/100km; de Boer, 2010b). However, the present systematic survey was confined to deep water only (1200-3300m) whereas those studies off Gabon also spanned shelf areas where the cetacean abundance was higher. Tropical shelf waters, for example off the Maldives in the Indian Ocean, generally hold a very diverse and abundant tropical cetacean community, where the total relative abundance was more than twice that of the present study (35.3 ind/100km; Clark et al., 2012).

The productivity of the region, especially the nearby Venezuelan Atlantic front, is significant and one of the highest among neighbouring areas in the adjacent Caribbean (Longhurst, 1998; Miloslavich, 2011). During the summer there is an increase in productivity apparent off Suriname and French Guiana with areas of upwelling which are providing more nutrients (Miloslavich, 2011). The current regime in the study area can only be described as highly changeable (Fig. 6). The cetacean activity was rather patchy where an increase in sighting records, usually lasting over several days, was most likely related to the formation of temporal localised eddies (Fig. 6). However, more data is needed to allow studying the relation between cetacean distribution and these dominating current regimes.

Cetaceans and turtles are vulnerable to human-related threats in the WCR, including direct exploitation (removal from populations by live-captures), fishery interactions (by-catch), habitat degradation or loss from coastal development, pollution, acoustic disturbances and vessel strikes (Reeves, 2005; Borobia & Barros, 2006). Information on the occurrence of cetaceans and turtles in the Guianas is therefore vital to assessing biodiversity and mitigating such potential threats. A major threat to cetaceans in the WCR is that of bycatch in fishing gear (Bolanos-Jimenez and Rojas-Bracho, 2005). The only reports of cetacean bycatch in Suriname found in literature involved the incidental capture of the Guiana dolphin by Vidal et al. (1994) and Van Waerebeek (1990). Vidal et al. (1994) reported three dolphins caught between May 1964-November 1972 at the mouth of the Coppename River and four dolphins (three at Pomona and one at Braamspunt) were caught in shrimp trawls at the mouth of the Suriname River between February and May 1971. More data on the occurrence of cetaceans and the interactions with fisheries are necessary. Coastal fishing in Suriname is artisanal in nature and fisheries deploy drift gillnets and demersal longlines to catch inshore demersal species. Demersal longlines are also set in brackish water off the main estuaries

as are drift gillnets. During the present survey, offshore long-line activity was noted in the immediate study area and dead seabirds were documented thought to be potentially bycaught in these fisheries (De Boer et al., in prep). It is suggested that the interaction with long-line fisheries have a negative impact on false killer whales within Caribbean waters (Baird & Gorgone 2005; Luksenburg, 2011). Other species are also known to interact with these fisheries, e.g. Risso's, rough-toothed, Pantropical spotted, spinner, long-beaked common and Fraser's dolphins, melon-headed, pygmy killer, killer whales and sperm whales (Donoghue et al., 2003). Since sea turtle occurrence overlaps with fisheries, particularly the driftnet fisheries in near-shore zones adjacent to these major Guianas nesting sites, fisheries are considered a major source of mortality for leatherback turtles. Chevalier *et al.* (1999) and Hilterman and Goverse (2004) reported that in the 2003 nesting season, at least 21.1% (472 individuals) had injuries that may have been fisheries related, up from 17% in 2002. The considerable decline in nesting of olive ridleys on Eilanti, the major nesting beach in Suriname (Reichart and Fretey 1993), has been attributed to incidental capture in shrimp fisheries (Tambiah 1994, Reichart and Fretey 1993, Laurent *et al.*, 1999). Mortality in coastal fishing gear ranged from 7% to 14%; with most capture events occurring in the eastern sections of Suriname to its border with French Guiana (Madarie 2006). Suriname and French Guiana also represent an area with growing interest in relation to offshore exploration by the oil and gas industry and there are potential impacts to cetaceans and turtles related regarding pollution and anthropogenic sound. The likelihood of cetaceans or turtles being caught for human consumption is low in Suriname as this is strictly forbidden although the poaching of turtle eggs does take place (Fossette *et al.*, 2008). Within the region, habitat loss and pollution also form potential threats to both cetaceans and turtles due to an increase in size of the human coastal communities (Borobia & Barros, 2006; Plouvier et al., 2012).

Despite the different threats that the cetacean and turtle fauna in the Guiana's are potentially facing there are little protected measures currently in place. The listing of Protected Areas under the (SPAW) Protocol is under development (UNEP, 2012) 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 behavioural studies are needed in order to assess the status of cetaceans and marine turtles and to develop effective regionally and nationally specific conservation measures not only in Suriname waters but within the Guinea Shield as a whole. As emphasised by this study, it is important that all research activities in this area report their opportunistic sightings; so that a better overall picture can be produced regarding the occurrence and ecology of species within the Guiana Shield through a synthesis of these sparse data sets.

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REFERENCES

- Agudo, A. I., and M. E. Ponson Jr. 1996. Primeiro rexistro de cetaceos na illa de Aruba (Antillas Holandesas). *Eubalaena* (9):5–9.
- Alberico M., Cadena A., Hernandez-Camacho J. and Muñoz-Saba Y. (2000) Mamíferos (Synapsida: Theria) de Colombia. *Biota Colombiana* 1, 43–75.
- Baines, M. & Lewis, T. (2012): Passive Acoustic Monitoring Report, Suriname 3D seismic survey for Tullow Oil. Unpublished report to Tullow Oil from RPS Energy.
- Baird R.W. and Gorgone A.M. (2005) False killer whale dorsal fin disfigurements as a possible indicator of long-line fishery interactions in Hawaiian waters. *Pacific Science* 59, 593–601.
- de Boer, M.N. (2010a) First record of a white rough-toothed dolphin (*Steno bredanensis*) off West Africa including notes on rough-toothed dolphin surface behaviour. *Marine Biodiversity Records*. Volume 3, 4 pp.
- de Boer, M.N. (2010b) Cetacean distribution and relative abundance in offshore Gabonese waters. *Journal of the Marine Biological Association of the United Kingdom*, 90(8): 1613-1621 doi:10.1017/S0025315410001165
- de Boer, M.N., Riechelt, M., Saulino, J., Williams, A., Baines, M., Lewis, T. 2012. Marine Fauna Report to Tullow Oil. Report no. 6.
- Boisseau 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 the International Fund for Animal Welfare.
- Boisseau O, Leaper R, Moscrop A (2006) Observation of small cetaceans in the eastern Caribbean. Paper SC/58/SM24 presented to the International Whaling Commission Scientific Committee (unpublished)
- Bolaños-Jiménez, J and S. Boher. 1996. Cetaceos des Venezuela, lista actualizada. *Naturèa* 104:51–53. Caracas, Venezuela.
- Bolaños-Jiménez, J., Fertl, D., Iñiguez, M. 2008. Killer whale (*Orcinus orca*) occurrence in Venezuelan waters, 2001-2008. Paper SC/60/SM8 presented to the Scientific Committee, 60th Annual Meeting of the International Whaling Commission.
- Bolaños-Jiménez, J, Pirela, D., Rojas, J., León, T. (2008). Bufo negro, *Sotalia guianensis* Van Beneden 1863. Page 12 in Rodríguez, J.P. and Rojas-Suárez, F. (Eds). Libro Rojo de la Fauna de Venezuela. Tercera Edición. Provita and Shell Venezuela S.A., Caracas, Venezuela.
- Bolaños-Jiménez, J, L. Bermúdez-Villapol, A. Sayegh and G. Sole. 2006. Current status of small cetaceans in Venezuela. SC/58/SM9. Presented to the Scientific Committee. 58th Annual Meeting of the International Whaling Commission. St. Kitts & Nevis.

