

Quantification of ferry traffic in the Canary Islands (Spain) and its implications for collisions with cetaceans

FABIAN RITTER*

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

ABSTRACT

The Canary Islands, known for their high cetacean species diversity, have witnessed a rapid expansion of fast ferry traffic during the past few years. At the same time, ship strikes have been repeatedly documented. In this paper an overview of the inter-island ferry traffic in the archipelago is given. Ferry types in use (normal, fast and high speed vessels) are described, and the transects on which they operate are identified. To quantify the extent of the inter-island ferry traffic, three parameters were determined: (1) the actual transects from the different ports on the islands; (2) the number of journeys made per week on each transect; and (3) the length of each transect. Resulting numbers indicate that normal ferries travel approx. 66,000km, fast ferries travel approx. 570,000km and high speed ferries travel approx. 845,000km between islands each year. Fast and high speed ferry traffic is concentrated in the western islands. Areas of high risk for ship strikes within the archipelago are identified by comparing the location of transects with known areas of high cetacean abundance. It is argued that the Canary Islands are a hot spot for vessel-whale collisions and that a policy to counteract this situation is urgently needed.

KEYWORDS: CETACEANS; SHIP STRIKES; CANARY ISLANDS; NORTHERN HEMISPHERE; EUROPE; SPERM WHALES; WHALEWATCHING

INTRODUCTION

Collisions between vessels and cetaceans globally are an issue of growing concern. Since large ships reached travelling speeds of greater than 14 knots around the 1950s, collisions with vessels have increased and today affect a rising number of cetacean populations (Laist *et al.*, 2001). Different types of vessels have been reported to collide with whales, including container ships, ferries, whale-watching boats and military vessels (Jensen and Silber, 2004; Laist *et al.*, 2001; Van Waerebeek *et al.*, 2007).

Resident coastal populations appear to be especially vulnerable to ship strikes, but seasonally abundant cetaceans, migration corridors for larger whales as well as animals living on the high seas may all be affected (Pesante *et al.*, 2002). The problem appears to be of special concern in geographical areas where there exists an overlap between a high amount of maritime traffic, both commercial and non-commercial, and a high abundance of cetaceans (ACCOBAMS, 2005; de Stephanis and Urquiola, 2006; IWC, 2006; Panigada, 2006; Pesante *et al.*, 2002).

The Canary Islands (NE Atlantic Ocean, Spain), are a major European tourist destination with several million tourists visiting annually. With 29 identified species the islands are renowned for their high cetacean species diversity and have witnessed a rapid expansion of fast and high speed ferry traffic during the past few years (Aguilar *et al.*, 2000; de Stephanis and Urquiola, 2006). In an ever growing number of ferry transects, which connect most of the seven islands in the archipelago with each other, 'normal' ferries have been replaced by fast moving vessels of different sizes. At the same time, ship strikes have been repeatedly documented and also appear to have increased in numbers (de Stephanis and Urquiola, 2006; Carrillo and Ritter, 2010).

In 2005, the IWC set up the Ship Strike Working Group (SSWG) under its Conservation Committee to deal with this issue. One goal of the SSWG is to assess the problem on a global scale, including the identification of 'high risk areas', where either a higher number of collisions have been reported or there is an elevated likelihood of such events occurring, for the reasons mentioned above (IWC, 2006). Up to now, only a small number of high risk areas have been described and/or identified, mainly due to the fact that the real number of collisions in a given area is rarely known, even when collisions are regularly reported (ACCOBAMS, 2005; Laist *et al.*, 2001; Panigada *et al.*, 2006). Moreover, a quantitative assessment of collision risk is hard to achieve as long as the actual amount of ship traffic (e.g. expressed as the number of transects of certain types of vessels, travel distances and the frequency of transects) and the number and distribution of cetaceans are not known (ACCOBAMS, 2005; IWC, 2006). In this paper, this knowledge gap is addressed by quantifying the extent of inter-island ferry traffic in the Canary Islands to create a basis for further assessments. A description of the different types of fast ferries operating in the Canary Islands is included.

METHODS

In the Canarian archipelago, ferries connect most of the seven islands with each other. Transects were identified by searching the internet for regular schedules of the three known ferry companies operating in 2007. Hard copy schedules were collected on La Gomera and Tenerife, and travel agencies were interviewed about available schedules. The timetables for each inter-island connection were then analysed for the number of transects made per day and per week.

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

A distinction was made between ferries moving at speeds of 15–20 knots (termed normal ferries), ferries with travel speeds of 21–29 knots (fast ferries) and ferries travelling at speeds of 30 knots or more, (high speed ferries). Three (in part overlapping) transect categories were distinguished accordingly.

To quantify the total extent of the inter-island ferry traffic, three parameters were determined: (1) the actual transects to and from the different ports on the islands linked by ferries; (2) the number of travels made on each transect (per day, per week and per year); and (3) the length of each transect. For a technical description of ferry types, information was taken from the websites of the operators.

The lengths of the transects were measured using the distance measuring application ('ruler function') of internet based Google Earth Software. The shortest possible distance between two harbours was taken as the (minimum) length of the transect, in some cases being a straight line from port to port. Otherwise the transect was assumed to lie as close as possible to the direct straight line.

