Habitat partitioning by cetaceans in a multi-species ecosystem around the oceanic island of La Gomera (Canary Islands)

VOLKER SMIT, FABIAN RITTER, ANDREA ERNERT , NINA STRUEH

M.E.E.R. e.V., Bundesallee 123, 12161 Berlin, Germany

Contact e-mail: info@m-e-e-r.de

ABSTRACT

Off the coast of La Gomera (Canary Islands), a multitude of cetacean species can be sighted. The presence and distribution as well as the combined occurrence of different species were monitored from regular whale watching vessels from 1995 until 2007. 5,739 cetacean sightings of 21 species were made. For the five most abundant species - bottlenose dolphins (*Tursiops truncatus*), short-finned pilot whales, (*Globicephala macrorhynchus*), Atlantic spotted dolphins, (*Stenella frontalis*), common dolphin (*Delphinus delphis*) and rough-toothed dolphins (*Steno bredanensis*) - physical characteristics of the sighting locations (distance to coast, depth and slope) were analysed and compared. It could be shown that each species prefers a specific set of habitat characteristics, while there is still a substantial overlap in distribution. Thus, off this subtropical oceanic island, where niche selection appears especially difficult because of relative homogeneity of the environment, it appears that a species' habitat selection can be driven by a combination of physical characteristics and the presence/absence of other cetacean species.

This was underlined by the fact that none of the most abundant species occurred exclusively alone. Some of the multi-species aggregations were observed regularly, e.g. bottlenose dolphins were seen together with pilot whales during a large proportion of total sightings. On occasion the animals behaved like one group rather than an aggregation of two species. Other species, on the contrary, mostly, if not generally avoided any other cetaceans, i.e. the propensity of one species to mingle with another was selective. Some of the underlying reasons for this selectivity are discussed.

KEYWORDS : ABUNDANCE, DISTRIBUTION, HABITAT SELECTION, MULTI-SPECIES, LA GOMERA

INTRODUCTION

The distribution of cetaceans within deep water environments is linked to the physical characteristics of their habitat (Baird *et al*., 2003; Certain *et al*., 2008). Habitat selection can be well described by using features like distance to nearest coast, water depth, and sea bottom slope (Cañadas *et al*., 2002; Ingram & Rogan, 2002), which can be derived from GPS position data. Here, we describe differences between habitat characteristics in five species inhabiting the same general area off an oceanic island (La Gomera, Canary Islands): bottlenose dolphins (*Tursiops truncatus*), short-finned pilot whales, (*Globicephala macrorhynchus*), Atlantic spotted dolphins, (*Stenella frontalis*), rough-toothed dolphins (*Steno bredanensis*) and short-beaked common dolphin (*Delphinus delphis*). These represent the five most abundant species in an area used by up to 21 cetacean species over time. All five species are resident off La Gomera, or form part of larger populations inhabiting the Canary Island archipelago. Oftentimes, more than one species can be seen here swimming together, or actually intermingling with, another species.

METHODS

La Gomera (17°15'W - 17°21'W and 28°1'N - 28°14'N) lies about 400 kilometres off the West African mainland in the Northeast Atlantic Ocean. The island is of volcanic origin and surrounded by deep waters close to the coast due to the absence of a shelf (Martin *et al*., 1992). To its South and Southwest, the sea-bottom drops steeply to about 4,000 metres into the Canaries basin (Rothe, 1986).

Data on cetacean abundance was collected during a long term monitoring scheme resulting from a co-operation between the non-profit association MEER and local whale watching operators. The platform for the collection of data was small former fishing boats now being used as whale watching vessels and operating in the South/Southwest of the island. From 1st September 1995 to 16th November 2007, sighting data was collected during regular whale watching trips, usually taking place once or twice a day according to sea state and tourist demand.

The sea was scanned by eye for cetaceans by one or two experienced observers. In case of a sighting, data collection began with identifying species to the lowest possible taxa. It also included date, time, position (by GPS), sea state, group size, and the presence of other (cetacean or non-cetacean) species. Depth and distance to the coast were derived using a Spanish sea chart (SP 517, Instituto Hidrografico, Cadiz 1995). Slope was calculated using the slope function with ArcGIS (*ESRI corp*.). Statistical calculations were made with SPSS. A Kruskal Wallis Test was applied to test the inter-species differences for significance.

RESULTS

A total of 5,739 sightings with 21 cetacean species were made. Thereof, 1,673 were made with bottlenose dolphins, 1,235 with short-finned pilot whales, 1,233 with Atlantic spotted dolphins, 592 with rough-toothed dolphins and 271 with common dolphins. These five species thus accounted for 87% of all sightings. Sighting locations are shown in Figure 1.