- Bolaños-Jiménez, J and A.J. Villarroel-Marín. 2003. Three new records of cetacean species for Venezuelan waters. *Caribbean Journal of Science* 39: 230-232.
- Bolanos-Jimenez, J., and L. Rojas-Bracho. 2005. A review of fisheries by-catch of marine mammals in the wider Caribbean. *In: Regional Workshop of experts on the development of the marine mammal action plan for the wider Caribbean region.* UNEP, Bridgetown, Barbados.
- Bonnelly de Calventi, I. 1994. Mamíferos Marinos en la República Dominicana. República Dominicana, CIBIMA - DEBIO - WWF - FUNDEMAR, 77 p.
- Borobia M. and Barros N.B. (2006) Major threats to small cetaceans in the Caribbean region: a summary report. Paper SC/58/SM15 presented to the Scientific Committee, 58th Annual Meeting of the International Whaling Commission, St Kitts and Nevis.
- Borobia, M., S. Siciliano, Lodi, L., Hoek, W. (1991) Distribution of the South American dolphin *Sotalia*. *Canadian Journal of Zoology* 69(4): 1025-1039. <http://dx.doi.org/10.1139/z91-148>
- Bouillet, S., Leclere, M., de Thoisy, B. (2002). Le sotalie, *Sotalia fluviatilis*: éléments bibliographiques et premières données (distribution, menaces) sur la Guyane. Kwata.
- van Bree, P. J. H., and I. Kristensen. 1974. On the intriguing stranding of four Cuvier's beaked whales, *Ziphius cavirostris* G. Cuvier, 1823, on the Lesser Antillean island of Bonaire. *Bijdragen tot de Dierkunde* 44(2): 235–238.
- van Bree, P. J. H., F. Creutzberg, and I. Kristensen. 1973. On strandings of Cuvier's whale, *Ziphius cavirostris* G. Cuvier, 1823, on the Lesser Antillean Islands of Sint Maarten and Curaçao. *Lutra* 15(1/3):6–8.
- Brichett, M. 2012. Workshop 5: North East of South America, Regional Cooperation for a Marine Mammals Conservation Strategy Workshop – MAMA COCO SEA Project, In: E. Hoyt (editor) *Proceedings of the second International Conference on marine mammal protected areas. ICMMPA 2: Endangered Spaces, Endangered Species* November 7–11, 2011 Fort-de-France, Martinique.
- Brichet, M., Martinez, C., Souan., H. (2011). Elements for a regional cooperation project for marine mammal conservation in areas under Amazonian influence in northeastern Latin America, Agence des Aires Marines Protégées - SPAW RAC.
- Caldwell, D. K., M. C. Caldwell and R. V. Walker. 1976. First records for Fraser's dolphin (*Lagenodelphis hosei*) in the Atlantic and the melon-headed whale (*Peponocephala electra*) in the western Atlantic. *Cetology* 25:1-4.
- Van Canneyt, O., Grégoire, C., Ghislain, D., Sophie, L., Vincent, R., Jaime, B., Stéphane, J., Pierre, W. (2009). Distribution and abundance of marine megafauna in French Guiana, REMMOA Campaign – Guiana. CRMM, La Rochelle, France, 41 pp.
- Carlson, C. A., I. Seipt, R. Brown, E. Lewis, and A. Moscrop. 1995. Report on a project by the International Fund for Animal Welfare (IFAW) to enhance public awareness and promote the appropriate development of whale watching in Dominica. International Whaling Commission. An Information Paper, Working group on Whale Watching. 15 pp.

Casinos, A. 1981. *Ziphius cavirostris* G. Cuvier, 1823 (Cetacea, Hyperoodontidae) en la Isla de Margarita (Venezuela). *Publicaciones del Departamento de Zoología de la Universidad de Barcelona*.6: 61-63.

Casinos, A. and J. Bou. 1980. On a massive stranding of short-finned pilot whales (*Globicephala macrorhynchus*), Gray, 1846, on Margarita Island (Venezuela). *Scientific Reports of the Whale Research Institute*. 32:145-148.

Chevalier, J., X. Desbois, and M. Girondot. 1999. The reason for the decline of leatherback turtles (*Dermochelys coriacea*) in French Guiana: A hypothesis. *In: 9th Extraordinary meeting of the Societas Europaea Herpetologica*. Université de Savoie, Le bourget du lac, Université de Savoie.

Clark R. A., Johnson C. M., Johnson G., Payne R., Kerr I., Anderson R. C., Sattar S. A., Godard C. J. and Madsen P. T. (2012), Cetacean sightings and acoustic detections in the offshore waters of the Maldives during the northeast monsoon seasons of 2003 and 2004. *J. Cetacean Res. Manage* 12(2): 227-234.

Cobarrubia, S. & Bolaños-Jiménez, J. 2008. Western range extension (from northeastern to central Venezuela) for the long-beaked common dolphin (*Delphinus capensis*). Paper SC/SM/9 presented to the IWC 60th Scientific Committee, June 2008, Santiago de Chile.

Condie, S.A., 1991: Separation and recirculation of the North Brazil Current. *Journal of Marine Research*, 49, 1-19.

Davis, R.W. and G. S. Fargion, eds. 1996. Distribution and abundance of cetaceans in the north-central and western Gulf of Mexico: final report. Volume II: Technical Report. OCS Study MMS 96-0027. Prepared by the Texas Institute of Oceanography and the National Marine Fisheries Service. US Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana, USA. 357 pp.

Debrot A.O. (1998) New cetacean records for Curaçao, Netherlands Antilles. *Caribbean Journal of Science* 34, 168–170.

Debrot A.O. and Barros N.B. (1994) Additional cetacean records for the Leeward Dutch Antilles. *Marine Mammal Science* 10, 359–368.

Debrot, A. O., J. A. de Meyer and P. J. E. Dezentjé, 1998. An overview of the cetacean fauna of the Leeward Dutch Antilles. *Caribbean Journal of Science* 34: 204-210.

Donoghue M., Reeves, R.R., Stone G.S. 2003. Report of the workshop on interactions between cetaceans and longline fisheries, Apia, Samoa: November 2002. New England Aquarium Aquatic Forum Series Report 03-, 1New England Aquarium, May 2003.

Eckert SA, Bowles A, Berg E (1998) The effect of seismic airgun surveys on leatherback sea turtles (*Dermochelys coriacea*) during the nesting season. Final report submitted to BHP Petroleum. Hubbs-SeaWorld Research Institute, San Diego, CA.

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

Erdman, D. S. 1970. Marine mammals from Puerto Rico to Antigua. *J. Mammal.* 51(3):636–639.

Erdman, D. S., J. Harms, and M. M. Flores. 1973. Cetacean records from the northeastern Caribbean region. *Cetology* (17):1–14.

Febres-Ortega, G. and L.E. Herrera, 1976: Caribbean Sea Circulation and water mass transports near the Lesser Antilles. *Boletín del Instituto Oceanográfico*, 15, 83-96.

Feuillet, G. & de Thoisy, B. 2007. La Tortue olivatre [The olive ridley sea turtle]. Collection Nature Guyanaise, Sepanguy, Association Kwata.

Fossette, S., Kelle, L., Girondot, M., Goverse, E., Hilterman, M.L., Verhage, B., Thoisy, B. de, Georges, J-Y. (2008). The world's largest leatherback rookeries: A review of conservation-oriented research in French Guiana/Suriname and Gabon. *Journal of Experimental Marine Biology and Ecology* 356 (2008) 69–82.

Gero S. and Whitehead H. (2006) Opportunistic sightings of small cetaceans off the leeward shore of the Commonwealth of Dominica. Paper SC/58/SM1 presented to the Scientific Committee, 58th Annual Meeting of the International Whaling Commission, St Kitts and Nevis.

Girondot, M., Godfrey, M.H., Ponge, L., Rivalan, P. (2007). Modeling Approaches to Quantify Leatherback Nesting Trends in French Guiana and Suriname. *Chelonian Conservation and Biology*, May 2007, Vol. 6, No. 1, pp. 37-46.

Gómez-Salazar, C., Portocarrero-Aya, M., Trujillo F., Caballero S, Bolaños-Jiménez J., Utreras V., McGuire, F., Ferrer-Pérez A., Pool, M., Aliago-Rossel, E. 2010. Update on the freshwater distribution of *Sotalia* in Colombia, Ecuador, Peru, Venezuela and Suriname. *LAJAM* 8(1-2): 171-178.

Goverse, E.& Hilterman, M. L. (2006) - *Status of leatherback nesting population in Suriname with notes on leatherback nesting in Guyana and French Guiana*- Atlantic Leatherback Strategy Retreat at St Catherines Island, WWF, IUCN and STINASU

Gyory, J, Mariano, A and Ryan, E (2005) - *The Guiana Current, Ocean Surface Currents*. University of Miami Rosenstiel School of Marine and Atmospheric Science (RSMAS), NOAA's Cooperative Institute for Marine and Atmospheric Sciences (CIMAS) and the National Oceanographic Partnership Program (NOPP) (<http://oceancurrents.rsmas.miami.edu/atlantic/guiana.html>, accessed in 2012)

Hersh, S. L. and D. K. Odell. 1986. Mass strandings of Fraser's dolphin, *Lagenodelphis hosei*, in the western north Atlantic. *Mar. Mamm. Sci.* 2: 73–76.

