Increasing Numbers of Ship Strikes in the Canary Islands: Proposals for Immediate Action to Reduce Risk of Vessel-Whale Collisions

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ABSTRACT

The Canary Islands, known for their extraordinarily high cetacean species diversity, have witnessed a rapid expansion of fast and high speed ferry traffic during the past few years. At the same time, ship strikes have been increasingly reported. 556 cetacean carcasses, found ashore in the Canary Islands (or being reported) between 1991 and 2007, were examined. 59 strandings (10.6%) were found to involve vessel-whale collisions, the great majority of strandings (58%) occurred on Tenerife. Species most affected were sperm whales (*Physeter macrocephalus*, N=24, 41%), pygmy sperm whales (*Kogia breviceps*, N=10, 17%), Cuvier's beaked whales (*Ziphius cavirostris*, N=7, 12%), short-finned pilot whales (*Globicephala macrorhynchus*, N=6, 10%) and at least three baleen whale species (N=9, 15%). 26 animals (44%, N=42) were either calves or juveniles, and one was a newborn. The temporal distribution of strandings indicated that lethal strikes have dramatically increased in recent years. Many ship strikes, assumingly by large and fast moving vessels, likely caused the death of the cetaceans as indicated by severe injuries like huge slashes, cuts or animals separated into halves. Given these numbers and the widely accepted fact that only a portion of ship strikes will be recorded due to lack of reporting and carcasses drifting away or sinking, ship strikes appear to be a major threat to at least some cetacean populations in the Canary Islands, and especially to sperm whales. Moreover, the issue is a matter of human safety, as crew and passengers are at risk of being harmed, too. In this situation, a number of measures to mitigate the risk of ship strikes are recommended as a matter of high priority. These include the placement of dedicated look-outs on fast moving vessels, the shift of ferry transects where feasible, a speed limitation for a number of high-risk areas where cetacean abundance is notably high, the introduction of an obligatory reporting system of vessel-whale collisions and the conduction of detailed studies dealing with this pressing issue.

KEYWORDS : CETACEANS, SHIP STRIKES, CANARY ISLANDS, FAST FERRY TRAFFIC, MITIGATION

INTRODUCTION

Historical records of collisions between ships and cetaceans date back to the early 17th century. Ship strikes in the context used here are, however, a relatively new phenomenon. The worldwide number of collisions increased markedly from the 1950s on, which corresponds to the period of time when ships customarily began to reach maximum speeds of 14-15 knots or more (Laist *et al.*, 2001; IWC, 2008). Whales may be hit either by the bow, the keel or any other part of a vessel`s hull, or by its propeller. Hit whales at times may be stuck on the bow of large ships and are often brought into a harbour, sometimes after carrying the carcass over substantial distances (e.g. Laist *et al.*, 2001; Félix & Van Waerebeek, 2005).

During recent decades, with the rapid development of shipping traffic on a global scale, the situation in some parts of the world has become critical. Cetacean species affected include both large whales and small cetaceans like dolphins, beaked whales a.o. (see review by Van Waerebeek *et al.*, 2007). However, certain species are especially vulnerable, namely those ones which swim slowly and stay at the surface for longer periods of time, for example right whales (*Eubalaena spp.*) and sperm whales (*Physeter macrocephalus*). Still there is another species which is affected: humans. Collisions with whales can pose a threat to human safety, which is highlighted by the fact that considerable damage to ships has been reported (Laist *et al.*, 2001; IWC, 2008), as well as instances where sailors and ferry passengers have been hurt, including a case of human fatality in the Canary Islands (De Stephanis & Urquiola, 2006).

Although relatively little is known about the geographical distribution of collision cases on a global scale, a number of hot spots have been identified, where ship strikes significantly affect the status of cetacean populations (Pesante *et al.*, 2002; ACCOBAMS, 2005). These include the east coast of the United States of America (Knowlton & Kraus, 2001; Douglas *et al.*, 2008), the northern Mediterranean Sea (Panigada *et al.*, 2006), the Strait of Gibraltar (De Stephanis & Urquiola, 2006), the Western Pacific (IMO, 2007) and the Canary Islands (De Stephanis & Urquiola, 2006; Ritter, 2007). These areas are characterized by a substantial overlap between high levels of shipping traffic and a known high abundance of cetaceans.

Types of vessels involved include a great variety of watercraft comprising large ships like tankers, cargo or cruise ships, but also whale watching vessels, navy ships, yachts (especially those one that travel at high speed), hydrofoils and others (Laist *et al.*, 2001, Jensen & Silber, 2004; Van Waerebeek *et al.*, 2007). Finally, large high speed craft (HSC) have become a major concern, because they travel regularly speeds of up to 35-40 knots, and collisions appear to be increasing (Weinrich, 2004; Ritter, 2007). These craft typically incorporate modern hull shapes like wave-piercing catamarans or trimarans which intuitively appear especially dangerous to cetaceans.

