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Preliminary account of cetacean diversity and humpback whale (*Megaptera novaeangliae*) group characteristics around the Union of the Comoros (Mozambique Channel)

Jeremy Kiszka^{1,2,*}, Michel Vely¹ and Olivier Breysse¹

¹ Megaptera Océan Indien, 4 rue Pierre et Marie Curie, 77186 Noisieu, France, e-mail: jeremy.kiszka@wanadoo.fr

² LIENSS (LIttoral, ENvironnement et Sociétés), UMR 6250 CNRS-Université de La Rochelle, 2 rue Olympe de Gouges, 17000 La Rochelle, France

*Corresponding author

Abstract

Cetacean diversity and occurrence has never been investigated in the Union of the Comoros, located in the northern Mozambique Channel. Small boat-based surveys were conducted during the austral winter of 2002, primarily to assess the occurrence of humpback whales (*Megaptera novaeangliae*) and whether the area represents a wintering ground where the species reproduce. All other cetacean species were also recorded. Opportunistic sighting records were used to provide information on the diversity of cetaceans occurring in the area. Between 2000 and 2003, 12 cetacean species were recorded around the Comoros, including: *Megaptera novaeangliae*, *Stenella longirostris*, *Peponocephala electra*, *Stenella attenuata*, *Tursiops truncatus*, *Globicephala macro-rhynchus*, *Mesoplodon densirostris*, *Physeter macrocephalus*, *Lagenodelphis hosei*, *Grampus griseus*, *Mesoplodon pacificus* and possibly *Tursiops aduncus*. During the dedicated surveys, the humpback whale was the most commonly encountered species (72% of sightings) followed by the spinner dolphin (15%). Humpback whale group composition was heterogeneous, but mother-calf pairs were the most commonly sighted (49%). This study demonstrates that the Union of the Comoros is an important site for migrating humpback whales in the southwest Indian Ocean and for a wide variety of toothed cetacean species.

Keywords: cetaceans; diversity; group characteristics; humpback whale; Indian Ocean Whale Sanctuary; *Megaptera novaeangliae*; Union of the Comoros.

Introduction

The Indian Ocean was designated as a whale sanctuary by the International Whaling Commission (IWC) in 1979 (Leatherwood and Donovan 1991). However, few studies on cetacean populations have been conducted off the islands of the western part of the Indian Ocean Sanctuary (Keller et al. 1982 for the Seychelles; Corbett 1994 for Mauritius; Rosen-

baum et al. 1997 for Antongil Bay, Madagascar; Balance et al. 2001 for the Maldives; Amir et al. 2002 for Zanzibar; Kiszka et al. 2007 for Mayotte; and Dulau-Drouot et al. 2008 for La Réunion). In the eastern African region, there are at least 32 cetacean species recorded, including nine baleen whales, 12 toothed whales and 11 delphinids (de Lestang 1993, reviewed by De Boer et al. 2002, Kiszka et al. 2009). No previous detailed studies on the diversity, status and distribution of cetaceans have been conducted around the Union of the Comoros (Grande Comore, Anjouan and Mohéli called here “Comoros”). The Cuvier’s beaked whale (*Ziphius cavirostris*) was noted by Robineau (1975) on Grande Comore based on a stranded individual. A provisory list of marine mammal species from the Comoros archipelago (including Mayotte, under French administration) was established by Tilot (1997) and Paris (1999) and reviewed by Louette et al. (2004). However, species determinations remain unclear and some records could be inaccurate. Very close to the Comoros (80 km apart from Anjouan), the diversity of cetaceans has been described around Mayotte (Kiszka et al. 2007), where 19 species of cetaceans have been recorded.

The Comoros are situated in the northern Mozambique Channel, in the southwest tropical Indian Ocean (Figure 1). The Union of the Comoros consists of four main islands and many surrounding small islets. The islands of Mohéli, Anjouan and Grande Comore constitute volcanic islands. Anjouan and Grande Comore feature deep oceanic waters in close proximity to the coastline. In contrast, Mohéli has a large reef complex in the south of the island, with shallow waters, including fringing reefs and pinnacles, as well as smaller islands extending to the 100-m isobath (around 404 km²).