Herskovitz, P. 1963. Notes on South American dolphins of the genera *Inia*, *Sotalia* and *Tursiops*. *Journal of Mammalogy* 44(1): 98-103.

Hilterman, M. L., and E. Goverse. 2004. Annual report on the 2003 leatherback turtle research

and monitoring project in Suriname. World Wildlife Fund - Guianas Forests and Environmental Conservation Project (WWF-GFECF) Technical Report of the Netherlands Committee for IUCN (NC-IUCN). Amsterdam, the Netherlands.

Hoyt, E. 2012. Proceedings of the Second International Conference on Marine Mammal Protected Areas (ICMMPA 2), Fort-de-France, Martinique, 7-11 Nov. 2011, ppi-vi, 1-103

Husson, A. M. 1978. The mammals of Suriname. *Zoölogische Monographiën van het Rijksmuseum van Natuurlijke Historie* 2: 1–569.

IFAW. 1996. Cetacean field research conducted from *Song of the Whale* off Dominica and Grenada: Spring 1996. Unpublished Report to the International Fund for Animal Welfare.

IUCN (2012) – The IUCN Red List of Threatened Species (<http://www.iucnredlist.org/apps/redlist/>, accessed in 2012)

Jefferson, T.A. and Barros, N.B. (1997) *Peponocephala electra*. *Mammalian Species. American Society Mammalogists* 553: 1-6

Jefferson T. and Lynn S.K. (1994) Marine mammal sightings in the Caribbean Sea and Gulf of Mexico, summer 1991. *Caribbean Journal of Science* 30, 83–89.

Jefferson, T. A. and A. J. Schiro. 1997. Distribution of cetaceans in the offshore Gulf of Mexico. *Mamm. Rev.* 27: 27–50.

Jefferson, Thomas, Marc A. Webber, and Robert L. Pitman (2008). *Marine Mammals of the World: A Comprehensive Guide to their Identification*. London: Academic.

Jefferson, T.A., Fertl, D., Bolaños-Jiménez, J., Zerbini, A.N. 2009. Distribution of common dolphins (*Delphinus* spp.) in the western Atlantic Ocean: a critical re-examination. *Marine Biology* 156:1109–1124

Jérémie, S., Gannier, A., Bourreau S., 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 to the Scientific Committee, 58th Annual Meeting of the International Whaling Commission, St Kitts and Nevis.

Kingston S.E., Adams L.D. and Rosel P.E. (2009) Testing mitochondrial sequences and anonymous nuclear markers for phylogeny reconstruction in a rapidly radiating group: molecular systematics of the Delphininae (Cetacea: Odontoceti: Delphinidae). *BMC Evolutionary Biology* 9, 245.

Laurent, L., R. Charles, and R. Lieveld. 1999. Fishery Sector report for the Guayana Shield Sea Turtle Conservation Regional Strategy Action Plan 2000-2005. WWF Suriname Agreement No. FH-13.

LeDuc R.G., Perrin W.F., Debrot A.O., Barros N.B. and van Bree P.J.H. (1997) *Stenella attenuata* from Curaçao misidentified as *Stenella coeruleoalba*. *Marine Mammal Science* 13, 356–357.

Linares, O. J. and J. Bolaños. 1995. A recent list of sirenians and cetaceans deposited in Venezuelan museums. In: *Abstracts, Eleventh Biennial Conference on the Biology of Marine Mammals*, 18–21 December, Orlando, Florida, USA.

Lira, C., J. Bolaños and E. Mondolfi. 1995. On two strandings of fin whale (*Balaenoptera physalus*) and its presence in Venezuelan waters. In: *Abstracts, Eleventh Biennial Conference on the Biology of Marine Mammals*, 14–16 December, Orlando, Florida, USA, p. 169.

Longhurst A (1998) Ecological geography of the sea. New York: Academic Press. 398 pp.

Luksenburg, J.A. 2011. Three new records of cetacean species for Aruba, Leeward Antilles, southern Caribbean. *Marine Biodiversity Records*, page 1- 4 Volume 4: e4. doi:10.1017/S1755267210001193

Mattila D.K., Clapham P.J., Katona S.K. and Stone G.S. (1989) Population composition of humpback whales, *Megaptera novaeangliae*, on Silver Bank, 1984. *Canadian Journal of Zoology* 67, 281–285.

Mead, J. G. 1977. Records of sei and Bryde's whales from the Atlantic coast of the United States, the Gulf of Mexico, and the Caribbean. *Rep. Int. Whal. Comm. Spec. Iss.* 1:113–116.

Mignucci-Giannoni, A. A. 1998. Zoogeography of cetaceans off Puerto Rico and the Virgin Islands. *Carib. J. Sci.* 34(3–4): 173–190.

Mignucci-Giannoni A.A., Swartz S.L., Martínez A., Burks C.M. and Watkins A.A. (2003) First records of the pantropical spotted dolphin (*Stenella attenuata*) for the Puerto Rican Bank, with a review of the species in the Caribbean. *Caribbean Journal of Science* 39, 381–392.

Miloslavich P, Klein E., Diaz JM, Hernandez CE, Bigatti G, Campos L, Artigas F, Castillo J, Penschaszadeh PE, Neill PE, Carranza A, Retana MV, Diaz de Astarloa JM, Lewis M, Yorio P, Piriz ML, Rodriguez D, Yoneshigue-Valentin Y, Gamboa L, Martin A. 2011. Marine Biodiversity in the Atlantic and Pacific Coasts of South America: Knowledge and Gaps. *PLOS One*. Volume 6 (1): e14631

Mignucci-Giannoni AA (1998) Zoogeography of cetaceans off Puerto Rico and the Virgin Islands. *Caribbean Journal of Science* 34: 173–190.

Mignucci-Giannoni A., A.R. Montoya-Ospina, J.J Pérez-Zayas, M.A Rodríguez-Lopez, E.H. Williams, 1999. New records of Fraser's dolphin (*Lagenodelphis hosei*) for the Caribbean. *Aquatic Mammals*, 25.1, 15-19.

Mörzer Bruyns W.F.J. (1971) *Field guide of whales and dolphins*. CA Mees, Amsterdam, the Netherlands.

Mullin, K. D., W. Hoggard, C. L. Roden, R. R. Lohofener, C. M. Rogers, and B. Taggart. 1994. Cetaceans on the upper continental slope in the northcentral Gulf off Mexico. *Fish. Bull.* 92(4):773–786.

Naveira , J. L. and O. Diaz. 1996. Primer registro de varamiento del cetaceo Barbado *Megaptera novaeangliae* (Borowski, 1781) (Mysticeti: Balaenopteridae) para la region nororiental de Venezuela. *Boletin Instituto Oceanografico Venezuela, Universidad Oriente* 35 (1 and 2): 94 –104.

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

Olesun, E.M., Barlow, J., Gordon, J., Rankin, S. & Hildebrand, J.A. (2003) Low frequency calls of Bryde's whales. *Marine Mammal Science*, 19(2):407-419.

Oviedo, L., N. Silva, L. Bermudez and D. K. Odell. 2005. Distribution of Bottlenose Dolphins (*Tursiops truncatus*) on the East Coast of Isla Margarita and the Los Frailes Archipelago, Venezuela. *Aquatic Mammals* 31: 442-446.

Palacios, G. M., T. Gerrodette, S. Beltran, P. Rodriguez, and P. Brennen. 1995. Cetacean sighting cruises off the Colombian Caribbean Sea and Pacific Ocean. In: *Abstracts, Eleventh Biennial Conference on the Biology of Marine Mammals*, 14–16 December, Orlando, Florida, USA. p. 88.

Palacios, D. M., P. Rodriguez, B. J. Brennen, S. Beltran, and F. Trujillo. 1996. Cetacean sightings during cruises in the southwestern Caribbean Sea. Reunion de Trabajo de Especialistas en Mamiferos Acuaticos de America del Sur. Programas y Resumenes. 22–25 Octubre 1996, Via del Mar, Chile, pp. 76.

Pardo M.A. and Palacios D.M. (2006) Cetacean occurrence in the Santa Marta region, Colombian Caribbean, 2004–2005. *Latin American Journal of Aquatic Mammals* 5, 129–134.