Not surprisingly, fatality rates and severity of lesions are related to size and speed of vessels. According to Laist *et al.* (2001), 89% of accounts where the whale was severely hurt or killed occurred at speeds of 14 knots or more. Moreover, most lethal and serious injuries were caused by large ships of 80m length or more. Thus, speed appears to be the central factor with regard to collisions. High travelling speed also limits the time frame left to take evasive navigational action. For example, detecting a whale in the ship's path 600 m away at a speed of 40 knots leaves a vessel's captain areaction time of 30 seconds before a whale potentially is hit.

Here we summarize collision cases in the Canary Islands from 1991-2007, identified through the investigation of dead animals. We relate ship strikes to the high density of fast and high speed inter-island traffic in the archipelago and point out the urgent need to introduce mitigation measures so as to preserve the integrity of the natural populations and to conserve the extraordinary high cetacean species diversity found in the Canary Islands.

METHODS

This study investigated cetaceans which stranded between 1st January 1991 and 31st December 2007 on the coasts of the Canary Islands or were found floating dead at sea. Moreover, reports from eye witnesses, as well as those in the press and the internet, were analyzed and included, as long as a description of the injuries in cases where the observations were unambiguously pointing to a vessel-whale collision.

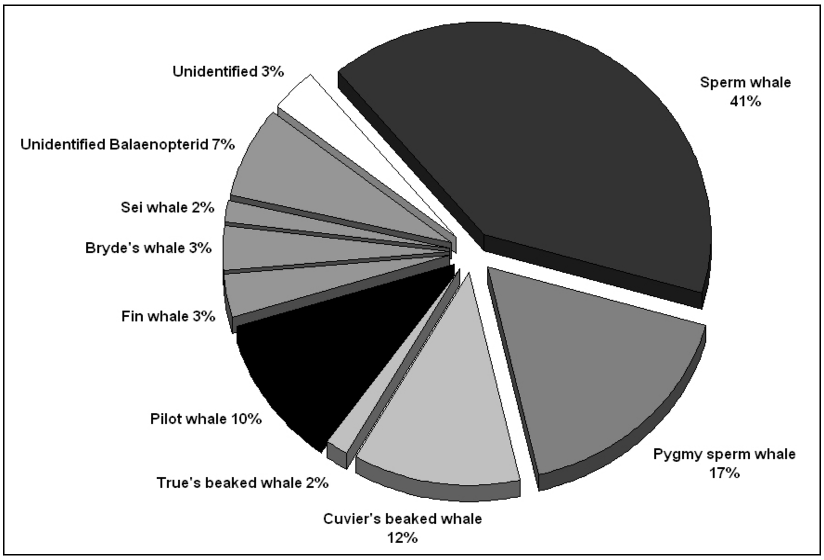
Direct investigation of carcasses included the determination of species and of the state of decomposition. Sex and age class were identified as far as possible. External measurements, date and locality of the carcass were noted, and photographs were taken wherever feasible. Each stranding was assigned a unique ID code. All cases were introduced into a data base. Five categories were used for the state of decomposition: 1. Fresh, 2. Little decomposition, 3. Moderate decomposition, 4. Advanced decomposition and 5.Indeterminate (European Cetacean Society, 1991). For the determination of age classes, the following categories were used: 1. Adult, 2. Juvenile, 3. Calf and 4. Newborn (compare Ritter, 2003). Carcasses were searched for indications of collisions with vessels. A collision event was identified if one or more of the following symptoms were detected: 1. Lesions like deep parallel cuts, usually dorsal, indicative of propeller strikes, 2. Large and/or deep slashes, sometimes cutting off large proportions of the body, 3. Massive blunt trauma: broken bones like vertebrae, jaws, etc. or 4. Animals wedged on the bow of a vessel.

RESULTS

From 1991 until 2007, 556 cetacean carcasses were found stranded on the shoreline of the seven main Canary Islands, or were reported floating dead at sea.

59 animals, representing 10.6 % of strandings, showed signs of collisions or were reported being hit by a ship. The latter was the case nine times, whereas 50 animals were directly investigated by the first author and members of the Canarian Cetacean Stranding Network. One animal was found on the bow of a large vessel (see Table 1).

