

Cetacean Sightings in the Eastern Caribbean and Adjacent Waters, Spring 2004

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Abstract

A cetacean line-transect survey was conducted in the eastern Caribbean Sea and the adjacent southwestern North Atlantic Ocean from 17 April to 14 May 2004 to obtain information on cetacean distribution and density. The survey area was divided into coastal and offshore blocks; the coastal blocks contained the insular continental shelf. A total of 2,273 nmi (4,210 km) was searched (1,528 nmi [2,830 km] in coastal blocks and 745 nmi [1,380 km] in offshore blocks) with 76 cetacean sightings (64 and 12 for the coastal and offshore blocks, respectively). Twelve species were identified (number of individuals/groups observed in coastal blocks-offshore blocks): 4/4(2/2) Bryde's whale (*Balaenoptera edeni*), 7/5(2/1) humpback whale (*Megaptera novaeangliae*), 5/5(0/0) sperm whale (*Physeter macrocephalus*), 32/3(0/0) short-finned pilot whale (*Globicephala macrorhynchus*), 132/4(0/0) melon-headed whale (*Peponocephala electra*), 1/1(0/0) Risso's dolphin (*Grampus griseus*), 42/6(0/0) bottlenose dolphin (*Tursiops truncatus*), 30/1(0/0) Fraser's dolphin (*Lagenodelphis hosei*), 505/9(33/3) pantropical spotted dolphin (*Stenella attenuata*), 35/1(35/1) Atlantic spotted dolphin (*S. frontalis*), 35/1(0/0) spinner dolphin (*S. longirostris*), and 90/1(0/0) striped dolphin (*S. coeruleoalba*). Additionally, 28 groups were sighted for which the species could

not be identified: 5/5(2/2) large whales, 11/5(0/0) *Mesoplodon* spp., 1/1(0/0) ziphiid whale, 5/1(0/0) *Stenella* spp., and 39/11(10/3) dolphins. Due to the low number of sightings on account of the poor sighting conditions during the survey, abundance of cetaceans could not be estimated.

Key Words: cetacean, whale, dolphin, distribution, density, Caribbean Sea, Lesser Antilles, North Atlantic, sighting survey

Introduction

The cetacean fauna is diverse in the Caribbean Sea where at least 26 species of cetacean are thought to occur (Debrot et al., 1998). To obtain information on cetacean occurrence, density, and behavior, a number of studies have been conducted (e.g., Marine Mammal Bibliography, 2006). However, except for humpback whales (*Megaptera novaeangliae*) and sperm whales (*Physeter macrocephalus*), most information has come from strandings, opportunistic sightings, and direct cetacean fisheries (e.g., Caldwell et al., 1971; Jefferson & Lynn, 1994; Watkins et al., 1994; Debrot et al., 1998; Mignucci-Giannoni, 1998). Furthermore, most studies focused on inshore areas with few inter-island or pelagic surveys (e.g., Marine Mammal Bibliography, 2006). To learn more about cetacean distribution and density in the entire Caribbean Sea, offshore surveys are required.

As part of a Food and Agriculture Organization (FAO) project, a cetacean line-transect survey was conducted for 28 d in April and May 2004 in the coastal and offshore waters of the eastern Caribbean and adjacent southwestern North Atlantic Ocean. The objective of this survey was to obtain information on distribution and density of cetaceans inhabiting the region.

Materials and Methods

The survey was conducted within the Exclusive Economic Zone (EEZ), including territorial waters of seven Caribbean countries (St. Kitts and Nevis, Antigua and Barbuda, Commonwealth of Dominica, St. Lucia, Barbados, St. Vincent and the Grenadines, and Grenada) and two French Overseas Departments (Guadeloupe and Martinique) (Figure 1). Cetacean sighting reports collected in the northeastern Caribbean indicated that animals were observed more often near land masses or within

the insular continental shelf (Mignucci-Giannoni, 1998), which suggests that cetacean density is lower in offshore waters beyond the shelf. Thus, the survey area was divided into the coastal and offshore blocks (Figure 1), where the coastal blocks contained land masses and the continental shelf waters (< 200 m deep). Survey design consisted of seven coastal and two offshore blocks with track lines totaling 1,758 nmi (3,256 km). There were no track lines within the EEZ of Montserrat, a British overseas territory, due to lack of a vessel clearance. Track lines were set to have equal angles between successive lines and to keep coverage probability uniform in each of the coastal and offshore blocks. The starting point of the track line was chosen randomly in each block.