Perryman, WL (2009): Melon-headed whale - *Peponocephala electra*. In: *Encyclopedia of marine mammals* (Perrin WF, Würsig B, Thewissen JGM, eds.) Academic Press, Amsterdam, 719-721.

Plouvier, D., Gomes, L., Verweij, P., Verlinden, N. 2012. Living Guianas. 2012. WWF-Guyana. http://awsassets.panda.org/downloads/living_guianas_report_2012_wwf_guianas_printversion.pdf (accessed February 2013)

Pool M. 2012a. River seismic survey in manatee habitat in Suriname. In: *Sirenews-newsletter of the IUCN Sirenia Specialist Group*. October 2012 - Number 58, p. 14-17.

Pool, M. 2012b. *Dolphin monitoring and research programme in Suriname*. Workshop 5: North East of South America, Regional Cooperation for a Marine Mammals Conservation Strategy Workshop – MAMA COCO SEA Project, In: E. Hoyt (editor) *Proceedings of the second International Conference on marine mammal protected areas. ICMMPA 2: Endangered Spaces, Endangered Species* November 7–11, 2011 Fort-de-France, Martinique.

Prieto Rodríguez, M. 1988. Reporte de algunos cetáceos del Caribe Colombiano. *Bol. Fac. Biol. Mar.* (Univ. Jorge Tadeo Lozano, Bogotá) (8):30–40.

Prieto R., Janiger D., Silva M.A., Waring, G.T., Goncalves K.M. 2011. The forgotten whale: a bibliometric analysis and literature review of the North Atlantic sei whale *Balaenoptera borealis*. *Mammal Review*. doi: 10.1111/j.1365-2907.2011.00195.x

Reeves R.R. (2005a) Distribution and status of marine mammals of the wider Caribbean region: an update of UNEP documents. United Nations Environment Programme, Report UNEP(DEC)/CAR WG.27/INF.3, 18 July 2005, 8 pp.

Reeves R.R. 2005b. Insights of marine mammals of the Wider Caribbean Sea Region (Including the Gulf of Mexico) derived from whaling history documents. Regional Workshop of Experts on the Development of the Marine Mammal Action Plan for the Wider Caribbean Region. UNEP(DEC)/CAR WG.27/INF.8

Reichart, H. A. and J. Fretey. (1993) - *WIDECAST Sea Turtle Recovery Action Plan for Suriname*, Karen L. Eckert, Editor. CEP Technical Report No. 24, UNEP Caribbean Environment Programme, Kingston, Jamaica. xiv + 65 pp (<http://www.cep.unep.org/publications-and-resources/technical-reports/tr24en.pdf>, accessed in 2013)

Reichart, H., L. Kelle, L. Laurent, H. L. van de Lande, R. Archer, R. Charles, and R. Lieveld. 2003. Regional Sea Turtle Conservation Program and Action Plan for the Guianas. GFECF#10, WWF Guianas Forests and Environmental Conservation Project, Paramaribo, Suriname.

Rice, D. W. 1998. Marine mammals of the world. Systematics and distribution. Soc. Marine Mammalogy, Lawrence, KS, 231 p.

Ridoux, V., Certain G., Doremus G, Laran S., van Canneyt O., Watremez P. 2010. Mapping diversity and relative density of cetaceans and other pelagic megafauna across the tropics: general design and progress of the REMMOA aerial surveys conducted in the French EEZ and adjacent waters. Paper SC/62/E14 presented to the Scientific Committee, 62nd Annual Meeting of the International Whaling Commission.

Roden CL, Mullin KD (2000) Sightings of cetaceans in the northern Caribbean Sea and adjacent waters, winter 1995. *Caribbean Journal of Science* 36: 280–288.

Rodríguez, E., R. Acosta, C. Pérez, T. Urdaneta, M. Parada, E. W. Cabezas, S. Fuenmayor, D. Arrieche, L. Gómez, J. Bong, A. Vilorio and M. A. Duarte. 1993. *Orcinus orca* Linnaeus 1758 (Cetacea: Delphinidae) en la costa norte del Estado Zulia, Venezuela. *Anartia* 4:1-8.

Romero, A., A. Agudo, S.M. Green and G.N. di Sciara. 2001. Cetaceans of Venezuela: Their Distribution and Conservation Status. NOAA Technical Report NMFS, no. 151.

Slijper, E. J., W. L. van Utrecht, and C. Naaktgeboren. 1964. Remarks on the distribution and migration of whales, based on observations from Netherlands ships. *Bijdragen tot de Dierkunde* 34:1–93.

Stacy P.J., Leatherwood S. and Baird R.W. (1994) *Pseudorca crassidens*. *Mammalian Species* 456, 1–6.

Swartz SL, Martinez A, Stamates J, Burks C, Mignucci-Giannoni AA (2001) *Acoustic and visual survey of cetaceans in the waters of Puerto Rico and the Virgin Islands: February–March 2001*. NOAA Technical Memorandum NMFS-SEFSC- 463, Woods Hole, Massachusetts, USA.

Swartz S.L., Cole T., McDonald M.A., Hildebrand J.A., Oleson E.M., Martinez A., Clapham P.J., Barlow J. and Jones M.L. (2003) Acoustic and visual survey of humpback whales (*Megaptera novaeangliae*) distribution in the eastern and southeastern Caribbean Sea. *Caribbean Journal of Science* 39, 195–208.

Tambiah, C. R. 1994. Saving sea turtles or killing them: the case of US regulated TEDs in Guyana and Suriname, pp. 149-151. *In: Proceedings of the 14th annual symposium on sea turtle biology and conservation, 1-5 March 1994*. Hilton Head, South Carolina, USA. National Marine Fisheries Service, Southeast Fisheries Science Center. NOAA Technical Memorandum NMFS-SEFSC-351.

Townsend, C.H. 1935. The distribution of certain whales, as shown by logbook records of American whaleships. *Zoologica* 19(1):1-50.

Varona, L. S. 1964. Un Cráneo de *Ziphius cavirostris* del Sur de Isla de Pinos. *Poeyana Ser A* (4):1–3.

Varona, L. S. 1974. Catálogo de los mamíferos vivientes y extinguidos de las Antillas. Academia de Ciencias de Cuba, La Habana, 139 p.

Vidal, O. 1990. Lista de los mamíferos acuáticos de Colombia. Informe del Museo del Mar (Universidad Tadeo Lozano, Bogotá, Colombia) 37:1–18.

Vidal O., van Waerebeek, K., Findley L.T. 1994. Cetaceans and fillnet fisheries in Mexico, Central America and the Wider Caribbean: a preliminary review. *Rep. Int. Whal. Commn (Special Issue 15)*: 221-233.

Villarroel, A.J., J. Bolaños, A. Ferrer, and S. Narciso. 2001. On two strandings of the pygmy killer whale (*Feresa attenuata* Gray, 1874) in the central coast of Venezuela: first records for the southern Caribbean Sea. *In: Abstracts Book, 14th Biennial Conference on the Biology of Marine Mammals, Vancouver*.

Vines, J., Teixeira, M. and Paixao, I. (2010). Marine mammal observer's report during Guyane Maritime 3D/2D seismic survey GFGUMA093DS11C, RPS Energy, Axminster.

van Waerebeek. K. 1990. Preliminary notes on the existence of a dolphin by-catch off French Guiana. *Aquatic Mammals* 16:71-72.

Ward 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. Report UNEP(DEC)/CAR IG.20/INF.3, First Meeting of the Contracting Parties (COP) to the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region. Havana, Cuba, 24–25 September 2001.

Watkins, W. A., G. Notarbartolo di Sciara, and K. E. Moore. 1979. Observations and radio tagging of *Balaenoptera edeni* near Puerto La Cruz, Venezuela. Ref. No. WHOI-79-78. Woods Hole Oceanographic Institute, Woods Hole, Massachusetts, USA.

Watkins, W. A., K. E. Moore, and P. Tyack. 1985. Sperm whale acoustic behaviours in the southeast Caribbean. *Cetology* 49. 15 pp.

Watkins, W. A., M. A. Dahler, A. Samuels, and D. P. Gannon. 1997. Observation of *Peponocephala electra*, the melon-headed whale, in the southeastern Caribbean. *Carib. J. Sci.* 33: 33–40.