***Figure 1:* Cetaceans hit by vessels in the Canary Islands 1991-2007 (N=59)**



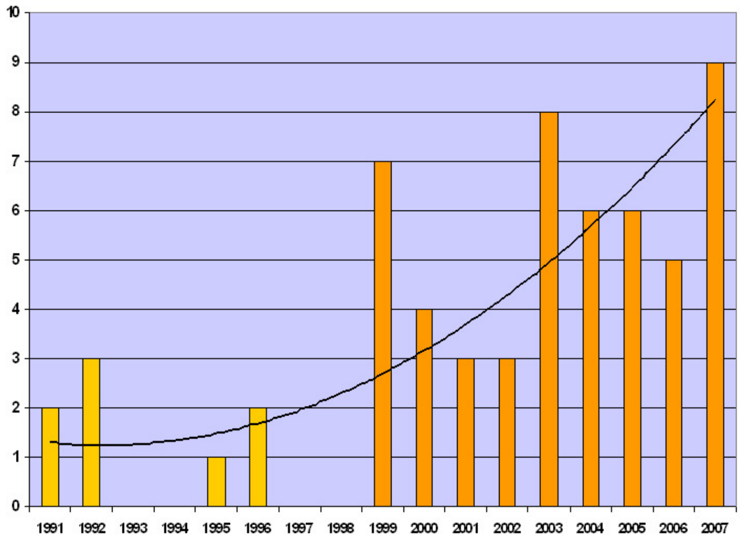
The species primarily involved were sperm whales (*Physeter macrocephalus*, N=24, 41%), pygmy sperm whales (*Kogia breviceps*, N=10, 17%), Cuvier's beaked whales (*Ziphius cavirostris*, N=7, 12%), short-finned pilot whales (*Globicephala macrorhynchus*, N=6, 10%) and one True's beaked whale (*Mesoplodon europaeus*; see Figure 1). At least three baleen whale species (N=9, 15%) were found being hit by a vessel: two fin whales (*Balaenoptera* *physalus*), two Bryde's whales (*B. edeni*) and one Sei whale (*B. borealis*). Four balaenopterid whales could not be identified to the species level, and in another two genus and species remained unknown (see Figure 1).

58% of cetaceans thought hit by vessels were found on Tenerife (N=24) and 20% on Gran Canaria (N=12). On La Gomera, six animals (10%) were encountered and three on Fuerteventura (5%). El Hierro accounted for two strandings, La Palma and Lanzarote one each (see Table 1).

Most animals were either juveniles (N=13, 22%) or calves (N=13, 22%). 15 animals (25%) were adults and one was a newborn. However, in almost one third of all strandings the age class remained indeterminate. Of those animals, where the sex could be determined (N=36), 19 (53%) were females, and 17 (47%) were males. In 23 carcasses, the sex was not identifiable. Details on all strandings, together with some remarks on the types of injuries encountered, are presented in Table 1.

The temporal distribution of strandings of collision specimen shows a marked increase over the data collection period and indicates that the number of collisions is on a consistently high level since 1999 (see Figure 2). From 1991-1998 the number of ship strikes recorded varied from 0 to 3, with an average of 1 per year. From 1999-2007, this number ranges from 3 to 9, averaging 6.4 per year.

***Figure 2:** Temporal distribution of vessel whale collisions in the Canary Islands 1991-2007 (N=59)*
Solid line represents polynomic trend.



DISCUSSION

This study found that almost 11% of cetaceans stranded in the Canary Islands showed signs of collisions with vessels. Other studies have found similar percentages. Laist *et al.* (2001) reported ship strikes as possible or known cause of death in 16 out of 127 strandings (13%) on the French coast from 1972-1998, in 14 out of 407 strandings along the US Atlantic (1976-1993), and in 11 out of 55 strandings (20%) on the coast of South Africa from 1963-1998. In the Mediterranean Sea, Panigada *et al.* (2006) found that 16% (46 of 287) cetacean deaths were caused by vessels. However, all of these areas are at least an order of magnitude larger than the spatial area described here.

As previously reported (Laist *et al.*, 2001; Van Waerebeek *et al.*, 2007), a variety of different cetacean species, including large and small cetaceans, were affected by vessel collisions. Nonetheless, the numbers presented here are based exclusively on strandings and animals found floating dead at sea. To date, no single case has been corroborated by the ferry operators, despite several witness reports for example from tourists and fishermen (Aguilar *et al.*, 2000; Ritter, unpubl. data; see also Table 1). As pointed out by Weinrich (2004), intentionally not reporting collisions may entail the attempt to avoid the implication of an industry in vessel whale collisions. Thus, the true numbers of ship collisions remain largely unknown. The only official numbers available are given in the Spanish IWC progress reports and vary from 1 to 9 ship strikes per year since 2000. This presumably is an underestimation, not least because collisions may go unnoticed, animals hit may sink to the seafloor or simply drift away (Laist *et al.*, 2001; ACCOBAMS, 2005). Therefore, it is not possible to date to calculate any collision risk or conduct sound modelling for Canarian waters, despite the relatively predictable numbers concerning ferry traffic (see below).