The total distance travelled by all ferries operating on the same transect (both ways) was then calculated by multiplying the length of the transect (in km) with the number of transects travelled per day, per week and per year. The number of transects per week was determined and the number of transects per year was calculated by multiplying the number of transects per week by 52. Finally, the total amount of inter-island ferry traffic in the archipelago was estimated by adding those numbers previously calculated for each of the transects.

In addition, the literature on abundance and distribution of cetaceans in the Canaries was searched so as to make out small areas of high cetacean abundance and Special Areas of Conservation (SAC) under the European Union Habitat Directive. Where these overlapped with ferry traffic concentrations, primary and secondary high risk areas for ship strikes were identified. Primary high risk areas are here defined as areas with known high cetacean abundance which receive the highest number of transects (>2,000) per year. Secondary high risk areas are areas with known high cetacean abundance (i.e. habitats where concentrations of several cetacean species have been found) and/or a considerable concentration of ferry traffic (>1,000 transects/year). The location of high risk areas was then plotted on a map.

RESULTS

The estimates of distance travelled presented here are based on a synthesis of five internet schedules, three hard copy schedules, and supplementary information from two travel agencies. Fifteen ferry transects were identified, frequented by three operators. All transects are given in Tables 1 and 2 and they are graphically represented in Figure 1.

Ferry types

One normal ferry is operating in the Canary Islands. It is a regular monohull ship (Fig. 2a) which travels at speeds of around 17 knots (see Table 1). There are four fast ferries operating in the Canaries, run by one operator. These are large monohull ships (length 132–143m, see Fig. 2f) which can accommodate up to 1,350 passengers and 300 cars while travelling 23–25 knots (see Table 1).

High speed ferries of four different types are run by two operators in the Canary Islands: large wave-piercing catamarans, a large wave-piercing trimaran and a smaller wave-piercing catamaran (all taking passengers and cars) as well as smaller wave piercing catamarans for passengers only. The large catamarans have lengths of approx. 95m and a capacity of up to 891 passengers and 271 cars (Fig. 2b). Travel speed is around 38 knots. The trimaran ferry (see Fig. 2c), said to be the largest car ferry existing (length 127m, capacity 1,291 passengers/341 cars), has a travel speed of approximately 40 knots. The smaller catamaran car ferry (66m in length, see Fig. 2d) takes up to 436 passengers and 96 cars and travels at a speed of 30 knots. Likewise, the smaller catamaran passenger ferry (length 40m, see Fig. 2e) travels at around 30 knots and has a capacity of 348 passengers. An overview of ferries and their technical data is given in Table 1.

Normal ferry traffic

The normal ferry connects the harbours of Playa Blanca (Lanzarote) and Corralejo (Fuerteventura, see Fig. 1). This transect is 14km long. The number of transects is 94 per week (4,888/year = 1,269km, see Table 2a). The minimum estimate of total distance travelled by normal ferries thus is 1,269km per week (65,988km per year, see Table 2a).

Fast ferry traffic

Twelve transects are frequented by fast ferries which are run by one operator. Fast ferries travel on all transects shown

Table 1
Ferry types operating in the Canary Islands (for abbreviations see Table 2).

| No. | Ferry type | Length | Capacity | Travel speed | Transects |
|-----|--|----------|------------------------------------|--------------|--|
| 1 | Large catamaran high speed ferry | 95m | 871 passengers 271 cars | 38kn | LC-VV, LC-SS, SC-AG |
| 2 | Large trimaran high speed ferry | 118m | 1,290 passengers 280 cars | 35–40kn | LC-SS, LC-SCLP |
| 3 | Large monohull fast ferry | 132–143m | 1,200–1,500 passengers 300 cars | 23–24.5kn | LC-SS, SS-VV, SCLP-VV, LC-SCLP, LC-VV, SS-SCLP, SC-SCLP, SC-AR, SC-LPGC, SC-VV, LPGC-AR, LPGC-MO, LPGC-PR, PB-CO |
| 4 | Small catamaran high speed ferry | 66m | 436 passengers 96 cars | 30kn | PB-CO |
| 5 | Small catamaran high speed ferry (passengers only) | 40m | 348 passengers | 30kn | LC-VGR |
| 6 | Large Monohull normal ferry | 78m | 700 passengers 120 cars | 17kn | PB-CO |

Table 2
Ferry traffic in the Canary Islands: length, frequency of ferry transects and distances travelled in 2007.

