21 cetacean species off La Gomera (Canary Islands): Possible reasons for an extraordinary species diversity

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INTRODUCTION

To date, 26 cetacean species are known to inhabit or visit the waters of the Canary Islands (Ritter & Brederlau 1998), making the archipelago an important area for cetacean observation.

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 Atlantic Ocean and belongs to the Western Canary Islands. The islands are steep volcanoes surrounded by deep waters close to the coast. Some authors see the oceanographic circumstances as an absence of a shelf (Martin et al. 1992). In the Western part of the archipelago, the sea-bottom drops steeply to about 4.000 metres into the Canaries basin (Rothe 1986).

In the Southwest of La Gomera, a depth of 2000 m is only a few kilometres away from the coast. The climate is mainly determined by the island's position in the north-eastern trade-wind. Water temperatures are approximately 22°C - 24°C in summer and 17°C - 19°C in winter. This temperature is lower than might be expected for a subtropical region, mainly due to the cold upwelling off West Africa and the cooler Canaries Current (Fernandopullé 1976).

METHODS

The platform for the collection of data were small former fishing boats now being used as whale watching vessels and operating in the Southwest of the island. From 1 September 1995 to 31 January 2000, sighting data were 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, depth (using a Spanish sea chart SP 517, Instituto Hidrografico, Cadiz 1995), and the duration of the encounter. Also, the duration of 126 whale watching trips was determined, which was used to calculate the total sighting effort by multiplying the mean value with the total number of trips.

Additional observations of cetacean sightings were communicated by the whale watching skippers for the period from 1994 until 1999.

RESULTS

From 1 September 1995 to 31 January 2000, 1104 whale watching trips were conducted and 1116 sightings were made. Sighting effort totalled in 4306 hours. Whale watching trips lasted a mean of 3h 54 min (range 37 min - 12h 45 min, n=126). Mean sighting success per month ranged from 55 % in November to 96 % in April. 15 cetacean species could be identified.

Moreover, during the period from June 1998 to January 1999, three more species - the Fraser´s dolphin (*Lagenodelphis hosei*), the Northern right whale (*Eubalaena glacialis*) and the humpback

whale (*Megaptera novaeangliae*) were encountered (B. Brederlau, pers. comm.). Additionally, the skipper of another whale watching boat operating in the area reliably reported the sighting of a Northern bottlenose whale (*Hyperoodon ampullatus*) in August 1997 (E. Koolmuus, pers. comm.). One more report comes from 1994, when Orcas (*Orcinus orca*) were encountered and photographed on one day in April (P. Stallbaum, pers. comm.).

A complete list of these 21 species along with the number of sightings is given in Table 1. The species comprise three mysticete families and seven odontocete families of the cetacean order. Six species were seen regularly, i.e. year round: bottlenose dolphin (*Tursiops truncatus*), short-finned pilot whale (*Globicephala macrorhynchus*), Atlantic spotted dolphin (*Stenella frontalis*), rough-toothed dolphin (*Steno bredanensis*), striped dolphin (*Stenella coeruleoalba*), and dense beaked whale (*Mesoplodon densirostris*, Ritter & Brederlau 1999), the other species showed up only sporadically. For seven species, the number of sightings was less than 10, seven species were only encountered only once (see Table 1). Two species showed a notable seasonality: common dolphin (*Delphinus delphis*) were observed only from December to May and Risso´s dolphin (*Grampus griseus*), which were only seen during February through June.

The bottlenose dolphin (375 sightings/32%) is the most frequent cetacean off La Gomera, followed by the short-finned pilot whale (171/15%.) and the Atlantic spotted dolphin (164/15%.). Figure 2 shows the relative abundance of cetaceans off La Gomera, demonstrating that the four most abundant species represent 74% of all sightings.

There was a distinct peak in the seasonal abundance of cetaceans with March, April and May being the months with the most sightings (see Figure 1). Particularly during April and May, the relative number of sightings was very high and sighting success never was less than 85 %. All of the highest values for sighting success were recorded for April. The month with the lowest average sighting success was November. The sighting frequencies of the three most abundant species, and the common dolphin, showed the same trend, with most of the sightings being made from March through May.