It was found that each species preferred a certain range of either habitat characteristic, with bottlenose and rough-toothed dolphins on average being found closest to the coast and pilot whales farther offshore than all others (see Table 1 & Figure 2a). Mean depth values mirrored this general distribution trend (see Figure 2b). Slope values also varied significantly between species, with pilot whales and spotted dolphins preferring steeper bottom topography, while bottlenose and rough-toothed dolphins were found where the bottom slope gradient was smaller (see Table 1 & Figure 2c).

237 sightings (5%) were made with more than one species. The most common aggregation of two species were pilot whales together with bottlenose dolphins (164 sightings), accounting for 10% of bottlenose dolphin and 13% of pilot whale sightings, respectively. All of the five species were seen at least a few times together with each other, except the common dolphin, which was not seen together with bottlenose and rough-toothed dolphins. During 13 sightings, three species were seen together, and three encounters involved four species.

DISCUSSION

This long-term study showed that the distribution of cetaceans is related to physical characteristics of their habitat. Different species' abundance was significantly correlated to water depth, distance to coast and sea bottom slope. Similar findings involving small odontocetes were made e.g. in Ireland (Ingram & Rogan, 2002), the Mediterranean Sea (Cañadas *et al*., 2002), the Bay of Biscay (Certain *et al*., 2008), and the Hawaiian archipelago (Baird *et al*., 2003; Webster *et al.*, 2005). The results indicate that different species use different parts of the same general and relatively unstructured habitat. Habitat partitioning within areas used by several cetacean species also was evidenced in regions like the Azores (Quérouil *et al*., 2008), Hawaii (Baird *et al*., 2003), and others (see review in Bearzi, 2005).

Sympatric ecology is a field of interest for many ecologists. In cetaceans, the reasons for species living (or staying, respectively) in the same area and or habitat, are not very well understood. Different species may use the same habitat differently, e.g. by separating abundance on a fine spatial scale, the pursuit of different prey organisms and/or hunting at different times of day. It has been suggested that dietary divergence is the dominating factor (see Bearzi, 2005; Herzing *et al.*, 2003; Querouil, 2008). But why do animals of different species actively seek out the company of each other, as is apparently the case with bottlenose dolphins and pilot whales off La Gomera and with different species in other areas (Garcia-Tiscar *et al*., 2000; Frantzis & Herzing, 2002; Jefferson *et al*., 2006; Gannier, 2009)? It is not very likely that a common prey causes these aggregations due to the different foraging strategies of deep diving pilot whales as opposed to bottlenose dolphins, predominantly feeding close to the surface and in coastal waters. To date, we can only speculate about the causes, but it is reasonable to think that the mutual protection from predators in an open deep water habitat may play a role, even if it were a one-sided strategy by the smaller animals, i.e. the dolphins. We also observed social interactions between these two species, and thus a social factor might also be in place. This could also be true for the aggregations between bottlenose and rough-toothed dolphins and between spotted and striped dolphins. During such encounters the animals sometimes behaved like one group and/or altered their usual behaviour significantly and repeatedly performed close interspecies interactions. Nonetheless, during many multi-species sightings of small dolphins the animals probably are in pursuit of the same available prey patches (i.e. fish shoals). Even so, if the ecological niches differ too much, we don't observe mixed groups of the according species, which probably is the case with bottlenose dolphin and rough-toothed dolphins and common dolphin, respectively.

However, there are numerous accounts in which different dolphins interacted negatively with each other even with fatal consequences (Barnett *et al.*, 2009; Bearzi, 2005, Coscarella & Crespo, 2010). Yet aggressive interactions do appear to be more the exception than the rule, at least off La Gomera, because we have observed apparent agonistic behaviours between species only very rarely. To summarise, the findings presented here indicate that cetaceans occupying the same living space are separated by their specialisation on certain types of prey, which in turn is reflected by the type of habitat they use. Moreover, they will associate with other cetaceans as long as there is a foraging advantage (e.g. by following cues like feeding seabirds or other predators) or by seizing a chance for social interaction if the momentary status of the group allows it.

Future investigation will try to find out, if there are seasonal or long-term changes in the distribution of the odontocete community off La Gomera and if inter-species associations relate to certain behavioural states, or are influenced by factors like time of day or season.