Weir, C.R., Calderan S., Unwin M., Paulatto, M. 2011. Cetacean encounters around the island of Montserrat (Caribbean Sea) during 2007 and 2010, including new species state records. *Marine Biodiversity Records*, p. 1-10. doi:10.1017/S1755267211000480; Vol. 4; e42

Weir, C. R., Goncalves, L., May, D. 2013. New Gulf of Guinea (Africa) range state records for pygmy killer whale (*Feresa attenuata*) and Fraser's dolphin (*Lagenodelphis hosei*). *Marine Biodiversity Records*

WWF (2013). <http://www.conserveturtles.org/wwf/> Accessed February 2013.

Witte R.H., van Buurt G., Debrot, D.A., Bermudez-Villapol, L.A., Simal F. 2012. First record of Fraser's dolphin *Lagenodelphis hosei* for the Dutch Caribbean. *Marine Biodiversity Records*, Vol. 5: e46, pp 1-4. doi:10.1017/S1755267212000279

Würsig, B., T.A. Jefferson, and D. Schmidly. 2000. *The marine mammals of Mexico*. Texas A & M University Press, College Station, Texas, USA.

Yoshida H, Compton J, Punnett S, Lovell T, Draper K, Franklin G, Norris N, Phillip P, Wilkins R, Kato H (2010) Cetacean sightings in the eastern Caribbean and adjacent waters, spring 2004. *Aquatic Mammals* 36: 154–161.

Table 1. Extent of dedicated visual survey effort during the three survey periods (Shift 1-3) off Suriname between 17 May and 3 September 2012.

Survey	Period	Total effort (hrs:min)	Effort (km)
Shift 1	17 May – 24 June	388:48	2922.09
Shift 2	25 June – 24 July	376:21	3151.46
Shift 3	25 July – 3 September	502:58	--
Total	17 May – 3 September	1268:07	--

Table 2.

Species	All sightings (S)	All Individuals (Ind.)	S (Ind)	S (Ind)	S (Ind)	Incidental Sightings (ind)	Abundance Index ind/km*100	Opportunistic Records: strandings† & at-sea sightings
Cetacean species	<i>Shift 1-3</i>	<i>Shift 1-3</i>	<i>Shift 1</i>	<i>Shift 2</i>	<i>Shift 3</i>	<i>Shift1-3</i>	<i>Shift1-2</i>	<i>Other</i>
Fin whale	-	-	-	-	-	-	--	2†
<i>Balaenoptera physalus</i>								(2)
Bryde's whale	1	1	1	0	0	0	0.016	-
<i>Balaenoptera brydei</i>			(1)					
Sei whale	-	-	-	-	-	-	--	1†
<i>Balaenoptera borealis</i>								(1)
Sei/Bryde's whale	3	5	1	2	0	0	0.082	-
			(3)	(2)				
Large <i>Balaenopterid</i>	2	2	0	2	0	2	0.033	3
				(2)				(4)
Minke whale	-	-	-	-	-	-	--	1†
<i>B. acutorostrata?</i>								(1)
Humpback whale	-	-	-	-	-	-	--	2?
<i>Megaptera novaeangliae</i>								(3)
Sperm whale	8	67	1	5	2	0	0.955	10
<i>Physeter macrocephalus</i>			(20)	(38)	(9)			(39)
Short-finned pilot whale	-	-	-	-	-	-	--	1
<i>Globicephala macrorhynchus</i>								(8)
False killer whale	1	3	0	1	0	0	0.049	1
<i>Pseudorca crassidens</i>				(3)				(10)
Melon-headed whale	3	520	1	1	1	0	5.269	-
<i>Peponocephala electra</i>			(120)	(200)	(200)			
Small Blackfish sp.	1	30	0	1	0	0	0.494	1
				(30)				(100)
Spinner dolphin	9	410	0	4	5	1	2.552	9
<i>Stenella longirostris</i>				(155)	(255)	(5)		(725)
Pantropical spotted dolphin	3	290	0	1	2	0	0.988	2
<i>Stenella attenuata</i>				(60)	(230)			(24)
Atlantic spotted dolphin	-	-	-	-	-	-	--	5
<i>Stenella frontalis</i>								(90)
Fraser's dolphin	2	90	0	1	1	0	0.494	-
<i>Lagenodelphis hosei</i>				(30)	(60)			
Long-beaked common dolphin	1	50	1	0	0	0	0.823	-
<i>Delphinus capensis</i>			(50)					
Rough-toothed dolphin	2	65	0	1	1	0	0.659	2
<i>Steno bredanensis</i>				(40)	(25)			(18)
Bottlenose dolphin	-	-	-	-	-	-	--	4
<i>Tursiops truncatus</i>								(37)
Guiana dolphin	0	0	0	0	0	2	--	(Resident)
<i>Sotalis guianensis</i>						(13)		
<i>Stenella sp.</i>	1	30	0	1	0	1	0.494	-
				(30)		(4)		
<i>Dolphin sp</i>	24	582	6	6	12	1	3.425	-
			(123)	(85)	(374)	(2)		
<i>Whale sp.</i>	4	4	1	2	1	0	0.049	-
			(1)	(2)	(1)			
Total	65	2149	12	28	25	5	16.38	44
			(318)	(677)	(1154)	(22)		(1062)

Table 3.

Species	All sightings (S)	All Individuals (Ind.)	S (Ind)	S (Ind)	S (Ind)	Incidental Sightings (ind)	Abundance Index ind/km*100	Opportunistic Records: at-sea sightings
Turtle species	<i>Shift 1-3</i>	<i>Shift 1-3</i>	<i>Shift 1</i>	<i>Shift 2</i>	<i>Shift 3</i>	<i>Shift1-3</i>	<i>Shift1-2</i>	Other
<i>Green turtle</i>	-	-	-	-	-	-	--	3
<i>Chelonia mydas</i>								(3)
<i>Loggerhead turtle</i>	1	1	0	1	0	0	0.016	1
<i>Caretta caretta</i>				(1+)				(1)
<i>Olive Ridley turtle</i>	1	1	1	0	0	0	0.016	-
<i>Lepidochelys olivacea</i>			(1)					
<i>Leatherback turtle</i>	-	-	-	-	-	-	--	1
<i>Dermochelys coriacea</i>								(1)
<i>Hard-shelled turtle sp.</i>	0	0	0	0	0	1	--	-
						(1)		
Total	2	2	1	1	0	1	0.033	5
			(1)	(1)		(1)		(5)