| Ferry line | Operator | Transect | Length (km) | Transects/d | Transects/wk | Transects/yr | Total km/d | Total km/week | Total km/year |
|---------------------------------------|------------------|----------|--------------|-------------|--------------|---------------|------------------|---------------|----------------|
| (a) Normal ferry transects | | | | | | | | | |
| LZ-FV | ARMAS | PB-CO | 14 | 10–14 | 94 | 4,888 | 70–98 | 1,269 | 65,988 |
| Total | | | | | | | | 1,269 | 65,988 |
| (b) Fast ferry transects | | | | | | | | | |
| TF-LG | ARMAS | LC-SS | 39 | 1–4 | 36 | 1,872 | 39–156 | 1,404 | 73,008 |
| LG-LP | ARMAS | SS-SCLP | 96 | 0–2 | 6 | 312 | 0–192 | 576 | 29,952 |
| LG-EH | ARMAS | SS-VV | 86 | 0–1 | 2 | 104 | 0–86 | 172 | 8,944 |
| GC-TF | ARMAS | LPGC-SC | 97 | 1–3 | 26 | 1,352 | 97–291 | 2,522 | 131,144 |
| GC-LZ | ARMAS | LPGC-AR | 206 | 0–1 | 6 | 312 | 0–312 | 1,236 | 64,272 |
| GC-FV | ARMAS | LPGC-MO | 105 | 2 | 14 | 728 | 210 | 1,470 | 76,440 |
| GC-FV | ARMAS | LPGC-PR | 191 | 0–1 | 4 | 208 | 0–191 | 764 | 39,728 |
| TF-LP | ARMAS | SC-SCLP | 144 | 0–1 | 2 | 104 | 0–144 | 288 | 14,976 |
| TF-LZ | ARMAS | SC-AR | 272 | 0–1 | 4 | 208 | 0–272 | 1,088 | 56,576 |
| TF-LP | ARMAS | LC-SCLP | 125 | 0–1 | 4 | 208 | 0–125 | 500 | 26,000 |
| TF-EH | ARMAS | SC-VV | 197 | 0–1 | 4 | 208 | 0–197 | 788 | 40,976 |
| EH-LP | ARMAS | SCLP-VV | 103 | 0–1 | 2 | 104 | 0–103 | 206 | 10,712 |
| Total | | | 1,661 | 4–19 | 110 | 5,720 | 556–2,279 | 11,014 | 572,728 |
| (c) High speed ferry transects | | | | | | | | | |
| TF-LG | OLSEN | LC-SS | 39 | 8 | 56 | 2,912 | 312 | 2,184 | 113,568 |
| | Garajonay Expres | LC-SS | 39 | 6 | 42 | 2,184 | 234 | 1,638 | 85,176 |
| | Garajonay Expres | SS-VGR | 28 | 6 | 42 | 2,184 | 168 | 1,176 | 61,152 |
| TF-LP | OLSEN | LC-SCLP | 125 | 2 | 14 | 728 | 250 | 1,750 | 91,000 |
| TF-EH | OLSEN | LC-VV | 120 | 2 | 12 | 624 | 240 | 1,440 | 74,880 |
| TF-GC | OLSEN | SC-AG | 66 | 12–16 | 104 | 5,408 | 792–1,056 | 6,864 | 356,928 |
| LZ-FV | OLSEN | PB-CO | 14 | 10–14 | 90 | 4,680 | 135–189 | 1,215 | 63,180 |
| Total | | | | 76 | 360 | 18,720 | 3,376 | 16,267 | 845,884 |

Abbreviations: Islands (from W to E): EH = El Hierro; FV = Fuerteventura; GC = Gran Canaria; LG = La Gomera; LP = La Palma; LZ = Lanzarote; TF = Tenerife. Ports (from W to E): VV = Valverde/El Hierro; SCLP = Santa Cruz/La Palma; VGR = Valle Gran Rey/La Gomera; SS = San Sebastian/La Gomera; LC = Los Christianos/Tenerife; SC = Santa Cruz/Tenerife; AG = Agaete/Gran Canaria; LPGC = Las Palmas/Gran Canaria; MO = Morrojaible/ Fuerteventura; PR = Puerto Rosario/Fuerteventura; CO = Corralejo/Fuerteventura; PB = Playa Blanca/Lanzarote; AR = Arrecife/Lanzarote.

in Fig. 1 except on the transects between Lanzarote and Fuerteventura, Lanzarote and Gran Canaria, between Tenerife and Agaete on Gran Canaria and along the South coast of La Gomera.

The number of transects varies from two per week (104/year, transect SS-VV) up to 36 per week (1,872/year, transect LC-SS). Transect length varies between 39km (transect LC-SS) and 272km (SC-AR). An overview is given in Table 2b.

Distances travelled on one transect ranged from 172km

per week (8,944km/year, transect SS-VV) to 2,552km per week (131,144km/year, transect SC-LPGC). The minimum estimation of total distance travelled by fast ferries was 11,014km per week (572,728km/year, see Table 2b).

High speed ferry traffic

Six transects are frequented by high speed ferries (see Fig. 1): between Los Christianos (Tenerife) and San Sebastian (La Gomera), San Sebastian and Valle Gran Rey (La Gomera), Valverde (El Hierro) and Santa Cruz (La Palma);

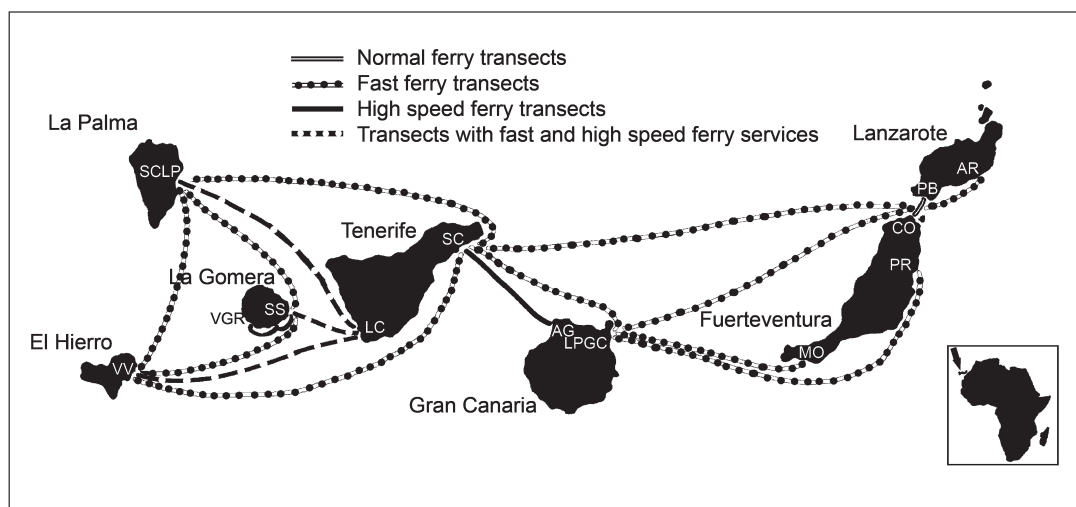


Fig. 1. Inter-island ferry transects in the Canary Islands in 2007.