The survey was conducted on the *Shonan Maru No. 1* (712 tons), a dedicated cetacean sighting survey vessel. This vessel has been engaged continuously for over 20 y in the Antarctic cetacean sighting survey cruise for the International Whaling

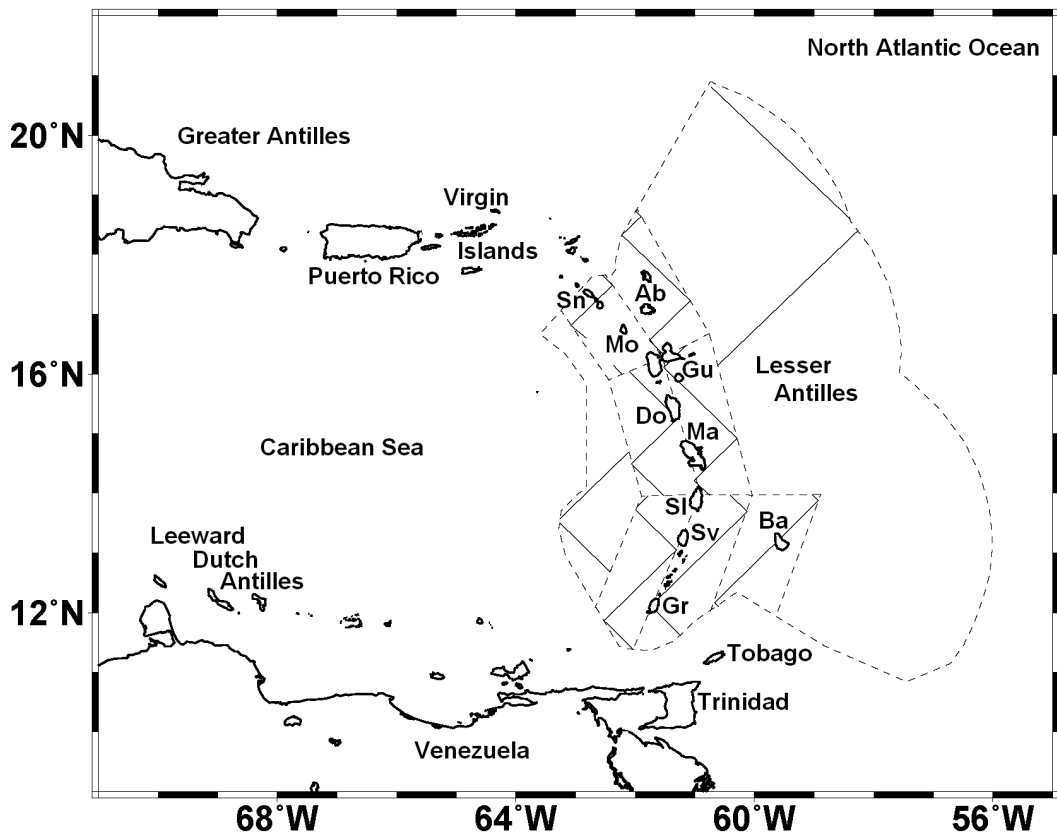


Figure 1. Predetermined survey track lines and blocks for the cetacean line-transect survey in the eastern Caribbean and adjacent waters, spring 2004; two blocks were set in offshore waters, and seven coastal blocks were around the Lesser Antilles: Antigua and Barbuda (Ab), Barbados (Ba), Commonwealth of Dominica (Do), Grenada (Gr), Guadeloupe (Gu), Martinique (Ma), Montserrat (Mo), St. Lucia (Sl), St. Kitts and Nevis (Sn), and St. Vincent and the Grenadines (Sv).