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Figure 1 : Cetacean sightings off La Gomera (1995-2007)

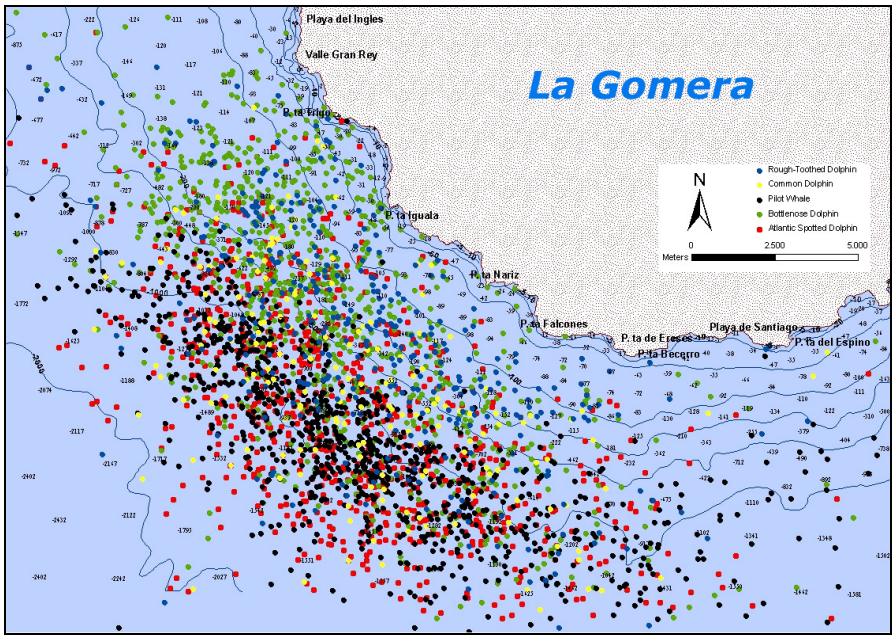

Figure 2 : Distribution of distance to coast, depth & slope values of cetaceans sighted off La Gomera (1995-2007)

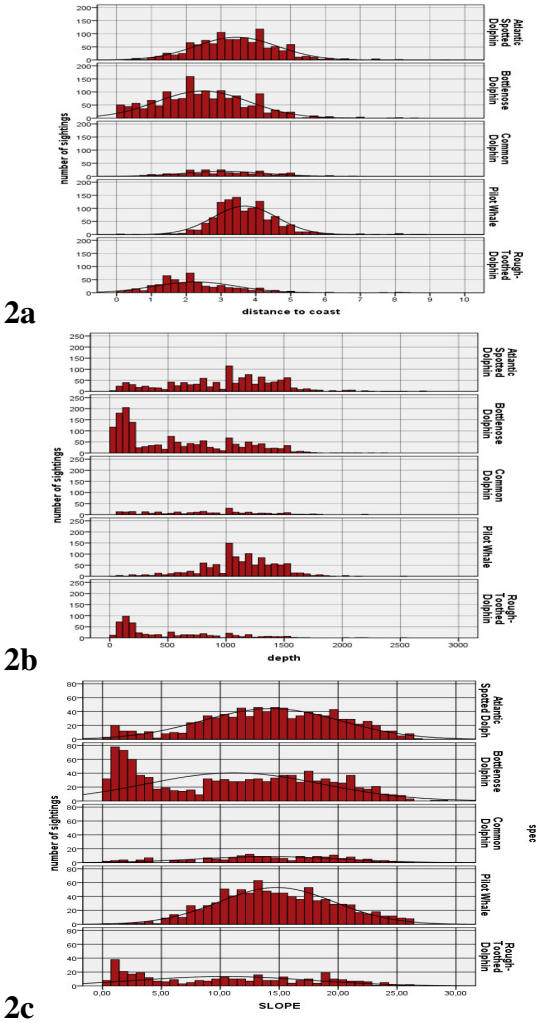

Table 1 : Distance to coast, depth & slope values of cetaceans sighted off La Gomera (1995-2007)

	Median Depth (m)	Median Distance (nm)	Mean Slope	N (Dist)
BD	565	2,46	11,14	1552
PW	1119	3,68	14,77	1121
ASD	988	3,43	14,31	1146
RTD	489	2,25	10,34	548
CD	799	3,08	14,06	254

	Minimum Depth	Minimum Distance	Slope	N (Depth)
BD	10	0,05	0,25	1515
PW	210	1,5	0,54	1143
ASD	19	0,4	0,38	1109
RTD	20	0,1	0,39	534
CD	62	0,4	0,43	254

	Maximum Depth	Maximum Distance	Slope	N (Slope)
BD	2350	8,5	29,07	1060
PW	2500	8,8	26,35	914
ASD	2701	9,5	26,99	912
RTD	2500	8,4	26,04	350
CD	2200	6,8	26,13	186

Legend : BD=bottlenose dolphin, PW=pilot whale, ASD=Atl. spotted dolphin, RTD=rough-toothed dolphin, CD=common dolphin