(a) Normal ferry



(b) Large catamaran



(c) Large trimaran



(d) Smaller catamaran (passengers and cars)



(e) Smaller catamaran



(f) Fast ferry



Fig. 2. Ferry types operating in the Canary Islands (2007). Photographs (a), (c), (d) and (f) taken from operator websites.

between San Sebastian (La Gomera) and Santa Cruz (La Palma); between Santa Cruz (Tenerife) and Agaete (Gran Canaria) and between Play Blanca (Lanzarote) and Corralejo (Fuerteventura). Thus, the greater part of the high speed ferry traffic is concentrated in the western part of the archipelago, mainly around Tenerife and neighbouring islands.

The number of transects ranged from 12 per week (624/year, transect LC-VV) and 104 per week (5,408km/year, transect SC-AG). Transect length varied between 14km (transect PB-CO) and 125km (transect LC-VV). An overview is given in Table 2c.

Distances travelled on one transect ranged from 1,176km per week (61,152/year, transect SS-VGR) and 6,864 per week (356,928/year, transect SC-AG). The minimum estimation of total distance travelled by all high speed ferries was 16,267km per week (845,884km/year, see Table 2c).

Overlap with known cetacean habitats

The Canary Islands are known for their extraordinary cetacean species diversity. Twenty nine species have been identified so far. Due to the fact that coastal bottlenose dolphin, rough-toothed dolphin, (Martin *et al.*, 1995; Mayr

and Ritter, 2005; Ritter, 2003) pelagic pilot whale and dolphin populations are found (Heimlich-Boran, 1993; Ritter, 2003), it can be assumed that ferries may come across cetaceans virtually everywhere in the archipelago. However, certain areas have been investigated and/or are subject to whalewatching activities and thus the presence and distribution of cetaceans is known in more detail (Fig. 3). Areas with high cetacean abundance are: the waters south and southwest of the Islands of Tenerife, La Gomera, Gran Canaria and Fuerteventura as well as the channels between Tenerife and La Gomera and Gran Canaria respectively (Heimlich-Boran, 1993; Martin *et al.*, 1995; Mayr and Ritter, 2005; Ritter, 2003; Urquiola *et al.*, 1997). Some of these were already declared as Special Areas of Conservation (SACs, see Fig. 3) under the EU Habitat Directive (Carrillo, 2003; Ritter, 2003). There exists considerable overlap between these areas and a large part of the ferry operations:

- (1) the region between Tenerife and Gran Canaria, which is a prime habitat for sperm whales (André, 1998). This area receives a total of 6,760 ferry transects every year, 80% thereof made by high speed ferries and 20% made by fast ferries;
- (2) the waters around La Gomera and Tenerife, which are inhabited by a variety of cetaceans, especially the lee (southwest) sides of the islands, where calmer waters favour their observation and oceanographic features contribute to a high productivity (Carrillo, 2003; Ritter, 2001; 2003). The whole area receives 11,128 transects per year, 72% made by high speed ferries and 28% by fast ferries.
 - (a) In the Southwest of Tenerife, declared as a SAC and a proposed 'Marine Park for Cetaceans' (Gobierno de Canarias, 2002), the highest concentration of ferry traffic occurs. This area receives a total of 8,944 ferry transects per annum, 65% made by high speed ferries and 35% by fast ferries.
 - (b) In the South and Southwest of La Gomera, declared as a SAC, one of the highest species diversity areas

(related to its size) in Europe was found (Ritter, 2003). The smaller catamaran passenger high speed ferry accounts for 2,184 transects per year.

High risk areas

By relating the available information on abundance and distribution of cetaceans to the ferry transects, four primary high risk areas were identified (see Fig. 4):

- (1) the channel between Tenerife and La Gomera – due to a known high density of several cetacean species and an extreme concentration of ferry traffic (172 transects/week, 8,944 transects/year; 65% by high speed ferries and 35% by fast ferries);
- (2) the waters south and southwest to La Gomera – due to a known high density of several cetacean species and a considerable concentration of ferry traffic (42 transects/week, 2,184 transects/year; 100% high speed ferries);
- (3) the channel between Tenerife and Gran Canaria and the area around the harbour of Las Palmas – due to a known high density of sperm whales (and probably other cetaceans) and a considerable concentration of ferry traffic (130 transects/week, 6,760 transects/year; 80% by high speed ferries and 20% by fast ferries);
- (4) the area between Lanzarote and Fuerteventura – due to an extreme concentration of ferry traffic (184 transects/week, 9,568/year; 51% by the normal ferry and 49% by high speed ferries) while only deficient data on cetacean abundance/distribution are available.