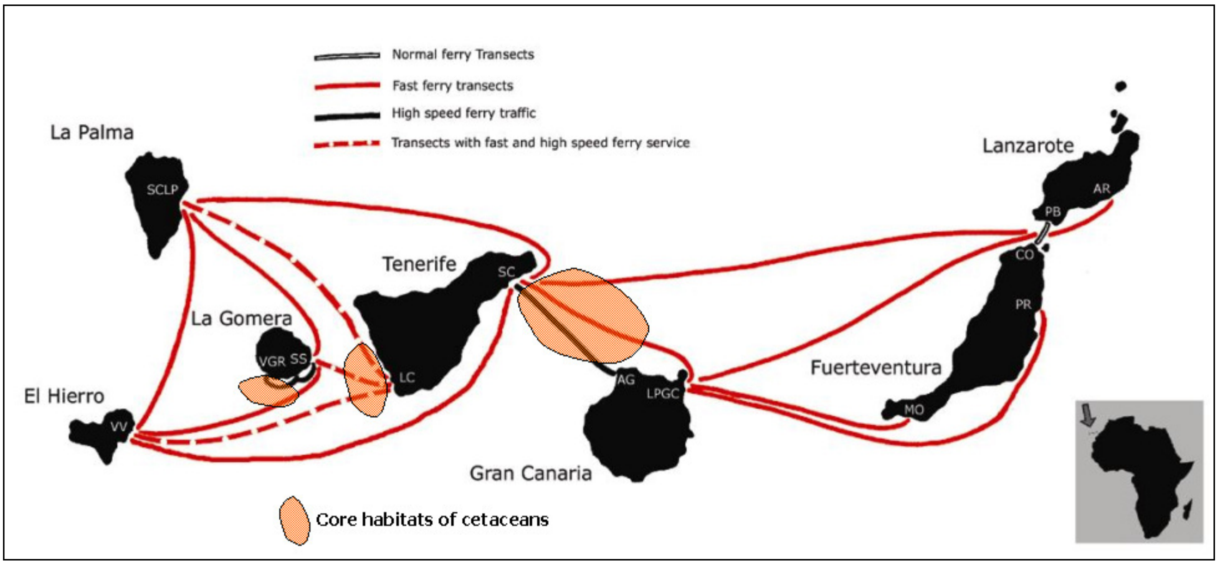
A high percentage of juveniles and calves being hit by vessels has been observed before (Laist *et al.*, 2001; Lammers *et al.*, 2007; Panigada, 2006). This alarming fact could be explained by a greater naivety of younger animals towards ships, or less experience.

Most ship strikes (41%) involved sperm whales. This number is unprecedented, as elsewhere other cetacean species are more commonly affected. In the Mediterranean Sea, fin whales are the species at highest risk to be hit by vessels (Panigada *et al.*, 2006), despite the year-round presence of sperm whales. 4.8% of ship strikes in the Mediterranean Sea were reported to involve sperm whales (ACCOBAMS, 2005). Also, in the Strait of Gibraltar, sperm whales are partially resident (Canadas *et al.,* 2005), still "only" two collisions have been reported from 2001 until 2005 (De Stephanis & Urquiola, 2006). In Jensen & Silber's (2004) large whale ship strike data base, 5% of strandings were sperm whales. To our knowledge, there is no other area where sperm whales are at an especially high risk of being hit by vessels. Thus, sperm whales in the Canaries apparently are more vulnerable than elsewhere. André *et al.* (1997) found little or no behavioural reactions of Canarian sperm whales after the playback of artificial sound, which was explained by a loss of sensitivity to low frequencies or habituation processes. This could explain at least partly the elevated percentage of strikes. More generally, it may be difficult for whales to detect ship noise due to a variety of different biological and physical factors (ACCOBAMS, 2005). On the other hand, little is known today about the low frequency sound radiation of large vessels (Dietrich Wittekind, pers. comm.). Whales also may be unaware of ships because they are distracted or asleep. This may be especially true for the sperm whales which only recently were found to show apparent bi-hemispheric sleep and may not react to approaching vessels at all (Miller *et al.*, 2008).

What is more, the high density of ferry traffic in the Canaries may also play a central role. Several million people – tourists and locals alike - travel from one island to the other every year (Rodriguez *et al.*, 2005), therefore ferry traffic is an important transport medium within the islands. There are several types of ferries operating between the islands to date, including one traditional monohull and a number of different fast ferries (travelling at approx. 25 knots) as well as high speed crafts (HSC, reaching maximum velocities of 40 knots, see Ritter, 2007), including the largest ferry trimaran in the world. The large catamarans are so called wave-piercing vessels and strongly dominate the inter-island traffic in the Canaries today.