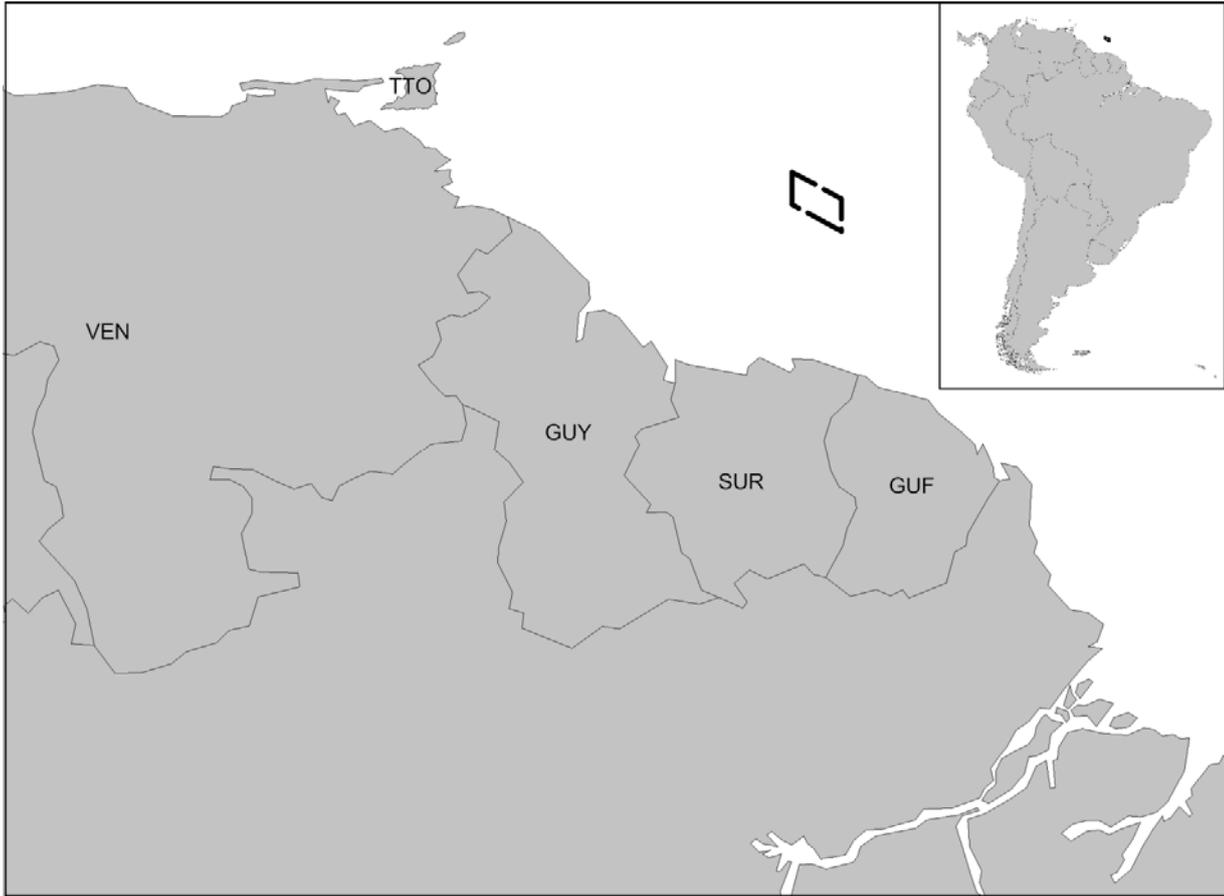


Fig. 1. The Guianas, Guyana (GUY), Suriname (SUR) and French Guiana (GUF) and Venezuela (VEN) with Trinidad and Tobago (TTO) and the study area (outlined in black dashed line).

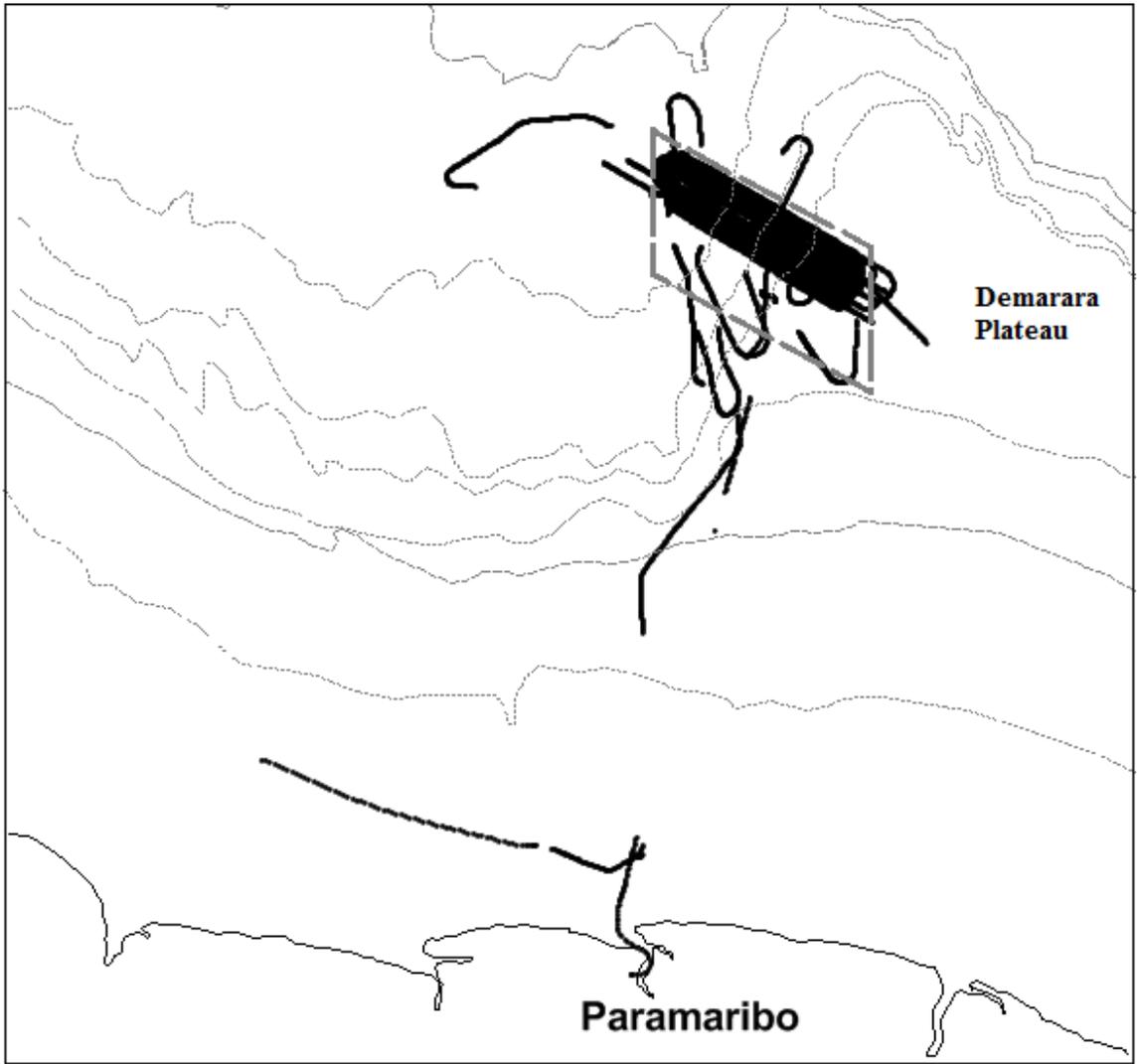


Fig. 2. Study area together with the GPS tracks (in black). The vessel entered Surinam waters on 17 May 2012. No GPS tracks were available from 28 July onwards but the vessel continued to operate within the same study area (grey dashed box).

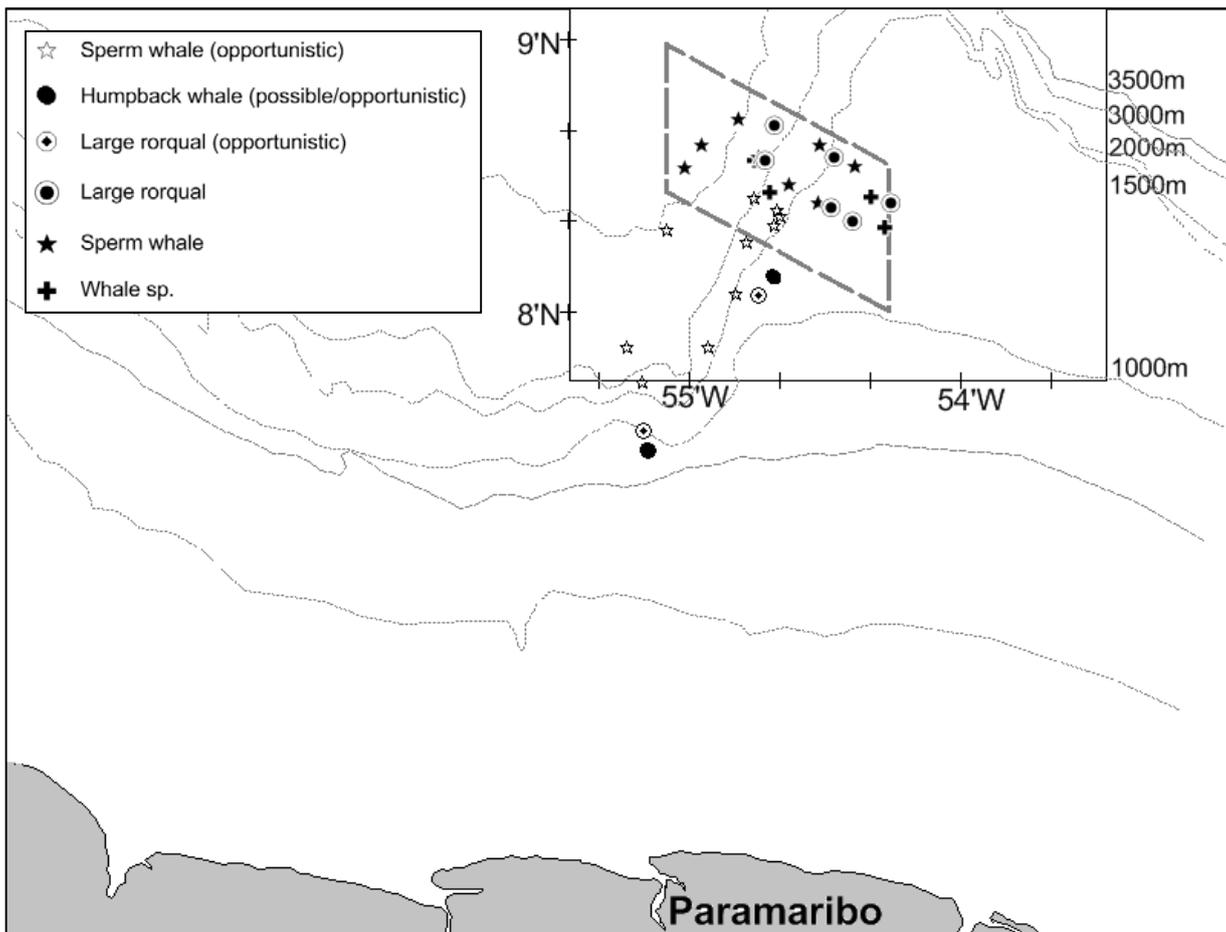


Fig. 3. Sighting positions of different whale species seen during the systematic and opportunistic surveys.