Only two species were seen close to the shoreline within less a few hundred metres: the bottlenose dolphin quite regularly, and the rough-toothed dolphin on rare occasions. All other species were found more offshore in deep waters. The species differed notably concerning the average values for distance to the coast, depth and group size. Of the species regularly seen, striped dolphins were found most far offshore with a mean of 4,11 nm and an according average depth of 976 m, followed by the short-finned pilot whale (4,05 nm, 932 m). The Atlantic spotted dolphin showed by far the largest mean (82,8) and total (650) group size. Descriptive statistics of the sightings are given in Table 2.

A seasonal variation of group size was found in the Atlantic spotted dolphin and again there was a peak in springtime. Also, the number of species encountered per month (range 7 - 13) was highest in April.

DISCUSSION

The number of 21 cetacean species without doubt appears very high. Taking into account the small size of the study area (roughly 100 nm^2), it delineates an important species diversity. Up to now, 81 % of the species recorded for the Canary Islands and 64 % of the species recorded for the Northeast Atlantic Ocean (compare Carwardine 1995) were observed off La Gomera. A comparison with other island archipelagos in the Atlantic Ocean underlines the fact, that such areas are a significant habitat for great numbers of cetacean species: Simas et al. (1998) and Steiner et al. (1998) found 25 and 18 species, respectively in the Azores, Reiner et al. (1996) counted 13 species in the Cape Verde islands.

Especially during springtime, the waters off La Gomera seem to concentrate large numbers of cetaceans, both on the species level and the total number of animals. However, the reasons for this concentration are not known. We do not know if the Southwest, representing the lee side of the island during most of the year, differs greatly from other areas around Gomera, as conditions for observing cetaceans usually are too rough there. Also, we do not know if this situation holds for other islands of the Canary Archipelago. The area Southwest off Tenerife is known to be inhabited by a population of short-finned pilot whales (HEIMLICH-BORAN 1993). High density of squid, a main prey of pilot whales (HERNANDEZ-GARCIA & MARTIN 1994), has been suggested to be the reason for this residency, but acorresponding proof is missing (HEIMLICH-BORAN 1993). In the same area, many other cetacean species can be seen (ESCORZA et al. 1992, URQUIOLA et al. 1997). A variety of species was found off Lanzarote (POLITI et al. 1996), suggesting that a greater number of species can be found all over the archipelago. But data for the other Canary Islands is scarce.

Observational data (RITTER 1996 and RITTER, unpublished data) indicate that in several delphinid species surface feeding activities are more frequently observed off La Gomera during springtime (predominantly March and April) than during other seasons. Also, the main season for the local tuna fishery is in springtime. As tuna occupies a similar position in the food web like many delphinids do, this is another indication for high prey availability during this period.

For many cetacean species a relationship between distribution and oceanographic features has been reported (e.g. BALLANCE et al. 1998, EVANS 1994, MAZE & WÜRSIG 1998, PERRIN et al. 1994, TYNAN 1998). For the short-finned pilot whales off Tenerife a correlation of distribution and sea surface temperature was found (MONTERO & ARECHAVALETA 1996). Thus it seems reasonable that during springtime the oceanographic conditions off La Gomera favour high productivity, hence elevated abundance of cetacean prey species and consequently high cetacean abundance in the study area. The main question is then: what are the reasons for high productivity, as it is known that the Canary waters usually are oligotrophic and there is a large mesoscale variability in chlorophyll distribution throughout the archipelago (ARISTEGUI et al. 1997).

The Canary islands lie in a transition zone between the Northwest African coastal upwelling area and the open ocean of the subtropical gyre (ARISTEGUI et al. 1997). Filaments containing upwelling water masses can spread far offshore the African coast (VAN CAMP et al. 1991) and reach the archipelago. This accounts especially for summer and autumn, when upwelling is strongest north of 25° (HERNANDEZ-GUERRA & NYKJAER 1997). However, the highest near surface values for chlorophyll (>0,5 mg chl a/m^3) are found in March, coinciding with the erosion of the thermocline, i.e. the maximum penetration of the surface mixed layer. Consequently, there is a late winter phytoplankton bloom apparent from January through March (ARISTEGUI et al. 1997).

The Canary Islands - seen as obstacles in a permanent current system such as the Canaries Current - also generate cyclonic and anticyclonic eddies "downstream" of the land masses (ARISTEGUI et al. 1997). This is a general and recurrent phenomenon in the archipelago, acting as an important source of primary production and generating much of the phytoplankton masses during most of the year (ARISTEGUI et al. 1997).