The temporal distribution of strandings indicates that the number of collisions is on a consistently high level since 1999 (see Figure 3). In the same year, a regular high speed craft service was introduced in the Canaries (Rodriguez *et al.*, 2005). Interestingly, within the first weeks of the operation, a number of ship strikes were documented (Aguilar *et al.*, 2000). A hydrofoil operating between Tenerife and Gran Canaria in 1999 collided with a whale, which caused numerous injured passengers and one fatality (De Stephanis & Urquiola, 2006). The collision risk has increased markedly since 1999.

Figure 3: ***Ferry Transects in the Canary Islands in 2007. From Ritter (2007), modified.***



Commercial, fast and HSC ferries today are almost the only means to travel between the islands at sea. This is illustrated in Figure 3, which represents an overview over the inter-island ferry transects**,** and the types of ferries operating on each transect. Ritter (2007) calculated, that there were around 29,000 transects between the islands and almost 1.5 million kilometres were covered in 2007, the vast majority by fast and high speed ferries. As can be seen from Figure 3, there is a considerable overlap with important cetacean habitats, as well as with Special Areas of Conservation under the EU Habitat Directive. Based on several cetacean studies conducted in the Canary Islands, Ritter (2007) also identified (small scale) high risk areas for vessel whale collisions, these are located between the islands of Tenerife and Gran Canaria as well as La Gomera and Tenerife.

It was found that the major proportion of animals (58%) came ashore on Tenerife. Strikingly, 14 of 21 sperm whales (66%) were found on the coast of this island, and one should question the reason for this accumulation. In one of the most detailed studies on Canarian sperm whales, André (1998), identified the region between Tenerife and Gran Canaria as a prime habitat for this species, where the animals were seen most regularly. This area overlaps with HSC ferry transects (see Figure 3), and for this reason also was identified as a high risk area by Ritter (2007, see above). Ritter (2007) pointed out, too, that if a sperm whale was hit in this area, one would expect the carcass to appear somewhere west or southwest to this region due to constant south-westerly direction of the Canaries current. Most likely such a carcass therefore would strand on Tenerife.

Although to date a huge knowledge gap exists, especially concerning true numbers of vessel-whale collisions, it can be stated that a minimum of 1-3 sperm whales are hit per year (see Table 1). This certainly is a matter of concern. Both in terms of sustainability at population level and passenger safety, this situation poses a risk to humans and cetaceans alike.

Furthermore, some types of trauma (large whales cut in half, large longitudinal slashes, see Figure 4) leave almost no other conclusion than that the animal was killed by large, wave-piercing vessel. Sometimes animals are caught on top of the bulb of monohull vessels, which was the case with one whale during this study. In any case, bulbous bows will not be capable to separate large proportions from a whale's body, as is expected from the sharp-edged wave-piercing hulls of catamarans customarily used in the Canary Islands, as witnessed several times by ferry passengers and fishermen (Aguilar *et al.*, 2000; see also Table 1). HSC were reported to have caused 43% of ship strikes in the Mediterranean Sea (Panigada, 2006). Weinrich (2004), in reviewing collision cases with ferries on a global scale, found that 46% involved ferries travelling at speeds >30 knots. Hence, we suspect that wave piercing HSC play a major role for the magnitude of collision numbers in the Canary Islands.

Related to the size of the geographical area, the number of ship strikes in the Canarian archipelago is extremely high, probably higher than anywhere else in the world. In light of the numbers presented here, we have to acknowledge that the Canary Islands are a major hot spot for vessel-whale collisions. There is grave concern that ship strikes alone will harm, if not endanger, some of the cetacean populations in the archipelago, and this is especially true for the sperm whale. Thus, there is an urgent need for mitigative action to avoid ship strikes, to achieve more transparency in reporting and to obtain more reliability for recorded numbers of collisions, in the interest of both cetacean conservation and passenger safety.