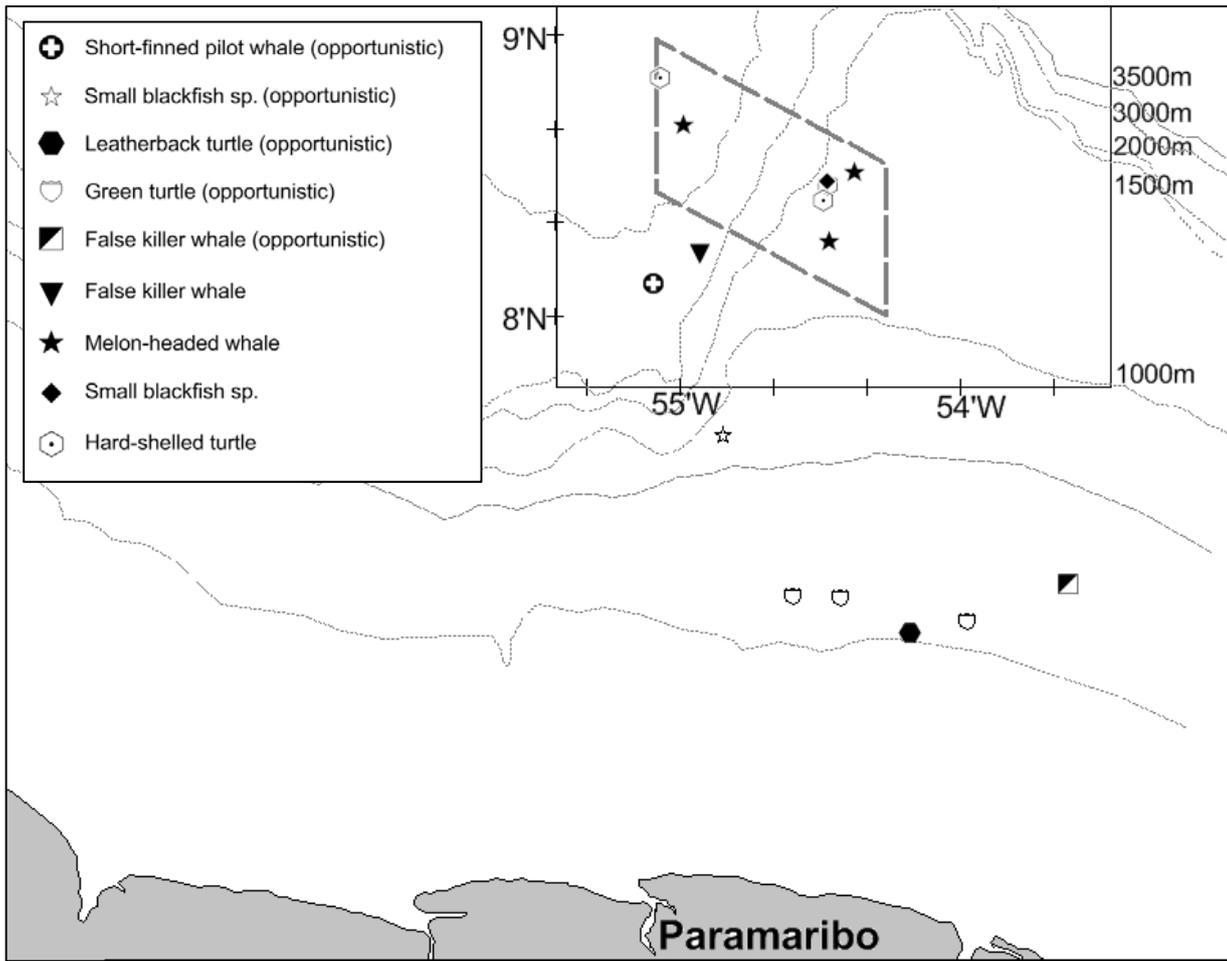


Fig. 4. Position of sightings of turtles and blackfish species (false killer whales, short-finned pilot whales, melon-headed whales and small blackfish sp.) encountered during the systematic and opportunistic surveys

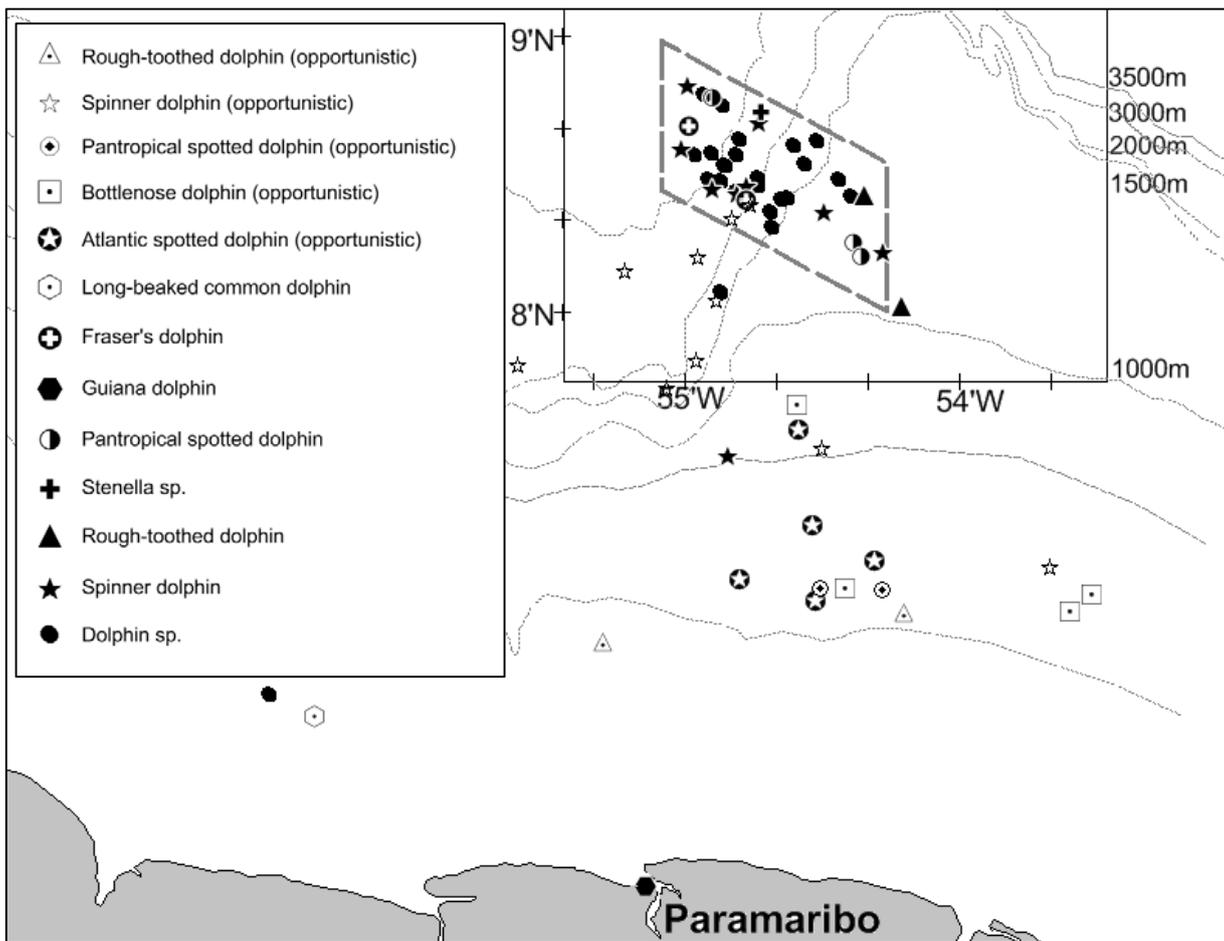


Fig. 5. Sighting positions of all dolphin species encountered during the systematic and opportunistic surveys.