Additionally, there is a considerable spatial concentration of ferry traffic around the main ferry harbours on different islands (besides the harbours lying within the primary high risk areas described above). Although little is known about cetacean abundance and distribution here, two areas were identified as secondary high risk areas due to the fact that they are the start and end points of a high number of ferry transects. These areas are found off the harbours of:

- (5) Santa Cruz de La Palma: 26 transects per week/1,352 per year (69% by high speed and 31% by fast ferries); and

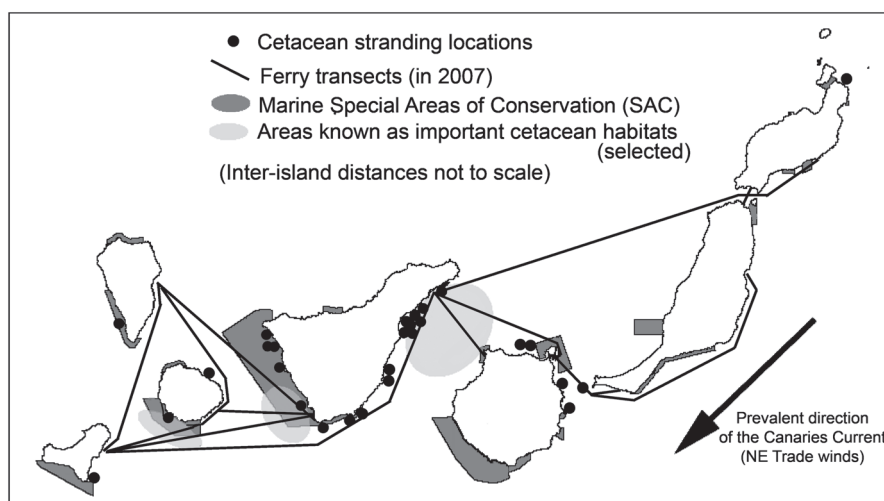


Fig. 3. Schematic map of Special Areas of Conservation (SACs) and important cetacean habitats in the Canary Islands (from Boehlke, 2006, modified). Black dots indicate strandings of cetaceans with obvious signs of ship strike injuries.

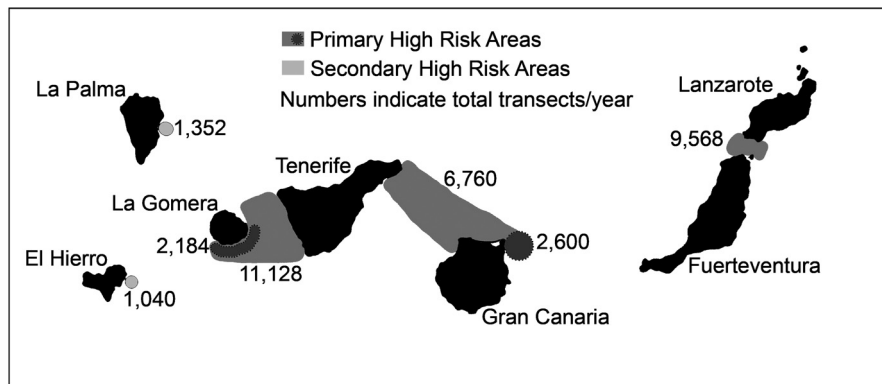


Fig. 4. Primary and secondary high risk areas for ship strikes in the Canary Islands. Dark grey areas are frequented by numbers of transects as indicated.

- (6) Valverde (El Hierro): 20 transects per week/1,040 per year (60% by high speed and 40% by fast ferries)

The primary and secondary high risk areas for ship strikes are illustrated in Fig. 4.

DISCUSSION

This quantification of the ferry traffic in the Canary Islands has brought to light a huge amount of inter-island ferry traffic. A distance of 65,988km is travelled by normal ferries together with 572,728km travelled by fast ferries and 845,884 travelled by high speed ferries each year add up to more than 1.48 million kilometres. The number of transect may actually not be as high as calculated due to bad weather conditions or technical malfunction of the ferries. However, the transect distances were set as straight lines, which represents a minimum estimation of the distances travelled. Ferries in reality might take different routes between ports, thereby considerably diverging from the direct line. Thus, it can be assumed that the real distances travelled are probably higher than the minimum estimations made in this paper. The resulting numbers clearly signify an enormous concentration of ferry traffic within a comparably small area. Although almost all islands are connected with fast ferries, there is a prominence of fast and high speed ferry traffic in the western part of the Canarian archipelago, especially between Tenerife and its surrounding islands. In fact, the large catamaran and trimaran high speed ferries are exclusively operating between the western islands (see Fig. 1).

Ferry schedules change regularly, sometimes at short notice, so the calculations made here constitute a 'snapshot' of ferry traffic in spring 2007. However, there is a general trend towards more fast and high speed ferries. Tregenza *et al.* (2000) counted 4,624 ferry transects between Tenerife and La Gomera (transect LC-SS) in 2000. Today, that number has reached 6,968, representing an over 50% increase. Hence, it can be assumed that the amount of ferry traffic likely will increase further or stay at the same level in the future.

Likewise, this investigation only dealt with inter-island ferry traffic. There are several additional ferry lines connecting the Canaries with mainland Spain and Madeira. If the high quantity of commercial (fishing, merchant, whale watching, etc.) and non commercial (sailing, big game fishing, motor yachting, etc.) vessel traffic that can be found

in the Canary Islands is noted, the archipelago as a whole must be considered as a high risk area for ship strikes.