Small boat surveys were conducted in 2002, specifically to assess cetacean diversity, group characteristics and occurrence, with a focus on wintering humpback whales (*Megaptera novaeangliae*). In addition, opportunistic sighting data collected from 2000 to 2003 by both Mohéli Marine Park and the NGO *Megaptera Océan Indien* provided additional information on the diversity of cetaceans in this area. A description of the data is presented in this paper, particularly regarding the diversity of species, their occurrence as well as information on wintering humpback whale group composition around these islands.

Materials and methods

Sightings data were collected during the months of August and September 2002. The survey effort was focused north

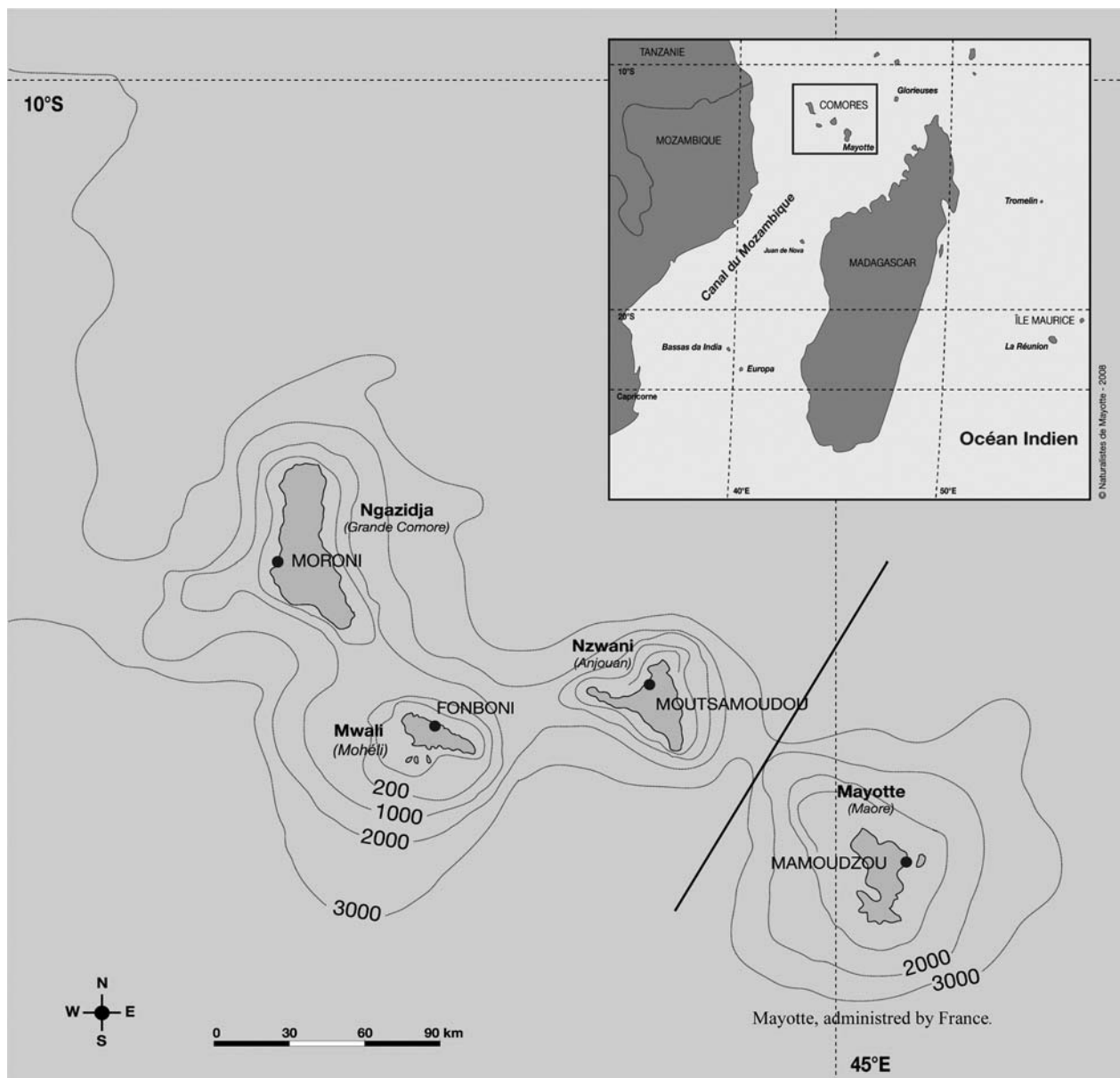


Figure 1 The Comoros.