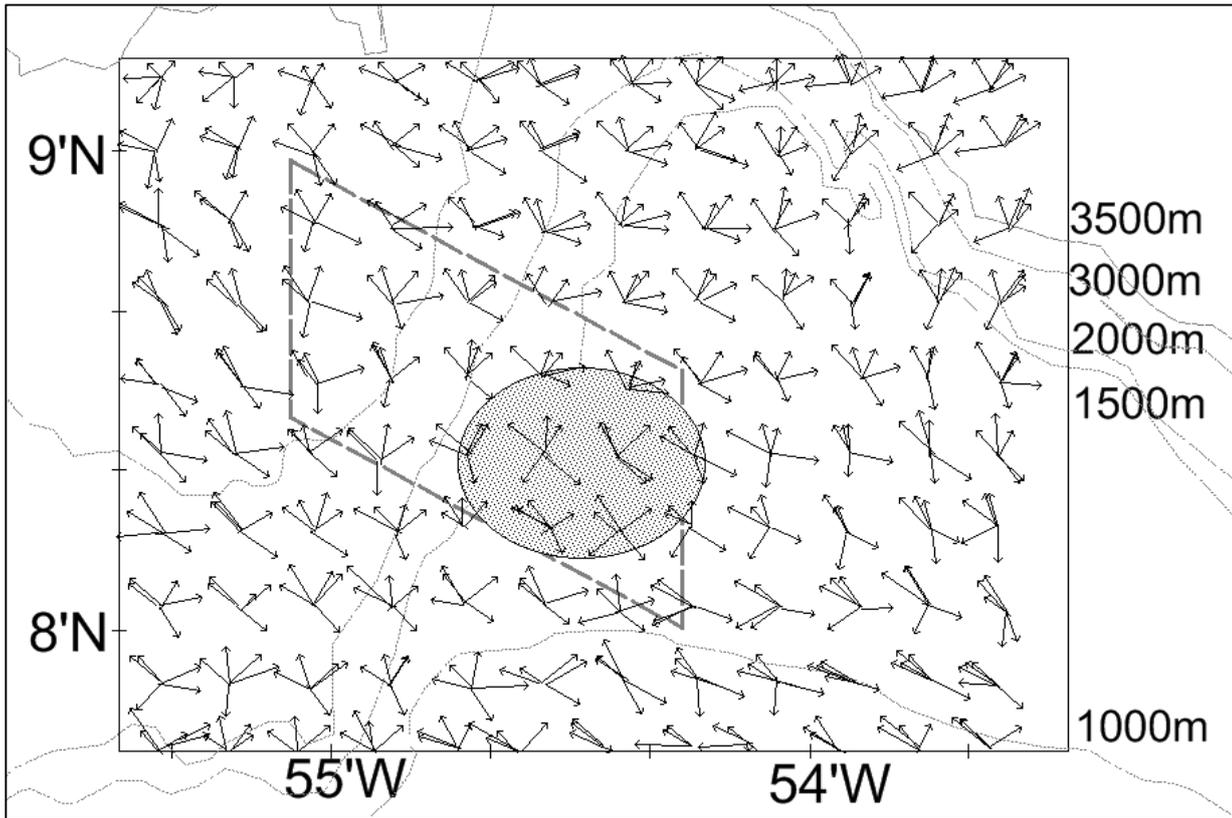


Fig. 6. Current directions measured at different positions on five different days during the study period. The position of a localised eddy in August is also shown.

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

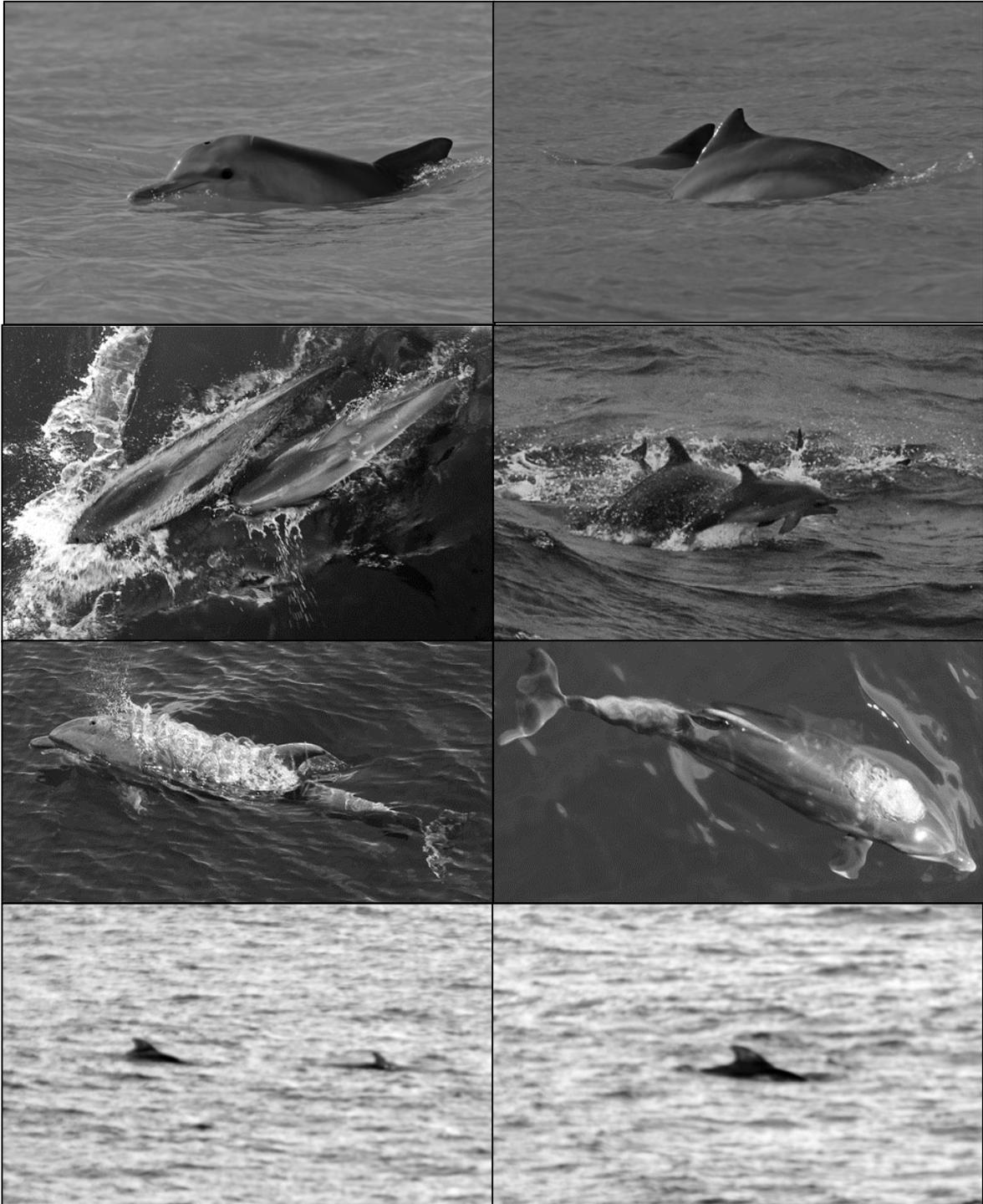
Table 4. Inventory of cetacean species occurring in Suriname waters.



Photographs of sperm whale, long-beaked common dolphin, false killer whale and Fraser's dolphin. Photographs © M. de Boer (A-F, H) and A. Williams (G)



Photographs of melon-headed whale, pan-tropical spotted, spinner and rough-toothed dolphins.
Photographs © M. de Boer (B, E-H) and A. Williams (A, C-D)



Photographs of Guiana, Atlantic spotted, bottlenose dolphin and short-finned pilot whale. Photographs © M. de Boer (A-B), S. Milne (C-D), B. Bennett (E-F) and F. Penin (G-H).