Another possible factor is the *island mass effect*, leading to the concentration of nutrient-rich waters in the lee side of islands, thus increasing the development of the trophic chain (HERNANDEZ-LÉON 1986, ESCORZA et al. 1992).

One more influence can be the islands conveying trace elements (such as Fe, Ni, Zn, etc.) which may act as limiting factors in the open sea (CULLEN 1991, MARTIN et al. 1991). As an example, a large increase of chlorophyll in the vicinity of the Galapagos Islands is suspected to be related to the iron input by the islands (MARTIN et al. 1991).

All these components may interact with each other (e.g. the island mass effect with upwelling filaments and/or cyclonic eddies, etc.), making the situation even more complex. Only direct investigation of the oceanographic and biological parameters like the plankton and nutrient composition,

along with regular cetacean surveys in the archipelago will help to answer these puzzling questions. Revealing the dynamics of such complex scenarios like the interplay of oceanographic and biological processes needs a profound interdisciplinary co-operation.

Finally - as we are not aware of any other small-scale area with such a variety of cetacean species - the association M.E.E.R. proposes to apply a protection status to the waters off La Gomera, so as to avoid adverse developments like excessive expanding of whale watching activities or negative impacts through the rapidly growing mass tourism on La Gomera. A protection status greatly enhances the public awareness, which is precondition for humans dealing responsibly with their natural environment.

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Table 1: Complete list of cetaceans species encountered off La Gomera (1994 - 2000).

	A. Odontocetes:	(No. of sightings)
1	Bottlenose Dolphin (*Tursiops truncatus*)	(375)
2	Short-finned pilot whale (*Globicephala macrorhynchus*)	(171)
3	Atlantic Spotted Dolphin (*Stenella frontalis*)	(164)
4	Rough-Toothed Dolphin (*Steno bredanensis*)	(133)
5	Common Dolphin (*Delphinus delphis*)	(61)
6	Dense Beaked Whale (*Mesoplodon densirostris*)	(40)
7	Striped Dolphin (*Stenella coeruleoalba*)	(30)
8	Cuvier´s Beaked Whale (*Ziphius cavirostris*)	(7)
9	Risso´s Dolphin (*Grampus griseus*)	(6)
10	Sperm Whale (*Physeter macrocephalus*)	(5)
11	False Killer Whale (*Pseudorca crassidens*)	(2)
12	Pygmy Sperm Whale (*Kogia breviceps*)	(1)
13	Orca (*Orcinus orca*)	(1)
14	Fraser´s Dolphin (*Lagenodelphis hosei*)	(1)
15	Northern Bottlenose Whale (*Hyperoodon Ampullatus*)	(1)
	B. Mysticetes:	
16	Sei Whale (*Balaenoptera borealis*)	(73)*
17	Bryde´s Whale (*Balaenoptera edeni*)	^
18	Fin Whale (*Balaenoptera physalus*)	(5)
19	Blue Whale (*Balaenoptera musculus*)	(1)
20	Northern Right Whale (*Eubalaena glacialis*)	(1)
21	Humpback Whale (*Megaptera novaeangliae*)	(1)

* Sightings of sei and Bryde´s whales were pooled due to the difficulty to distinguish between these two species.

Table 2: Descriptive statistics of the 11 most abundant cetacean species off La Gomera.

a) Distance to coast (nm)

SPECIES	Mean	SD	Min	Max	n
Bottlenose dolphin *(Tursiops truncatus)*	2,36	1,68	0,01	8	238
Short-finned pilot whale *(Globicephala macrorhynchus)*	4,05	1,38	1,5	8	114
Atlantic spotted dolphin *(Stenella frontalis)*	3,97	1,79	1	11	104
Rough-toothed dolphin *(Steno bredanensis)*	2,19	1,43	0,01	8	67
Common dolphin *(Delphinus delphis)*	3,69	1,57	1	10	54
Dense beaked whale *(Mesoplodon densirostris)*	2,74	1,29	0,3	5	26
Striped dolphin *(Stenella coeruleoalba)*	4,11	1,67	1	7	25
Sperm whale *(Physeter macrocephalus)*	5,06	2,00	2,8	7	5
Sei whale *(Balaenoptera borealis)*	5,70	3,99	1	12	5
Risso´s dolphin *(Grampus griseus)*	4,18	3,19	0,5	8	4
Cuvier´s beaked whale *(Ziphius cavirostris)*	5,08	1,58	3	6,8	4

b) Depth (m)