Commission/International Decades of Cetacean Research (IWC/IDCR) and Southern Ocean Whale and Ecosystem Research (IWC/SOWER) (Matsuoka et al., 2003). Survey methods followed the procedures of IWC/IDCR and SOWER cruises (e.g., Matsuoka et al., 2003). A total of nine researchers were on board. The daily survey began 30 min after sunrise (approximately 0600 h during the present survey) at the location where the vessel ended the previous day's survey, and finished at 30 min before sunset (approximately 1800 h). Primary search effort was conducted when the weather conditions were acceptable for searching (Beaufort wind scale ≤ 4 and visibility ≥ 3 nmi [5.6 km]). The vessel followed the predetermined track line at 11.5 kts (21.3 km/h). Two dedicated observers surveyed for cetaceans from a sighting mast elevated 20 m above the sea surface using hand-held 7×50 binoculars. They focused searching ahead of the vessel, up to 60° of either side of the track line. Each of the six observers rotated in 2-h shifts. Six to seven additional dedicated observers (e.g., researchers, officers, and crew) also surveyed simultaneously from the upper bridge with 11.8 m elevation and 360° visibility, using handheld 7×50 binoculars. From years of observation, the ship's crew were skilled in shipboard cetacean searching and species identification techniques. When the weather conditions were unacceptable for searching, the vessel drifted until the weather improved or the daily survey was ended. When the schedule was tight, the vessel ran on the predetermined track line under secondary search effort, with observers only searching from the upper bridge. Secondary search effort was also used during transits from the end point to the start point in the next block. All sightings recorded during the primary search effort were classified as primary sightings, and all others were classified as secondary sightings.

During daily surveys, environment condition and effort data were recorded every hour and when research activities (i.e., search effort, vessel speed, and course) changed. These data included time, location from GPS, Beaufort sea state, speed-direction of wind, visibility, position of severe glare, sea surface temperature (SST), and speed-course of vessel. When a cetacean group was sighted, time, location, bearing angle and radial distance to the sighting, and SST were recorded. The vessel was then diverted from the predetermined track line to approach the animals for species identification, group-size count, photography, calf identification/count, and behavioral observations. Species identification was made from visual observation and photographic checks but was not always possible due to sea state or behavior of the animals. After the observations,

the vessel returned to the predetermined track line on a convergent course, making a 45° angle to the line, and resumed searching. The density index was calculated as the number of primary sightings of groups and individuals recorded per 100 nmi of the primary searching (Table 1).

Results

The survey covered a total of 2,273 nmi (4,210 km) of track lines. Primary search effort consisted of 1,217 nmi (2,254 km), while secondary search effort covered 1,056 nmi (1,956 km) (Table 1). SST ranged from 25.6 to 28.1°C ($n = 566$, mean = 27.4, SD = 0.46). Seventy-six cetacean groups (1,063 individuals) were encountered (Table 1). Of the 76 groups, 64 (979) were observed in the coastal blocks, and 12 (84) were observed in the offshore blocks. Species identification could be made for two mysticete and 10 odontocete species.

Bryde's whales (*Balaenoptera edeni*) were sighted six times as solitary animals, exclusively in the southern part of the survey area (Figure 2a; Table 1). Of these, five sightings were along the 2,000-m depth isobath in the Grenada and Tobago Basins, and the remainder were observed in shallow waters with 63 m depth northeast of Grenada. Humpback whales were encountered in the northern part of the survey area (Figure 2a; Table 1). Of the six sightings, three were of single animals, and the other three were groups of two animals. No mother-calf pairs were observed. Five groups were near islands, and one was in offshore waters deeper than 2,000 m. Bryde's and humpback whales were encountered in both coastal and offshore blocks. The density index was calculated to be 0.41 individuals/0.41 groups observed per 100 nmi searching for Bryde's whales (0.37/0.37 in coastal blocks and 0.50/0.50 in offshore ones) and 0.33/0.25 for humpback whales (0.25/0.25 in coastal blocks and 0.50/0.25 in offshore blocks) (Table 1).