and south of the island of Anjouan, off the southern coast of Mohéli, and off the western and southern coasts of Grande Comore. Two to four observers recorded cetacean sightings (species, position, group size) from small motorized boats (5–7 m long, 25–40 HP engine). A closing mode methodology was employed when a group of cetaceans was detected, i.e., the survey vessel left the trackline and approached the encountered group of whales or dolphins to confirm species identification and to collect data on group size. As survey areas were not strictly defined and survey tracks were not random or homogeneously distributed, data collected could not be used in analyses of habitat preferences, distribution or density of the encountered species. Groups of humpback whales were classified into one of seven classes:

mother-calf pairs, mother-calf-escort, pairs, competitive groups, non-competitive, singers and singletons. Group classification was based on observed attributes or behavioral characteristics previously described for this species (Tyack and Whitehead 1983, Baker and Herman 1984, Clapham et al. 1992). For other cetaceans encountered, the species, mean group size and geographical position were recorded. Cetaceans were identified to species level using morphological characters and compared with a published identification guide (Jefferson et al. 1993).

Opportunistic records were collated from incidental sightings data from 2000 to 2003 throughout the year gathered by local field naturalists and other observers, trained in cetacean identification. The data were also recorded by experi-

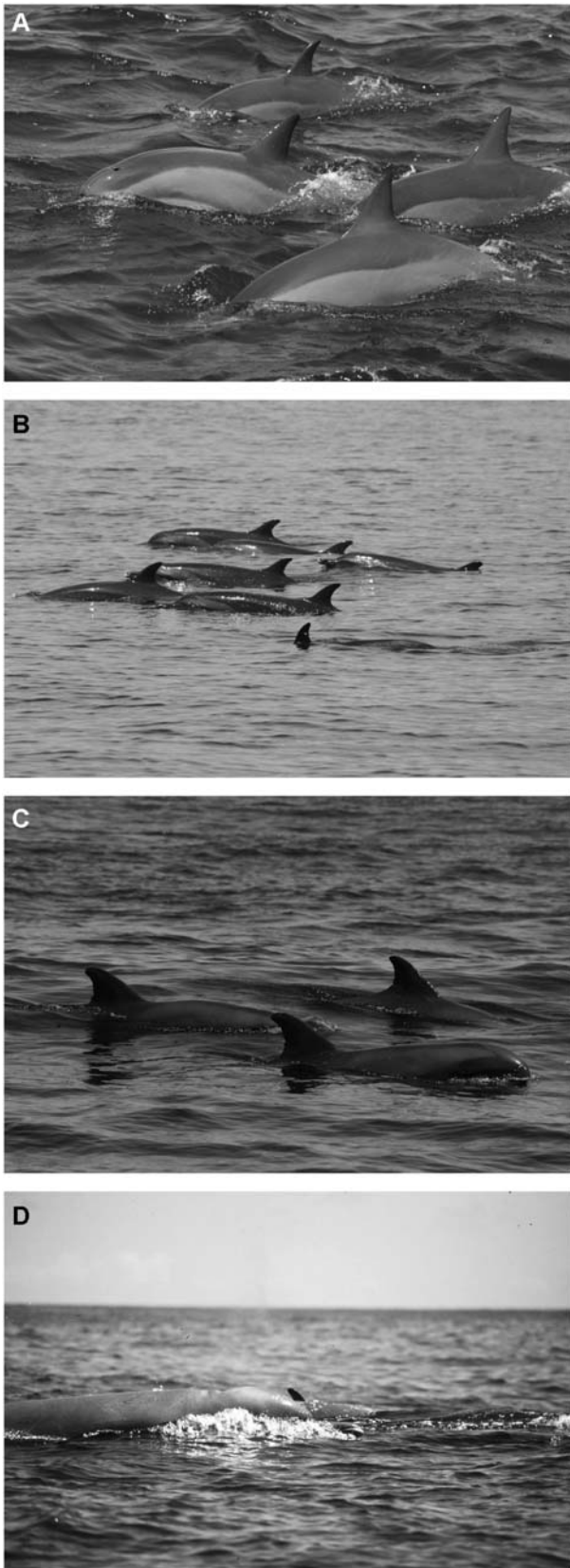


Figure 2 (A) The spinner dolphin (*Stenella longirostris*, photograph by J. Kiszka), (B) the pantropical spotted dolphin (*Stenella attenuata*, photograph by J. Kiszka), (C) the melon-headed whale (*Peponocephala electra*, photograph by J. Kiszka) and (D) the Longman's beaked whale (*Mesoplodon pacificus*, photograph by O. Breyse) observed in the Comoros.