SPECIES	Mean	SD	Min	Max	n
Bottlenose dolphin *(Tursiops truncatus)*	440	450	10	2150	216
Short-finned pilot whale *(Globicephala macrorhynchus)*	932	467	200	2500	108
Atlantic spotted dolphin *(Stenella frontalis)*	955	562	100	2500	98
Rough-toothed dolphin *(Steno bredanensis)*	429	490	30	2500	62
Common dolphin *(Delphinus delphis)*	639	407	150	1750	56
Dense beaked whale *(Mesoplodon densirostris)*	412	378	100	1500	22
Striped dolphin *(Stenella coeruleoalba)*	976	606	150	2250	21
Sperm whale *(Physeter macrocephalus)*	1125	691	350	2000	4
Sei whale *(Balaenoptera borealis)*	1098	696	90	2000	5
Risso´s dolphin *(Grampus griseus)*	850	699	150	1500	4
Cuvier´s beaked whale *(Ziphius cavirostris)*	1275	737	200	1800	4

c) Group Size

SPECIES	Mean	SD	Min	Max	n
Bottlenose dolphin *(Tursiops truncatus)*	14,3	13,1	1	80	230
Short-finned pilot whale *(Globicephala macrorhynchus)*	23,7	10,6	5	53	111
Atlantic spotted dolphin *(Stenella frontalis)*	82,8	181,9	1	650	103
Rough-toothed dolphin *(Steno bredanensis)*	17,7	12,5	1	45	64
Common dolphin *(Delphinus delphis)*	36,3	42,8	3	225	44
Dense beaked whale *(Mesoplodon densirostris)*	3,2	2,0	1	9	26
Striped dolphin *(Stenella coeruleoalba)*	37,5	20,7	9	80	27
Sperm whale *(Physeter macrocephalus)*	3,2	2,6	1	6	5
Sei whale *(Balaenoptera borealis)*	2,0	1,2	1	4	5
Risso´s dolphin *(Grampus griseus)*	10,5	4,0	6	18	6
Cuvier´s beaked whale *(Ziphius cavirostris)*	1,8	1,0	1	3	4

FIGURE 1: Number of Cetaceans sightings off La Gomera (1995-2000) per Months

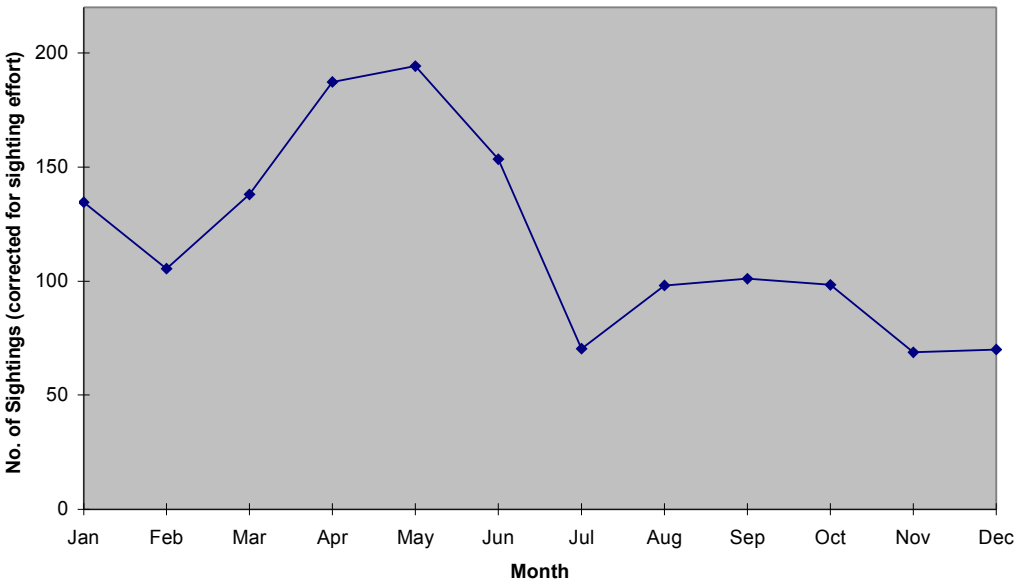

FIGURE 2: Relative Abundance of Cetaceans off La Gomera (Canary Islands) 1995-2000