The ten odontocete species identified were sperm whales and nine delphinid species. Sperm whales were observed as single animals on five occasions in the southern part of the survey area (Figure 2a; Table 1). Three sightings were made in waters deeper than 2,000 m in the Grenada Basin, and two were recorded in shallow waters (about 200 m depth) between Martinique and St. Lucia. They were encountered in coastal blocks only. With 12 group sightings, the pantropical spotted dolphin (*Stenella attenuata*) was the most frequently encountered species in our survey (Table 1). All but one group were observed in the southern part of the survey area, and ten were recorded in waters $> 2,000$ m depth (Figure 2c). At least seven groups included calves. Two groups of Atlantic

Table 1. Cetacean species encountered (individuals/groups) and distance searched (nmi) during the cetacean line-transect survey in the eastern Caribbean and adjacent waters, spring 2004

Species/distance	Blocks			Group size ¹	Surface temp (°C) ¹
	All	Coastal	Offshore		
Bryde's whale	6/6(5/5-1/1) ² [0.41/0.41] ³	4/4(3/3-1/1) [0.37/0.37]	2/2(2/2-0/0) [0.50/0.50]	1	27.3-27.7
Humpback whale	9/6(4/3-5/3) [0.33/0.25]	7/5(2/2-5/3) [0.25/0.25]	2/1(2/1-0/0) [0.50/0.25]	1-2	26.0-27.4
Sperm whale	5/5(4/4-1/1) [0.33/0.33]	5/5(4/4-1/1) [0.49/0.49]	0/0(0/0-0/0) [0.0/0.0]	1	27.5-27.8
Short-finned pilot whale	32/3(25/1-7/2) [2.05/0.08]	32/3(25/1-7/2) [3.07/0.12]	0/0(0/0-0/0) [0.0/0.0]	3-25	27.0-27.8
Melon-headed whale ⁴	132/4(127/3-5/1) [10.44/0.25]	132/4(127/3-5/1) [15.60/0.37]	0/0(0/0-0/0) [0.0/0.0]	2-70	27.7-28.1
Risso's dolphin	1/1(0/0-1/1) [0.0/0.0]	1/1(0/0-1/1) [0.0/0.0]	0/0(0/0-0/0) [0.0/0.0]	1	27.1
Bottlenose dolphin	42/6(15/2-27/4) [1.23/0.16]	42/6(15/2-27/4) [1.84/0.25]	0/0(0/0-0/0) [0.0/0.0]	3-12	27.2-27.9
Fraser's dolphin ⁴	30/1(30/1-0/0) [2.47/0.08]	30/1(30/1-0/0) [3.69/0.12]	0/0(0/0-0/0) [0.0/0.0]	30	27.7
Pantropical spotted dolphin	538/12(240/6-298/6) [19.72/0.49]	505/9(222/4-283/5) [27.27/0.49]	33/3(18/2-15/1) [4.47/0.50]	3-130	27.0-27.8
Atlantic spotted dolphin	70/2(0/0-70/2) [0.0/0.0]	35/1(0/0-35/1) [0.0/0.0]	35/1(0/0-35/1) [0.0/0.0]	35	27.2-27.5
Spinner dolphin	35/1(0/0-35/1) [0.0/0.0]	35/1(0/0-35/1) [0.0/0.0]	0/0(0/0-0/0) [0.0/0.0]	35	27.4
Striped dolphin	90/1(0/0-90/1) [0.0/0.0]	90/1(0/0-90/1) [0.0/0.0]	0/0(0/0-0/0) [0.0/0.0]	90	27.7
Unidentified large whale	7/7(5/5-2/2) [0.41/0.41]	5/5(3/3-2/2) [0.37/0.37]	2/2(2/2-0/0) [0.50/0.50]	1	27.3-27.8
<i>Mesoplodon</i> spp.	11/5(11/5-0/0) [0.90/0.41]	11/5(11/5-0/0) [1.35/0.61]	0/0(0/0-0/0) [0.0/0.0]	1-3	27.1-27.7
Ziphiid whale	1/1(0/0-1/1) [0.0/0.0]	1/1(0/0-1/1) [0.0/0.0]	0/0(0/0-0/0) [0.0/0.0]	1	27.0
<i>Stenella</i> spp.	5/1(5/1-0/0) [0.41/0.08]	5/1(5/1-0/0) [0.61/0.12]	0/0(0/0-0/0) [0.0/0.0]	5	27.6
Unidentified dolphin	49/14(8/5-41/9) [0.66/0.41]	39/11(6/4-33/7) [0.74/0.49]	10/3(2/1-8/2) [0.50/0.25]	1-15	26.9-28.0
Total	1,063/76 (479/41-584/35)	979/64 (453/33-526/31)	84/12 (26/8-58/4)	1-130	26.0-28.1
Distance searched	2,273(1,217-1,056) ⁵	1,528(814-714)	745(403-342)	--	--