Indien. In order to have accurate identifications during dedicated surveys, photographs of all groups of cetacean encountered were taken, for a *posterior* identification if needed (particularly for beaked whales and the rarest delphinids; Figure 2).

Results

From August 4th to October 4th 2002, 42 boat trips were performed during daylight hours. A total of 117 h was spent at sea around the three islands (41 h around Mohéli, 45 h around Grande Comore and 31 h around Anjouan), to undertake cetacean closing mode surveys. A total of 13 cetacean species were recorded around the Comoros ($n=151$ sightings, of which 92 were collected during the dedicated surveys in winter 2002, i.e., 78%). These included humpback whale ($n=98$ sightings), spinner dolphin (*Stenella longirostris*, $n=21$), melon-headed whale (*Peponocephala electra*, $n=10$), pantropical spotted (*Stenella attenuata*, $n=7$), bottlenose dolphin (*Tursiops* spp., cf. *aduncus*, $n=5$), Fraser's (*Lagenodelphis hosei*, $n=1$), short-finned pilot whale (*Globicephala macrorhynchus*, $n=3$), Blainville's beaked whale (*Mesoplodon densirostris*, $n=2$), Risso's dolphin (*Grampus griseus*, $n=1$), common bottlenose dolphin (*Tursiops truncatus*, $n=1$), sperm whale (*Physeter macrocephalus*, $n=1$) and Longman's beaked whale (*Mesoplodon pacificus*, $n=1$). Mean group sizes varied among species, smallest groups were observed in Indo-Pacific bottlenose dolphin, humpback whale, and Blainville's beaked whale, and largest group size was recorded for melon-headed whale, pantropical spotted dolphin, short-finned pilot whale and spinner dolphin (Table 1).

The humpback whale was by far the most encountered species during the dedicated surveys in 2002 (71.5% of encounters), followed by the spinner dolphin (15.3%). A total of 13 groups were encountered in Anjouan, 27 off Grande Comore and 23 off Mohéli (with 25, 57, and 23 individuals observed, respectively; Table 2). The species was encountered throughout the study area, with an average occurrence of 0.42 groups/h of effort off Anjouan, vs. 0.56 off Mohéli, and 0.60 off Grande Comore (Table 2). Humpback whale group composition was heterogeneous, with a majority of mother-calf pairs (48.6%), mother-calf pairs with an escort (20%), singletons/singers (17.1%) and competitive groups (14.3%).

Discussion

One of the most significant limitations of this study is the lack of effort-related data, necessary to explore spatial and

enced observers during trips dedicated to other activities than cetacean census which are centralized in the databases of the Mohéli Marine Park and the NGO *Megaptera Océan*

Table 1 Group size and occurrence of odontocetes around the Comoros during the cetacean dedicated survey in 2002.

	Individuals, n	Groups, n	Mean group size	Individual/h, n	Group/h, n
<i>Stenella longirostris</i>	851	17	50	7.3	0.145
<i>Stenella attenuata</i>	400	5	80	3.4	0.043
<i>Peponocephala electra</i>	550	3	183	4.7	0.026
<i>Megaptera novaeangliae</i>	122	63	2	1.0	0.538
<i>Globicephala macrorhynchus</i>	60	1	60	0.5	0.009
<i>Mesoplodon pacificus</i>	15	1	15	0.1	0.009
<i>Tursiops</i> spp. (cf. <i>aduncus</i>)	6	2	3	0.1	0.017
<i>Mesoplodon densirostris</i>	5	1	5	0.0	0.009

Table 2 Occurrence and distribution of humpback whales around the Comoros during the dedicated survey in 2002.