The amount of ferry traffic alone appears to be a major threat to cetaceans in the archipelago and ship strikes have regularly been reported. From 1985 until 2005, 37 whales were reported to have been hit by ships, and 30 of these (81%) occurred after the introduction of fast ferries in 1999 (de Stephanis and Urquiola, 2006). The first whales were hit only weeks after the start of operation of the first high-speed ferry (Aguilar *et al.*, 2000). The species involved is predominantly the sperm whales, but baleen whales, pygmy sperm whales, Cuvier's beaked whales and other beaked and short-finned pilot whales were also found (de Stephanis and Urquiola, 2006). Carrillo and Ritter (2010) found that of a total of 556 cetaceans stranded between 1996 and 2007, 59 (11%) involved animals being hit by a vessel. They also documented that 41% of stranded animals showing ship strike related injuries were sperm whales. Numbers given by the local government say that the percentage of sperm whales hit by vessels is as high as 52% (Gobierno de Canarias, 2009). Sperm whales thus appear especially vulnerable. They are known to stay for prolonged periods at the surface while recovering from deep and long dives (Watwood *et al.*, 2006). Moreover, they may have bi-hemispheric sleep (Miller *et al.*, 2008). Recognition of ship strikes mainly comes through strandings of carcasses or dead animals found floating at sea which show clear signs of collisions. In other cases, lesions typical for ship strikes have been identified through post mortem examinations. The reported numbers of whales hit per year between 2000 and 2008 varied from 3–7 according to official numbers (Gobierno de Canarias, 2009). Yet, this probably is an underestimate of the true numbers due to the fact that dead animals may drift offshore or sink and thus are not found. Reporting by ferry operators does not occur.

At a finer scale, a considerable overlap between ferry transects and prime cetacean habitats has been identified. Within the primary high risk areas one would expect a higher frequency of ship strikes than elsewhere in the archipelago, due to a high concentration of ferry traffic, a high density of cetaceans, or both. De Stephanis and Urquiola (2006) showed, that the largest portion of stranded animals hit by ships were found on the coasts of Tenerife. Carrillo and Ritter (2010) also found that a large portion of the animals that showed clear signs of ship strike related injuries stranded on the coast of Tenerife (see Fig. 2). This is exactly what one

would expect to happen to animals hit between Tenerife and Gran Canaria since the Canaries current flows in a southeasterly direction and thus transports carcasses towards Tenerife's shoreline. A similarly high number of stranded animals were found on the South-west coast of Tenerife within one of the zones identified as high risk areas (see Fig. 3). Tregenza *et al.* (2000), with a simple model of collision risk, calculated that each pilot whale off Tenerife is at risk of 1.7 ship strikes per year. Near collision events regularly occur (pers. obs.).

Cetaceans may have already learned to avoid certain high risk areas where they frequently and predictably encounter vessel traffic. This may also apply to the primary high risk area between Fuerteventura and Lanzarote and the areas around the largest harbours in the Canaries (Santa Cruz on Tenerife and Las Palmas on Gran Canaria). Off Southwest Tenerife, where besides the highest number of ferry transects a large amount of whalewatching takes place (10–15,000 trips per year as for 2002, see Servidio *et al.*, 2003), the situation is taken to extremes, in that cetaceans constantly live under the pressure of avoiding whalewatching vessels or ferries. Off La Gomera, where a high species diversity is also found (Ritter, 2003), the high speed ferry connecting Tenerife and El Hierro (transect LC-VV) has been seen to pass through the SAC of La Gomera although the transect is usually much farther offshore (Ritter, unpublished data).

The true extent of the problem still remains unclear. Ferry captains do not in general report collisions, although there have been reports by tourists travelling on high speed ferries and other vessels (for example Aguilar *et al.*, 2000; Ritter, unpublished data). To date, a carcass is identified as a victim of a ship strike if it is either found floating at sea or washed ashore. Stranded cetaceans are examined in detail by one of the Canarian specialist groups, who try to determine whether a ship strike was involved.

There are many different types of ferries operating in the archipelago. However, it is not even known if high-speed ferries have a higher collision risk than normal and fast ferries, or if the larger high-speed ferries collide more often than smaller ones. Depending on their construction features and sizes these vessels have differing manoeuvrabilities and presumably different abilities to avoid collisions. The Canaries Government reported 42 ship strike cases between 2000 and 2008 out of a total of 54 documented since 1985. Thus, 78% of registered ship strikes in the Canary Islands occurred after the introduction of regular fast and high speed ferry traffic (Gobierno de Canarias, 2009). Panigada (2006) found, however, that since their introduction in 1996 in the Mediterranean Sea, 43% of ship strikes involved fast ferries. Moreover, Weinrich (2004) found that all collisions of large vessels with cetaceans at a speed greater than 18 knots were fatal. Likewise, Laist *et al.* (2001) recognised that the most severe injuries in cetaceans were observed after collisions with vessel travelling faster than 14 knots. Jensen and Silber (2004) reported that relatively large and relatively fast moving vessels were most often involved in ship strikes. Hence, vessel speed and vessel size are crucial (see also Vanderlaan and Taggart, 2007).