¹ Range of all sightings² In parentheses, numbers of primary and secondary sightings³ Density index; density index is calculated as the number of primary sightings [individuals/groups] per 100 nmi primary searching.⁴ Includes one primary sighting of a mixed group of 70 melon-headed whales and 30 Fraser's dolphins⁵ In parentheses, distance of primary and additional secondary searching

spotted dolphin (*S. frontalis*) were observed in the Atlantic Ocean (Figure 2c; Table 1). Calves were identified in one group. Pantropical and Atlantic spotted dolphins were detected in both coastal and offshore blocks. Bottlenose dolphins (*Tursiops truncatus*) were the second most sighted delphinid species with six sightings (Table 1). They were

observed in coastal blocks only, with five groups recorded in waters less than 200 m deep near the islands and one in deep waters at a depth of 1,500 m (Figure 2b). Calves were identified in two groups. One individual was observed carrying a remora (unidentified *Echeneidae* sp.) on its body. Sightings of melon-headed whales (*Peponocephala*

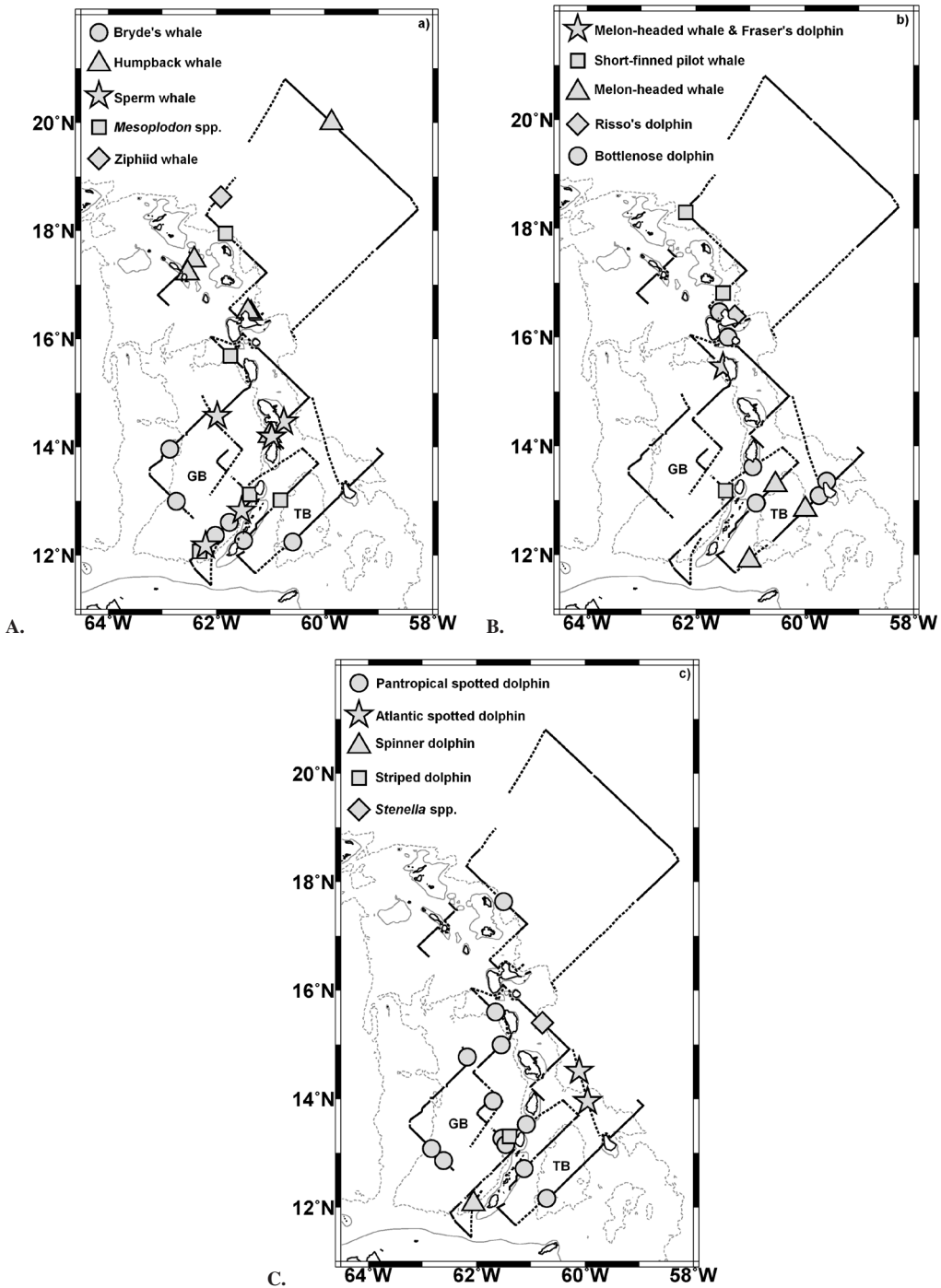


Figure 2. Survey tracks and cetacean sighting positions (A: baleen, sperm, and beaked whales; B: five delphinid species; and C: four *Stenella* spp.) recorded during the cetacean line-transect survey in the eastern Caribbean and adjacent waters, spring 2004; primary search effort is represented by bold lines, and the secondary search effort is represented by dotted lines. Isobaths were at 200 m and 2,000 m depth. GB = Grenada Basin; TB = Tobago Basin.

electra) were made four times in waters along the 2,000-m isobath in the Grenada and Tobago Basins (Figure 2b). One sighting was of a mixed group that included Fraser's dolphins (*Lagenodelphis hosei*). This was the only encounter of Fraser's dolphins in our survey. Short-finned pilot whales (*Globicephala macrorhynchus*) were sighted on three occasions at waters deeper than 1,000 m in the coastal blocks (Figure 2b; Table 1). A group of 25 individuals encountered northeast of St. Kitts included at least three calves, and a group of three animals sighted west of St. Vincent was accompanied by a dead calf. Risso's dolphin (*Grampus griseus*), spinner dolphin (*S. longirostris*), and striped dolphin (*S. coeruleoalba*) were observed one time each. The Risso's dolphin sighting was of a single animal and was made very close to Guadeloupe, but in deep water that was about 2,000 m deep (Figure 2b). Spinner and striped dolphins were encountered in waters deeper than 2,000 m off the west coast of the islands (Figure 2c). No calves were identified in the two groups. Some striped dolphins were attended by remoras.