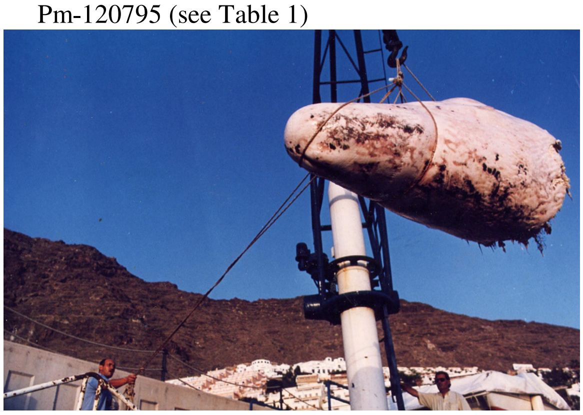
<u>Figure 4:</u> Examples of injuries found in cetaceans hit by ships in the Canary Islands. All images © Manuel Carrillo

a) Sperm whale with large dorsal cut
Pm-050703 (see Table 1)

b) Sperm whale calf missing caudal peduncle
Pm-160507 (SeeTable 1)

c) Cuvier's Beaked whale remainders
Zc-090600 (see Table 1)

d) Sperm whale head,
Pm-120795 (see Table 1)



CONCLUSIONS

Several measures have been discussed to mitigate the risk of vessel-whale collisions, such as a reduction of speed, placing dedicated observers on board, the shift of shipping lanes, remote sensing of cetaceans via night vision, laser, sonar or infrared techniques, passive acoustic monitoring (PAM) systems, among others (ACCOBAMS, 2005; IWC 2008).

While technical measures up to now mostly have failed to prove their efficacy (ACCOBAMS, 2005) or are extremely expensive to install, a number of measures are relatively easy to realize in the short term. First of all, and most obviously, reducing speed will have an instant effect. Vanderlaan & Taggart (2007), reviewing collisions listed in Laist. *et al.* (2001), found that at 15 knots 80% of collisions were fatal to the whales. At speeds of 11.8 and 8.6 knots the percentage of fatal collisions dropped to 50% and 20%, respectively. A speed limitation was introduced in Hawaii for the new "super ferry" which was scheduled to start operating in 2007. Also, on the US East Coast mariners are asked to slow down as soon as they enter right whale habitats. Speed reduction has also been used to lower the risk with marine mammals other than cetaceans (Calleson & Frohlich, 2007), although problems with compliance often will remain.

A shift of shipping lanes as a consequence of cetacean presence have been applied with the realignment of the Traffic Separation Scheme (TSS) servicing Boston (IMO, 2007) and a recent change of the TSS in southern Spain off Almeria (Tejedor *et al.*, 2007)

Dedicated observers on board have proven to be an effective means to detect whales in the path of a ship (Weinrich, 2004; ACCOBAMS, 2005), which under high speed conditions is a crucial aspect. In Hawaii, the newly introduced HSC ferry has two full time look-outs (IWC, 2008).

Therefore, under the current state of knowledge, and re-iterating some of the recommendations by Ritter (2007), we propose the following measures to be taken immediately as high priority action in the Canary Islands:

- The placement of dedicated on board observers (look-outs) on all fast and high speed vessels.
- The shift of ferry transects away from high risk areas wherever possible.
- Introduction of a speed limitation of 13 knots for any high risk area and existing Special Areas of Conservation, respectively (see Laist et al., 2001).
- The introduction of a mandatory reporting scheme for collisions, thereby making use of the database being developed by the IWC Vessel Strike Data Standardisation Group (Van Waerebeek and Leaper, 2007).

To address knowledge gaps, we recommend the following studies to be conducted on the short term:

- A Canarian wide quantification of both cetacean densities and shipping traffic which in turn will enable modelling collision risk.
- Experimental on-board application of technical mitigation measures to test their feasibility and effectiveness.

It should again be stressed that the current situation is very favourable for research being conducted on board ferries, not least because ferry operators may now be accepting observers, as indicated by De Stephanis & Urquiola (2006). A goal-orientated co-operation between scientists, agencies and ferry operators holds enormous potential to gain insight into some of the most pressing questions related to the ship strike issue in general. Finally, to achieve a workable and widely accepted consensus, the establishment of a round table with participants from all stakeholder groups (administrations, operators, scientists, NGOs, etc.) will be crucial. In this way, the Canaries can be turned into a centre for the investigations of ways how to avoid ship strikes. The ultimate goal must be to protect the integrity of the Canarian cetacean populations on the grounds of precaution and sustainability and to develop an effective policy to manage shipping traffic so as to secure both human and animal safety.

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***Table 1:* Details of vessel-whale collision cases in the Canary Islands (1991-2007).**