It must be stressed that the current situation indicated that research must be conducted onboard ferries. Such research is urgently needed, e.g. to study the responsive behaviour of

the animals to fast approaching ships, something that probably can be assessed by onboard observers (Capoulade, 2002; Ritter, 2007). Another important issue is the actual effect that ship strikes have on local cetacean populations (see also Tregenza *et al.*, 2000; Weinrich, 2004).

To address these issues, it is vital that effective communication between the ferry operators and the Canaries administration is established. Up to now, although dialogue has begun, there have been no substantial advances towards more transparency. It is therefore recommended (see also Carrillo and Ritter, 2010) to act on a precautionary ground and:

- (1) install an obligatory reporting system making use of the IWC ship strike database, see http://www.iwcoffice.org/sci_com/shipstrikes.htm;
- (2) implement shifts of transects away from primary high risk areas and/or speed restrictions;
- (3) install onboard observers on ferries operating in primary high risk areas;
- (4) implement research projects assessing the actual number of collision or near-collision events, preferably by placing researchers on board of the ferries; and
- (5) develop a general strategy integrating different available mitigation measures.

Onboard observers appear to be an effective measure to lower collision risk (ACCOBAMS, 2005), and one Canarian ferry operator is already accepting such observers (de Stephanis and Urquiola, 2006). Other possible mitigation measures have been proposed, such as a Whale Anti Collision System (WACS, see Andre *et al.*, 2002). However, they are not very likely to be implemented in the short term. There has already been an attempt to modify certain transects (de Stephanis and Urquiola, 2006), but as long as monitoring and enforcement does not occur, these efforts will not be fruitful.

Finally, ship strikes may not only involve large or medium-sized whales but also dolphins (apart from being dangerous for other marine wildlife living more or less close to the surface), as indicated by a large number of dolphins showing propeller wounds (Van Waerebeek *et al.*, 2007; Ritter, unpublished data). It should also be noted that ship strikes also present a human safety issue. During a collision event, not only might the vessel be damaged, but also passengers may be hurt, or even killed. As an example, in a collision of a jet foil (which was afterwards taken out of operation), between Tenerife and Gran Canaria in 1999, one passenger was killed (de Stephanis and Urquiola, 2006) and many were injured. In light of this, an effective policy to manage ferry traffic so as to secure both human and animal safety appears an urgent matter.

ACKNOWLEDGEMENTS

I would like to thank the following persons for their review of earlier drafts as well as for their helpful comments: Volker Boehlke; Sarah Renner; Anne Saunders; Volker Smit; and Koen Van Waerebeek. Mark Simmonds and Mason Weinrich kindly reviewed the final draft. The preparation of this

paper was supported by M.E.E.R. e.V. (Berlin), Deutsche Umwelthilfe (Radolfzell) and Gesellschaft zur Rettung der Delphine (München).