Discussion

In the 2004 spring survey, 12 cetacean species were identified. Of these, four species were encountered in both coastal and offshore blocks and eight were observed in the coastal blocks only. There were no species recorded in the offshore blocks only. Cetacean sighting records collected in the northeastern Caribbean (Mignucci-Giannoni, 1998) suggest that their density is higher near land masses or within the insular continental shelf. Our results may indicate the same distribution pattern of cetaceans.

Occurrence of Bryde's whales has been reported in the eastern Caribbean, but most of them were from the southern part of the region. In the northeastern Caribbean, where inter-island survey cruises have been conducted, no Bryde's whale sightings were recorded (Mattila & Clapham, 1989; Roden & Mullin, 2000; Swartz et al., 2002). Of the 2,016 cetacean sighting records collected in Puerto Rico and the Virgin Islands, none were of Bryde's whales (Mignucci-Giannoni, 1998), while one stranding has been reported (Mignucci-Giannoni et al., 1999b). In contrast, many records have been collected in Grenada (Romero & Hayford, 2000), the Leeward Dutch Antilles (Debrot et al., 1998), and the Caribbean coast of Venezuela (Romero et al., 2001). A ship survey conducted throughout the eastern Caribbean, including the Venezuelan coast in February-March of 2000, recorded five Bryde's whale sightings off the Venezuelan coast but none in the northern region (Swartz et al., 2001; Oleson et al., 2003). Our survey and these studies suggest

that, in the eastern Caribbean, Bryde's whales are more common in the southern region. In addition, our results indicate that, except for seasonally migratory humpback whales, Bryde's whales are the most abundant mysticete in the region.

Humpback whales are thought to migrate to the eastern Caribbean for mating and calving in the winter season (Clapham, 2002), but no mother-calf pairs were observed during our survey. The humpback survey in 2000, which was conducted 2 mo prior to ours, recorded 31 humpback whale sightings, including three mother-calf pairs (Swartz et al., 2003). Sightings collected in the northeastern Caribbean suggest that migration peak of the species is in February and March (Mignucci-Giannoni, 1998). The timing of our survey was probably late for humpback whale observation; they had likely already started their northward migration to high latitude summer feeding grounds.