Island	Effort, h	Individuals, n	Individual/h, n	Groups, n	Groups/h, n	Mean group size
Anjouan	31	25	0.8	13	0.4	1.9
Grande Comore	45	57	1.3	27	0.6	2.1
Mohéli	41	40	1	23	0.6	1.7

temporal patterns of distribution of cetaceans in the area. However, the dedicated survey conducted in 2002 together with opportunistic sighting records provides a first assessment of the cetacean diversity and humpback whale group characteristics around the Comoros. The diversity of cetaceans was found to be relatively high in the area, despite the limitations of this study. Cetacean diversity described around the island of Mayotte is similar to the other island of the Comoros, with few exceptions. The higher number of species recorded around Mayotte could be related to the higher observation effort undertaken around this island (Kiszka et al. 2007). The cetacean community in the Comoros is diverse and is composed of coastal (bottlenose dolphin), semi-pelagic (spinner and spotted dolphins) and offshore species (beaked whales, large delphinids). Overall, the high diversity of odontocetes recorded around the Comoros could be linked to the higher diversity of habitat types encountered around the archipelago. However, it is still difficult to compare studied areas among them, because the number of species recorded is also linked to the spatial and temporal distribution of effort.

The presence of reef banks and shallow coastal waters provide ideal habitat characteristics of that used by resting small delphinids of the genus *Stenella*, such as spinner and pantropical spotted dolphins (Norris et al. 1985, Norris 1991, Psarakos et al. 2003). Such habitats occur all around the Comoros (Quod et al. 2000). For bottlenose dolphins, the IWC recognizes two species of *Tursiops*: the Indo-Pacific bottlenose dolphin *Tursiops aduncus* and the Common bottlenose dolphin *Tursiops truncatus* (International Whaling Commission 2000). Around Mayotte, both *Tursiops* species occur. *T. aduncus* has been observed in the lagoon and adjacent waters associated with reef complexes, and *T. truncatus*, significantly longer, heavier and darker than the coastal species, has been observed in deeper waters outside the lagoon.

Mean group size is significantly different between the two species. The Indo-Pacific bottlenose dolphin forms small groups, whereas common bottlenose dolphin aggregate in large schools (Kiszka et al. 2007). Bottlenose dolphins around the Comoros were observed in the coastal waters in small groups. Then, we can hypothesize that the animals sighted during the survey belong to the Indo-Pacific bottlenose dolphin (*T. aduncus*). However, the common bottlenose dolphin has been clearly identified in September 2003, in association with a group of short-finned pilot whales.

Melon-headed whales were occasionally seen around the Comoros. This species is found in deep tropical and warm temperate waters worldwide (Perryman 2002). A recent study suggests that melon-headed whales can use shallower waters around oceanic islands to rest and socialize during the day (Brownell et al. 2009). This pattern could occur around the Comoros, as melon-headed whales were mostly observed resting (M. Vely and O. Breyse, personal observations).

Several large oceanic delphinids (*Grampus griseus*, *Globicephala macrorhynchus*), beaked whales (*Mesoplodon densirostris*, *Mesoplodon pacificus*) and the sperm whale have also been encountered around the Comoros, but less frequently. These species have been observed throughout the southwest Indian Ocean (Leatherwood and Donovan 1991, Kiszka et al. 2009). Low rates of encounters of these oceanic species can be explained by the low observation effort undertaken in the far offshore regions, where these species preferentially inhabit.

The IWC recognizes seven major low-latitude wintering regions (A–G) for management of Southern Hemisphere humpback whale populations (International Whaling Commission 2000, International Whaling Commission 2004). The south-western Indian Ocean has been designated Wintering Region C and is currently further partitioned into three smaller units; Wintering sub-Region C1, C2 and C3. These sub-

regions largely correspond to the termini of three migratory streams postulated to exist within the south-western Indian Ocean (Best et al. 1998). One of the proposed migratory destinations is the Comoros archipelago, designated by the IWC as Wintering sub-Region C2. Despite their close proximity, aggregations of whales in the Comoros archipelago are differentiated, for the purpose of management, from aggregations found along the eastern coast of South Africa and Mozambique (C1) (Findlay et al. 1994, Findlay and Best 1996) and from aggregations found along eastern and southern coast of Madagascar (C3) (Best et al. 1996, 1998, Rosenbaum et al. 1997, Ersts et al. 2009).

The shallow waters and reef complexes of the waters around the Comoros provide ideal habitat characteristics for wintering humpback whales (Dawbin 1966, Balcomb and Nichols 1982, Whitehead and Moore 1992). Around the Comoros, there is strong evidence that humpback whales are common during austral winter, particularly from July to October (Ersts et al. 2009). The presence of mother-calf pairs around the Comoros indicates that this area constitutes a nursing ground for this species. The presence of competitive groups and evidence of mating behaviors suggest that copulation also occurs in the area.

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