Date	*Species*	Code	Island	Length (cm)	Sex	Condition	Age Class	Notes
07.07.1991	*Physeter macrocephalus*	Pm.070791	TF	n.n.	F	Fresh	Calf	Huge cuts. Collision with jet-foil (Company Trasmediterranea).
07.07.1991	*Physeter macrocephalus*	Pm.070791	TF	n.n.	F	Fresh	Adult	Huge cuts. Collision with jet-foil (Company Trasmediterranea).
26.02.1992	*Globicephala macrorhynchus*	Gm.260292	TF	340	F	MoD	Juvenile	Found floating on 22/02/92 with a large dorsal cut .
28.02.1992	*Indeterminado*		FV	1200				Impact with ferry "Princesa Teguise". Described as large cetacean of > 12 m. Passengers: 1 injury and 18 with contusions.
30.05.1992	*Ziphius cavirostris*	Zc.300592	TF	550	M	MoD	Juvenile	Clear cut which separated the caudal peduncle from body. Cookie cutter marks and other shark bites.
12.07.1995	*Physeter macrocephalus*	Pm.120795	TF	n.n.		Fresh	Calf	Only head of animal was found.
09.04.1996	*Physeter macrocephalus*	Pm.090496a	GC	1010	F		Adult	Ferry Armas.
09.04.1996	*Physeter macrocephalus*	Pm.090496b	GC	680	M		Calf	Ferry Armas.
04.05.1999	*Balaenopteridae*	B.040599	GC	n.n.				Collision observed by fishermen.
10.06.1999	*Globicephala macrorhynchus*	Gm.100699	TF	n.n.				Collision with ferry "Gomera Jet".
00.07.1999	*Balaenoptera physalus*	Bp.000799	TF	n.n.			Adult	Male of more than 20m. Press report in " La Gaceta" (18 Sep 99): "¿Por qué mueren las ballenas?".
04.08.1999	*Physeter macrocephalus*	Pm.040899	TF	n.n.				Head separated from body. Burried by technicians from Tenerife Council (Servicio de Recuperación Fauna).
06.08.1999	*Physeter macrocephalus*	Pm.060899	TF	1050	F	Fresh	Adult	Deep mediodorsal cut. Found floating and brought into harbour.
10.09.1999	*Balaenopteridae*	B.100999	LG	n.n.				Rorqual tropical with a deep cut. Body was hauled off.
06.10.1999	*Balaenoptera edeni*	Be.061099	GC	1200	F	MoD	Adult	Hematoms found all over the body.
20.01.2000	*Balaenopteridae*	B.200100	LG	n.n.				Reported by passenger of ferry "Gomera Jet".
09.06.2000	*Ziphius cavirostris*	Zc.090600	TF	n.n.	F	Fresh	Juvenile	Cut at the level of dorsal fin.
06.04.2000	*Physeter macrocephalus*	Pm.060400	LZ	n.n.	M	MoD	Calf	Two cuts on head typical for propeller strikes.
12.06.2000	*Physeter macrocephalus*	Pm.120600	TF	n.n.		Fresh	Juvenile	Head separated from body. Many plastic items found in stomach.
21.08.2001	*Physeter macrocephalus*	Pm.210801	TF	600	F	Fresh	Calf	Large wound on posterior third of body: 600 cm.
23.09.2001	*Physeter macrocephalus*	Pm.230901	TF	n.n.		Fresh	Calf	Length of the head (which was separated from the body): 135 cm.
24.09.2001	*Physeter macrocephalus*	Pm.240901	TF	790	M	AD		Deep lateral cut lefthand side from lower jaw to dorsal fin.
07.02.2002	*Kogia breviceps*	Kb.070202	TF	240	M	AD	Juvenile	Deep cuts mediodorsal and caudal.
18.04.2002	*Globicephala macrorhynchus*	Gm.180402	TF	167	F	AD	Calf	Politraumatised on the skull, jaws, ribs and vertebrae, but without external marks.
21.06.2002	*Ziphius cavirostris*	Zc.210602	TF	525	M	AD	Adult	Medio-lateral cut at the height of the dorsal fin.
02.04.2003	*Globicephala macrorhynchus*	Gm.020403	TF	1,60(+)		AD	Adult	Support from technicians of the "Servicio de Fauna del Cabildo de Tenerife". Only first third of body appeared.
28.04.2003	*Kogia breviceps*	Kb.280403	TF	250	M	AD	Juvenile	Body cut at two locations: 1. At the height of the lung, 2. At the height of reproductive organs.
30.06.2003	*Kogia breviceps*	Kb.300603	TF	238	M	AD	Juvenile	Deep cut from pectoral flipper to the vertebral column.
02.07.2003	*Kogia breviceps*	K.020703	LP	300		AD	Adult	Deep sagittal cut.
05.07.2003	*Physeter macrocephalus*	Pm.050703	TF	490	M	Fresco	Calf	Two traversing cuts: 1. From head to behind the blowhole, 2. Deep cut close to dorsal fin.