In the Caribbean, habitat separation has been discussed for pantropical and Atlantic spotted dolphins. Leatherwood et al. (1976) speculated that they are parapatric, but Mignucci-Giannoni et al. (2003) asserted that they are sympatric. Off Puerto Rico and the Virgin Islands, Atlantic spotted dolphins have been encountered more frequently than pantropical spotted dolphins (Mattila & Clapham, 1989; Mignucci-Giannoni, 1998; Roden & Mullin, 2000; Swartz et al., 2002). In southern waters, however, the ratio of their occurrence reverses. Pantropical spotted dolphins were most commonly identified in survey cruises conducted in the open Caribbean Sea and around the Lesser Antilles; sightings of Atlantic spotted dolphins were rare (Jefferson & Lynn, 1994; Boisseau et al., 2006; Gero & Whitehead, 2006; Jérémie et al., 2006; Rinaldi et al., 2006). Occurrences of pantropical spotted dolphins were also reported in St. Vincent and the Leeward Dutch Antilles (Caldwell et al., 1971; Debrot et al., 1998). On the Caribbean coast of Venezuela, the ratio reverses once again. Atlantic spotted dolphins have been observed throughout the coastal and offshore areas in Venezuela, in contrast to only one sighting of pantropical spotted dolphins (Romero et al., 2001). Our survey and these studies indicate that pantropical spotted dolphins occur mainly in open sea and around the Lesser Antilles, and that Atlantic spotted dolphins are more common around the Greater Antilles and the continental coast. They seem to be parapatric as Leatherwood et al. (1976) speculated.

One mixed group of melon-headed whales and Fraser's dolphins was observed in our survey. Mixed groups of the two species have been previously documented (e.g., Jefferson & Leatherwood, 1994; Mullin et al., 1994). In the eastern Caribbean, sightings of the two species have been mainly

reported from the middle part of the Lesser Antilles—that is, from Guadeloupe to Grenada (Caldwell et al., 1976; Watkins et al., 1994, 1997; Boisseau et al., 2006; Gero & Whitehead, 2006; Jérémie et al., 2006; Rinaldi et al., 2006). In the northern and southern regions, little information on these two species has been collected. No sightings were reported around Puerto Rico and the Virgin Islands (Mattila & Clapham, 1989; Mignucci-Giannoni, 1998; Roden & Mullin, 2000; Swartz et al., 2002), except a stranding of a melon-headed whale (Mignucci-Giannoni et al., 1998) and two strandings of a Fraser's dolphin (Mignucci-Giannoni et al., 1999a). In the Leeward Dutch Antilles and the Venezuelan coast, sightings are also rare (Debrot et al., 1998; Romero et al., 2001; Bolaños-Jiménez & Villarroel-Marín, 2003). Melon-headed whales and Fraser's dolphins appear to be more common around the middle part of the Lesser Antilles.

Common dolphins (*Delphinus* spp.) were not sighted in our survey, although they previously have been sighted in the eastern Caribbean (Erdman et al., 1973; Watkins & Moore, 1982; Mignucci-Giannoni, 1998). The validity of these reports, however, has been called into question (Roden & Mullin, 2000). Jefferson et al. (2009) reexamined common dolphin records in the western Atlantic and concluded that they are absent throughout most of the Caribbean Sea, only occurring in a very limited coastal area of Venezuela. Our survey supports their conclusion.

During the 2004 survey, the easterly trade winds were strong, and a high sea state with whitecaps was often recorded, which reduced detectability of cetaceans, particularly of delphinid species. To estimate abundance of a biological population via the line-transect method at least 60 to 80 sightings are recommended, although for some purposes, as few as 40 might be adequate (Buckland et al., 1993). To overcome a small number of sightings, data pooling for species with similar sighting characteristics (e.g., large whales, small dolphins, and long-diving species) are sometimes used (e.g., Mullin & Fulling, 2004). In our survey, however, abundance estimation from data pooling was difficult due to just 41 primary sightings. Nevertheless, we believe that information from the 2004 survey will be useful in providing further insight into cetacean distribution in the eastern Caribbean, especially in the open sea, where only a few research cruises have been conducted.

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