REFERENCES

- ACCOBAMS. 2005. Report of the Joint ACCOBAMS/Pelagos Workshop on Large Whale Ship Strikes in the Mediterranean Sea, Monaco, 14–15 November 2005. 35. [Available from <http://www.accobams.com>].
- Aguilar, N., Carrillo, M., Delgado, I., Díaz, F. and Brito, A. 2000. Fast ferries impact on cetacean in Canary Islands: collisions and displacement. *Eur. Res. Cet.* 14: 164.
- Andre, M. 1998. Cachalotes en Canarias. Doctoral thesis, La Universidad de Las Palmas de Gran Canaria.
- Andre, M., Potter, J.R., Delory, E., Degollada, E., Kamminga, C. and Van der Weide, J.A.M. 2002. A passive Sonar System to prevent Ship Collisions with Cetaceans. In: Pesante, G., Panigada, S. and Zanardelli, M. (eds). *Proceedings of the Workshop: Collisions between Cetaceans and Vessels: Can we find solutions?* 15th Annual Meeting of the European Cetacean Society in Rome, 2001. ECS Newsletter No. 40: 34–40 (Special Issue).
- Boehlke, V. 2006. Wale und Delfine bei den Kanarischen Inseln. 55. Natucan, Tenerife.
- Capoulade, F. 2002. Whale and Ferries in Ligurian Sanctuary: Captain's Experience and Owner's Actions. In: Pesante, G., Panigada, S. and Zanardelli, M. (eds). *Proceedings of the Workshop: Collisions between cetaceans and Vessels: Can we find solutions?* 15th Annual Meeting of the European Cetacean Society in Rome, 2001. ECS Newsletter No. 40: 18–25 (Special Issue).
- Carrillo, M. 2003. Studies applied to conservation of cetacean populations in SAC ES-7020017, Tenerife (Canary Islands). Unpublished [Only abstract seen].
- Carrillo, M. and Ritter, F. 2010. Increasing numbers of ship strikes in the Canary Islands: proposals for immediate action to reduce risk of vessel-whale collisions. *J. Cetacean Res. Manage.* 11(2). [This volume]
- de Stephanis, R. and Urquiola, E. 2006. Collisions between ships and cetaceans in Spain. Paper SC/58/BC5 presented to the IWC Scientific Committee, May 2006, St. Kitts and Nevis, West Indies (unpublished). 6pp. [Paper available from the Office of this Journal].
- Gobierno de Canarias. 2002. Anteproyecto de Ley de Declaration de el Parque Natural Marino de las Ballenas.
- Gobierno de Canarias. 2009. Activities on cetaceans carried out by the Canary Islands Government in 2008 and Review of Historic Data Records of Cetaceans and Ship Strikes in the Canary Islands. Paper IWC/61/CC16 presented to the IWC Conservation Committee, Madeira, June 2009 (unpublished). [Paper available from the Office of this Journal].
- Heimlich-Boran, J. 1993. Social organisation of the short-finned pilot whale, *Globicephala macrorhynchus*, with special reference to the comparative social ecology of delphids. PhD thesis, University of Cambridge, Cambridge, UK. 132pp.
- International Whaling Commission. 2006. Ship Strikes Working Group – first progress report to the Conservation Committee. Paper IWC/58/CC3 presented to the Conservation Committee of IWC, May 2006, St. Kitts and Nevis (unpublished). 31pp. [Paper available from the Office of this Journal].
- Jensen, A.S. and Silber, G.K. 2004. Large Whale Ship Strike Database. US Department of Commerce, NOAA Technical Memorandum, NMFS-F/OPR-25, January 2004. 37pp.
- Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whales. *Mar. Mammal Sci.* 17(1): 35–75.
- Martin, V., Carrillo, M., Andre, M. and Hernandez-Garcia, V. 1995. Records of cetaceans stranded on the Canary Islands coasts from 1992 to 1994. International Council for Exploration of the Sea. Marine Mammals Committee, CM 1995/N:9.
- Mayr, I. and Ritter, F. 2005. Photo-identification of Rough Toothed Dolphins off La Gomera (Canary Islands) with new insights into social organisation. Poster presented at the Annual Conference of the ECS, La Rochelle, France, April 2005.
- Miller, P.J.O., Aoki, K., Rendell, L.E. and Armano, M. 2008. Stereotypical Resting Behaviour of the Sperm Whale. *Current Biology* 18(1).
- Panigada, S. 2006. Ship Strikes in the Mediterranean Sea and the ACCOBAMS activities. Special – Ship Strikes. Vol. 3(1), August 2006. 12pp.
- Panigada, S., Pesante, G., Zanardelli, M., Capoulade, F., Gannier, A. and Weinrich, M. 2006. Mediterranean fin whales at risk from fatal ship strikes. *Mar. Poll. Bull.* 52: 1287–98.
- Pesante, G., Collet, A., Dhermain, F., Frantzis, A., Panigada, S., Podesta, M. and Zanardelli, M. 2002. Review of collisions in the Mediterranean Sea. In: Pesante, G., Panigada, S. and Zanardelli, M. (eds). *Proceedings of the Workshop: Collisions between Cetaceans and Vessels: Can we find solutions?* 15th Annual Meeting of the European Cetacean Society in Rome, 2001. ECS Newsletter No. 40: 5–12 (Special Issue).
- Ritter, F. 2001. 21 cetacean species off La Gomera (Canary Islands): possible reasons for an extraordinary species diversity. Proceedings of the 15th Annual Conference of ECS (poster presentation), Rome, Italy.
- Ritter, F. 2003. *Interactions of Cetaceans with Whale Watching Boats – Implications for the Management of Whale Watching Tourism*. MEER eV, Berlin, Germany. 91pp. A report based on the findings of the research project M.E.E.R. La Gomera, March 2003. [Available from the author].
- Ritter, F. 2007. Cetacean sightings in the North Atlantic Ocean during a commercial Arctic Cruise, summer 2006. Paper SC/59/WW21 presented to the IWC Scientific Committee, May 2007, Anchorage, USA (unpublished). 6pp. [Paper available from the Office of this Journal].
- Servidio, A., Elejabeitia, C., Lopez Yanes, T. and Iani, V. 2003. Analisis socioeconomico de la industria de observacion de cetaceos en Tenerife. Report to the Canaries Government. 5pp.
- Tregenza, N., Aguilar, N., Carrillo, M., Delgado, I., Brito, A. and Martin, V. 2000. Potential impact of fast ferries on whale populations: a simple model with examples from the Canary Islands. *Eur. Res. Cet.* 14: 195–97.
- Urquiola, E., Sevilla, J.A. and Iani, V. 1997. The development of whale-watching in the Canaries after the regulations of 1995: a year of study. *Eur. Res. Cet.* 11: 62–66.
- Van Waerebeek, K., Baker, A.N., Félix, F., Gedamke, J., Iñiguez, M., Sanino, P.G., Secchi, E., Sutaria, D., van Helden, A. and Wang, Y. 2007. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere; an initial assessment. *LAMAM* 6(1): 43–69.
- Vanderlaan, A. and Taggart, C.T. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Mar. Mammal Sci.* 23(1): 144–56.
- Watwood, S.L., Miller, P.J.O., Johnson, M., Madsen, P.T. and Tyack, P.L. 2006. Deep-diving foraging behaviour of sperm whales (*Physeter macrocephalus*). *J. Anim. Ecol.* 75(3): 814–25.
- Weinrich, M. 2004. A review of worldwide collisions between whales and fast ferries. Paper SC/56/BC9 presented to the IWC Scientific Committee, July 2004, Sorrento, Italy (unpublished). 8pp. [Paper available from the Office of this Journal].

INTERNET SOURCES

<http://www.fredolsen.es>
<http://www.navieraarmas.com/>
<http://www.directferries.es>
<http://www.garajonayexpres.com/>

Date received: February 2010

Date accepted: March 2010