***Table 1 (continued):* Details of vessel-whale collision cases in the Canary Islands (1991-2007).**

Date	*Species*	Code	Island	Length (cm)	Sex	Condition	Age Class	Notes
11.10.2003	*Physeter macrocephalus*	Pm.111003	H	953	M	AD	Joven	Deep dorsal cut (mid body).
14.11.2003	*Mesoplodon europaeus*	Me.141103	TF	282+	M	AD	Adult	Body cut off behind the genital area. Has been floating several days.
25.11.2003	*Physeter macrocephalus*	Pm.251103	GC	1200				Referenced in the press media.
15.04.2004	*Balaenoptera borealis*	Bb.150404	GC	n.n.	F	AD	Joven	Body cut into halves behind the dorsal fin.
06.05.2004	*Ziphius cavirostris*	Zc.060504	TF	n.n.		MoD	Adult	Animal cut at the onset of dorsal fin.
21.06.2004	*Kogia breviceps*	Kb.210604	TF	188	M	AD	Juvenile	Appeared the day before at La Caleta, then drifted to harbour of Güimar. Partially sectioned in front of dorsal fin.
12.08.2004	*Physeter macrocephalus*	Pm.120804	LG	n.n.		AD	Juvenile	Body cut in front of pectoral fin. Animal brought quickly to dumping site.
01.10.2004	*Physeter macrocephalus*	Pm.011004	TF	1050	F	AD	Adulto	Cut at the height of cervical vertebrae.
31.12.2004	*Ziphius cavirostris*	Zc.311204	TF	620	M	AD	Adult	Hauled off by Guardia Civil but the resighted. Cut at the height of digestive apparatus.
15.02.2005	*Physeter macrocephalus*	Pm.150205	TF	500	M	AD	Calf	Deep cuts at level of thorax. Numerous shark bites.
11.05.2005	*Physeter macrocephalus*	Pm.110505	FV	686	F	Fresh	Calf	Numerous propeller cuts.
25.05.2005	*Balaenopteridae*	B.250505	LG	1000		AD	Joven	First seen floating off Tenerife, stranded on 22 May on La Gomera.
29.06.2005	*Globicephala macrorhynchus*	Gm.290605	TF	115	M	AD	Calf	Floating body was accompanied by bottlenose dolphins up to the harbour of Alcalá. Head cut off.
20.07.2005	*Indeterminado*	I.200705	FV	n.n.				Referenced in the press media. Probable collision with jet-foil.
27.09.2005	*Kogia breviceps*	Kb.270905	GC	285	F	Fresh		Referenced in the press media/internet.
31.03.2006	*Kogia breviceps*	Kb.310306	LG	280	F	Fresh	Juvenile	Found floating off LG. Full necropsie by veterenarians of the Las Palmas University. Hematoms present. No obvious markings.
18.04.2006	*Kogia breviceps*	Kb.180406	TF	274	F	AD	Adult	Fetus of 37 cm length. Skull destroyed.
27.04.2006	*Physeter macrocephalus*	Pm.270406	TF	460	F	Fresh	Calf	Appeared 28/05/06 at Las Maretas. Longitudinal mediodorsal cut.
04.06.2006	*Ziphius cavirostris*	Zc.040606	LG	490+	M	AD	Adult	Deep cut which separated the tail stock.
05.07.2006	*Ziphius cavirostris*	Zc.050706	TF	400+	F	AD		Animal was observed 4 days floating in the area. No shark bites. Last third of body cut off at the level of genitals.
25.02.2007	*Balaenoptera physalus*	Bp.250207	GC	1700		MoD	Juv	Animal wedged on the bow of monohull ferry (Company Trasemediterranea).
06.04.2007	*Kogia breviceps*	Kb.060407	TF	275(282)	F	SD	Adult	Dorsal and mediodorsal cuts of 15-30 cm lenth and up to 12 cm deep. Orca attack?
16.05.2007	*Physeter macrocephalus*	Pm.160507	TF	325 (+)	M	SD	Calf	Animal cut at the level of the anus. Numerous shark bites.
04.06.2007	*Globicephala macrorhynchus*	Gm.010607	TF	100 (+)	F	AD	Newborn	Animal cut at the end of the genital opening. Curved cuts 25-30 cm length. Shark bites. Clearly visible fetal folds on right side.
20.03.2007	*Balaenoptera borealis*	Bb.200307	GC	1390	F	MoD	Adult	Fractured thoracic vertebrae. Hematoms (anterior region right side).
00.07.2007	*Physeter macrocephalus*	Pm.000707	GC	n.n.		AD		Only part of the first third appeared.
20.06.2007	*Kogia breviceps*	Kb.200607	GC	170 (+)		AD		Curved mediodorsal cuts. Stomach contents present.
08.07.2007	*Physeter macrocephalus*	Pm.080707	H	n.n.		AD		Deep cut at the head. No skull present. Stomach contents present.
16.07.2007	*Physeter macrocephalus*	Pm.160707	GC	1300		AD		Deep cut at the level of cervical vertebrae. Head separated from body at the stranding site.